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

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 *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.

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).

Accepted as an ERM®, Berlin, 2004-04-14, revised 2017-06-29

BAM Berlin
Department 1
Analytical Chemistry;
Reference Materials

F. Emmerling
(Head of Department)

BAM Berlin
Division 1.6
Inorganic Reference Materials

Dr. S. Recknagel
(Head of Division)

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 *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.

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 %

Line no.	Cu	Zn	Pb	Fe	Ni	Sn
1	58.20	37.86	2.82	0.1907	0.1008	0.2012
2	58.22	37.94	2.83	0.198	0.1022	0.2063
3	58.29	38.00	2.85	0.200	0.1025	0.2063
4	58.29	38.00	2.87	0.201	0.1026	0.2067
5	58.30	38.03	2.90	0.201	0.1033	0.2074
6	58.32	38.04	2.90	0.202	0.1044	0.2080
7	58.33	38.07	2.92	0.202	0.1050	0.2081
8	58.34	38.19	2.93	0.203	0.1055	0.2082
9	58.37		2.93	0.209	0.1057	0.2092
10	58.37		2.95	0.210	0.1062	0.2095
11	58.39		2.96	0.212	0.1064	0.2102
12	58.44		2.96	0.212	0.1074	0.2106
13			2.99	0.214	0.1078	0.2158
14				0.215	0.1095	0.2183
15				0.215	0.1104	
16				0.217		
17				0.218		
18						
M :	58.32	38.02	2.91	0.207	0.1053	0.2090
s_M :	0.07	0.10	0.05	0.008	0.0028	0.0041
$\bar{s}$:	0.03	0.09	0.02	0.0024	0.0009	0.0015

mass fraction in µg/g

Ag	Al	As	Bi	Cd	Co	Mn	Sb	Si	Te
153	256	213	62.8	80.9	187.3	210	109	-	48.5
157	262	221	64.5	81.3	191.9	215	112	189	50.9
161	265	221	66.8	82.3	192.5	215	115	202	51.5
164	266	224	66.8	82.5	195.5	216	118	203	52.0
165	267	226	67.5	83.7	195.7	220	119	205	53.0
166	268	228	68.6	83.7	195.7	220	120	208	53.4
168	269	228	70.1	84.2	196.6	220	121	212	53.8
168	270	229	72.1	84.3	197.1	222	123	229	54.2
169	273	229	73.0	85.3	199.0	227	124	239	56.0
170	277	232	73.3	85.7	200.5	224	125		56.5
173	279	232		86.9	201.8	224	127		62.5
175	288	233		87.7	203.4	226	128		(<50)
176		233		88.6		226	129		
		237		89.8		228	132		
		240		91.6		229			
		240		95.4		229			
		240				230			
		248							
166	270	231	68.6	85.9	196.4	222	122	211	53.8
7	8	8	3.5	4.0	5	6	7	16	4
2.1	3	4	2.0	2.0	1.7	2.4	2.2	2.2	1.3

P	Ge	In
7.7	*11.7*	-
8.1	*12.0*	*99.0*
9.2	*15.0*	*101.1*
9.5	*17.2*	*102.2*
-	*20.9*	*115.7*
(< 20)		
(< 50)		
8.6	*15.3*	*104.5*
0.9	*3.8*	*7.6*
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

$\bar{s}$: 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	ICP-OES
	3, 9, 10, 11, 13	FAAS
	5	ETAAS
	8	NAA
Al	1, 2, 3, 6, 7, 9, 10, 11, 12	ICP-OES
	4, 8	FAAS
	5	Photometric with Chromazurol S
As	1	HG AAS
	2, 5, 7, 8, 9, 10, 11, 12, 13, 16, 18	ICP-OES
	3	Photometric with DDC
	4	NAA
	6	PAA
	14	ETAAS
	15, 17	Photometric as Molybdenum Blue
Bi	1, 3, 7	ICP-OES
	2	HG AAS / FIAS
	4, 6, 9	FAAS
	5, 8, 10	ETAAS
Cd	1, 2, 6, 7, 11, 12, 14, 15	ICP-OES
	3, 4, 5, 8, 9, 10, 16	FAAS
	13	PAA
Co	1, 6, 7, 11, 12	FAAS
	2, 3, 4, 5, 9, 10	ICP-OES
	8	NAA
Cu	1	X-ray fluorescence analysis
	2, 4, 5, 6, 7, 8, 9, 10, 11, 12	Electrogravimetry
	3	Electrogravimetry, separation of Sn and Pb (as sulphate)
Fe	1, 3, 4, 5, 6, 11, 14	FAAS
	2, 7, 8, 10, 12, 13, 16, 17	ICP-OES
	9, 15	Photometric with 1,10-Phenanthroline
Mn	1, 3, 9, 11	FAAS
	2, 5, 6, 7, 8, 12, 13, 15, 16, 17	ICP-OES
	4, 10	Photometric as permanganate
	14	PAA
Ni	1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14	ICP-OES
	4	PAA
	8, 12	FAAS
	15	Photometric with Diacetyldioxime
Pb	1	Gravimetric as chromate
	2, 6, 12	FAAS
	3	PAA
	4, 5, 7, 8, 9, 11, 13, 14	ICP-OES
	10	Electrogravimetry
Si	1, 2, 3, 5, 6, 9	ICP-OES
	4, 8	Gravimetry
	7	ETAAS
Sb	1, 2, 4, 8, 10, 11	ICP-OES
	3	HG AAS
	5, 9, 13	FAAS
	6	PAA
	7	NAA
	12, 14	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

PARTICIPANTS

Bundesanstalt für Materialforschung und -prüfung, Berlin (Germany)
Centre Technique des Industries de la Fonderie (CTIF), Sèvres (France)
DIEHL Metall, Röthenbach (Germany)
HÜTTENWERKE Kayser AG, Lünen (Germany)
Institut Glörfeld, Willich (Germany)
KM Europa Metal AG, Berlin (Germany)
KM Europa Metal AG, Osnabrück (Germany)
Krupp VDM GmbH, Werdohl (Germany)
Mansfelder Kupfer und Messing GmbH-Nord, Hettstedt (Germany)
Mansfelder Kupfer und Messing GmbH-Süd, Hettstedt (Germany)
Max-Planck-Institut für Metallforschung, Stuttgart (Germany)
Norddeutsche Affinerie AG, Hamburg (Germany)
Ridsdale & Co Ltd., Middlesbrough (United Kingdom)
TRÉFIMÉTAUX S. A., Serifontaine (France)
Technische Universität Bergakademie Freiberg, Freiberg (Germany)
Wieland-Werke AG, Ulm (Germany)

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:

Richard-Willstätter-Straße 11, 12489 Berlin, Germany

Phone: +49 30 8104 2061 e-mail: sales.crm@bam.de

Fax: +49 30 8104 72061 internet: www.bam.de