

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-M321

AlCu4Mg1

Certified Values

Element	Mass fraction ¹⁾ in %	Uncertainty ²⁾ in %
Si	0.0490	0.0022
Fe	0.0495	0.0017
Cu	4.38	0.06
Mn	0.808	0.010
Mg	1.51	0.04
Cr	0.0558	0.0013
Ni	0.0504	0.0007
Zn	0.147	0.003
Ti	0.0436	0.0022
Sc	0.0502	0.0020
Sn	0.0286	0.0010
V	0.0105	0.0003
Zr	0.1554	0.0026
	in mg/kg	in mg/kg
Be	4.9	0.2
Bi	323	14
Ca	5.2	0.8
Cd	30	4
Ga	87.9	2.0
Li	5.8	0.4
Na	2.9	0.9
Pb	99	6

¹⁾ Unweighted mean value of the means of accepted sets of data (consisting of at least 6 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 02/2050.

Sample Description

The Reference Material is available in the form of discs (approx. 65 mm diameter and 30 mm height).

Recommended Use

The CRM is intended for establishing or checking the calibration of spark optical emission and X-ray spectrometers for the analysis of samples of similar matrix composition. The minimum sample size for wet chemical analysis is 0.2 g.

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 must be prepared by turning or milling of the sample surface.

An area 8mm in diameter in the centre of the discs should be avoided for spark optical emission spectrometry.

Transport and Storage

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

Participating Laboratories

Aleris Aluminium Duffel BVBA, Duffel, Belgium
ALERIS Rolled Products Germany GmbH, Koblenz, Germany
AMAG Austria Metall AG, Ranshofen, Austria
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany
Constellium, Centre de Recherches de Voreppe, Voreppe, France
Hydro Aluminium Rolled Products GmbH, R&D, Bonn, Germany
Hydro Aluminium Rolled Products GmbH, Hamburg, Germany
Institute of Non-Ferrous Metals, Gliwice, Poland
Leichtmetall Aluminium Giesserei Hannover GmbH, Hannover, Germany
Otto Fuchs KG, Meinerzhagen, Germany
TRIMET Aluminium SE, Essen, Germany

Means of Accepted Data Sets

Certified values

Mass fraction in %

Mass fraction in mg/kg

Line No.	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Sc	Sn	V	Zr	Be	Bi	Ca	Cd	Ga	Li	Na	Pb	
1	0.0425	0.0471	4.28	0.786	1.470	0.0540	---	0.1413	0.0421	0.0489	0.0271	0.0101	0.1502	---	---	4.4	28.3	85.8	5.3	2.4	---	
2	0.0455	0.0476	4.31	0.794	1.490	0.0544	0.0495	0.1437	0.0428	0.0489	0.0274	0.0101	0.1503	---	---	4.7	28.5	86.3	5.4	2.5	95.4	
3	0.0455	0.0485	4.32	0.794	1.493	0.0546	0.0499	0.1458	0.0432	0.0492	0.0274	0.0103	0.1507	4.83	307	4.9	29.0	86.5	5.7	2.6	96.5	
4	0.0483	0.0487	4.36	0.796	1.497	0.0552	0.0500	0.1460	0.0432	0.0500	0.0283	0.0103	0.1510	4.87	309	5.7	29.1	86.7	5.8	3.4	97.0	
5	0.0486	0.0490	4.38	0.803	1.498	0.0552	0.0501	0.1462	0.0433	0.0505	0.0285	0.0105	0.1542	4.87	316	6.5	30.1	88.3	5.8	3.8	97.9	
6	0.0493	0.0490	4.39	0.806	1.499	0.0554	0.0503	0.1468	0.0434	0.0506	0.0285	0.0105	0.1543	4.88	318		30.2	88.6	5.9		98.1	
7	0.0500	0.0494	4.40	0.809	1.504	0.0559	0.0503	0.1470	0.0434	0.0518	0.0287	0.0106	0.1560	4.93	319		30.7	88.8	6.0		98.4	
8	0.0505	0.0495	4.41	0.810	1.504	0.0559	0.0505	0.1473	0.0436	0.0519	0.0288	0.0106	0.1568	5.00	322		30.8	88.9	6.1		98.4	
9	0.0513	0.0496	4.43	0.812	1.507	0.0560	0.0507	0.1476	0.0440		0.0290	0.0107	0.1569	5.10	326		30.8	89.7	6.1		100.2	
10	0.0515	0.0498	4.45	0.813	1.510	0.0565	0.0507	0.1480	0.0448		0.0290	0.0107	0.1573		332		31.8	89.8	6.2		100.3	
11	0.0523	0.0502	4.47	0.815	1.516	0.0570	0.0512	0.1480	0.0456		0.0296	0.0107	0.1583		339		32.3	---			100.8	
12	0.0524	0.0504		0.821	1.519	0.0575	0.0514	0.1482	---		0.0298	0.0112	0.1589		343		32.8				100.8	
13		0.0512		0.823	1.537	0.0578		0.1494	---		0.0299	---	0.1604									101.8
14		0.0512		0.832	1.545			---				---	0.1608									
15		0.0514																				
16																						
17																						
18																						
<i>M</i>	0.0490	0.0495	4.38	0.808	1.506	0.0558	0.0504	0.1466	0.0436	0.0502	0.0286	0.0105	0.1554	4.93	323	5.2	30.4	87.9	5.8	2.9	98.8	
<i>s_M</i>	0.0031	0.0013	0.07	0.013	0.019	0.0012	0.0006	0.0021	0.0010	0.0012	0.0009	0.0003	0.0038	0.10	12	0.9	1.5	1.5	0.3	0.7	2.0	
\bar{s}_i	0.0008	0.0011	0.03	0.005	0.008	0.0004	0.0004	0.0016	0.0003	0.0003	0.0003	0.0002	0.0012	0.07	6	0.5	0.4	0.9	0.3	0.2	3.2	

