in cooperation with the WG 'Aluminium'
of the Committee of Chemists of GDMB

# CERTIFICATE OF ANALYSIS

## ERM®-EB316

## AlSi12

| Certified Values | | |
|---|---|---|
| | Certified value [1] | Uncertainty [2] |
| Element | Mass fraction in % | |
| Si | 11.98 | 0.20 |
| Fe | 0.1054 | 0.0021 |
| Cu | 0.0297 | 0.0008 |
| Mn | 0.204 | 0.004 |
| Mg | 0.045 | 0.004 |
| Ni | 0.0235 | 0.0011 |
| Zn | 0.0611 | 0.0012 |
| Ti | 0.0790 | 0.0015 |
| | | |
| Element | Mass fraction in mg/kg | |
| Cr | 59.3 | 2.6 |
| Be | 2.95 | 0.17 |
| Bi | 140 | 7 |
| Cd | 20.8 | 1.5 |
| Ga | 105 | 5 |
| Pb | 87 | 7 |
| Sr | 260 | 7 |
| V | 98 | 7 |
| Zr | 32.8 | 0.7 |

[1] Unweighted mean value of the means of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of measurement. The values are traceable to the SI (Système International d'Unités) via calibration using pure metals or substances of known stoichiometry.

[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, ISO, 1993.

This certificate is valid until 09/2059; this validity may be extended as further evidence of stability becomes available.

### DESCRIPTION OF THE SAMPLE

The Reference Material is available in the form of discs (50 mm diameter and 30 mm height). It is intended for establishing and checking the calibration of optical emission and X-ray spectrometers (excluding micro-analysis) for the analysis of samples of similar materials.

## NOTE

European Reference Material ERM®-EB316 was produced and certified under the responsibility of Federal Institute for Materials Research and Testing (BAM) in cooperation with the Committee of Chemists of the GDMB, Gesellschaft für Bergbau, Metallurgie, Rohstoff- und Umwelttechnik according to the principles laid down in the technical guidelines of the European Reference Materials® co-operation agreement between BAM-LGC-IRMM. Information on these guidelines is available on the Internet (http://www.erm-crm.org).

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## Indicative Values[1)]

| | Indicative value [2)] | Uncertainty [3)] |
|---|---|---|
| Element | Mass fraction in mg/kg | |
| Ag | 183 | 10 |
| Ca | 11.3 | 1.4 |
| Hg | 35 | 7 |
| Sb | 56 | 5 |
| Sn | 106 | 11 |

[1)] Values were not certified, but given as indicative values, when the number of accepted data sets was considered to be too low (< 5) and/or when the uncertainty from the inter-laboratory certification was considerably larger than the expected range.

[2)] Unweighted mean value of the means of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of measurement. The values are traceable to the SI (Système International d'Unités) via calibration using pure substances of known stoichiometry.

[3)] 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, ISO, 1993.

## Informative Values

| | Informative value | *s*[1)] |
|---|---|---|
| Element | Mass fraction in mg/kg | |
| B | < 1.5 | |
| Co | < 1.5 | |
| Li | 1.00 | 0.03 |

[1)] No homogeneity data available, *s* is the standard deviation calculated from the means of accepted data sets from the certification interlaboratory comparison.

