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Sindie 2622 G3 M-SERIES

Sulfur Analyzer



Sulfur Analysis with Compliance Flexibility

The Sindie 2622 bench-top analyzer complies with ASTM D2622, D7039 and ISO 20884 methods, enabling complete flexibility in sulfur analysis. No compromises in detection, performance and reliability - the SINDIE 2622 analyzer is the ideal sulfur analytical solution from ultra low sulfur diesel and gasoline to heavy fuel oil and crudes. One analyzer – three compliance solutions.

Application Areas:

- Total sulfur analysis from ultra low sulfur fuels to crudes.
- For use in refinery labs, pipeline terminals, additive plants and inspection laboratories.
- Complies with ASTM D2622, D7039 and ISO 20884.

Features and Benefits:

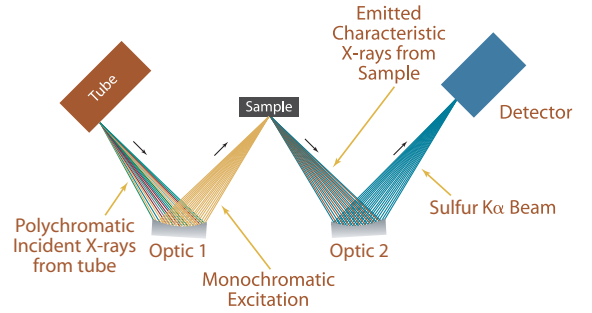
- LOD: 0.15 ppm at 300 s.
- Dynamic Range: 0.15 ppm to 10%
- Fits on any bench: 37 cm (w) x 50 cm (d) x 34 cm (h).
- Plug-it-in and measure: power is the only utility.
- Touch Screen user interface.
- User programmable measurement time: 30-900 s.
- Two calibrations cover a variety of products over full dynamic range:
 - 0.15 – 3000 ppm wt
 - 0.3 – 10% wt
- No conversion gasses, heating elements, quartz tubes or columns.
- 75 W air-cooled excitation tube.
- Robust polyamide window for easy cleaning.

Options:

- LIMS data output software capability.

MWD XRF

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the sulfur characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



ACCU-CELL Sample Cups

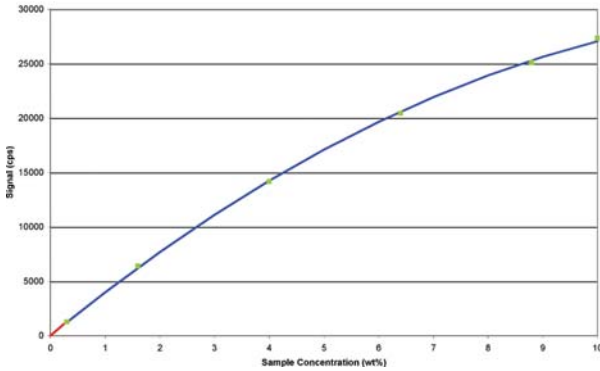
- No assembly of separate film & cup components
- Pre-vented sample cups
- Eliminates sample & cup contamination
- One discharge of 1 ml pipette will fill the cup

Precision

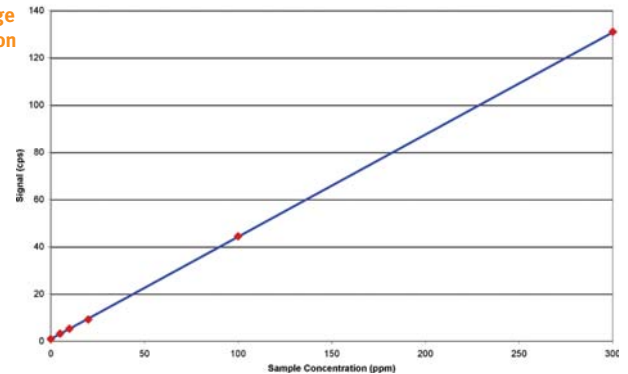
Typical repeatability (r) and reproducibility (R) values in diesel fuel, at 95% confidence. 300 s measurement time.

Sulfur Concentration (ppm)	r	R
2	0.3	0.7
5	0.5	0.8
8	0.6	1.0
15	0.8	1.4
100	2	4
500	5	10

SINDIE-XR Calibration Curve



Low Range Calibration



Product Specifications

Test Method	ASTM D7039, D2622 and ISO 20884
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Sample Cup Volume	1 ml
I/O Ports	Ethernet 10/100 base T, RS232
Optional Computer Interface	Pentium, 100 MHz, 32 MB RAM/Windows 98 or newer operating system
Ambient Temperature Requirements	5-40° C (40-104° F)
Dynamic Range	Standard: 0.15 ppm – 10% ppm
Measurement	User selectable: 30-900 s
Calibration	8 calibration curves. Automatic and Manual Calibration functionality



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Sindie 2622 M-SERIES

Sulfur Analyzer



Sulfur Analysis with Compliance Flexibility

The Sindie 2622 bench-top analyzer complies with ASTM D2622, D7039 and ISO 20884 methods, enabling complete flexibility in sulfur analysis. No compromises in detection, performance and reliability - the SINDIE 2622 analyzer is the ideal sulfur analytical solution from ultra low sulfur diesel and gasoline to heavy fuel oil and crudes. One analyzer – three compliance solutions.

Application Areas:

- Total sulfur analysis from ultra low sulfur fuels to crudes.
- For use in refinery labs, pipeline terminals, additive plants and inspection laboratories.
- Complies with ASTM D2622, D7039 and ISO 20884.

Features and Benefits:

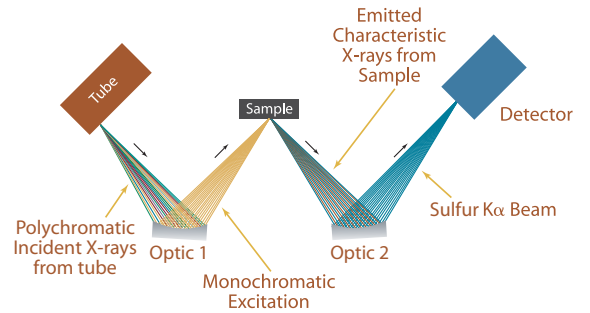
- LOD: 0.4 ppm at 300 s.
- Dynamic Range: 0.4 ppm to 10%
- Fits on any bench:
37 cm (w) x 50 cm (d) x 34 cm (h).
- Plug-it-in and measure: power is only utility.
- Touch Screen user interface.
- User programmable measurement time: 30-900 s.
- Two calibrations covers both gasoline and diesel matrices over full dynamic range:
 - 0.4 – 3000 ppm wt
 - 0.3 – 10% wt
- No conversion gasses, heating elements, quartz tubes or columns.
- 75 W air-cooled excitation tube.
- Robust polyamide window for easy cleaning.

Options:

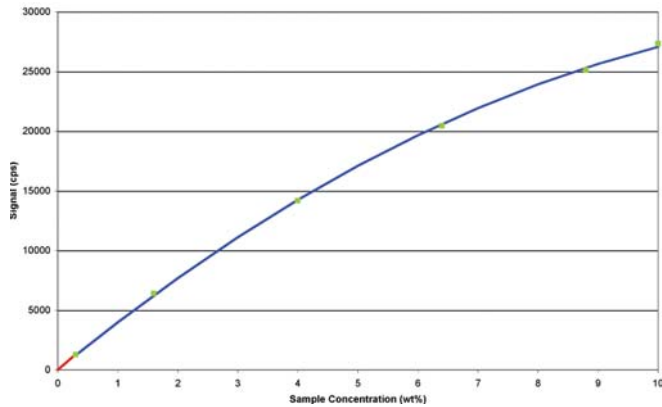
- LIMS data output software capability.

MWD XRF

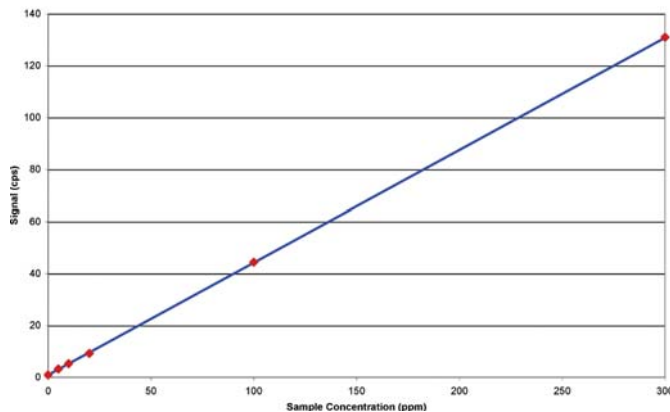
Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the sulfur characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



SINDIE-XR Calibration Curve



Low Range Calibration



Precision

Typical repeatability (r) and reproducibility (R) values in diesel fuel, at 95% confidence. 300s measurement time.

Sulfur Concentration (ppm)	r	R
4	0.4	1.0
8	0.7	1.2
15	0.9	1.7
100	3	6
500	6	12

Product Specifications

Test Method	ASTM D7039, D2622 and ISO 20884
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Sample Cup Volume	10 ml
I/O Ports	Ethernet 10/100 base T, RS232
Ambient Temperature Requirements	5-40° C (40-104° F)
Dynamic Range	0.4 ppm – 10%
Measurement	User selectable: 30-900 s
Calibration	8 calibration curves. Automatic and Manual Calibration functionality.



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Sindie 7039 G3 M-SERIES

Sulfur Analyzer



Sulfur Analysis with Unprecedented Precision

No compromises in detection, performance and reliability - the SINDIE 7039 G3 analyzer is the ideal sulfur analytical solution for the energy industry. From ultra low sulfur diesel and gasoline to heavy fuel oil and crudes, the analyzer delivers unprecedented precision and accuracy. The Sindie 7039 G3 bench-top analyzer is easy-to-use, robust and complies with both ASTM D7039 and ISO 20884 methods. Plug it in and measure. Results with one touch. Unrivaled precision.

Application Areas:

- Total sulfur analysis from ultra low sulfur fuels to crudes.
- For use in refinery labs, pipeline terminals, additive plants, testing vans and inspection laboratories.
- Complies with ASTM D7039 and ISO 20884.

Features and Benefits:

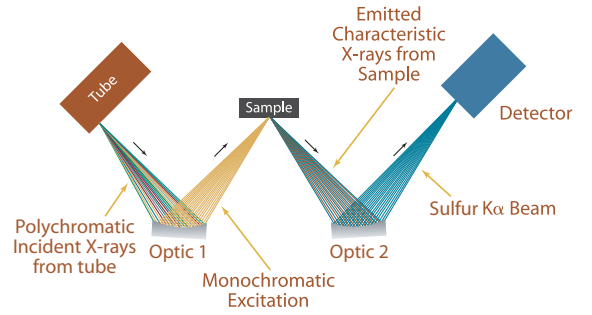
- LOD: 0.15 ppm at 300 s.
- Dynamic Range:
 - Standard: 0.15 ppm to 3000 ppm
 - XR package: 0.15 ppm to 10%
- Available with 8 cell auto-sampler.
- Fits on any bench and compatible for use in mobile labs/vans.
- Plug-it-in and measure: power is only utility.
- Touch screen user interface.
- Utilizes ACCU-CELL pre-assembled and pre-vented sample cups for enhanced precision, extreme ease-of-use and enhanced productivity.
- User programmable measurement time: 30-900 s.
- One calibration curve will run both diesel and gasoline up to 3000 ppm.
- No conversion gasses, heating elements, quartz tubes or columns.
- 75 W air-cooled excitation tube.
- Robust polyamide window for easy cleaning.

Options:

- Extended Range package: from 0.15 ppm up to 10%.
- 8 cell Autosampler.
- LIMS data output software capability.

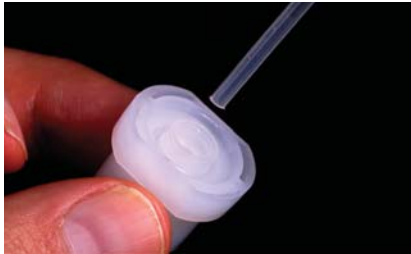
MWD XRF

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the sulfur characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



SINDIE Autosampler

- 8 sample cell capacity
- Increases productivity
- Utilizes XOS Accu-Cell cups



ACCU-CELL Sample Cups

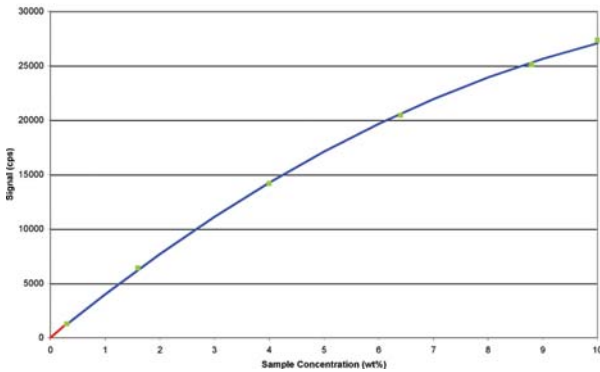
- No assembly of separate film & cup components
- Pre-vented sample cups
- Eliminates sample & cup contamination
- One discharge of 1 ml pipette will fill the cup

Precision

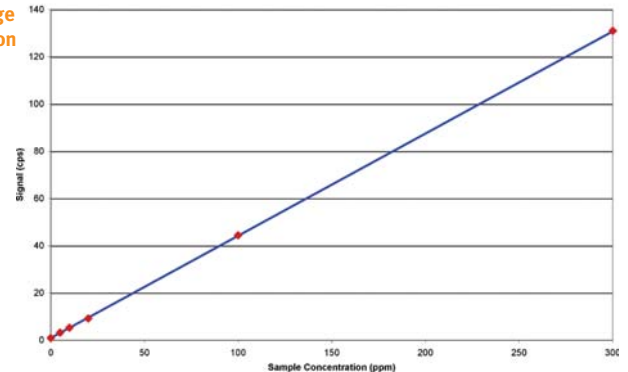
Typical repeatability (r) and reproducibility (R) values in diesel fuel, at 95% confidence. 300 s measurement time.

Sulfur Concentration (ppm)	r	R
2	0.3	0.7
5	0.5	0.8
8	0.6	1.0
15	0.8	1.4
100	2	4
500	5	10

SINDIE-XR Calibration Curve



Low Range Calibration



Product Specifications

Test Method	ASTM D7039 and ISO 20884
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Sample Cup Volume	1 ml
I/O Ports	Ethernet 10/100 base T, RS232
Optional Computer Interface	Pentium, 100 MHz, 32 MB RAM/Windows 98 or newer operating system
Ambient Temperature Requirements	5-40° C (40-104° C)
Dynamic Range	Standard: 0.15 – 3000 ppm, XR Package: 0.15 ppm – 10%
Measurement	User selectable: 30-900 s
Calibration	8 calibration curves. Automatic and Manual Calibration functionality





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Sindie 7039 M-SERIES

Sulfur Analyzer



Sulfur Analysis in Petroleum and Bio Fuels

From ultra low sulfur diesel and gasoline to heavy fuel oil and crudes, the Sindie 7039 analyzer delivers unprecedented precision and accuracy. The analyzer is the ultimate easy-to-use and robust sulfur analyzer for petroleum and bio fuels. The ideal analytical solution for the energy industry where detection, performance and reliability are critical. SINDIE 7039 complies with ASTM D7039 and ISO 20884 methods. Plug it in and measure. Results with one touch. Unrivaled precision.

Application Areas:

- Total sulfur analysis from ultra low sulfur fuels to crudes.
- For use in refinery labs, pipeline terminals, additive plants, testing vans and inspection laboratories.
- Complies with ASTM D7039 and ISO 20884.

