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WHY Alloy Analysis

Analytical and technological equipment and software

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WHY XRF?

X-ray fluorescence (XRF) provides outstanding efficiency in alloy analysis and sorting.
Being a truly non-destructive method it requires minimal sample preparation and provides more versatility than OES. It is suited for analyzing all existing alloy types, which makes it a welcome technology in a scrapyard, construction site, foundry and various other heavy engineering enterprises.
XRF analyzers will drastically reduce your analysis time and cost. Unlike conventional analysis in which each new measurement adds cost, xrf cost is 99% initial capital expenditure, which means that each new measurement is more cost effective.

ALLOY XRF ANALYSIS BASICS AND FACTS TO KNOW

Due to the advent of SDD detector, XRF elemental detection range has been extended to Na to U and covers almost the whole periodical table. Most alloys elements are within this detection range. Since most alloys are homogeneous structures and as such are 100% x-ray detectable, they are ideally suited for XRF analysis. Alloys are analyzed from tens to several hundred microns deep into the sample depending on the alloy density.

Therefore corroded or plated samples may require grinding or polishing. Accuracy of the method can vary for different elements and depending on the alloy type is typically accurate to 2 to 5 relative parts per thousand. Measurements are performed in a matter of seconds. Sorting and grade identification can take as little as 2 to 5 seconds, more accurate analysis may require longer measurement times, 10 seconds or more. Analysis of light elements such as Mg in Al alloys may require up to 1 minute.

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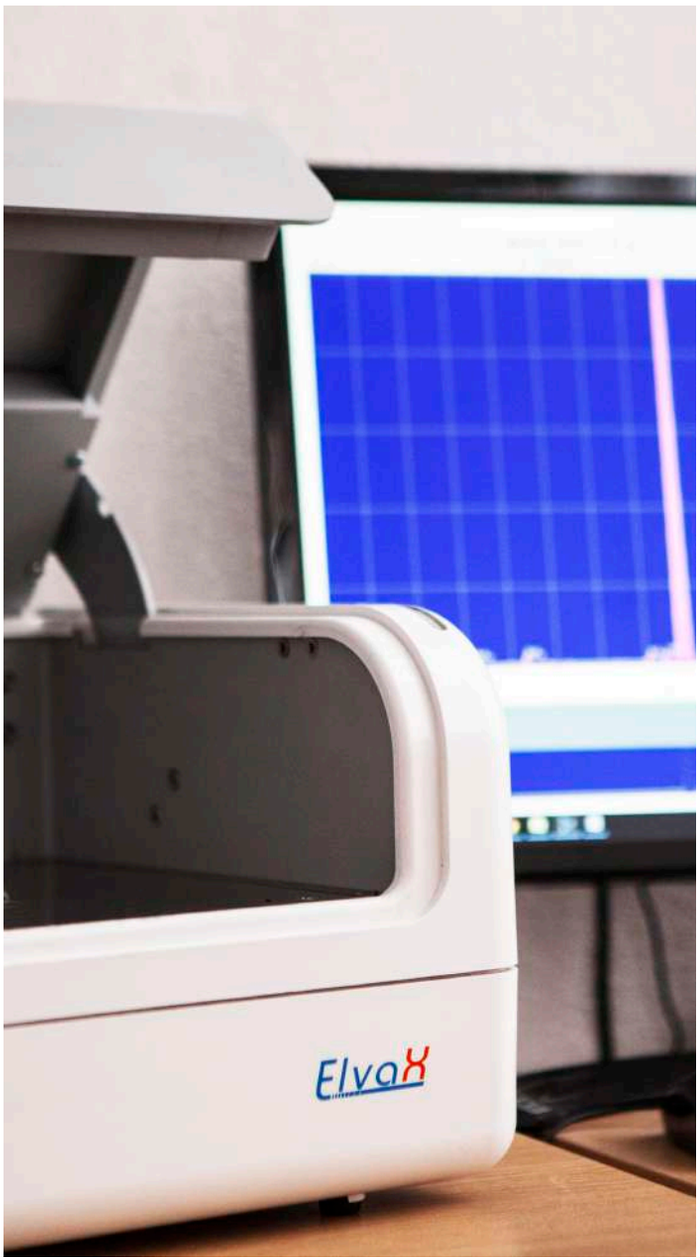
XRF ANALYZERS FOR ON-SITE AND LABORATORY BASED ANALYSIS

There are several points to consider in choosing between a bench-top and a handheld analyzer.

