

CERTIFICATE OF ANALYSIS

ERM[®]-EB388

CuAl5Zn5Sn

Certified Values		
Element	Certified value ¹⁾	Uncertainty ²⁾
	Mass fraction in %	
Cu	89.27	± 0.17
Al	4.972	± 0.05
Zn	4.81	± 0.12
Sn	0.857	± 0.06
	Mass fraction in mg/kg	
Fe	303	± 15
Mn	512	± 15
Ni	74	± 7
Pb	9.7	± 2.0

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 $k=2$, corresponding to a level of confidence of about 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993. U is calculated according to:

$$U = 2 \cdot u_c = 2 \cdot \sqrt{\frac{s^2}{n} + s_{\text{hom}}^2}$$

with
 s = Std.-dev. of the means of data sets from the certification round robin
 n = Number of data sets from the certification round robin
 s_{hom} = Uncertainty coming from the variation of the results of the homogeneity test over the area of a sample. Since it is not possible to separate contributions coming from real inhomogeneities and contributions coming from the scatter of the analytical method used for the homogeneity test (spark emission spectrometry) this represents a worst case estimation. The mass fraction of copper was calculated as matrix during the homogeneity test.

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[®]-EB388 was originally certified as BAM-M388. 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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DESCRIPTION OF THE SAMPLE

The Reference Material is available in the form of discs (approx. 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	Al	Zn	Sn
1	89.11	4.905	4.710	0.8282
2	89.14	4.908	4.733	0.8290
3	89.23	4.938	4.750	0.8352
4	89.24	4.952	4.758	0.8452
5	89.25	4.961	4.793	0.8475
6	89.26	4.967	4.802	0.8508
7	89.26	4.971	4.803	0.8517
8	89.28	4.972	4.822	0.8553
9	89.30	4.974	4.828	0.8567
10	89.31	4.991	4.841	0.8650
11	89.31	4.991	4.843	0.8665
12	89.37	5.001	4.860	0.8742
13	89.40	5.021	4.864	0.8750
14		5.060	4.869	0.8828
15			4.890	0.8840
16				
17				
M :	89.265	4.972	4.811	0.857
s_M :	0.0800	0.0411	0.0537	0.0180
\bar{s}_i :	0.0356	0.0250	0.0304	0.0094

mass fraction in mg/kg

Line no.	Fe	Mn	Ni	Pb
1	282.8	494.5	68.33	7.79
2	283.0	503.2	68.33	8.10
3	290.7	503.3	71.00	8.25
4	293.8	503.3	71.61	8.99
5	296.5	510.5	71.94	9.16
6	296.6	510.9	73.16	9.17
7	299.7	511.9	73.26	10.25
8	303.0	512.6	73.74	10.33
9	309.0	513.8	74.33	10.50
10	312.8	517.1	74.49	10.76
11	316.7	518.3	75.19	11.15
12	319.3	518.3	76.67	11.83
13	332.8	525.8	77.25	---
14	---	530.7		
15				
16				
17				
M :	302.8	512.5	73.61	9.69
s_M :	14.76	9.55	3.435	1.297
\bar{s}_i :	3.76	3.45	1.850	0.825

The laboratory mean values have been examined statistically (Grubbs, Cochran) to eliminate outlying values. Where a " --- " appears in the table it indicates that an outlying value has been omitted.

M : mean of means of data sets

s_M : standard deviation of means of data sets*

\bar{s}_i : mean of standard deviations of data sets

*calculated of at least 4 but usually 6 single values

ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line-No.	Method
Al	1, 2, 4, 5, 7, 8, 10, 12 3, 6, 9, 11, 14 13	Inductively coupled plasma – optical emission spectrometry (ICP OES) Flame atomic absorption spectrometry (FAAS) Spectrophotometry after ion exchange
Cu	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13 8	Electrogravimetry Inductively coupled plasma – optical emission spectrometry (ICP OES)
Fe	1, 2, 5, 7, 8, 9, 10, 12 4, 6, 11, 13 3	Inductively coupled plasma – optical emission spectrometry (ICP OES) Flame atomic absorption spectrometry (FAAS) Spectrophotometry
Mn	1, 2, 5, 6, 9, 10, 12, 14 3, 4, 8, 11, 13 7	Inductively coupled plasma – optical emission spectrometry (ICP OES) Flame atomic absorption spectrometry (FAAS) Spectrophotometry
Ni	1, 2, 4, 10, 12 3, 5, 6, 7, 8, 9, 11 13 14	Flame atomic absorption spectrometry (FAAS) Inductively coupled plasma – optical emission spectrometry (ICP OES) Inductively coupled plasma – mass spectrometry (ICP-MS) Photon activation analysis (PAA)
Pb	1, 6, 9, 11 2 3, 7, 8, 10, 12 4 5	Inductively coupled plasma – optical emission spectrometry (ICP OES) Inductively coupled plasma – mass spectrometry (ICP-MS) Flame atomic absorption spectrometry (FAAS) Electrothermal atomic absorption spectrometry (ET AAS) Spectrophotometry
Sn	1, 8, 9, 15 2 3, 4, 5, 6, 7, 10, 11, 12, 13 14	Flame atomic absorption spectrometry (FAAS) Spectrophotometry after extraction Inductively coupled plasma – optical emission spectrometry (ICP OES) Photon activation analysis (PAA)
Zn	1, 4, 7, 11, 13 2, 6, 8, 9, 10, 12, 14, 15 3 5	Flame atomic absorption spectrometry (FAAS) Inductively coupled plasma – optical emission spectrometry (ICP OES) Complexometric titration after extraction Photon activation analysis (PAA)

PARTICIPANTS

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INSTRUCTIONS FOR USE

Before use, the surface of the material must be cleaned by turning on a lathe. An area of approx. 5 mm diameter in the centre of the discs should not be used for spark emission spectrometry.

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[®]-EB388 is available on request.

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