

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-M313a

AlMg3

Certified Values

Element	Mass fraction ¹⁾ in %	Uncertainty ²⁾ in %
Si	0.346	0.012
Fe	0.388	0.010
Cu	0.0932	0.0027
Mn	0.486	0.006
Mg	3.35	0.08
Cr	0.117	0.004
Ni	0.0296	0.0007
Zn	0.1481	0.0026
Ti	0.099	0.006
	in mg/kg	in mg/kg
Be	5.4	0.3
Bi	92	5
Ca	10.4	1.2
Cd	4.7	0.6
Ga	106.7	2.2
Hg	3.7	0.7
Li	11.3	0.4
Mo	4.8	0.8
Na	25	5
Pb	38.0	1.4
Sb	6.1	1.0
Sn	193	6
V	308	8
Zr	355	10

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).

This certificate is valid until 12/2050.

Values for information

Element	Mass fraction ¹⁾ in mg/kg	Uncertainty ²⁾ in mg/kg
As	3.8	1.4
Tl	5.1	0.6

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 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).

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 8 mm 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 can be done under normal ambient conditions.

Participating Laboratories

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
revierlabor, Essen, Germany
TRIMET Aluminium SE, Essen, Germany

Means of Accepted Data Sets

Certified values
Mass fraction in %

Line No.	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti
1	---	0.375	0.0902	0.476	3.26	0.1151	0.0279	0.1448	0.0961
2	0.332	0.381	0.0903	0.477	3.27	0.1153	0.0288	0.1461	0.0972
3	0.335	0.381	0.0918	0.479	3.30	0.1155	0.0290	0.1463	0.0983
4	0.340	0.383	0.0921	0.480	3.30	0.1157	0.0290	0.1464	0.0985
5	0.340	0.385	0.0923	0.481	3.31	0.1166	0.0291	0.1466	0.0988
6	0.341	0.386	0.0936	0.481	3.32	0.1168	0.0293	0.1467	0.0989
7	0.341	0.386	0.0937	0.482	3.35	0.1170	0.0293	0.1468	0.0989
8	0.349	0.387	0.0939	0.484	3.36	0.1172	0.0296	0.1490	0.0990
9	0.350	0.387	0.0940	0.484	3.36	0.1179	0.0296	0.1493	0.0990
10	0.352	0.389	0.0940	0.484	3.39	0.1185	0.0300	0.1497	0.0992
11	0.358	0.391	0.0945	0.485	3.40	0.1187	0.0301	0.1498	0.0992
12	0.372	0.394	0.0951	0.490	3.42	0.1188	0.0303	0.1502	0.0996
13		0.395	0.0957	0.497	3.42	0.1192	0.0305	0.1507	0.0996
14		0.396		0.501	3.46	0.1196	0.0315	0.1514	0.1001
15		0.400		0.509					0.1002
<i>M</i>	0.346	0.388	0.0932	0.486	3.35	0.1173	0.0296	0.1481	0.0988
<i>s_M</i>	0.012	0.007	0.0017	0.010	0.06	0.0016	0.0009	0.0022	0.0011
\bar{s}_i	0.005	0.006	0.0009	0.005	0.03	0.0013	0.0006	0.0023	0.0013

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)