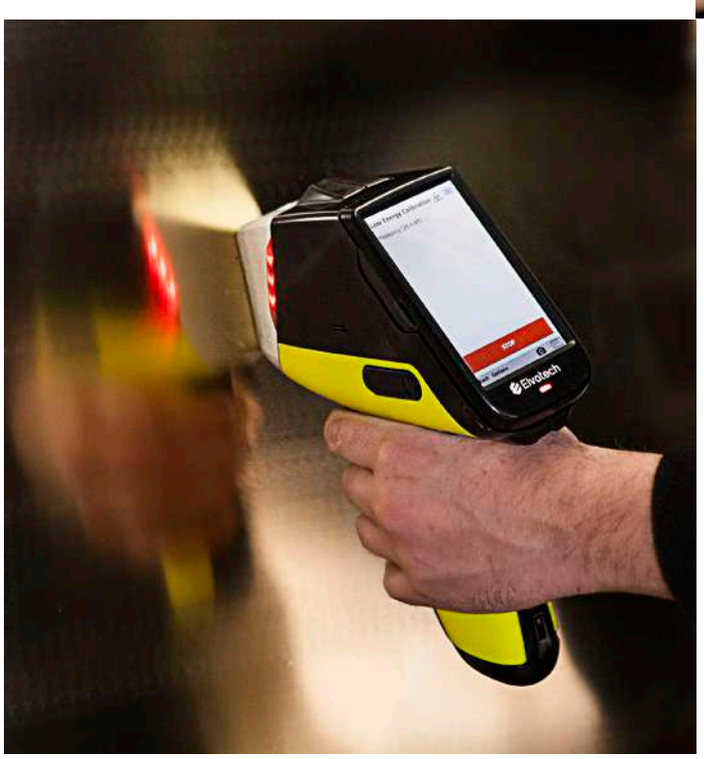


Benchtop analyzers Advantages

- Higher sensitivity to light elements due to helium purge option
- Customizable software allowing to adjust measurement parameters such as x-ray tube current, filter type etc
- Advanced analytical tools excellent for analysing non-standard alloys
- Convenient measurement of small and uneven samples

Disadvantages

- The need to get samples from site to laboratory



Handheld analyzers Advantages

- On site analysis
- Extra intuitive software that doesn't require any XRF theory knowledge

Disadvantages

- Lower sensitivity to light elements due to absence of helium purge
- The need to synchronize with a PC for more detailed spectra Analysis
- Long measurement times difficult without use of a lab-stand

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HANDHELD XRF ANALYZER ElvaX ProSpector

ElvaX ProSpector is ideally suited for sorting, quality control and quality assurance, when it comes to analyzing alloys. Thanks to a high resolution SDD detector and high count rate (up to 100.000 cps) ProSpector informs you about sample's alloy grade and elemental composition in seconds. The use of primary beam filters and automatic selection of optimal excitation modes for different alloy types enables ProSpector to improve signal to background ratio. Analysis takes seconds and data is displayed on the PDA screen. If necessary results are compared with known alloy grades, which are contained in an integrated alloy library. ProSpector handheld analyzer weighs 1,4 kg, operates 8 hours on battery and has a rugged design.

- **Suitable for sorting as well as for instant high accuracy analysis**
- **Detects concentrations from ppm to %**
- **Accurate Light element analysis option**
- **8 hours operation on battery**

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BENCHTOP XRF ANALYZER ElvaX

ElvaX is a versatile system for laboratory based analysis providing uncompromised quality in alloy analysis. The software combines usability and intuitiveness with a set of powerful analytical tools that can be used by an advanced user. The detection range is from Na to U. Helium purge function increases ElvaX sensitivity to light elements (Na, Mg, Al, Si, P, S) as much as up to 10 times. ElvaX can be equipped with an 8-position autosampler, which moves samples to the analytical window automatically.

