



CERTIFICATE

CERTIFIED REFERENCE MATERIAL BAM-M316a

AlSi12(Fe)

Certified Value(s)

Element	Mass fraction ¹⁾ in %	Uncertainty ²⁾ in %
Si	11.87	0.16
Fe	0.986	0.018
Cu	0.0290	0.0006
Mn	0.0240	0.0008
Mg	0.0473	0.0012
Ni	0.0251	0.0007
Zn	0.0593	0.0011
Ti	0.0791	0.0014
	in mg/kg	in mg/kg
Cr	62.6	1.4
Ag	184	6
Be	4.6	0.5
Bi	151	6
Ca	17.9	1.4
Cd	19.5	0.9
Ga	95.4	2.0
Pb	89	5
Sb	47	4
Sn	100.5	2.8
Sr	298	8
V	98.4	1.9
Zr	29.1	1.5

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

Informative Value(s)

Element	Mass fraction ¹⁾ in mg/kg	Uncertainty ²⁾ in mg/kg
<i>B</i>	2.5	0.6
<i>Hg</i>	38	5

- 1) Values were not certified, but given for information, because the number of accepted data sets was considered to be too low (< 5).
- 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).

End of Validity

This certificate is valid until there is a revocation from the producer of the material.

Material Description

The Reference Material is available in the form of discs (approx. 50 mm diameter and 30 mm height).

Recommended Use

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

Handling

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.

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.

Participating Laboratories

AMAG Austria Metall AG, Ranshofen, Austria
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany
Constellium, Centre de Recherches de Voreppe, Voreppe, France
Speira GmbH, R&D, Bonn, Germany
Leichtmetall Aluminium Giesserei Hannover GmbH, Hannover, Germany
Łukasiewicz Research Network – Institute of Non-Ferrous Metals, Gliwice, Poland
Novelis Koblenz GmbH, Koblenz, Germany
OTTO FUCHS KG, Meinerzhagen, Germany
Raghavendra Spectro Metallurgical Laboratory, Bangalore, India
revierlabor, Essen, Germany

Means of Accepted Data Sets

Certified Values

Mass fraction in %

Mass fraction in mg/kg

Line No.	Si	Fe	Cu	Mn	Mg	Ni	Zn	Ti	Cr	Ag	Be	Bi
1	11.62	0.933	0.0268	---	---	---	---	0.0742	---	172.2	4.08	---
2	11.68	0.970	0.0282	0.0218	0.0448	0.0236	0.0569	0.0763	59.8	174.9	4.20	140.9
3	11.78	0.974	0.0283	0.0222	0.0456	0.0237	0.0580	0.0773	59.9	176.2	4.33	144.6
4	11.80	0.975	0.0285	0.0232	0.0460	0.0246	0.0585	0.0776	60.4	181.2	4.47	144.7
5	11.83	0.979	0.0288	0.0233	0.0462	0.0249	0.0586	0.0786	60.8	181.3	4.62	145.6
6	11.90	0.987	0.0291	0.0234	0.0463	0.0249	0.0588	0.0791	61.7	187.7	4.73	151.3
7	11.91	0.987	0.0291	0.0234	0.0464	0.0250	0.0591	0.0791	61.8	188.4	4.75	155.2
8	12.04	0.992	0.0292	0.0239	0.0466	0.0250	0.0591	0.0795	62.2	192.6	4.76	156.6
9	12.29	0.996	0.0293	0.0240	0.0468	0.0251	0.0594	0.0801	62.2	194.7	4.79	157.2
10		1.002	0.0293	0.0240	0.0469	0.0253	0.0598	0.0801	63.1	195.0	4.81	158.2
11		1.015	0.0293	0.0243	0.0493	0.0253	0.0598	0.0802	63.2		4.92	160.5
12		1.027	0.0295	0.0244	0.0494	0.0256	0.0599	0.0807	63.9		5.33	
13		---	0.0295	0.0248	0.0502	0.0257	0.0612	0.0819	65.3			
14		---	0.0296	0.0248	0.0504	0.0258	0.0613	0.0825	65.7			
15			0.0310	0.0248		0.0264			67.1			
16				0.0274								
<i>M</i>	11.87	0.986	0.0290	0.0240	0.0473	0.0251	0.0593	0.0791	62.6	184.4	4.65	151.5
<i>s_M</i>	0.20	0.024	0.0010	0.0014	0.0019	0.0008	0.0012	0.0023	2.3	8.5	0.34	7.0
\bar{s}_i	0.13	0.009	0.0007	0.0005	0.0008	0.0005	0.0011	0.0013	1.5	3.7	0.21	4.0

