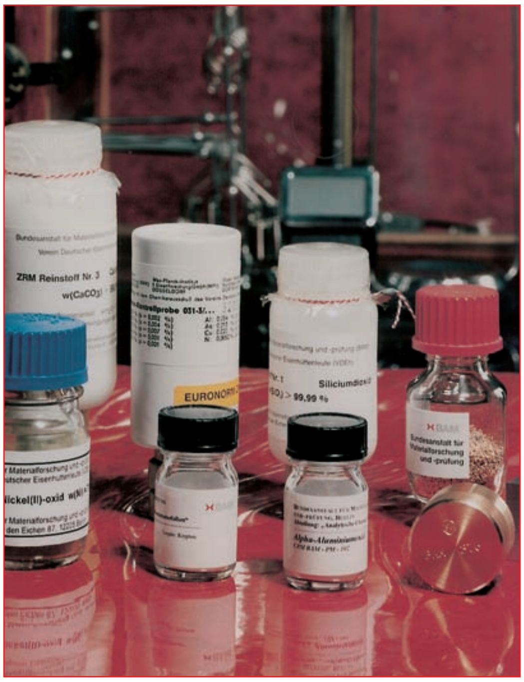
BAM

Federal Institute for
Materials Research
and Testing



Catalogue '07

Certified Reference Materials

Pursuing its Mission BAM ensures:

Safety in technology and chemistry

Objectives

The Federal Institute (Bundesanstalt für Materialforschung und -prüfung, BAM) has its responsibility in the interacting fields of Materials – Chemistry – Environment – Safety, in particular:

- statutory functions for technical safety in the public domain, especially relating to dangerous goods and substances
- collaboration in developing legal regulations like on safety standards and threshold values
- consulting on safety aspects of materials technology and chemistry for the Federal Government and industry
- development and supply of reference materials and reference methods, especially for chemical analysis and materials testing
- assistance in developing standards and technical rules for the evaluation of substances materials, structures and processes with reference to damage prevention, life time prediction, protection of the environment and conservation of economical values.

Activities

BAM is engaged in the interdependent and complementary activities:

- research and development
- testing, analysis, approvals
- consultation and information

National and international cooperation

The tasks of BAM for technology, science, economy and society require interdisciplinary cooperation. BAM collaborates closely with technological institutions in Germany and abroad, especially with national institutes. It gives advice to Federal Ministries, economy associations, industrial enterprises and consumer organizations. It provides expertise to administrative authorities and law-courts. In the area of measurement, standardization, testing and quality assurance BAM is the competent national authority for testing techniques. BAM is cooperating with numerous technical, legislative and standardization bodies in order to develop technical rules and safety regulations and represents the Federal Republic of Germany both on the national and international level.

Status

BAM is a senior technical and scientific Federal Institute with responsibility to the Federal Ministry of Economics and Technology. It is the successor of the Public Materials Testing Office (Staatliches Materialprüfungsamt) founded in 1871 and of the Chemical-Technical State Institute (Chemisch-Technische Reichsanstalt) set up in 1920. BAM has a staff of about 1600, including over 700 scientists and engineers working at the main grounds of Berlin-Lichterfelde and at the extension Berlin-Adlershof.

Certified Reference Materials Catalogue

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Unter den Eichen 87
12205 Berlin, Germany
Mailing address: 12200 Berlin, Germany
Phone: +49 30 8104-0
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Internet: http://www.bam.de

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Edited by:
Rita Pradel

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Foreword

Certified Reference Materials, as defined in the ISO Guide 30 and the International Vocabular of Metrology (VIM), can act as traceability links to the International System of Measurement (SI). By application, e.g. of a CRM whose matrix and analyte levels match those of the samples under investigation as closely as possible, the analyst is able to assure himself that his measurements have been properly carried out to the required level of accuracy.

The Federal Institute for Materials Research and Testing (BAM) has a long tradition in the production of Certified Reference Materials. Starting in 1912 with a "Normal Steel" for the determination of carbon, the development of new CRMs has increased continuously. One year later 8 steel samples with different carbon contents were available. The development continued with the participation of regional German material research and testing institutes as well as industry (1957). In 1968 within the framework of EURONORM, the first European CRMs in the field of iron and steel were issued (see page 10).

Today a large range of ferrous and non ferrous CRMs together with environmental CRMs and CRMs for engineering materials are offered in our new catalogue.

The catalogue provides technical and general ordering information for the CRMs currently available from the Federal Institute for Materials Research and Testing (BAM).

Reference material (RM): material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Certified reference material (CRM): reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes its traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

Ordering BAM reference materials

General

Purchase orders for BAM-CRMs should be directed to:

Bundesanstalt für Materialforschung
und –pruefung (BAM)
Fachgruppe I.1 Anorganisch-chemische Analytik, Referenzmaterialien
Richard-Willstaetter-Str. 11
12489 Berlin, Germany

Phone:	**+49 30 8104-2061**
Fax:	**+49 30 8104-1117**

Email:	sales.crm@bam.de
Webshop:	http://www.webshop.bam.de

Terms and conditions

For prices see separate price list, which is also available on our homepage.

http://www.bam.de/en/fachthemen/referenzmaterialien/index.htm

Packaging, postage and other forwarding costs will be charged extra. Shipment will be made only by parcel post. Insurance will be arranged by the customer.

Iron and steel products

EURONORM certified reference materials for the chemical analysis of iron and steel products

EURONORM certified reference materials are prepared under the auspices of the European Committee for Iron and Steel Standardization (ECISS) in a collaboration between the producing organizations in:

France: Institute de Recherches de la Sidérurgie (IRSID), Centre de Dévelopement des Industries de Mise en Forme des Matériaux (CTIF),

the Federal Republic of Germany: Iron and Steel CRM Working Group comprising Bundesanstalt für Materialforschung und -prüfung (BAM), Max-Planck-Institut für Eisenforschung, Verein Deutscher Eisenhüttenleute (VDEh),

the United Kingdom: Bureau of Analysed Samples Limited,

Sweden/Finland: Jernkontoret, Swedish Institute for Metals Research.

Starting in 1968 EURONORM-CRMs have been analysed by laboratories in the European Community (EC) and further European countries. These samples are indicated by an asterisk in the tables. A number of former national CRMs are also listed in the tables. After examination by laboratories in the EC they have been accepted as EURONORM-CRMs.

Approximately 20 laboratories take part in the analysis. Each laboratory is requested to analyse the elements to be determined four times. A statistical evaluation of the laboratory mean values is carried out with respect to their normal distribution and the identification of any outlying values.

The finely divided EURONORM-CRMs are supplied in glass bottles containing 100 g. Some EURONORM-CRMs are also available in solid form (discs). Samples in the form of chips, pins and balls with certified oxygen and nitrogen content are also available.

This catalogue represents European CRMs of German origin. For CRMs of British and French origin please contact the above mentioned producers. Details of all ECRMs are given in CEN-Report CR 10317 and Information Circular No. 5 (ECSC), both of which are available from the national standards body in your country.

Types of material

The following types of material are available as EURONORM-CRM:

Unalloyed steels (0), alloyed steels (1), highly alloyed steels (2), special alloys (3), cast iron (4), ferro-alloys (5), ores (6), ceramics (7) and slags (8).

Our system of numbering of the samples allows an easy orientation about the type of material. The first digit of the sample number shows the type of material (0 - unalloyed steel, 1 - low alloyed steel, 2 - highly alloyed steel etc.). The second and third digit characterizes the single sample. Another digit, separated by a hyphen gives the number of editions of the material.

Content of the certificate

On the head of the certificate the EURONORM-number and the type of material of the sample is given. The mean values of the laboratories involved in the certification campaign are given in a table together with indicative values. The mean values of the accepted data sets, their standard deviations and the standard deviations of the laboratories are also given in the table. The sign "-" in the table stands for an outlier pointed out by statistical tests. The certified values are given in a second table together with their uncertainties (95%-level) or standard deviations. Additionally the following information are given: The owner of the material, a characterization of the sample (e.g. grain size, dimensions of compact samples), the laboratories involved in the certification campaign, the analytical methods used for element determination, sources for getting additional information published by ECISS/EGKS.

The following information are given in the tables:

* - analysed by 20 to 25 European laboratories

Indicative values (not certified) are given in parenthesis.

Authentic for the certified element contents are only the values given in the certificates, not the values given in this catalogue.

Samples for the determination of nitrogen and oxygen (N-O-materials)

Three different types of material are available:

Unalloyed steel: the pin-shaped material (100 mm long, 8 mm in diameter) forms an iron oxide coating. Before analysis this layer has to be removed by turning and care has to be taken to prevent a reoxidation of the cleaned surface.

Highly alloyed stainless steel: after formation of a reproducible and constant oxide layer the chipped material is protected (passivated) against further oxidation. There is no need for sample pretreatment.

Ball-bearing steel: The surfaces of the balls are protected against oxidation by a layer of gold. The diameter of the balls is kept constant with high reproducibility resulting in masses of 1,00050 g ± 0,00015 g. Weighing of the material is not necessary.