- **As much analytical power as you can get at the market**
- **Superior light element detection due to helium purge**
- **Open customizable software**
- **Accurate Light element analysis option**
- **Camera for precise sample**

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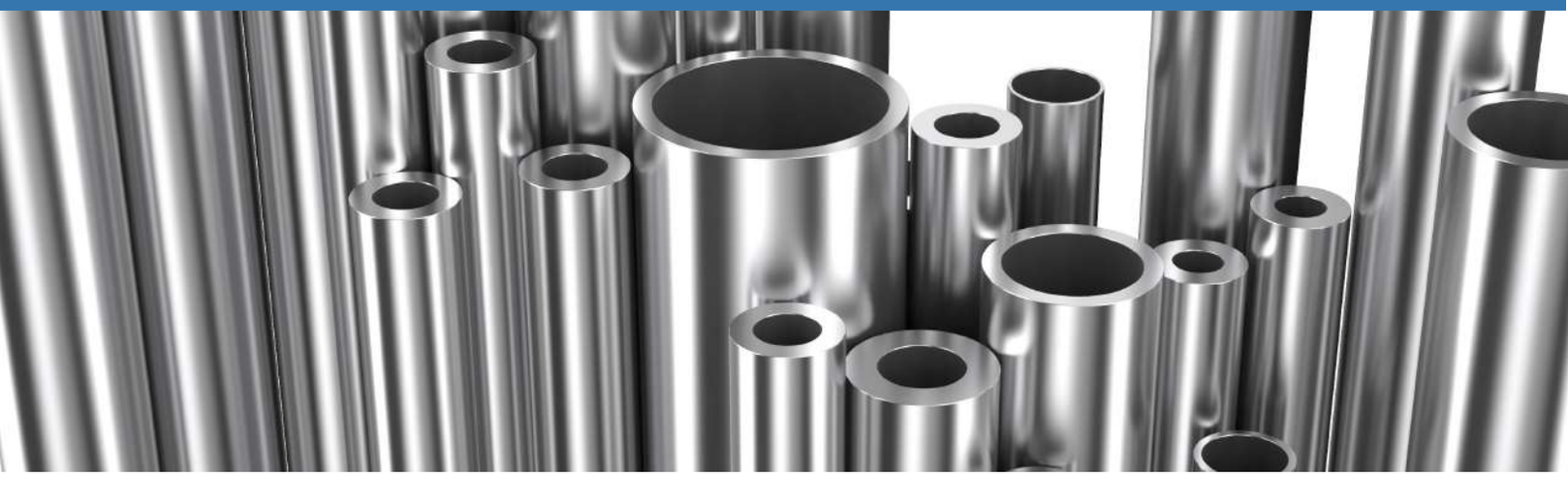

CARBON AND ALLOY STEEL ANALYSIS USING XRF

Carbon steel is one of the most widely used material in large structures. As its name suggests the main alloying constituent is carbon. XRF comes in handy when there's a need to quickly sort carbon steel from other alloys like in scrap metal industry or during incoming inspection. Alloy steel properties are determined not by carbon. XRF is indispensable for the analysis of this type of steels, because contents of alloyants such as Mn, Ni, Mo, V etc, which determine steel properties and cost, are measured within seconds.

Detection Ranges in Alloys for ElvaX Low alloy steel, high alloy steel and heat resistant alloys with Ni and Fe-Ni base:

Element	Detection range (mass fraction), %			
	Beginning of range		End of range	
	Value	Absolute Error	Value	Absolute Error
Al	0.01	0.003	2	0.1
Si	0.01	0,003	5	0,2
P	0.005	0.003	0.1	0.01
S	0.005	0.003	0.1	0.01
Cr	0,05	0,02	30	0,3
Ni	0,05	0,03	30	0,3
Cu	0,01	0,005	4	0,04
Ti	0,02	0,005	5	0,1
Mo	0,005	0,002	15	0,2
V	0,02	0,01	3	0,15
W	0,02	0,01	20	0,2
Co	0,02	0,01	5	0,2
Mn	0,05	0,02	20	0,2
Nb	0,01	0,005	3	0,04
Sn	0.007	0.004	0.1	0.01
Sb	0.007	0.004	0.1	0.01
Pb	0.007	0.004	0.1	0.01
Fe	base			

Comparison of measurement by ElvaX and SRM 1155 Stainless Steel (Cr18-Ni12-Mo2) AISI316 (NIST)

Element	Certified	Measured
Si	0,509	0,497
P	0,02	0,021
S	0,0175	0,016
Cr	18,37	18,32
Mn	1,619	1,59
Co	0,105	0,097
Ni	12,35	12,38
Cu	0,173	0,169
As	0,0107	0,011
Mo	2,386	2,378
W	0,11	0,108
W	0,05	0,02

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ALUMINUM ALLOYS ANALYSIS USING XRF

Aluminum alloys analysis requires detection of such elements as Cu, Mn, Si, Mg, Zinc etc. One of the imporetant and complex tasks in aluminum alloys analysis is correct detection of Mg and Si (so called light elements) due to the low energy of their characteristic peaks and their closeness to aluminum spectrum peak. Correct detection of Mg and Si is necessary for identifying some 4000 and 5000 aluminum alloy series. Elvatech XRF analyzers are capable to distinguish all aluminum alloys from 1000 to 8000 Series.

