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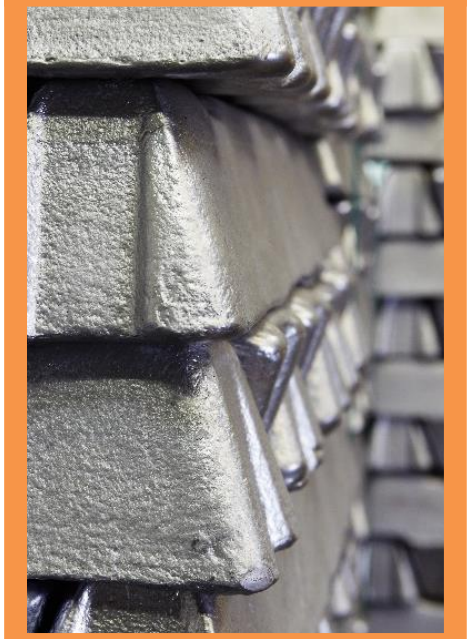


OE750 FOR HIGH-DEMAND ALUMINIUM ANALYSIS

BACKGROUND

The new OE750 is a ground-breaking new OES metals analyser. Covering the complete spectrum of elements in metal, it has some of the lowest detection limits in its class.

Fast measurement times, high reliability and low operating costs mean the OE750 is invaluable for everyday analysis and total quality control, with performance on a par with larger and more expensive spectrometers.

The OE750 is designed to meet the exacting requirements of aluminum foundries, especially those requiring lower detection limits for phosphorous, bismuth and antimony.

The OE750 comes with software that makes analysis faster, more accurate and easier to interpret. This offers results analysis that helps with process control, and data management functionality allows full traceability of results – essential when it comes to audit time.

Optional extras include: adapters for wires and small samples, floor stand version, consumables and spare part kits, and sample preparation devices

KEY FEATURES

- Mid pressure system for extreme stability and highest transparency
- Wavelength range : 120 – 780 nm
- State-of-the-art CMOS high dynamic detectors
- Best optical resolution in class
- Minimised maintenance time
- Better reliability from newly developed excitation source

APPLICATION OF AL ALLOYS

Aluminium is remarkable for its low density and ability to resist corrosion through the phenomenon of passivation. Aluminium forms alloys with many materials, including copper, magnesium, manganese, silicon, tin and zinc. These alloys are used extensively in the aerospace, transportation and building industries; in aircraft skins, building facades and window frames. It's possible to create stiffer and lighter components with Al alloys than is usually achieved with steel.

There are two principal Al alloy classifications: cast alloys and wrought alloys. These classes are subdivided further into heat-treatable and non-heat-treatable categories. Wrought alloys make up the majority of Al alloy use, with about 85% used for wrought products, such as rolled plates, foils and extrusions.

Cast Al alloys yield cost-effective products due to their low melting point, although they generally have a lower tensile strength than wrought Al alloys. The most important cast Al alloy system is Al–Si, where high levels of silicon (4.0–13%) give the alloy good casting characteristics.

Aluminium alloy surfaces will develop a white, protective layer of Al_2O_3 if left unprotected from the atmosphere. Anodising and / or painting are the usual methods of surface protection. Al alloys can be susceptible to galvanic corrosion in certain conditions. This occurs when the alloy is in electrical contact with a metal of higher corrosion potential within an electrolyte that allows ion exchange.

It's important to heat treat Al alloys properly. Failure to do so causes elements within the alloy to separate and the alloy then corrodes from the inside out.

The OE750 is ideal for the control of tramp elements in aluminium. Aluminum foundries supplying to the automotive industries need to perform aluminium melt analysis at the highest level. For example, P, Ca, Bi and Sb tramp elements in the alloy must not exceed 120 ppm in total, as it would negate the effect of adding other elements to control the melt properties.

SAMPLE PREPARATION

Correct sample preparation is very important for precise and accurate OES results. A flat sample surface is essential. To achieve this, different techniques, like grinding or milling, are appropriate, depending on the material and the elements to be analysed.

Our recommendation is to use a milling machine equipped with indexable inserts specified for aluminium alloys. The machine should be optimised for each Al alloy.

Alternatively, you can use a turning lathe.

For the results presented in this application note, all aluminium alloys were milled.

