APPLICATION NOTE

VULCAN Expert

HITACHI
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LIBS FOR SORTING ALUMINIUM ALLOYS

Laser Induced Breakdown Spectroscopy (LIBS) is the latest technology for sorting and analysing aluminium alloys. In handheld form, LIBS is an easy to use and extremely fast, rugged tool for use in the field. Hitachi High-Tech's Vulcan Expert not only detects virtually any aluminium alloy in just one second, but also determines its full chemical composition. Elements typically challenging to handheld XRF instruments, such as silicon and magnesium can be accurately quantified in just one second.

One of the fastest tools for analysing and identifying aluminium alloys.

Aluminium is a versatile metal with low density, light weight, relative high strength and an ability to resist corrosion. For these reasons aluminium is commonly used in automotive and aircraft components, packaging and power lines to name a few.

Aluminium is one of the most recycled materials today after paper and steel. More than 50% of the aluminium produced today is from recycled material. Aluminium recycling is also environmentally friendly as up to 90–95% of energy is conserved compared to producing aluminium from bauxite.

TYPES OF ALUMINIUM

Aluminium alloys are typically categorised as either wrought aluminium or cast aluminium. Wrought aluminiums are pressed, forged or hammered whilst cast aluminiums are poured into a mould in their molten forms to give them the required shape. Wrought aluminiums are the stronger of the two.

Although cast aluminiums are alloyed with the same elements as wrought aluminiums, they have lower strength. Aluminium alloys are commonly used for automobile parts, furniture, and cookware. Cast aluminiums are used when large quantities are required, quickly offsetting the costs of developing the mould.

The International Alloy Designation System is the most widely accepted naming scheme for wrought alloys. In general, there are seven different series of wrought aluminium alloys with different alloying elements. Each alloy is given a four-digit number, where the first digit indicates the major alloying elements and the second digit indicates the modification of the alloy (1st, 2nd etc.). The third and fourth numbers are arbitrary numbers given to identify a specific alloy in the series.

This means that Vulcan Expert can separate all the common wrought aluminium series shown in table 2 from 1000 to 7000 as well as separate alloys within the series in most of the cases. Common separations such as 2011/2014/2024 based on Cu and Mg, 3003/3004 based on Mg, 6061/6063 based on Si and Mg and 7075/7050 based on Cr and Zr can be carried out quickly and reliably.

Series	Key Elements	Properties and typical use
1000	**> 99 % Al**	Superior corrosion resistance and electrical conductivity. Poor mechanical properties.
2000	**Cu, Mg**	High strength Al alloys, can be hardened to strengths comparable to steel.
3000	**Mn, Mg**	Common multipurpose Al alloy used for example for drinking cans.
4000	**Si**	Lower melting point. Castings, welding wires, architectural applications, extrusions.
5000	**Mg**	Weldable, used in pressure vessels, construction, automotive industry.
6000	**Si, Mg**	General purpose, profiles, easy to machine, weldable.
7000	**Zn, Mg, Cu**	Highest strength Al alloys, aerospace applications.

Table 1. Aluminium series and the key alloying elements

2024	Cu	Fe	Mg	Mn
1	4.71	0.11	1.12	0.50
2	4.95	0.15	1.2	0.48
3	4.76	0.09	1.17	0.48
4	4.74	0.10	1.15	0.47
5	4.81	0.20	1.23	0.54
6	4.93	0.16	1.18	0.50
7	4.78	0.20	1.15	0.56
8	4.98	0.19	1.17	0.55
9	4.65	0.14	1.13	0.52
10	5.04	0.21	1.17	0.54
AVG	4.84	0.16	1.17	0.51
REF	**4.70**	**0.20**	**1.30**	**0.57**

6061	Cu	Fe	Mg	Si
1	0.24	0.14	0.77	0.57
2	0.26	0.16	0.76	0.55
3	0.26	0.17	0.83	0.66
4	0.26	0.18	0.78	0.59
5	0.26	0.17	0.73	0.51
6	0.26	0.19	0.79	0.61
7	0.24	0.20	0.75	0.55
8	0.26	0.17	0.76	0.57
9	0.27	0.20	0.74	0.56
10	0.26	0.19	0.78	0.62
AVG	0.26	0.18	0.77	0.58
REF	**0.29**	**0.19**	**0.81**	**0.55**

7075	Cr	Cu	Fe	Mg	Zn
1	0.20	1.39	0.07	2.16	5.67
2	0.21	1.39	0.14	2.26	5.68
3	0.19	1.45	0.09	2.28	5.52
4	0.20	1.34	0.10	2.10	5.74
5	0.21	1.38	0.10	2.18	5.76
6	0.22	1.46	0.11	2.28	5.65
7	0.18	1.34	0.07	2.14	5.74
8	0.24	1.36	0.11	2.08	5.74
9	0.22	1.41	0.14	2.12	5.63
10	0.20	1.37	0.11	2.12	5.82
AVG	0.21	1.39	0.10	2.17	5.70
REF	**0.19**	**1.40**	**0.13**	**2.26**	**5.60**

Table 2. Three common aluminium alloys measured 10 times with Vulcan Expert handheld LIBS analyser.

The results above show both excellent accuracy and quality precision on three common aluminium alloys; 2024, 6061 and 7075. All the key alloying elements as well as lower level alloying elements such as Fe and Cr are reliably identified for accurate grade identification.

TRUE MULTI-PURPOSE TOOL

Vulcan Expert's unique features and capabilities make it an ideal tool for both scrap yards and positive material identification (PMI) quality assurance/quality control (QA/QC) applications alike. The built-in pre-burn feature in the Vulcan series of LIBS analysers makes it possible to measure samples that are not clean and polished, without sample pre-treatment. The user selectable pre-burn mode helps the operator to ensure that the measurement time is always optimised. The pre-burn feature is powerful enough to burn through anodisation and thin layers of oil or dust. Heavier contamination must be cleaned mechanically before taking a measurement.

For quality assurance and quality control carried out by metals fabricators, Vulcan Expert provides unparalleled speed combined with ease of use and the most advanced reporting tools. The analyser leaves a barely visible burn mark on the sample surface, making it suitable for use on finished goods and components.

METAL ANALYSIS TOOLBOX FROM HITACHI

Hitachi High-Tech's extensive range of elemental handheld, portable and stationary analysers provides a solution to virtually any alloy analysis need. Handheld LIBS technology is complemented by optical emission spectroscopy (OES) when the highest accuracy and lowest detection limits are required. Handheld XRF instruments on the other hand deliver rapid and accurate non-destructive analysis and grade ID of various alloys including aluminium.

VULCAN EXPERT FOR FASTEST ALUMINIUM SORTING

Vulcan Expert is one of the fastest handheld tools available to analyse and identify aluminium alloys. It provides full chemistry and grade identification in just one second, including the traditionally challenging close grades such as 6061/6063, 3003/3004 and 7050/7075 – a task that can easily take 5–10 seconds or even more with handheld XRF.

When Wi-Fi is available, Vulcan Expert connects to a cloud based data storage and management service making analysis results available in real time from any computer, anywhere.

Visit **www.hitachi-hightech.com/hha** for more information.

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Hitachi High-Tech Analytical Science

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