Features and Benefits:

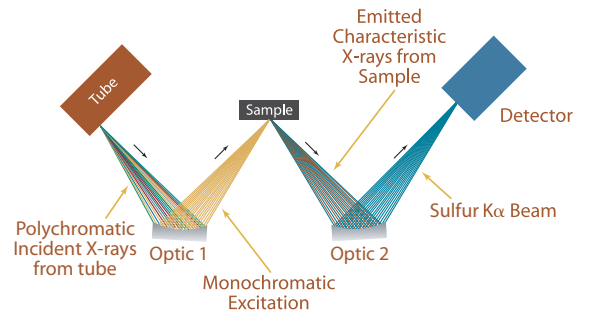
- LOD: 0.4 ppm at 300 s.
- Dynamic Range:
Standard: 0.4 ppm to 3000 ppm
XR package: 0.4 ppm to 10%
- Fits on any bench and compatible for use in mobile labs and vans :
37 cm (w) x 50 cm (d) x 34 cm (h)
- Plug-it-in and measure: no additional utilities required.
- Touch Screen user interface.
- User programmable measurement time: 30-900 s.
- One calibration curve will run both diesel and gasoline up to 3000 ppm
- No conversion gasses, heating elements, quartz tubes or columns.
- 75 W air-cooled excitation tube.
- Robust polyamide window for easy cleaning.

Options:

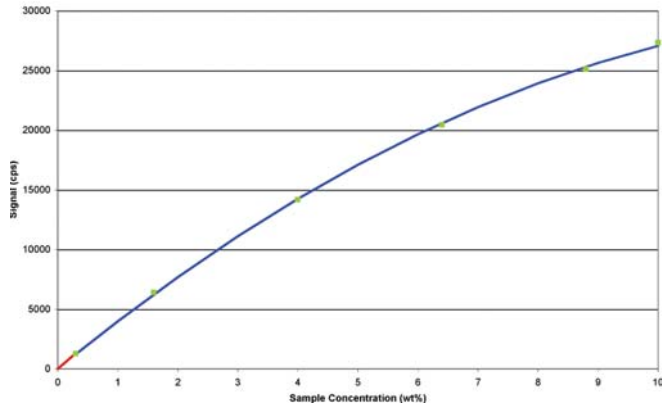
- Extended Range package: from 0.4 ppm up to 10%.
- LIMS data output software capability.

MWD XRF

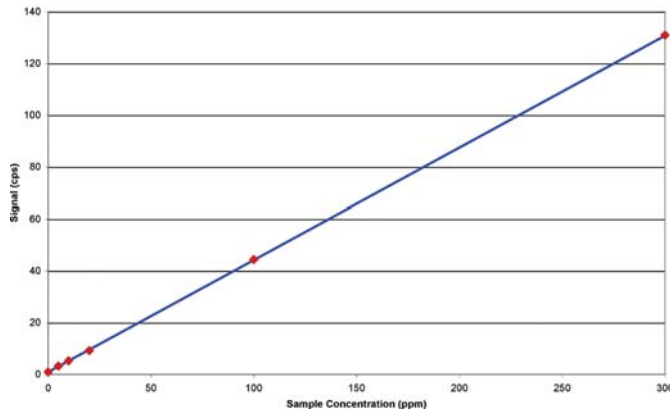
Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the sulfur characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



SINDIE-XR Calibration Curve



Low Range Calibration



Precision

Typical repeatability (r) and reproducibility (R) values in diesel fuel, at 95% confidence. 300s measurement time.

Sulfur Concentration (ppm)	r	R
2	0.4	1.0
8	0.7	1.2
15	0.9	1.7
100	3	6
500	6	12

Product Specifications

Test Method	ASTM D7039 and ISO 20884
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Sample Cup Volume	10 ml
I/O Ports	Ethernet 10/100 base T, RS232
Optional Computer Interface	Pentium, 100MHz, 32MB RAM/Windows 98 or newer operating system
Ambient Temperature Requirements	5-40° C (40-104° C)
Dynamic Range	Standard: 0.4 – 3000 ppm, XR Package: 0.4 ppm – 10%
Measurement	User selectable: 30-900 s
Calibration	8 calibration curves. Automatic and Manual Calibration functionality.





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Sindie

Sulfur and Chlorine Analyzer

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+ Cl
Chlorine



TWO critical measurements, ONE push of a button, ZERO hassle

Sindie +Cl is a two-in-one instrument enabling trace analysis of both sulfur and chlorine with one push of a button. It is the ideal solution to certify sulfur levels in finished products, assess chlorine for corrosion mitigation, and optimize process parameters.

Application Areas:

- Total sulfur analysis from ultra low sulfur fuels to crudes.
- Total chlorine analysis from aqueous solutions and aromatic products to heavy fuels, crudes, and catalyst.
- For use in refinery labs, pipeline terminals, additive plants and inspection laboratories.
- Complies with ASTM D2622, D7039, D7536, and SH / T 0842.

Features and Benefits:

- Sulfur
 - LOD: 0.4 ppm at 300 s.
 - Dynamic Range: 0.4 ppm to 5%
- Chlorine
 - LOD: 0.3 ppm at 300 s.
 - Dynamic Range: 0.3 ppm to 3000 ppm
- Extremely low maintenance: no conversion gasses, heating elements, columns, or quartz tubing.
- Automatic sulfur correction for chlorine.
- Easy to use
 - Intuitive touch screen
 - Just plug-in and measure
 - Measurement time: 30-900s
- Fits on any bench:
37 cm (w) x 50 cm (d) x 34 cm (h).

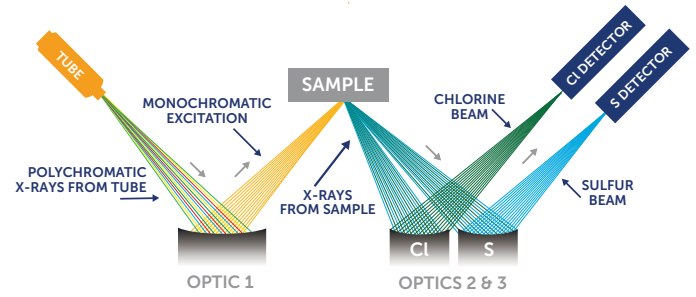
Options:

- LIMS data output software capability.

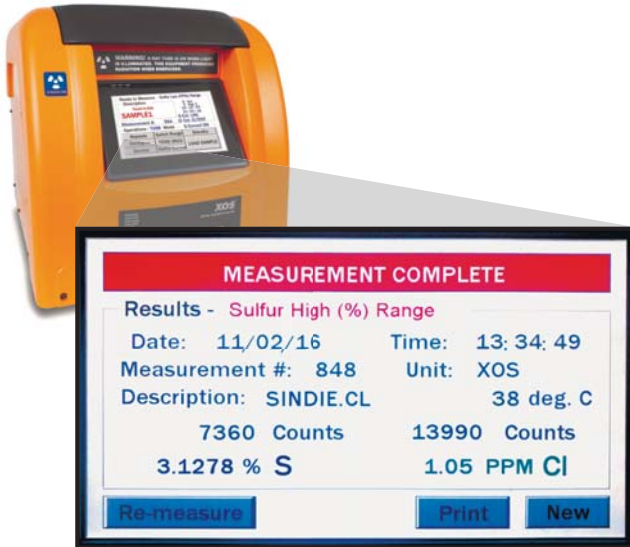
Trusted Precision

Using the industry's most advanced optics, doubly curved crystals, Sindie +Cl achieves a high signal-to-background ratio for the most reproducible results.

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWDXRF) using doubly curved crystal optics has the advantage of very high sensitivity and precision. This technique has been successfully used to deliver very precise measurements of low levels of sulfur and chlorine.

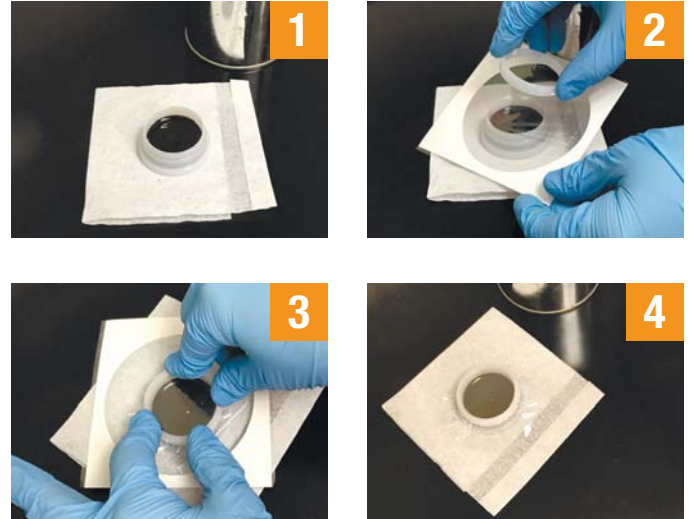


Two Critical Measurements



Sindie +Cl performs trace analysis of both sulfur and chlorine with one push of a button. You can measure both elements in one sample, or measure each separately by simply inserting a new sample.

Zero Hassle



Sindie +Cl analyzes a broad range of liquid samples from aqueous solutions to the heaviest of hydrocarbons (e.g. VGO or crude oil), all without the need for dilution, combustion gasses, or other hassles like changing detectors, boats, injectors, furnaces, etc.

Product Specifications

Test Method	ASTM D7039, D2622, D7536, and SH / T 0842
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Sample Cup Volume	10 ml
I/O Ports	Ethernet 10/100 base T, RS232
Ambient Temperature Requirements	5-40° C (40-104° F)
Dynamic Range	Sulfur: 0.4 ppm - 5% Chlorine: 0.3 ppm - 3000 ppm
Measurement	User selectable: 30-900 s
Calibration	8 calibration curves. Automatic and Manual Calibration functionality



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Sindie 7039 Plus Pb

Sulfur Analyzer



Sulfur and Lead Analysis of Petroleum Products

From ultra low sulfur diesel and gasoline to heavy fuel oil and crude, the Sindie 7039 Plus Pb Analyzer delivers unprecedented precision and accuracy for sulfur detection with the added option for measuring lead. As aviation industry requirements become more stringent, lead detection is critical in such products as aviation gasoline and jet fuel. XOS offers an ideal analytical solution for the energy industry where detection, performance, and reliability are essential. Simply plug it in and measure. Results with one touch. Unrivalled precision.

Application Areas:

- Total sulfur and lead analysis from ultra low sulfur diesel to aviation gasoline and crudes.
- For use in refinery labs, pipeline terminals, additive plants, testing vans and inspection laboratories.
- Complies with ASTM D7039 and ISO 20884.

Features and Benefits:

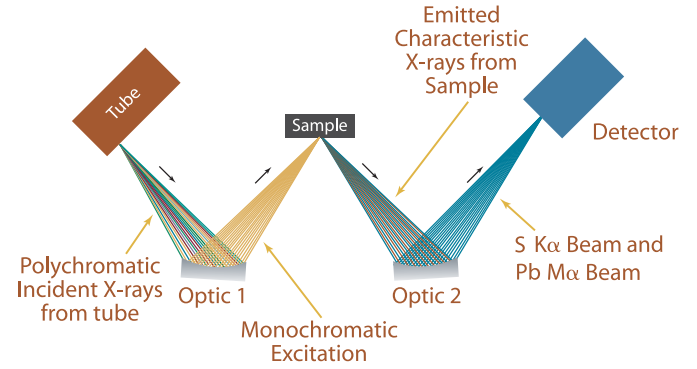
- LOD:
 - Sulfur: 0.7 ppm at 300 s
 - Lead: 0.002 g/L at 300 s
- Dynamic Range:
 - Sulfur: 1 ppm to 5000 ppm
 - Lead: 0.002 g/L to 10.000 g/L
- Fits on any bench and compatible for use in mobile labs and vans :
37 cm (w) x 50 cm (d) x 34 cm (h)
- Plug-it-in and measure: no additional utilities required
- Touch Screen user interface
- User programmable measurement time: 30-900 s
- No conversion gasses, heating elements, quartz tubes or columns
- 75 W air-cooled excitation tube
- Robust polyamide window for easy cleaning

Options:

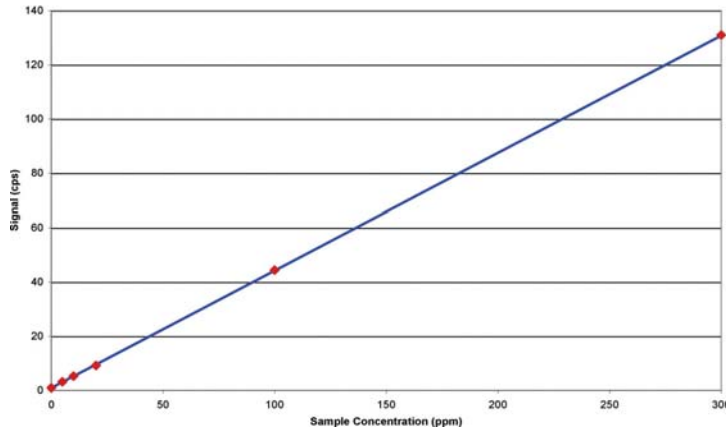
- LIMS data output software capability.

MWD XRF

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the sulfur and lead characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



Sulfur Low Range Calibration

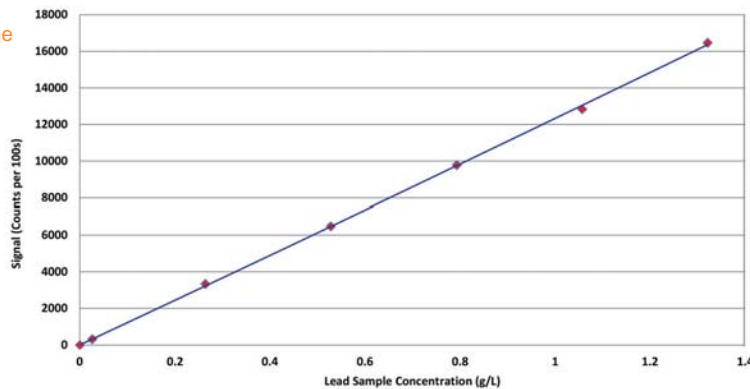


Sulfur Precision

Typical repeatability (r) and reproducibility (R) values in diesel fuel, at 95% confidence. 300 s measurement time.

Sulfur Concentration (ppm)	r	R
2	0.4	1.0
8	0.7	1.2
15	0.9	1.7
100	3	6
500	6	12

Lead Low Range Calibration



Lead Precision

Typical repeatability (r) and reproducibility (R) values in iso-octane at 95% confidence. 300 s measurement time.

Lead Concentration (g/L)	r	R
0.03	0.0027	0.0053
0.1	0.0049	0.0097
0.3	0.0084	0.0168
0.5	0.0109	0.0217
1	0.0154	0.0308

Product Specifications

Test Method (Sulfur)	ASTM D7039 and ISO 20884
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Sample Cup Volume	10 ml
I/O Ports	Ethernet 10/100 base T, RS232
Optional Computer Interface	Pentium, 100MHz, 32MB RAM/Windows 98 or newer operating system
Ambient Temperature Requirements	5-40° C (40-104° C)
Dynamic Range	Sulfur: 1 ppm to 5000 ppm; Lead: 0.002 g/L to 10.000 g/L
Measurement	User selectable: 30-900 s
Calibration	8 calibration curves. Automatic and Manual Calibration functionality.



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Sindie OTG

Sulfur Analyzer



Plug-It-In & Measure. Results with One Touch. Unrivaled Precision.

The Sindie OTG is the only PORTABLE sulfur analyzer and provides reliable quality results from ULSD and gasoline to marine fuels and crudes. The analyzer is suitable for operating in-the-field, on-board marine environments and in laboratories. The analyzer uses Monochromatic WD XRF per ASTM D7039 and is compliant with ISO 20884. Analysis on demand, when and where you need it.

Application Areas:

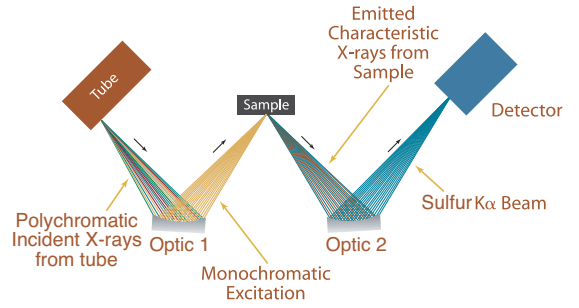
- Total sulfur analysis from ultra low sulfur fuels up to crude.
- For refinery labs, pipeline terminals, on-board use, additive plants, testing vans and inspection laboratories.
- Complies with ASTM D7039 and ISO 20884.