Samples for optical emission and X-ray fluorescence spectrometry

The samples are in form of discs (cylinders of 36 to 41 mm diameter and 20 to 35 mm height) and except D 098-1 also available in form of chips. The samples 035-2 and 290-1/291-1 are prepared by hot isostatic pressing (HIP) of powder which is atomized from the melt and solidified in inert gas giving a material of high homogeneity.

Unalloyed steels

Mass fraction in % ± standard deviation

CRM-No.	**D 030-4**	**D 031-3**	**D 032-2**	**D 035-2*[1)]**	**D 036-1**
Year of issue	1973	1972	1968	1998	1968
Chips, powder	•	•	•	•	•
Disc				•	
C	0,456 ± 0,004	0,055 ± 0,002	0,271 ± 0,007	1,277 ± 0,005	0,858 ± 0,008
Si	0,318 ± 0,007	0,037 ± 0,004	0,282 ± 0,007	0,216 ± 0,004	0,194 ± 0,005
Mn	0,603 ± 0,004	0,329 ± 0,007	0,556 ± 0,008	0,305 ± 0,002	0,327 ± 0,010
P	0,018 ± 0,002	0,014 ± 0,001	0,0129 ± 0,0007	0,0038 ± 0,0003	0,0074 ± 0,0009
S	0,021 ± 0,002	0,021 ± 0,001	0,0254 ± 0,0010	0,0111 ± 0,0003	0,0095 ± 0,0009
Cr	0,117 ± 0,004	—	(0,088)	0,0104 ± 0,0003	(0,091)
Mo	—	—	—	0,0056 ± 0,0002	—
Ni	0,042 ± 0,002	—	(0,040)	0,0190 ± 0,0004	(0,058)
Al_{total}	0,042 ± 0,006	0,054 ± 0,002	—	0,0193 ± 0,0005	(0,015)
$Al_{insol.}$	—	—	—	—	—
$Al_{acid-sol.}$	—	—	—	0,0177 ± 0,0004	—
As	0,012 ± 0,002	0,013 ± 0,002	0,020 ± 0,002	0,0017 ± 0,0001	0,0233 ± 0,0007
Cu	0,061 ± 0,002	0,020 ± 0,002	0,085 ± 0,002	0,0085 ± 0,0002	0,065 ± 0,005
N	0,0051 ± 0,0003	0,0050 ± 0,0004	0,0044 ± 0,0009	0,0230 ± 0,0004	0,0100 ± 0,0008
Nb	—	—	—	—	—
Pb	—	—	—	—	—
Sn	0,0055 ± 0,0007	—	(0,006)	—	(0,006)
Ti	—	—	—	0,0030 ± 0,0001	—
V	—	—	—	—	(0,019)
Te	—	—	—	—	—

(Values in parenthesis are indicative values)

- continued –

1) Powdered material, produced by atomization of the melt

Unalloyed steels (continued)

CRM-No.	**D 039-2**	**D 042-1**	**D 077-2***	**D 079-2***	**D 082-1***	**D 083-1***
Year of issue	1971	1972	1976	1989	1976	1978
Chips, powder	•	•	•	•	•	•
Disc						
C	0,107 ± 0,003	0,108 ± 0,003	0,151 ± 0,004	0,596 ± 0,006	0,415 ± 0,003	0,0262**R**± 0,0003+
Si	0,011 ± 0,002	0,037 ± 0,005	0,293 ± 0,008	0,247 ± 0,006	0,235 ± 0,005	—
Mn	1,274 ± 0,014	0,666 ± 0,010	1,28 ± 0,02	0,743 ± 0,013	0,769 ± 0,008	0,289 ± 0,004
P	0,083 ± 0,004	0,0057**R**±0,0004	0,022 ± 0,001	0,0234 ± 0,0012	0,013 ± 0,001	0,0077 ± 0,0009
S	0,310 ± 0,005	0,024 ± 0,024	0,014 ± 0,001	0,192 ± 0,006	0,030 ± 0,001	0,0100 ± 0,0005
Cr	0,048 ± 0,003	0,016 ± 0,004	(0,016)	0,0382 ± 0,0023	0,018 ± 0,001	(0,0129)
Mo	—	—	(0,003)	—	—	—
Ni	0,051 ± 0,003	0,029 ± 0,002	(0,021)	0,0219 ± 0,0010	0,027 ± 0,001	0,014 ± 0,001
Al	—	0,010 ± 0,001	0,034 ± 0,002	0,0209 ± 0,0017	0,032 ± 0,002	(0,0044)
As	0,018 ± 0,001	—	0,007 ± 0,001	0,0040 ± 0,0007	(0,029)	(0,0043)
Cu	0,117 ± 0,006	0,041 ± 0,002	(0,029)	0,0462 ± 0,0010	0,025 ± 0,001	0,016 ± 0,001
N	0,0113 ± 0,0004	0,0078 ± 0,0007	0,0054 ±0,0005	0,0074 ± 0,0005	(0,0047)	0,0022 ± 0,0003
Nb	—	0,054 ± 0,005	—	—	—	—
Pb	0,207 ± 0,005	—	—	—	0,149 ± 0,004	—
Sn	0,016 ± 0,001	—	(0,003)	0,0037 ± 0,0008	—	—
Ti	—	—	—	(0,0021)	—	—
V	—	—	0,058 ± 0,003	—	—	—
Te	—	—	—	—	0,030 ± 0,001	—

(Values in parenthesis are indicative values) **R**: revised value + 95%-confidence interval

Pure iron

Disc

Mass fraction in µg/g

± 95%-confidence interval

CRM-No.	**D 098-1***
Year of issue	1993
C	5,1 ± 1,3
Si	4,8 ± 1,1
Mn	0,8 ± 0,4
P	(0,6)
S	3,1 ± 0,5
Cr	57,1 ± 2,4
Mo	8,5 ± 0,8
N	2,4 ± 0,7

(Values in parenthesis are indicative values)

Alloy steels

Mass fraction in % ± standard deviation

CRM-No.	**D 126-1**	**D 128-1**	**D 130-1**	**D 179-2***
Year of issue	1963	1972	1968	1990
Chips, powder	•	•	•	•
Disc				•
C	0,841 ± 0,008	0,085 ± 0,003	0,546 ± 0,005	0,598 ± 0,009
Si	(0,241)	0,949 ± 0,010	0,313 ± 0,006	0,579 ± 0,011
Mn	1,817 ± 0,009	0,839 ± 0,010	1,593 ± 0,009	0,539 ± 0,010
P	0,0092 ± 0,0011	0,007 ± 0,001	0,0209 ± 0,0017	0,0267 ± 0,0024
S	0,0050 ± 0,0007	0,007 ± 0,001	0,0158 ± 0,0011	(0,0006)
Cr	0,317 ± 0,009	0,108 ± 0,003	(0,032)	1,08 ± 0,03
Mo	—	—	—	0,070 ± 0,006
Ni	(0,038)	0,046 ± 0,006	(0,031)	0,078 ± 0,007
Al	—	0,286 ± 0,010	0,0037 ± 0,0005	—
$Al_{acid\ soluble}$	—	—	0,0019 ± 0,0006	—
As	—	—	0,0167 ± 0,0011	—
B	—	—	—	—
Co	—	—	—	(0,015)
Cu	(0,098)	0,055 ± 0,003	0,072 ± 0,003	0,111 ± 0,004
N	—	(0,0024)	0,0093 ± 0,0008	0,0068 ± 0,0005
Nb	—	—	—	0,00144 ± 0,00013
Pb	—	—	—	0,00013 ± 0,00002
Sn	—	—	(0,006)	—
Ti	—	0,890 ± 0,013	—	(0,0014)
V	0,143 ± 0,004	(0,008)	(0,003)	0,188 ± 0,007
W	—	—	—	1,87 ± 0,05
Bi	—	—	—	< 0,00003
Ca	—	—	—	—
Cd	—	—	—	< 0,00003
Ga	—	—	—	0,00129 ± 0,00012
Hg	—	—	—	(< 0,00001)
Mg	—	—	—	—
Sb	—	—	—	0,00175 ± 0,00010
Se	—	—	—	(< 0,00020)
Te	(0,0002)	—	—	< 0,00020
Tl	—	—	—	(< 0,000035)
Zn	—	—	—	0,00023 ± 0,00004

(Values in parenthesis are indicative values)

- continued -

Alloy steels (continued)

