

# 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-M319

AlMgSc (Scalmalloy® powder)

#### Certified Values

Element	Mass fraction <sup>1)</sup> in %	Uncertainty <sup>2)</sup> in %
Si	0.1043	0.0020
Fe	0.291	0.013
Cu	0.0015	0.0003
Mn	0.371	0.006
Mg	4.96	0.06
Sc	0.847	0.015
Zn	0.0073	0.0004
Ti	0.0030	0.0002
Zr	0.324	0.014

<sup>1)</sup> Unweighted mean value of the means of accepted sets of data (consisting of at least 5 but usually 5 single results), each set being obtained by a different laboratory and/or a different method of measurement.

<sup>2)</sup> 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 11/2039.

#### Sample description

The Reference Material is available in the form of powder ( $d_{50} = 93.057 \mu\text{m}$ ). It is supplied in glass bottles containing 100 g.

#### Transport and Storage

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

#### Recommended Use

The reference material is intended for development, validation and quality control of analytical methods for the determination of trace elements in samples of similar matrix composition. The minimum sample size for chemical analysis is 0.1 g.

### Values for information

Element	Mass fraction in %
Bi	< 0.001 <sup>1)</sup>
Cd	< 0.0002 <sup>1)</sup>
Cr	0.060 <sup>2)</sup>
Ga	0.015 <sup>2)</sup>
Ni	0.037 <sup>2)</sup>
Pb	< 0.001 <sup>1)</sup>
Sn	< 0.001 <sup>1)</sup>
V	0.0093 <sup>2)</sup>

<sup>1)</sup> Values obtained by one laboratory  
<sup>2)</sup> Values obtained by three laboratories (unweighted mean value of the means)

### Particle size distribution <sup>1)</sup>

d 10	67.88 µm
d 50	93.06 µm
d 90	126.74 µm

<sup>1)</sup> Values obtained by one laboratory

### Tamped volume, tamped density and Hausner Factor <sup>1)</sup>

	Mean	Std.-dev.
tamped volume in mL/100 g	63.3	0.4
tamped density in g/mL	1.58	0.01
Hausner Factor	1.05	

<sup>1)</sup> Values obtained by one laboratory

### Metrological Traceability

The values are traceable to the SI (Système International d'Unités) via calibration using pure metals or substances of known stoichiometry or well checked standard solutions.

### Participating Laboratories

ALERIS Rolled Products Germany GmbH, Koblenz, Germany

ACL Analytisch Chemisches Labor GmbH, Hailfingen, Rottenburg, Germany

Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany

Division „Inorganic Reference Materials“

Division „Thermochemical Residues Treatment and Resource Recovery“

Forschungsinstitut Edelmetalle & Metallchemie, Schwäbisch Gmünd, Germany

Fraunhofer-Institut für Silicatforschung ISC, Hanau, Germany

Hydro Aluminium Rolled Products GmbH, R&D, Bonn, Germany

Institut für Materialprüfung Glörfeld GmbH, Willich, Germany

revierlabor GmbH, Essen, Germany

### Means of Accepted Data Sets (mass fraction in %)

Line. No.	Certified values									values for information								
	Si	Fe	Cu	Mn	Mg	Sc	Zn	Ti	Zr		<i>Bi</i>	<i>Cd</i>	<i>Cr</i>	<i>Ga</i>	<i>Ni</i>	<i>Pb</i>	<i>Sn</i>	<i>V</i>
1	---	0.280	0.0011	0.357	---	0.814	0.0069	---	0.290		< 0.001	< 0.0002	0.0566	0.0145	0.0338	< 0.001	< 0.001	0.0077
2	---	0.282	0.0013	0.360	4.85	0.820	0.0070	---	0.296				0.0592	0.0150	0.0371			0.0093
3	---	0.282	0.0013	0.365	4.94	0.829	0.0070	0.0027	0.316				0.0655	0.0153	0.0396			0.0108
4	0.0997	0.283	0.0014	0.367	4.94	0.829	0.0071	0.0029	0.320									
5	0.1038	0.287	0.0014	0.369	4.94	0.851	0.0072	0.0030	0.328									
6	0.1041	0.291	0.0015	0.370	4.95	0.858	0.0073	0.0030	0.328									
7	0.1041	0.294	0.0016	0.370	4.98	0.860	0.0074	0.0030	0.329									
8	0.1047	0.295	0.0019	0.372	5.00	0.863	0.0076	0.0031	0.331									
9	0.1057	0.299	0.0020	0.373	5.01	0.870	0.0077	0.0031	0.334									
10	0.1081	0.300		0.379	5.01	0.873			0.364									
11		0.302		0.381	---													
12		---		0.384														
<i>M</i>	0.1043	0.291	0.0015	0.371	4.96	0.847	0.0073	0.0030	0.324				0.0604	0.0149	0.0368			0.0093
<i>s<sub>M</sub></i>	0.0025	0.008	0.0003	0.008	0.06	0.022	0.0003	0.0002	0.021									
$\bar{s}_i$	0.0017	0.006	0.0001	0.010	0.04	0.024	0.0003	0.0001	0.010									

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 for technical or statistical reasons (Grubbs 95 %). A data set consists of at least 5 but usually 6 single values of one laboratory.