Features and Benefits:

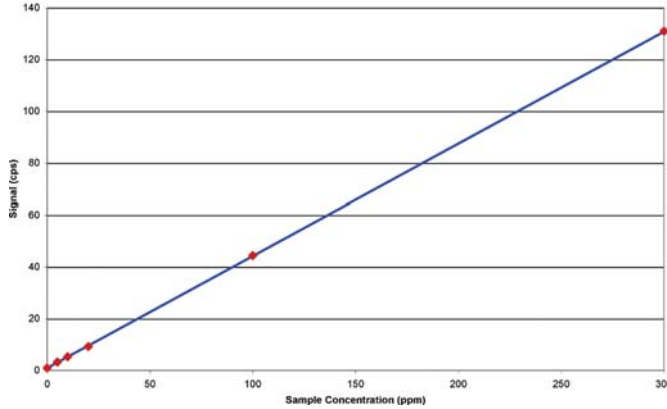
- Fits on any bench and compatible for use in mobile labs/vans.
- Dimensions: 33 cm (h) x 30 cm (w) x 23 cm (d).
- Weight: 18.5 kg.
- Utility: Standard wall power: 100-240 VAC at 2.2 A.
- No need for gasses, no high temp operating conditions.
- LOD: 0.7 ppm at 900s
- Dynamic Range: 0.7 ppm-10% ppm wt.
- User Interface: Touch Screen.
- ACCU-CELL pre-assembled sample cups for enhanced precision, operator ease-of-use and increased productivity.
- User programmable measurement time: 30-900 s.
- One calibration curve will run both diesel and gasoline.
- Extremely low maintenance: No conversion gasses, heating elements, quartz tubes or columns.
- Robust polyimide window for easy cleaning.
- 20 W air-cooled excitation tube.

MWD XRF

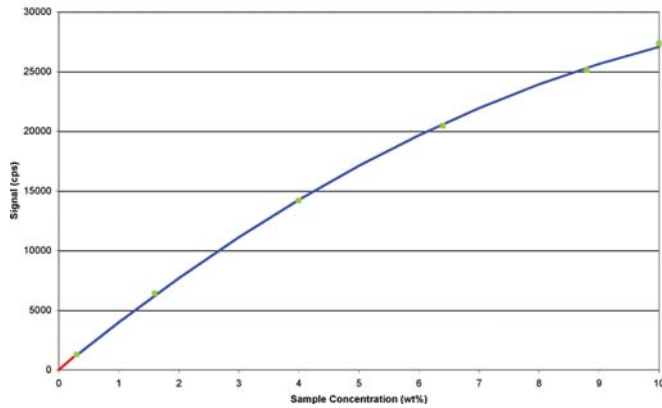
Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the sulfur characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



Low Range Calibration



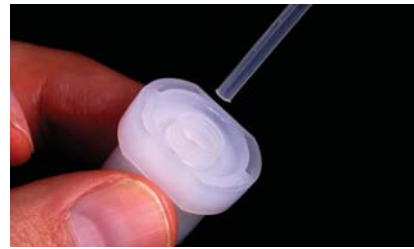
SINDIE-XR Calibration Curve



Precision

Typical repeatability (r) and reproducibility (R) values in diesel fuel, at 95% confidence. 900 s measurement time.

Sulfur Concentration (ppm)	r	R
2	0.6	1.2
8	0.9	1.8
15	1.1	2
100	3	6
500	6	12



ACCU-CELL Sample Cups

- No assembly of separate film & cup components
- Pre-vented sample cups
- Eliminates sample & cup contamination
- One discharge of 1ml pipette will fill the cup

Product Specifications

Test Method	ASTM D7039 and ISO 20884.
Dimensions	34 cm (w) x 23.5 cm (d) x 30 cm (h)
Power	100-240 VAC at 2.2 Amps
Other Utilities	None
Sample Introductions	Maximum sample cup volume: 1 ml.
Ambient Temperature Requirements	5-35° C (40-95° F)
Dynamic Range	0.7 ppm - 10% ppm wt.
Measurement	30-900 s



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Sindie[®] ON-LINE

Sulfur Analyzer



On-Line Sulfur Analysis in Petroleum Fuels

The Sindie[®] On-Line Analyzer is an industrial grade process sulfur analyzer with breakthrough detection capability for monitoring fuel streams as exacting as ultra low sulfur diesel and gasoline. This process analyzer presents the ultimate solution for pipeline terminals, where measurement speed and reliability are essential. The Sindie On-Line Analyzer is powered by Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) technology, offering a limit of detection (LOD) of 0.6 ppm and a dynamic range of 3000 ppm. This direct and non-destructive measurement technique does not require sample conversion or consumable gasses and does not involve high temperature operations. The result: a robust process analyzer with minimal maintenance and unprecedented detection capability and measurement speed.

Application Areas

- Refinery: hydrotreating, hydrofiner, and blending processes
- Pipeline terminals: interface cuts, custody transfer acceptance, and tank contamination prevention

Features & Benefits

- Excellent detection capability: LOD: 0.6 ppm
- Dynamic range from 0.6 ppm - 3000 ppm sulfur in diesel, gasoline, naphtha, and kerosene
- Continuous monitoring with programmable response times:
 - 30 seconds: pipeline interface cuts
 - 5 minutes: most demanding refinery processes
- Direct measurement without sample conversion; Analysis in ppm (wt)
- No density conversion needed
- No consumables, no gasses, no high temperature processes
- Extremely low maintenance:
 - No heating elements
 - No quartz tubing
 - No columns
- Dynamic window module design is operator independent and ensures measurement stability
- Robust industrial design: wall mounted or stand alone
- Outstanding linearity:
One calibration curve for diesel and gasoline matrixes, over full dynamic range
- Total sulfur determination using MWD XRF
- Extended range available for measurements above 3000 ppm up to weight percent levels
- Uses ASTM D7039 technology

MWD XRF Technology

Monochromatic Wavelength Dispersive X-Ray Fluorescence

(MWD XRF) analysis provides dramatically improved S/B over conventional XRF techniques, in a compact and simplified on-line configuration. The improved S/B is achieved by eliminating the scattering of bremsstrahlung from the x-ray source.

The configuration of a MWD XRF unit is shown in Figure 1. It consists of an x-ray source, a point-focusing optic for excitation, a sample cell, a focusing optic for collection and an x-ray detector. In this system, the first excitation optic captures a narrow bandwidth of x-rays from the source and focuses an intense monochromatic beam in a small spot on the sample cell. The monochromatic primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted. The second collection optic collects only the characteristic sulfur x-rays which are then focused onto the detector.

FIGURE 1
Analytical Engine Configuration

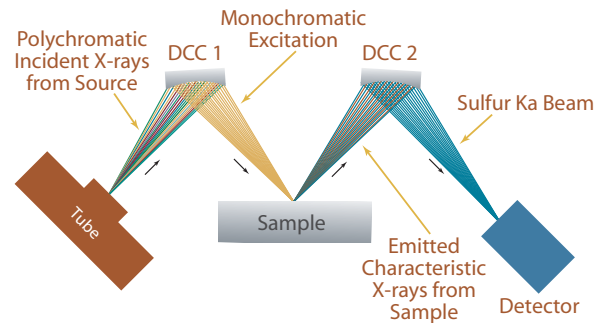


FIGURE 2

Linear Calibration
0-500 ppm

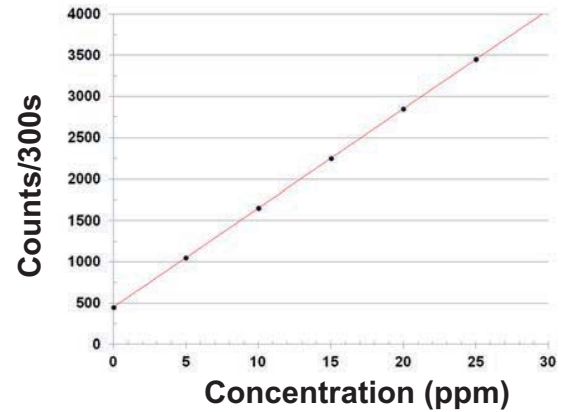
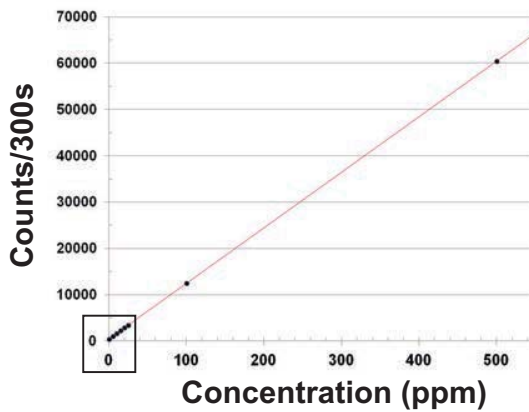
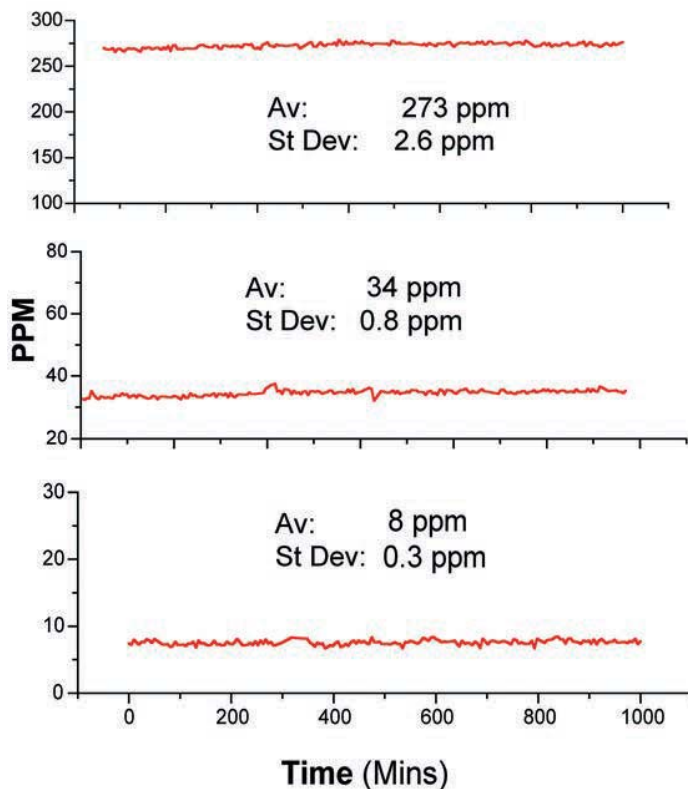


FIGURE 3

On-Line Monitoring of Diesel Fuels at Various Sulfur



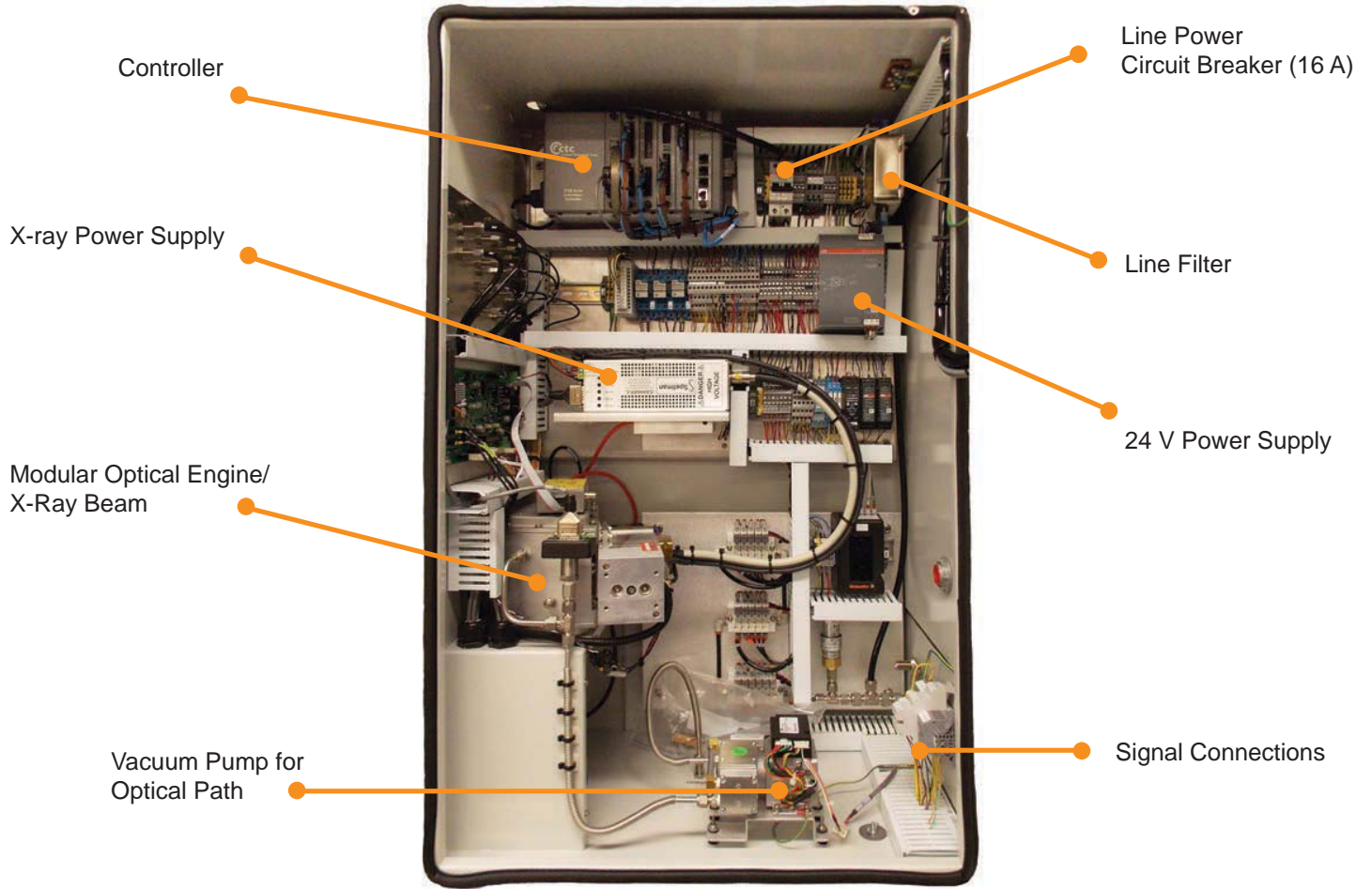
Repeatability

Typical values in diesel fuel
95% confidence
300 s measurement time

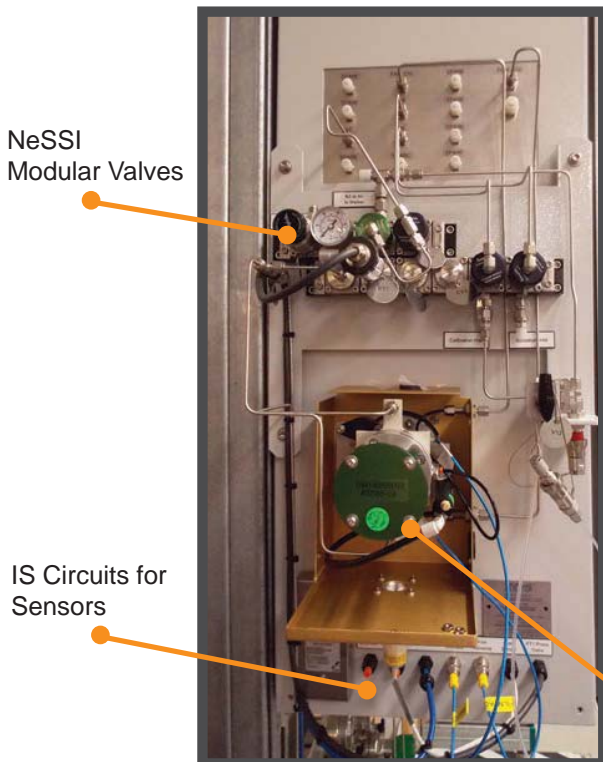
S Concentration (ppm)	r
2	0.6
8	1
15	1.5
100	5
500	9

A closer look at the Sindie On-Line Analyzer...

