

MICROWAVE INDUCTIVELY COUPLED ATMOSPHERIC PLASMA - OPTICAL EMISSION SPECTROSCOPY (MICAP™-OES 1000) UTILIZED FOR DETERMINATIONS OF EXTRACTED SILICONE IN METHYLISOBUTYL KETONE (MIBK)

**NO ARGON.
NO CHILLER.
NO PROBLEM!**

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MICAP-OES 1000



Introduction

MICAP-OES 1000 operates on industrial grade (99.9%) nitrogen and 1000 W power. The technology to create the stable plasma is called Cerawave™ which replaces the traditional water-cooled coil RF generators. The design of a light-weight modular component microwave plasma with an echelle-based spectrometer provides real-time full spectrum elemental fingerprint wherever needed.

Silicone lubricants are used in many manufacturing processes and as a result can be a source of contamination into the final product. If the extracted silicone source is known, simple analysis by atomic spectroscopy can be performed to quantify the amount of silicone applied. This presentation will summarize the process for extracting silicone lubricant from rubber stoppers using methyl-isobutyl ketone as the extracting solution. The MICAP-OES 1000 is utilized to determine the silicone extracted to ensure the silicone lubricant applied to the stoppers does not exceed the intended amount for a quality process.



Smarter. Faster. More efficient.

Radom's proprietary Cerawave™ technology sets a new standard for productivity. Cerawave replaces water cooled coils and traditional RF generators. MICAP-OES 1000 is a powerful analytical instrument with a simple design eliminating the need for a chiller and permanent installation location.

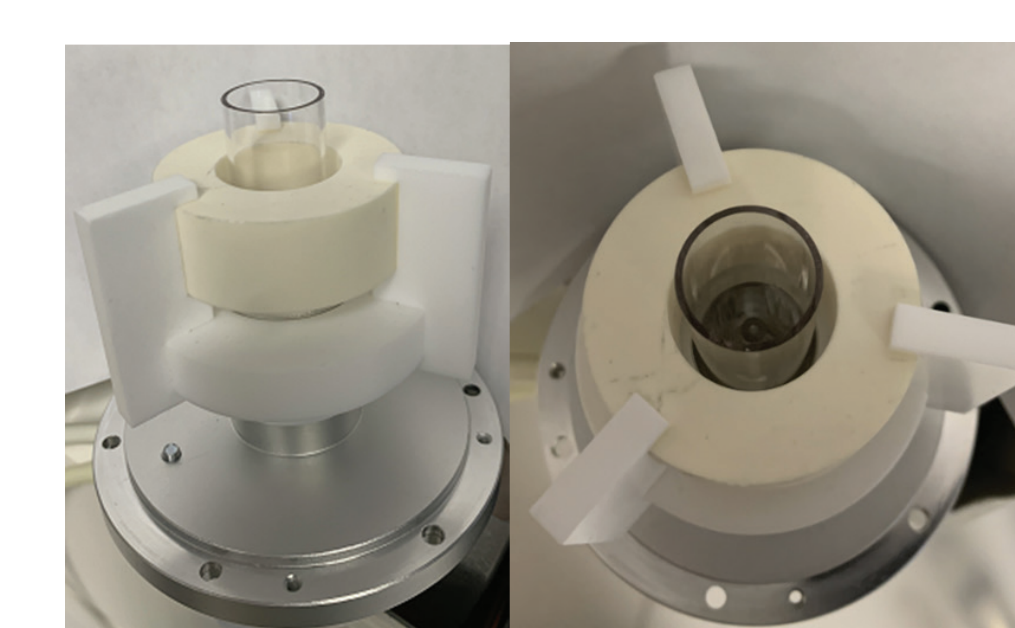
Current Commercial Optical Emission

Traditional inductively coupled plasma generated with Water Cooled Copper Coil RF generator frequencies 27MHz or 40 MHz



