

CALIBUS



Comparison: HH-LIBS versus HH-XRF



COMPARISON HH-LIBS VERSUS HH-XRF

Traditionally, mobile metal analysis has been performed by either portable optical emission spectroscopy (OES) or handheld x-ray fluorescence (XRF) analysers. However, another technology is now emerging as a new option to consider for portable testing, offering the benefits of 1second measurements, no radiation source and virtually non-destructive approach. The newest metal analysis option is Laser Induced Breakdown Spectroscopy (LIBS).

Handheld X-ray fluorescence spectrometry (HH-XRF) has been established as the gold standard method for in-situ elemental determination in metals and alloys in the last 10 years. It is used for scrap metals sorting and positive material identification (PMI). PMI is a quality assurance tool consisting of the identification of alloy grades in various industries using metals to verify compliance to specification and to avoid mixing up of the materials. **Handheld laser induced breakdown spectrometry (HH-LIBS)** is an emerging method which show promising capabilities for alloy analysis and may be able to complement HH-XRF in alloy analysis, especially in alloys containing low atomic number elements like Be, Li, Mg, Al and Si (e.g. light elements).

When compared to HH-XRF, HH-LIBS offers new possibilities in terms of applications: Li can be detected in aluminium alloys used in aerospace, Be can be detected in Be-bronze and C can be detected in carbon steel and cast iron. The sensitivity of Mg and Al is much higher in HH-LIBS than HH-XRF so that sorting of Aluminium and Titanium alloys is significantly faster (few seconds versus 30-60s with HH-XRF). In contrast, HH-LIBS may not be able to detect low concentrations of S and P which can be quantified by HH-XRF in stainless steel (SS 303, SS 416) and in phosphorous bronzes.

Generally, for scrap metal sorting, HH-LIBS is expected to be faster for aluminium alloys and equivalent to HH-XRF for stainless steel. HH-LIBS may be able to sort most of the Ti alloys faster than HH-XRF, with few exceptions like Ti Grade 11 containing around 0.15% Pd, which can be identified using HH-XRF. Sorting of stainless steel can be done within



few seconds using both HH-XRF and HH-LIBS. For heavier alloys like super alloys, copper alloys (except aluminium and beryllium bronze), solders, lead alloys or precious metal alloys, HH-XRF delivers better sensitivity and accuracy for the analysis than HH-LIBS. In addition, the measurement of Tramp elements in scrap may be difficult for HH-LIBS. For example, the detection of Pb and Sn in stainless steel alloys at 100-500 ppm will be difficult using HH-LIBS.

For fast sorting of aluminium alloys based upon light elements, HH-LIBS is clearly the best alternative as well as for separating many magnesium and titanium grades. When precision and accuracy matter more as in PMI analysis and quality control or when price figures are required in scrap trading (Ni, Mo, etc.), then HH-XRF is still the method of choice. From a regulatory point, the use of HH-XRF requires, paperwork, licensing and in some countries, long radiation safety training. In contrast, the utilization of lasers (class 1 or 3b) does not require any of these.

If your main application is measuring magnesium, aluminium or titanium alloys or red metals containing significant amounts of Be, Al or Si, the instrument of choice will be HH-LIBS. If your application is measuring stainless steel, high temp alloys or other heavy metal alloys, the instrument of choice will be HH-XRF. In both cases, the instrument of choice can be used to measure most alloy classes, however, there are compromises in speed, accuracy and precision which must be understood.



Pros & Cons of HH-XRF and HH-LIBS

HH-XRF	HH-LIBS
<p>Pros</p> <ul style="list-style-type: none"> • Speed of analysis 2-5s • Established technique • Robust and reliable method • Large analysed surface (7 to 50mm²) • Excellent sensitivity and accuracy for metals with atomic number >>22 • Good for analysis of tramp elements • Completely non-destructive method 	<p>Pros</p> <ul style="list-style-type: none"> • Speed of analysis (1s) including light element • Fast sorting especially for aluminium, stainless steel, magnesium, and titanium alloys • Lower LODs for light elements with low excitation potential/low ionization potential (alkaline and alkaline-earth elements) • No x-ray safety requirement • Ideal to analyse small areas like welding • Ability to measure Li, Be, B, C
<p>Cons</p> <ul style="list-style-type: none"> • Needs compliance with local radiation safety regulation • Long measurement time when light elements required (30-60s) • No detection of Li, Be, B, C, Na 	<p>Cons</p> <ul style="list-style-type: none"> • Sample preparation needed • Not yet suitable for trace analysis e.g. cannot analyse Tramp elements • Cannot quantify C at 200-300ppm • High LODs for S, P • Poorer accuracy due to transient nature of plasma • Small analysed area sensitive to heterogeneities • Destructive method (small crater or pattern left on the analysed item)