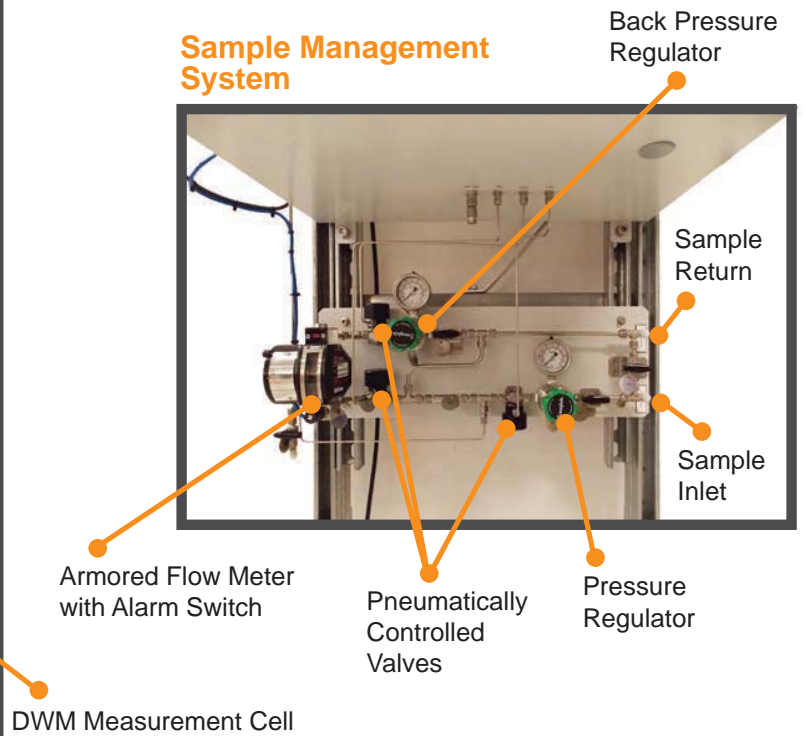
Open Unit



Outer Side Panel



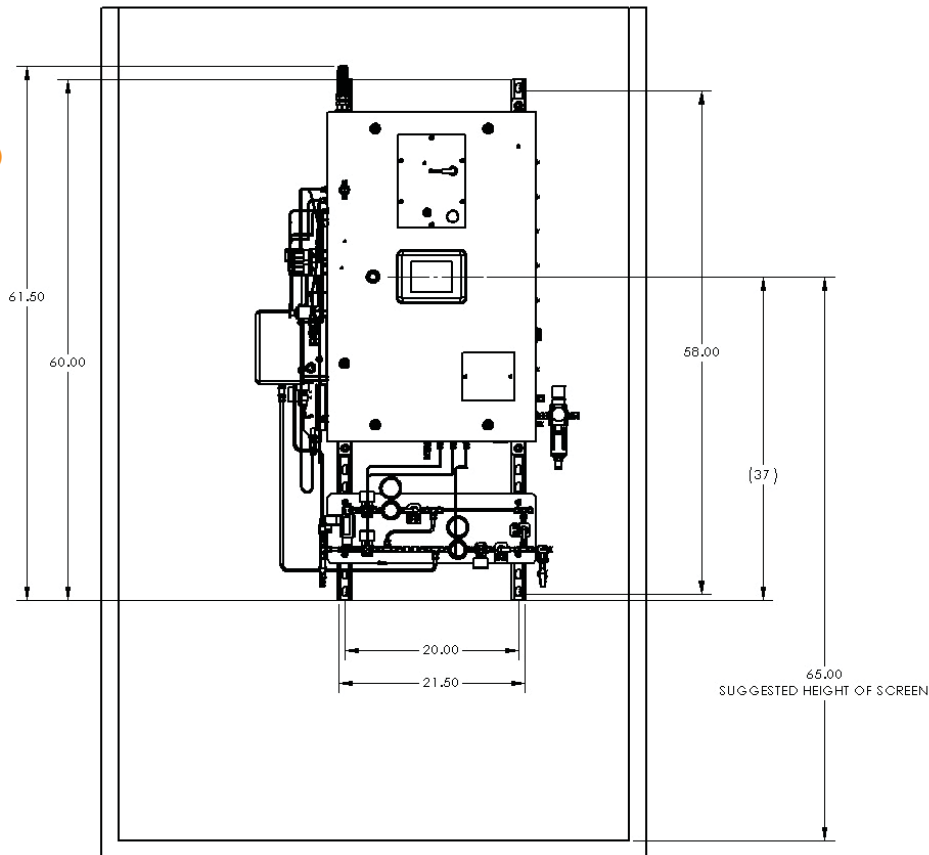
Sample Management System



Product Specifications

Electrical	Input voltage: 115/230 VAC Input frequency: 47-63 Hz Requires 15 amp, dedicated circuit with disconnect Entry Hub for 1" NPT conduit (RMC or IMC)
Purge	Instrument Air < 0.5 scfm @ 40-115 psig 4 scfm during initial purge cycle (21 minutes @ 40 -115 psig) Connections: (1) 3/8" SST tubing
Sampling Management System Included	Inlet: 1.5-3.0 gph @ 25-80 psig Outlet: 1.5-3.0 gph @ 10-65 psig (Approximately 15 psig pressure drop)
Ambient Temperature Requirements	0-35°C (32-95°F)
Size and Weight	38"w x 18"d x 60"h 280 lbs.
Communication	(2) 4-20mA proportional to sulfur concentration (standard) Modbus TCP (optional) Modbus RS-485 (optional) Modbus RS-232 (optional) Ethernet (optional)
Sample Conditioning Systems	Optional: Particle and H2O Removal
Classification	Class I, Division 2, Groups B, C, D, T4A (Z-Purge)

Sindie On-Line Schematic
(Dimensions in inches)



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Clora M-SERIES
Chlorine Analyzer



Chlorine Analysis in Liquid Hydrocarbons, Aqueous Solutions and Catalyst

The Clora Bench-Top analyzer is a compact Chlorine analyzer, designed for use with liquid hydrocarbons such as aromatics, distillates, heavy fuels and crude oils, as well as aqueous solutions. The analyzer delivers unprecedented accuracy and precision for petroleum and petrochemical applications where ease-of-use, reliability and measurement speed are critical. Plug it in and measure. Results with one touch. Unrivaled precision.

Now Available with



Application Areas:

- Total Chlorine analysis from aqueous solutions and aromatic products to heavy fuels, crudes, and catalyst.
- For refineries, petrochemical and additive plants, pipeline terminals, and test laboratories.

Features and Benefits:

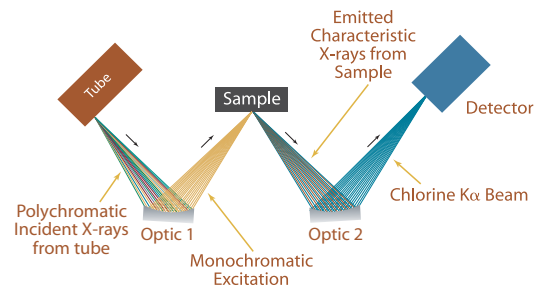
- LOD: 0.13 ppm wt. for hydrocarbons.
- Dynamic range:
 - Standard: 0.13 ppm wt. up to 3000 ppm wt.
 - XR Package: 0.13 ppm wt. up to 4% wt.
- Fits on any bench, in any lab: 37 cm (w) x 50 cm (d) x 34 cm (h).
- Plug-it-in and measure. Standard wall power is only utility required.
- User-friendly with touch screen interface.
- User programmable measurement time: 30 -900 s
- Extremely low maintenance:
 - No conversion gasses
 - No columns
 - No heating elements
 - No quartz tubing
- Replaceable air-cooled x-ray tube.
- No sample conversion or combustible gasses required.
- Robust polyimide window for easy cleaning.

Options:

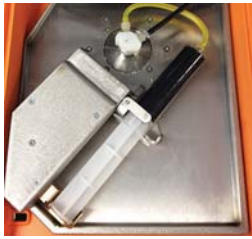
- LIMS data output compatible software.
- Extended Range capability.
- Catalyst testing capability.
- Autosampler (cannot be combined with Accu-Flow)
- Accu-Cell sample basket

MWD XRF

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the chlorine characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



Now available with:



ACCU-FLOW Technology

- Eliminates particulate settling effects
- Simplified design, optimized for everyday use
- Available add-on for all M-series analyzers

– or –



Clora Autosampler

- 8 sample cell capacity
- Increases productivity
- Utilizes XOS Accu-Cell cups

Precision

Typical repeatability (r) and reproducibility (R) values, at 95% confidence. Measurement time: 600 s xylene, 300 s crude oil and water.

Chlorine (ppm)	Xylene		Crude Oil			Water	
	r	R	Chlorine (ppm)	r	R	r	R
.05	0.15	0.27	5	0.4	0.7	0.6	1.0
1	0.17	0.29	10	0.8	1.4	1.0	1.5
5	0.31	0.53	50	1.2	2.0	1.5	2.5
10	0.50	0.90					

Product Specifications

Test Method	ASTM D7536
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Other Utilities	None
Sample Cup Volume	10ml
Ambient Temperature Requirements	5-40° C (40-104° F)
Dynamic Range	0.13 ppm–4% ppm (wt.)
Measurement	30-900 s
X-Ray Tube Setting	50 kv @ 1.5 mA max



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Clora 2XP
Chlorine Analyzer

Twice the Precision ■ Twice the Performance ■ Improved Sub-ppm Analysis



Chlorine Analysis in Liquid Hydrocarbons, Aqueous Solutions and Catalyst

The Clora 2XP Benchtop analyzer is designed for use with liquid hydrocarbons such as aromatics, distillates, heavy fuels and crude oils, as well as aqueous solutions. The enhanced precision of Clora 2XP is ideal for testing related to catalyst poisoning in reformers or for sites with fluid catalytic crackers and hydrocrackers monitoring very low levels of chlorine.

Application Areas:

- Total Chlorine analysis from aqueous solutions and aromatic products to heavy fuels, crudes and catalyst
- For refineries, petrochemical and additive plants, pipeline terminals and test laboratories

Features and Benefits:

- LOD: 0.07 ppm wt. in hydrocarbons
- Dynamic range:
0.07 ppm wt. up to 3000 ppm wt.
- Automatic sulfur correction
- Fits on any bench, in any lab:
37 cm (w) x 50 cm (d) x 34 cm (h)
- Plug-it-in and measure
- User-friendly with touch screen interface
- User programmable measurement time:
30-900 s
- Extremely low maintenance:
 - No conversion gasses
 - No columns
 - No heating elements
 - No quartz tubing
- Replaceable air-cooled x-ray tube
- No sample conversion or combustible gasses required
- Robust polyamide window for easy cleaning

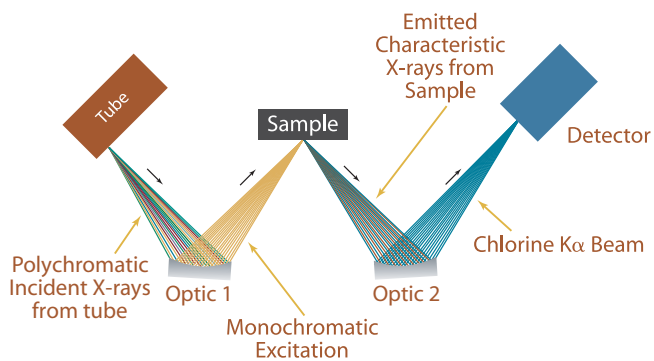
Options:

- LIMS data output compatible software
- Extended Range capability; 0.07 ppm up to 2%

MWD XRF

Dramatically lower levels of detection and faster response times

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the chlorine characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



Clora 2XP Test Results

All values in ppm

Total Chlorine in Gasoline from the Pump (600s)	0.29	Total Chlorine in LMH Vacuum Gas Oil (300s)	1.41	Total Chlorine in 0.3 ppm Mineral Oil Standard (300s)	0.30
	0.31		1.42		0.33
	0.30		1.44		0.31
	0.33		1.36		0.31
	0.36		1.43		0.30
	0.40		1.35		0.27
	0.36		1.44		0.23
	0.32		1.47		0.34
	0.32		1.39		0.32
0.31	1.46	0.34			
Standard deviation	0.032	Standard deviation	0.040	Standard Deviation	0.035
Average	0.327	Average	1.417	Average	0.305

Precision

Typical repeatability (r) and reproducibility (R) values, at 95% confidence. Measurement time: 600 s xylene, 300 s crude oil and water.

Xylene			Crude Oil			Water	
Chlorine (ppm)	r	R	Chlorine (ppm)	r	R	r	R
0.2	0.10	0.19	5	0.4	0.8	0.5	1.0
0.5	0.11	0.22	10	0.6	1.2	0.7	1.4
1	0.14	0.27	50	1.2	2.4	1.6	3.2
5	0.25	0.50					

Product Specifications

Test Method	ASTM D7536
Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Other Utilities	None
Sample Cup Volume	10ml
Ambient Temperature Requirements	5-40° C (40-104° F)
Dynamic Range	0.07 ppm–2% (wt.)
Measurement	30-900 s
X-Ray Tube Setting	50 kv @ 1.5 mA max



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Clora

Chlorine On-Line Analyzer



On-Line Chlorine Analysis in Hydrocarbon or Water

Chlorine contributes significantly to the corrosion of plant equipment and must be treated accordingly. With ever-changing crude quality and blends, chlorine levels can shift quickly; therefore, real-time analytical results are invaluable. The Clora On-Line analyzer presents a breakthrough analytical solution for quantification of total chlorine from 0.2 ppm up to 3000 ppm. By monitoring desalted crude, a plant can optimize performance and immediately see impacts of crude changes (including organic chloride). Additionally, monitoring overhead water can provide the needed feedback for chemical feed.

Application Areas:

- Upstream desalting, refining, power generation and effluent management.
- Total chlorine analysis in:
 - raw and desalted crudes
 - water and effluent streams
 - refinery process streams
 - finished product

Features and Benefits:

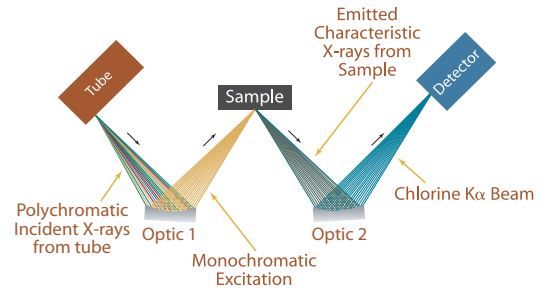
- LOD: 0.2 ppm in hydrocarbon matrices (at 300s)
0.5 ppm in aqueous streams (at 300 s)
- Dynamic range: 0.2 ppm – 3000 ppm wt.
- No consumable liquids or gasses required
- No combustion or sample conversion: ensures safe and low maintenance operation
- Calibration is linear up to 3000 ppm and one calibration curve runs all hydrocarbon matrices
- Not sensitive to sample temperature changes
- Direct measurement in ppm wt.
- Continuous and real time analysis
- Uses ASTM D7536 technology

Options:

- Multi-stream analysis capability
- Auto-validation capability.

MWD XRF

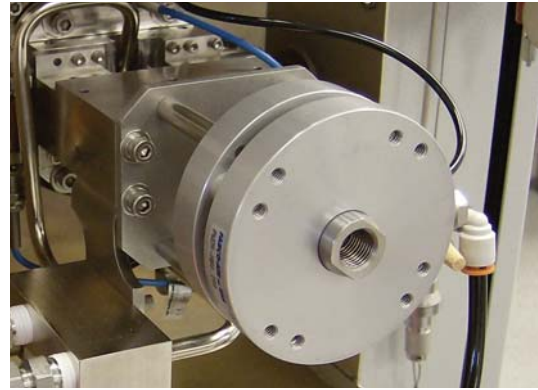
Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over traditional WD XRF instruments. This enables significantly improved detection limits and precision. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the chlorine characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



Precision

The MWD XRF analytical platform enables unrivalled precision and accuracy. Long term stability studies indicate highly stable and precise results.

	Crude 1	Crude 2	Water
Average Value	14 ppm	3 ppm	10 ppm
Run Time	5 min	5 min	5 min
STD DEV	0.4 ppm	0.25 ppm	0.6 ppm



Viscosity and Sample Conditioning

The CLORA On-Line Analyzer can accept most all crude oil streams with a maximum viscosity limitation of 160 cSt at 70°F (1.6 cm³/s at 21°C). More viscous materials can be analyzed by increasing sample temperature up to 275°F. A 100 micron self-cleaning by-pass flow style filter assembly or an in-line filter assembly is recommended. The analyzer is insensitive to water content in the crude oil. Aqueous matrices can be tested for chlorine concentration in the same fashion as hydrocarbon matrices.