*M* : mean of laboratory means

*s<sub>M</sub>* : standard deviation of laboratory means

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

Note: "< - values" were not included into the calculation of *M* and *s<sub>M</sub>*

## Analytical Method used for Certification

Element	Line Number	Method
Si	4	ICP-OES, dissolution with NaOH/H <sub>2</sub> O <sub>2</sub>
	5, 7, 10	ICP-OES, dissolution with NaOH
	6	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
	8	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
	9	Spectrophotometry, dissolution with NaOH
Fe	1	ICP-OES, dissolution with NaOH/H <sub>2</sub> O <sub>2</sub>
	2	Spectrophotometry, dissolution with HCl/H <sub>2</sub> O <sub>2</sub>
	3, 11	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	4	ICP-OES, dissolution with HNO <sub>3</sub> /HCl
	5, 8, 10	ICP-OES, dissolution with NaOH
	6	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
	7	FAAS, dissolution with HCl/H <sub>2</sub> O <sub>2</sub>
	9	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
Cu	1, 3, 8, 9	ICP-OES, dissolution with NaOH
	2	ICP-OES, dissolution with HNO <sub>3</sub> /HCl
	4, 5	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	6	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
	7	ETAAS, dissolution with HCl/HNO <sub>3</sub>
Mn	1, 11	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	2, 4, 5, 10	ICP-OES, dissolution with NaOH
	3	ICP-OES, dissolution with HNO <sub>3</sub> /HCl
	6	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
	7	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
	8	FAAS, dissolution with HCl/H <sub>2</sub> O <sub>2</sub>
	9	Spectrophotometry, dissolution with HNO <sub>3</sub>
	12	ICP-OES, dissolution with NaOH/H <sub>2</sub> O <sub>2</sub>
Mg	2	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	3	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
	4, 5, 7, 9	ICP-OES, dissolution with NaOH
	6	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
	8	ICP-OES, dissolution with NaOH/H <sub>2</sub> O <sub>2</sub>
	10	FAAS, dissolution with HCl/H <sub>2</sub> O <sub>2</sub>
Sc	1, 4, 6, 8	ICP-OES, dissolution with NaOH
	2	ICP-OES, dissolution with NaOH/H <sub>2</sub> O <sub>2</sub>
	3	ICP-OES, dissolution with HNO <sub>3</sub> /HCl
	5	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
	7, 9	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	10	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
Zn	1	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
	2, 4, 5, 9	ICP-OES, dissolution with NaOH
	3	ICP-OES, dissolution with HNO <sub>3</sub> /HCl
	6	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	7	FAAS, dissolution with HCl/H <sub>2</sub> O <sub>2</sub>
	8	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF

<b>Element</b>	<b>Line Number</b>	<b>Method</b>
Ti	3	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
	4, 7	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	5, 8	ICP-OES, dissolution with NaOH
	6	Spectrophotometry, dissolution with HCl/H <sub>2</sub> O <sub>2</sub>
	9	ICP-OES, dissolution with HNO <sub>3</sub> /HCl
Zr	1	ICP-OES, dissolution with HNO <sub>3</sub> /HCl
	2, 7, 9	ICP-OES, dissolution with NaOH
	3, 10	ICP-OES, dissolution with HCl/HNO <sub>3</sub>
	4	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
	5	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF/H <sub>3</sub> BO <sub>4</sub>
	6	Spectrophotometry, dissolution with NaOH
	8	ICP-OES, dissolution with NaOH/H <sub>2</sub> O <sub>2</sub>
Cr	1, 3	ICP-OES, dissolution with NaOH
	2	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
Ga	1, 3	ICP-OES, dissolution with NaOH
	2	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
Ni	1, 3	ICP-OES, dissolution with NaOH
	2	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
V	1, 2	ICP-OES, dissolution with NaOH
	3	ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF
Bi, Cd, Pb, Sn		ICP-OES, dissolution with HNO <sub>3</sub> /HCl/HF

**Abbreviations:** ETAAS – Electrothermal atomic absorption spectrometry  
 FAAS – Flame atomic absorption spectrometry  
 ICP-OES – Inductively coupled plasma - optical emission spectrometry

### Technical Report

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify BAM-M319 is available on request or can be downloaded from BAM website ([www.bam.de](http://www.bam.de)).

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**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.



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