

CERTIFICATE OF ANALYSIS

ERM[®]-EB378

CuSn6

Certified Values		
Element	Certified value ¹⁾	Uncertainty ²⁾
	Mass fraction in %	
Cu	94.13	± 0.04
Sn	5.74	± 0.21
	Mass fraction in mg/kg	
Ag	26.6	± 1.3
As	99.5	± 2.5
Cd	100.7	± 2.2
Co	89	± 5
Cr	311	± 5
Fe	182	± 7
Mg	28.7	± 0.8
Ni	18.3	± 0.9
P	602	± 23
Sb	86.1	± 2.6
Te	85.0	± 2.6

¹⁾ Unweighted mean value of the means of accepted sets of data (at least 5 usually 6), each set being obtained in a different laboratory and/or a different method of measurement. The values are traceable to the SI (Système International d'Unités) via calibration using sufficiently pure substances of known stoichiometry.

²⁾ Estimated expanded uncertainty U with a coverage factor of about $k=2$, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993. For Sn inhomogeneity contributed significantly to the uncertainty.

This certificate is valid until 09/2053; this validity may be extended as further evidence of stability becomes available.

The minimum sample size for wet chemical analysis is 0.5 g.

NOTE

European Reference Material ERM[®]-EB378 was originally certified as BAM-378. It was produced and certified under the responsibility of Bundesanstalt für Materialforschung und –prüfung (BAM) in cooperation with the Committee of Chemists of the GDMB, Gesellschaft für Bergbau, Metallurgie, Rohstoff- und Umwelttechnik 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>).

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Indicative Values³⁾		
	Indicative value ⁴⁾	Uncertainty ⁵⁾
Element	Mass fraction in mg/kg	
Mn	0.74	± 0.24
Pb	4.2	± 0.7
S	9.1	± 1.9
Ti	29.4	± 4
Zn	7.3	± 1.0
Zr	1.7	± 0.09
Element	Mass fraction in mg/kg	
Al, Bi	< 1	
Se	< 2	
Si	< 10	
<p>³⁾ Values were not certified, but given as indicative values, when the number of accepted data sets was considered to be too low, when the spread from the round robin certification was considerably larger than the state of the practice or when only 'lower as' values were reported from the round robin certification.</p> <p>⁴⁾ Unweighted mean value of the means of accepted sets of data, each set being obtained in a different laboratory and/or a different method of measurement. The values are traceable to the SI (Système International d'Unités) via calibration using sufficiently pure substances of known stoichiometry.</p> <p>⁵⁾ Estimated expanded uncertainty U with a coverage factor of about $k=2$, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993.</p>		

DESCRIPTION OF THE SAMPLE

The Reference Material is available in the form of discs (40 mm diameter and 30 mm height). It is intended for establishing and checking the calibration of optical emission and X-ray spectrometers for the analysis of samples of similar materials

MEANS OF ACCEPTED DATA SETS (FOR ONE METHOD AT ONE LABORATORY, RESPECTIVELY)

Line No.	Mass fraction in %		Mass fraction in mg/kg																
	Cu	Sn	Ag	As	Cd	Co	Cr	Fe	Mg	Ni	P	Sb	Te	Mn	Pb	S	Ti	Zn	Zr
1	94.05	5.70	25.0	-	96.0	73	300	-	27.3	15.1	547	79.0	-	0.63	3.4	(<5)	26.65	6.1	-
2	94.09	5.71	25.4	-	96.8	79	304	162	27.4	15.7	569	83.2	81.5	0.68	4.0	8.63	27.52	6.63	1.62
3	94.09	5.71	26.3	95.7	97.9	85	304	165	27.5	16.3	582	83.5	83.8	0.79	4.3	9.13	28.35	6.98	1.68
4	94.10	5.72	26.6	96.4	98.3	85	305	166	27.7	17.0	589	84.1	84.5	0.87	4.5	9.5	31.03	7.38	1.68
5	94.12	5.72	26.8	98.9	98.7	89	307	167	27.8	18.0	603	86.0	85.2	-	4.8		33.6	7.42	1.72
6	94.12	5.75	28.2	99.7	100.4	89	306	172	29.2	18.1	603	87.6	87.3	(<1)	-			7.53	
7	94.14	5.77	28.3	101.2	101.6	90	313	176	29.3	18.7	611	88.2	87.6	(<1)	(<10)			9.38	
8	94.16	5.78		102.2	101.7	91	315	177	29.7	18.8	620	88.8		(<3)	(<10)				
9	94.18	5.79		102.3	102.1	92	318	181	29.8	18.9	628	90.1							
10	94.21				102.9	94	319	182	29.9	19.2	664	90.1							
11					103.4	98	319	185	30.3	19.3									
12					108.4	100	322	188		19.4									
13							-	191		19.7									
14								194		19.8									
15								196		20.7									
16								200											
17								203											
<i>M</i> :	94.13	5.738	26.6	99.5	100.7	89	311	182	28.7	18.3	602	86.1	85.0	0.8	4.2	9.1	29.4	7.3	1.7
<i>s_M</i> :	0.05	0.04	1.3	2.6	3.5	8	8	13	1.2	1.6	33	4	2.3	0.1	0.5	0.4	2.8	1.0	0.04
<i>s̄_i</i> :	0.04	0.03	0.6	2.3	1.5	2.8	5.0	6	0.8	0.9	11	1.5	1.3	0.1	0.3	0.6	2.2		

The laboratory mean values have been examined statistically to eliminate outlying values. Where a " - " appears in the table it indicates that an outlying value has been omitted. A data set consists of at least 5 but usually 6 single values of one laboratory. " < "-values have not been considered in statistical evaluation.

