Six Second Soil Mehlich-3-ICP SampleSense Soil

SampleSense Soil on the Avio 500 ICP

Mehlich-3-ICP is a method for determining bioavailable concentrations of 11 extractable micronutrient elements in soil samples. Mehlich-3-ICP is invaluable for determining the amount of fertilizer to apply to farm fields. Because soil analyses must be completed in a narrow time window, ultra-high sample throughput with high-reliability is required.

SampleSense Soil uses an inert injection valve with built-in optical sensors that automatically detect the liquid sample, inject the valve and trigger the ICP read in a tightly-timed analytical sequence. SampleSense Soil eliminates wasted time from the ICP method and can double or even triple sample throughput while recording missing or empty tubes.

SampleSense Soil Benefits

- 10 samples per minute Mehlich-3-ICP
- Automatic sensing, injection, and triggering of the ICP analytical read
- Detection and reporting of missing or empty sample tubes as “unsensed” samples
- Adding SampleSense Soil can double or even triple sample throughput

SampleSense Soil

SampleSense Soil Advantages for Mehlich-3-ICP:

Ease of Use

- Optical detection of the filled sample loop automatically triggers ICP analysis
- Removes timing and read delay adjustments
- Eliminates method development when changing sample loop size for other methods

Automated Compensation of Physical Clogs and Timing Variables

- Reliable timing down to 0.05 s and better
- Compensates for:
  - Partial clogs from filter paper fibers, particles, etc.
  - Accidental line kinks
  - Timing variables caused by high or low sample tube levels
  - ICP computer slow-down from software and data storage

Increased Productivity

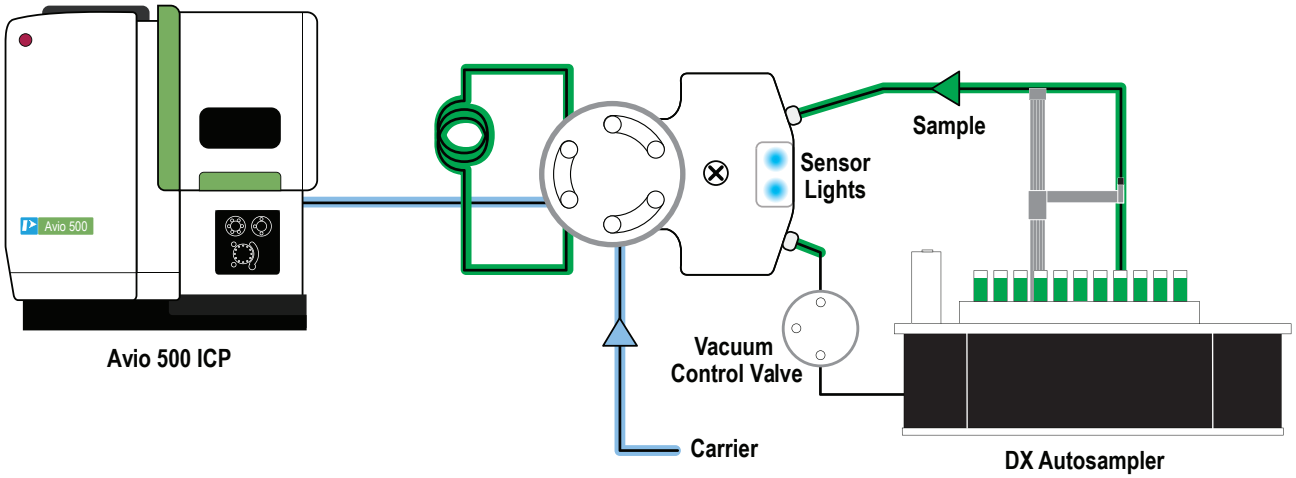
- Produces long analytical runs without operator intervention
- Minimized sample consumption allows reanalysis
- Doubles or triples throughput of ICP instrument
- Reduces argon consumption

SampleSense valve with dual optical sensors

SampleSense Soil for Mehlich-3-ICP Soil Analysis:

- SampleSense Soil ICP (Avio 500)
- 11 Elements determined: B, Ca, Cu, Fe, K, Mg, Mn, Na, S, P, Zn
- ICP read triggered from dual sensor optical sample detection
- 360 samples analyzed in <35 minutes
- 6 second sample-to-sample time
- <2 mL of sample consumed (vacuum control)
- Automatic detection of empty or missing sample tubes
- Most reliable high-throughput system on the market

