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*FAST*Fluidic FilterProbe Oil

4th Generation ICP Valve Injection with Backflush Rinsing

New RidingRinse with Filter Backflush. 15 Second Sample-to-Sample. Clog-Free Analysis.

High Rinse Out Factor with High-Throughput Oil and Lubricant Analysis

ICP analysis of oils and lubricants is critical for monitoring equipment health, detecting wear metals, verifying additive concentrations, and identifying external contamination. These samples present unique challenges: complex matrices, wide concentration ranges, and the risk of cross-contamination between high-additive and low-metal samples. In high-throughput environments, speed is essential—but rapid analysis increases the risk of carryover. Effective rinsing between samples remains a key factor in maintaining accuracy and data integrity. In response, many oil laboratories increase the rinse time between samples to ensure carryover does not impact their analyses to the detriment of sample throughput. *FAST*Fluidic FilterProbe Oil uses a small inert free-flowing filter at the top of the autosampler probe to prevent particulates from entering the nebulizer or valves. The FilterProbe is rapidly syringe-backflushed in less than one second while the ICP analytes are measured, clearing it while rinsing between each sample. This approach minimizes carryover without slowing down your workflow, maintaining ultra high-throughput oil analyses and data integrity.

*FAST*Fluidic FilterProbe Oil Benefits Oil Labs in Several Ways

- Inline free-flowing filter catches particulates
- Syringe-driven backflush while samples are measured
- Prevents clogs in valves and nebulizers
- Improved rinse out between samples
- High-throughput (15 seconds per sample) with two replicates
- RidingRinse eliminates autosampler translation movement to rinse station
- Very low valve maintenance

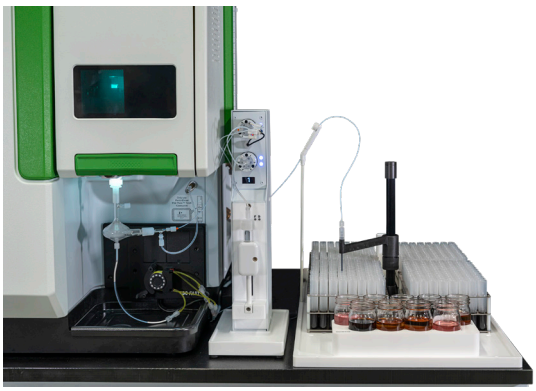

Figure 1. *FAST*Fluidic FilterProbe Oil configured for oil and lubricant analysis with an Avio 550 Max.

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.

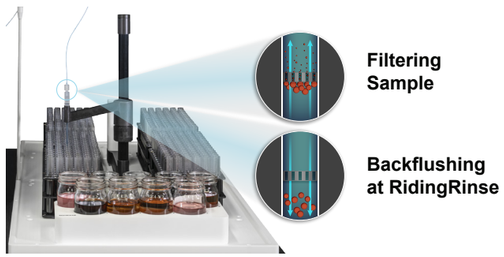

Figure 2. FilterProbe catches particulates and backflushes them to waste while the sample is measured.

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 Oil 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 Oil 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 narrower than a conventional 4-rack autosampler.

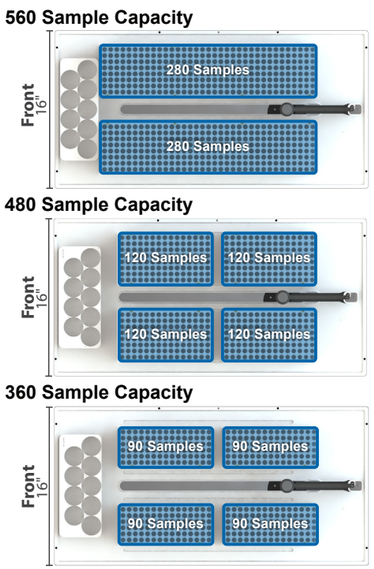

Figure 4. 4DXW autosampler example rack layouts. Capacities up to 560 samples taking up only 16" (400 mm) of linear lab bench space.

Gas Infusion Mixing

*FAST*Fluidic FilterProbe Oil delivers fast, accurate sample introduction with built-in mass flow controlled mixing, homogenizing each sample immediately before analysis. This eliminates manual mixing after dilution and prevents separation that commonly occurs in diluted oil samples. It removes the need for immediate analysis after prep and ensures consistent results across long runs. Optimal mixing is maintained for any vial size and oil viscosity.