Means of Accepted Data Sets

Certified values
Mass fraction in mg/kg

Values for information
Mass fraction in mg/kg

Line No.	Be	Bi	Ca	Cd	Ga	Hg	Li	Mo	Na	Pb	Sb	Sn	V	Zr	As	Tl
1	5.00	84.5	7.6	4.09	102.7	2.7	10.5	3.1	23.0	35.7	5.1	182	298	331	2.1	4.4
2	5.00	88.3	9.7	4.33	103.2	3.4	11.0	3.7	23.4	36.8	5.3	189	300	335	2.3	5.2
3	5.02	89.7	9.9	4.36	103.7	3.4	11.0	4.1	24.4	37.1	5.6	190	301	344	2.6	5.4
4	5.22	90.6	10.2	4.42	103.7	3.8	11.4	4.6	24.5	37.4	6.7	190	302	348	3.7	5.4
5	5.31	91.0	10.4	4.52	105.7	3.8	11.5	4.8	25.6	37.9	6.9	191	306	348	4.4	
6	5.34	91.6	11.2	4.63	105.8	4.3	11.5	5.7	27.3	38.1	7.2	191	307	348	5.3	
7	5.36	91.9	11.5	4.74	106.1	4.7	11.7	5.9	28.2	38.7		191	307	355	6.6	
8	5.40	92.0	12.5	4.78	107.2		12.0	6.3		38.7		195	309	362		
9	5.42	92.6		4.90	108.3					39.4		195	312	362		
10	5.52	93.0		5.05	108.5					39.9		197	315	363		
11	5.90	93.3		5.25	109.5					---		198	315	363		
12	6.00	95.0		5.27	109.7							200	317	365		
13		96.2			112.7							201	318	370		
14														371		
15																
<i>M</i>	5.37	91.5	10.4	4.69	106.7	3.7	11.3	4.8	25.2	38.0	6.1	193	308	355	3.8	5.1
<i>s_M</i>	0.32	3.0	1.5	0.38	3.0	0.7	0.5	1.2	2.0	1.3	0.9	6	7	13	1.7	0.5
\bar{s}_i	0.11	1.9	0.9	0.25	2.6	0.5	0.4	0.3	1.9	1.4	0.7	3	4	7	0.3	0.3

Analytical Method used for Certification

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

Element	Line Number	Method
Hg	1	ICP-OES, dissolution with NaOH
	2, 6	ICP-MS, dissolution with acid
	3, 4	ICP-OES, dissolution with acid
	5	Atomic fluorescence spectrometry
	7	CVAAS
Li	1, 2, 4, 5, 7, 8	ICP-OES, dissolution with acid
	3, 6	ICP-OES, dissolution with NaOH
Mo	1, 3, 5, 7	ICP-OES, dissolution with acid
	2, 8	ICP-OES, dissolution with NaOH
	4, 6	ICP-MS, dissolution with acid
Na	1, 2, 3, 4, 5, 7	ICP-OES, dissolution with acid
	6	ICP-MS, dissolution with acid
Pb	1, 2, 7, 9, 10	ICP-OES, dissolution with acid
	3, 5	ICP-MS, dissolution with acid
	4, 6, 8	ICP-OES, dissolution with NaOH
Sb	1, 3, 5	ICP-OES, dissolution with acid
	2, 4	ICP-MS, dissolution with acid
	6	ICP-OES, dissolution with NaOH
Sn	1, 7, 9, 10, 11	ICP-OES, dissolution with acid
	2, 4, 5, 6, 12, 13	ICP-OES, dissolution with NaOH
	3, 8	ICP-MS, dissolution with acid
V	1, 3, 5, 7, 8, 11	ICP-OES, dissolution with acid
	2, 4, 6, 9, 10, 13	ICP-OES, dissolution with NaOH
	12	Spectrophotometry
Zr	1	Spectrophotometry
	2, 7, 8, 11, 12, 13	ICP-OES, dissolution with NaOH
	3, 4, 5, 9, 10, 14	ICP-OES, dissolution with acid
	6	ICP-MS, dissolution with acid
As	1, 6, 7	<i>ICP-OES, dissolution with acid</i>
	2, 3	<i>ICP-MS, dissolution with acid</i>
	4, 5	<i>ICP-OES, dissolution with NaOH</i>
Tl	1, 2	<i>ICP-OES, dissolution with acid</i>
	3, 4	<i>ICP-MS, dissolution with acid</i>

Abbreviations: CVAAS – Cold vapor 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 of stated purity or traceable commercial calibration solutions.

Technical Report

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify BAM-M313a is available on request or can be downloaded from BAM website (www.bam.de).

Accepted as BAM-CRM on 2020-

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:

Bundesanstalt für Materialforschung und -prüfung (BAM)
Richard-Willstätter-Str. 11, 12489 Berlin

Phone: +49 30 8104 2061
Fax: +49 30 8104 72061

Email: sales.crm@bam.de
Internet: www.webshop.bam.de