## MEANS OF ACCEPTED DATA SETS

**Certified values**
Mass fraction in %

Mass fraction in mg/kg

**Indicative and informative values**
Mass fraction in mg/kg

| Line no. | Si | Fe | Cu | Mn | Mg | Ni | Zn | Ti | Cr | Be | Bi | Cd | Ga | Pb | Sr | V | Zr | *Ag* | *Ca* | *Hg* | *Sb* | *Sn* | *B* | *Co* | *Li* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | --- | 0.1024 | 0.0290 | 0.1958 | 0.0434 | 0.0217 | 0.0585 | 0.0766 | 57.1 | 2.65 | 131 | 19.6 | 101 | 78.7 | 250 | 88 | 31.7 | *166* | *10.2* | *28.9* | *43.0* | *87* | *0.88* | *0.32* | *0.97* |
| **2** | 11.91 | 0.1025 | 0.0291 | 0.2004 | 0.0447 | 0.0219 | 0.0597 | 0.0776 | 57.8 | 2.72 | 131 | 20.1 | 102 | 85.1 | 261 | 91 | 32.4 | *182* | *10.8* | *30.5* | *49.3* | *91* | *1.05* | *1.06* | *1.00* |
| **3** | 11.98 | 0.1026 | 0.0294 | 0.2006 | 0.0448 | 0.0226 | 0.0599 | 0.0780 | 58.1 | 2.96 | 132 | 20.1 | 103 | 85.4 | 261 | 95 | 32.6 | *186* | *11.0* | *30.9* | *55.5* | *108* | *< 1* | *< 1* | *1.01* |
| **4** | 11.98 | 0.1039 | 0.0294 | 0.2010 | 0.0449 | 0.0226 | 0.0600 | 0.0782 | 58.5 | 3.00 | 137 | 20.6 | 103 | 85.9 | 262 | 95 | 32.9 | *190* | *13.2* | *37.2* | *56.1* | *109* | *< 1* | *< 1* | *1.02* |
| **5** | 11.98 | 0.1040 | 0.0295 | 0.2028 | 0.0451 | 0.0227 | 0.0601 | 0.0786 | 58.7 | 3.00 | 137 | 20.7 | 103 | 86.1 | 265 | 99 | 33.0 | *191* | | *45.2* | *59.5* | *111* | | | --- |
| **6** | 12.00 | 0.1045 | 0.0299 | 0.2035 | 0.0451 | 0.0228 | 0.0609 | 0.0788 | 58.8 | 3.03 | 144 | 21.6 | 104 | 87.5 | --- | 102 | 33.1 | | | | *59.8* | *111* | | | |
| **7** | 12.04 | 0.1056 | 0.0301 | 0.2037 | 0.0453 | 0.0238 | 0.0609 | 0.0801 | 59.9 | 3.10 | 151 | 22.0 | 106 | 93.0 | | 114 | 33.1 | | | | | *126* | | | |
| **8** | | 0.1057 | 0.0311 | 0.2045 | 0.0461 | 0.0246 | 0.0616 | 0.0814 | 61.9 | 3.14 | 152 | 22.1 | 109 | 96.0 | | | 33.5 | | | | | | | | |
| **9** | | 0.1077 | --- | 0.2084 | 0.0475 | 0.0258 | 0.0631 | 0.0817 | 62.7 | | | --- | 117 | | | | | | | | | | | | |
| **10** | | 0.1095 | | 0.2097 | --- | 0.0264 | 0.0635 | | | | | | --- | | | | | | | | | | | | |
| **11** | | 0.1111 | | 0.2135 | | | 0.0641 | | | | | | | | | | | | | | | | | | |
| **M** | 11.98 | 0.1054 | 0.0297 | 0.2040 | 0.0452 | 0.0235 | 0.0611 | 0.0790 | 59.3 | 2.95 | 140 | 20.8 | 105 | 87 | 260 | 98 | 32.8 | *183* | *11.3* | *35* | *56* | *106* | *<1.5* | *<1.5* | *1.00* |
| **$s_M$** | 0.05 | 0.0030 | 0.0007 | 0.0050 | 0.0011 | 0.0016 | 0.0018 | 0.0018 | 1.9 | 0.18 | 9 | 1.0 | 5 | 6 | 6 | 9 | 0.6 | *11* | *1.4* | *7* | *5* | *14* | | | *0.03* |
| **$\bar{s}_i$** | 0.06 | 0.0020 | 0.0010 | 0.0024 | 0.0016 | 0.0013 | 0.0006 | 0.0006 | 1.3 | 0.05 | 7 | 0.4 | 3 | 3 | 6 | 2.4 | 0.9 | *8.4* | *1.4* | *1.5* | *2* | *4* | | | *0.05* |

The laboratory mean values have been examined statistically to eliminate outlying values. Each laboratory mean consists of at least 4 but usually 8 single values. Where ” --- ” appears in the table it indicates that an outlying value has been omitted (Grubbs 95 %). " < "-values have not been considered in statistical evaluation.

$M$ : mean of means of data sets

$\bar{s}_i$ : mean of standard deviations of data sets under repeatability conditions

$s_M$ : standard deviation of means of data sets

## TECHNICAL REPORT

A detailed technical report (in German) describing the analysis procedures and the treatment of the analytical data used to certify ERM®-EB316 is available on request.

## ANALYTICAL METHOD USED FOR CERTIFICATION

| Element | Line no. | Method |
|---|---|---|
| Si | 2, 3, 4, 5, 6 | ICP-OES, dissolution in NaOH |
| | 7 | XRF, reconstitution method |
| Fe | 1 | ICP-OES |
| | 2 | ICP-MS |
| | 3 | Spectrophotometry, 1,10-phenantroline |
| | 4, 5, 7, 8, 10 | ICP-OES, dissolution in NaOH |
| | 6, 11 | ICP-OES, dissolution in acid |
| | 9 | XRF, reconstitution method |
| Cu | 1 | ICP-MS |
| | 2 | ICP-OES |
| | 3, 5 | ICP-OES, dissolution in acid |
| | 4, 6, 7, 8 | ICP-OES, dissolution in NaOH |
| Mn | 1 | FAAS |
| | 2, 6, 7, 8, 11 | ICP-OES, dissolution in NaOH |
| | 3 | ICP-OES |
| | 4 | ICP-MS |
| | 5, 10 | ICP-OES, dissolution in acid |
| | 9 | XRF, reconstitution method |
| Mg | 1 | XRF, reconstitution method |
| | 2, 9 | ICP-OES, dissolution in acid |
| | 3, 6, 7, 8 | ICP-OES, dissolution in NaOH |
| | 4 | ICP-MS |
| | 5 | ICP-OES |
| Ni | 1, 6 | ICP-OES, dissolution in acid |
| | 2, 5, 7, 9, 10 | ICP-OES, dissolution in NaOH |
| | 3 | ICP-OES |
| | 4 | ICP-MS |
| | 8 | XRF, reconstitution method |
| Zn | 1 | NAA |
| | 2 | ICP-MS |
| | 3, 6, 10 | ICP-OES, dissolution in acid |
| | 4, 7, 8, 9 | ICP-OES, dissolution in NaOH |
| | 5 | ICP-OES |
| | 11 | XRF, reconstitution method |
| Ti | 1, 4, 6, 7, 8 | ICP-OES, dissolution in NaOH |
| | 2 | ICP-OES |
| | 3 | ICP-MS |
| | 5 | ICP-OES, dissolution in acid |
| | 9 | XRF, reconstitution method |
| Cr | 1, 5 | ICP-OES, dissolution in NaOH |
| | 2 | NAA |
| | 3 | ICP-OES |
| | 4, 7 | ICP-MS |
| | 6, 8 | ICP-OES, dissolution in acid |
| Be | 1 | ICP-OES, dissolution in acid |
| | 2, 4, 5, 7, 8 | ICP-OES, dissolution in NaOH |
| | 3 | ICP-MS |
| | 6 | ICP-OES |