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Experimental

In this experiment, ICP-OES was used in tandem with the *FAST*Fluidic FilterProbe Oil system to determine concentrations of 23 elements in oil samples, including wear metals, additive elements and ingress elements. Oil analyses must be completed quickly to deliver critical information to maintenance teams. To achieve this, laboratories require ultra-high sample throughput combined with consistent analytical reliability. Conventional oil methods often have extended rinse out times following sample measurement to prevent carryover, limiting productivity. *FAST*Fluidic FilterProbe Oil overcomes these limitations by achieving effective rinse out without sacrificing high-throughput, enabling consistent measurements across the full calibration range. ICP-OES, following ASTM D5180, is widely used in oil analysis to monitor wear metals, additive elements, and ingress contaminants; in this study it served as a representative high-throughput technique, while the described sample introduction approach is broadly applicable to other common oil and lubricant testing workflows.

Table 1. Instrument Conditions

Instrument	Avio 550 Max
Peri-Pump Rate	1.5 mL/min
Matrix	V-Solv
Radial Acquisition View	15 mm
Plasma Gas Flow	12 L/min
Auxiliary Gas Flow	0.9 L/min
Nebulizer Gas Flow	0.4 L/min
RF Power	1500 Watts
Read Time	2 x 0.6 = 1.2 Seconds

Table 2. Sample Introduction Parameters

***FAST* System**	*FAST*Fluidic FilterProbe Oil
Filter	FilterProbe CTFE Filter
Autosampler	ESI DXW with RidingRinse
Nebulizer	PFA ST3 Nebulizer
Spray Chamber	G3 Cyclonic
Injector/Torch	1.5 mm Demountable Quartz/Nitride
Sample Tubing	Black-Black Solva
Backflush Syringe	HPQ-24 mL

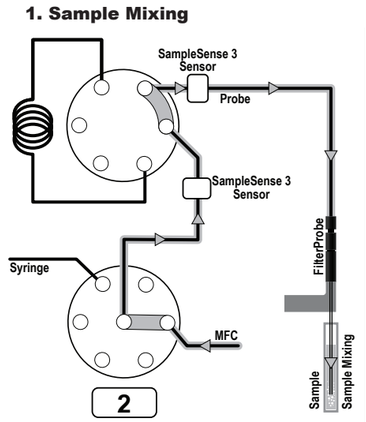

Figure 5. Sample gas mixing.

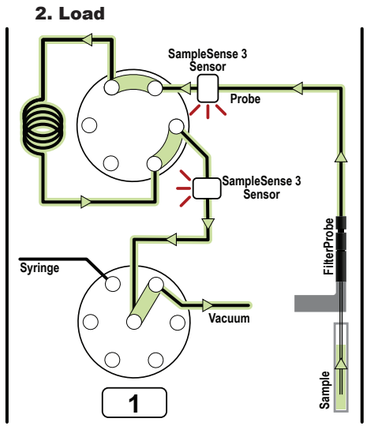

Figure 6. Sample loading with filtering.

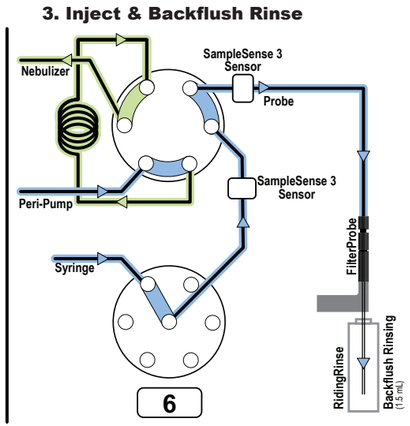

Figure 7. Sample injected and analyzed while FilterProbe is backflushed and rinsed.

Reproducibility Across Calibration Ranges

Analysis of 1,235 used motor oil samples was completed in just over five hours to evaluate the *FAST*Fluidic FilterProbe Oil system's stability, reproducibility, and analytical reliability across a representative sample range. Calibration included a blank and element concentration levels: 50 ppm, 100 ppm, 500 ppm, and 5,000 ppm. Results demonstrated excellent stability for all elements (Figure 8), with consistently low relative standard deviations (RSDs) confirming both reproducibility and reliability.

