Elemental Scientific

*FAST*Fluidic FilterProbe Soil

4th Generation ICP Valve Injection with Backflush

Video

>500x Rinse Out Factor. <10 Seconds Sample-to-Sample. Clog-Free Analysis.

High Rinse Out Factor with High-Throughput Agricultural Soil Analysis

Accurate determination of plant-available micronutrients in soil is needed to assess whether levels are likely to limit crop growth. Since many micronutrients are measured by ICP, high rinse-factors between sample analyses ensure that carryover in the analytical technique does not cause a low soil sample to be misread as having an adequate level of micronutrients. In response, many soil laboratories increase the rinse time between samples to ensure carryover does not impact their analyses to the detriment of sample throughput.

*FAST*Fluidic FilterProbe Soil uses a small inert free-flowing filter at the top of the autosampler probe to prevent fibers or particulates from entering the nebulizer or valves. The FilterProbe is rapidly syringe-backflushed in less than 1 second while the ICP analytes are measured, clearing it between each sample. This approach minimizes carryover without slowing down your workflow, maintaining ultra high-throughput soil analyses and data integrity.

*FAST*Fluidic FilterProbe Soil benefits soil labs in several ways

- Prevention of clogs in valves or nebulizers caused by fibers in the sample
- Improved rinse out between samples (>500x)
- High-throughput (<10 seconds per sample) with 3 second integration time
- Eliminate autosampler translation time by moving RidingRinse with autosampler arm
- Very low valve maintenance

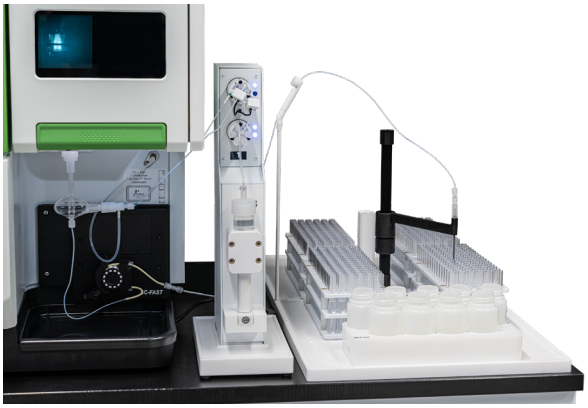


Figure 1. *FAST*Fluidic FilterProbe Soil configured for agriculture soil analysis with an Avio 550 Max.

Instrumentation

FilterProbe with Syringe-driven Backflush

The FilterProbe's inline CTFE filter prevents particulates, fibers and debris from entering the sample flowpath, significantly reducing valve and nebulizer maintenance. The free-flowing filter enables unrestricted sample transport without slowing analytical runs, while syringe-driven backflushing automatically clears the sample flowpath before the next sample is analyzed.

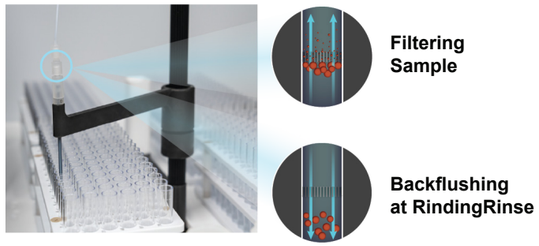


Figure 2. FilterProbe catches particulates and backflushes them to waste.

RidingRinse: Mobile Rinse Station

RidingRinse moves with the autosampler carriage, providing the fastest access to a rinse station and further expediting sample-to-sample time. With a simple rotary movement, *FAST*Fluidic FilterProbe Soil can perform backflushing and rinsing in place, preventing wasted autosampler movements required for a conventional fixed rinse location.

Figure 3. RidingRinse integrated to 4DXW autosampler.

Multiposition Magnetic SnapValves

*FAST*Fluidic FilterProbe Soil features patented Magnetic SnapValves with magnetic coupling technology, enabling valves to snap on and off by hand for tool-free installation and maintenance. Clearly labeled ports simplify line attachment, and cleaning takes just seconds, enhancing both usability and efficiency.

SampleSense 3

SampleSense 3 Optical Sensors are integrated into the sample flowpath, providing intelligent, real-time sample detection that automatically triggers ICP or ICPMS analysis. This eliminates fixed timing parameters, improving throughput and reducing sample consumption. It adapts dynamically to variable sample viscosities and detects missed or incomplete samples, delivering real-time error notifications.