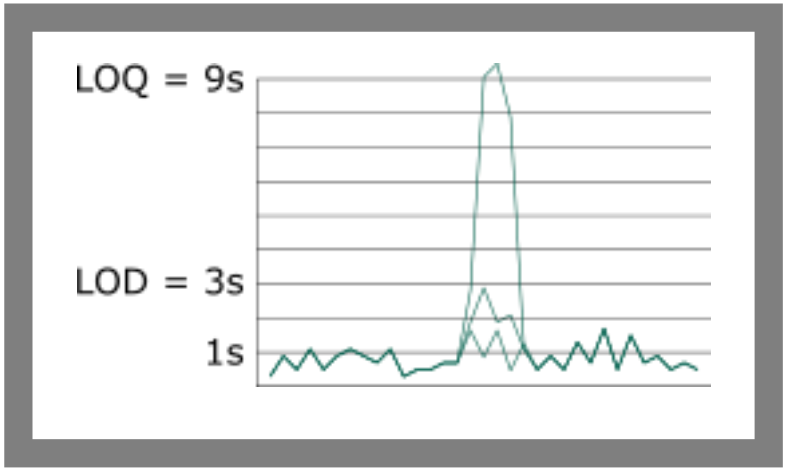
DIFFERENCE BETWEEN LOD AND LOQ

The BEC (equivalent concentration of spectral background) value is the concentration of the analysis sample required to produce the same intensity signal as the background at a given wavelength. The BEC is obtained from the calibration curve and is a fundamental process variable as it directly affects the LOD (**limit of detection**). The LOD is the smallest amount of an element detectable and it is calculated as follows:

$$LOD = \frac{3}{100} RSD_0 \times BEC$$

RSD_0 is correlated to the relative standard value of spectral background. With the BEC value calculated from the calibration curve, we are able to detect different elements in an alloyed copper base down to the level of precision (1δ).

However the **lowest quantitatively determinable amount** (Limit of Quantitation or LOQ) must be larger than the spectrometric LOC by a multiple of three. The resulting LOQ is the quantitatively readable value with our instrument.



Slickers. K. 1993. *Automatic-Atomic-Emission-Spectroscopy*. 2nd Edition. D-35334 Giessen. Germany: Brühlsche Universitätsdruckerei

Determination of aluminium alloys

SUB-programs & calibration range Al base

		Al 100 Low alloys		Al 200 Al-Cu alloys		Al 300		Al 400		Al 450		Al 500		Al 600		Al 000 Orientation	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Ag	Silver	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2
As	Arsenic	0.0003	0.05													0.003	0.05
B	Boron	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Ba	Barium	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Be	Beryllium	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02
Bi	Bismuth	0.0005	0.75	0.0005	0.75	0.001	0.75	0.001	0.75	0.001	0.75	0.001	0.75	0.0005	0.75	0.001	0.75
Ca	Calcium	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.025	0.0001	0.02	0.0001	0.02	0.0001	0.025
Cd	Cadmium	0.0002	0.15	0.0002	0.35	0.0002	0.35	0.0002	0.35	0.0002	0.35	0.0002	0.35	0.0002	0.35	0.0002	0.5
Ce	Cerium	0.0002	0.05	0.0005	0.05	0.0005	0.05	0.0002	0.05	0.0002	0.05	0.0005	0.05	0.0005	0.05	0.0002	0.05
Co	Cobalt	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5
Cr	Chromium	0.0002	0.6	0.0002	0.6	0.0002	0.6	0.0002	0.25	0.0002	0.25	0.0002	0.6	0.0002	0.6	0.0002	0.6
Cu	Copper	0.0003	1	0.001	11	0.0003	0.5	0.0003	2	0.0003	10	0.0003	2.5	0.0003	2.5	0.0003	12
Fe	Iron	0.0005	3	0.0002	3	0.0005	3	0.0005	3	0.0005	3	0.0005	1	0.0005	1	0.0005	3
Ga	Gallium	0.0001	0.12	0.0001	0.12	0.0001	0.12	0.0001	0.12	0.0001	0.12	0.0001	0.12	0.0001	0.12	0.0001	0.12
Hg	Mercury	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1
In	Indium	0.0001	0.15	0.0005	0.15	0.0005	0.15	0.0005	0.15	0.0005	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.12
La	Lanthanum	0.0001	0.05	0.0005	0.05	0.0005	0.05	0.0005	0.05	0.0005	0.05	0.0001	0.05	0.0001	0.05	0.0001	0.05
Li	Lithium	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Mg	Magnesium	0.0002	2	0.0005	5.5	0.0005	13	0.0005	5	0.0005	5	0.0005	5	0.0005	5	0.0005	13
Mn	Manganese	0.0002	2.2	0.0002	2.2	0.0002	0.5	0.0002	0.5	0.0002	0.5	0.0002	1.5	0.0002	1.5	0.0002	2.2
Mo	Molybdenum	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1
Na	Natrium	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Ni	Nickel	0.0005	1	0.0005	5.5	0.0005	5.5	0.0005	5.5	0.0005	5.5	0.0005	1	0.0005	1	0.0005	5.5
P	Phosphorous	0.0015	0.06	0.0015	0.075	0.0015	0.075	0.0015	0.075	0.0015	0.075	0.0015	0.075	0.0015	0.075	0.0015	0.075
Pb	Lead	0.0002	1.75	0.0002	1	0.001	1.75	0.0002	1	0.0002	1	0.001	1	0.001	1	0.0002	1.75
Sb	Antimony	0.001	0.2	0.002	0.75	0.002	0.2	0.002	0.2	0.002	0.2	0.002	0.2	0.002	0.2	0.002	0.75
Sc	Scandium	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06
Si	Silicon	0.0003	1.5	0.0003	2	0.0003	1.25	1	25	1	25	0.0003	1.5	0.0003	15	0.0003	28
Sn	Tin	0.0002	1.25	0.0002	4	0.0002	1.25	0.0002	1.25	0.0002	1.25	0.0002	5	0.0002	5	0.0002	4.2
Sr	Strontium	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15
Ti	Titanium	0.0002	1	0.0002	0.5	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1
Tl	Thallium	0.0003	0.025													0.0003	0.025
V	Vanadium	0.0003	0.15	0.0003	0.15	0.0003	0.15	0.0003	0.15	0.0003	0.15	0.0003	0.15	0.0003	0.15	0.0003	0.15
Zn	Zinc	0.0002	2	0.0005	3.5	0.0005	2	0.0005	1	0.0005	1	0.0005	13	0.0005	13	0.002	13
Zr	Zirconium	0.0005	1	0.0005	1	0.0005	0.25	0.0005	0.25	0.0005	0.25	0.0005	1	0.0005	1	0.0005	1