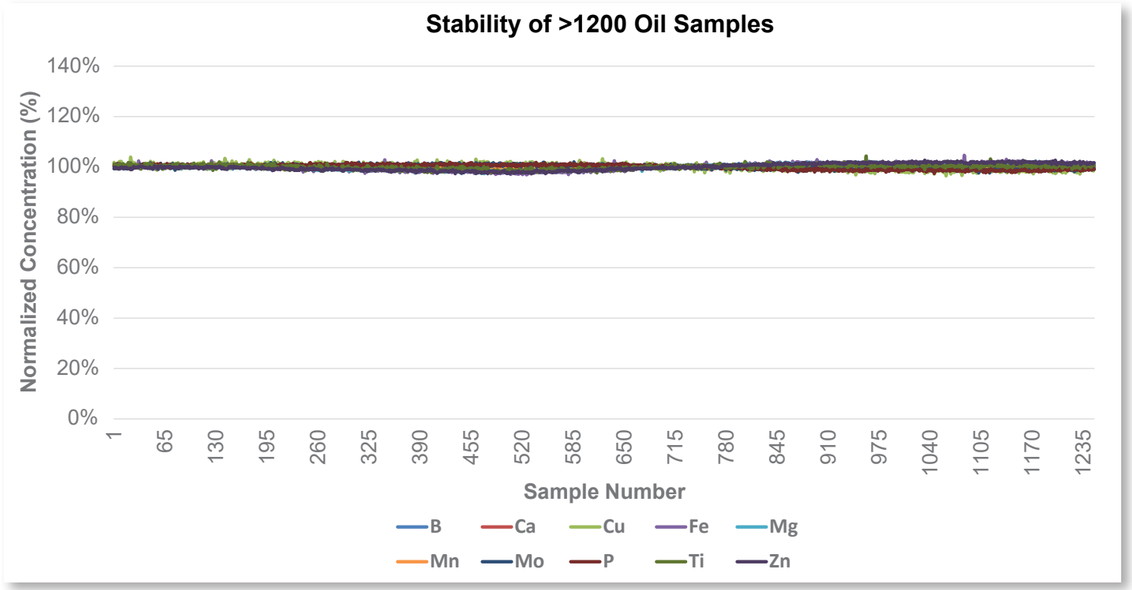

Figure 8. Signal stability of *FAST*Fluidic FilterProbe Oil over a 1235-sample sequence measured in just over 5 hours, with an average RSD of <2% across the entire sequence. This performance demonstrates *FAST*Fluidic FilterProbe Oil's ability to reliably identify all elements of importance across a wide calibration range. High-concentration elements shown above. Lower-concentration elements showed similar stability.

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Sample Throughput

Read Time

	F'n	Analyte	Integration Time (sec)	Read Time (sec)
1	A	Ag 328.068	0.020	0.600
2	A	Al 396.153	0.020	0.600
3	A	B 249.677	0.020	0.600
4	A	Ba 233.527	0.020	0.600
5	A	Ca 315.887	0.020	0.600
6	A	Cd 228.802	0.020	0.600
7	IS	Co 228.616	0.020	0.600
8	A	Cr 267.716	0.020	0.600
9	A	Cu 324.752	0.020	0.600
10	A	Fe 259.939	0.020	0.600
11	A	K 766.490	0.020	0.600
12	A	Mg 279.077	0.020	0.600
13	A	Mn 257.610	0.020	0.600
14	A	Mo 202.031	0.020	0.600

Figure 9. Each element was analyzed by ICP for 0.6 seconds within the *FAST*Fluidic FilterProbe Oil method.

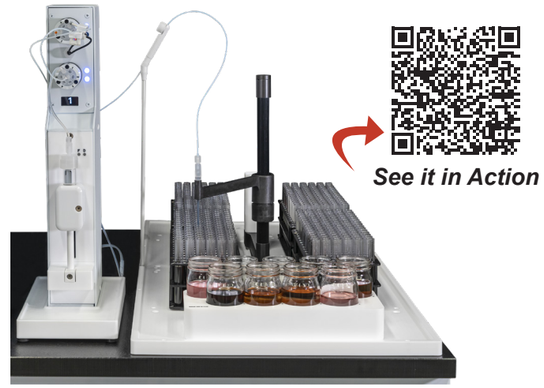
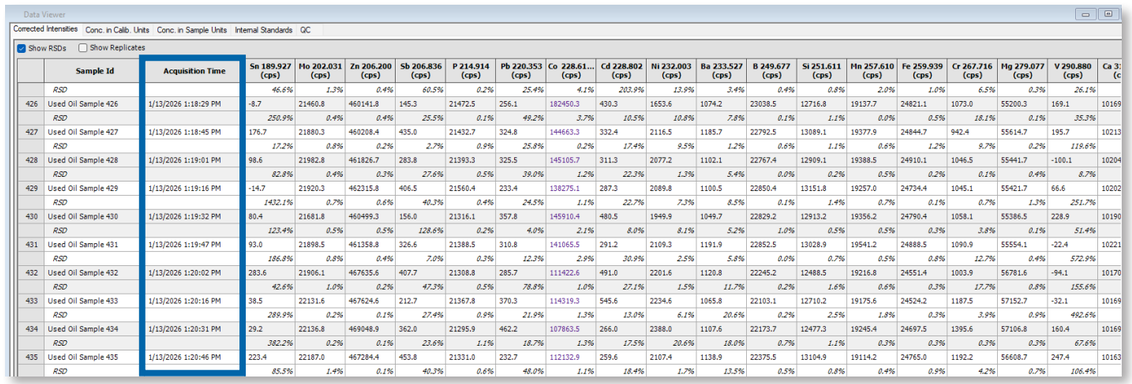


Figure 10. *FAST*Fluidic FilterProbe Oil.