4DXW Autosampler

The innovative 4DXW autosampler increases sample capacity by 55% in a footprint similar to a conventional 4-rack autosampler.

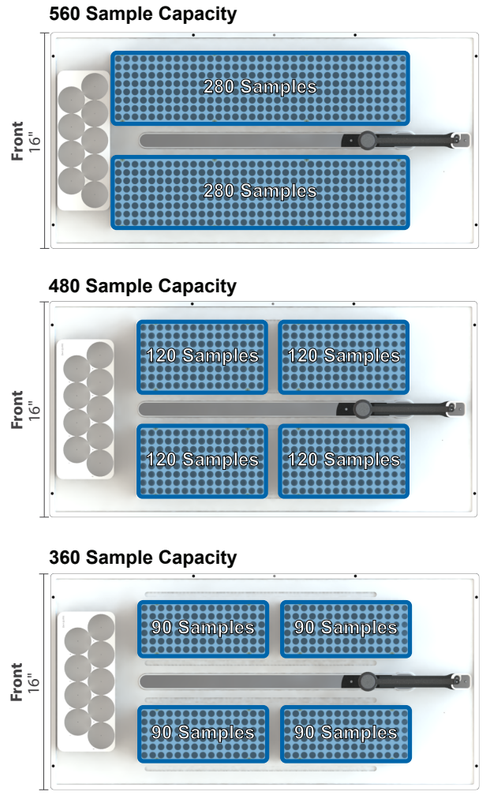


Figure 4. 4DXW autosampler example rack layouts. Capacities up to 560 samples taking up only 16" of linear lab bench space.

Elemental Scientific

Experimental

In this experiment, ICPOES was used in tandem with the *FAST*Fluidic FilterProbe Soil to determine bioavailable concentrations of 11 extractable micronutrient elements in soil samples. Because soil analyses must be completed within a narrow seasonal time window, laboratories require ultra-high sample throughput with high analytical reliability. Conventional soil methods often have extended rinse out times following sample measurement to prevent carryover, limiting productivity. *FAST*Fluidic FilterProbe Soil overcomes these limitations by achieving effective rinse out without sacrificing high-throughput, enabling consistent measurements across the full calibration range. Mehlich-3-ICP is widely used to determine fertilizer application rates in agricultural soils; in this study it served as a representative high-throughput method, while the described sample introduction approach is broadly applicable to other common soil extraction methods.

The ICP operating conditions and sample introduction parameters used in this study are summarized below.

Table 1. Instrument Conditions

Instrument	Avio 550 Max
Peri-Pump Rate	1.5 mL/min
Matrix	2% HNO_3
Radial Acquisition View	15 mm
Plasma Gas Flow	12 L/min
Auxiliary Gas Flow	0.5 L/min
Nebulizer Gas Flow	0.55 L/min
RF Power	1500 Watts
Read Time	**3 Seconds**

Table 2. Sample Introduction Parameters

***FAST* System**	*FAST*Fluidic FilterProbe Soil
Filter	FilterProbe CTFE Filter
Autosampler	ESI 4DXW with RidingRinse
Nebulizer	PFA ST3 Nebulizer
Spray Chamber	G3 Cyclonic
Injector/Torch	2.0 mm Quartz ZipTorch
Sample Tubing	Black-Black
ISTD Tubing	Orange-Green
Backflush Syringe	HPQ-24 mL

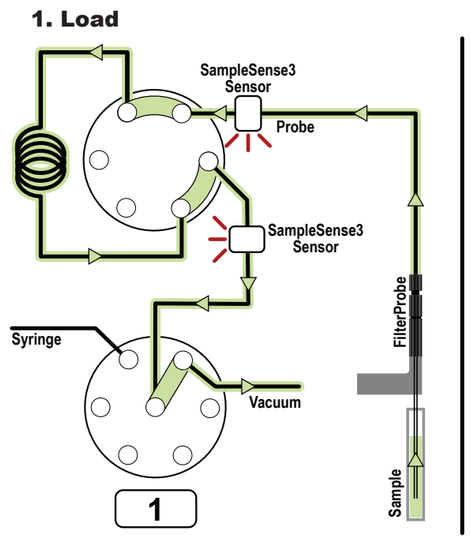


Figure 5. Sample loading with filtering diagram.

