

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-M112

Pure Lead

Certified Values

Element	Mass fraction ¹⁾ in mg/kg	Uncertainty ²⁾ in mg/kg
Cu	8.2	0.6
Ni	5.3	0.4
Pt	5.4	0.5
Se	5.2	0.4
Te	5.3	0.3

¹⁾ Unweighted mean value of the means of accepted sets of data (consisting of at least 4 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 07/2050.

Sample description

The Reference Material is available in the form of discs (approx. 38 mm diameter and 38 mm height).

Recommended Use

The CRM is intended for establishing or checking the calibration of spark optical emission spectrometers for the analysis of samples with similar matrix composition. It is also suitable for validation of wet chemical analysis methods. The minimum sample size for wet chemical analysis is 0.1 g.

Values for information

Element	Mass fraction in mg/kg
Ag	8
Bi	70
Tl	13
S	3.7

Instructions for Use

Before use, the surface of the material must be prepared by milling or turning on a lathe. For wet chemical analysis chips have to be prepared by turning or milling of the sample.

Participating Laboratories

Aurubis AG, Hamburg, Germany
 Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany
 Berzelius Stolberg, Stolberg, Germany
 Clarios Germany GmbH & Co. KGaA, Hannover, Germany
 Clarios Zwickau GmbH & Co. KG, Zwickau, Germany
 Hoppecke Batterien GmbH & Co. KG, Brilon-Hoppecke, Germany
 Muldenhütten Recycling und Umwelttechnik GmbH, Freiberg, Germany
 WESER METALL GmbH, Nordenham, Germany

Means of Accepted Data Sets

Certified values
 Mass fraction in mg/kg

values for information

Line No.	Cu	Ni	Pt	Se	Te		<i>Ag</i>	<i>Bi</i>	<i>Tl</i>	<i>S</i>
1	7.66	5.06	---	4.72	4.87		7.2	67	10.4	2.7
2	7.82	5.21	---	4.98	5.18		7.6	67	12.3	3.9
3	8.22	5.22	4.46	5.22	5.20		7.8	67	12.3	4.0
4	8.22	5.28	5.35	5.23	5.25		7.8	73	13.1	4.0
5	8.25	5.30	5.49	5.47	5.28		8.1	73	13.2	
6	8.25	5.33	5.55	5.48	5.48		8.6	74	13.7	
7	8.43	5.46	5.71	5.52	5.61					
8	8.58	5.74	5.85							
<i>M</i>	8.18	5.33	5.40	5.23	5.27		7.9	70	12.5	3.7
<i>s_M</i>	0.31	0.21	0.50	0.30	0.24					
\bar{s}_i	0.24	0.19	0.22	0.16	0.19					

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 4 but usually 6 single values of one laboratory.

M : mean of laboratory means

s_M : standard deviation of laboratory means

\bar{s}_i : averaged repeatability standard deviation (square root of the mean of laboratory variances)

Analytical Method used for Certification

Element	Line Number	Method
Cu	1, 2, 5, 8	ICP-OES, dissolution with tartaric acid/HNO ₃
	3	ICP-OES, dissolution with HNO ₃ /HCl
	4	ETAAS, dissolution with HNO ₃
	6	ICP-MS, dissolution with HNO ₃
	7	ICP-OES, dissolution with tartaric acid/HNO ₃ , precipitation of Pb as sulphate
Ni	1	ICP-OES, dissolution with HNO ₃ /HCl
	2	ICP-MS, dissolution with HNO ₃
	3, 4, 6, 7	ICP-OES, dissolution with tartaric acid/HNO ₃
	5	ICP-OES, dissolution with tartaric acid/HNO ₃ , precipitation of Pb as sulphate
	8	ETAAS, dissolution with HNO ₃
Pt	3	ICP-OES, dissolution with aqua regia, precipitation of Pb as sulphate
	4, 6	Fire assay, Ag-collection, ICP-OES after dissolution with HNO ₃ /HCl
	5	ICP-MS, dissolution with HNO ₃ /HCl
	7, 8	ICP-OES, dissolution with HNO ₃ /HCl
Se	1, 5, 6, 7	ICP-OES, dissolution with tartaric acid/HNO ₃
	2	ICP-OES, dissolution with aqua regia, precipitation of Pb as sulphate
	3	ICP-MS, dissolution with HNO ₃
	4	ICP-OES, dissolution with HNO ₃ /HCl
Te	1, 3, 4, 5	ICP-OES, dissolution with tartaric acid/HNO ₃
	2	ICP-MS, dissolution with HNO ₃
	6	ICP-OES, dissolution with aqua regia, precipitation of Pb as sulphate
	7	ICP-OES, dissolution with HNO ₃ /HCl
Ag, Bi, Tl	1	<i>ICP-OES, dissolution with tartaric acid/HNO₃</i>
	2, 3, 4, 5, 6	<i>SOES</i>
S	1, 2, 3, 4	<i>SOES</i>

Abbreviations: ETAAS – Electrothermal atomic absorption spectrometry
 ICP-OES – Inductively coupled plasma - optical emission spectrometry
 ICP-MS – Mass spectrometry with inductively coupled plasma
 SOES – spark optical emission spectrometry

Transport and Storage

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

Metrological Traceability

To ensure traceability of the certified mass fractions to the SI (Système International d'Unités) calibration was performed using standard solutions prepared from pure metals or stoichiometric compounds or well checked commercial calibration solutions.

Technical Report

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify BAM-M112 is available on request or can be downloaded from BAM website (www.bam.de).

Accepted as BAM-CRM on 2020-09-04

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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