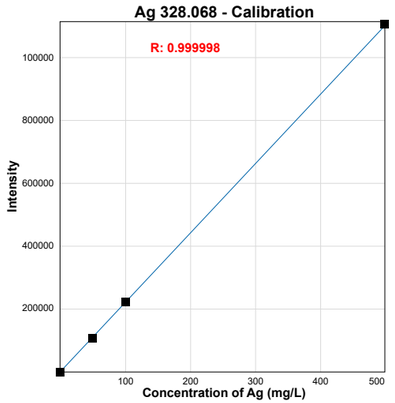
Acquisition Time

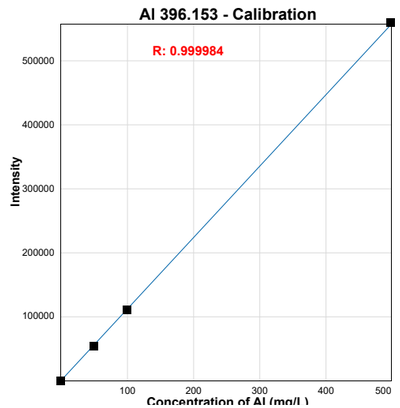


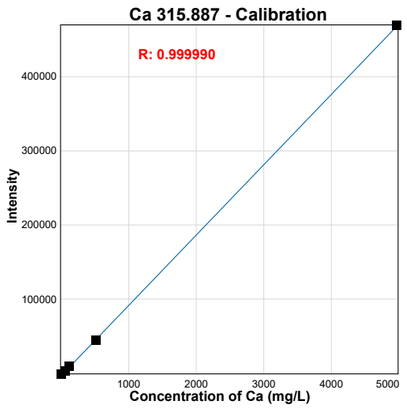
	Sample Id	Acquisition Time	Sn 189.927 (cps)	Mo 202.031 (cps)	Zn 206.200 (cps)	Sb 206.836 (cps)	P 214.914 (cps)	Pb 220.353 (cps)	Co 228.61... (cps)	Cd 228.802 (cps)	Ni 232.003 (cps)	Ba 233.527 (cps)	B 249.677 (cps)	Si 251.611 (cps)	Mn 257.610 (cps)	Fe 259.939 (cps)	Cr 267.716 (cps)	Mg 279.077 (cps)	V 290.880 (cps)	Ca 3: (c
	RSD		46.6%	1.3%	0.4%	60.5%	0.2%	25.4%	4.1%	203.9%	13.9%	3.4%	0.4%	0.8%	2.0%	1.0%	6.5%	0.3%	26.1%	
426	Used Oil Sample 426	1/13/2026 1:18:29 PM	-8.7	21460.8	460141.8	145.3	21472.5	256.1	182450.3	430.3	1653.6	1074.2	23038.5	12716.8	19137.7	24821.1	1073.0	55200.3	169.1	10169
	RSD		250.9%	0.4%	0.4%	25.5%	0.1%	49.2%	3.7%	10.5%	10.8%	7.8%	0.1%	1.1%	0.0%	0.5%	18.1%	0.1%	35.3%	
427	Used Oil Sample 427	1/13/2026 1:18:45 PM	176.7	21880.3	460208.4	435.0	21432.7	324.8	144663.3	332.4	2116.5	1185.7	22792.5	13089.1	19377.9	24844.7	942.4	55614.7	195.7	10213
	RSD		17.2%	0.8%	0.2%	2.7%	0.9%	25.8%	0.2%	17.4%	9.5%	1.2%	0.6%	1.1%	0.6%	1.2%	9.7%	0.2%	118.6%	
428	Used Oil Sample 428	1/13/2026 1:19:01 PM	98.6	21982.8	461826.7	283.8	21393.3	325.5	145105.7	311.3	2077.2	1102.1	22767.4	12909.1	19388.5	24910.1	1046.5	55441.7	-100.1	10204
	RSD		82.8%	0.4%	0.3%	27.6%	0.5%	39.0%	1.2%	22.3%	1.3%	5.4%	0.0%	0.2%	0.5%	0.2%	0.1%	0.4%	8.7%	
429	Used Oil Sample 429	1/13/2026 1:19:16 PM	-14.7	21920.3	462315.8	406.5	21560.4	233.4	138275.1	287.3	2089.8	1100.5	22850.4	13151.8	19257.0	24734.4	1045.1	55421.7	66.6	10202
	RSD		1432.1%	0.7%	0.6%	40.3%	0.4%	24.5%	1.1%	22.7%	7.3%	8.5%	0.1%	1.4%	0.7%	0.1%	0.7%	1.3%	251.7%	