Determination of aluminium alloys

Table of precision Al alloys

Element	Ag	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cu	Fe	Ga	Hg	In	La	Li
LOD	0.8	15	2	0.2	0.1	6	1	1.5	3	3	2	3	10	4	2	3	2	1
Concentration range (%)	0.00008- 1.2	0.0015-0.05	0.0002-0.025	0.00002-0.025	0.00001-0.02	0.0006- 0.75	0.0001-0.025	0.00015- 0.5	0.0003-0.05	0.0003- 0.5	0.0002- 0.6	0.0003- 12	0.001-3	0.0004- 0.12	0.0002- 0.1	0.0003- 0.05	0.0002- 0.05	0.0001-0.025
Precision (1s) in % -ranges																		
0.001	0.0001		0.0001	0.00005	0.00002	0.0001	0.0001	0.00006	0.0001	0.0002	0.0001	0.0001		0.00005	0.0001	0.0001	0.00001	0.00001
0.005	0.00012	0.0001	0.0002	0.0001	0.00004	0.0003	0.0002	0.0001	0.0001	0.0002	0.0002	0.0002	0.0005	0.0001	0.0002	0.0002	0.00008	0.0002
0.01	0.00015	0.0002	0.0004	0.0002	0.00007	0.0004	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0008	0.0002	0.0003	0.0002	0.0002	0.0006
0.05	0.0002	0.001	0.0015		0.0003	0.001	0.001	0.00012	0.0012	0.0003	0.0004	0.0013	0.001	0.0006	0.0008	0.0007	0.0008	0.003
0.1	0.0004					0.002		0.0025		0.0005	0.0008	0.0015	0.0015	0.0013	0.0015			
0.5	0.0015					0.01		0.012		0.002	0.005	0.004	0.004					
1	0.0025					0.02					0.01	0.007	0.007					
5												0.025	0.01					
10												0.04						
20												0.1						

Element	Li	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sc	Si	Sn	Sr	Ti	Tl	V	Zn	Zr
LOD	1	4	1	3	0.5	4	9	5	11	0.5	2	3	0.1	1.5	7	1.5	1	1
Concentration range (%)	0.0001-0.025	0.0004-13	0.0001-2.2	0.0003- 1	0.00005-0.025	0.0004- 5.5	0.0009- 0.075	0.0005-1.75	0.0011- 0.75	0.00005-0.06	0.0002- 28	0.0003- 5	0.00001-0.15	0.00015- 1	0.0007-0.025	0.00015-0.15	0.0001- 13	0.0001- 1
Precision (1s) in % -ranges																		
0.001	0.00001	0.0001	0.0001	0.0001	0.00006	0.0001		0.0002		0.00005		0.0001	0.00004	0.0001	0.0001	0.0001	0.0002	0.00007
0.005	0.0002	0.0004	0.0002	0.0003	0.0002	0.0002	0.0003	0.0003	0.001	0.0003	0.0003	0.0002	0.0001	0.0001	0.0002	0.0001	0.0007	0.00008
0.01	0.0006	0.0005	0.0002	0.0005	0.0005	0.0003	0.0006	0.0003	0.0015	0.0006	0.001	0.0003	0.00015	0.0003	0.0003	0.00015	0.0007	0.0001
0.05	0.003	0.0008	0.0005	0.001	0.002	0.0005	0.003	0.0006	0.004	0.003	0.002	0.0006	0.0006	0.0008	0.0008	0.0003	0.0008	0.0002
0.1		0.0012	0.0007	0.006		0.0009	0.005	0.0026	0.006		0.003	0.001	0.0013	0.001		0.0005	0.0009	0.0004
0.5		0.004	0.003	0.03		0.003		0.012	0.03		0.004	0.005		0.015			0.002	0.002
1		0.009	0.006	0.06		0.007		0.025	0.06		0.008	0.01		0.03			0.0035	0.0035
5		0.04	0.03			0.035		0.1			0.03	0.05					0.015	
10		0.09									0.04						0.03	
20		0.2									0.07						0.04	

PERFORMANCE DISCLAIMER

Calibration ranges can be extended with customer's samples.
Values obtained for certified reference samples only!
Samples must be flat grinded or milled!

The published values are averaged data from very different type of material and should be regarded as "typical" values.