CRM-No.	**D 180-1***	**D 181-1***	**D 182-1***	**D 183-1***	**D 184-1***
Year of issue	1973	1973	1974	1973	1978
Chips, powder	•	•	•	•	•
Disc					
C	0,197 ± 0,005	0,590 ± 0,005	0,790 ± 0,008	0,083 ± 0,002	0,333 ± 0,003
Si	0,362 ± 0,007	1,054 ± 0,015	0,368 ± 0,014	0,421 ± 0,006	0,218 ± 0,005
Mn	1,286 ± 0,015	1,047 ± 0,008	0,389 ± 0,007	0,354 ± 0,004	0,528 ± 0,006
P	0,0174 ± 0,0010	0,018 ± 0,001	0,0076**R** ± 0,0005	0,089 ± 0,002	0,0047**R** ± 0,0003
S	0,0249 ± 0,0010	0,035 ± 0,001	0,011 ± 0,001	0,031 ± 0,001	0,0032 ± 0,0003
Cr	1,250 ± 0,018	0,126 ± 0,004	0,591 ± 0,012	0,670 ± 0,013	1,287 ± 0,011
Mo	—	—	—	—	0,457 ± 0,009
Ni	0,096 ± 0,008	0,070 ± 0,004	0,152 ± 0,005	0,073 ± 0,004	3,318 ± 0,015
Al	—	0,022 ± 0,004	0,020 ± 0,003	0,027 ± 0,002	0,0052 ± 0,0007
$Al_{acid\ soluble}$	—	—	—	—	—
As	0,030 ± 0,002	(0,026)	(0,0202)	(0,013)	0,0180 ± 0,0011
B	—	—	—	—	—
Co	—	—	—	—	0,0560 ± 0,0019
Cu	0,115 ± 0,004	0,174 ± 0,005	0,141 ± 0,004	0,445 ± 0,010	0,060 ± 0,002
N	0,0068 ± 0,0009	0,0068 ± 0,0005	0,0102 ± 0,0004	0,0064 ± 0,0006	0,0051 ± 0,0004
Nb	—	—	—	—	—
Pb	—	—	0,0039 ± 0,0003	—	—
Sn	—	(0,015)	(0,0135)	—	0,0044 ± 0,0004
Ti	—	—	—	—	—
V	—	—	0,177 ± 0,010	—	0,108 ± 0,006
W	—	—	—	—	—
Ca	—	—	—	—	—
Mg	—	—	(0,0005)	—	—
Sb	—	(0,004)	0,0042 ± 0,0005	—	(0,0015)
Te	—	—	—	—	—
Zn	—	—	0,0015 ± 0,0002	—	—

(Values in parenthesis are indicative values) **R**: revised value

- continued -

Alloy steels (continued)

CRM-No.	**D 187-1***	**D 191-1***	**D 191-2***	**D 192-1***	**D 193-1***	**D 194-1***
Year of issue	1982	1986	2006	1994	1990	1993
Chips,	•		•	•	•	•
Disc		•		•	•	•
C	0,195 ± 0,003	0,013 ± 0,002	0,0043 ± 0,0002+	0,1875 ± 0,0009	0,139 ± 0,004	0,1532 ± 0,0011+
Si	0,026 ± 0,002	3,140 ± 0,022	3,267 ± 0,012+	0,219 ± 0,004	0,404 ± 0,006	0,431 ± 0,004+
Mn	1,354 ± 0,011	0,025 ± 0,002	0,1334 ± 0,0019+	1,377 ± 0,006	0,972 ± 0,017	1,188 ± 0,004+
P	0,014 ± 0,001	0,011 ± 0,001	0,0087 ± 0,0004+	0,0029 ± 0,0002	0,0063 ± 0,0006	0,0097 ± 0,0006+
S	0,025 ± 0,001	0,0017 ± 0,0003	0,0029 ± 0,0002+	0,0010 ± 0,0001	0,0086 ± 0,0006	0,00059**R** ± 0,00005+
Cr	1,186 ± 0,015	0,025 ± 0,002	0,0314 ± 0,0006+	0,0717 ± 0,0018	0,182 ± 0,006	0,733 ± 0,006+
Mo	0,035 ± 0,002	(0,0021)	0,0020 ± 0,0002+	0,482 ± 0,004	0,347 ± 0,011	0,2857 ± 0,0026+
Ni	0,096 ± 0,003	0,018 ± 0,002	0,0224 ± 0,0004+	0,755 ± 0,004	1,178 ± 0,019	0,3417 ± 0,0027+
Al	0,046 ± 0,002	0,397 ± 0,015	0,985 ± 0,006+	0,0308 ± 0,0008	0,0257 ± 0,0015	0,0837 ± 0,0020+
Al$_{\text{acid soluble}}$	—	—	—	0,0285 ± 0,0008	—	—
As	0,018 ± 0,002	0,0031 ± 0,0006	0,0018 ± 0,0003+	(0,003)	0,0062 ± 0,0007	0,0042 ± 0,0004+
B	0,0004 ± 0,0002	—	—	(0,00016)	(0,0002)	0,0020 ± 0,0002+
Co	0,014 ± 0,001	—	—	0,0055 ± 0,0002	0,0073 ± 0,0007	—
Cu	0,161 ± 0,003	0,0080 ± 0,0006	0,0165 ± 0,0003+	0,0453 ± 0,0008	0,598 ± 0,009	0,0751 ± 0,0011+
N	0,014 ± 0,001	0,0026 ± 0,0003	0,00105 ± 0,00009+	0,0118 ± 0,0002	0,0108 ± 0,0004	0,0115 ± 0,0002+
Nb	—	—	—	—	0,0232 ± 0,0019	—
Pb	—	—	—	—	(0,0002)	—
Sn	0,011 ± 0,001	—	0,0050 ± 0,0005+	(0,0030)	—	—
Ti	—	0,009 ± 0,002	0,0024 ± 0,0002+	(0,0009)	(0,0013)	—
V	—	—	—	(0,003)	(0,0019)	0,0243 ± 0,0009+
W	—	—	—	—	—	—
Ca	—	—	—	—	—	0,0026 ± 0,0002+
Mg	—	—	—	—	—	—
Sb	—	—	(0,0007)	—	—	—
Te	—	—	—	—	—	—
Zn	—	—	—	—	—	—

(Values in parenthesis are indicative values) **R**: revised value + 95%-confidence interval

Highly alloyed steels

Mass fraction in % ± standard deviation

CRM-No.	D 226-1	D 227-1	D 231-2*	D 235-1
Year of issue	1967	1971	2002	1972
Chips	•	•	•	•
Disc				
C	0,416 ± 0,007	0,950 ± 0,013	0,0140 ± 0,0003^{+}	0,912 ± 0,014
Si	0,514 ± 0,007	0,272 ± 0,013	0,368 ± 0,006^{+}	0,094 ± 0,010
Mn	0,434 ± 0,013	0,236 ± 0,007	1,263 ± 0,009^{+}	12,73 ± 0,07
P	0,0207 ± 0,0012	0,016 ± 0,001	0,0179 ± 0,0007^{+}	0,045 ± 0,002
S	0,0094 ± 0,0014	0,022 ± 0,002	0,0250 ± 0,0007^{+}	0,0072 ± 0,0007
Cr	13,67 ± 0,06	4,25 ± 0,02	18,071 ± 0,018^{+}	0,354 ± 0,014
Mo	0,024 ± 0,006	2,64 ± 0,05	0,301 ± 0,004^{+}	0,032 ± 0,003
Ni	0,139 ± 0,014	0,114 ± 0,008	10,105 ± 0,021^{+}	(0,08)
Al	—	—	0,0032 ± 0,0004^{+}	—
As	(0,0256)	—	0,0048 ± 0,0003^{+}	—
B	—	—	0,0020 ± 0,0002^{+}	—
Co	(0,0246)	—	0,0402 ± 0,0011^{+}	—
Cu	—	0,124 ± 0,005	0,0941 ± 0,0009^{+}	0,073 ± 0,002
N	0,0362 ± 0,0017	0,040 ± 0,002	0,0444 ± 0,0004^{+}	0,020 ± 0,0008
Nb	—	—	—	—
Pb	—	—	(0,00007)	—
Sn	(0,0068)	0,0251 ± 0,0024	0,0043 ± 0,0003^{+}	—
Ti	—	—	0,0007 ± 0,0002^{+}	—
V	0,022 ± 0,003	2,44 ± 0,03	0,0708 ± 0,0008^{+}	(0,012)
W	—	3,03 ± 0,06	0,0141 ± 0,0010^{+}	—
Zr	—	—	—	—
Ag	—	(0,000064)	—	—
O	—	—	—	—
Sb	—	0,0035 ± 0,0005	0,0011 ± 0,0001^{+}	—
Ta	—	—	—	—
Ca	—	—	0,00074 ± 0,00014^{+}	—

(Values in parenthesis are indicative values) $^{+}$95%-confidence interval   - continued -

Highly alloyed steels (continued)