Detection Ranges in Alloys for ElvaX Aluminum alloys base:

Element	Detection range (mass fraction), %			
	Beginning of range		End of range	
	Value	Absolute Error	Value	Absolute Error
Cu	0,005	0,002	10	0,3
Si	0,03	0,01	22	0,3
Mg	0,05	0,025	15	0,3
Mn	0,005	0,002	2	0,05
Ni	0,005	0,002	4	0,1
Zn	0,005	0,002	8	0,1
Fe	0,01	0,005	2	0,02
Cr	0,005	0,003	0,5	0,05
Sn	0,005	0,002	23	0,3
Pb	0,005	0,003	5	0,1
Sb	0,005	0,002	6	0,1
Ti	0,005	0,002	1	0,05
Zr	0,003	0,001	1	0,05
Sr	0,003	0,001	1	0,05
Al	base			

Comparison of measurement by ElvaX and SRM 1259 Aluminum Alloy 7075 (NIST)

Element	Certified	Measured
Si	0,18	0,176
Fe	0,205	0,211
Cu	1,6	1,587
Mn	0,079	0,077
Cr	0,173	0,177
Ni	0,063	0,066
Zn	5,44	5,47
Mg	2,48	2,54

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COPPER ALLOY ANALYSIS USING XRF

Copper alloys are mostly represented by two groups: brasses and bronzes. Superior electrical conductivity of brasses and low friction indicators of copper alloys enable them to be one of the most used metal commodities. XRF is very well suited for copper analysis due to its simplicity and speed. The main components of copper alloys are Zn, Sn, Fe, Mn, Al, Si, P, Sb, Pb, Ni. Alloys of Cu and Ni is another important group copper alloys, though not so widely used as brasses and bronzes. Cu and Ni alloys are used where high corrosion resistance and excellent mechanical properties are required.

Detection Ranges in Alloys for ElvaX Bronze, brass, and copper nickel alloys:

Element	Detection range (mass fraction), %			
	Beginning of range		End of range	
	Value	Absolute Error	Value	Absolute Error
Fe	0,02	0,01	8	0,2
Mn	0,02	0,005	5	0,06
Cr	0,02	0,01	1	0,03
Si	0,02	0,01	5	0,1
Al	0,02	0,01	15	0,3
P	0,005	0,003	0,4	0,02
Ti	0,02	0,01	0,5	0,02
Sn	0,005	0,002	12	0,1
Pb	0,005	0,002	13	0,3
Ni	0,05	0,015	99	0,3
Zn	0,05	0,02	50	0,3
Sb	0,005	0,002	2	0,03
Cd	0,005	0,002	1	0,015
As	0,005	0,003	0,1	0,01
Bi	0,005	0,003	0,1	0,01
Ag	0,005	0,002	1	0,03
Cu	base			

Comparison of measurement by ElvaX and IARM-87A (Crade 857) (Ana-lytical Reference Materials International, INC)

Element	Certified	Measured
Pb	0,92	0,893
Sn	0,55	0,547
Zn	37,49	37,61
Mn	0,008	0,006
Al	0,42	0,428
Fe	0,23	0,223
Ni	0,33	0,342
P	0,006	0,007
Sb	0,01	0,012
Co	0,02	0,021
Ag	-0,005	0,004

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NICKEL ALLOY ANALYSIS USING XRF

Nickel alloys are mostly used where exceptional strength as well as temperature and corrosion resistance are required. Nickel is the base alloying element of a number of so called superalloys, e.g. Waspalloy, Inconel, Hastelloy etc. Typical applications are in aerospace, petrochemical and military industries. Four main types of Nickel alloys include: 1) pure nickel alloys - at least 99% of nickel; 2) nickel-copper alloy - commercial name Monel; 3) nickelchromium-iron alloys - for example Waspalloy, Astroloy, Inconel, which due to contents of Al, Ti and Si, allow for precipitation hardening; 4) temperature resistant alloys of Ni and Al, Ti, V, Co, Mo, W, Nb, Zr for the use in extreme mechanical and temperature conditions.

