

CERTIFICATE OF ANALYSIS

ERM®-EB375

CuZn39Pb3

Certified Values		
	Certified value ¹⁾	Uncertainty ²⁾
Element	Mass fraction in %	
Cu	58.32	± 0.05
Zn	38.02	± 0.08
Pb	2.90	± 0.03
Fe	0.207	± 0.004
Ni	0.1053	± 0.0015
Sn	0.2090	± 0.0024
Element	Mass fraction in mg/kg	
Ag	166	± 4
Al	270	± 5
As	231	± 4
Bi	68.6	± 2.5
Cd	85.9	± 2.1
Co	196.4	± 2.8
Mn	222	± 3
Sb	122	± 4
Si	211	± 14
Te	53.8	± 2.4
¹⁾ 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.		
²⁾ Estimated expanded uncertainty <i>U</i> with a coverage factor of about <i>k</i> =2, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993.		

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®-EB375 was originally certified as BAM-375. 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 Values ³⁾		
	Indicative value ⁴⁾	Uncertainty ⁵⁾
Element	Mass fraction in mg/kg	
P	8.6	± 1.2
Ge	15	± 5
In	104	± 13
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 <i>U</i> with a coverage factor of about <i>k</i> =2, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993.		

DESCRIPTION OF THE SAMPLE

The Reference Material is available in the form of discs (40 mm diameter, 30 mm thickness). 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)

Mass fraction in %							mass fraction in µg/g												
Line no.	Cu	Zn	Pb	Fe	Ni	Sn	Ag	Al	As	Bi	Cd	Co	Mn	Sb	Si	Te	P	Ge	In
1	58.20	37.86	2.82	0.1907	0.1008	0.2012	153	256	213	62.8	80.9	187.3	210	109	-	48.5	7.7	11.7	-
2	58.22	37.94	2.83	0.198	0.1022	0.2063	157	262	221	64.5	81.3	191.9	215	112	189	50.9	8.1	12.0	99.0
3	58.29	38.00	2.85	0.200	0.1025	0.2063	161	265	221	66.8	82.3	192.5	215	115	202	51.5	9.2	15.0	101.1
4	58.29	38.00	2.87	0.201	0.1026	0.2067	164	266	224	66.8	82.5	195.5	216	118	203	52.0	9.5	17.2	102.2
5	58.30	38.03	2.90	0.201	0.1033	0.2074	165	267	226	67.5	83.7	195.7	220	119	205	53.0	-	20.9	115.7
6	58.32	38.04	2.90	0.202	0.1044	0.2080	166	268	228	68.6	83.7	195.7	220	120	208	53.4	(< 20) (< 50)		
7	58.33	38.07	2.92	0.202	0.1050	0.2081	168	269	228	70.1	84.2	196.6	220	121	212	53.8			
8	58.34	38.19	2.93	0.203	0.1055	0.2082	168	270	229	72.1	84.3	197.1	222	123	229	54.2			
9	58.37		2.93	0.209	0.1057	0.2092	169	273	229	73.0	85.3	199.0	227	124	239	56.0			
10	58.37		2.95	0.210	0.1062	0.2095	170	277	232	73.3	85.7	200.5	224	125		56.5			
11	58.39		2.96	0.212	0.1064	0.2102	173	279	232		86.9	201.8	224	127		62.5			
12	58.44		2.96	0.212	0.1074	0.2106	175	288	233		87.7	203.4	226	128		(<50)			
13			2.99	0.214	0.1078	0.2158	176		233		88.6		226	129					
14				0.215	0.1095	0.2183			237		89.8		228	132					
15				0.215	0.1104				240		91.6		229						
16				0.217					240		95.4		229						
17				0.218					240				230						
18									248										
<i>M</i> :	58.32	38.02	2.91	0.207	0.1053	0.2090	166	270	231	68.6	85.9	196.4	222	122	211	53.8	8.6	15.3	104.5
<i>s_M</i> :	0.07	0.10	0.05	0.008	0.0028	0.0041	7	8	8	3.5	4.0	5	6	7	16	4	0.9	3.8	7.6
<i>s̄</i> :	0.03	0.09	0.02	0.0024	0.0009	0.0015	2.1	3	4	2.0	2.0	1.7	2.4	2.2	2.2	1.3	3.8	0.8	1.2