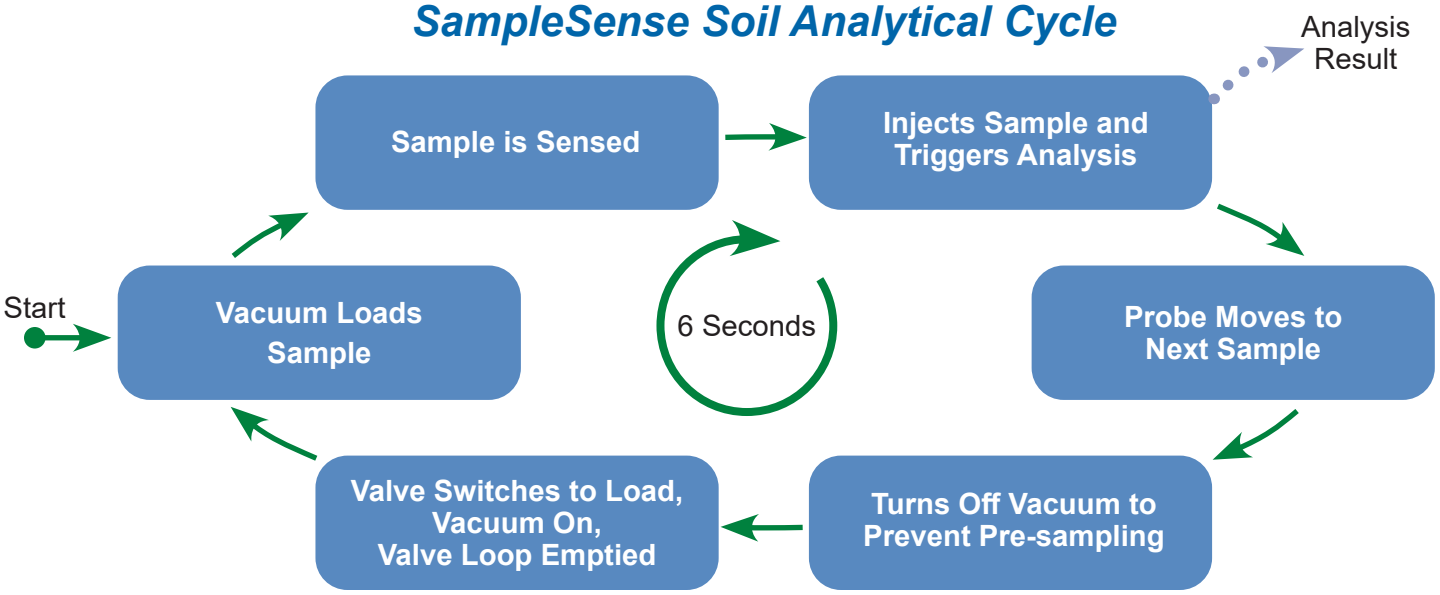
SampleSense Soil Flow Diagram



Sample not present, valve sensors not activated

Valve sensors activated, sample is sensed

SampleSense Soil Analytical Cycle



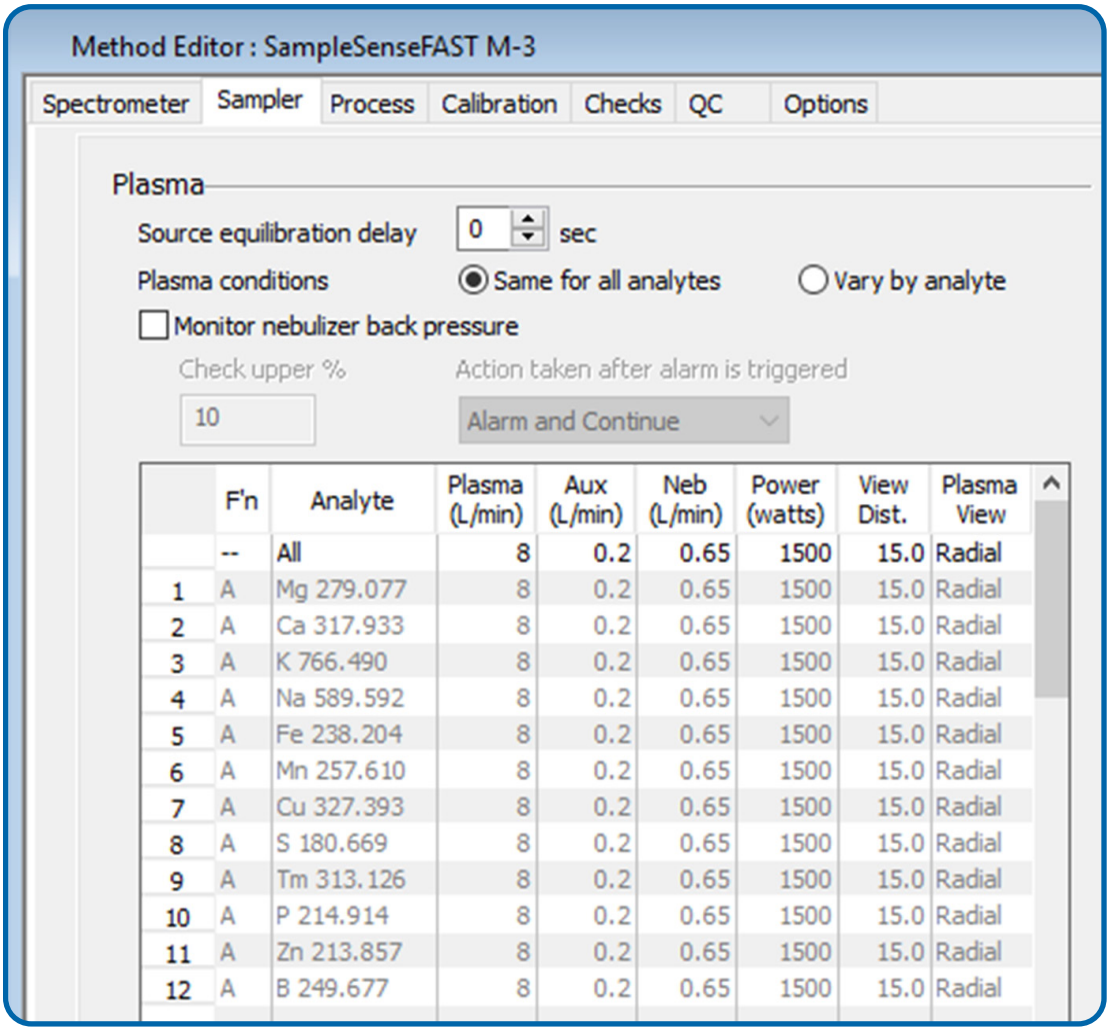
ICP Method for Avio 500 ICP

ICP Conditions

- Plasma Gas Flow: 8 L/min
- Aux Gas Flow: 0.2 L/min
- Nebulizer Gas Flow: 0.6 L/min
- Plasma Power: 1500 W
- Plasma View: Radial
- Replicates: 2
- Total Analysis Time ~6 sec per sample

Mehlich Soil Analytes (nm):

- B 249.677
- Ca 317.933
- Cu 327.393
- Fe 238.204
- K 766.490
- Mg 279.077
- Mn 257.610
- Na 589.592
- P 214.914
- S 180.669
- Zn 213.857



	F'n	Analyte	Plasma (L/min)	Aux (L/min)	Neb (L/min)	Power (watts)	View Dist.	Plasma View
	--	All	8	0.2	0.65	1500	15.0	Radial
1	A	Mg 279.077	8	0.2	0.65	1500	15.0	Radial
2	A	Ca 317.933	8	0.2	0.65	1500	15.0	Radial
3	A	K 766.490	8	0.2	0.65	1500	15.0	Radial
4	A	Na 589.592	8	0.2	0.65	1500	15.0	Radial
5	A	Fe 238.204	8	0.2	0.65	1500	15.0	Radial
6	A	Mn 257.610	8	0.2	0.65	1500	15.0	Radial
7	A	Cu 327.393	8	0.2	0.65	1500	15.0	Radial
8	A	S 180.669	8	0.2	0.65	1500	15.0	Radial
9	A	Tm 313.126	8	0.2	0.65	1500	15.0	Radial
10	A	P 214.914	8	0.2	0.65	1500	15.0	Radial
11	A	Zn 213.857	8	0.2	0.65	1500	15.0	Radial
12	A	B 249.677	8	0.2	0.65	1500	15.0	Radial