430	Used Oil Sample 430	1/13/2026 1:19:32 PM	80.4	21681.8	460499.3	156.0	21316.1	357.8	145910.4	480.5	1949.9	1049.7	22829.2	12913.2	19356.2	24790.4	1058.1	55386.5	228.9	10190
	RSD		123.4%	0.5%	0.5%	128.6%	0.2%	4.0%	2.1%	8.0%	8.1%	5.2%	1.0%	0.5%	0.5%	0.3%	3.8%	0.1%	51.4%	
431	Used Oil Sample 431	1/13/2026 1:19:47 PM	93.0	21898.5	461358.8	326.6	21388.5	310.8	141065.5	291.2	2109.3	1191.9	22852.5	13028.9	19541.2	24888.5	1090.9	55554.1	-22.4	10221
	RSD		186.8%	0.8%	0.4%	7.0%	0.3%	12.3%	2.9%	30.9%	2.5%	5.8%	0.0%	0.7%	0.5%	0.8%	12.7%	0.4%	572.9%	
432	Used Oil Sample 432	1/13/2026 1:20:02 PM	283.6	21906.1	467635.6	407.7	21308.8	285.7	111422.6	491.0	2201.6	1120.8	22245.2	12488.5	19216.8	24551.4	1003.9	56781.6	-94.1	10170
	RSD		42.6%	1.0%	0.2%	47.3%	0.5%	78.8%	1.0%	27.1%	1.5%	11.7%	0.2%	1.6%	0.6%	0.3%	17.7%	0.8%	155.6%	
433	Used Oil Sample 433	1/13/2026 1:20:16 PM	38.5	22131.6	467624.6	212.7	21367.8	370.3	114319.3	545.6	2234.6	1065.8	22103.1	12710.2	19175.6	24524.2	1187.5	57152.7	-32.1	10169
	RSD		289.9%	0.2%	0.1%	27.4%	0.9%	21.9%	1.3%	13.0%	6.1%	20.6%	0.2%	2.5%	1.8%	0.3%	3.9%	0.9%	492.6%	
434	Used Oil Sample 434	1/13/2026 1:20:31 PM	29.2	22136.8	469048.9	362.0	21295.9	462.2	107863.5	266.0	2388.0	1107.6	22173.7	12477.3	19245.4	24697.5	1395.6	57106.8	160.4	10169
	RSD		382.2%	0.2%	0.1%	23.6%	1.1%	18.7%	1.3%	17.5%	20.6%	18.0%	0.7%	1.1%	0.3%	0.3%	0.3%	0.3%	67.6%	
435	Used Oil Sample 435	1/13/2026 1:20:46 PM	223.4	22187.0	467284.4	453.8	21331.0	232.7	112132.9	259.6	2107.4	1138.9	22375.5	13104.9	19114.2	24765.0	1192.2	56608.7	247.4	10163
	RSD		85.5%	1.4%	0.1%	40.3%	0.6%	48.0%	1.1%	18.4%	1.7%	13.5%	0.5%	0.8%	0.4%	0.9%	4.2%	0.7%	106.4%	

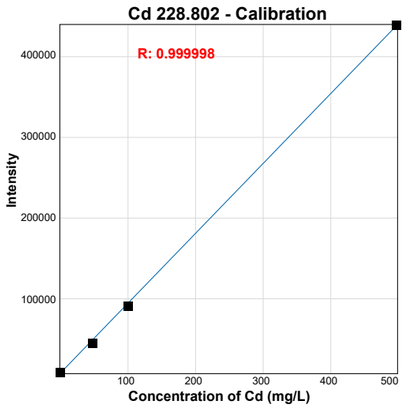
Figure 11. Screen capture of Syngistix ICP showing 15 second sample-to-sample time.

