AN APPLICATION REPORT FROM
SPECTRO ANALYTICAL INSTRUMENTS

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SPECTRO **xSORT Alloy** XHH04

Analysis of Solid Metal Samples

Introduction

SPECTRO products are viewed around the world as standards for onsite metal analysis. No other company possesses comparable know- how and similarly comprehensive experience in this area.

As one of the leading international manufacturers of XRF instruments, laboratory analyses with extremely powerful X-ray fluorescence spectrometers is also an area in which SPECTRO excels.

With the SPECTRO xSORT Alloy, SPECTRO introduces a compact energy dispersive X-ray fluorescence spectrometer for the continuous, fatigue-free handheld analysis and sorting of metals.

It makes use of innovative efficient components for excitation and detection. Together with other top quality modules, they are the basis for the unique precision, speed and safety of this system; combining the experience with onsite metal analysis and the demands for laboratory quality measurement results.



Summary

Excitation of the fluorescence radiation in the sample by an X-ray tube has been optimized so that extremely short measuring times with a high sample throughput are possible.

The Si PIN diode detector technology enables moderate signal throughput at efficient resolution; allowing for a good analytical flexibility.

With the SPECTRO xSORT Alloy it is possible to conduct reliable analyses in a single measuring cycle that lasts only seconds for elements Z ≥ 21.

The analysis screen provides the operator with all the necessary information at a glance and also allows the measurement results to be displayed in different ways during the measurement. The analysis results are saved and can be displayed and processed again later.

The powerful XRF Analyzer Mobile operating software and the responsive "Industrial Android" modules offer touch operation, high security, fast access and Windows PC compatibility.

Instrumentation

To test an alloy group, the SPECTRO calibration module "Standard - 5mm" is preinstalled on the SPECTRO xSORT Alloy, e.g. for the testing of stainless steels.

The measurement of precious metals does not require an additional module.

Technical Data

Detector

- Si PIN diode

Excitation

- X-ray tube with Rh anode
- up to 50 kV tube voltage

Operation

A sample name can be entered and then the start button can be released after the first result is displayed on the screen or continue to press until the preset measurement time is elapsed.

Spectrometer Control

- Computer integrated
- Android OS
- Bluetooth, WiFi, USB (USB-C type)

Dimensions and Weight

- Height: 265 mm (10.43")
- Width: 85 mm (3.35")
- Depth: 200 mm (7.87")
- Weight instrument: 1.6 kg (3.53 lbs) including battery pack

Power/ Electrical Connection

- Battery operation with Li-polymer batteries, rechargeable
- 90 – 264 V, 50/60 Hz (AC adapter/ charger)
- 14 W during analysis
- 8 W standby mode



Options
- Video camera spot (built-in)
- Video camera overview incl. QR/ barcode functionality (built-in)
- Additional battery pack
- Battery charging station
- Mobile 3G WiFi Router
- GPS module (built-in)
- Docking station (with transport case)
  - With/without external computer
- Portable, attachable small sample chamber
- Instrument/battery holster

Accessories (Included)
- Transport case
- One battery pack
- AC adapter (charger)
- USB cable
- Consumables

Software
- iCAL (intelligent Calibration Logic)
- Post-processing of stored measurement values and protocols

Analysis Mode
- Automatic fingerprint analysis
- Automatic average calculation
- Calculation standard deviation and relative standard deviation

Grade ID Mode
- Grade identification (Grade search) based on stored library of grade specifications
- Grade verification (Grade control) based on selected grade specification
- Optional display of analysis and/or grade identification
- Grade library easily edited and expanded

Sorting Mode
- Fast pass/fail assessment based on a reference sample
- Symmetrical and asymmetrical tolerances allowed
- Log reports

Documentation
- Operating instructions incl. safety instructions and backup on USB stick

Sample Preparation

To enhance accuracy samples can be prepared with grinding paper (approx. 60 or 80 grit aluminum or zirconium oxide) or a milling machine can be used.
Sample preparation is often not necessary for finished products if they have polished surfaces.

Detection Limits

In ED-XRF the detection limits are sample specific. They are influenced by matrix effects, line overlaps as well as signal processing of the detector.

The following data are related to measurements of pure single element standards at a measuring time of 8 seconds for elements $Z \geq 21$. A protective film between sample and measuring head has been used.

