

Bundesanstalt für Materialforschung und -prüfung (BAM)

in cooperation with the Committee of Chemists of the GDMB
Gesellschaft der Metallurgen und Bergleute e.V.

Certified Reference Material

BAM-M603

Zinc powder

Certified Values

Element	Mass fraction ¹⁾ in mg/kg	Uncertainty ²⁾ in mg/kg
Pb	15.8	0.5
Ag	1.00	0.09
Cd	1.69	0.12
Cu	3.69	0.21
Fe	2.18	0.14
Ni	0.43	0.05
Tl	3.81	0.23

¹⁾ Unweighted mean value of the means of accepted sets of data (consisting of at least 3 but usually 5 single results), each set being obtained by a different laboratory and/or a different method of measurement.

²⁾ Estimated expanded uncertainty U with a coverage factor of $k = 2$, corresponding to a level of confidence of approx. 95 %, as defined in the Guide to the Expression of Uncertainty in Measurement, (GUM, ISO/IEC Guide 98-3:2008).

This certificate is valid until 09/2029.

Sample description

The Reference Material is available in the form of powder ($d_{50} = 148 \mu\text{m}$). It is supplied in plastic bottles containing 200 g.

Transport and Storage

The material should be stored in a dry and clean environment at room temperature. Transport under normal ambient conditions.

Recommended Use

The reference material is intended for development, validation and quality control of analytical methods for the determination of trace elements in samples of similar matrix composition. The minimum sample size for chemical analysis is 0.25 g.

Values for information

Element	Mass fraction ¹⁾ in mg/kg	Uncertainty ²⁾ in mg/kg
Al	0.22	0.15
Bi	0.102	0.002
Co	0.041	0.004
Sb	0.04	0.02
As	< 1	
In	< 0.5	
Sn	< 1	
V	< 0.2	
¹⁾ Values were not certified, but given for information, when the number of accepted data sets was considered to be too low (< 5) or when the uncertainty from the inter-laboratory certification was considerably larger than the expected range or in case there were hints that the material was not homogeneous enough. ²⁾ Estimated expanded uncertainty <i>U</i> with a coverage factor of <i>k</i> = 2, corresponding to a level of confidence of approx. 95 %, as defined in the Guide to the expression of uncertainty in measurement, (GUM, ISO/IEC Guide 98-3:2008).		

Metrological Traceability

The values are traceable to the SI (Système International d'Unités) via calibration using pure metals or substances of known stoichiometry or well checked standard solutions.

Participating Laboratories

Agilent GmbH AG, Waldbronn, Germany

AMCO united, Duisburg, Germany

Boliden Odda, Norway

Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany

Division „Inorganic Reference Materials“

Division „Inorganic Trace Analysis

Chemad GmbH, Duisburg, Germany

Inspectorate International Limited, Witham, Essex, United Kingdom

MKM Mansfelder Kupfer und Messing GmbH, Hettstedt, Germany

Norzinco GmbH, Goslar, Germany

revierlabor GmbH, Essen, Germany

Thyssenkrupp Steel Europe AG, Duisburg, Germany

TU Clausthal, Institut für Aufbereitung, Deponietechnik und Geomechanik, Clausthal, Germany

VARTA Consumer Batteries GmbH & Co. KGaA, Dischingen, Germany

VARTA Microbattery GmbH, Ellwangen, Germany

Means of Accepted Data Sets (mass fraction in mg/kg)