High Viscosity Dynamic Window Module

The High Viscosity Dynamic Window Module (HV-DWM) ensures stable and accurate test results independent of sample matrix. The HV-DWM automatically and at preprogrammed intervals positions a new and robust window material in the measurement area. As a result, the measurement is stable and drift caused by contamination build up is eliminated. The HV-DWM uses an x-ray transparent polyimide film allowing stream pressures up to 80 psi (550kPa). While the sample stream continuously flows through the HV-DWM, the sample analysis takes place continuously as well ensuring rapid and highly representative chlorine monitoring of the sample stream.

Product Specifications

Analytical Platform	Monochromatic WD XRF
Dynamic Range	0.2 - 3000 ppm wt.
Calibration	3 - 5 point cal curve (depending on range)
Data Communication	Analog outputs: 2x 4 - 20 mA, multiple discrete alarm outputs
Digital Communication	Modbus RS-232, Modbus RS-485 (Half or Full Duplex), Modbus TCP
Remote Diagnostics	Optional via TCP/IP or UDP
Local HMI	Touch screen display
Ambient Temperature	0 - 40°C, (32 - 104°F)
Power	110 - 240 VAC, 50 - 60Hz, 750W max.
Instrument Air - Purge and Valve	40 - 100 psig, (275-690 kPa) 4 scfm max; -40°F (-40°C) dewpoint, oil free, N ₂ optional
Dimensions	62" (h) x 34" (w) x 18" (d), 158 cm (h) x 86 cm (w) x 46 cm (d)
Certifications	ATEX Zone 1 Ex d ia [ia] px IIC T4; CE, NEC Class I Div 2 Groups B,C,D T4A
Flowrate	Continuous flow through measurement cell at 8-12 GPH (30.3 - 45.4 lph)
Sample Pressure	30 - 80 psi (210 - 550 kPa)
Sample Temperature	Min: > Cloudpoint, Max: 275°F (135°C)
Sample Viscosity	Max 160 cSt at 70°F, (1.6 cm ² at 21°C) more viscous material may require sample heating
Sample Filtration	No water removal required, particle filtration to 100 micron



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HD Prime Analyzer

Complies with
ASTM F2853 and F2617



For Lead and Other Toxic Elements

The HD Prime analyzer uses XOS's breakthrough **High Definition X-ray Fluorescence (HDXRF®)** technique to measure for lead and other toxic elements in toys and children's products at unprecedented detection limits.

Advances in optics and analytical technology let the HD Prime analyzer measure the concentration of these elements in the product's paint and separately in the base material. This analytical technique was developed specifically to meet the CPSIA's current and future regulatory limits. The HD Prime analyzer is ideal for the rapid screening and precise determination of toxic elements in toys in a highly user-friendly and cost-effective manner. Measurements are non-destructive and do not require costly and time-consuming sample preparation that would destroy the tested merchandise and degrade the audit trail. HDXRF® equips industry and government agencies, which are responsible for ensuring product safety, with truly unprecedented benefits of speed, precision, and ease of use.



Application areas

- Multi-element detection in toys and children's products for compliance with regulatory requirements of the **CPSIA**.
- Rapid and precise screening and quantification of toxic elements.
- For use in factory production and lab environments, third-party test labs, retail, and regulatory applications.
- RoHS, F963, EN 71, Conflict Minerals, and more

Features and benefits

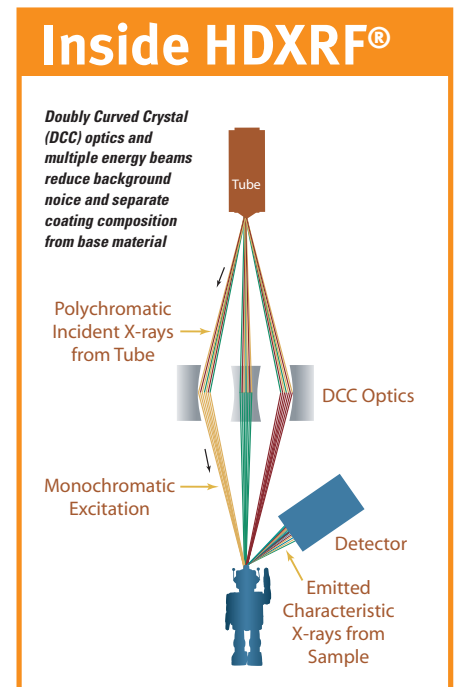
- Determination of regulated elements (Pb, Sb, As, Ba, Cd, Cr, Hg, Se, Br, and Cl).
- The concentration of the toxic elements in the **paint** and the base materials are both reported **separately**.
- Analysis area of 1mm; enables testing of small features and irregular shapes.
- Ease of use enables testing in factory and laboratory environments with minimal training.
- No sample preparation required: eliminates time-consuming paint removal and digestion steps, is nondestructive to the product, and won't degrade the audit trail.
- Screening mode rapidly detects the presence of all relevant toxic elements.
- Quantification mode precisely and accurately determines the concentration of elements in the paint and the substrate.

Powered by



The Right Technology Matters

HDXRF® is an elemental analysis technique which uses XOS's patented DCC optics to enhance measurement precision and accuracy. An important benefit of HDXRF® is that it provides elemental quantification in the coating and substrate **separately**. Multiple DCC optics capture x-rays from a divergent x-ray beam emitted from the tube, and the optics redirect several select and narrow energy regions into an intense and focused beam on the surface of the product. By selectively using **multiple monochromatic-excitation** beams ranging from low to high energy, HDXRF® allows the user to quantify toxic element concentrations for both the coating and the base materials separately. Using multiple monochromatic-excitation, HDXRF® eliminates the scattering background under the fluorescence peaks, greatly enhancing elemental detection limits. Since this technique applies focused excitation beams, an analysis area on the sample of 1 mm diameter is achieved without reducing the analyzer's sensitivity by using collimators to reduce the beam size. The diagram shows the basic configuration of HDXRF® and its use of multiple monochromatic excitation.

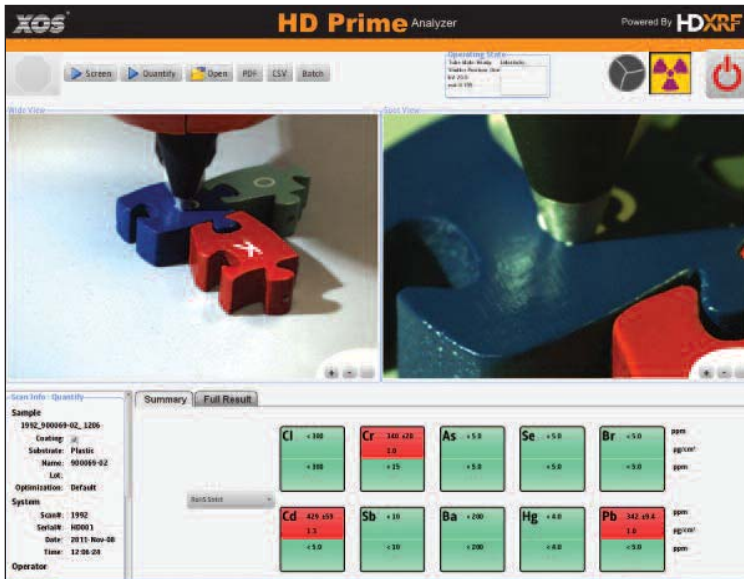


The HD Prime accommodates everything from large toys to small jewelry.

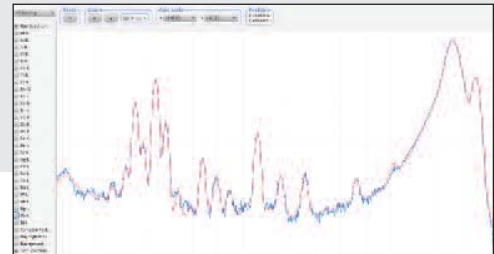
Detection Limits

LOD in ppm	Pb	Cd	Cr	As	Br	Sb	Se	Hg	Ba	Cl
Plastic Substrate	.8	2	2	.8	1	5	1	1	50	100*
PVC Substrate	1	2	5	1	1	5	1	2	100	N/A
Coating on Plastic	5	50*	15	5	5	100*	5	8	200*	150*
Metal Substrate	10	5	15	8	N/A	20	5	10	200*	N/A
Coating on Metal	8	30*	15	8	5	60*	5	10	200*	150*

User Interface and Data Management



- Color-coded indicators present results as Pass or Fail - separately for the product's substrate and coating.
- Elemental concentrations are indicated in ppm and in $\mu\text{g}/\text{cm}^2$.
- The fluorescence spectrum is recorded and accessible for each measurement.
- Two digital images (of whole sample and of test area) are stored with each test.
- All test results are recorded in tamper-proof format.
- Data export capability in electronic and hard copy form.
- Operation is mouse-driven and highly user-friendly.



- Large sample chamber easily accepts large and irregular shaped products.
- Plug-it-in and measure: No need for special utilities or consumables.
- Camera captures image of whole toy and analysis area.
- Measurement head is easily adjustable in all directions
- Sample chamber secured by safety interlocked doors.



Control box and computer

Measurement head

Monitor display

Keyboard and mouse

Product Specs

Elements	Pb, Sb, As, Ba, Cd, Cr, Hg, Se, Br, and Cl in addition to other elements of interest
Analysis Modes	Screening Mode: rapid determination for presence of elements Quantification Mode: accurate and precise determination of elemental concentration
Measurement Time: Screening Mode Substrate and Coating	~1 minute for plastics, wood, glass, rubber, leather, textiles, bulk paint ~2 minutes for metals
Measurement time: Quantification Mode Substrate only	~2 minutes for plastics, wood, glass, rubber, leather, textiles, bulk paint ~3 minutes for metal samples
Measurement time: Quantification Mode Coatings and Substrate	~5 minutes
Analysis area	1mm diameter
Ambient Temperature	5-35° C
Relative Humidity	80% maximum
Facility AC Power requirements	90-264 VAC, 47-63 Hz
Tube voltage	20-50kV
Tube current	0.2 – 2 mA
Power Consumption	200 watts maximum

Configuration

Analyzer dimensions	H: 812 mm W: 914 mm D: 660 mm (32"x36"x26")
Sample chamber size	H: 305 mm W: 610 mm D: 457 mm (12"x24"x18")
Analyzer weight	110 kg (240 lbs)
Data output	Hard drive storage, USB output
Cameras	1 camera, 2 images: large-angle image of sample and close-up view of analysis area

User Interface

Material selection options	Plastic, Metal, Wood, Glass, Rubber, Leather, Textiles, Bulk Paint
Quantification: Test Results	Concentration in substrate in ppm (wt.). Color-coded pass/fail indicators (adjustable) Concentration in coating ppm (wt) and ug/cm ² . Color-coded pass/fail indicators (adjustable) Spectrum analysis capability included
Screening: Test Results	Pass or Fail color-coded indicators
User and sample identification and description	User inputs operator and sample detail
Digital Images	Images of sample and test areas are stored with each test result



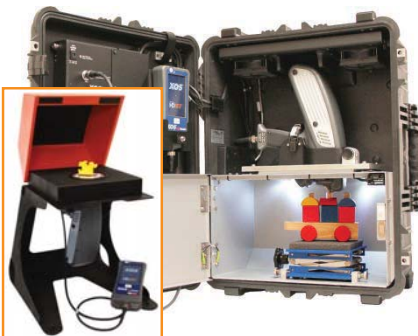
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HD Mobile™ Analyzer

HDXRF in a Portable Format



Compliance with the ultimate in convenience and flexibility

HD Mobile™ extends the superior HDXRF® standard for compliance out of the lab and into many different work environments. Now the precision and confidence of HDXRF analysis is available for use in portable applications – on the manufacturing floor, at the shipping dock, in the warehouse, or on the retail shelf.

Complies with ASTM F2853 & F2617

Application Areas:

- Multi-element detection in toys and children's products for compliance with regulatory requirements of the CPSIA
- RoHS, F963, and EN-71
- Rapid, precise screening and quantification of toxic elements
- Compliance verification across the supply chain:
 - Manufacturing process and finished goods QA/QC
 - Warehouses and retailers
 - Regulatory agencies

Features and Benefits:

- Unprecedented limits of detection for "true screening" and/or certification
- Pinpoint analysis plus ability to capture high-resolution sample image
- Increase testing frequency while reducing cost
- User-friendly interface and data management

Powered by
HDXRF®

The Right Technology Matters

HDXRF® is an elemental analysis technique which uses XOS's patented DCC optics to enhance measurement precision and accuracy. Multiple DCC optics capture x-rays from a divergent x-ray beam emitted from the tube, and the optics redirect several select and narrow energy regions into an intense and focused beam on the surface of the product. Using multiple monochromatic-excitation, HDXRF eliminates the scattering background under the fluorescence peaks, greatly enhancing elemental detection limits. The technique of applying focused excitation beams also provides a true, highly focused, 1-mm analysis area. The diagram shows the basic configuration of HDXRF and its use of multiple monochromatic excitation.

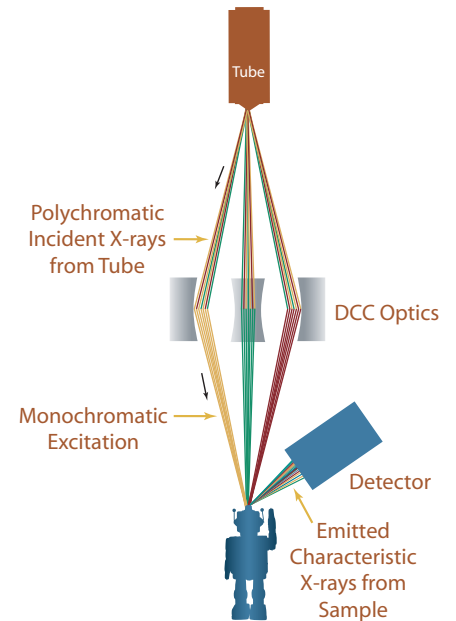
Fast, True, Cost-Effective Compliance

XOS developed HD Mobile to extend HDXRF's proven technology beyond the laboratory and into the field. Compliant with **ASTM F2853-10 and F2617**, HD Mobile will provide highly precise screening for lead well below the regulatory limits defined in CPSIA for both coatings and substrates.

HDXRF analyzers are able to analyze lead in paint and substrate materials with one measurement.

HD Mobile also precisely measures cadmium, arsenic, mercury, antimony, and other elements that may be of concern in consumer products.

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HDXRF®



Doubly Curved Crystal (DCC) optics and multiple energy beams reduce background noise and separate coating composition from base material.

The ultimate in convenience and flexibility

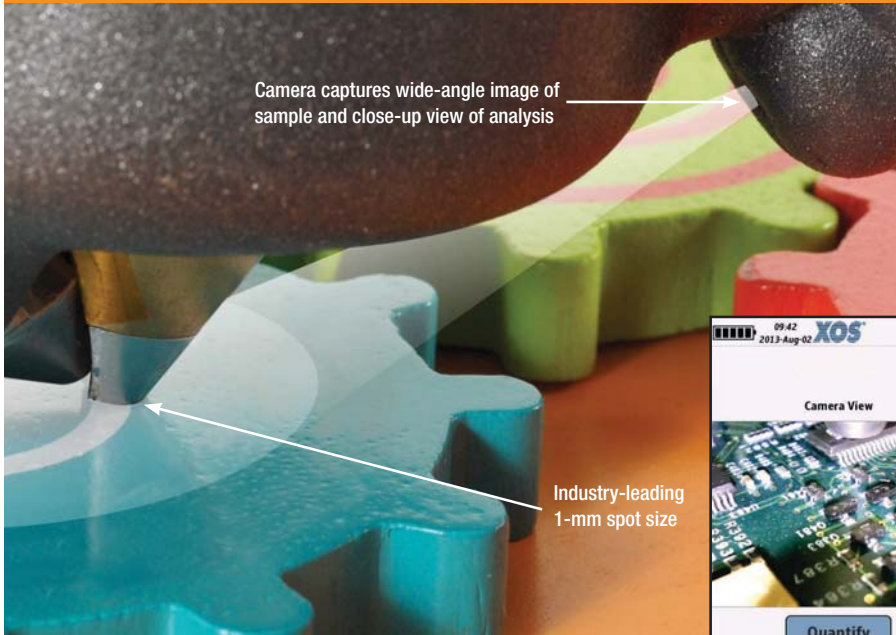
Now you can analyze large and small products and components anywhere in the consumer supply chain using our new HD Mobile portable analyzer. Easily switches between stationary and handheld analysis.