Taking line overlaps, sum peaks and other detector artefacts into account, the SPECTRO xSORT software calculates the detection limits for each sample and displays them in the analysis result. The LOD is calculated as 3 times standard deviation (SD).

Table 1: Iron base

Element	LOD [%]
As	0.02
Cd	0.06
Co	0.3
Cr	0.04
Cu	0.03
Mn	0.07
Mo	0.02
Nb	0.02
Ni	0.05
Pb	0.07
Sb	0.07
Sn	0.07
Ti	0.08
V	0.05
W	0.05
Zn	0.03
Zr	0.02

Table 2: Ferroleg Alloys

Element	LOD [%]
Co	0.2
Cr	0.05
Cu	0.03
Mn	0.07
Mo	0.03
Nb	0.03
Ni	0.05
Ti	0.08
V	0.05
W	0.05

Table 3: Nickel base

Element	LOD [%]
Ag	0.06
Cd	0.08
Co	0.06
Cu	0.2
Cr	0.04
Fe	0.04
Hf	0.2
Mn	0.04
Mo	0.03
Nb	0.02
Pb	0.09
Re	0.1
Sb	0.08
Sn	0.08
Ta	0.1
Ti	0.08
V	0.05
W	0.1
Zn	0.08

Table 4: Titanium base

Element	LOD [%]
Cd	0.03
Co	0.02
Cr	0.06
Cu	0.02
Fe	0.03
Mn	0.03
Mo	0.01
Nb	0.01
Ni	0.02
Pd	0.03
Ru	0.01
Sn	0.04
Ta	0.05
V	0.3
Zn	0.02
Zr	0.01

Table 5: Cobalt base

Element	LOD [%]
Cd	0.06
Cr	0.04
Cu	0.1
Fe	0.08
Mn	0.03
Mo	0.02
Nb	0.02
Ni	0.2
Pb	0.07
Sn	0.07
Ta	0.09
Ti	0.07
V	0.05
W	0.09
Zn	0.04
Zr	0.02

Table 6: Lead base

Element	LOD [%]
As	0.17
Au	0.1
Ag	0.1
Cd	0.1
Co	0.06
Cu	0.06
Fe	0.06
Cr	0.08
Mn	0.07
Ni	0.08
Sb	0.2
Sn	0.1
Ti	0.2
V	0.08
Zn	0.07

Table 7: Copper base

Element	LOD [%]
Ag	0.08
As	0.03
Bi	0.08
Cd	0.1
Co	0.04
Cr	0.04
Fe	0.04
Mn	0.03
Mo	0.02
Ni	0.06
Pb	0.08
Sb	0.1
Se	0.03
Sn	0.1
Te	0.2
Ti	0.08
V	0.06
W	0.2
Zn	0.1

Table 8: Gold base

Element	LOD [%]
Ag	0.1
Bi	0.1
Cd	0.1
Co	0.04
Cr	0.06
Cu	0.05
Fe	0.05
In	0.1
Mn	0.05
Nb	0.02
Ni	0.04
Os	0.08
Pb	0.2
Pd	0.1
Pt	0.6
Rh	0.2
Ru	0.04
Sn	0.2
Te	0.05
Ti	0.1
V	0.08
Zn	0.1

Table 9: Zinc base

Element	LOD [%]
Ag	0.08
Bi	0.07
Cd	0.1
Co	0.04
Cr	0.05
Cu	0.06
Fe	0.04
In	0.059
Mn	0.03
Ni	0.04
Pb	0.07
Sb	0.1
Se	0.03
Sn	0.09
Ti	0.08
V	0.06

Table 10: Tin base

Element	LOD [%]
Ag	0.1
As	0.03
Bi	0.06
Cd	0.1
Co	0.04
Cr	0.06
Cu	0.02
Fe	0.04
Ge	0.02
Hg	0.013
In	0.03
Mn	0.04
Mo	0.02
Nb	0.02
Ni	0.03
Pb	0.06
Pd	0.08
Sb	0.3
Se	0.03
Ti	0.3
V	0.09
Zn	0.02