CRM-No.	**D 237-1**	**D 271-1***	**D 278-1***	**D 283-1***	**D 284-2***	**D 286-1***
Year of issue	1973	2006	1973	1985	2000	1985
Chips	•	•	•	•	•	•
Disc		•			•	
C	0,068 ± 0,002	0,3698 ± 0,0021+	0,903 ± 0,019	1,219 ± 0,009	0,0201 ± 0,0005+	0,100 ± 0,005
Si	0,482 ± 0,013	0,923 ± 0,006+	0,336 ± 0,008	0,345 ± 0,017	0,537 ± 0,008+	—
Mn	1,443 ± 0,018	0,437 ± 0,004+	0,405 ± 0,006	0,217 ± 0,010	1,745 ± 0,009+	1,92 ± 0,03
P	0,032 ± 0,002	0,0120 ± 0,0004+	0,0154 ± 0,0014	0,022 ± 0,002	0,0258 ± 0,0008+	0,026 ± 0,002
S	0,012 ± 0,001	0,00045± 0,00008+	0,0052 ± 0,0011	0,029 ± 0,002	0,0237 ± 0,0005+	0,280 ± 0,014
Cr	17,24 ± 0,04	5,002 ± 0,019+	18,11 ± 0,08	4,15 ± 0,06	16,811 ± 0,019+	18,13 ± 0,08
Mo	0,306 ± 0,006	1,247 ± 0,006+	1,040 ± 0,030	3,41 ± 0,09	2,111 ± 0,010+	0,329 ± 0,009
Ni	10,32 ± 0,04	0,1552 ± 0,0020+	0,236 ± 0,024	—	10,72 ± 0,05+	8,54 ± 0,04
Al	—	0,0234 ± 0,0011+	—	0,0099± 0,0014	0,0027 ± 0,0004+	(0,0023)
As	—	0,0057 ± 0,0004+	—	(0,0096)	0,0063 ± 0,0003+	—
B	—	(0,0003)	—	0,0003± 0,0001	0,0026 ± 0,0001+	(0,0003)
Co	0,221 ± 0,006	0,0139 ± 0,0005+	—	10,27 ± 0,17	0,0525 ± 0,0011+	0,150 ± 0,008
Cu	0,123 ± 0,005	0,1371 ± 0,0015+	0,077 ± 0,008	—	0,1831 ± 0,0014+	—
N	0,035 ± 0,002	0,0137 ± 0,0003+	—	0,033 ± 0,002	0,0151 ± 0,0002+	0,043 ± 0,002
Nb	0,660 ± 0,023	(0,0009)	—	—	(0,0028)	—
Pb	—	(0,0005)	—	(< 0,0005)	—	(0,0003)
Sn	—	0,0084 ± 0,0002+	—	(0,0065)	0,0047 ± 0,0002+	0,0084± 0,0009
Ti	—	0,0020 ± 0,0002+	—	—	0,191 ± 0,004+	—
V	0,057 ± 0,005	0,850 ± 0,007+	0,077 ± 0,008	3,28 ± 0,03	0,0425 ± 0,0016+	—
W	—	0,0054 ± 0,0005+	—	9,66 ± 0,12	(0,0183)	—
Zr	—	(0,00013)	—	—	(0,0005)	—
Ag	—	—	—	—	—	—
Ca	—	0,0009 ± 0,0002+	—	—	—	—
Mg	—	(0,00013)	—	—	—	—
O	—	0,0020±0,0002+1)	—	—	0,0099± 0,0007+2)	—
Sb	—	(0,0017)	—	—	—	(0,0315)
Ta	—	—	—	—	(0,0013)	0,0014± 0,0004

(Values in parenthesis are indicative values)

1) Oxygen certified only for disc
2) Oxygen certified only for chips

+95%-confidence interval

- continued

Highly alloyed steels (continued)

CRM-No.	**D 288-1***	**D 289-1***	**D 290-1*[1)]**	**D 291-1*[1)]**	**D 294-1***	**D 297-1***
Year of issue	1986	1990	1990	1990	2005	2005
Chips	•	•	•	•	•	•
Disc	•	•	•	•	•	•
C	2,08 ± 0,02	0,0489 ± 0,0022	0,911 ± 0,010	0,903 ± 0,008	0,0657 ± 0,0010+	0,0223 ± 0,0004+
Si	0,260 ± 0,012	0,531 ± 0,013	0,072 ± 0,007	0,907 ± 0,018	0,283 ± 0,005+	0,344 ± 0,006+
Mn	0,292 ± 0,008	1,016 ± 0,016	0,244 ± 0,010	0,808 ± 0,011	18,68 ± 0,04+	0,897 ± 0,007+
P	0,024 ± 0,002	0,0114 ± 0,0010	0,0160 ± 0,0005	0,0168 ± 0,0016	0,0273 ± 0,0013+	0,0135 ± 0,0004+
S	(0,0012)	0,0027 ± 0,0004	0,0160 ± 0,0008	0,0087 ± 0,0007	0,00031±0,00009+	0,0101 ± 0,0003+
Cr	12,00 ± 0,08	14,63 ± 0,11	4,18 ± 0,06	17,10 ± 0,10	17,98 ± 0,05+	18,37 ± 0,03+
Mo	0,103 ± 0,007	1,102 ± 0,015	4,83 ± 0,09	2,10 ± 0,06	0,0861 ± 0,0022+	0,290 ± 0,005+
Ni	0,298 ± 0,007	24,68 ± 0,19	0,329 ± 0,018	0,563 ± 0,011	0,427 ± 0,006+	12,33 ± 0,02+
Al	0,012 ± 0,002	0,199 ± 0,011	—	0,0030 ± 0,0006	(0,0095)	0,0195 ± 0,0009+
As	(0,0065)	(0,0056)	—	—	0,00365±0,00029+	0,0040 ± 0,0005+
B	—	0,0044 ± 0,0004	—	—	(<0,00005)	1,146[2)] ± 0,009+
Co	0,018 ± 0,002	0,065 ± 0,006	5,12 ± 0,12	0,0233 ± 0,0022	0,0288 ± 0,0009	0,0413 ± 0,0007+
Cu	0,060 ± 0,004	—	0,081 ± 0,004	0,0711 ± 0,0019	0,0242 ± 0,0007+	0,204 ± 0,004+
N	0,0151 ± 0,0004	—	0,0325 ± 0,0012	0,1142 ± 0,0038	0,566 ± 0,011+	0,0152 ± 0,0007+
Nb	—	—	—	(0,0057)	(0,00117)	(0,0089)
Pb	—	(0,0008)	—	—	(0,000128)	—
Sn	(0,0043)	0,111 ± 0,010	—	—	(0,0014)	—
Ti	0,020 ± 0,002	2,01 ± 0,05	—	—	(0,0008)	0,0072 ± 0,0004+
V	0,055 ± 0,004	0,260 ± 0,015	1,91 ± 0,04	0,388 ± 0,016	0,0694 ± 0,0021+	0,0535 ± 0,0008+
W	(0,682)	—	6,27 ± 0,14	—	(0,00114)	(0,0057)
Zr	—	—	—	—	(0,0001)	(0,0002)
Ag	—	—	—	—	—	—
Ca	—	—	—	—	(0,00026)	(0,0002)
O	—	—	—	—	—	—
Sb	(0,0014)	(0,0013)	—	—	(0,00053)	—
Ta	—	—	—	—	—	—
Te	—	—	—	—	(<0,00008)	—

(Values in parenthesis are indicative values) +95%-confidence interval

1) Powdered material, produced by atomization of the melt
2) Boron isotope ratio $^{10}B/^{11}B$ (0,24811)

Special alloys

Chips

Mass fraction in % ± standard deviation

CRM-No.	D 326-1	D 327-2	D 328-1
Year of issue	1972	1972	1973
C	0,092 ± 0,002	0,152 ± 0,003	0,390 ± 0,005
Si	1,46 ± 0,025	2,052 ± 0,028	0,629 ± 0,014
Mn	0,406 ± 0,008	1,289 ± 0,018	1,395 ± 0,012
P	0,0093 ± 0,0009	0,0228 ± 0,0014	0,005 ± 0,001
S	0,0028 ± 0,0006	0,0046 ± 0,0012	0,003 ± 0,001
Cr	16,37 ± 0,05	24,35 ± 0,08	20,54 ± 0,07
Mo	(0,025)	0,174 ± 0,009	4,41 ± 0,07
Ni	61,16 ± 0,16	19,72 ± 0,08	20,38 ± 0,19
Al_{total}	(0,79)	0,070 ± 0,006	0,070 ± 0,006
Co	0,223 ± 0,011	0,159 ± 0,010	41,65 ± 0,24
Cu	(0,027)	0,060 ± 0,003	0,013 ± 0,003
N	(0,0359)	0,059 ± 0,0024	0,027 ± 0,002
Nb	—	—	3,61 ± 0,22
V	(0,024)	0,044 ± 0,004	—
W	—	—	4,16 ± 0,04
Zr	0,129 ± 0,008	—	—
Fe	—	—	2,40 ± 0,06
Ta	—	—	0,18 ± 0,02

(Values in parenthesis are indicative values)