	Type	Purity Range (%)	Operating Pressure Ranges (PSI)	Operating Flow Range (L/min)	
Gas	Argon	99.9 to 99.996	70 to 109	9 to 26	
	Nitrogen	99.99 to 99.999	70 to 109	1.5 to 14	
	Sheer Air	Compressed air	80	28	
Physical Specifications ICP-OES only	Width Range (in)	Height Range (in)	Depth Range (in)	Weight Range (lb)	
	24 to 46	34 to 37	27 to 29	176 to 326	
	Power Specification	200 - 240 V 13 to 20 amp			
	Chiller	Cooling (°C)	Power Range (W)	Size WxDxH (in)	Typical Weight (lb)
	10 - 30	>750 to 2000	15 x 27 x 24	178 to 190	
				Power Specification	
				208 - 230 V 15 amp	

Microwave Inductively Coupled Atmospheric Plasma - Optical Emission Spectrometer 1000



	Type	Purity Range (%)	Operating Pressure Ranges (PSI)	Operating Flow Range (L/min)	
Gas	Nitrogen*	99.9	50 - 70	18L/min	
	Sheer Air	Compressed, dried air	50 - 70	20L/min	
	Argon	99.995	60 - 70	During ignition sequence only	
Physical Specifications ICP-OES only	Width Range (in)	Height Range (in)	Depth Range (in)	Weight Range (lb)	
	24	29	20	67	
	Power Specification	208 - 240V * 120V			
	Chiller	No Chiller			



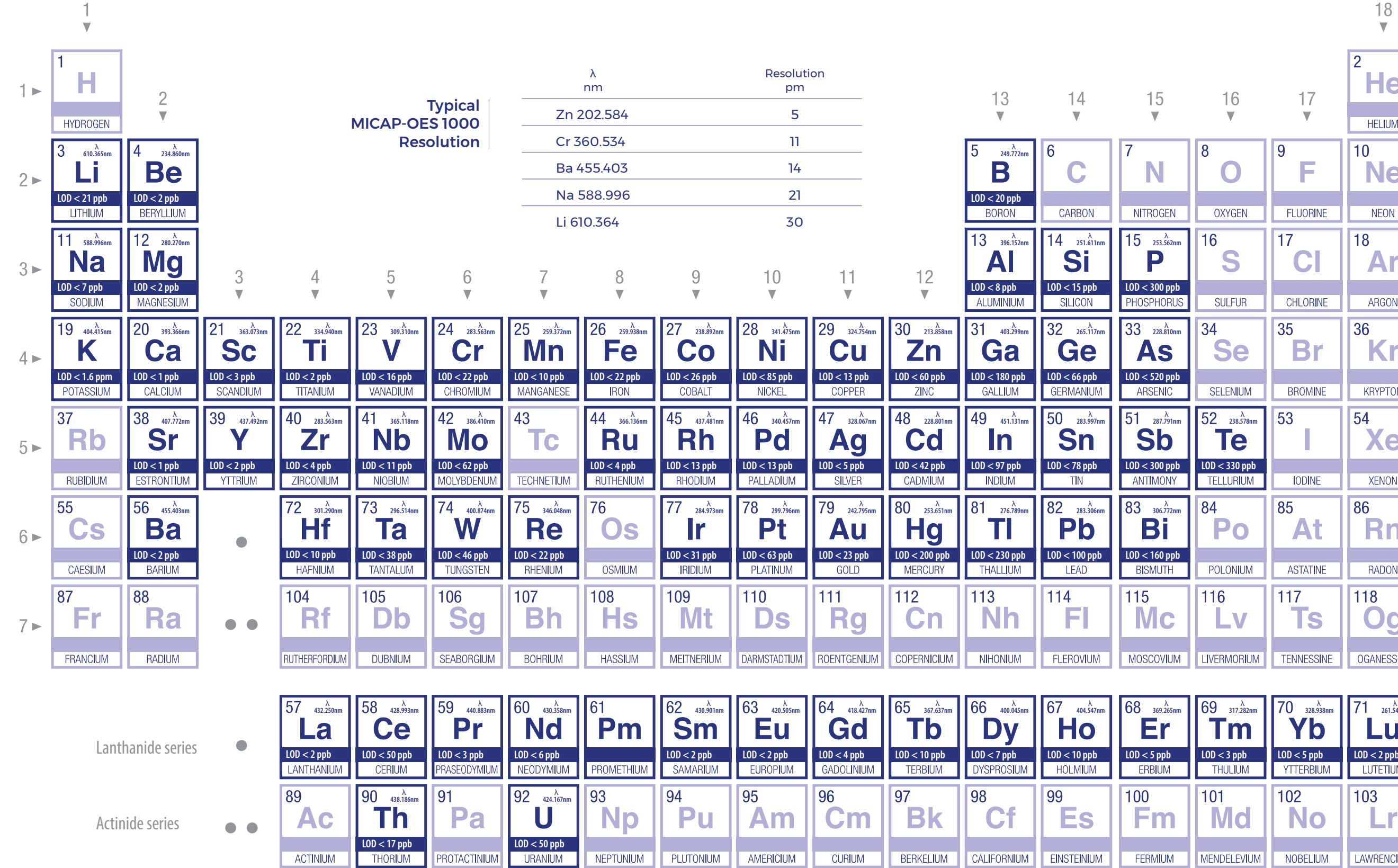
Torch installation assembly:
Easy to use and reproducible set up.
Axial viewed plasma with automated plasma tail removal, no optimization required.