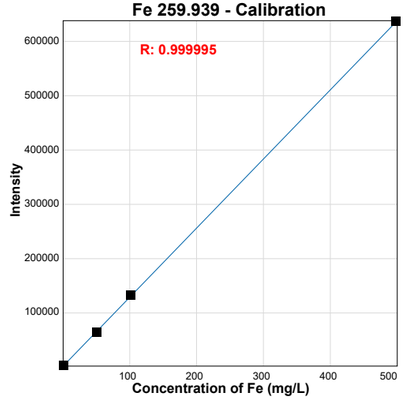
Calibration Curves for 23 Elements in Oil

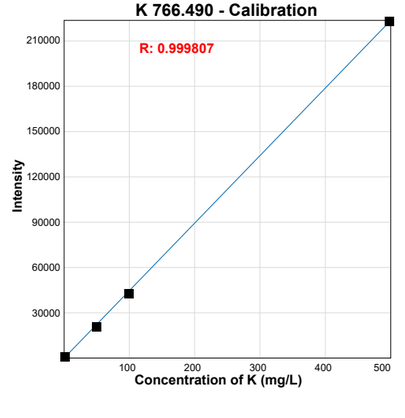












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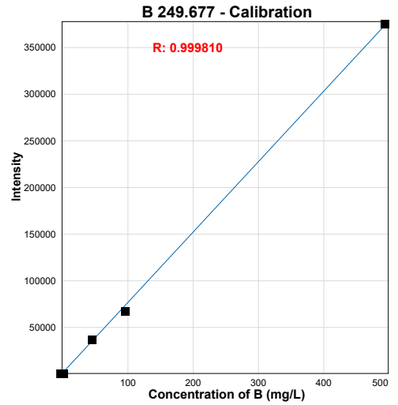
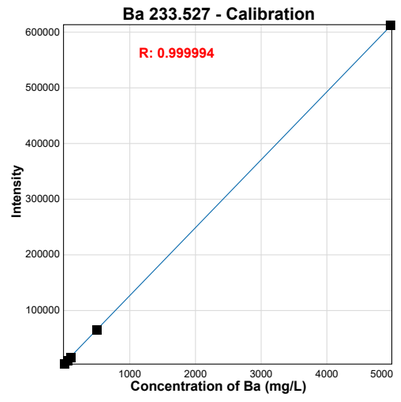
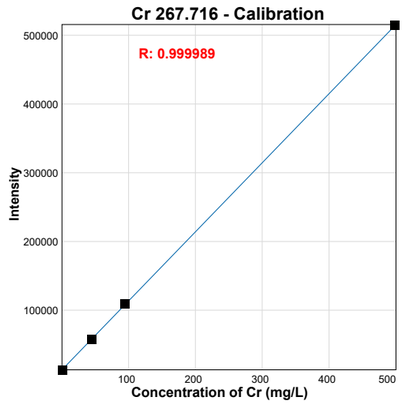
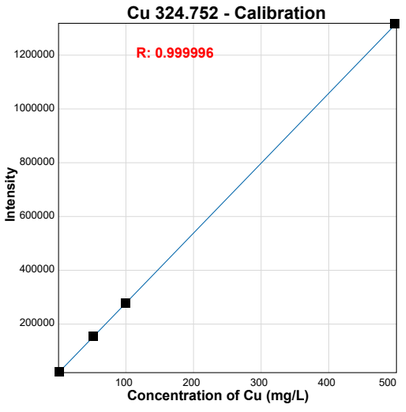
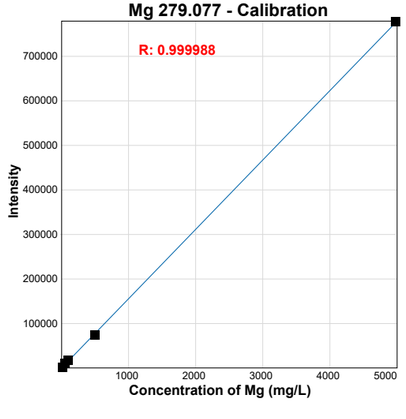
Calibration Curves for 23 Elements in Oil *(continued)*

