in cooperation with the WG ‘Copper’
of the Committee of Chemists of GDMB

European Reference Materials

CERTIFICATE OF ANALYSIS

ERM®-EB383

Pure copper

ausverkauft / out of stock

Certified Values		
	Certified value 1)	Uncertainty 2)
Element	Mass fraction in mg/kg	
Ag	4.70	0.20
As	1.93	0.15
Bi	1.02	0.09
Cd	1.48	0.15
Co	1.37	0.05
Cr	1.03	0.09
Fe	10.9	0.5
Mg	2.37	0.29
Mn	1.24	0.05
Ni	3.59	0.21
Pb	1.31	0.20
Sb	1.44	0.17
Sn	4.7	0.6
Te	1.40	0.16
Ti	1.56	0.16

1) Unweighted mean value of the means of accepted sets of data (at least 4 but usually 6), 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.

2) Estimated expanded uncertainty U with a coverage factor of about k=2, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993.

This certificate is valid until 01/2056; this validity may be extended as further evidence of stability becomes available.

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

NOTE

European Reference Material ERM®-EB383 was originally certified as BAM-M383. It was produced and certified under the responsibility of BAM Bundesanstalt für Materialforschung und –prüfung 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[3)]		
	Indicative value [4)]	Uncertainty [5)]
Element	Mass fraction in mg/kg	
Al	2.3	0.6
S	2.8	1.4
Se	1.16	0.19
Zn	7.8	0.4
Element	Mass fraction in mg/kg	
Si	< 10	
Zr	< 9	

[3)] Values were not certified, but given as indicative values, when the number of accepted data sets was considered to be too low, when the spread from the round robin certification was considerably larger than the state of the practice or when only 'lower as' values were reported from the round robin certification.

[4)] Unweighted mean value of the means of accepted sets of data, 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 substances of known stoichiometry.

[5)] Estimated expanded uncertainty *U* with a coverage factor of about *k*=2, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1993.

DESCRIPTION OF THE SAMPLE

The Reference Material is available in the form of discs (40 mm diameter and 30 mm height). It is intended for establishing and checking the calibration of optical emission and X-ray spectrometers for the analysis of samples of similar materials.

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

Mass fraction in mg/kg

Certified values

Line no.	Ag	As	Bi	Cd	Co	Cr	Fe	Mg	Mn	Ni	Pb	Sb	Sn	Te	Ti
1	4.18	1.698	0.90	1.30	1.29	0.91	9.42	1.92	1.113	2.890	0.848	0.910	3.486	1.154	1.203
2	4.25	1.73	0.94	1.322	1.32	0.92	10.36	1.988	1.228	3.377	1.025	1.113	4.303	1.178	1.435
3	4.28	1.74	1.03	1.33	1.33	0.923	10.38	2.08	1.240	3.378	1.173	1.283	4.497	1.197	1.498
4	4.36	1.76	1.04	1.380	1.34	0.973	10.60	2.26	1.243	3.505	1.258	1.29	4.60	1.282	1.570
5	4.54	1.883	1.08	1.395	1.342	0.98	10.63	2.32	1.252	3.575	1.373	1.295	4.663	1.297	1.573
6	4.65	1.91	1.11	1.42	1.38	0.985	10.70	2.34	1.263	3.592	1.464	1.367	4.883	1.417	1.652
7	4.69	2.017	---	1.65	1.39	0.997	10.71	2.64	1.297	3.683	1.47	1.368	5.262	1.493	1.738
8	4.83	2.08		1.67	1.44	1.02	11.21	2.79	1.307	3.73	1.498	1.380	5.900	1.52	1.81
9	4.85	2.088		1.87	1.47	1.042	11.35	3.03	---	3.794	1.657	1.440	---	1.630	
10	4.90	2.35		---	---	1.26	11.77		---	3.844	---	1.512		1.842	
11	4.94	---				1.31	11.81			4.11		1.644			
12	4.95						11.86					1.760			
13	5.07											1.82			
14	5.34											2.000			
M :	4.70	1.93	1.015	1.483	1.367	1.029	10.90	2.37	1.24	3.59	1.308	1.44	4.70	1.40	1.56
s_M:	0.345	0.209	0.081	0.201	0.059	0.132	0.725	0.375	0.059	0.315	0.256	0.288	0.704	0.223	0.188
$\overline{s}_i$:	0.194	0.153	0.078	0.056	0.062	0.063	0.455	0.141	0.052	0.163	0.132	0.087	0.157	0.149	0.055

Indicative values

Line no.	Al	S	Se	Si	Zn	Zr
1	1.63	0.51	0.60	0.86	---	0.06
2	1.67	0.88	0.87	1.0	---	0.31
3	1.69	1.56	0.96	1.95	7.05	0.62
4	1.8	3.50	1.21	2.72	7.23	0.76
5	2.09	3.63	1.22	6.32	7.6	1.25
6	2.11	3.74	1.28		7.65	1.73
7	2.85	3.83	1.28		7.77	2.98
8	2.9	5.1	1.32		7.84	3.25
9	3.9		1.38		7.9	3.50
10	---		1.49		8.51	6.33
11			---		8.67	6.53
12						
13						
14						
M :						
s_M:						
$\overline{s}_i$:						

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 4 but usually 6 single values of one laboratory. " < "-values have not been considered in statistical evaluation.

M : mean of means of data sets

$\overline{s}_i$: 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®-EB383 is available on request.

ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line no.	Method
Ag	1, 3, 5, 8, 11	Atomic emission spectrometry with inductively coupled plasma
	2	Arc spectroscopy
	4, 9	Neutron activation analysis
	6, 12, 13	Mass spectrometry with inductively coupled plasma
	7	Electrothermal atomic absorption spectrometry
	10	activation analysis with High-Energy Photons
	14	Synchrotron X-Ray fluorescence spectroscopy
Al	1, 9	Mass spectrometry with inductively coupled plasma
	2, 3, 4	Spark emission spectroscopy
	5, 7, 8	Atomic emission spectrometry with inductively coupled plasma
	6	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
As	1	Arc spectroscopy
	2, 4	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
	3, 5	Mass spectrometry with inductively coupled plasma
	6	Neutron activation analysis
	7	Activation analysis with high-energy photons
	8	Electrothermal atomic absorption spectrometry
	9, 10	Atomic emission spectrometry with inductively coupled plasma
Bi	1, 2	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
	3	Arc spectroscopy
	4	Atomic emission spectrometry with inductively coupled plasma
	5, 6	Mass spectrometry with inductively coupled plasma
Cd	1, 4, 7, 9	Atomic emission spectrometry with inductively coupled plasma
	2	Electrothermal atomic absorption spectrometry after electrolytic Cu separation
	3, 6, 8	Mass spectrometry with inductively coupled plasma
	5	Electrothermal atomic absorption spectrometry
Co	1	Electrothermal atomic absorption spectrometry
	2	Neutron activation analysis
	3, 4, 9	Atomic emission spectrometry with inductively coupled plasma
	5, 6, 8	Mass spectrometry with inductively coupled plasma
	7	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
Cr	1, 5, 8, 9	Atomic emission spectrometry with inductively coupled plasma
	2	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
	3	Neutron activation analysis
	4, 7, 11	Mass spectrometry with inductively coupled plasma
	6	Electrothermal atomic absorption spectrometry
	10	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
Mg	1, 7, 9	Mass spectrometry with inductively coupled plasma
	2, 3, 5, 6, 8	Atomic emission spectrometry with inductively coupled plasma
	4	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation

Element	Line no.	Method
Mn	1, 7	Mass spectrometry with inductively coupled plasma
	2, 4, 5, 6	Atomic emission spectrometry with inductively coupled plasma
	3	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
	8	Electrothermal atomic absorption spectrometry
Ni	1, 5, 11	Mass spectrometry with inductively coupled plasma
	2, 6, 10	Electrothermal atomic absorption spectrometry
	3, 4	Atomic emission spectrometry with inductively coupled plasma
	7	Arc spectroscopy
	8	Activation analysis with high-energy photons
	9	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
Pb	1, 3	Atomic emission spectrometry with inductively coupled plasma
	2, 6, 7	Mass spectrometry with inductively coupled plasma
	4	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
	5	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
	8	Electrothermal atomic absorption spectrometry
	9	Arc spectroscopy
S	1, 5, 8	Sparc emission spectrometry
	2	Atomic emission spectrometry with inductively coupled plasma
	3	IR-detection after combustion (gas calibration)
	4, 7	Photometry
	6	Titration
Sb	1, 12	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
	2	Synchrotron X-Ray fluorescence spectroscopy
	3, 4, 6	Mass spectrometry with inductively coupled plasma
	5, 14	Neutron activation analysis
	7	Electrothermal atomic absorption spectrometry
	8, 11	Atomic emission spectrometry with inductively coupled plasma
	9	Arc spectroscopy
	10	Photometry
	13	Activation analysis with high-energy photons
Se	1	Arc spectroscopy
	2	Electrothermal atomic absorption spectrometry
	3	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
	4	Neutron activation analysis
	5, 8, 10	Sparc emission spectrometry
	6, 9	Mass spectrometry with inductively coupled plasma
	7	Atomic emission spectrometry with inductively coupled plasma
Si	1, 2, 3, 4	Sparc emission spectrometry
	5	Atomic emission spectrometry with inductively coupled plasma
Sn	1, 2, 3	Atomic emission spectrometry with inductively coupled plasma
	4, 6	Mass spectrometry with inductively coupled plasma
	5	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
	7	Electrothermal atomic absorption spectrometry
	8	Synchrotron X-Ray fluorescence spectroscopy

Element	Line no.	Method
Te	1, 10	Atomic emission spectrometry with inductively coupled plasma
	2, 9	Atomic emission spectrometry with inductively coupled plasma after Lanthanum precipitation
	3	Synchrotron X-Ray fluorescence spectroscopy
	4	Arc spectroscopy
	5	Electrothermal atomic absorption spectrometry
	6, 7, 8	Mass spectrometry with inductively coupled plasma
Ti	1, 7, 8	Mass spectrometry with inductively coupled plasma
	2, 3, 4, 6	Atomic emission spectrometry with inductively coupled plasma
	5	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
Zn	3, 4	Sparc emission spectrometry
	5, 6, 8, 11	Atomic emission spectrometry with inductively coupled plasma
	7, 9	Mass spectrometry with inductively coupled plasma
	10	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
Zr	1, 7	Mass spectrometry with inductively coupled plasma
	2, 4, 5, 6	Atomic emission spectrometry with inductively coupled plasma
	3	Atomic emission spectrometry with inductively coupled plasma after electrolytic Cu separation
	8	Activation analysis with high-energy photons
	9, 10, 11	Sparc emission spectrometry

PARTICIPANTS

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INTENDED USE

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

INSTRUCTIONS FOR USE, STORAGE

Before use, the surface of the material must be cleaned by milling or turning on a lathe. The material should be stored at ambient conditions in a dry and clean environment.

Supply of Reference Materials by Bundesanstalt für Materialforschung und –prüfung:

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