Echelle spectrometer with CMOS camera, measures the entire wavelength range with every solution injection.

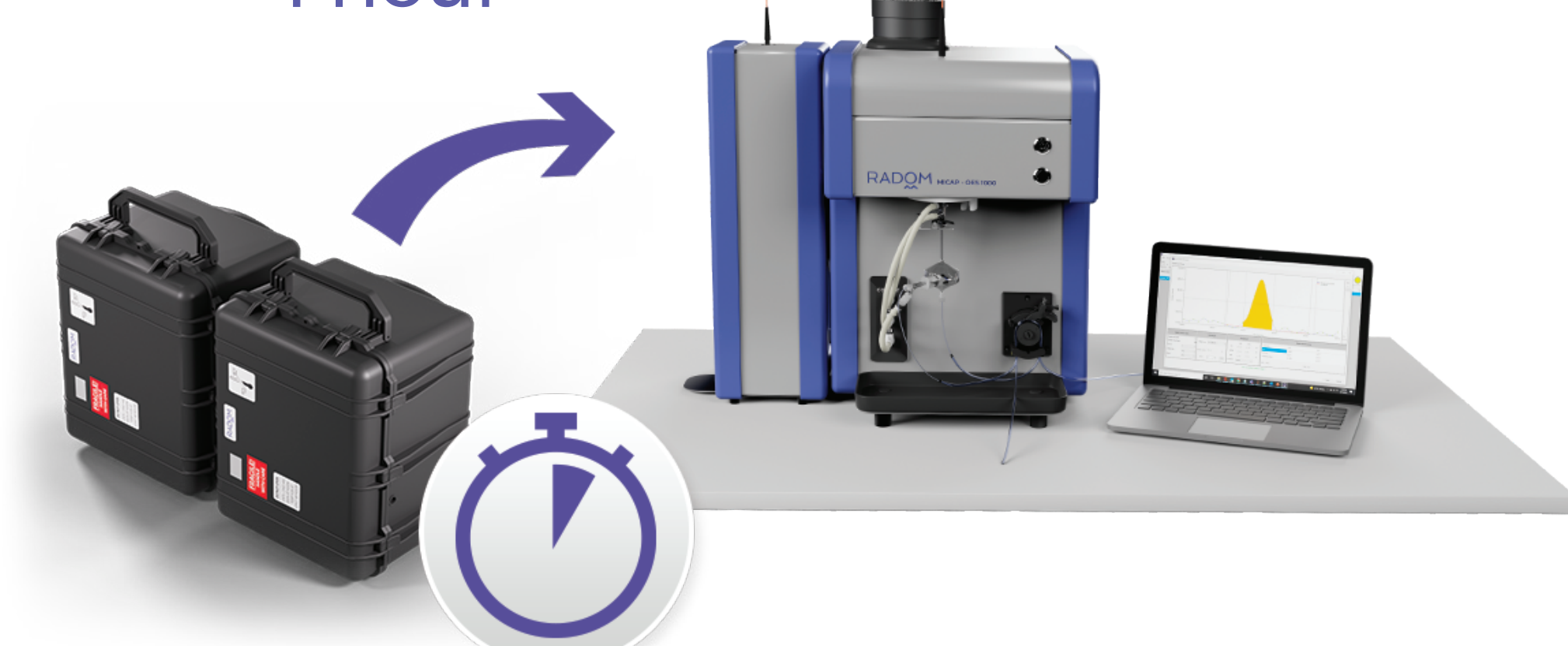
MICAP-OES 1000

Typical Limit of Detection and Resolution



CERAWAVE BENEFITS FOR MICAP-OES 1000

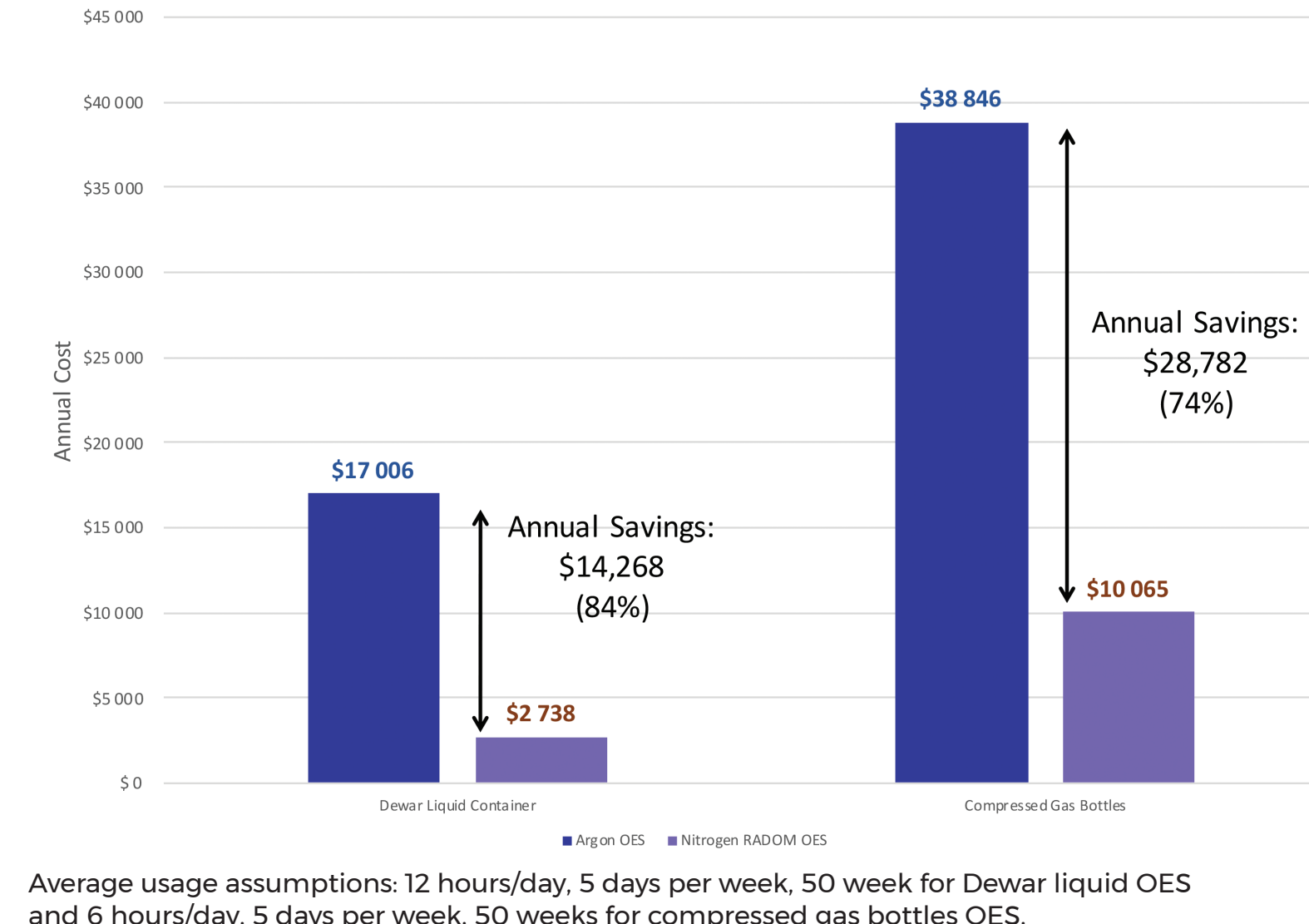
Box-to-Bench < 1 hour



Nitrogen technology

Advantages of using nitrogen gas source:

- ★ Less expensive to operate
- ★ Readily available
- ★ Safe to use



PEAK i-Flow Mini

Nitrogen can be generated from air. PEAK i-Flow Mini provides uninterrupted analyses and increases productivity.

Annual CO₂e Emissions Savings Compared to Argon

kWh saved	metric tons of CO ₂ e saved