Detection Ranges in Alloys for ElvaX Nickel alloys:

Element	Detection range (mass fraction), %			
	Beginning of range		End of range	
	Value	Absolute Error	Value	Absolute Error
Al	0,03	0,01	10	0,2
Si	0,05	0,02	5	0,2
Cr	0,05	0,02	30	0,3
Cu	0,03	0,01	4	0,04
Ti	0,02	0,02	5	0,1
Mo	0,005	0,002	15	0,2
V	0,02	0,01	3	0,15
W	0,05	0,02	20	0,15
Co	0,05	0,02	60	0,3
Fe	0,05	0,03	50	0,3
Mn	0,05	0,02	20	0,2
Nb	0,005	0,003	3	0,04
Ni	base			

Comparison of measurement by ElvaX and 24XWASP3 (batch E) (MBH Analytical Ltd)

Element	Certified	Measured
Si	0,403	0,383
Mn	0,65	0,635
Cu	0,47	0,467
Fe	1,197	1,232
Cr	19,76	19,86
Nb	0,149	0,153
Mo	3,98	3,971
Co	13,77	13,757
Ti	3,904	3,926
Al	1,54	1,48
V	0,082	0,065
W	-0,11	0,127
Zr	0,146	0,143
Ni	53,51	53,8

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TITANIUM ALLOY ANALYSIS USING XRF

Titanium alloys are known for their lightness, hardness and temperature resistance. The main applications are military, aerospace, sports equipment, medical industry. Titanium components in such applications are usually high fidelity parts and non-destructive analysis is especially important in such applications. XRF provides instant and accurate analysis of all titanium grades.

Detection Ranges in Alloys for ElvaX Nickel alloys:

Element	Detection range (mass fraction), %			
	Beginning of range		End of range	
	Value	Absolute Error	Value	Absolute Error
Al	0,07	0,03	10	0,25
V	0,05	0,02	20	0,3
Mo	0,005	0,002	15	0,05
Sn	0,01	0,002	5	0,05
Zr	0,005	0,002	20	0,2
Mn	0,01	0,005	2,5	0,05
Cr	0,01	0,005	12	0,1
Si	0,05	0,02	1	0,07
Fe	0,01	0,005	5	0,07
Cu	0,01	0,005	5	0,05
Ni	0,01	0,003	1	0,03
Nb	0,005	0,002	5	0,05
W	0,01	0,005	2	0,03
Ti	base			

Comparison of measurement by ElvaX and 24XWASP3 (batch E) (MBH Analytical Ltd)

Element	Certified	Measured
Al	6,245	6,286
Cr	0,0165	0,015
Cu	0,004	0,005
Fe	0,213	0,223
Ni	0,0203	0,019
V	4,154	4,143
Mo	0,0068	0,006
Si	0,019	0,022
Ti	89,15	89,26
Zr	0,0053	0,005
Sn	0,01	0,012

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ZINK ALLOY ANALYSIS USING XRF

Zinc alloys are extensively used in die casting to make parts for many industries. Another important use of zinc alloys is galvanizing to improve corrosion and shock resistance of various parts. Casted zinc components are applied in many industries including automobile, electronics, construction, furniture etc. Galvanizing is used in transport, automobile industry, construction etc.

Detection Ranges in Alloys for ElvaX Zinc alloys:

Element	Detection range (mass fraction), %			
	Beginning of range		End of range	
	Value	Absolute Error	Value	Absolute Error
Cu	0.04	0,02	10	0,3
Fe	0,005	0,002	1	0,02
Mn	0,005	0,002	0.1	0,003
Si	0,005	0,002	0.1	0,003
Al	0,01	0,003	15	0,3
Sn	0,003	0,0015	0.1	0,002
Pb	0,005	0,002	1	0,02
Sb	0,003	0,0015	0.1	0,003
Cd	0,003	0,0015	0.5	0,005
Zn	base			

Comparison of measurement by ElvaX and 43X Z2 (batch N) (MBH Ana-lytical Ltd)