Remove handheld unit from case for portable applications and screening

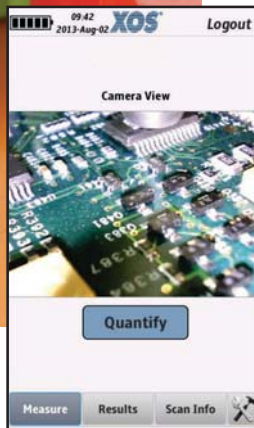
Easy to read interface makes navigation easy and intuitive



Advanced Imaging Capability



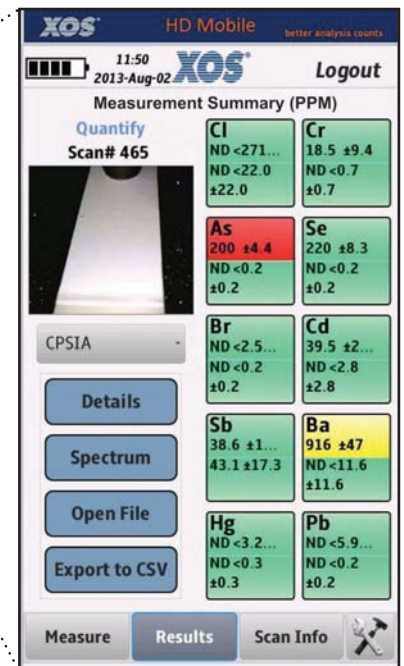
The built-in camera allows the operator to precisely pinpoint the position of the 1-mm analysis area and record the image. This unique design makes the operator's job easier and provides a traceable record of the analysis for robust auditing and compliance.



HD Mobile records image view of sample and analysis area and stores it with each test for documentation in a tamper-evident format.

User-Friendly Interface and Data Management

- Color-coded indicators present results as Pass or Fail separately for the product's substrate and coating.
- Elemental concentrations are indicated in ppm and, for coatings, $\mu\text{g}/\text{cm}^2$ is also reported.
- The analysis spectrum is recorded and viewable for each measurement.
- High-resolution image of analysis area is stored with each test.
- All test results are recorded in tamper-evident format.
- Data export capability in electronic and hard copy form.



Detection Limits

LOD in ppm	Pb	Cd	Cr	As	Br	Sb	Se	Hg	Ba	Cl
Plastic Substrate	0.8	2	2	.8	1	5	1	1	10	100*
PVC Substrate	1	2	5	1	1	5	1	2	10	N/A
Coating on Plastic	5	50*	15	5	5	100*	5	8	100	150*
Metal Substrate	10	5	15	8	N/A	15	5	10	200	N/A
Coating on Metal	15	30*	15	8	5	60*	5	10	200	150*

*Longer measurement time

Product Specs

Analyzer Weight	3.6 lbs (1.6 kg)
Interface Module Weight (with battery)	1.75 lbs (0.8 kg)
Analyzer Dimensions	12.3 x 3.7 x 8.6 in
Interface Module Dimensions	3.1 x 6.6 in
X-Ray Tube voltage, current	25-50kV, 200uA
Detector	25 mm SDD
System Electronics	512MB Dual Core Processor
Display	4.3" WVGA (800RGBx480) TFT with touch screen, 16.7M colors, 217dpi
Analysis Area	1 mm
Elemental Range	10 elements displayed in icons on results screen, up to maximum of 40 on secondary screen
Test Results	Concentration in substrate ppm (wt). Color coded pass/fail indicators (user adjustable) Concentration in coating ppm (wt). And ug/cm2 Color coded pass / fail indicators (user adjustable) Spectrum analysis capability
Data Entry	Touch screen keyboard with icons
Data Storage	Up to 10,000 readings including camera images
Data Transfer	SDHC Card
Security	Password-protected user security
Integrated CCD Camera for aligning analysis area and storing images	High resolution image focused at measurement spot with 25 degree wide angle view
Battery	Li-ion, ~8hr run time normal operation (2 included)
Licensing / Registration	Varies by region, contact your local distributor
Compliance	CE

Test Stand/Transport Case

Benchtop Test Stand	21.8 x 16.7 x 10.6 in.
Sample Chamber	9.5 x 10 x 4 in.
Portable Transporter Case - Modified Pelican 1610 with handle and wheels	25.5 x 19 x 11.5 in.
Sample Chamber	9 x 16 x 9.5 in.
Power Requirements	90-264VAC, 47 ~ 63Hz, 3A @ 115V
Charging Station	Rapid battery charger
Standard Accessories	Operators manual, check samples and standards



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HD Mobile is a trademark of XOS.

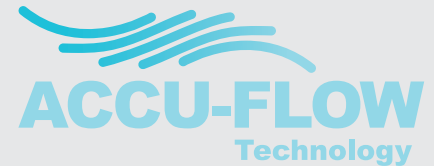


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HD Maxine



Now available with



Application Areas:

- Contaminants, Additives, Wear Metals.
- Refineries, Lubricant Plants, Engine Service Centers.
- Crudes and downstream hydrocarbons, lubricants and used oil.
- Elements: S, Cl, P, K, Ca, V, Mn, Fe, Co, Ni, Cu, Zn, Hg, As, Pb, Se.

Features and Benefits:

- Fits on any bench.
- Plug-it-in and measure: no additional utilities required.
- Touch Screen user interface.
- Utilizes ACCU-CELL pre-assembled and pre-vented sample cups for enhanced precision, extreme ease-of-use and enhanced productivity.
- No sample dilution, conversion gasses, heating elements, quartz tubes or columns.
- Air-cooled excitation tube.

Options:

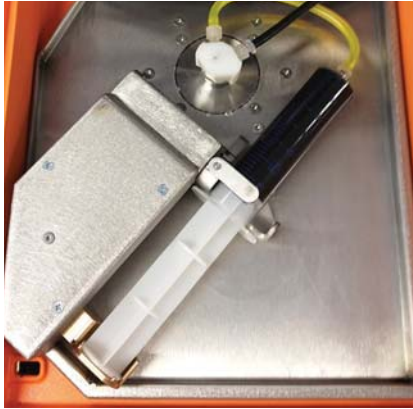
- LIMS data output software capability.
- Ink-jet Printer output.

Trace Metal Analysis in Hydrocarbons

HD Maxine assures precise determination of trace metals in crudes, lubricants and used oils without extensive sample preparation or expensive consumables. The analyzer enables the direct analysis of metals from Phosphorus to Lead, at unprecedented detection limits in a robust analyzer configuration designed to perform in demanding petroleum and industrial environments. Plug it in and measure. Results with one touch. Unrivaled precision.

HDXRF

High Definition X-Ray Fluorescence (HD XRF) is a multi-element analysis technique offering significantly enhanced detection performance over traditional ED or WD XRF. This technique applies state-of-the-art monochromating and focusing optics, enabling multiple select-energy excitation beams that efficiently excite a broad range of target elements in the sample. Monochromatic excitation dramatically reduces scattering background under the fluorescence peaks, greatly enhancing elemental detection limits and precision. HDXRF is a direct measurement technique and does not require consumables or special sample preparation.



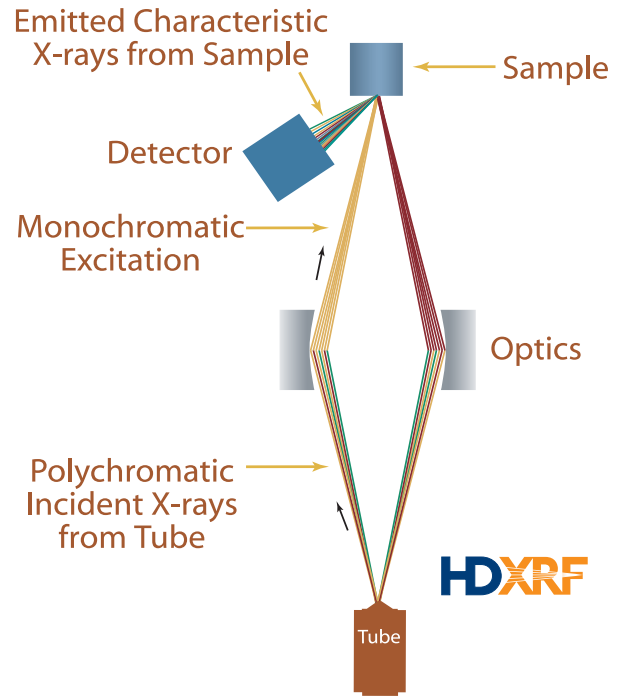
ACCU-FLOW Technology

- Eliminates particulate settling effects
- Simple design, optimized for everyday use
- Available add-on for all M-series analyzers



ACCU-CELL Sample Cups

- No assembly of separate film & cup components
- Pre-vented sample cups
- Eliminates sample & cup contamination
- One discharge of 1 ml pipette will fill the cup



Product Specifications

Analysis Range	Up to 5000 ppm (higher concentrations can be accurately achieved with additional calibrations)
Measurement Time	300 s or 600 s
Ambient Temperature	5-35° C
Facility AC Power requirements	90-264 VAC, 47-63 Hz
Tube voltage	20-50 kV
Tube current	0.2 – 2 mA
Power Consumption	200 w Max.
Analyzer dimensions	41 cm (h) x 39 cm (w) x 53 cm (d)
Analyzer weight	23 kg
User Interface	Touch Screen
Sample cell volume	1 ml

Target Elements and Detection Limits

Element	LOD (ppm) (600s)
Phosphorous (P)	15
Sulfur (S)	9
Chlorine (Cl)	6
Potassium (K)	1
Calcium (Ca)	0.7
Vanadium (V)	0.7
Manganese (Mn)	0.7
Iron (Fe)	0.7
Cobalt (Co)	0.4
Nickel (Ni)	0.28
Copper (Cu)	0.14
Zinc (Zn)	0.14
Mercury (Hg)	0.08
Arsenic (As)	0.06
Lead (Pb)	0.08
Selenium (Se)	0.06





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HD Rocksand[®]

Conserve Time. Conserve Money.
Powerful Heavy Metal Detection in Soil and Water.

Offering much more than simple screening, HD Rocksand delivers a quantifiable analysis for heavy metals in the field.



Complies with ASTM D8064 & EPA 6200 methods

Applications:

- Environmental Risk Assessments of Soil and Water
- Industrial Site Characterization
- Remediation Validation

Features:

- Patented HDXRF analysis technology
- Hands-free testing mode
- A lightweight, easy-to-carry portable test stand
- Snap-in sample rotator
- Handheld measurement capability

Benefits:

- On-site data collection enables real-time decision making
- Time and cost savings by minimizing lab measurements
- Ultra low detection limits
- Results at the push of a button
- Ability to traverse large brownfield sites with ease
- Outstanding measurement repeatability and reproducibility

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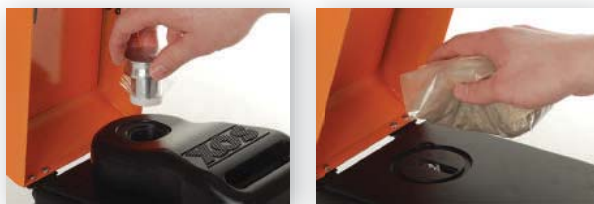
NEW: Introducing HD Rocksand¹⁰¹ - the ideal solution for customers seeking a best-in-class screening tool.

HD Rocksand



HD Rocksand offers much more than simple screening. With best-in-class limits of detection, HD Rocksand delivers analysis below regulatory limits – particularly for elements like Cadmium, Arsenic, and Mercury. It features an easy-to-use sample cup rotator for soil and water samples enabling improved results for heterogeneous samples.

- On par with laboratory methods
- Best-in-class levels of detection
- Hassle-free operation



Limits of Detection in Parts Per Million (ppm)

Elements	Soil In Test Stand	Water in Test Stand	Soil with Handheld Analyzer
As	0.5	0.1	1.0
Cd	0.8	0.9	3.0
Hg	0.5	0.3	2.0
Cr	5.0	1.0	10.0
Cu	1.5	0.9	5.0
Ni	3.0	0.3	8.0
Pb	0.5	0.2	2.0
Sb	5.0	5.0	15.0
Se	0.4	0.1	1.0
Ag	2.0	2.0	6.0
Zn	1.0	0.6	3.0
Ba	15.0	10.0	20.0

Product Specifications

Test Method	ASTM D8064 & EPA 6200
Total Weight	<6.0 kg (13.2 lbs)
Test Stand Dimensions	25.4W x 21.8D x 37.8H cm
Sample Chamber Dimensions	22.1W x 16.3L x 5.1H cm
X-Ray Tube voltage, current	25-50kV, 200 µA
Optics	3 Doubly Curved Crystal Optics
Detector	SDD
System Electronics	512 MB Dual Core Processor
Battery	Li-ion, ~8hr run time normal operation
Display	10.9 cm WVGA (800RGBx480) TFT with touch screen, 16.7M colors, 217 dpi for viewing in full sunlight
Elemental Range	14 elements displayed on results screen, maximum of 40 elements on secondary screen
Licensing / Registration	Varies by region, contact your local distributor
Compliance	CE
Power Requirements	Operates on shared analyzer battery power or plugin to 90-264VAC, 47 ~ 63Hz, 3A @ 115V

Includes: portable test stand with sample rotator, handheld analyzer and HIM (human interface module), cross-contamination analyzer cap (for soil), charger (100-250 AC, 1A), (2) batteries, AC power cord, travel carrying case, (3) NIST soil validation samples, (10) single open-ended sample cups, (1) pack of 100 polypropylene 12um sample films

NEW: HD Rocksand¹⁰¹



Large samples like long drill cores, pit walls, and chunks of material can be easily screened without the need to remove a sample.

HD Rocksand¹⁰¹

is a streamlined option for customers who have screening needs today, but want the option to quantify results at low levels in the future. Customers can realize increased portability for easier screening analysis without forfeiting best-in-class precision. With its lightweight handheld analyzer and display, HD Rocksand 101 enables users to easily perform their testing in any terrain.