PerkinElmer Avio 500 ICP method conditions

Avio 500 Calibration Standards

Method Editor : SampleSenseFAST M-3

Spectrometer | Sampler | Process | Calibration | Checks | QC | Options

Calibration units and standard concentrations

	Analyte	Calib Units	Bottom	Low Mid	High Mid	Top
1	Mg 279.077	mg/L	24	60	120	240
2	Ca 317.933	mg/L	10	25	50	100
3	K 766.490	mg/L	40	100	200	400
4	Na 589.592	mg/L	6	15	30	60
5	Fe 238.204	mg/L	8	20	40	80
6	Mn 257.610	mg/L	2	5	10	20
7	Cu 327.393	mg/L	0.8	2	4	8
8	S 180.669	mg/L	4	10	20	40
9	Tm 313.126	mg/L	0.1	0.1	0.1	0.1
10	P 214.914	mg/L	8	20	40	80
11	Zn 213.857	mg/L	0.4	1	2	4
12	B 249.677	mg/L	0.2	0.5	1	2

The ICP system was calibrated for the 11 elements of interest with a blank and 4 standards at varying concentrations across the ppm range. The additional element Tm was introduced to assess injection completeness and stability. The linearity of the resulting calibrations are shown in the table above.

Missing Samples Detected

Message

Unsensed Samples

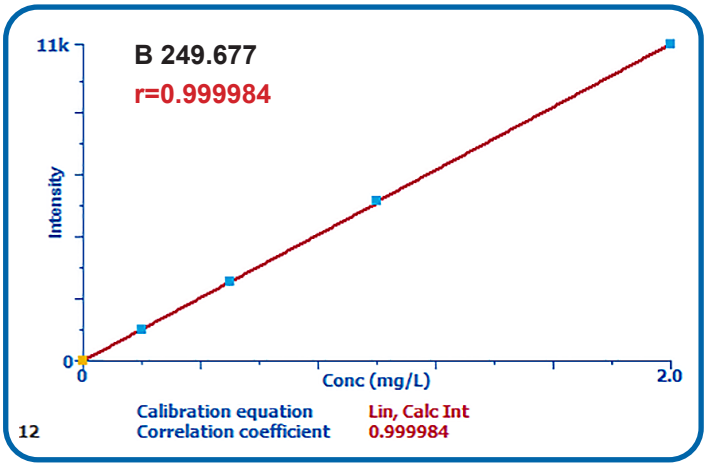
	SC Rack Number	SC Vial Number	Instrument Rack	Instrument Vial	Time
▶	1	45	1	45	20190813 9:05:00
	1	90	1	90	20190813 9:09:34
	2	45	2	45	20190813 9:14:08
	2	90	2	90	20190813 9:18:42
	3	45	3	45	20190813 9:23:16
	3	90	3	90	20190813 9:27:50

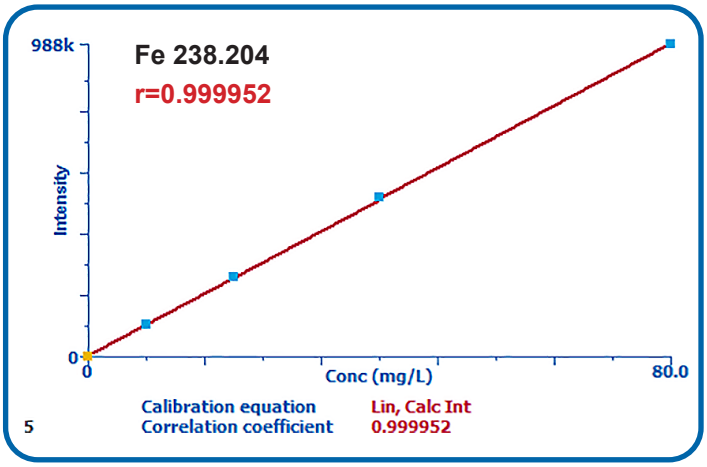
This table demonstrates the automatic missed sample logging capabilities provided by the SampleSense Soil sensors. Empty sample vials were placed in the first three sample racks at positions 45 and 90. SampleSense identified the missing samples and provides this information in the software log shown here.

