

# CERTIFICATE OF ANALYSIS

ERM<sup>®</sup>-EB602

<b>ZnAl4Cu1</b>		
	Certified value <sup>1)</sup>	Uncertainty <sup>2)</sup>
Element	Mass fraction in %	
Al	4.08	0.11
Cu	0.812	0.017
Mg	0.0415	0.0020
	Mass fraction in mg/kg	
Pb	19.5	2.9
Cd	1.1	0.5
Sn	1.0	0.5
Ni	2.5	0.4
Si	11.4	1.9
Ti	4.8	0.4

<sup>1)</sup> Unweighted mean value of the means of accepted sets of data (consisting of at least 5 but usually 6 single results), each set being obtained in a different laboratory and/or a different method of measurement. The values are traceable to the SI (Système International d'Unités) via calibration using sufficiently pure metals or substances of known stoichiometry or well characterised monoelement solutions.

<sup>2)</sup> Estimated expanded uncertainty U with a coverage factor of  $k = 2$ , corresponding to a level of confidence of approximately 95 %, as defined in the Guide to the expression of uncertainty in measurement (GUM), ISO/IEC Guide 98-3:2008.

Accepted as an ERM<sup>®</sup>, Berlin, 2013-xx-xx.

BAM Department 1  
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Indicative Values <sup>1)</sup>		
	Indicative value	Uncertainty
Element	Mass fraction in mg/kg	
Fe	8.7	4.3
<p><sup>1)</sup> Values were not certified, but given as indicative values, when the number of accepted data sets was considered to be too low (&lt; 5) or when the uncertainty from the inter-laboratory certification was considerably larger than the expected range. The values are traceable to the SI (Système International d'Unités) via calibration using pure metals or substances of known stoichiometry.</p> <p><sup>2)</sup> Estimated expanded uncertainty <math>U</math> with a coverage factor of <math>k=3</math> as defined in the Guide to the expression of uncertainty in measurement, (GUM, ISO/IEC Guide 98-3:2008).</p>		

## NOTE

European Reference Material ERM<sup>®</sup>-EB602 was produced and certified under the responsibility of BAM Federal Institute for Materials Research and Testing in cooperation with the Committee of Chemists of the GDMB, Gesellschaft der Metallurgen und Bergleute e.V. according to the principles laid down in the technical guidelines of the European Reference Materials<sup>®</sup> co-operation agreement between BAM-LGC-IRMM. Information on these guidelines is available on the Internet (<http://www.erm-crm.org>).

## INTENDED USE

The CRM is intended for establishing or checking the calibration of optical emission and X-ray spectrometers for the analysis of samples of similar composition. The minimum sample size for wet chemical analysis is 0.5 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 have to be prepared by turning or milling of the sample surface.

## DESCRIPTION OF THE SAMPLE

The Reference Material is available in the form of discs (40 mm diameter and 40 mm height).

## STORAGE

The material should be stored in a dry and clean environment at room temperature (approximately 20 °C).

## TECHNICAL REPORT

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify ERM<sup>®</sup>-EB602 is available on request or can be downloaded from BAM website ([www.bam.de/en/fachthemen/referenzmaterialien/index.htm](http://www.bam.de/en/fachthemen/referenzmaterialien/index.htm)).

## MEANS OF ACCEPTED DATA SETS (FOR ONE METHOD AT ONE LABORATORY, RESPECTIVELY)

Certified values  
 Mass fraction in %

Indicative value

Mass fraction in mg/kg

Line no.	Al	Cu	Mg	Pb	Cd	Sn	Ni	Si	Ti	Fe*	Fe*
1	3.987	---	0.0390	15.67	---	0.517	1.57	8.17	4.52	7.18	
2	4.030	0.7973	0.0391	16.96	0.93	0.733	2.00	10.12	4.65	7.28	
3	4.061	0.7992	0.0394	17.22	1.00	1.000	2.38	10.48	4.73	7.50	
4	4.065	0.8035	0.0405	18.80	1.03	1.000	2.52	10.83	4.78	7.58	
5	4.070	0.8046	0.0411	19.02	1.03	1.388	2.58	11.18	4.87		9.38
6	4.072	0.8062	0.0413	19.17	1.06	1.450	2.59	13.64	4.92		9.89
7	4.084	0.8083	0.0416	20.83	1.08	< 5	2.95	15.00	5.00		10.00
8	4.087	0.8088	0.0418	20.88	1.13	< 5	2.97		5.02		10.00
9	4.092	0.8093	0.0428	22.75	1.17	< 5	3.05				10.30
10	4.094	0.8122	0.0429	23.33	< 2		---				10.33
11	4.168	0.8287	0.0445	---	< 5		---				10.60
12	4.202	0.8305	0.0448				< 5				
13											
<i>M</i>	4.084	0.810	0.0416	19.46	1.06	1.03	2.51	11.35	4.81	8.73*	
<i>s<sub>M</sub></i>	0.056	0.011	0.0020	2.24	0.08	0.37	0.49	2.28	0.180	0.20	0.39
$\bar{s}_1$	0.037	0.007	0.0004	1.11	0.10	0.24	0.14	2.33	0.34	0.05	1.61

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 but usually 6 single values of one laboratory.

*M* : mean of means of data sets

*s<sub>M</sub>* : standard deviation of mean of means of data sets

$\bar{s}_1$  : square root of mean of variances of data sets under repeatability conditions

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

\*The mean value of Fe is calculated from the mean values of the two populations forming the data of this element. Consequently for uncertainty calculation *n* = 2 is used.

## PARTICIPANTS

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 ThyssenKrupp Steel AG, Duisburg, Germany  
 Umicore AG & Co KG., Hanau, Germany  
 Weser-Metall GmbH, Nordenham, Germany

## ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line no.	Method
Al	1, 4, 5, 6, 7, 8, 9, 10, 11, 12 2, 3	ICP-OES Titration
Cu	2, 6, 7, 8, 9, 10, 11, 12 3, 4, 5	ICP-OES FAAS
Mg	1, 2, 3, 4, 5, 7, 9, 11, 12 6, 8, 10	ICP-OES FAAS
Pb	2, 3, 4, 5, 6, 7 1, 9, 10 8	ICP-OES FAAS ICP-MS
Cd	2, 4, 7, 9, 10, 11 3, 5, 8 6	ICP-OES FAAS ETAAS
Sn	1, 2, 3, 4, 6, 7, 8, 9 5	ICP-OES ICP-MS
Ni	1, 2, 3, 4, 5, 7, 8, 9, 12 6	ICP-OES ETAAS
Si	1, 2, 3, 4, 5, 6 7	ICP-OES Spectrophotometry
Ti	1, 2, 3, 5, 6, 7, 8 4	ICP-OES ICP-MS
Fe	1, 2, 3, 4, 7, 8, 10, 11 5 6 9	ICP-OES ETAAS FAAS Spectrophotometry

**Abbreviations:** ETAAS – Electrothermal atomic absorption spectrometry  
 FAAS – Flame atomic absorption spectrometry  
 ICP OES – Atomic emission spectrometry with inductively coupled plasma  
 ICP-MS – Mass spectrometry with inductively coupled plasma

This certificate is valid until 12/2063.

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