Certified Values

Mass fraction in mg/kg

Line No.	Ca	Cd	Ga	Pb	Sb	Sn	Sr	V	Zr
1	16.0	---	89.3	80.0	41.5	95.0	284.3	94.0	25.1
2	16.8	18.1	90.2	81.2	42.6	97.0	288.7	94.4	25.5
3	17.0	18.2	94.3	81.5	44.7	97.0	290.9	96.3	27.9
4	17.5	18.4	94.5	81.8	46.4	98.3	294.0	96.7	27.8
5	18.1	18.9	94.5	82.5	46.4	99.8	294.6	97.5	28.3
6	18.6	19.2	94.6	86.9	46.9	101.3	296.8	98.2	28.4
7	21.3	19.4	95.4	87.9	47.8	101.7	297.5	98.4	28.6
8		19.4	96.4	89.2	48.8	102.0	299.4	99.2	29.0
9		19.7	96.4	92.0	48.9	104.2	303.3	99.4	29.0
10		19.8	97.4	92.5	49.0	104.3	303.5	99.4	29.3
11		20.0	99.0	94.3	52.8	104.5	304.8	100.0	29.4
12		20.2	99.1	101.2		105.0	312.5	100.0	30.4
13		21.0	99.3	102.8				100.4	33.9
14		21.7						103.3	34.7
<i>M</i>	17.9	19.5	95.4	88.8	46.9	100.5	297.5	98.4	29.1
<i>s_M</i>	1.8	1.1	3.2	7.6	3.2	3.3	7.8	2.5	2.7
\bar{s}_i	1.7	0.6	2.8	3.4	2.1	2.0	5.0	1.7	1.2

Informative Values

<i>B</i>	<i>Hg</i>
2.3	32.0
2.3	37.5
2.3	40.6
3.2	43.2

2.5	38.3
0.5	4.9
0.3	4.0

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.