239,850	170

Equivalent to:

- Homes' annual electricity use: 33
- Gasoline-powered passenger vehicles: 37
- Total gallons of gasoline consumed: 19,127
- Total smartphones charged: 20,676,512



Test Articles
20mm self-sealing, rubber stoppers
CRC Food Grade silicone
Blaster Industrial Silicone
10 caps per sample size, sprayed with each product.
Average silicone per cap based on 10 cap extraction with 4-Methyl-2-Pentanone

Stock Standard
MicroLubrol® Silicone Oil
Type 200 Fluid
1000 cSt Viscosity
Polydimethylsiloxane
CAS # 63148-62-9

Stock standard prepared in 4-Methyl-2-Pentanone, 999.94 wt/wt

Method Parameters

Instrument Parameters	Sampling Parameters
Coil	140 (mm)
Auxiliary	0.42 (mm)
Injection	1.5 (mm)
Flow	1000 (ml/min)
Pressure	1000 (psi)

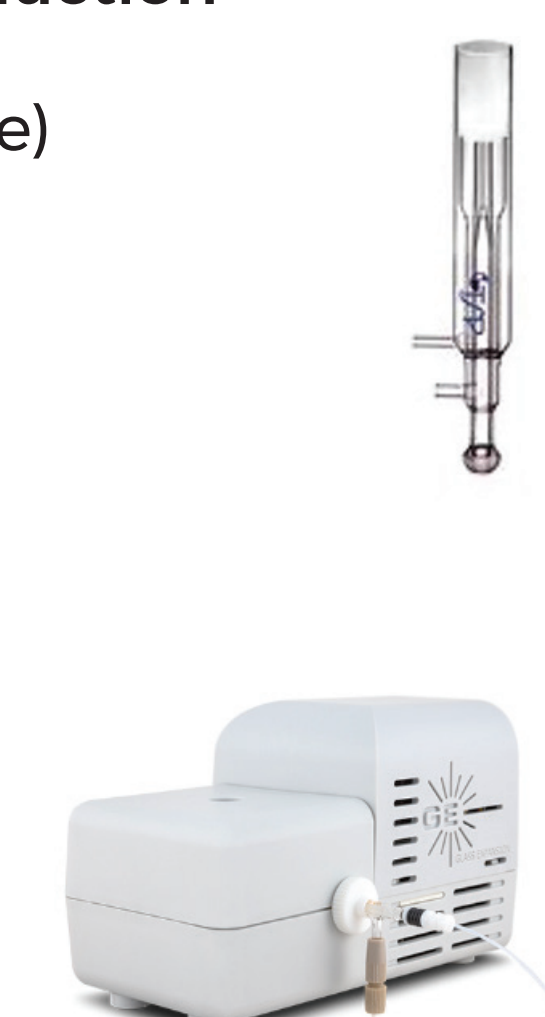
Working Standards						
Unit	Standard 1	Standard 2	Standard 3	Standard 4	Standard 5	Standard 6
ppm	0.0000	4.0010	20.0010	80.0030	119.9760	200.0190

MICAP-OES 1000 Sample Introduction

Radom Torch (20 mm outer tube)
1.5 mm injector
No oxygen addition required
No carbon buildup

Glass Expansion
IsoMist XR programmable temperature-controlled spraychamber

Set point = (-10 °C)
0.4 ml/min MicroMist nebulizer (self-aspirating)



Lowest Carbon Footprint

MICAP-OES 1000 has the lowest carbon footprint of any OES instrument in the market.

