

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-M320

AlMgSc

Certified Values

Element	Mass fraction ¹⁾ in %	Uncertainty ²⁾ in %
Si	0.197	0.007
Fe	0.206	0.006
Cu	0.147	0.005
Mn	0.699	0.008
Mg	3.98	0.08
Cr	0.1044	0.0023
Zn	0.252	0.006
Ti	0.102	0.004
Ga	0.0208	0.0008
Sc	0.282	0.007
Zr	0.102	0.005
	in mg/kg	in mg/kg
Ni	20.9	1.3
Be	22.4	0.7
Ca	11.7	2.2
Cd	15.2	1.9
Co	20.9	1.2
Li	9.1	0.4
Na	6.4	1.3
Pb	44.8	2.4
Sn	45.6	2.9
V	75.9	2.5

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 Aluminum 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
Suisse Technology Partners AG, Neuhausen, Switzerland
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	Zn	Ti	Ga	Sc	Zr	Ni	Be	Ca	Cd	Co	Li	Na	Pb	Sn	V
1	0.189	0.2027	0.1418	0.680	3.90	0.1002	0.242	0.0986	0.0190	0.275	0.0988	17.5	22.0	6.7	13.2	19.2	---	5.9	41.2	38.5	71.5
2	0.190	0.2032	0.1440	0.686	3.94	0.1013	0.242	0.0998	0.0198	0.275	0.0993	18.8	22.0	11.0	14.2	19.2	8.7	5.9	41.5	40.8	71.5
3	0.190	0.2037	0.1444	0.689	3.94	0.1023	0.247	0.1000	0.0202	0.279	0.0998	19.3	22.1	11.1	14.6	20.0	8.8	6.0	42.5	41.7	72.5
4	0.191	0.2040	0.1446	0.696	3.96	0.1026	0.248	0.1004	0.0203	0.280	0.1007	19.7	22.2	11.6	15.2	20.3	8.9	6.6	42.8	42.0	74.4
5	0.195	0.2043	0.1450	0.699	3.96	0.1031	0.251	0.1007	0.0204	0.282	0.1009	19.8	22.2	13.0	15.3	20.8	9.0	6.9	42.9	43.2	75.0
6	0.196	0.2044	0.1458	0.700	3.97	0.1038	0.252	0.1009	0.0205	0.282	0.1022	20.0	22.2	13.7	15.6	20.9	9.1	7.1	43.4	43.3	75.8
7	0.197	0.2057	0.1462	0.701	3.97	0.1045	0.253	0.1014	0.0206	0.283	0.1023	20.0	22.3	15.0	15.7	21.0	9.1		43.7	43.4	76.4
8	0.198	0.2059	0.1467	0.701	3.98	0.1045	0.254	0.1015	0.0208	0.285	0.1029	20.2	22.3		15.8	21.1	9.2		44.5	44.4	76.6
9	0.201	0.2060	0.1468	0.702	3.98	0.1047	0.255	0.1022	0.0209	0.286	0.1034	20.5	22.6		15.8	21.3	9.2		45.6	46.2	77.7
10	0.203	0.2066	0.1473	0.703	3.99	0.1047	0.256	0.1025	0.0214	0.286	0.1038	22.0	22.7		17.1	21.3	9.2		48.2	48.5	77.9
11	0.203	0.2074	0.1476	0.705	3.99	0.1058	0.257	0.1030	0.0215	0.289	0.1040	22.6	23.0		---	21.3	9.7		50.4	50.0	80.2
12	0.209	0.2074	0.1490	0.708	4.00	0.1062	0.257	0.1034	0.0215	---	0.1043	22.8	23.0			21.6			51.5	50.8	80.8
13		0.2075	0.1504	0.710	4.02	0.1075	0.260	0.1042	0.0220		0.1045	23.0	23.4			22.2				52.0	---
14		0.2093	0.1527	0.712	4.05	0.1076	0.260	0.1045	0.0224		0.1045	23.1				22.2				53.9	
15		0.2107			4.07	0.1078		---				24.1									
16		0.2114																			
17																					
18																					
<i>M</i>	0.197	0.2062	0.1466	0.699	3.98	0.1044	0.252	0.1016	0.0208	0.282	0.1022	20.9	22.4	11.7	15.2	20.9	9.1	6.4	44.8	45.6	75.9
<i>s_M</i>	0.007	0.0026	0.0028	0.009	0.05	0.0023	0.006	0.0017	0.0009	0.005	0.0020	1.9	0.5	2.7	1.1	1.0	0.3	0.6	3.5	4.7	3.1
\bar{s}_i	0.002	0.0018	0.0010	0.003	0.03	0.0009	0.002	0.0007	0.0003	0.003	0.0009	0.9	0.3	0.7	0.3	0.4	0.2	0.5	1.4	0.8	0.9

