

CERTIFICATE OF ANALYSIS

ERM[®]-EB393a

CuZn21Si3P		
Mass fraction in %		
Element	Certified value ¹⁾	Uncertainty ²⁾
Cu	75.8	0.3
Si	3.35	0.06
P	0.0454	0.0012
Mass fraction in mg/kg		
Pb	104	4
Fe	143	5
Sn	39.0	0.9
Al	2.1	0.4
Cr	1.56	0.28
Mn	18.5	0.6
Ni	29.7	1.5
As	1.34	0.16
Cd	0.61	0.17

¹⁾ Unweighted mean value of the means of accepted sets of data, each set being obtained by at least 5 laboratories and/or with different methods of measurement. The values are traceable to the SI (Système International d'Unités) by the use of pure substances of known stoichiometry for calibration.

²⁾ Estimated expanded uncertainty U with a coverage factor of $k = 2$ (AI: $k = 2.5$), corresponding to a level of confidence of about 95 %, as defined in the ISO/IEC Guide 98-3:2008 [Uncertainty of measurement -- Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)].

This certificate is valid until 6/2066.

Accepted as an ERM[®], Berlin, 2016-07-08BAM Department 1
Analytical Chemistry;
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Indicative values		
Element	Mass fraction in mg/kg	
	Indicative value ¹⁾	Uncertainty ²⁾
Bi	0.19	0.05
Sb	0.93	0.29
Se	0.47	0.15

Indicative values were not certified, nevertheless given for information, when the number of accepted data sets was considered to be too low (< 5) or when the uncertainty from the inter-laboratory certification was considerably larger than the expected range.

¹⁾ Unweighted mean value of the means of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of measurement. The values are traceable to the SI (Système International d'Unités) via calibration using pure substances of known stoichiometry.

²⁾ Estimated expanded uncertainty U with a coverage factor of $k = 2.5$ (Bi: $k = 3$), corresponding to a level of confidence of about 95 %, as defined in the ISO/IEC Guide 98-3:2008 [Uncertainty of measurement -- Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)].

Additional Material Information	
Parameter	Mass fraction ¹⁾ in %
Zinc	20.8

¹⁾ The value stated is based on the analysis of one laboratory.

NOTE

European Reference Material ERM[®]-EB393a was produced and certified under the responsibility of Bundesanstalt für Materialforschung und -prüfung (BAM) in cooperation with the Committee of Chemists of the GDMB Society of Metallurgists und Miners according to the principles laid down in the technical guidelines of the European Reference Materials[®] co-operation agreement between BAM-LGC-IRMM. Information on these guidelines is available on the Internet (<http://www.erm-crm.org>).

DESCRIPTION OF THE SAMPLE

The Certified Reference Material (CRM) is available in the form of discs (40 mm diameter and 30 mm height).

INTENDED USE

The CRM is intended for establishing or checking the calibration of optical emission and X-ray spectrometers (excluding micro-analysis) for the analysis of samples of similar matrix composition.

INSTRUCTIONS FOR USE

Before use, the surface of the material must be prepared by milling or turning on a lathe. For wet chemical analysis chips have to be prepared by turning or milling of the sample surface. The minimum sample size for wet chemical analysis is 0.1 g.