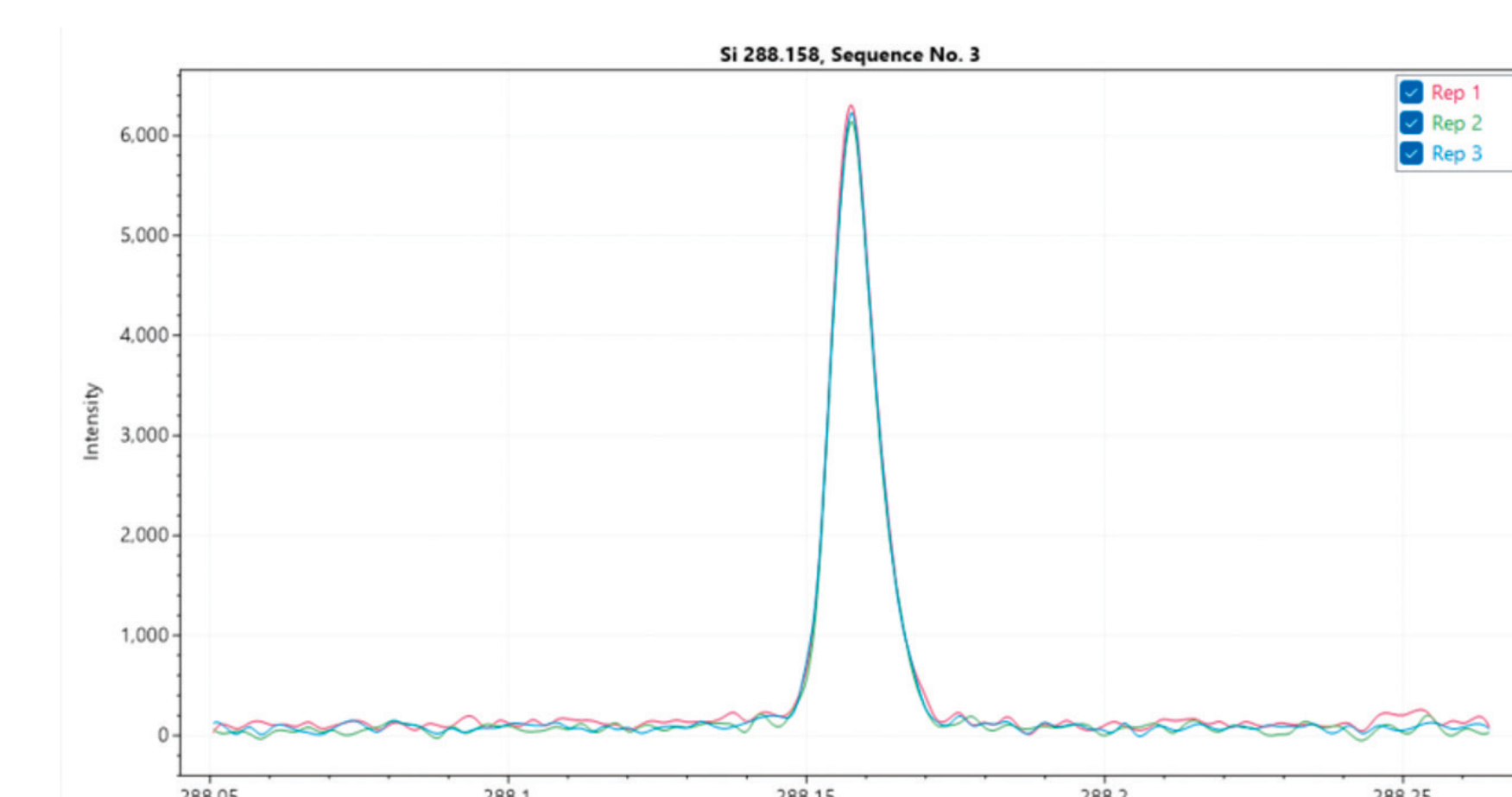
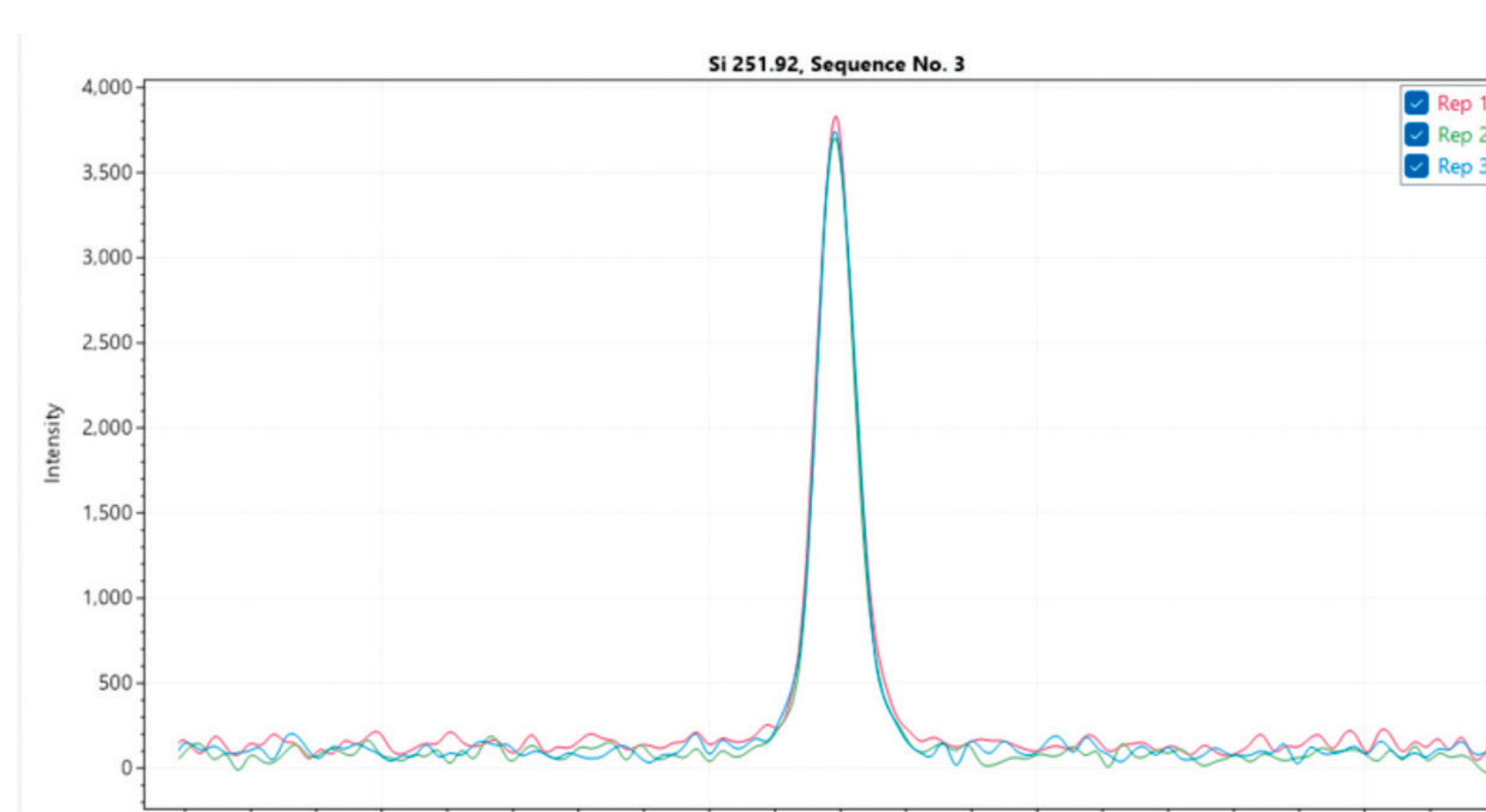
Use	Element	Intensity	Ion
✓	Si 251.611	1,009,240	I
✓	Si 251.432	332,440	I
✓	Si 252.847	257,440	III
✓	Si 288.158	253,730	I
✓	Si 251.920	190,450	I
✓	Si 250.690	182,120	I