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 (Grubbs 95 %). A data set consists of at least 5 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
Si	1, 2, 3, 5, 9, 10, 11, 12 4, 7 6, 8	ICP-OES, dissolution with NaOH Spectrophotometry ICP-OES, dissolution with acid
Fe	1, 3, 4, 10, 12 2 5, 6, 8, 9, 11, 13, 15 7 14	ICP-OES, dissolution with acid FAAS, dissolution with acid ICP-OES, dissolution with NaOH Spectrophotometry ICP-MS, dissolution with acid
Cu	1, 2, 3, 9 4, 6, 7, 8, 10, 11 5	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH FAAS, dissolution with acid
Mn	1, 3, 5, 12, 14 2, 4, 6, 7, 8, 9, 11 10 13	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH Spectrophotometry FAAS, dissolution with acid
Mg	1, 4, 6, 7, 11 2, 5, 8, 9, 10, 12, 13, 14 3	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH FAAS, dissolution with acid
Cr	1, 3, 4, 8, 9, 10, 12 2, 5, 6, 7, 11 13	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid ICP-MS, dissolution with acid
Ni	2, 4, 6, 7, 8, 9, 12 3, 5, 10, 11	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid
Zn	1, 9 2, 5, 6, 11 3, 7, 8, 10, 12, 13 4	FAAS, dissolution with acid ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
Ti	1, 2, 6, 7, 9, 10 3, 4, 8, 11 5	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid Spectrophotometry
Sc	1, 2, 4 3, 5, 6, 7, 8	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid
Sn	1, 7 2, 4, 6, 10, 12 3, 5, 8, 9, 11, 13	ICP-MS, dissolution with acid ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH
V	1, 2, 4, 7, 9 3, 5, 6, 10, 11, 12 8	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH Spectrophotometry
Zr	1, 4, 8, 11, 12, 14 2, 3, 5, 7, 10, 13 6 9	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid Spectrophotometry

Element	Line Number	Method
Be	3, 6	ICP-OES, dissolution with NaOH
	4, 7, 8, 9	ICP-OES, dissolution with acid
	5	ICP-MS, dissolution with acid
Bi	3, 4, 5, 9	ICP-OES, dissolution with acid
	6, 8, 11, 12	ICP-OES, dissolution with NaOH
	7, 10	ICP-MS, dissolution with acid
Ca	1, 3, 4, 5	ICP-OES, dissolution with acid
	2	ICP-OES, dissolution with NaOH
Cd	1, 2, 5, 6, 8, 11	ICP-OES, dissolution with acid
	3, 7, 10, 12	ICP-OES, dissolution with NaOH
	4, 9	ICP-MS, dissolution with acid
Ga	1, 9	ICP-MS, dissolution with acid
	2, 4, 5, 8	ICP-OES, dissolution with NaOH
	3, 6, 7, 10	ICP-OES, dissolution with acid
Li	1, 3, 4, 8, 9, 10	ICP-OES, dissolution with acid
	2	ICP-MS, dissolution with acid
	5, 6, 7	ICP-OES, dissolution with NaOH
Na	1	ETAAS, dissolution with acid
	2, 3, 4, 5	ICP-OES, dissolution with acid
Pb	2, 5, 8, 12, 13	ICP-OES, dissolution with acid
	3, 4, 7, 9, 10	ICP-OES, dissolution with NaOH
	6, 11	ICP-MS, dissolution with acid

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

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-M321 is available on request or can be downloaded from BAM website (www.bam.de).

Accepted as BAM-CRM on 2020-03-12

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.



Deutsche
Akkreditierungsstelle
D-RM-11075-01-00

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