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 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
Si	1, 2, 3, 4, 6, 7, 8, 9, 12 5, 11 10	ICP-OES, dissolution with NaOH Spectrophotometry ICP-OES, dissolution with acid
Fe	1, 2, 5, 6, 8, 11, 13, 15, 16 3 4, 7, 10, 14 9 12	ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid ICP-OES, dissolution with acid Spectrophotometry FAAS, dissolution with acid
Cu	1, 2, 4, 10, 11, 14 3 5, 6, 7, 8, 9, 12, 13	ICP-OES, dissolution with acid FAAS, dissolution with acid ICP-OES, dissolution with NaOH
Mn	1, 2, 3, 4, 5, 6, 10, 11, 13 7, 9, 12 8 14	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid Spectrophotometry FAAS, dissolution with acid
Mg	1, 4, 5, 6, 7, 8, 10, 12, 13 2, 3, 9, 11, 15 14	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid FAAS, dissolution with acid
Cr	1, 5, 6, 7, 11, 12, 13, 14, 15 2, 3, 4, 9, 10 8	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid ICP-MS, dissolution with acid
Zn	1, 3, 6, 7, 10, 12, 13 2, 4, 5, 8, 9, 14 11	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid FAAS, dissolution with acid
Ti	1, 3, 4, 5, 7, 9, 11, 13 2, 6, 10, 12, 14 8	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid Spectrophotometry
Ga	1, 4, 7, 9, 10, 11, 13 2, 3, 5, 8, 12, 14 6	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid ICP-MS, dissolution with acid
Sc	1, 2, 4, 5, 8, 9, 10 3, 6, 7, 11	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid
Zr	1, 2, 3, 4, 5, 6, 10 7, 9, 11, 12, 13, 14 8	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid Spectrophotometry
Ni	1, 4, 5, 6, 7, 8, 11 2, 3, 9, 10, 13, 15 12, 14	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
Be	1, 5, 6, 9, 10 2, 3, 4, 8, 11, 12 7, 13	ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid ICP-MS, dissolution with acid

Element	Line Number	Method
Ca	1, 2, 3, 4, 5 6, 7	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH
Cd	1, 2, 4, 7, 9, 10 3, 6 5, 8	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
Co	1, 5, 14 2, 4, 6, 12 3, 7, 8, 9, 10, 11, 13	ICP-MS, dissolution with acid ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid
Li	2 3, 4 5, 6, 7, 8, 9, 10, 11	ICP-MS, dissolution with acid ICP-OES, dissolution with NaOH ICP-OES, dissolution with acid
Na	1 2, 3, 4, 5, 6	ETAAS, dissolution with acid ICP-OES, dissolution with acid
Pb	1, 2, 4, 8, 11, 12 3, 7, 9 5, 6, 10	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
Sn	1, 3, 5, 8, 12 2, 9, 10, 11, 13, 14 4, 6, 7	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH ICP-MS, dissolution with acid
V	1, 2, 5, 9, 11 3, 4, 6, 7, 10, 12 8	ICP-OES, dissolution with acid ICP-OES, dissolution with NaOH 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-M320 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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