Table 11: Zirconium base

Element	LOD [%]
Cd	0.04
Co	0.05
Cu	0.05
Cr	0.07
Fe	0.06
Mn	0.07
Mo	0.4
Nb	0.09
Ni	0.04
Pb	0.03
Sb	0.1
Sn	0.2
Ti	0.2
V	0.09
W	0.1
Zn	0.07

Table 12: Platinum base

Element	LOD [%]
Ag	0.08
Au	0.8
Cd	0.1
Co	0.04
Cr	0.07
Cu	0.07
Fe	0.04
Ir	1
Mn	0.06
Ni	0.04
Pd	0.08
Rh	0.1
Ru	0.03
Ti	0.1
V	0.08
W	1
Zn	0.07

Table 13: Silver base

Element	LOD [%]
Au	0.05
Cd	0.2
Co	0.04
Cu	0.04
Fe	0.04
Mn	0.04
Ni	0.04
V	0.08
Zn	0.03

Table 14: Palladium base

Element	LOD [%]
Ag	0.1
Au	0.01
Cr	0.05
Cu	0.03
Fe	0.03
Ga	0.01
In	0.11
Mn	0.05
Sn	0.03
Ti	0.1
V	0.08
Zn	0.03

Some Typical Measurement Examples

Analysis pauses are used to correct possible gain shifts. This procedure guarantees reproducible and accurate results as shown in the tables at different and changing ambient temperatures (ASD: Analytical Standard Deviation of 5 measurements). All data in mass percentage.

Table 15: Iron base

AISI 304				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Mn	8s	1.43	0.04	1.48
Cr	8s	18.52	0.12	18.37
Mo	8s	0.21	0.01	0.2
Ni	8s	8.05	0.11	8.09
Cu	8s	0.37	0.04	0.4
Fe	8s	71.1	0.16	70.94

AISI 316				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Mn	8s	1.77	0.05	1.78
Cr	8s	16.72	0.08	16.56
Mo	8s	2.09	0.03	2.11
Ni	8s	10.26	0.16	10.38
Cu	8s	0.14	0.04	0.168
Fe	8s	68.6	0.13	68.19

SS-CRM No. 493/2				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Mn	8s	11.7	0.07	11.74
Cr	8s	0.22	0.01	0.179
Ni	8s	3.11	0.06	3.01
Mo	8s	0.98	0.02	0.955

Table 16: Copper base

CDA 932				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Sb	8s	<0.24		0.16
Ni	8s	0.39	0.02	0.46
Zn	8s	2.47	0.07	2.62
Pb	8s	6.92	0.12	6.80
Sn	8s	6.52	0.11	6.77
Cu	8s	83.7	0.16	83.2

CDA 706				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Mn	8s	0.61	0.02	0.62
Fe	8s	1.35	0.02	1.30
Co	8s	<0.04		0.013
Ni	8s	10.28	0.06	10.03
Zn	8s	<0.12		0.082
Cu	8s	87.8	0.17	87.9

Table 17: Nickel base

ALLOY 825				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Mn	8s	0.29	0.06	0.36
Fe	8s	30.08	0.12	29.7
Cr	8s	22.64	0.08	22.11
Mo	8s	3.1	0.02	3.25
Co	8s	0.28	0.09	0.27
Cu	8s	1.72	0.08	1.8
Ti	8s	1.01	0.03	0.91
Ni	8s	40.32	0.12	40.7

Table 18: Cobalt base

Ultimet 1233				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Cr	8s	25.35	0.09	25.4
Mn	8s	0.82	0.04	0.79
Fe	8s	3.14	0.07	2.99
Ni	8s	9.77	0.10	9.47
Nb	8s	<0.02		0.016
Mo	8s	4.59	0.04	4.72
W	8s	2.51	0.06	2.39
Co	8s	53.8	0.14	53.4

Table 19: Gold base

NCS 54910				
Element	Meas. Time	Analysis [%]	ASD [%]	Certificate [%]
Au	15s	78.76	0.23	78.99
Ag	15s	5.78	0.08	5.97
Cu	15s	15.46	0.06	15.0

Conclusion

With the SPECTRO xSORT, elements Z ≥ 21 can be analysed in seconds within a single measurement cycle. The software corrects line overlaps and all detector artefacts and determines the sample composition using fundamental parameters.

The LODs listed in this report show the sensitivity of the SPECTRO xSORT Alloy. The typical analysis results demonstrate the precision and accuracy.

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