Cast irons

Mass fraction in % ± standard deviation

CRM-No.	**D 428-2*[1)]**	**D 476-3***	**D 478-2***	**D 479-1*[1)]**	**D 480-1*[1)]**
Year of issue	1998	1996	1996	1978	1979
Chips, powder	•	•	•	•	•
Disc					
C_{total}	2,747 ± 0,009$^+$	3,390 ± 0,011$^+$	4,003 ± 0,013$^+$	2,86 ± 0,04	3,03 ± 0,02
Si	1,752 ± 0,007$^+$	1,813 ± 0,005$^+$	2,411 ± 0,021$^+$	2,02 ± 0,02	2,41 ± 0,02
Mn	0,750 ± 0,05$^+$	0,987 ± 0,008$^+$	0,321 ± 0,005$^+$	0,136 ± 0,008	0,151 ± 0,005
P	0,0691 ± 0,0011$^+$	0,0908 ± 0,0023$^+$	0,201 ± 0,006$^+$	0,076 ± 0,003	0,0021**R** ± 0,0005
S	0,1105 ± 0,0018$^+$	0,0493 ± 0,0009$^+$	0,0460 ± 0,0015$^+$	0,089 ± 0,003	0,0086 ± 0,0010
Cr	0,0366 ± 0,0017$^+$	0,0648 ± 0,0012$^+$	0,251 ± 0,005$^+$	1,00 ± 0,02	(0,0164)
Mo	(0,0014)	—	—	0,196 ± 0,005	—
Ni	0,0358 ± 0,0005$^+$	0,0549 ± 0,0014$^+$	0,151 ± 0,007$^+$	1,012 ± 0,015	0,483 ± 0,007
Al	—	—	—	0,014 ± 0,002	0,016 ± 0,001
As	0,0156 ± 0,0005$^+$	0,0145 ± 0,0007$^+$	(0,0018)	—	—
B	—	—	0,0006 ± 0,0001$^+$	—	—
Cu	0,0996 ± 0,0014$^+$	0,2445 ± 0,0025$^+$	0,1276 ± 0,0019$^+$	—	(0,0052)
N	—	0,0038 ± 0,0001$^+$	0,0023 ± 0,0002$^+$	—	—
Ti	0,0311 ± 0,0005$^+$	0,0222 ± 0,0005$^+$	0,0328 ± 0,0007$^+$	—	—
V	0,0120 ± 0,0003$^+$	0,0115 ± 0,0002$^+$	0,0113 ± 0,0003$^+$	—	—
Mg	—	—	—	—	0,017 ± 0,001

(Values in parenthesis are indicative values) **R**: revised value $^+$ 95%-confidence interval

[1)] Powdered material, produced by atomization of the melt

Ferro alloys

Powder

Mass fraction in % ± standard deviation

CRM-No.	**D 502-2***	**D 529-1**	**D 589-1***	**D 591-1***
Description	FeMn	FeSi	FeTi	FeV
Year of issue	2004	1975	1991	1996
C	6,941 ± 0,023	0,10 ± 0,01	0,132 ± 0,008	0,141 ± 0,004
Si	(0,092)	91,11 ± 0,33	(0,41)	0,847 ± 0,012
Mn	77,88 ± 0,10	0,04 ± 0,005	0,151 ± 0,005	0,307 ± 0,004
P	0,148 ± 0,004	0,013 ± 0,001	(0,0107)	0,0299 ± 0,0017
S	(0,0024)	—	0,0152 ± 0,0011	0,0153 ± 0,0008
Cr	0,0265 ± 0,0006	—	0,506 ± 0,023	—
Mo	—	—	0,934 ± 0,017	—
Ni	0,0384 ± 0,0003	—	0,663 ± 0,015	0,0141 ± 0,0014
Al	—	0,86 ± 0,02	5,34 ± 0,08	3,19 ± 0,05
As	—	—	—	0,0022 ± 0,0002
B	(0,0006)	—	—	(0,0018)
Co	(0,048)	—	0,115 ± 0,006	—
Cu	0,0371 ± 0,0006	0,01 ± 0,001	0,146 ± 0,006	0,0596 ± 0,0016
N	(0,017)	—	0,64 ± 0,05	(0,308)
Sn	—	—	0,55 ± 0,03	—
Ti	0,0034 ± 0,0003	0,09 ± 0,004	68,4 ± 0,5	(0,044)
V	—	—	2,32 ± 0,07	79,72 ± 0,14
Zr	—	—	0,866 ± 0,030	—
Ca	—	0,46 ± 0,04	—	(0,0328)
Fe	(14,6)	6,15 ± 0,08	16,93 ± 0,17	14,59 ± 0,10
Mg	—	0,04 ± 0,006	—	(0,044)
O	—	—	—	(0,516)
Zn	—	—	(0,0103)	—
Pb	0,0179 ± 0,0011	—	—	—

(Values in parenthesis are indicative values)

Ores, iron oxide

Powder

Mass fraction in % ± standard deviation

CRM-No.	**D 627-2**	**D 629-1**	**D 630-1**	**D 631-1**	**D 633-1**
Description	Iron ore	Iron ore	Iron ore	Iron ore	Manganese ore
Year of issue	1966	1966	1969	1969	1967
Fe_{total}	31,77 ± 0,12	36,21 ± 0,13	65,63 ± 0,17	61,09 ± 0,09	1,64 ± 0,04
Si	—	—	—	—	—
SiO_2	9,24 ± 0,08	19,25 ± 0,14	5,88 ± 0,07	3,20 ± 0,06	10,39 ± 0,15
Al	—	—	—	—	—
Al_2O_3	4,49 ± 0,12	4,07 ± 0,08	0,88 ± 0,038	1,06 ± 0,05	1,64 ± 0,12
Ca	—	—	—	—	—
CaO	15,67 ± 0,21	5,63 ± 0,08	0,10 ± 0,017	0,75 ± 0,038	2,02 ± 0,12
Mg	—	—	—	—	—
MgO	1,57 ± 0,08	1,64 ± 0,08	0,47 ± 0,046	0,54 ± 0,059	0,58 ± 0,10
Mn	0,250 ± 0,012	0,390 ± 0,012	0,060 ± 0,005	0,044 ± 0,006	47,85 ± 0,21
P	0,661 ± 0,014	0,696 ± 0,013	0,043 ± 0,003	0,114 ± 0,005	0,170 ± 0,007
S	0,114 ± 0,009	0,063 ± 0,006	0,032 ± 0,004	0,033 ± 0,006	0,227 ± 0,009
Na	—	—	—	—	—
Na_2O	—	—	—	(0,04)	—
K	—	—	—	—	—
K_2O	—	—	—	(0,04)	—
As	0,020 ± 0,001	0,023 ± 0,001	—	—	(0,0040)
BaO	—	—	—	—	1,13 ± 0,08
Cr	0,018 ± 0,003	0,016 ± 0,002	—	—	—
Cu	(0,002)	(0,001)	—	—	—
F	—	—	—	—	—
Ni	—	—	—	—	—
Pb	—	—	—	—	—
Ti	—	—	—	—	—
TiO_2	0,225 ± 0,014	0,216 ± 0,013	0,066 ± 0,013	0,109 ± 0,006	0,079 ± 0,009
V	—	—	—	—	—
Zn	—	—	—	—	—

(Values in parenthesis are indicative values)

Ores, iron oxide (continued)

CRM-No.	**D 678-1***	**D 680-1***	**686-1***
Description	Iron ore	Iron ore	Iron oxide
Year of issue	1975	1977	2002
Fe_{total}	60,75 ± 0,07	59,98 ± 0,08	69,44 ± 0,11
Si	1,73 ± 0,04	4,20 ± 0,02	0,0083 ± 0,0005
SiO_2	—	8,98 ± 0,04	—
Al	0,28 ± 0,03	0,66 ± 0,02	0,0407 ± 0,0012
Al_2O_3	—	1,23 ± 0,04	—
Ca	3,92 ± 0,09	0,45 ± 0,02	0,0097 ± 0,0007
CaO	—	0,63 ± 0,03	—
Mg	0,57 ± 0,02	0,14 ± 0,01	0,0027 ± 0,0002
MgO	—	0,23 ± 0,02	—
Mn	0,08 ± 0,01	0,025 ± 0,002	0,231 ± 0,004
P	1,61 ± 0,04	0,018 ± 0,002	0,0078 ± 0,0001
S	0,021 ± 0,002	0,544 ± 0,017	—
Na	0,11 ± 0,01	0,128 ± 0,004	0,0058 ± 0,0005
Na_2O	0,15	—	—
K	0,11 ± 0,01	0,078 ± 0,003	0,0024 ± 0,0004
K_2O	0,13	—	—
As	—	0,057 ± 0,003	—
Cr	—	0,005 ± 0,001	0,0182 ± 0,0006
Cu	—	0,063 ± 0,003	0,0038 ± 0,0003
F	0,29 ± 0,02	—	—
Ni	—	0,007 ± 0,001	0,0127 ± 0,0004
Pb	—	0,317 ± 0,008	—
Ti	0,13 ± 0,01	0,045 ± 0,003	0,0014 ± 0,0001
TiO_2	—	0,08 ± 0,005	—
V	0,12 ± 0,01	—	—
Zn	—	0,165 ± 0,004	0,0004 ± 0,0001
Cl	—	—	0,095 ± 0,006
Co	—	—	0,0019 ± 0,0001
Mo	—	—	0,0007 ± 0,0001
Sn	—	—	0,0025 ± 0,0002

(Values in parenthesis are indicative values)

Ceramic materials

Powder

Mass fraction in % ± standard deviation

CRM-No.	**D 777-1***	**D 779-1***
Description	Silica brick	Magnesite, low boron
Year of issue	1984	1991
Si	44,44 ± 0,15	0,182 ± 0,015
SiO_2	95,06 ± 0,32	—
Ca	2,02 ± 0,08	1,691 ± 0,023
CaO	2,83 ± 0,10	—
Mg	0,043 ± 0,007	(54,57)
MgO	0,071 ± 0,012	—
Al	0,42 ± 0,02	0,105 ± 0,007
Al_2O_3	0,80 ± 0,04	—
B	—	0,0116 ± 0,0012
Cr	—	(0,0030)
Fe	0,23 ± 0,03	3,73 ± 0,06
Fe_2O_3	0,33 ± 0,04	—
K	0,13 ± 0,02	(0,0020)
K_2O	0,15 ± 0,02	—
Mn	—	0,503 ± 0,017
Na	0,02	(0,0058)
P	—	0,0267 ± 0,0026
Ti	0,27 ± 0,02	0,0081 ± 0,0012