6 wavelengths were included for method development.

Radom Intuitive Software (RIS) has the flexibility to add or remove wavelengths during or post analysis.

The two wavelengths with the best LOD and %error were 251.92nm and 288.158nm

The other 4 wavelengths were confirmatory to the primary wavelengths selected



Sample Type	Si 251.920 [nm]	% Error	Si 288.158 [nm]	% Error	Si 250.690 [nm]	% Error	Si 251.611 [nm]	% Error	Si 251.432 [nm]	% Error	Si 252.847 [nm]	% Error
Standard 1_0.000	-0.016		-0.02		-0.006		-0.031		0.002		-0.012	
Standard 2_4.0010	4.178	104%	4.203	105%	4.027	101%	4.36	109%	3.949	99%	4.098	102%
Standard 3_20.0010	20.746	104%	21.577	108%	21.249	106%	21.259	106%	20.343	102%	21.311	107%
Standard 4_80.0370	81.972	102%	79.281	99%	80.758	101%	77.243	97%	82.859	104%	80.603	101%
Standard 5_119.9760	117.726	98%	116.619	97%	118.378	99%	116.626	97%	120.843	101%	118.022	98%
Standard 6_200.0760	189.138	95%	190.133	95%	191.412	96%	192.449	96%	191.611	96%	189.884	95%

Standard Readbacks

Sample Type	Si 251.920 [nm]	% Recovery	Si 288.158 [nm]	% Recovery	Si 250.690 [nm]	% Recovery	Si 251.611 [nm]	% Recovery	Si 251.432 [nm]	% Recovery	Si 252.847 [nm]	% Recovery
CCV_200.0760	185.039	92%	186.121	93%	187.203	94%	188.049	94%	187.794	94%	185.551	93%
CCV2_119.9760	112.502	94%	110.352	92%	112.135	93%	109.869	92%	115.41	96%	114.44	95%
CCV3_80.0370	78.537	98%	75.472	94%	76.539	96%	73.177	91%	78.558	98%	76.538	96%
CCV4_20.001	19.366	97%	19.884	99%	19.592	98%	19.863	99%	18.819	94%	19.577	98%
CCV5_4.0010	3.9	97%	3.901	98%	3.867	97%	4.058	101%	3.665	92%	3.946	99%
CCB	0.185		-0.043		0.068		-0.047		-0.132		0.087	

Sample ID	Measured Mg/Kg	Ave Mg silicone/cap	Measured Mg/Kg	Ave Mg silicone/cap	Measured Mg/Kg	Ave Mg silicone/cap	Measured Mg/Kg	Ave Mg silicone/cap	Measured Mg/Kg	Ave Mg silicone/cap	Measured Mg/Kg	Ave Mg silicone/cap
CRC 5x	230	1.41	230	1.41	230	1.41	220	1.36	230	1.41	230	1.41
Blaster 5x	130	0.80	140	0.86	140	0.86	130	0.80	130	0.80	140	0.86

Conclusion

In the last 10 years, the advancements in spectroscopy were not plasma formation-centric. Radom Corporation commercialized CERAWAVE™ technology as the backbone for robust, reliable nitrogen-based inductively coupled plasma formation.

MICAP-OES 1000 innovations:

- Eliminates the need for water-cooled copper coils and reduces the weight and size of the power generation system
- Robust, reliable plasma sustained with industrial grade nitrogen (99.9%)
- Provides the ability to analyze total dissolved solids and organic solvents

Reimagine Plasma with MICAP-OES 1000



Please use the code to view more...

RADOM
Reimagine Plasma

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