M : mean of means of data sets

s_M : standard deviation of means of data sets

s̄_i : mean of standard deviations of data sets under repeatability conditions

numbers in *italics* are indicative values

ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line no.	Method
Cu	1	X-ray fluorescence analysis
	2, 4, 6, 7, 8, 9	Electrogravimetry
	3, 5, 10	Electrogravimetry, separation of Sn
Sn	1, 3, 4, 6, 8	ICP OES
	2, 9	FAAS
	5	Iodometric titration
	7	X-ray fluorescence analysis
Ag	1	ICP OES
	2, 5, 6, 7	FAAS
	3	IDMS
	4	NAA
As	1	ICP OES, As-precipitation
	2	FAAS, electrolytic separation of Cu
	3	NAA
	4, 5	ICP OES
	6	PAA
	7	Photometric determination as Molybdenum Blue
	8	ICP OES, As-separation by distillation
	9	ICP OES, separation of Sn, electrolytic separation of Cu
	Cd	1, 10
2, 3		FAAS, separation of Sn, electrolytic separation of Cu
4, 5, 6, 7, 11		ICP OES
8		FAAS, electrolytic separation of Cu
9		FAAS
12		IDMS
Co		1, 3
	2, 6, 8	ICP OES, separation of Sn, electrolytic separation of Cu
	4, 5, 7, 9, 12	ICP OES
	10	FAAS, electrolytic separation of Cu
	11	NAA
	Cr	1, 3, 4, 6, 8, 10, 12
13		FAAS
9		FAAS, separation of Sn, electrolytic separation of Cu
2		PAA
5		IDMS
7		NAA
11		voltametric titration
Fe		1, 6, 13, 14
	2	IDMS
	3, 5, 8, 9, 12, 15, 16, 17	ICP OES
	4	FAAS, electrolytic separation of Cu
	7	ICP OES, separation of Sn, electrolytic separation of Cu
	10	FAAS, separation of Sn, electrolytic separation of Cu
	11	Photometric with 1,10-Phenanthroline

Mg	1, 4, 7, 9, 10 2, 3, 6, 8 5, 11	ICP OES FAAS ICP OES, separation of Sn, electrolytic separation of Cu
Ni	1, 7, 8, 9, 14, 15 2, 6 3, 12 4 5 10 11 13	ICP OES FAAS, electrolytic separation of Cu ICP OES, separation of Sn, electrolytic separation of Cu Photometric with Diacetyldioxime, extraction FAAS IDMS FAAS, separation of Sn, electrolytic separation of Cu PAA
P	1, 2 6 3, 4, 5, 7, 8, 9, 10	Photometric as phosphovanadomolybdate, after extraction Photometric as phosphovanadomolybdate, without extraction ICP OES
Pb	1, 6 2 3 4, 7 5 8	ICP OES ET AAS, La(OH) ₃ -precipitation FAAS, electrolytic separation of Cu FAAS IDMS PAA
Sb	1 2 3 4 5, 6, 7 8 9 10	ICP OES, separation of Sn, electrolytic separation of Cu FAAS, electrolytic separation of Cu FAAS ET AAS ICP OES PAA NAA Photometric with Rhodamine B
Te	1 2 3, 4 5 6 7	ET AAS FAAS, electrolytic separation of Cu ICP OES FAAS, separation by precipitation ICP OES, separation by precipitation FAAS
Al	1, 2 3, 4	ICP OES ICP OES, separation of Sn, electrolytic separation of Cu
Bi	1 2	ET AAS FAAS, electrolytic separation of Cu
Mn	1, 3, 4, 5 2, 7 6 8	ICP OES ICP OES, separation of Sn, electrolytic separation of Cu FAAS, electrolytic separation of Cu PAA

S	1	Photometric determination of H ₂ S as Molybdenum Blue
	2	Microtitration of sulphide
	3	Infrared absorption after combustion
	4	ICP OES
Se	1	FAAS, electrolytic separation of Cu
	2	ICP OES
	3	NAA
	4	PAA
Si	1, 2	ICP OES
Ti	1, 2, 3, 4	ICP OES
	5	PAA
Zn	1, 5	ICP OES
	2, 3, 4	FAAS
	6	IDMS
	7	NAA
Zr	1, 2, 4	ICP OES
	3	PAA
	5	Photometry as pyrocatechol violet

Abbreviations:

ET AAS:	Electrothermal Atomic Absorption Spectrometry
FAAS:	Flame Atomic Absorption Spectrometry
ICP-MS:	Inductively Coupled Plasma - Mass Spectrometry
ICP OES:	Inductively Coupled Plasma - Optical Emission Spectrometry
IDMS:	Isotope Dilution Mass Spectrometry
NAA:	Neutron Activation Analysis
PAA:	Photon Activation Analysis

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INSTRUCTIONS FOR USE

Before use, the surface of the material must be cleaned by turning on a lathe.

STORAGE

The material should be stored at ambient conditions in a dry and clean environment.

TECHNICAL REPORT

A detailed technical report (in German) describing the analysis procedures and the treatment of the analytical data used to certify ERM[®]- EB378 is available on request.

Supply of Reference Materials by Bundesanstalt für Materialforschung und –prüfung:

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