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

s̄ : mean of standard deviations of data sets

s_M : standard deviation of means of data sets*

*calculated of at least 5 but usually 6 single values

numbers in *italics* are indicative values

ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line no.	method
Ag	1, 2, 4, 6, 7, 12 3, 9, 10, 11, 13 5 8	ICP-OES FAAS ETAAS NAA
Al	1, 2, 3, 6, 7, 9, 10, 11, 12 4, 8 5	ICP-OES FAAS Photometric with Chromazurol S
As	1 2, 5, 7, 8, 9, 10, 11, 12, 13, 16, 18 3 4 6 14 15, 17	HG AAS ICP-OES Photometric with DDC NAA PAA ETAAS Photometric as Molybdenum Blue
Bi	1, 3, 7 2 4, 6, 9 5, 8, 10	ICP-OES HG AAS / FIAS FAAS ETAAS
Cd	1, 2, 6, 7, 11, 12, 14, 15 3, 4, 5, 8, 9, 10, 16 13	ICP-OES FAAS PAA
Co	1, 6, 7, 11, 12 2, 3, 4, 5, 9, 10 8	FAAS ICP-OES NAA
Cu	1 2, 4, 5, 6, 7, 8, 9, 10, 11, 12 3	X-ray fluorescence analysis Electrogravimetry Electrogravimetry, separation of Sn and Pb (as sulphate)
Fe	1, 3, 4, 5, 6, 11, 14 2, 7, 8, 10, 12, 13, 16, 17 9, 15	FAAS ICP-OES Photometric with 1,10-Phenanthroline
Mn	1, 3, 9, 11 2, 5, 6, 7, 8, 12, 13, 15, 16, 17 4, 10 14	FAAS ICP-OES Photometric as permanganate PAA
Ni	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14 4 8, 12 15	ICP-OES PAA FAAS Photometric with Diacetyldioxime
Pb	1 2, 6, 12 3 4, 5, 7, 8, 9, 11, 13, 14 10	Gravimetric as chromate FAAS PAA ICP-OES Electrogravimetry
Si	1, 2, 3, 5, 6, 9 4, 8 7	ICP-OES Gravimetry ETAAS
Sb	1, 2, 4, 8, 10, 11 3 5, 9, 13 6 7 12, 14	ICP-OES HG AAS FAAS PAA NAA ETAAS

Sn	1, 2, 3, 4, 6, 9, 10, 11, 14 5, 8, 12, 13 7	ICP-OES FAAS PAA
Te	1, 2, 7, 10, 12 3, 5, 9 4, 6, 8 11	ICP-OES ETAAS FAAS PAA
Zn	1, 3, 7 2, 8 4 5, 6	Titration with EDTA and Xylenol orange FAAS Titration with iron hexacyanoferrate (II) X-ray fluorescence analysis
P	1, 2, 3, 5, 6, 7 4	ICP-OES Photometric as Molybdenum Blue
Ge	1, 2, 3, 4, 5	ICP-OES
In	2, 3, 4, 5	ICP-OES

Abbreviations:

ETAAS:	Electrothermal Atomic Absorption Spectrometry
FAAS:	Flame Atomic Absorption Spectrometry
HG AAS:	Hydride Generation Atomic Absorption Spectrometry
ICP-MS:	Inductively Coupled Plasma - Mass Spectrometry
ICP-OES:	Inductively Coupled Plasma - Optical Emission Spectrometry
DDC:	Diethyldithiocarbamate
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.

For the determination of lead in melted samples by X-ray-analysis, the reference material has to be treated in the same way as the sample (melting, solidification). The melted reference sample should only be used for the determination of lead due to loss of trace elements (eg. Al, As, Cd, Si, Te, Zn) during the melting process. The uncertainty of the certified lead value increases due to loss of mass during the melting process ($u = 0.09\%$ at 2% loss of mass).

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®-EB375 is available on request.

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

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