Certified values

values for information

Line. No.	Pb	Ag	Cd	Cu	Fe	Ni	Tl		Al	As	Bi	Co	Sb	In	Sn	V
1	---	0.84	---	2.96	---	0.30	3.46		< 0.15	< 0.01	0.102	0.038	0.02	0.11	0.025	0.010
2	14.2	1.01	1.28	3.00	1.68	0.33	3.60		0.16	< 0.02	0.103	0.040	0.04	< 0.2	0.030	< 0.02
3	14.5	1.02	1.35	3.20	2.00	0.38	3.78		0.17	0.14	0.103	0.043	0.04	0.44	< 0.3	0.034
4	14.8	1.05	1.40	3.33	2.02	0.39	3.80		< 0.25	0.16	< 0.2	---	0.05		0.515	0.11
5	15.1	1.07	1.62	3.62	2.02	0.39	3.82		0.33	< 0.5	---		0.06		< 1	< 0.2
6	15.6		1.64	3.65	2.02	0.40	3.91			< 1			< 0.3		< 1	
7	15.7		1.65	3.71	2.06	0.40	4.34								1.19	
8	15.8		1.70	3.84	2.07	0.40										
9	15.8		1.71	3.86	2.14	0.43										
10	15.9		1.75	3.97	2.20	0.52										
11	15.9		1.76	3.98	2.21	0.52										
12	16.1		1.77	4.00	2.50	0.55										
13	16.6		1.80	4.06	2.51	0.56										
14	16.8		1.99	4.07	2.52											
15	16.8		2.00	4.16	2.56											
16	17.3		2.00													
17	---															
<i>M</i>	15.8	1.00	1.69	3.69	2.18	0.43	3.81		0.23	< 1	0.102	0.041	0.04	< 0.5	< 1	< 0.2
<i>s_M</i>	0.9	0.09	0.23	0.40	0.26	0.09	0.28		0.10		0.001	0.003	0.02			
<i>s_i</i>	0.4	0.04	0.04	0.18	0.18	0.04	0.09		0.07		0.010	0.004	0.01			

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 (Grubbs 95 %). A data set consists of at least 3 but usually 5 single values of one laboratory.

M : mean of laboratory means

s_M : standard deviation of laboratory means

s_i : averaged repeatability standard deviation (square root of the mean of laboratory variances)

Note: "< - values" were not included into the calculation of *M* and *s_M*

Analytical Method used for Certification

Element	Line Number	Method
Pb	2, 6, 8, 9, 11, 14, 15, 16	ICP-OES
	3, 5, 7, 10, 12, 13	ICP-MS
	4	ETAAS
Ag	1, 2, 4	ICP-OES
	3, 5	ICP-MS
Cd	2, 7, 8, 9, 12, 13	ICP-MS
	3, 4, 5, 6, 10, 11, 15, 16	ICP-OES
	14	ETAAS
Cu	1, 2, 6, 7, 8, 10, 12, 15	ICP-OES
	3, 4, 5, 9, 11, 14	ICP-MS
	13	ETAAS
Fe	2, 3, 5, 7, 9, 11, 13	ICP-OES
	4, 6, 8, 10, 14, 15	ICP-MS
	12	ETAAS
Ni	1, 3, 5, 7, 8, 11	ICP-MS
	2, 4, 6, 9, 10, 12	ICP-OES
	13	ETAAS
Tl	1, 2, 4, 5	ICP-MS
	3, 7	ICP-OES
	6	ETAAS
Al	1, 3	ICP-MS
	2, 4, 5	ICP-OES
As	1, 2	ICP-MS
	3, 4, 5, 6	ICP-OES
Bi	1, 2, 3	ICP-MS
	4	ICP-OES
Co	1, 2, 3	ICP-MS
Sb	1, 2, 3, 4, 5, 6	ICP-MS
In	1, 2	ICP-OES
	3	ICP-MS
Sn	1, 2, 5	ICP-MS
	3, 4, 6, 7	ICP-OES
V	1, 2, 4	ICP-MS
	3, 5	ICP-OES

Abbreviations: ETAAS – Electrothermal atomic absorption spectrometry
ICP-OES – Inductively coupled plasma - optical emission spectrometry

ICP-MS – Mass spectrometry with inductively coupled plasma

Technical Report

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify BAM-M603 is available on request or can be downloaded from BAM website (www.bam.de).

Accepted as BAM-CRM on

Bundesanstalt für Materialforschung und -prüfung (BAM)



Dr. S. Richter
Committee for Certification

Dr. S. Recknagel
Project Coordinator

BAM holds an accreditation as a reference material producer according to ISO 17034. This accreditation is valid only for the scope as specified in the certificate D-RM-11075-01-00.

DAkkS is a signatory of the multilateral agreement (MLA) between EA, ILAC and IAF for mutual acceptance.



This Reference Material is offered by:

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