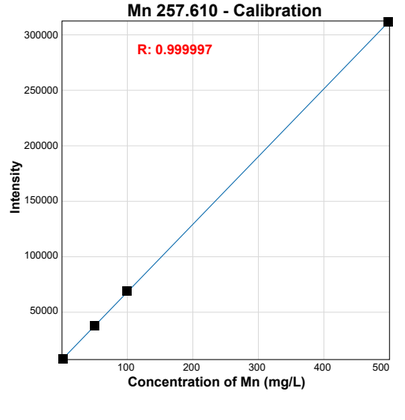




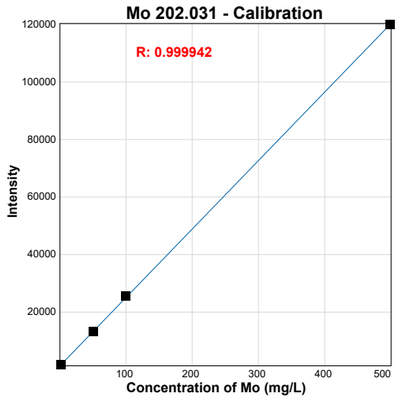


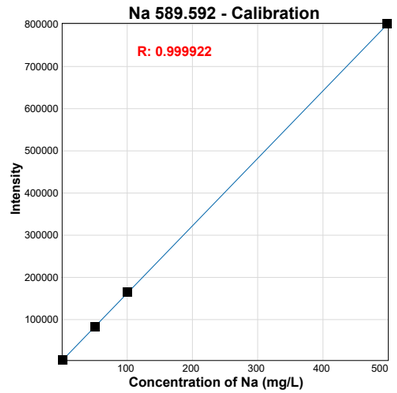


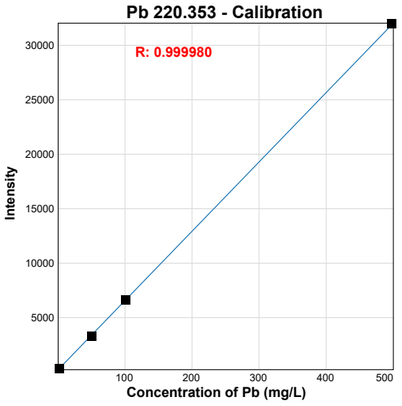


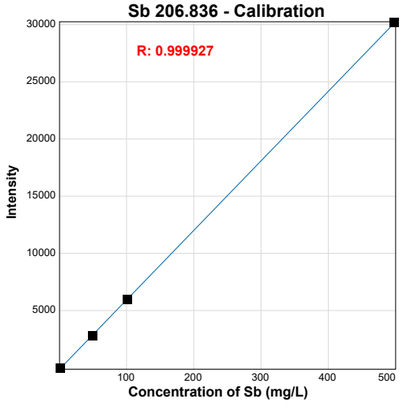


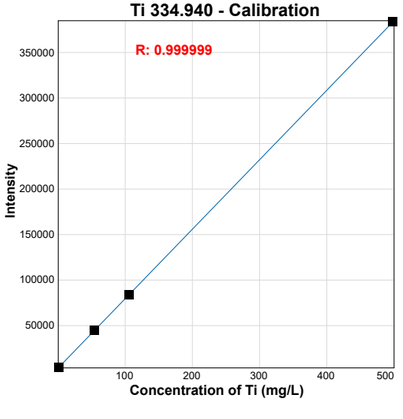
Calibration Curves for 23 Elements in Oil *(continued)*

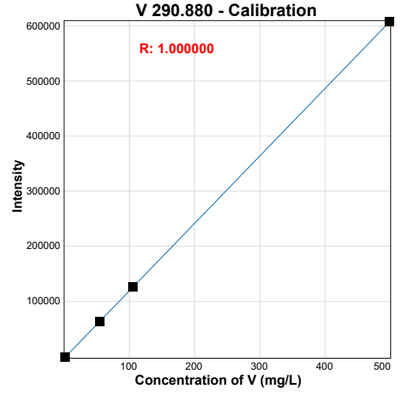












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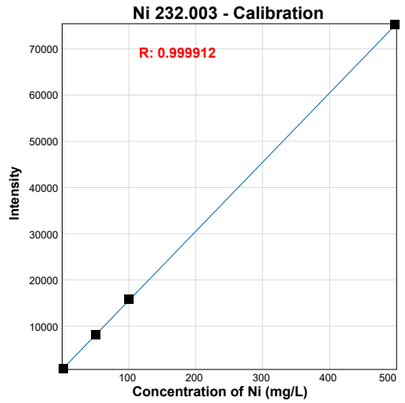
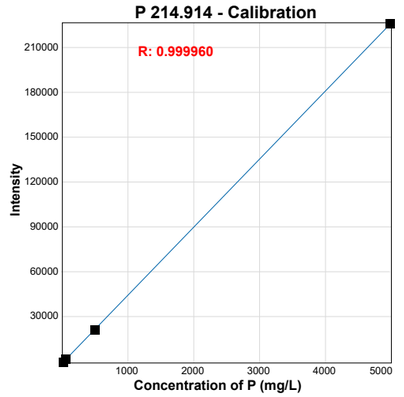
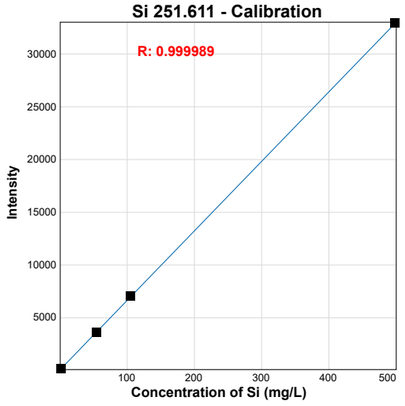
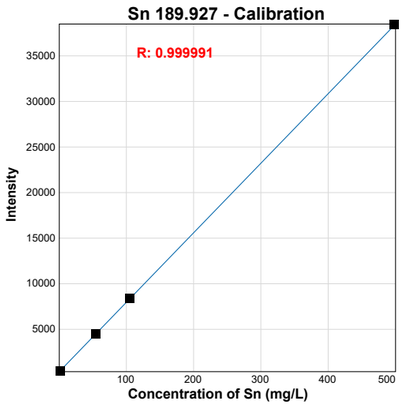