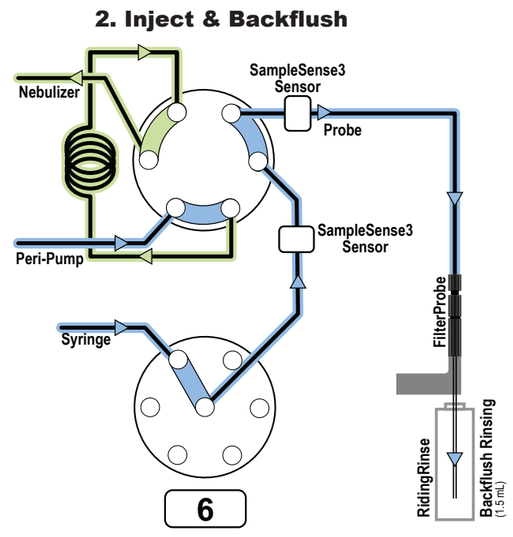


Figure 6. Sample injected and analyzed while FilterProbe is backflushed and rinsed.

Reproducibility Across Calibration Ranges

Analysis of 1000 calibration standards (STDs) in under 3 hours to evaluate *FAST*Fluidic FilterProbe Soil's stability and reproducibility across the calibration range. The calibration levels consisted of blanks and four concentration levels spanning low to high (low, mid-low, mid-high and high), representing soil nutrient conditions from deficient to highly enriched. Excellent stability was observed within each concentration level, along with consistent return to baseline for blanks (Figure 7). Carryover performance was assessed by analyzing three blanks after three high standards. Low relative standard deviations (RSDs) across all concentration levels, including the low end of the calibration range, demonstrate *FAST*Fluidic FilterProbe Soil's reproducibility and effectiveness in identifying nutrient-deficient soils.

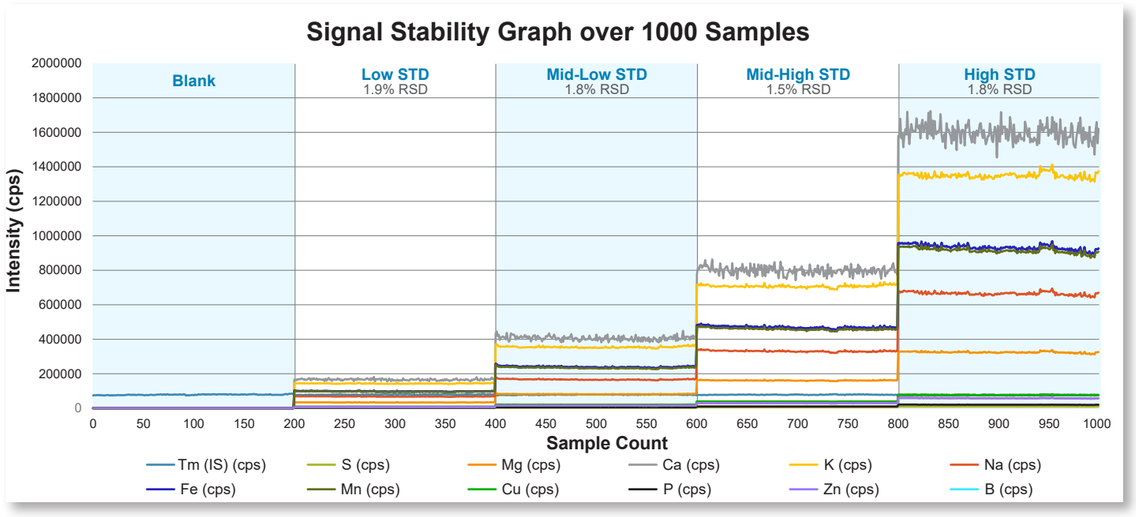


Figure 7. Signal stability of *FAST*Fluidic FilterProbe Soil over a 1000-sample sequence measured in under 3 hours, with an average RSD of <2% across the entire method. This performance demonstrates *FAST*Fluidic FilterProbe Soil's ability to reliably identify nutrient-deficient soils across a wide calibration range.

Elemental Scientific

Sample Throughput and Rinse Out

Read Time

	F'n	Analyte	Integration Time (sec)	Read Time (sec)
1	A	S 180.668	0.100	3.000
2	A	Mg 279.077	0.100	3.000
3	A	Ca 317.933	0.010	0.050
4	A	K 766.490	0.100	3.000
5	A	Na 589.592	0.100	3.000
6	A	Fe 238.204	0.100	3.000
7	A	Mn 257.610	0.100	3.000
8	A	Cu 327.393	0.100	3.000
9	IS	Tm 313.126	0.100	3.000
10	A	P 214.914	0.100	3.000
11	A	Zn 213.857	0.100	3.000
12	A	B 249.677	0.100	3.000

Figure 8. Each element was analyzed by ICP for ≤3 seconds within the *FAST*Fluidic FilterProbe Soil method.

