in cooperation with the WG 'Copper'
of the Committee of Chemists of GDMB

CERTIFICATE OF ANALYSIS

ERM®-EB377

CuSn6

Certified Values			
	Certified value [1]	Uncertainty [2]	
Element	Mass fraction in %		
Cu	94.04	±	0.05
Sn	5.92	±	0.13
Element	Mass fraction in mg/kg		
Ag	64.4	±	1.1
Al	45.1	±	1.2
Bi	42.2	±	1.5
Cr	66.9	±	2.1
Fe	104.2	±	2.7
Mn	92.1	±	2.1
Ni	107.4	±	1.5
Pb	44.9	±	2.3
Sb	13.0	±	1.3
Se	55	±	4
Zn	100.6	±	3.0

[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.

Date of issue: November 1999

All following pages are an integral part of the certificate.

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

NOTE

European Reference Material ERM®-EB377 was originally certified as BAM-377. 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).

Accepted as an ERM®, Berlin, 2004-04-14.

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Indicative Values[3)]		
	Indicative value [4)]	Uncertainty [5)]
Element	Mass fraction in mg/kg	
S	6.8	± 0.8
Element	Mass fraction in mg/kg	
Cd, Mg, Te, Ti	< 1	
Co	< 2	
As, P	< 10	
Si	134	

[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.

[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.

[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.

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

Mass fraction in %

Line No..	Cu	Sn
1	93.94	5.84
2	93.98	5.85
3	94.01	5.87
4	94.06	5.89
5	94.07	5.90
6	94.09	5.91
7	94.09	5.92
8	94.10	5.93
9	94.14	5.98
10		5.99
11		6.01
12		
13		
14		
15		
16		
M :	94.04	5.92
s_M :	0.06	0.06
$\overline{s}_i$:	0.04	0.05

Mass fraction in mg/kg

Ag	Al	Bi	Cr	Fe	Mn	Ni	Pb	Sb	Se	Zn
61.7	43.4	-	-	-	-	-	39.8	10.8	-	90.1
63.3	44.4	41.0	60.0	98	87.4	104.3	41.0	11.7	48.5	93.0
63.7	44.9	41.4	62.2	98	88.3	104.4	44.5	12.0	50.2	95.1
64.3	45.0	41.5	62.3	100	89.4	105.8	44.9	12.9	52.4	96.7
64.6	46.0	41.5	64.9	102	90.1	106.5	45.4	13.0	55.8	97.9
64.9	46.3	43.5	65.0	102	90.2	106.6	46.4	14.1	55.9	98.3
65.4	-	44.4	66.0	105	90.5	106.8	46.7	14.7	58.2	100.4
65.7			66.6	106	91.1	106.9	47.8	14.9	58.5	100.6
65.8			67.4	107	91.2	106.9	48.1		58.8	100.6
-			68.0	107	92.8	107.3	-			103.7
			68.3	108	95.4	108.0				104.3
			68.6	108	96.2	108.2				105.8
			68.6	111	97.2	110.8				106.3
			70.3		97.3	113.6				106.7
			72.2			-				109.0
			73.1							
64.4	45.0	42.2	66.9	104	92.1	107.4	44.9	13.0	55	101
1.3	1.1	1.4	3.7	4	3.4	2.5	2.9	1.5	4	6
0.9	1.6	1.2	1.2	2.2	1.6	1.7	1.0	0.7	1.6	2.1

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

$\overline{s}_i$: mean of standard deviations of data sets under repeatability conditions

numbers in *italics* are indicative values

Mass fraction in mg/kg (indicative values)

Line No.	As	Cd	Co	Mg	P	S	Si	Te	Ti
1	*1*	*< 1*	*0.14*	*0.7*	*5*	*6.5*	*121*	*0.6*	*0.3*
2	*< 1*	*< 1*	*0.3*	*0.7*	*< 2*	*6.5*	*147*	*< 0.5*	*< 1*
3	*< 3*	*< 1*	*2.0*	*< 0.3*	*< 10*	*6.7*		*< 1*	*< 1*
4	*< 3*	*< 1*	*< 1*	*< 1*	*< 10*	*7.5*			
5	*< 10*	*< 1*	*< 1*	*< 2*	*< 10*	*< 5*			
6	*< 10*	*< 1*	*< 1*	*< 5*					
7		*< 1.5*	*< 1.5*						
8			*< 5*						
9									
10									

ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line no.	Method
Cu	1	X-ray fluorescence analysis
	2, 7, 9	Electrogravimetry, separation of Sn
	3, 4, 5, 6, 8	Electrogravimetry
Sn	1, 2	Iodometric titration
	3, 5, 6, 9, 10	ICP OES
	4, 8	FAAS
	7	X-ray fluorescence analysis
	11	PAA
Ag	1, 2	ICP OES
	3	PAA
	4	NAA
	5	IDMS
	6, 8, 9	FAAS
	7	FAAS, separation of Sn
	10	ICP OES, separation of Sn, electrolytic separation of Cu
Al	1, 2, 4, 5	ICP OES
	3, 6	ICP OES, separation of Sn, electrolytic separation of Cu
	7	Photometric with Chromazurol S
Bi	1	FAAS, separation of Sn, $La(OH)_3$-precipitation
	2	FAAS, electrolytic separation of Cu
	3	ICP OES
	4, 7	FAAS
	5, 6	ET AAS

Cr	1, 4	FAAS, separation of Sn, electrolytic separation of Cu
	2, 5	FAAS
	3, 10, 13, 16	ICP OES, separation of Sn, electrolytic separation of Cu
	6	PAA
	7, 9, 11, 14, 15	ICP OES
	8	NAA
	12	IDMS
Fe	1, 3, 4, 8, 10	ICP OES
	2, 12	ICP OES, separation of Sn, electrolytic separation of Cu
	5	FAAS, separation of Sn, $La(OH)_3$-precipitation
	6	FAAS, electrolytic separation of Cu
	7	FAAS, separation of Sn, electrolytic separation of Cu
	9, 11	FAAS
	13	IDMS
Mn	1, 13	FAAS, separation of Sn, electrolytic separation of Cu
	2, 11, 14	ICP OES, separation of Sn, electrolytic separation of Cu
	3	FAAS, electrolytic separation of Cu
	4, 6, 8, 10, 12	ICP OES
	5, 7	FAAS
	9	PAA
Ni	1, 3, 13	ICP OES, separation of Sn, electrolytic separation of Cu
	2, 4, 8, 9, 10	ICP OES
	5	FAAS, electrolytic separation of Cu
	6, 15	FAAS, separation of Sn, electrolytic separation of Cu
	7, 12	FAAS
	11	IDMS
	14	PAA
Pb	1	FAAS, separation of Sn, $La(OH)_3$-precipitation
	2	FAAS, electrolytic separation of Cu
	3, 5, 9	FAAS
	4, 7, 8	ICP OES
	6	IDMS
	10	FAAS, separation of Sn, electrolytic separation of Cu
	11	ICP OES, separation of Sn, electrolytic separation of Cu
Sb	1	ET AAS
	2	FAAS, electrolytic separation of Cu
	3	ET AAS, $La(OH)_3$-precipitation
	4	PAA
	5	NAA
	6	Photometric with Rhodamine B
	7	FAAS
	8	ICP OES
Se	1	Photometrie
	2	PAA
	3	FAAS, electrolytic separation of Cu
	4	NAA
	5, 6, 8, 9	ICP OES
	7	ET AAS

Zn	1	NAA
	2, 4, 5	ICP OES
	3, 8, 9, 15	FAAS,
	6	ICP OES, electrolytic separation of Cu
	7	IDMS
	10	FAAS, separation of Sn, electrolytic separation of Cu
	11, 12, 13	ICP OES, separation of Sn, electrolytic separation of Cu
	14	FAAS, electrolytic separation of Cu
As	1	ET AAS, with Se as collector precipitate
	2	FAAS, electrolytic separation of Cu
	3	PAA
	4	NAA
	5	ICP OES, separation of Sn, electrolytic separation of Cu
	6	ICP OES
Cd	1, 2, 3, 7	ICP OES
	4, 5	ICP OES, separation of Sn, electrolytic separation of Cu
	6	FAAS, electrolytic separation of Cu
Co	1	NAA
	2, 3, 4, 7	ICP OES
	5	FAAS, electrolytic separation of Cu
	6, 8	ICP OES, separation of Sn, electrolytic separation of Cu
Mg	1, 2, 3	ICP OES
	4	FAAS, electrolytic separation of Cu
	5, 6	ICP OES, separation of Sn, electrolytic separation of Cu
P	1, 3, 4	ICP OES
	2, 5	Photometric as phosphovanadomolybdate
S	1	Photometric determination of H_2S as Molybdenum Blue
	2	ICP OES
	3	Microtitration of sulphide
	4	Coulometry after combustion
	5	Infrared absorption after combustion
Si	1, 2	ICP OES
Te	1	ET AAS, with Se as collector precipitate
	2	ET AAS
	3	FAAS, electrolytic separation of Cu
Ti	1, 2, 3	ICP OES

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

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

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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®- EB377 is available on request.

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

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