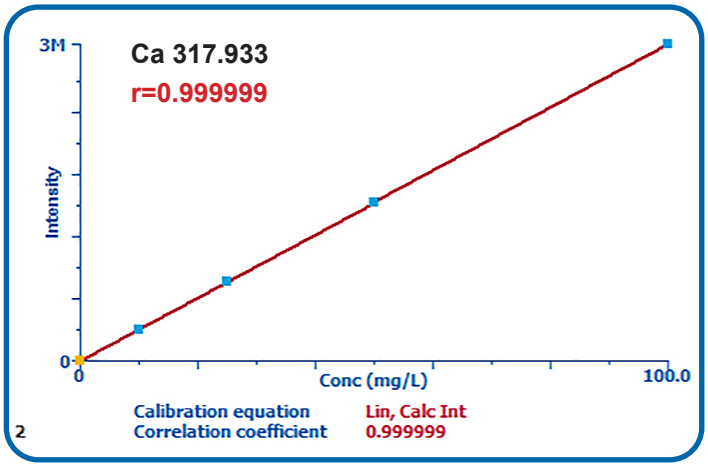
Low Sample Consumption

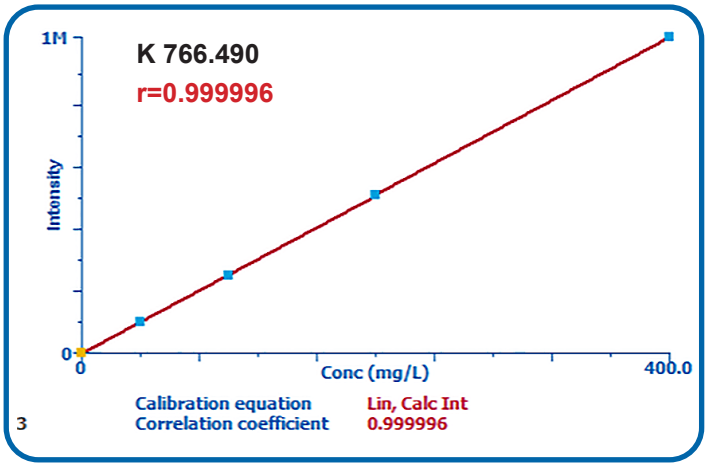
SampleSense Soil consumes < 2 mL of sample. The black line shows the original level of 5 mL extract. Post analysis 3.5 mL remains. Samples can be reanalyzed without re-extraction