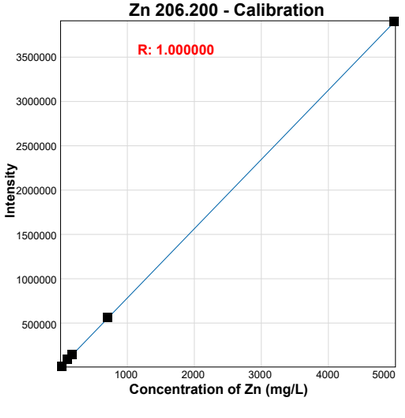


Figure 11. Calibration curves for 23 analytes in oil are completed in just over a minute, delivering R > 0.9995 for all elements.

Calibration Levels for 23 Elements in Oil

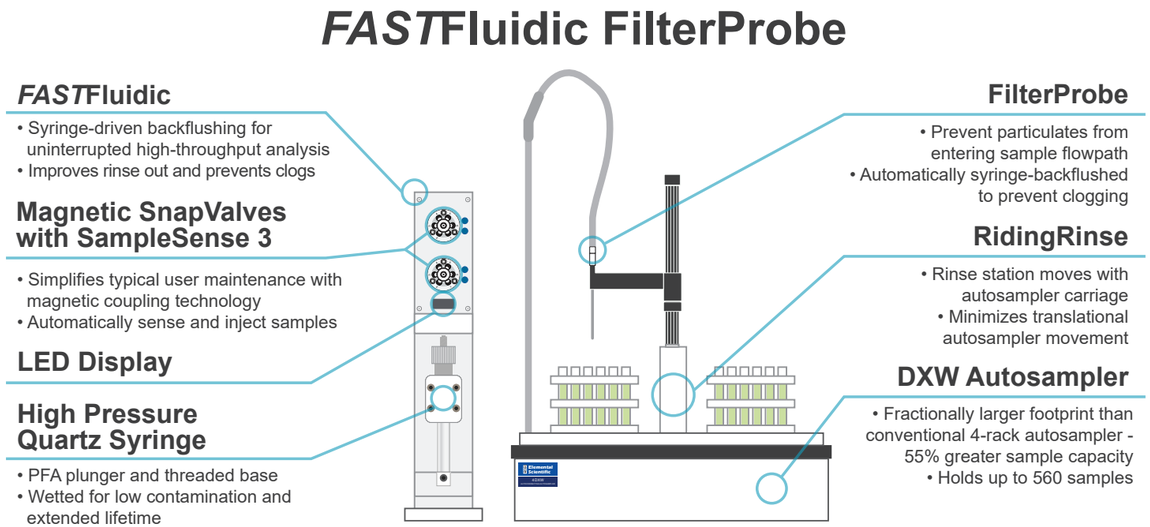
Table 5. Calibration table for all 23 analytes with levels shown below.

Element (λ)	50 ppm	100 ppm	500 ppm	5000 ppm
Ag 238.068	50	100	500	-
Al 396.153	50	100	500	-
B 249.677	50	100	500	-
Ba 233.527	50	100	500	5000
Ca 315.887	50	100	500	5000
Cd 228.802	50	100	500	-
Cr 267.716	50	100	500	-
Cu 324.752	50	100	500	-
Fe 259.077	50	100	500	-
K 766.490	50	100	500	-
Mg 279.077	50	100	500	5000
Mn 257.610	50	100	500	-
Mo 202.031	50	100	500	-
Na 579.592	50	100	500	-
Ni 232.003	50	100	500	-
P 214.914	50	100	500	5000
Pb 220.353	50	100	500	-
Sb 206.836	50	100	500	-
Si 251.611	50	100	500	-
Sn 251.611	50	100	500	-
Ti 335.940	50	100	500	-
V 290.880	50	100	500	-
Zn 206.200	50	100	500	5000

Elemental Scientific

Conclusion

*FAST*Fluidic FilterProbe Oil automates high-throughput oil analysis while delivering rinse-out performance previously unattainable at these operating speeds. By maintaining rapid sample-to-sample operation with minimal carryover, it ensures accurate determination of wear metals, additive elements, and ingress elements—enhancing both reliability and efficiency in oil testing workflows.



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