(Values in parenthesis are indicative values)

Slags

Powder

Mass fraction in % ± standard deviation

CRM-No.	**D 826-1**	**D 827-1**
Description	Basic slag	Basic slag
Year of issue	1976	1976
SiO_2	8,96 ± 0,15	6,21 ± 0,15
Al	0,696 ± 0,008	—
Al_2O_3	—	(0,57)
CaO	46,48 ± 0,54	47,38 ± 0,49
MgO	(2,46)	(3,70)
P_2O_5	14,65 ± 0,15	20,70 ± 0,16
P_2O_5 citric acid sol.	10,73 ± 0,14	18,79 ± 0,22
B	(0,0029)	—
Cr	0,182 ± 0,005	—
Cr_2O_3	—	(0,14)
Cu	(0,0019)	—
F	(0,3667)	—
Fe_{total}	(20,73)	(15,72)
K	0,0278± 0,0017	—
Mn_{total}	(3,46)	(2,34)
Mo	(0,0011)	—
Na	0,375 ± 0,009	—
Ni	(0,0017)	—
Pb	(0,0049)	—
V	0,503 ± 0,008	—
V_2O_5	(0,89)	(1,15)

(Values in parenthesis are indicative values)

Samples for the determination of oxygen and nitrogen

Mass fraction in % ± standard deviation

CRM-No.	**D 026-1**	**D 026-2**	**D 027-1**	**D 028-1**
Description	Unalloyed steel	Unalloyed steel	Unalloyed steel	Unalloyed steel
Year of issue	1969	1973	1970	1970
Shape	Rods	Rods	Rods	Rods
O	0,0031 ± 0,0003	0,0025 ± 0,0004	0,0084 ± 0,0006	0,0113 ± 0,0007
N	0,0053 ± 0,0004	0,0042 ± 0,0003	0,0157 ± 0,0010	0,0029 ± 0,0005

CRM-No.	**D 029-1**	**D 099-1***	**D 271-1***	**D 284-2***	**D 286-1***
Description	Unalloyed steel	Ball-bearing steel	Stainless steel	Stainless steel	Stainless steel
Year of issue	1970	1987	2005	2000	1985
Shape	Rods	Balls	Disc	Chips	Chips
O	0,0312 ± 0,0010	0,0008 ± 0,0002	0,00203 ± 0,00016^{+}	0,0099 ± 0,0007^{+}	(0,0315)
N	0,0083 ± 0,0008	0,0078 ± 0,0005	0,0137 ± 0,0003^{+}	0,0151 ± 0,0002^{+}	0,043 ± 0,002

(Values in parenthesis are indicative values)

$^{+}$ 95%-confidence interval

Setting-up sample for spectrometric analysis of low alloyed steels

BAM SUS-1 R

The setting-up sample is suitable for direct reading spark emission and X-ray fluorescence spectrometers analysing low alloyed steels.

The material was prepared by hot isostatic pressing (HIP) of powder which was atomised from the melt of the alloy and solidified in inert gas. Therefore it is of particular high homogeneity. Analysis of the sample was carried out in BAM.

Dimensions: cylinder, 50 mm in diameter, 42 mm high

Element	**Uncertified mass fraction in %**
C	0,9
Si	0,8
Mn	1,1
P	0,02
S	0,017
Cr	1,7
Mo	0,9
Ni	2,9
V	0,5
W	0,7
Cu	0,7
Co	0,3
Nb	0,55

Non ferrous metals and alloys

The **aluminium, copper, lead and zinc based samples** were produced and certified by BAM in collaboration with the Working Groups „Aluminium“, „Copper“, “Lead” and „Zinc“ of the Committee of Chemists of the Gesellschaft für Bergbau, Metallurgie, Rohstoff- und Umwelttechnik (GDMB).

The analyses were carried out in BAM and in laboratories of the non ferrous metals industry. The finely divided samples are supplied in glass bottles containing 100 g each.

Cylindrical samples in block form have been especially designed for spark emission and X-ray fluorescence spectrometers.

The **aluminium discs** are 2,5 cm high and 6 cm in diameter and have been analysed by 10 to 15 industrial laboratories (depending on the element) involved in an interlaboratory comparison organized by BAM.

The **copper blocks** of cylindrical shape have an approximate height of 3 cm and a diameter of about 4 cm. **Lead blocks** of cylindrical shape have a height of 3 cm and a diameter of 4 - 5 cm. **Zinc blocks** of cylindrical shape have a height of 3 cm and a diameter of about 4,5 cm.

The granulated **tin solder** was certified in a German-French collaboration by the Bureau National de Métrologie, involving several industrial laboratories of both countries. The sieved material (fraction 40 to 200 µm) is available from BAM in glass bottles containing 100 g each.

Potassiumdicyanoaurate(I) is provided for wet chemical analysis. It was certified by BAM in collaboration with the Working Group „Precious Metals“ of the Committee of Chemists of the GDMB. It is available in glass bottles containing 6 g each.

Each sample is distributed together with a certificate which contains the certified values together with their uncertainties (95%-level) and the indicative values. The mean values of the accepted data sets, their standard deviations and the standard deviations of the laboratories are also given in the certificate together with the laboratories participating in the certification campaign and the analytical methods used for element determination.

Authentic for the certified element contents are only the values given in the certificates, not the values given in this catalogue.

Aluminium

Chips

Mass fraction in %

CRM-No.	**201**	**209**	**300**	**301**
Description	GAlSi12	GAlSi10Mg	AlMg3	Al99,8
Year of issue	1963	1963	1959	1961
Al	**(matrix)**	**(matrix)**	**(matrix)**	**(matrix)**
Si	13,20	9,65	0,14	0,061
Mg	0,0024	0,31	2,67	0,0008
Cu	0,009	0,004	0,046	0,0016
Fe	0,18	0,18	0,203	0,054
Mn	0,38	0,36	0,018	0,001
Cr	—	—	0,23	—
Ni	—	—	—	—
Pb	—	—	0,016	—
Sn	—	—	(< 0,0005)	(< 0,0005)
Ti	0,011	0,023	0,011	0,005
V	—	—	—	0,0018
Zn	0,038	0,021	0,128	0,033

(Values in parenthesis are indicative values)

Aluminium

Discs

Mass fraction in % ± 95%-confidence interval

CRM-No.	**BAM-307**	**BAM-308**	**BAM-310**	**BAM-311**
Description	AlMg4,5Mn	AlZnMgCu1,5	Al99,85Mg1	AlCuMg2
Year of issue	1990	1990	1993	1993
Si	0,155 ± 0,005	0,0707 ± 0,0024	0,0797 ± 0,0012	0,2040 ± 0,0029
Fe	0,412 ± 0,004	0,1634 ± 0,0027	0,0705 ± 0,0012	0,310 ± 0,006
Cu	0,1043 ± 0,0012	1,315 ± 0,011	0,00169 ± 0,00009	4,653 ± 0,028
Mn	0,701 ± 0,004	0,0342 ± 0,0009	0,00307 ± 0,00011	0,694 ± 0,006
Mg	4,576 ± 0,021	2,290 ± 0,013	0,994 ± 0,015	1,567 ± 0,014
Cr	0,162 ± 0,003	0,1962 ± 0,0024	0,00090 ± 0,00012	0,1037 ± 0,0014
Ni	—	0,0122 ± 0,0004	0,00244 ± 0,00014	0,0519 ± 0,0009
Zn	0,0634 ± 0,0006	5,67 ± 0,04	0,0086 ± 0,0004	0,2005 ± 0,0022
Ti	0,1009 ± 0,0012	0,0285 ± 0,0009	0,00301 ± 0,00011	0,0562 ± 0,0006
Al	**(matrix)**	**(matrix)**	**(matrix)**	**(matrix)**
As	—	—	—	—
B	—	—	(0,0006)	—
Be	0,0011 ± 0,00003	0,00022 ± 0,00001	0,000128± 0,000014	0,00052 ± 0,00004
Bi	—	—	—	0,0500 ± 0,0030
Ca	0,00053 ± 0,00005	—	0,00073 ± 0,00004	(0,0006)
Cd	0,00489 ± 0,00009	—	0,00237 ± 0,00007	0,00127 ± 0,00005
Co	—	—	(0,0009)	0,00115 ± 0,00010
Ga	—	—	0,01152 ± 0,00024	0,0159 ± 0,0005
Hg	—	—	—	—
Li	0,00044 ± 0,00003	—	0,000366± 0,000012	0,00053 ± 0,00005
Mo	—	—	—	—
Na	0,00214 ± 0,00008	—	(0,0003)	(0,0018)
P	—	—	(0,0003)	—
Pb	—	—	0,00347 ± 0,00025	0,0504 ± 0,0011
Sb	—	—	—	—
Sn	—	—	0,00238 ± 0,00018	0,0127 ± 0,0012
Sr	—	—	—	—
Tl	—	—	—	—
V	—	—	0,00444 ± 0,00023	0,0240 ± 0,0008
Zr	—	0,0078 ± 0,0004	0,00135 ± 0,00019	0,140 ± 0,005