Acquisition Time

Show RSDs Show Replicates

	Sample Id	Acquisition Time	S (cps)	Mg 279.077 (cps)
1110	Bottom Soil Std	12/15/2025 10:49:19 AM	1337.3	37597.1
1111	Low Mid Soil Std	12/15/2025 10:49:29 AM	3272.6	91375.7
1112	Low Mid Soil Std	12/15/2025 10:49:38 AM	3300.7	92306.2
1113	Low Mid Soil Std	12/15/2025 10:49:48 AM	3336.6	93173.3
1114	High Mid Soil Std	12/15/2025 10:49:58 AM	6747.0	187370.2
1115	High Mid Soil Std	12/15/2025 10:50:08 AM	6645.8	183501.8
1116	High Mid Soil Std	12/15/2025 10:50:19 AM	6638.9	183373.4
1117	Top Soil Std	12/15/2025 10:50:28 AM	13467.8	370985.0
1118	Top Soil Std	12/15/2025 10:50:38 AM	13429.2	368930.1
1119	Top Soil Std	12/15/2025 10:50:48 AM	13288.1	364503.1
1120	Blank	12/15/2025 10:50:58 AM	29.3	561.7
1121	Blank	12/15/2025 10:51:08 AM	-26.3	-52.8
1122	Blank	12/15/2025 10:51:18 AM	-36.2	-6.3
1123	Bottom Soil Std	12/15/2025 10:51:28 AM	1417.4	40146.2

Figure 9. Screen capture of Syngistix ICP showing 10 second sample-to-sample time.

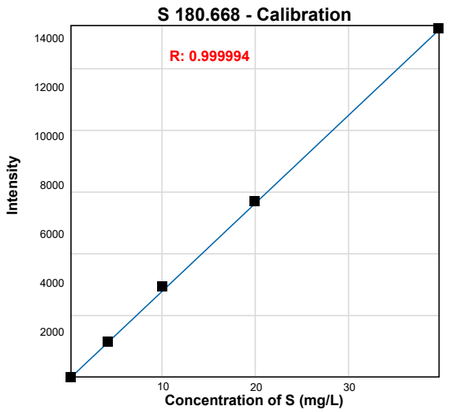
Rinse Out

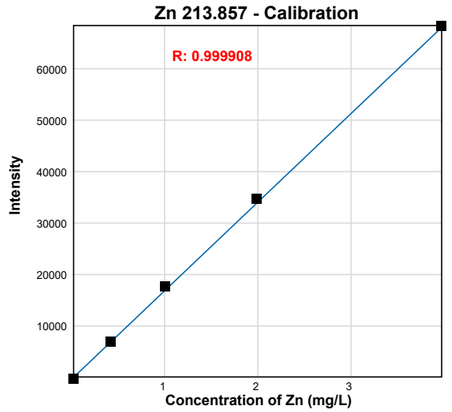
Table 3. Rinse out from the highest standard to the blank was evaluated using the *FAST*Fluidic FilterProbe Soil ≤10 second method, achieving rinse out factors of >500x for all analytes, except boron.

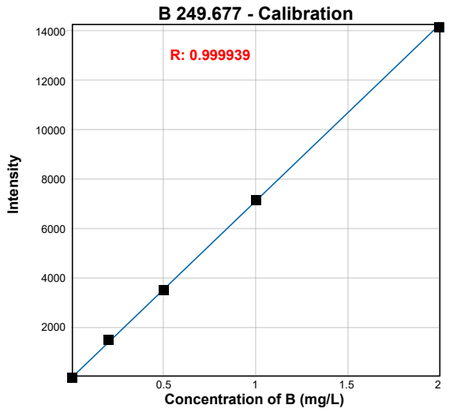
	S 180.668	Mg 279.077	Ca 317.933	K 766.490	Na 589.592	Fe 238.204	Mn 257.610	Cu 327.393	P 214.914	Zn 213.857	B 249.677
≤10 Seconds Method Rinse Out Factor	799	664	1592	507	701	645	642	566	514	659	325