Element	Certified	Measured
Pb	0,0125	0,013
Mg	0,0885	0,095
Al	4,02	4,103
Cd	0,008	0,0076
Fe	0,0023	0,002
Sn	0,0052	0,0055
Cu	1,049	1,053
Ni	0,0022	0,0018
Mn	0,099	0,102
Sb	0,0062	0,0059
Bi	0,0027	0,0032

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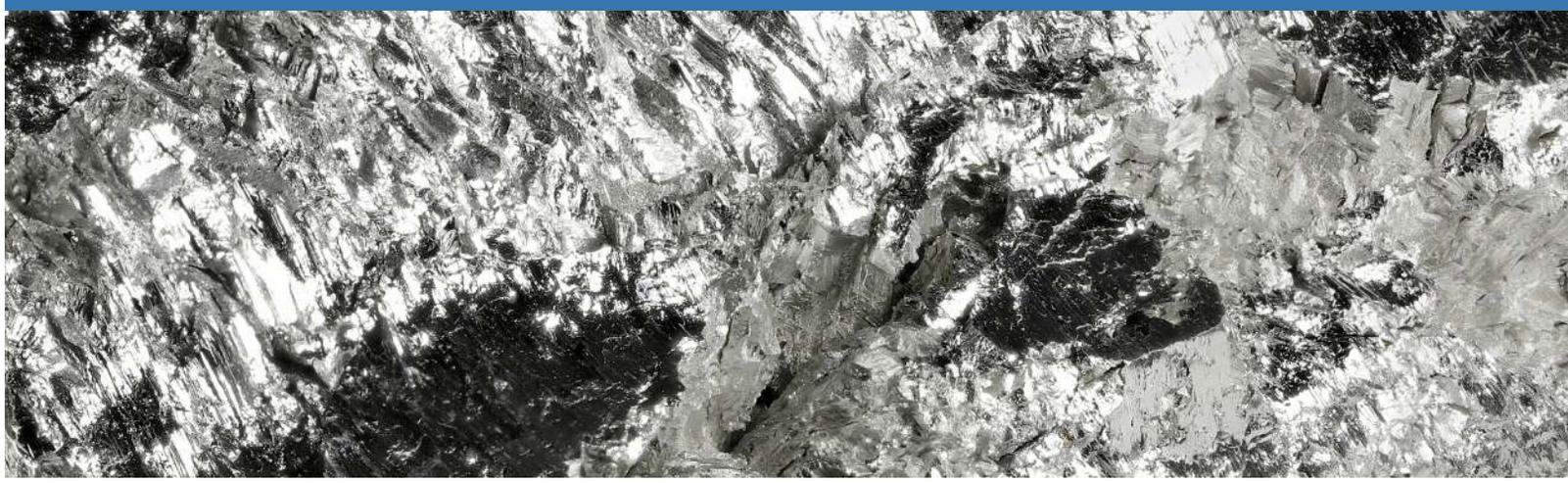

MAGNESIUM ALLOY ANALYSIS USING XRF

Magnesium alloys are valued for their lightness, hardness, excellent castability and comparative cost eectiveness. Because of such properties magnesium alloys are used in automobile and aerospace industry.

Detection Ranges in Alloys for ElvaX Magnesium alloys:

Element	Detection range (mass fraction), %			
	Beginning of range		End of range	
	Value	Absolute Error	Value	Absolute Error
Zn	0,005	0,002	10	0,2
Mn	0,005	0,003	2	0,05
Cu	0,005	0,003	1	0,03
Al	0,05	0,02	15	0,3
Si	0,01	0,003	1	0,03
Ti	0,005	0,003	0,1	0,007
Cr	0,005	0,003	0,1	0,007
Fe	0,005	0,003	0,5	0,01
Ni	0,007	0,005	0,1	0,01
Zr	0,005	0,003	1	0,03
Cd	0,01	0,005	3	0,1
La, Nd, Ce	0,01	0,005	2	0,05
Mg	base			

Comparison of measurement by ElvaX and 43X Z2 (batch N) (MBH Ana-lytical Ltd)

Element	Certified	Measured
Al	9,72	9,85
Zn	0,543	0,541
Mn	0,13	0,137
Cu	0,0153	0,0147
Si	0,027	0,029
Fe	0,0083	0,007
Ni	0,0011	-
Sn	0,0026	0,003
Pb	0,002	0,003