| Element | Line no. | Method |
|---|---|---|
| Bi | 1, 4, 6, 7, 8 | ICP-OES, dissolution in NaOH |
| | 2 | ICP-MS |
| | 3 | ICP-OES |
| | 5 | ICP-OES, dissolution in acid |
| Cd | 1, 2, 5, 6 | ICP-OES, dissolution in NaOH |
| | 3, 4 | ICP-OES, dissolution in acid |
| | 7 | ICP-MS |
| | 8 | ICP-OES |
| Ga | 1, 8 | ICP-OES, dissolution in acid |
| | 2, 6, 7 | ICP-OES, dissolution in NaOH |
| | 3 | ICP-OES |
| | 4, 5 | ICP-MS |
| | 9 | XRF, reconstitution method |
| Pb | 1, 2 | ICP-OES, dissolution in acid |
| | 3, 7, 8 | ICP-OES, dissolution in NaOH |
| | 4, 6 | ICP-MS |
| | 5 | ICP-OES |
| Sr | 1 | ICP-OES, dissolution in NaOH |
| | 2, 3 | ICP-OES, dissolution in acid |
| | 4 | ICP-MS |
| | 5 | ICP-OES |
| V | 1, 3 | ICP-OES, dissolution in acid |
| | 2 | ICP-OES |
| | 4, 5, 6 | ICP-OES, dissolution in NaOH |
| | 7 | XRF, reconstitution method |
| Zr | 1 | ICP-OES |
| | 2 | ICP-MS |
| | 3, 4, 6, 7 | ICP-OES, dissolution in NaOH |
| | 5, 8 | ICP-OES, dissolution in acid |
| *Ag* | *1* | *ICP-OES, dissolution in NaOH* |
| | *2, 3, 4* | *ICP-OES, dissolution in acid* |
| | *5* | *ICP-MS* |
| *B* | *1* | *ICP-OES* |
| | *2, 4* | *ICP-MS* |
| | *3* | *ICP-OES, dissolution in acid* |
| *Ca* | *1* | *ICP-OES, dissolution in acid* |
| | *2* | *ICP-MS* |
| | *3* | *ICP-OES* |
| | *4* | *ICP-OES, dissolution in NaOH* |
| *Co* | *1* | *NAA* |
| | *2* | *ICP-OES, dissolution in NaOH* |
| | *3* | *ICP-OES, dissolution in acid* |
| | *4* | *ICP-MS* |
| *Hg* | *1* | *ICP-OES* |
| | *2* | *ICP-OES, dissolution in NaOH* |
| | *3, 4* | *ICP-MS* |
| | *5* | *NAA* |

| Element | Line no. | Method |
|---|---|---|
| *Li* | *1, 3* | *ICP-MS* |
| | *2* | *ICP-OES, dissolution in acid* |
| | *4* | *ICP-OES* |
| | *5* | *ICP-OES, dissolution in NaOH* |
| *Sb* | *1, 2, 5* | *ICP-OES, dissolution in NaOH* |
| | *3* | *NAA* |
| | *4* | *ICP-OES* |
| | *6* | *ICP-MS* |
| *Sn* | *1, 4, 7* | *ICP-OES, dissolution in NaOH* |
| | *2, 6* | *ICP-OES, dissolution in acid* |
| | *3* | *ICP-OES* |
| | *5* | *ICP-MS* |

**Abbreviations:**

ICP-OES: Inductively coupled plasma optical emission spectrometry
ICP-MS: Inductively coupled plasma mass spectrometry
NAA: Neutron activation analysis
XRF: X-ray fluorescence spectrometry

## INTENDED USE

The CRM is intended for establishing and checking the calibration of optical emission and X-ray spectrometers (excluding micro-analysis) for the analysis of samples of similar materials.

## INSTRUCTIONS FOR USE

Before use, the surface of the material (approx. 0.1 mm) must be prepared by milling or turning on a lathe. An area with a diameter of approx. 10 mm in the centre of the discs should not be used for spark emission spectrometry and if possible not for X-ray spectrometry.

The minimum sample size for wet chemical analysis is 0.5 g.

## STORAGE

The material should be stored in a dry and clean environment at room temperature.

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