(Values in parenthesis are indicative values)

- continued -

Aluminium, discs (continued)

Mass fraction in % ± 95%-confidence interval

CRM-No.	**BAM-312**	**ERM®-EB313 (BAM-313)**	**BAM-314**	**BAM-M315**
Description	AlMgSi0,5	AlMg3	AlSi11Cu2(Fe)	AlSi9Cu3
Year of issue	1995	1997	1999	2006
Si	0,415 ± 0,006	0,363 ± 0,007	11,49 ± 0,10	9,18 ± 0,21
Fe	0,185 ± 0,004	0,391 ± 0,003	0,757 ± 0,007	0,59 ± 0,02
Cu	0,0419 ± 0,0008	0,0932 ± 0,0014	2,071 ± 0,0019	2,51 ± 0,09
Mn	0,0416 ± 0,0008	0,495 ± 0,003	0,400 ± 0,003	0,314 ± 0,007
Mg	0,410 ± 0,005	3,40 ± 0,04	0,1805 ± 0,0029	0,422 ± 0,012
Cr	0,0276 ± 0,0008	0,1224 ± 0,0012	0,0517 ± 0,0008	0,0311 ± 0,0007
Ni	0,00452 ± 0,00015	0,0278 ± 0,0006	0,221 ± 0,003	0,096 ± 0,003
Zn	0,0290 ± 0,0004	0,1579 ± 0,0015	1,195 ± 0,012	0,77 ± 0,02
Ti	0,0288 ± 0,0004	0,0947 ± 0,0014	0,1638 ± 0,0025	0,143 ± 0,005
Al	**(matrix)**	**(matrix)**	**(matrix)**	**(matrix)**
As	—	0,00072 ± 0,00007	0,00279 ± 0,00020	—
B	—	—	—	(< 3 µg/g)
Be	—	0,000547± 0,00002	0,000396 ±0,000021	5 µg/g ± 2 µg/g
Bi	0,0023 ± 0,0004	0,0095 ± 0,0008	0,0094 ± 0,0004	41 µg/g ± 7 µg/g
Ca	—	0,00057 ± 0,00008	—	(~ 15 µg/g **)
Cd	0,00226 ± 0,00010	0,00074 ± 0,00004	0,00130 ± 0,00005	11 µg/g ± 4 µg/g
Co	—	—	0,00532 ± 0,00021	(< 3 µg/g)
Ga	0,0115 ± 0,0004	0,0121 ± 0,0005	0,0154 ± 0,0006	101 µg/g ± 5 µg/g
Hg	—	0,00041 ± 0,00004	—	(33 µg/g ± 2 µg/g)
Li	—	0,000604± 0,00001	—	(~ 7 µg/g **)
Mo	—	0,00053 ± 0,00012	—	—
Na	—	0,00370 ± 0,00024	—	(~ 15 µg/g **)
P	—	—	—	(13 µg/g ± 7 µg/g)
Pb	0,00439 ± 0,00025	0,00433 ± 0,00028	0,221 ± 0,006	0,079 ± 0,004
Sb	—	0,00087 ± 0,00019	0,0093 ± 0,0005	(32 µg/g ± 24 µg/g)
Sn	(0,002)	0,0197 ± 0,0006	0,199 ± 0,005	0,0771 ± 0,0025
Sr	0,00082 ± 0,00010	—	—	(~ 70 µg/g **)
Tl	—	0,00064 ± 0,00004	—	—
V	0,00615 ± 0,00023	0,0299 ± 0,0006	0,0192 ± 0,0005	54 µg/g ± 2,5 µg/g
Zr	0,00101 ± 0,00005	0,0359 ± 0,0019	0,00552 ± 0,00013	30 µg/g ± 7 µg/g

(Values in parenthesis are indicative values)

** the given values are average values, the exact value must be calculated for each single sample

Copper

Chips

Mass fraction in % ± standard deviation

CRM-No.	**211**	**223**	**224**	**227**	**228**
Description	G-SnBz10	CuZn39Pb2	CuZn40MnPb	Rg7	Rg10
Year of issue	1974	1974	1975	1979	1979
Cu	87,71 ± 0,03	58,74 ± 0,02	57,40 ± 0,02	85,57 ± 0,03	85,34 ± 0,03
Sn	10,60* ± 0,04	0,089 ± 0,004	0,066 ± 0,003	6,01 ± 0,07	9,76 ± 0,05
Zn	0,56 ± 0,02	38,82 ± 0,09	39,40 ± 0,04	3,46 ± 0,03	3,32 ± 0,05
Pb	0,74 ± 0,02	2,13 ± 0,02	1,13 ± 0,04	4,12 ± 0,04	1,24 ± 0,03
Fe	0,110 ± 0,003	0,091 ± 0,002	0,136 ± 0,002	0,129 ± 0,002	0,036 ± 0,002
Ni	0,122 ± 0,002	0,0214 ± 0,0005	0,038 ± 0,001	0,284 ± 0,003	0,109 ± 0,005
Mn	0,0019 ± 0,0002	(< 0,001)	1,70 ± 0,03	—	(< 0,001)
Al	—	(< 0,002)	0,0012 ± 0,0002	(< 0,0001)	(0,0001)
Ag	0,059 ± 0,002	—	—	—	—
As	0,0213 ± 0,0008	0,0084 ± 0,0005	0,0025 ± 0,0002	0,081 ± 0,002	0,024 ± 0,001
Bi	0,0020 ± 0,0002	0,0018 ± 0,0001	0,0006 ± 0,0001	0,0088 ± 0,0002	0,0086 ± 0,0003
Cd	0,00144 ± 0,00005	—	—	—	—
Co	—	—	—	—	—
P	0,0267 ± 0,0005	0,0003 ± 0,00015	0,0112 ± 0,0002	(0,0002)	0,019 ± 0,001
S	0,0211 ± 0,0006	0,0011 ± 0,0001	0,0004 ± 0,0001	0,122 ± 0,005	0,036 ± 0,002
Sb	0,033 ± 0,001	0,0040 ± 0,0002	0,0026 ± 0,0001	0,160 ± 0,002	0,078 ± 0,001
Se	0,00114 ± 0,00005	(< 0,0001)	—	0,0028 ± 0,0002	0,0012 ± 0,0001
Si	—	(< 0,003)	(0,002)	(< 0,01)	—
Te	—	—	—	0,0012 ± 0,0003	—

(Values in parenthesis are indicative values)

- continued –

* Approximately 0,3% Sn are present presumably as SnO_2

Copper, chips (continued)

Mass fraction in µg/g (**bold in %**) ± 95%-confidence interval

CRM-No.	**BAM-229**	**BAM-365**	**BAM-366**
Description	CuZn37	Refined copper	SF-Cu
Year of issue	1996	1996	1992
Cu	**63,334% ± 0,007%**	**99,937% ± 0,012%**	**(matrix)**
Zn	**36,63% ± 0,04%**	—	15,6 ± 1,2
Sn	48,5 ± 1,1	(< 5)	111 ± 3
Pb	192 ± 5	28,8 ± 1,3	10,8 ± 0,5
Fe	106,1 ± 2,1	22,3 ± 1,3	23,4 ± 0,5
Ni	111,4 ± 0,9	175,3 ± 1,5	3,2 ± 0,7
Mn	—	(< 1)	—
Al	—	—	—
Ag	—	102,7 ± 1,7	7,9 ± 0,8
As	21,7 ± 0,8	29,8 ± 1,0	1,11 ± 0,08
Bi	—	29,4 ± 1,4	(< 0,3)
Cd	—	—	0,27 ± 0,04
Co	—	23,6 ± 1,4	—
P	(10,6 ± 1,6)	—	263 ± 6
S	—	(7,7 ± 1,4)	8,7 ± 0,6
Sb	7,2 ± 0,7	8,8 ± 0,3	0,99 ± 0,10
Se	34 ± 4	—	(< 1,1)
Si	—	—	—
Te	—	4,6 ± 0,6	(< 0,3)

(Values in parenthesis are indicative values)