- Improves in-the-field workflow
- Handheld analysis without the need to remove a sample
- Upgrade package available for lab-quality results

Limits of Detection (ppm)

Elements	Soil
As	1.0
Cd	3.0
Hg	2.0
Cr	10.0
Cu	5.0
Ni	8.0
Pb	2.0
Sb	15.0
Se	1.0
Ag	6.0
Zn	3.0
Ba	20.0

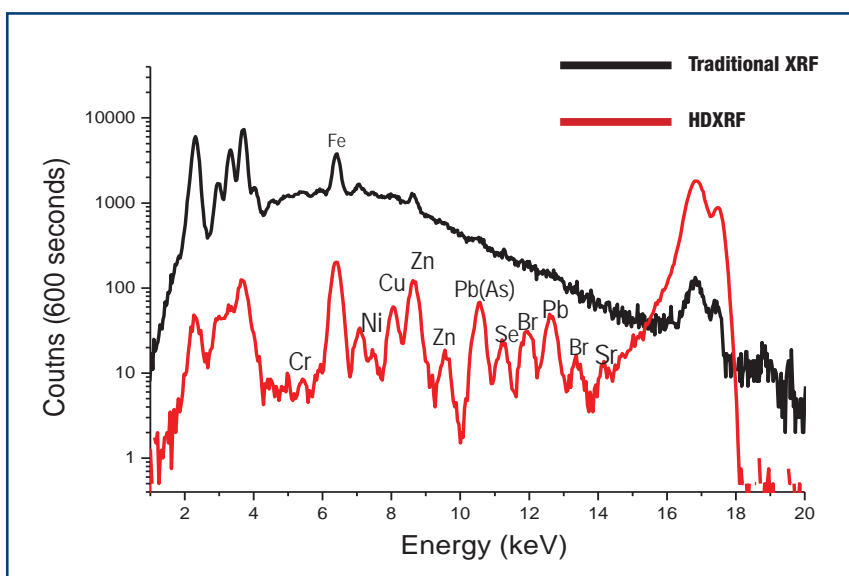
Product Specifications

Total Weight	<2.5 kg (5.6 lbs)
Analyzer Weight	1.7 kg (3.8 lbs)
HIM Weight	0.8 kg (1.8 lbs)
X-Ray Tube voltage, current	25-50kV, 200 µA
Optics	3 Doubly Curved Crystal Optics
Detector	SDD
System Electronics	512 MB Dual Core Processor
Battery	Li-ion, ~8hr run time normal operation
Display	10.9 cm WVGA (800RGBx480) TFT with touch screen, 16.7M colors, 217 dpi for viewing in full sunlight
Elemental Range	14 elements displayed on results screen, maximum of 40 elements on secondary screen
Licensing / Registration	Varies by region, contact your local distributor
Compliance	CE

Includes: handheld analyzer and HIM (human interface module), charger (100-250 AC, 1A), cross-contamination analyzer cap (for soil), (2) batteries, hard carrying case

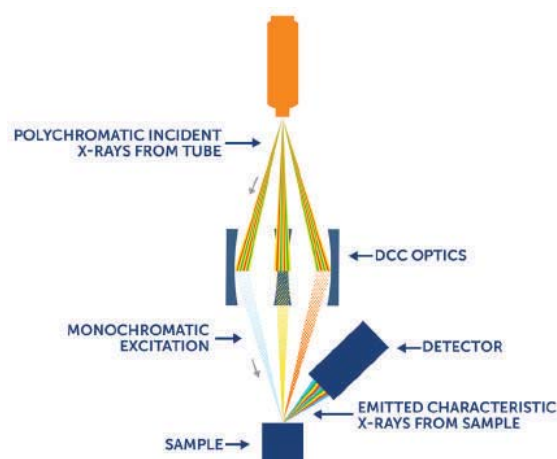
The Right Technology Matters

HDXRF is an elemental analysis technique which uses XOS's patented Doubly Curved Crystal (DCC) optics to enhance measurement sensitivity, precision, and accuracy. Multiple optics capture x-rays from a divergent x-ray beam. The optics redirect several select and monochromatic energy beams to focus intensely on the sample. By using focused monochromatic excitation beams in three different energy regions, HDXRF is able to eliminate scattering background and reduce interferences that hinder measurement sensitivity, repeatability, and speed. The diagram at the bottom right shows the basic configuration of HDXRF and the use of optics to create monochromatic excitation.



By eliminating the background signal from the polychromatic source x-rays, HD Rocksand is able to achieve dramatically better signal definition that produces its best-in-class limits of detection and quicker results.

Powered by
HDXRF



Double Curved Crystal (DCC) optics and multiple energy beams reduce background noise providing best-in-class sensitivity, repeatability, and speed.



Environmental Hazard Investigations

Brownfield sites possess many unique characteristics. They are large with uneven terrain, presenting many challenges to sampling. The HD Rocksand provides the flexibility to measure samples in numerous ways for simple, quick, accurate, and reliable analysis.



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HD Rocksand is a trademark of XOS.



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XOS Heavy Metal On-Line Analyzer



Product Features

- Innovative monochromatic wavelength dispersive X-ray fluorescence (MWDXRF) technology
- High performance testing and accuracy, with a lower limit of detection: 0.025ppm (lead) and 0.015ppm (arsenic)
- No issues with chromatic or turbidity interference compared with conventional colorimetry
- No consumption of reagents and chemicals and no secondary environmental pollution
- Direct measurement: no sample processing
- Replaceable, air-cooled, low-capacity (50W) X-ray tube
- Plug-and-play with common power supply
- Easy operation, no need for trained professionals
- Optional measurement time
- User-friendly touch screen
- Ultra-low maintenance requirements

Precise Measurement Without Frequent Maintenance

The XOS Heavy Metal On-Line Analyzer is a state-of-the-art instrument that measures lead and arsenic levels in water. This analyzer utilizes innovative Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWDXRF) technology to ensure the precise measurement performance and testing accuracy of the analyzer and to provide a convenient and reliable means of operation. It is a ground-breaking, cutting-edge product, leagues above other heavy metal analyzers on the market.

Operating Principles

The XOS Heavy Metal On-Line Analyzer utilizes Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWDXRF) technology for the measurement of lead and arsenic levels in water.

It contains the main MWDXRF analyzer, an on-line flow sampling device, a touch screen, an accessory electronic circuit device and corresponding computer hardware and software systems. The operating principles of the instrument are detailed in the following diagram. An X-ray tube generates a continuous X-ray spectrum with a maximum power of 50W (50kV and 1mA). The Doubly-Curved Crystal (DCC) reflector intercepts X-rays of a certain wavelength from the X-ray tube and focuses them into a highly intensive monochromatic excitation beam, which is cast onto the test sample to excite the electrons of the lead or arsenic. The emitted X-rays from the sample are then intercepted by another DCC reflector and focused onto a detector. The intensity measured by the detector (counts per second) is in direct proportion to the content of lead or arsenic (mg/kg) in the sample. As such, the content of lead or arsenic can be calculated via a calibration formula according to the detected intensity.

Compared with the multichromatic light excitation adopted by traditional high-capacity WDXRF technology, the XOS Heavy Metal On-Line Analyzer requires only a low-capacity X-ray tube integrated with a DCC reflector to generate monochromatic excited light rays of sufficient intensity. Monochromatic X-ray excitation distinctively reduces background noise, simplifies the base correction, and increases the Signal to Noise Ratio (SNR).

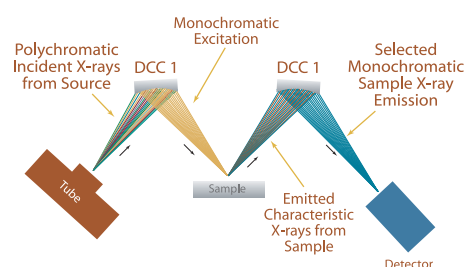


Figure 1. Optical Path of the MWDXRF Analyzer

Product Parameters

SPECIFICATIONS	DESCRIPTIONS
Power source	230 VAC \pm 10%, 50-60 Hz (hertz)
Power consumption	400 VA (volt-ampere)
Fuse rating	Independent breaker, 4A, 250V, with leakage protection (leaking current 30mA)
Equipment AC requirements	90-264 V AC, 47 – 63 Hz (hertz)
Measurement technology	Monochrome wavelength dispersive X-ray fluorescence (MWDXRF) technology
Analytical ranges	Arsenic – 0.015 mg/L.- 5 mg/L Lead – 0.025 mg/L.- 10 mg/L
Detection limits	Arsenic – 0.015 mg/L. Lead – 0.025 mg/L
Flow rate	50-80mL/min
Sample pressure	5-50psi
IP rating	IP 53
Communication ports	RS-485 (Modbus)
Relative humidity	30% - 85%
External dimensions	1040 mm \times 600 mm \times 437.16mm (H x W x D)
Operating temperature	10 - 40 degrees Celsius
Relays	220V, 3A, 2 channels
Product Name	Order Number
XOS 2-1 Heavy Metal On-Line Analyzer	402505-01PbAs
XOS Total Lead On-Line Analyzer	402505-01Pb
XOS Total Arsenic On-Line Analyzer	402505-01As



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Phoebe M-SERIES

Phosphorus Analyzer



Phosphorus Determination in Hydrocarbon and Aqueous Matrices

From crude oil to bio-fuels, in additives or water, the PHOEBE Bench-Top Analyzer delivers unprecedented precision and accuracy for quantification of phosphorus. Based on XOS's MWD XRF analytical platform, (as is found in SINDIE and CLORA Analyzers) PHOEBE offers a LOD of 0.4 ppm in hydrocarbon matrices in a ten minute measurement cycle. The analyzer's extreme easy of use with straightforward touch screen operation allows for use in a broad range of industrial environments. PHOEBE is a plug-it-in and measure analytical solution and does not require extensive sample preparation, consumable gasses or sample conversion.

Application Areas:

- Total phosphorus analysis in hydrocarbons (including crude-oil), bio-fuels and aqueous matrices.
- For use in refinery, additive plants, oil recycle facilities and test labs.

Features and Benefits:

- LOD: 0.4 ppm in 600s.
- Dynamic Range: 0.4-3000 ppm wt.
- Fits on any bench and is compatible for use in mobile labs.
- Robust touch-screen user interface.
- User programmable measurement time: 30 -900 s.
- No conversion or combustible gasses required. No heating elements, quartz tubes or columns.
- Low power air-cooled excitation x-ray tube.

Options:

- LIMS compatible data communication capability.



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Signal

Silicon Analyzer



Silicon Analysis in Petroleum and Bio Fuels

From gasoline to ethanol and toluene, the Signal bench-top analyzer delivers unprecedented precision and accuracy in quantitative analysis of silicon. The analyzer is based on XOS' MWD XRF technology platform (as applied in Sindie and Clora analyzers) ensuring a robust analysis solution for demanding petroleum and industrial environments.

Application Areas:

- Total silicon analysis in hydrocarbons and bio fuels.
- For use in refinery labs, pipeline terminals, additive plants, and inspection laboratories.

Features and Benefits:

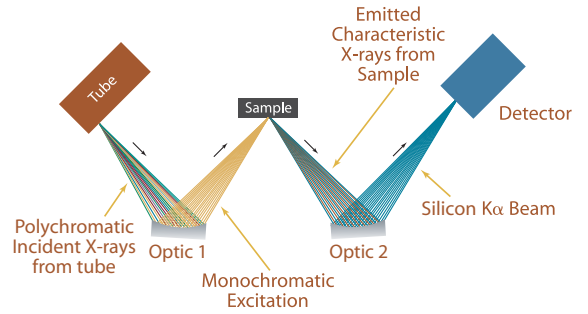
- LOD: 0.65 ppm at 600 s.
- Dynamic Range: 0.5 ppm to 3000 ppm.
- Fits on any bench.
- Touch Screen user interface.
- User programmable measurement time: 30-900 s.
- No conversion gasses, heating elements, quartz tubes or columns.
- 75 W air-cooled excitation tube.

Options:

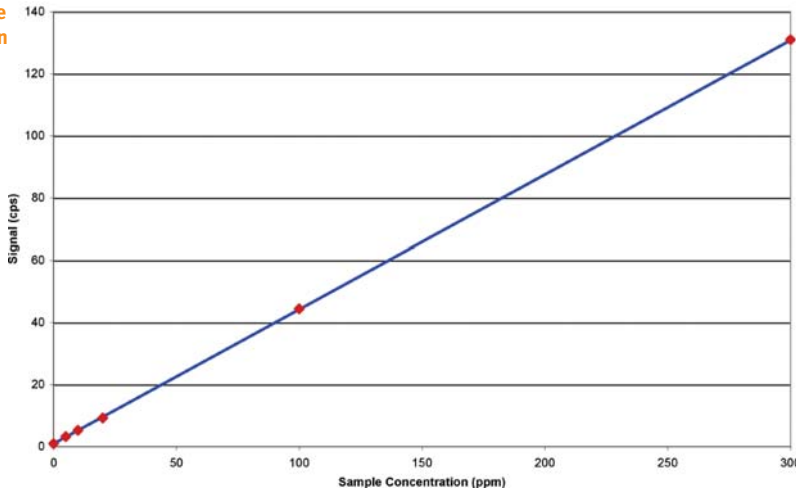
- LIMS compatible data output software.

MWD XRF

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the silicon characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



Low Range Calibration



Precision

Typical repeatability (r) and reproducibility (R) values in gasoline, at 95% confidence. 600 s measurement time.

Silicon Concentration (ppm)	r	R
2	0.4	0.7
5	0.5	0.8
8	0.6	1.0
15	0.8	1.4
100	2	4
500	5	10

Product Specifications

Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100-120 VAC, 47-63 HZ at 6.0 Amps/200-240 VAC, 47-63 HZ at 6.0 Amps
Sample Cup Volume	10 ml
I/O Ports	Ethernet 10/100 base T, RS232
Optional Computer Interface	Pentium, 100 MHz, 32 MB RAM/Windows 98 or newer operating system
Ambient Temperature Requirements	5-40°C (40-104°C)
Dynamic Range	Standard: 0.5 – 3000 ppm
Measurement	User selectable: 30-900 s
Calibration	8 calibration curves. Automatic and Manual Calibration functionality





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Polycapillary Optics

**FOR MICRO X-RAY FLUORESCENCE
AND X-RAY DIFFRACTION**



Improved Performance with Polycapillary Optics:

State-of-the-art optic captures a large solid angle from an X-ray source and redirects the beam into a micron-sized focal spot or highly collimated beam.

Features:

- Orders of magnitude flux gain from micron-sized spot
- Integration with compact, low-power sources provides flux equivalent to rotating anode sources
- Broad spectral bandwidth: 50 eV- 50 KeV
- Point-to-point focusing beam
- Point-to-parallel beam
- Custom designed enclosure available

Benefits:

- Extremely high flux density
- Increased spatial resolution
- Ideal for analysis of irregular shaped, unprepared, or low-Z samples

Advantages over Electron Probe X-ray Analysis:

- Enhanced detection sensitivity
- No special sample preparation needed
- Operation in air

Applications:

- Evaluation of small features
- Elemental mapping
- Film/plating thickness
- Detection of micro-contamination
- Multi-layered coatings for advanced circuit boards
- Small particle analysis
- Forensics
- Powder XRD
- Single crystal XRD

XRF and XRD with Polycapillary Optics

Custom Solutions. In XRF applications, focusing polycapillary optics deliver micron-sized focal spots and beam intensity superior to pinhole based micro XRF. Several orders of magnitude flux gain are possible, depending on the experimental geometry. In diffraction applications, polycapillary optics offer a highly collimated beam. Below are typical examples of polycapillary optics. Customized polycapillary optics based on customer requirements are available to meet specific instrument requirements.

Focusing Optics (μ XRF)

OFD (mm)	2	4	9	20	50	100	200
Focal spot size (μ m, FWHM, Mo Ka)	8	15	25	45	100	180	300
Intensity gain (vs a pinhole collimator of same size, 100mm from the source)	6000	3000	2200	1200	400	160	70

Note:

1. The above performance parameters relate to 50 μ m X-ray source.
2. The IFD of the optic is 20mm.

Collimating/Parallel-beam Optics (XRD/WDS)

Output beam diameter (mm)	0.5	1	2	3	4	6	10	15
Intensity gain	12	45	130	250	370	470	680	850

Note:

1. The above performance parameters are for a 50 μ m X-ray source at 8keV.
2. The IFD of the optic is 18mm and the output divergent angle is 0.2 degree.
3. Intensity gain determined by comparison to pinhole configuration at same distance from source and has the same beam size and divergent angle.

Slightly-focusing Optics (XRD/XRF)

Output convergent angle (degree)	0.25	0.5	1	2
Intensity gain	25	80	260	820

Note:

* 50 μ m X-ray source IFD: 18mm OFD: 140mm Energy: 8keV Focal spot size: 0.5mm, FWHM.

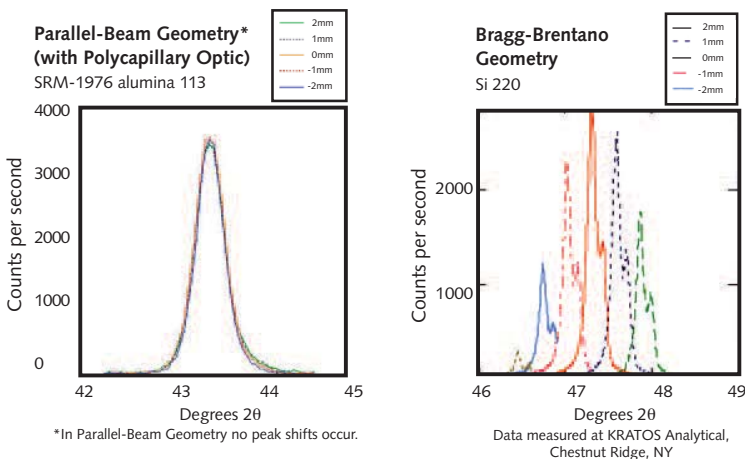


Figure 3 Peak shift as function of sample displacement for parallel-beam geometry and Bragg-Brentano geometry.