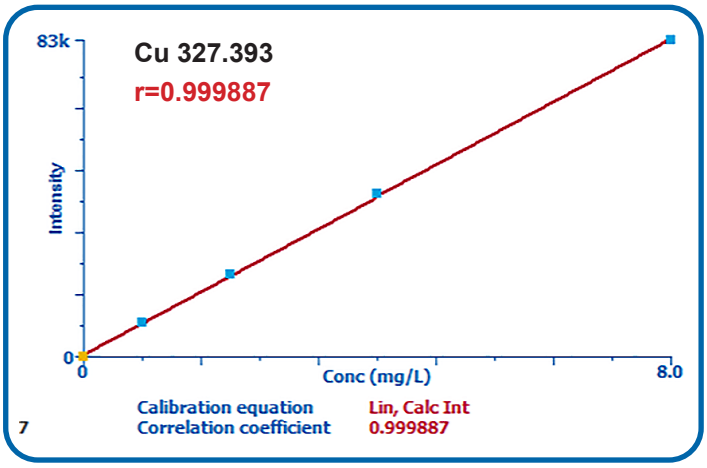
Calibration Curves 6s Soil Method

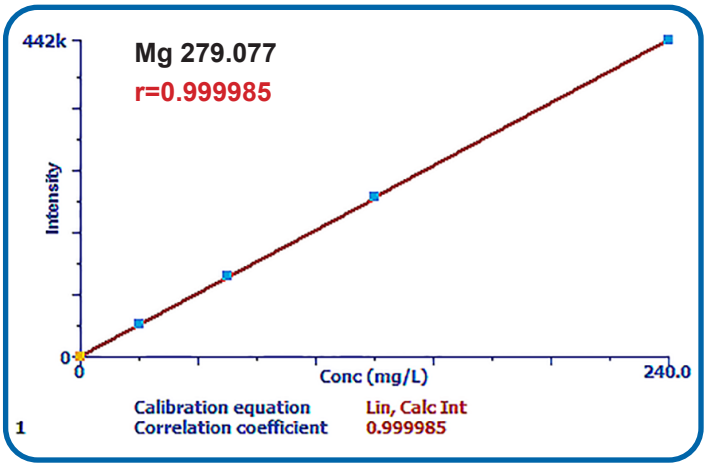


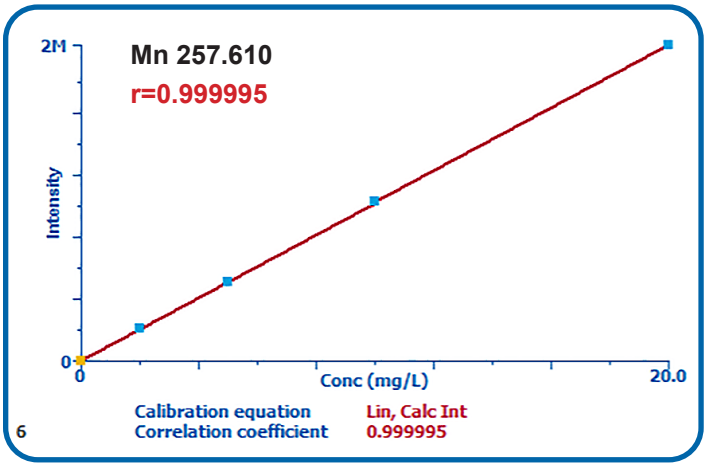


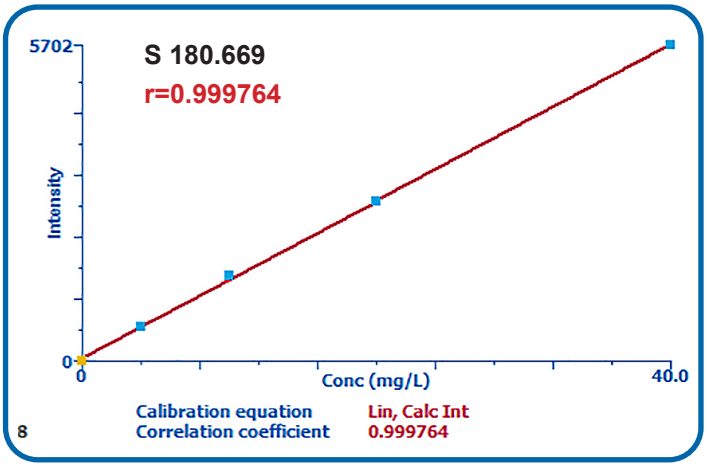


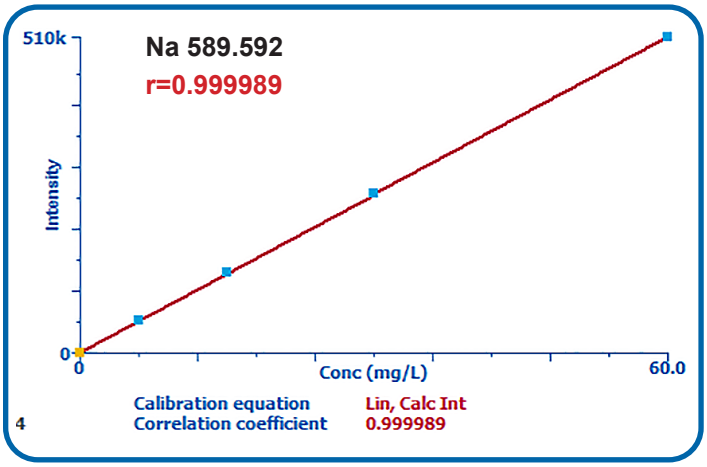


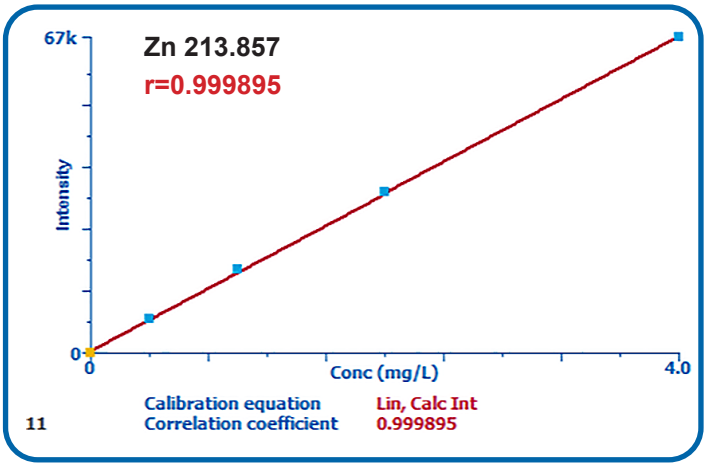


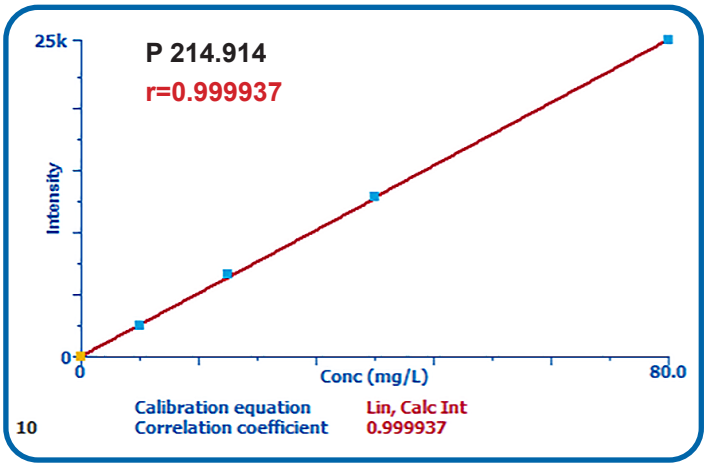








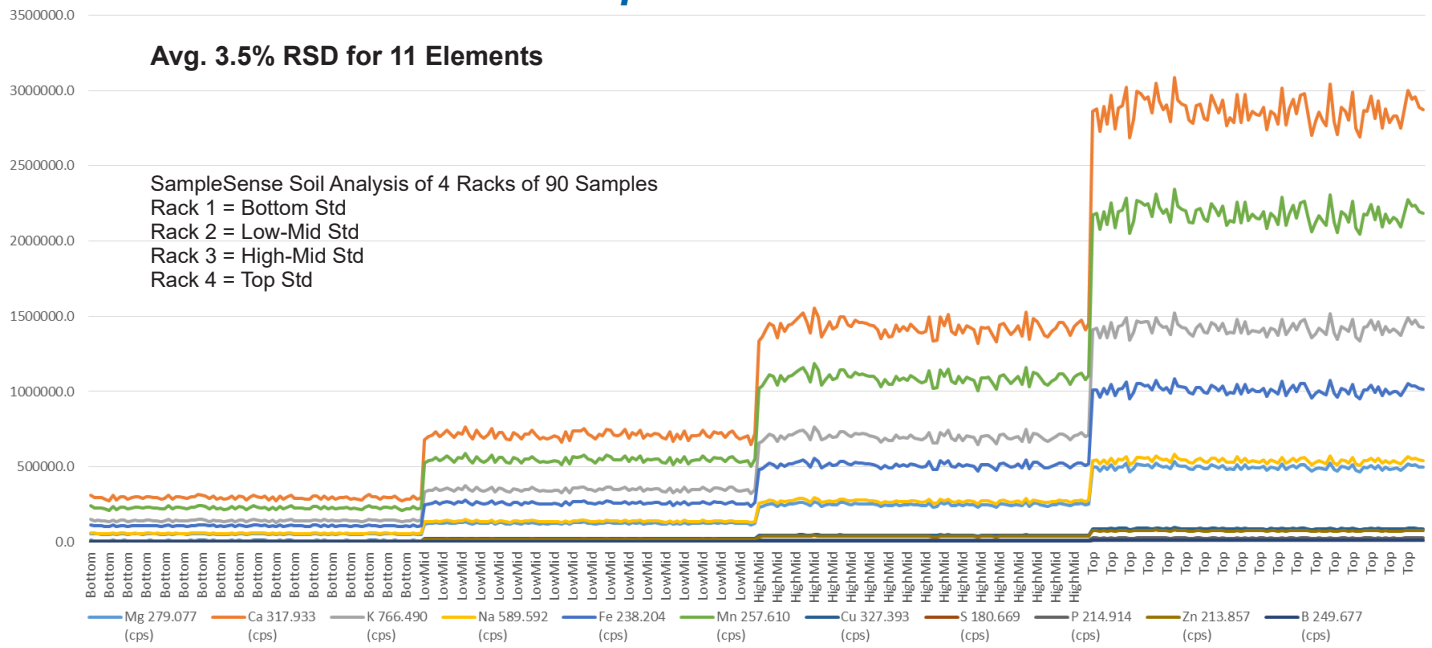




Calibration Results

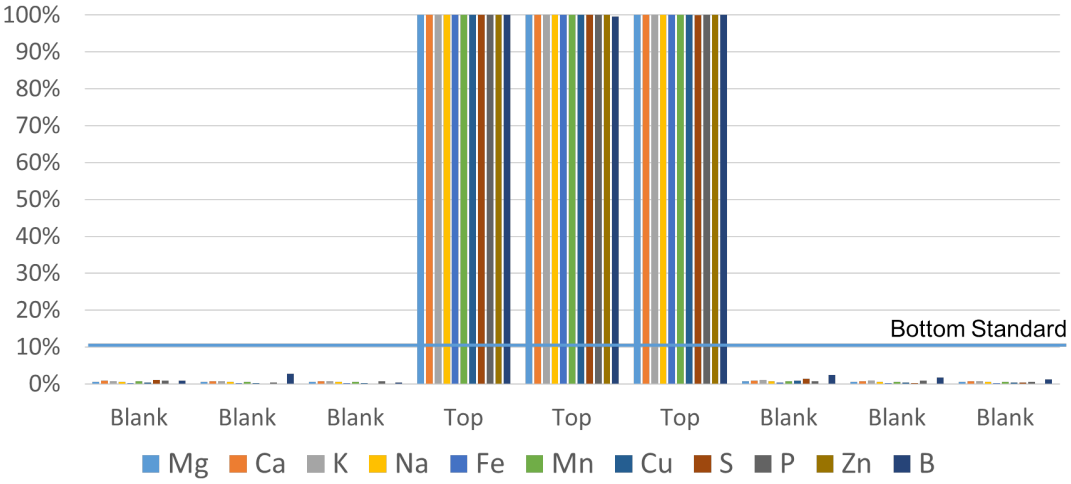
Element	Correlation Coefficient
B	0.999
Ca	0.999
Cu	0.999
Fe	0.999
K	1.000
Mg	1.000
Mn	1.000
Na	1.000
P	0.999
S	0.999
Zn	0.999

360 samples in 35 minutes



Analysis of 360 samples in 35 minutes. The four levels represent a rack of 90 samples, with each of the four calibration standards levels individually loaded with 5 mL of liquid into each of the 90 positions contained in each rack. Excellent stability observed from within each of the four concentration levels.

Rinseout



The SampleSense Soil rinse-out immediately reduces all elements to concentrations well below the bottom standard when using the six second Mehlich-3-ICP procedure. Additional seconds can be added to the rinse-out to meet lab requirements. The system can deliver rinse-out factors of 1,000x, 10,000x or more depending on how clear the spray chamber needs to be before the next sample is introduced.

Conclusion

At 10 samples per minute, SampleSense Soil for Mehlich-3-ICP method can more than double the productivity of the ICP instrument. It delivers reliable and reproducible data, while providing quick and effective sample rinse out.

Description	Avio 500 Part Numbers
SampleSense Soil 2DX	2F-SS6-UHT-37
SampleSense Soil 4DX	4F-SS6-UHT-37
SampleSense Soil 8DX	8F-SS6-UHT-37
SampleSense Soil 14DX	14F-SS6-UHT-37

Elemental Scientific

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