Analytical Methods

Element	Line Number	Method
Si	1, 3, 4, 5, 6, 7	ICP-OES, dissolution with NaOH
	2	Gravimetry
	8	Spectrophotometry
	9	ICP-OES, dissolution with acid
Fe	1, 2, 3, 5, 7, 8, 10	ICP-OES, dissolution with NaOH
	4	Spectrophotometry
	6, 11, 12	ICP-OES, dissolution with acid
	9	FAAS, dissolution with acid
Cu	1, 2, 6, 8, 9, 10, 11, 13	ICP-OES, dissolution with NaOH
	3, 4, 7, 12, 14	ICP-OES, dissolution with acid
	5	ICP-MS, dissolution with acid
	15	FAAS, dissolution with acid
Mn	2, 3, 13, 14, 15	ICP-OES, dissolution with acid
	4	FAAS, dissolution with acid
	5, 6, 7, 10, 11, 12, 16	ICP-OES, dissolution with NaOH
	8	Spectrophotometry
	9	ICP-MS, dissolution with acid
Mg	2	ICP-MS, dissolution with acid
	3, 7, 8, 9, 10, 12, 14	ICP-OES, dissolution with NaOH
	4, 5, 11, 13	ICP-OES, dissolution with acid
	6	FAAS, dissolution with acid
Ni	2	ICP-MS, dissolution with acid
	3, 6, 7, 8, 9, 15	ICP-OES, dissolution with NaOH
	4, 5, 10, 11, 12, 13	ICP-OES, dissolution with acid
	14	FAAS, dissolution with acid
Zn	2, 4, 6, 7, 9, 10	ICP-OES, dissolution with NaOH
	3, 5, 8, 11, 12, 13	ICP-OES, dissolution with acid
	14	FAAS, dissolution with acid
Ti	1, 5, 6, 7, 8, 9, 11, 14	ICP-OES, dissolution with NaOH
	2, 4, 10, 12, 13	ICP-OES, dissolution with acid
	3	ICP-MS, dissolution with acid
Cr	2, 4, 6, 7, 9, 14	ICP-OES, dissolution with acid
	3, 5, 8, 10, 11, 15	ICP-OES, dissolution with NaOH
	12	ETAAS, dissolution with acid
	13	ICP-MS, dissolution with acid
Ag	1, 2, 5, 6	ICP-OES, dissolution with acid
	3	FAAS, dissolution with acid
	4, 7, 8, 9	ICP-OES, dissolution with NaOH
	10	ICP-MS, dissolution with acid
Be	1, 3, 6, 8, 9	ICP-OES, dissolution with acid
	2, 5, 7, 10, 11, 12	ICP-OES, dissolution with NaOH
	4	ICP-MS, dissolution with acid
Bi	2, 7, 9, 11	ICP-OES, dissolution with NaOH
	3, 4, 5, 6, 10	ICP-OES, dissolution with acid
	8	ICP-MS, dissolution with acid
Ca	1, 3, 4, 5, 6, 7	ICP-OES, dissolution with acid
	2	ICP-OES, dissolution with NaOH
Cd	2, 4, 5, 10, 13, 14	ICP-OES, dissolution with acid
	3, 6	ICP-MS, dissolution with acid
	7, 8, 9, 12	ICP-OES, dissolution with NaOH
	11	ETAAS, dissolution with acid
Ga	1, 6	ICP-MS, dissolution with acid
	2, 3, 7, 8, 9, 10	ICP-OES, dissolution with NaOH
	4, 5, 11, 12, 13	ICP-OES, dissolution with acid

Element	Line Number	Method
Pb	1, 3, 4, 6, 12, 13 2, 10 5, 7, 9, 11 8	ICP-OES, dissolution with acid ICP-MS, dissolution with acid ICP-OES, dissolution with NaOH ETAAS, dissolution with acid
Sb	1, 2, 5, 8, 9, 10 3, 4, 11 6, 7	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
Sn	1, 2, 4, 7, 11 3, 5, 6, 8, 10 9, 12	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
Sr	1, 8, 9, 10 2 3, 4, 5, 6, 7, 11, 12	ICP-OES, dissolution with acid ICP-MS, dissolution with acid ICP-OES, dissolution with NaOH
V	1, 3, 8, 9, 11 2, 4, 5, 6, 7, 10, 12, 14 13	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
Zr	1, 3, 5, 8, 9, 10, 12 2, 7, 11, 13, 14 4 6	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid Spectrophotometry ICP-MS, dissolution with acid
B	1, 3, 4 2	<i>ICP-OES, dissolution with acid</i> <i>ICP-MS, dissolution with acid</i>
Hg	1, 2 3 4	<i>ICP-OES, dissolution with acid</i> <i>ICP-OES, dissolution with NaOH</i> <i>ICP-MS, dissolution with acid</i>

Abbreviations:

ETAAS – Electrothermal atomic absorption spectrometry
 FAAS – Flame atomic absorption spectrometry
 FAES – Flame atomic emission 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 with traceable commercial calibration solutions.

Literature

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify BAM-M316a is available on request or can be downloaded from BAM website (<https://rrr.bam.de>).

Accepted as a BAM-CRM on 2023-12-20

Bundesanstalt für Materialforschung und -prüfung (BAM)

Dr. S. Richter
Committee for Certification

Dr. S. Recknagel
Project Coordinator
Division 1.6

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 Certified Reference Material is offered by:

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