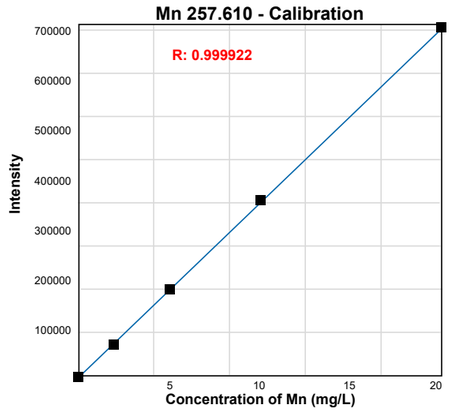
***FAST*Fluidic FIlterProbe Soil Video**

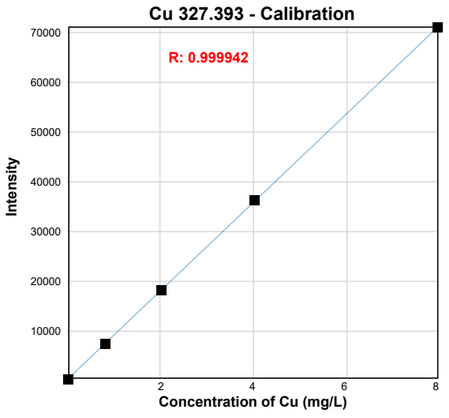
Calibration Curves for 11 Micronutrients in Soil

