

# Thermo

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## Progress in the Development of ICP

Thermo Fisher Scientific

To achieve further progress in the development of new ICP spectrometers, a thorough analysis was carried out into the needs of customers, instrument manufacturers and technical after-sales service. Customer-related issues concerned performance, sensitivity, analysis speed, sampling rate, ease of use, operating costs and enhanced functionality.

Manufacturers also strive to achieve a robust design, reduced assembly time, reduced calibration and test time, improved performance specification and reliability targets, as well as reduced installation times and associated costs.

To build all of these requirements into an ICP, a bold new design strategy needed to be used and completely change existing designs.

The outcome of this development is an ICP spectrometer which differs in terms of performance and design from any other instrument. In the iCAP 6000 Series from Thermo Fisher Scientific, the following components have been thoroughly optimized and implemented:

- Robust generator, instrument and optics based on 3 castings design
- Ergonomic design
- Optical system with all spherical concave and convex mirrors
- High-performance detector with CID86 chip
- Compact solid state generator
- Easy to assemble and fit torch design

The spectrometers have a small footprint, 84 cm in width, 74 cm in depth and 50 cm height without extraction flue. Weighing just 85 kg, these units are easy to transport and require a minimum of bench space in the laboratory.

Optical high resolution with no tailing into the baseline is achieved right across the detector surface. This means that the maximum radiation intensity of emission lines from the plasma is concentrated onto fewer pixels, resulting in higher intensities

with little or no increase in background. Together with the enhanced non-blooming CID detector, detection limits never before seen on any ICP spectrometer are now achievable.

### Experimental conditions

The wavelengths measured have a variety of excitation energies and were measured using a dual method - Thermo Scientific iTEVA software allows for the automatic selection of two sets of parameters in the same method. A lower power (950W) was used for elements like potassium and 1350W for arsenic.

Table I illustrates measurements for detection limit and stability. Calibration was performed with a blank and a 50 µg/L standard. The detection limit ( $3\sigma$ , based on 10 replicates of blank) is then determined after which the calibration standard is measured back after 2 and 4 hours.

### Conclusion

Detection limits of less than 1 µg/L can now be achieved for at least 65 elements using the Thermo Scientific iCAP 6000 Series. The broad linearity range of the detector system and radial view available with the Duo option, are ideal for precision measurements, even at high concentrations. The entire concept delivers dramatic progress in terms of sample throughput and operating costs. Extremely short installation and stabilization times are achieved through the compact configuration of the entire structure.

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**Table I: Measurements for detection limit and stability**

Element	Unit	Detection Limit	Calibration		After 2 hours		After 4 hours	
			Average	RSD%	Hrs.: 1st back measurement		Hrs.: 2nd back measurement	
					Average	RSD%	Average	RSD%
Al 167.079 nm	µg/L	0.042	50.0	2.5	50.8	0.4	52.2	0.5
As 189.042 nm	µg/L	0.96	50.0	2.7	50.6	0.7	50.3	0.3
B 249.773 nm	µg/L	0.43	50.0	1.5	52.5	4.8	51.4	0.1
Cd 214.438 nm	µg/L	0.023	50.0	1.6	49.9	1.2	49.7	0.7
Cr 205.552 nm	µg/L	0.079	50.0	1.7	51.0	0.5	51.0	0.3
Cu 324.754 nm	µg/L	0.14	50.0	0.5	46.5	15.2	51.4	0.4
K 766.490 nm	µg/L	0.11	50.0	0.2	49.9	11.0	49.9	0.4
Mo 202.030 nm	µg/L	0.12	50.0	1.4	50.1	0.4	50.5	0.2
Na 589.592 nm	µg/L	0.021	50.0	0.4	50.5	5.0	51.9	0.8
Ni 231.604 nm	µg/L	0.11	50.0	1.6	50.3	0.6	50.6	0.1
Pb 220.353 nm	µg/L	0.43	50.0	1.8	50.3	0.9	50.7	0.1
Sb 206.833 nm	µg/L	0.46	50.0	1.7	48.6	2.2	50.0	0.3
Sn 189.989 nm	µg/L	0.26	50.0	2.4	49.0	0.5	48.7	0.0
Ti 190.820 nm	µg/L	0.28	50.0	2.0	49.3	1.0	50.6	0.2
Zn 202.548 nm	µg/L	0.041	50.0	2.0	50.5	2.0	50.2	0.9