TECHNICAL NOTE 73452

Thermo Scientific iCAP PRO Series ICP-OES typical detection limits

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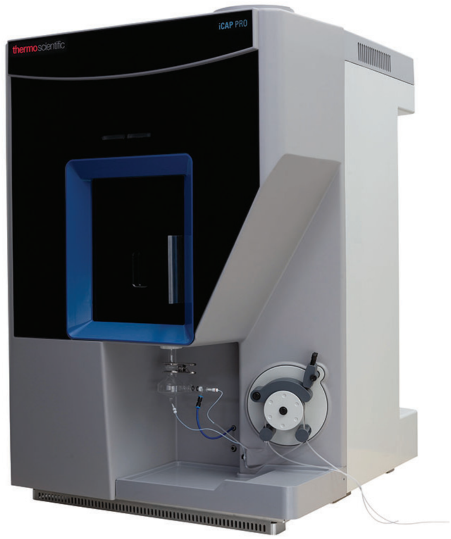

Detection limits

Detection limits (DL) are key indicators of an instrument's capabilities and are useful as an aid in determining the suitability of that instrument for a chosen task. They demonstrate the lowest level of analyte distinguishable from the background noise under optimal conditions and are typically determined several times for statistical accuracy. As a comparison between instruments, instrument detection limits (IDL) provide useful information to the laboratory chemist, either in the decision process for instrument acquisitions or as a measure of performance for current instruments. An IDL is a generic value that defines the lowest concentration of an analyte that can be detected under ideal conditions; it is normally measured on a single element basis, using a clean sample, e.g., ultrapure water. Typical detection limits are measured on several instruments of the same type to assess the average level of performance that can be expected. Typical detection limits, presented in Table 1, are the IDLs of the Thermo Scientific™ iCAP™ PRO Series ICP-OES as determined by applications chemists in a standard laboratory. The IDLs are an excellent indication of what is achievable with the instrument. The detection limits were determined on both the radial and duo version of the iCAP PRO Series ICP-OES using standard sample introduction components, including a concentric nebulizer and cyclonic spraychamber.

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Detection limit determination

To determine the detection limit for an element, a standard of 50 times the expected value of the IDL and a blank were prepared. Following plasma ignition and instrument stabilization, 10 measurements of each solution were taken, using 10 second integration times. The detection limits were calculated using the raw intensity data from the standard and the blank as follows:

$$IDL = 3SD_{blk} \frac{STD_{conc}}{STD_x - BLK_x}$$

Where:

IDL is the instrument detection limit

SD_{blk} is the standard deviation of the intensities of the multiple blank measurements

STD_{conc} is the concentration of the standard

STD_x is the mean signal for the standard

BLK_x is the mean signal for the blank

The multiplier of three is based on the student's *t*-test table and shows that a confidence interval of 99% is used to calculate the detection limit.

The detection limits were measured axially, using both the intelligent Full Range (iFR) and extended Ultra Violet (eUV) modes of a duo instrument, and radially using the iFR mode of a radial only instrument. The IDLs achieved are listed in Table 1. N.B. The typical detection limits listed in Table 1 are not a specification of the iCAP PRO Series ICP-OES but an example of what can be achieved in a typical laboratory under standard conditions.

Table 1. The typical detection limits for the iCAP PRO Series ICP-OES

Element	Wavelength (nm)	Duo Axial (iFR mode µg·L^{-1})	Duo Axial (eUV mode µg·L^{-1})	Radial (iFR mode µg·L^{-1})
Ag	328.068	1.5	-	2
Al	167.079	0.07	0.05	0.4
As	189.042	3.2	1.8	7.8
B	249.773	0.75	-	0.8
Ba	455.403	0.03	-	0.14
Be	313.042	0.02	-	0.04
Ca	393.366	0.02	-	0.03
Cd	214.438	0.14	0.12	0.52
Co	228.616	0.39	0.28	1
Cr	205.560	0.23	0.18	0.65
Cu	224.700	0.9	0.67	3
Fe	259.940	0.6	-	1
Hg	194.227	1.2	1.1	3
K	766.490	0.42	-	19
Mg	279.079	0.01	-	0.03
Mn	257.610	0.07	-	0.18
Mo	202.030	1.8	0.9	2.5
Na	589.592	2.7	-	8
Ni	221.647	0.47	0.3	1.6
P	177.495	1.9	1.4	5.7
Pb	220.353	1.8	0.8	9
S	180.731	2.7	2.5	5
Sb	217.581	3	2.1	15
Se	196.090	5.2	2.4	13
Si	251.661	2.3	-	3
Sn	189.989	1.7	1.1	5
Sr	407.771	0.01	-	0.04
Ti	334.941	0.15	-	0.5
Tl	190.856	5	2	13
V	292.402	0.7	-	0.9
Zn	213.856	0.2	0.13	0.6

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