MEANS OF ACCEPTED DATA SETS

Line no.	Certified values Mass fraction in %			Mass fraction in mg/kg									Indicative values Mass fraction in mg/kg			
	Cu	Si	P	Pb	Fe	Sn	Al	Cr	Mn	Ni	As	Cd		Bi	Sb	Se
1	75.62	3.247	0.0444	100.7	132.5	36.5	1.50	1.03	17.6	27.2	---	0.35		0.17	0.44	0.38
2	75.65	3.285	0.0445	100.7	137.2	37.7	1.80	1.20	17.8	28.2	1.09	0.45		0.20	0.70	0.45
3	75.68	3.307	0.0446	101.9	140.3	38.0	2.00	1.24	17.8	28.8	1.17	0.47		0.20	0.89	0.47
4	75.68	3.312	0.0450	102.0	140.3	38.6	2.02	1.31	17.9	29.2	1.35	0.59		---	0.98	0.58
5	75.71	3.328	0.0451	102.1	141.3	39.3	2.27	1.47	18.0	29.5	1.36	0.59		< 1	1.07	< 2
6	75.72	3.328	0.0452	102.2	141.4	39.4	2.30	1.50	18.0	29.6	1.42	0.60			1.16	
7	75.72	3.332	0.0455	102.7	142.3	39.5	2.80	1.63	18.3	29.9	1.48	0.63			1.28	
8	75.73	3.372	0.0462	103.2	143.7	39.6		1.82	18.9	30.0	1.52	0.68				
9	75.76	3.376	0.0467	107.5	144.2	39.7		1.87	19.0	30.2		0.80				
10	75.82	3.383	0.0471	108.5	149.7	39.8		2.50	19.1	30.3		0.94				
11	75.82	3.401		110.2	155.0	40.5			19.2	31.0						
12	75.82	3.403							19.2	32.5						
13	75.82	3.427							19.3							
14	75.89	3.435														
15																
<i>M</i>	75.75	3.352	0.0454	103.8	142.5	39.0	2.10	1.56	18.5	29.7	1.34	0.61		0.19	0.93	0.47
<i>s_M</i>	0.08	0.056	0.0010	3.4	6.0	1.2	0.42	0.43	0.64	1.3	0.16	0.19		0.02	0.29	0.09
\bar{s}_i	0.06	0.018	0.0005	0.04	2.7	0.03	0.28	0.28	0.04	1.0	0.22	0.06		0.03	0.12	0.06

The laboratory mean values have been examined statistically to eliminate outlying values. Each laboratory mean consists of at least 4 but usually 6 single values. Where " --- " appears in the table it indicates that an outlying value has been omitted (Grubbs 95 %, Cochran 99 %).

M : mean of laboratory means

s_M : standard deviation of laboratory means

\bar{s}_i : averaged repeatability standard deviation (square root of the mean of laboratory variances)

ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line no.	Method
Cu	1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13 10, 11, 14	Electrogravimetry ICP-OES
Si	1, 7, 9, 10, 11 2, 3, 4, 5, 6, 8, 13, 14 12	Gravimetry ICP-OES Spectrophotometry
P	1, 2, 3, 5, 6, 7, 9, 10 4, 8	ICP-OES Spectrophotometry
Pb	1, 2, 3, 5, 7, 8, 9, 10, 11 4, 6	ICP-OES ICP-MS
Fe	1, 2, 3, 4, 5, 6, 7, 9, 10, 11 8	ICP-OES ICP-MS
Sn	1, 2, 3, 5, 7, 8, 9, 10, 11 4, 6	ICP-OES ICP-MS
Al	1, 3, 4, 6 2 5, 7	ICP-OES GD-MS ICP-MS
Cr	1, 3, 5, 6, 8, 9, 10 2, 4 7	ICP-OES ICP-MS GD-MS
Mn	1, 12 2, 3, 4, 5, 6, 7, 8, 9, 11, 13 10	ICP-MS ICP-OES GD-MS
Ni	1, 6 2, 3, 4, 5, 7, 8, 9, 10, 11 12	ICP-MS ICP-OES GD-MS
As	2, 6 3 4, 7 5, 8	ICP-MS ETAAS ICP-OES GD-MS
Cd	1, 2, 3, 7, 8 4, 5, 6 9 10	ICP-OES ICP-MS ETAAS GD-MS
<i>Bi</i>	1, 3 2 5	<i>ICP-MS</i> <i>GD-MS</i> <i>ICP-OES</i>
<i>Sb</i>	1, 2 3, 6 4 5	<i>ICP-MS</i> <i>ETAAS</i> <i>GD-MS</i> <i>ICP-OES</i>
<i>Se</i>	1, 3 2 4 5	<i>ICP-MS</i> <i>ETAAS</i> <i>GD-MS</i> <i>ICP-OES</i>

Abbreviations:

ETAAS: Electrothermal atomic absorption spectrometry
GD-MS : Glow discharge mass spectrometry
ICP-MS: Inductively coupled plasma mass spectrometry
ICP-OES: Inductively coupled plasma optical emission spectrometry

STORAGE

The material should be stored in a dry and clean environment at room temperature (approx. 20 °C).

PARTICIPANTS

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TECHNICAL REPORT

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify ERM[®]-EB393a is available on request or can be downloaded from BAM website (<https://www.bam.de>).

This Reference Material is offered by:

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