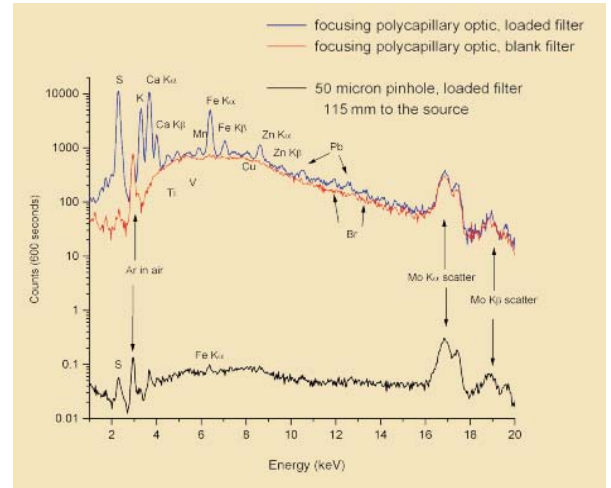


Figure 1 Comparison of μ XRF spectra generated using a focusing polycapillary optic and a pinhole aperture. The spectra shown is of an air particulate sample \sim 50 μ m in diameter. Mo excitation (40kV, 20W).

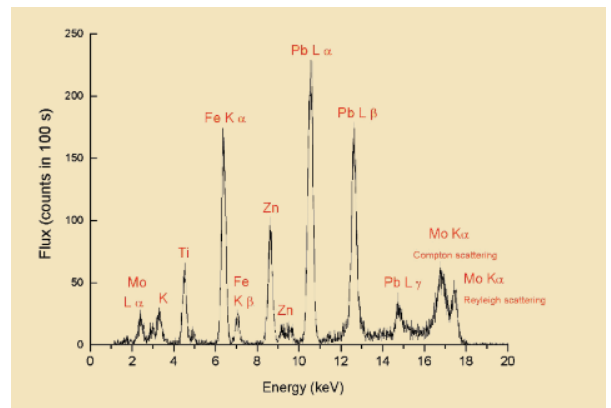


Figure 2 Spectrum of NIST SRM 1832 standard XRF sample using a polycapillary optic. Mo excitation (40kV, 12W).

Table 1

Picogram detection limits are possible using the polycapillary optic for this thin film SRM sample.

Element	K	Ti	Fe	Zn	Pb
Limit of Detection (pg)	4.1	1.5	0.57	0.28	0.52



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Polycapillary Optics

**FOR MICRO X-RAY FLUORESCENCE
AND X-RAY DIFFRACTION**



Improved Performance with Polycapillary Optics:

State-of-the-art optic captures a large solid angle from an X-ray source and redirects the beam into a micron-sized focal spot or highly collimated beam.

Features:

- Orders of magnitude flux gain from micron-sized spot
- Integration with compact, low-power sources provides flux equivalent to rotating anode sources
- Broad spectral bandwidth: 50 eV- 50 KeV
- Point-to-point focusing beam
- Point-to-parallel beam
- Custom designed enclosure available

Benefits:

- Extremely high flux density
- Increased spatial resolution
- Ideal for analysis of irregular shaped, unprepared, or low-Z samples

Advantages over Electron Probe X-ray Analysis:

- Enhanced detection sensitivity
- No special sample preparation needed
- Operation in air

Applications:

- Evaluation of small features
- Elemental mapping
- Film/plating thickness
- Detection of micro-contamination
- Multi-layered coatings for advanced circuit boards
- Small particle analysis
- Forensics
- Powder XRD
- Single crystal XRD

XRF and XRD with Polycapillary Optics

Custom Solutions. In XRF applications, focusing polycapillary optics deliver micron-sized focal spots and beam intensity superior to pinhole based micro XRF. Several orders of magnitude flux gain are possible, depending on the experimental geometry. In diffraction applications, polycapillary optics offer a highly collimated beam. Below are typical examples of polycapillary optics. Customized polycapillary optics based on customer requirements are available to meet specific instrument requirements.

Focusing Optics (μ XRF)

OFD (mm)	2	4	9	20	50	100	200
Focal spot size (μ m, FWHM, Mo Ka)	8	15	25	45	100	180	300
Intensity gain (vs a pinhole collimator of same size, 100mm from the source)	6000	3000	2200	1200	400	160	70

Note:

1. The above performance parameters relate to 50 μ m X-ray source.
2. The IFD of the optic is 20mm.

Collimating/Parallel-beam Optics (XRD/WDS)

Output beam diameter (mm)	0.5	1	2	3	4	6	10	15
Intensity gain	12	45	130	250	370	470	680	850

Note:

1. The above performance parameters are for a 50 μ m X-ray source at 8keV.
2. The IFD of the optic is 18mm and the output divergent angle is 0.2 degree.
3. Intensity gain determined by comparison to pinhole configuration at same distance from source and has the same beam size and divergent angle.

Slightly-focusing Optics (XRD/XRF)

Output convergent angle (degree)	0.25	0.5	1	2
Intensity gain	25	80	260	820

Note:

* 50 μ m X-ray source IFD: 18mm OFD: 140mm Energy: 8keV Focal spot size: 0.5mm, FWHM.

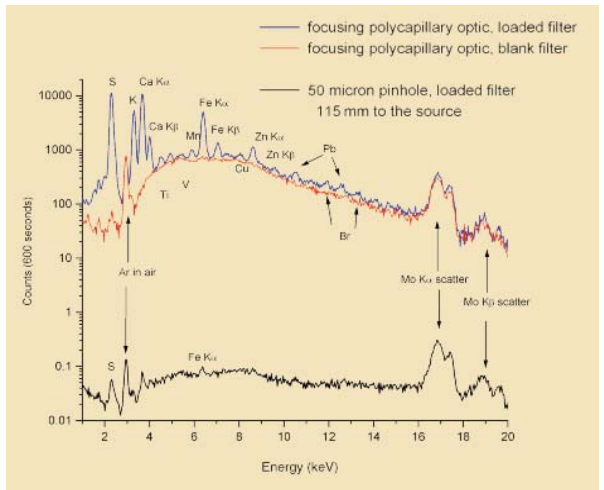


Figure 1

Comparison of μ XRF spectra generated using a focusing polycapillary optic and a pinhole aperture. The spectra shown is of an air particulate sample ~ 50 μ m in diameter. Mo excitation (40kV, 20W).

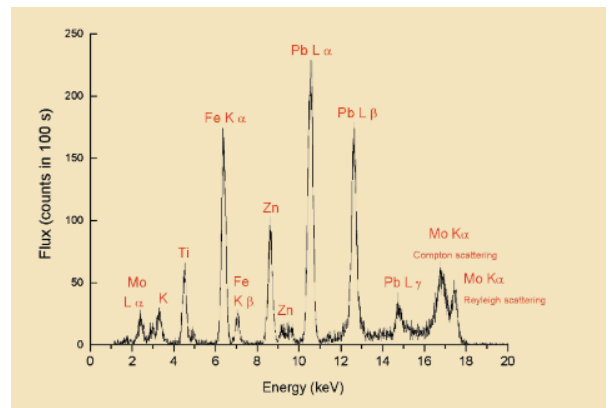


Figure 2

Spectrum of NIST SRM 1832 standard XRF sample using a polycapillary optic. Mo excitation (40kV, 12W).

Table 1

Picogram detection limits are possible using the polycapillary optic for this thin film SRM sample.

Element	K	Ti	Fe	Zn	Pb
Limit of Detection (pg)	4.1	1.5	0.57	0.28	0.52

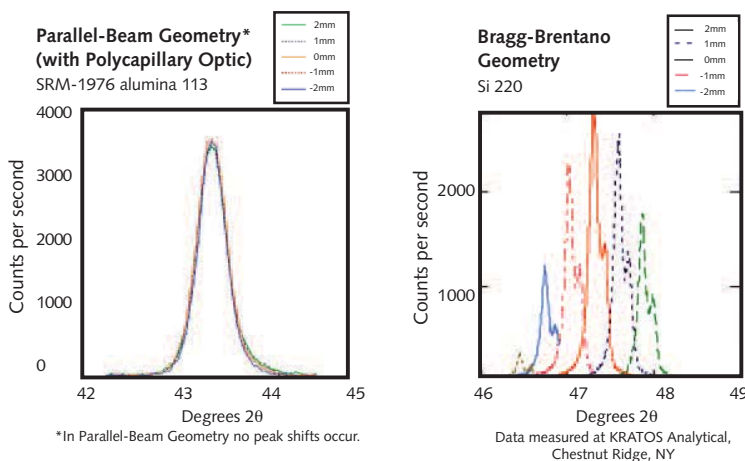


Figure 3 Peak shift as function of sample displacement for parallel-beam geometry and Bragg-Brentano geometry.



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fleX-Beam

Flexible Design, Unyielding Performance



The new XOS fleX-Beam maintains the performance of the well-known X-Beam while delivering a new level of flexibility: in design, integration, and serviceability. The fleX-Beam provides an excitation source aligned with industry-leading polycapillary optics that deliver unprecedented stability and intensity. The fully integrated solution is compact and easily integrates into any instrument or system.

The fleX-Beam platform provides fully-integrated X-ray beam solutions including an air-cooled X-ray source coupled to a focusing or collimating polycapillary optic. The flexible system design enables seamless exchanges of X-ray sources or different optics with easy field-alignment to provide consistent performance. The compact size and stability of the beam intensity allow for easy integration of the fleX-Beam, which reduces time-to-market for cutting edge, new instrument designs.

The fleX-Beam is available in several standard focused or collimated beam configurations and performance packages; it can also be customized to specific beam applications.

Features and Benefits

Industry-Leading Performance

- Extremely high flux density:
 - With focusing optic: 50W provides flux density greater than a 12KW rotating anode source
 - With collimating optic: 50W provides flux density approaching sealed tube performance
- Enhanced spatial resolution for focusing X-ray beam

Flexible Design with Smaller Footprint

- Compact geometry eases integration
- Supports interchangeable optics or apertures
- Integrated air-cooled system
- Integrated shutter module meets PTB regulations
- Oil-free packaging
- Safety inter-lock available
- PC controlled software interface included

Easy Serviceability

- Field-alignment for optics and easy tube replacement

Optional Features:

- High-performance Superflux option offers 2x-3x more intensity than standard model
- Integrated 8 position filter assembly
- 50W High Voltage Power Supply available
- PCS 50 controller offers precise command and custom settings

Applications:

- **XRF**
 - Micro XRF analysis
 - In-situ and in-line process monitoring
 - Small particle analysis
 - Film and plating thickness
 - Elemental mapping
 - Forensics
- **XRD**
 - Single crystal XRD
 - Powder XRD
 - In-situ and in-line process monitoring
 - Texture, stress, and strain measurements

fleX-Beam Compact X-ray sources with high flux

Custom Solutions. fleX-Beams can be used in different applications where compact X-ray source with high photon flux is required. Various configurations are available to be used in μ -XRF, diffraction, in-line process monitoring or in-situ analysis, and medical imaging applications. Below are few examples of available fleX-Beams. XOS can customize fleX-Beam optics based on customer requirements.

Standard - Focusing Beam (μ XRF)

OFD (mm)	2	4	9	20	50	100
Focal spot size (μ m, FWHM, Mo K α)	8	15	25	45	100	180
Output beam intensity (photon/s)*	2.5×10^7	5×10^7	1×10^8	1.5×10^8	2.5×10^8	3×10^8

Note:

* Mo K α with a Mo-anode X-Beam at 50kV/1mA.

Superflux - Collimating/Parallel-beam Optics (XRD/WDS)

Output beam diameter (mm)	0.5	1	2	3	4	6	10
Output beam intensity (photon/s)*	3.0×10^8	1.2×10^9	3.5×10^9	6.5×10^9	1.0×10^{10}	1.3×10^{10}	1.8×10^{10}

Note:

* Cu K α with a Cu-anode X-Beam at 50kV/1mA. Output beam divergent angle is 0.2 degree.

Superflux - Slightly Focusing Optics (XRD/XRF)

Output convergent angle (degree)	0.25	0.5	1	2
Output beam intensity	5.0×10^8	1.6×10^9	5.0×10^9	1.6×10^{10}

Note:

* Cu K α with a Cu-anode X-Beam at 50kV/1mA. OFD is 140mm and focal spot size is 0.5mm.

Specifications

Nominal Output Power	50W, cables customized
Nominal Source Current	1 mA
Stability	< 0.5% RSD over 8 hours, temperature independent
Ambient Operating Temperature	5°-60° C
Cooling Mode	Integrated forced air
Targets	Cr, Cu, Mo, Rh, W

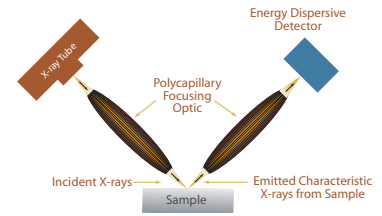


Figure 1

Overview of fleX-Beam system with polycapillary-focusing optic.

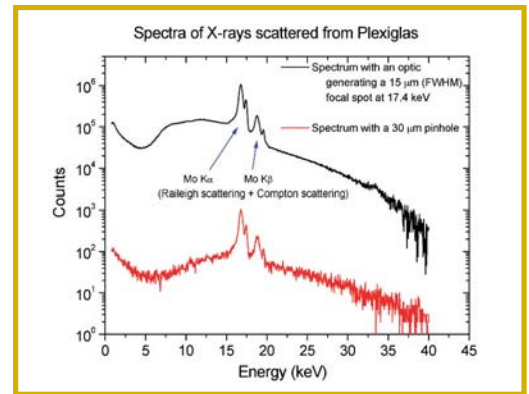


Figure 2

Comparison of MXRF spectra generated using a focusing polycapillary optic and a pinhole aperture.

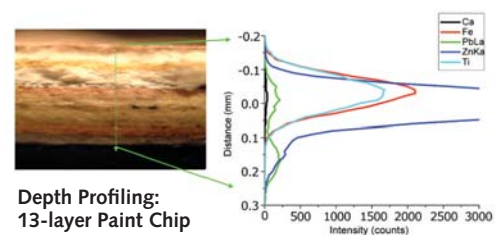


Figure 3

Confocal μ -XRF allows 3-D profiling of 13-layer paint chip for different elements at various depths.



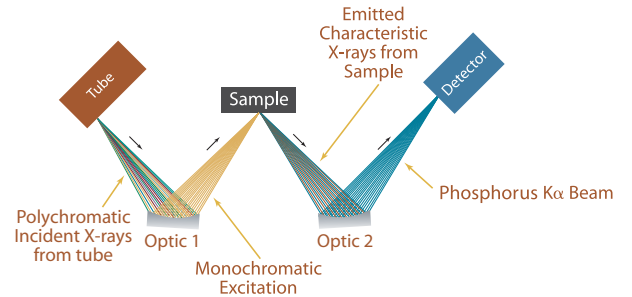
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MWD XRF

Monochromatic Wavelength Dispersive X-Ray Fluorescence (MWD XRF) utilizes state-of-the-art focusing and monochromating optics to increase excitation intensity and dramatically improve signal-to-background over high power traditional WD XRF instruments. This enables significantly improved detection limits and precision and a reduced sensitivity to matrix effects. A monochromatic and focused primary beam excites the sample and secondary characteristic fluorescence x-rays are emitted from the sample. A second monochromating optic selects the phosphorus characteristic x-rays and directs these x-rays to the detector. MWD XRF is a direct measurement technique and does not require consumable gasses or sample conversion.



Precision

Typical repeatability (r) and reproducibility (R) values, at 95% confidence. Measurement time: 600 s.

Phosphorus (ppm) in crude oil	r (ppm)	R (ppm)
2	0.8	1.2
5	1.0	1.6
10	1.4	2.0
15	1.7	2.5
20	1.9	2.8

Product Specifications

Dimensions	37 cm (w) x 50 cm (d) x 34 cm (h)
Power	100 - 120 VAC, 47 - 63 Hz at 6 Amp
Sample Cup Volume	10 ml
I/O Ports	Ethernet 10/100 baseT, RS 232
Ambient Temperature	5 - 40°C, (40 - 104°F)
Dynamic Range	0.4 ppm - 3000 ppm
Measurement Time	User selectable: 30s - 900s
Calibration	5 point calibration, capacity for 8 calibration curve

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