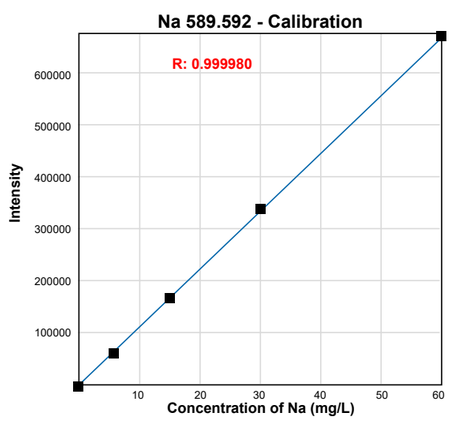






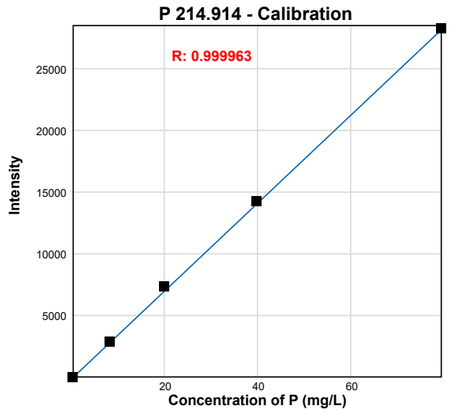


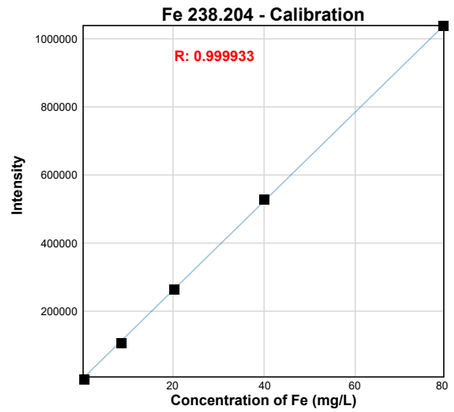


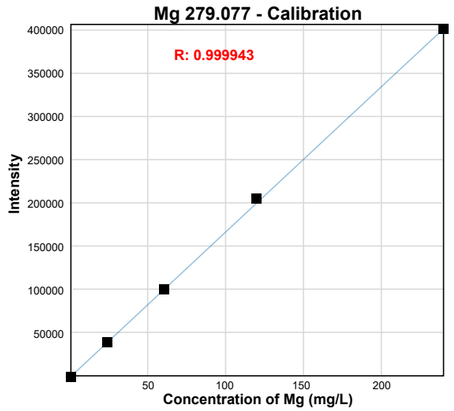


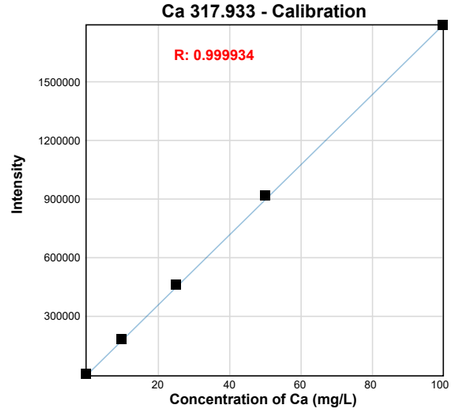
Elemental Scientific

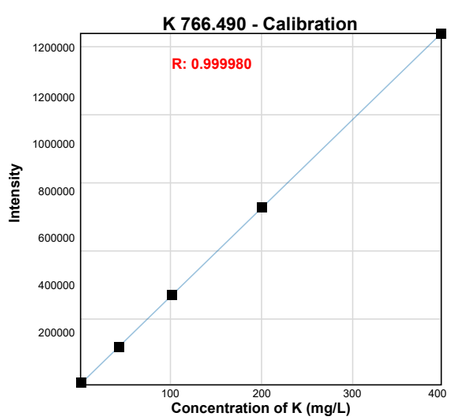
Calibration Curves for 11 Micronutrients in Soil *(continued)*











Element (λ)	Low STD	Mid-Low STD	Mid-High STD	High STD
S 180.668	4	10	20	40
Zn 213.857	0.4	1	2	4
P 214.914	8	20	40	80
Fe 238.204	8	20	40	80
B 249.677	0.2	0.5	1	2
Mn 257.610	2	5	10	20
Mg 279.077	24	60	120	240
Ca 317.933	10	25	50	100
Cu 327.393	0.8	2	4	8
Na 589.592	6	15	30	60
K 766.490	40	100	200	400

Figure 10. Representative 5-point calibration curves for the 11 Mehlich analytes (Ca, Cu, Fe, K, Mg, Mn, Na, P, S, Zn, B) with calibration levels show above. The entire calibration takes less than 50 seconds, with R>0.9995 for all elements.

Conclusion

*FAST*Fluidic FilterProbe Soil automates high-throughput soil analysis while delivering rinse out performance previously unattainable at these operating speeds. By maintaining rapid sample-to-sample operation with minimal carryover, *FAST*Fluidic FilterProbe Soil ensures accurate determination of micronutrient levels across all analytes, improving both reliability and efficiency in soil testing workflows.

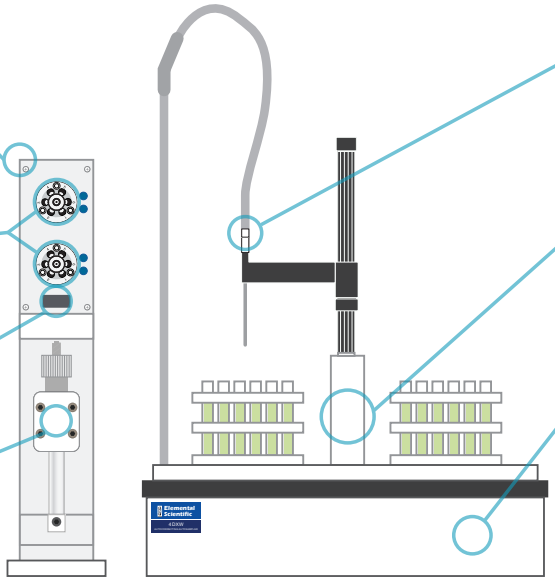
*FAST*Fluidic FilterProbe

*FAST*Fluidic
- Syringe-driven backflushing for uninterrupted high-throughput analysis
- Improves rinse out and prevents clogs

Magnetic SnapValves with SampleSense 3
- Simplifies typical user maintenance with magnetic coupling technology
- Automatically sense and inject samples

LED Display

High Pressure Quartz Syringe
- PFA plunger and threaded base
- Wetted for low contamination and extended lifetime



FilterProbe
- Prevent particulates from entering sample flowpath
- Automatically syringe-backflushed to prevent clogging

RidingRinse
- Rinse station moves with autosampler carriage
- Minimizes translational autosampler movement

DXW Autosampler
- Fractionally larger footprint than conventional 4-rack autosampler - 55% greater sample capacity
- Holds up to 560 samples

Enhance Your High-Throughput Soil Analysis Today.

Scan the QR code to contact ESI Experts.

© Elemental Scientific | 7277 World Communications Drive | Omaha, NE 68122
Tel: 1-402-991-7800 | sales@icpms.com | www.icpms.com

B-25220