Copper

Discs

Mass fraction in µg/g (bold in %) ± 95%-confidence interval

CRM-No.	**BAM-366**	**BAM-367**	**BAM-368**	**BAM-369**	**BAM-370**	**BAM-371**	**BAM-372**
Description	SF-Cu	CuNi10Fe1Mn	CuZn20Al2	OF-Cu	OF-Cu	OF-Cu	OF-Cu
Year of issue	1992	1995	1993	1993	1993	1995	1995
Cu	**(matrix)**	**87,88% ± 0,04%**	**77,049% ± 0,018%**	**(matrix)**	**(matrix)**	**(matrix)**	**(matrix)**
Al	—	—	**1,972% ± 0,014%**	—	12,6 ± 0,8	—	—
Ni	3,2 ± 0,7	**9,72% ± 0,05%**	258 ± 4	—	—	—	11,66 ± 0,24
Fe	23,4 ± 0,5	**1,443% ± 0,012%**	192,7 ± 2,9	—	—	18,3 ± 0,7	—
Mn	—	**0,723% ± 0,005%**	202,8 ± 2,4	—	—	—	11,4 ± 0,4
Zn	15,6 ± 1,2	715 ± 9	**(matrix)**	22,0 ± 0,6	—	—	—
Ag	7,9 ± 0,8	—	—	—	—	—	9,01 ± 0,29
As	1,11 ± 0,08	—	246 ± 9	—	—	—	10,3 ± 0,6
Be	—	—	—	—	—	11,5 ± 0,6	—
Bi	(< 0,3)	—	—	9,7 ± 0,4	—	—	—
C	—	28,7 ± 0,6	—	—	—	—	—
Cd	0,27 ± 0,04	—	—	—	—	1,63± 0,08	—
Co	—	498 ± 3	—	10,42 ± 0,29	—	—	—
Cr	—	—	—	9,2 ± 0,5	—	—	—
Mg	—	347 ± 13	62,1 ± 1,5	3,60 ± 0,18	—	—	—
P	263 ± 6	124 ± 6	89,9 ± 1,6	—	11,7 ± 0,7	—	—
Pb	10,8 ± 0,5	298 ± 6	131,3 ± 2,4	—	15,8 ± 1,1	—	—
S	8,7 ± 0,6	162 ± 9	(18,5 ± 2,9)	—	—	12,1 ± 0,9	—
Sb	0,99 ± 0,10	—	—	—	15,6 ± 1,3	—	—
Se	(< 1,1)	—	—	—	—	—	(8,4 ± 0,6)
Si	—	—	130 ± 7	—	18,7 ± 3,0	—	—
Sn	111 ± 3	105 ± 4	147 ± 4	—	16,8 ± 0,9	—	—
Te	(< 0,3)	—	—	—	—	14,4 ± 0,6	—
Ti	—	—	—	—	—	12,9 ± 0,7	—
Zr	—	—	—	—	—	—	5,8 ± 0,4

(Values in parenthesis are indicative values)

- continued -

Copper, discs (continued)

CRM-No.	**ERM®-EB374 (BAM-374)**	**ERM®-EB375 (BAM-375)**	**BAM-376**	**ERM®-EB377 (BAM-377)**
Description	CuSn8	CuZn39Pb3	Pure copper	CuSn6
Year of issue	1999	1999	1996	1999
Cu	**92,22% ± 0,04%**	**58,32% ± 0,05%**	**(matrix)**	**94,04% ± 0,05%**
Al	(< 1)	270 ± 5	(181,5 ± 10)	45,1 ± 1,2
Ni	32,7 ± 1,3	**0,1053% ± 0,0015%**	209 ± 6	107,4 ± 1,5
Fe	40 ± 4	**0,207% ± 0,004%**	234,6 ± 2,7	104,2 ± 2,7
Mn	4,3 ± 0,3	222 ± 3	205,9 ± 2,5	92,1 ± 2,1
Zn	40,4 ± 1,9	**38,02% ± 0,08%**	217,3 ± 2,7	100,6 ± 3,0
Ag	12,1 ± 1,3	166 ± 4	163,0 ± 2,4	64,4 ± 1,1
As	(4,3 ± 1,2)	231 ± 4	199,9 ± 2,5	(< 10)
Be	—	—	40,6 ± 0,9	—
Bi	(2,2 ± 1,3)	68,6 ± 2,5	200 ± 5	42,2 ± 1,5
C	—	—	—	—
Cd	(< 1)	85,9 ± 2,1	186,1 ± 2,5	(< 1)
Co	(< 1)	196,4 ± 2,8	207,9 ± 1,8	(< 2)
Cr	(< 1)	—	(400 ± 9)	66,9 ± 2,1
Mg	(< 1)	—	124 ± 4	(< 1)
P	**0,1697%± 0,0023%**	(8,6 ± 1,2)	203 ± 5	(< 10)
Pb	8,3 ± 0,9	**2,90% ± 0,03%**	236 ± 4	44,9 ± 2,3
S	(13 ± 5)	—	133 ± 5	(6,8 ± 0,8)
Sb	(6,3 ± 1,4)	122 ± 4	202 ± 5	13,0 ± 1,3
Se	(< 2)	—	210 ± 4	55 ± 4
Si	(< 10)	211 ± 14	—	(134)
Sn	**7,60% ± 0,13%**	**0,2090% ± 0,0024%**	247,3 ± 2,9	**5,92% ± 0,13%**
Te	(< 1)	53,8 ± 2,4	215 ± 7	(< 1)
Ti	(< 1)	—	(4,5 ± 1,7)	(< 1)
Zr	(< 1)	—	42,2 ± 1,9	—

(Values in parenthesis are indicative values) - continued -

Copper, discs (continued)

CRM-No.	**ERM®-EB378 (BAM-378)**	**BAM-M381**	**BAM-M382**	**BAM-M383**	**BAM-M384**
Description	CuSn6	Pure copper	Pure copper	Pure copper	Pure copper
Year of issue	2000	2006	2006	2005	2005
Cu	**94,13% ± 0,04%**	**(matrix)**	**(matrix)**	**(matrix)**	**(matrix)**
Al	(< 1)	(< 1)	< 2,5	(2,3 ± 0,6)	13,0 ± 0,8
Ni	18,3 ± 0,9	0,7 ± 0,2	1,7 ± 0,2	3,59 ± 0,21	5,7 ± 0,4
Fe	182 ± 7	3,3 ± 0,2	6,0 ± 0,4	10,9 ± 0,5	32,8 ± 1,9
Mn	(0,74 ± 0,24)	0,22 ± 0,03	0,76 ± 0,06	1,24 ± 0,05	6,88 ± 0,15
Zn	(7,4 ± 1,0)	5,3 ± 0,3	6,0 ± 0,5	(7,8 ± 0,4)	(12,7 ± 2,1)
Ag	26,6 ± 1,3	< 1	1,8 ± 0,2	4,70 ± 0,20	10,3 ± 0,4
As	99,5 ± 2,5	< 0,5	(0,6 ± 0,2)	1,93 ± 0,15	5,0 ± 0,4
Be	—	—	—	—	—
Bi	(< 1)	< 0,3	0,53 ± 0,03	1,02 ± 0,09	3,34 ± 0,22
C	—	—	—	—	—
Cd	100,7 ± 2,2	< 0,4	0,90 ± 0,09	1,48 ± 0,15	3,95 ± 0,09
Co	89 ± 5	< 0,3	0,73 ± 0,07	1,37 ± 0,05	3,88 ± 0,16
Cr	311 ± 5	< 0,4	0,56 ± 0,06	1,03 ± 0,09	6,53 ± 0,21
Mg	28,7 ± 0,8	< 0,6	(1,4 ± 0,3)	2,37 ± 0,29	14,6 ± 0,5
P	602 ± 23	—	—	—	—
Pb	4,2 ± 0,7	0,59 ± 0,07	1,0 ± 0,2	1,31 ± 0,20	5,7 ± 0,5
S	9,1 ± 1,9	(3,2 ± 1,3)	(3,2 ± 1,4)	(2,8 ± 1,4)	(4,1 ± 1,0)
Sb	86,1 ± 2,6	< 1	0,7 ± 0,2	1,44 ± 0,17	12,0 ± 0,4
Se	(< 2)	(< 1)	0,6 ± 0,1	(1,16 ± 0,19)	4,24 ± 0,19
Si	(< 10)	(< 3)	< 6	< 10	(5,0 ± 0,7)
Sn	**5,74% ± 0,21%**	3,86 ± 0,25	4,29 ± 0,21	4,7 ± 0,6	(10,2 ± 0,9)
Te	85,0 ± 2,6	(< 0,3)	0,61 ± 0,06	1,40 ± 0,16	7,0 ± 0,5
Ti	(29,4 ± 4)	(< 0,3)	(0,6 ± 0,2)	1,56 ± 0,16	(2,10 ± 0,23)
Zr	(1,7 ± 0,09)	< 6	< 3	< 9	< 9

(Values in parenthesis are indicative values)

- continued -

Copper, discs (continued)

CRM-No.	**ERM®-EB385 (BAM-M385)**	**ERM®-EB386 (BAM-M386)**	**ERM®-EB387 (BAM-M387)**	**ERM®-EB388 (BAM-M388)**
Description	Pure copper	Pure copper	CuZn20Ni5	CuAl5Zn5Sn
Year of issue	2003	2003	2004	2004
Cu	**(matrix)**	**(matrix)**	**75,18% ± 0,04%**	**89,27% ± 0,05%**
Al	28,6 ± 2,5	36,5 ± 2,5	—	**4,972% ± 0,024%**
Ni	11,9 ± 0,8	25,0 ± 1,0	**5,020% ± 0,025%**	73,6 ± 2,0
Fe	45,4 ± 1,4	64,7 ± 1,8	617 ± 10	303 ± 9
Mn	10,1 ± 0,2	13,3 ± 0,2	796 ± 6	512 ± 6
Zn	57,9 ± 4,0	49,5 ± 1,6	**19,57% ± 0,06%**	**4,81% ± 0,03%**
Ag	28,6 ± 0,8	47,4 ± 1,2	—	—
As	11,4 ± 0,8	24,2 ± 1,0	—	—
Be	—	—	—	—
Bi	5,81 ± 0,17	9,6 ± 0,5	—	—
C	—	—	—	—
Cd	5,8 ± 0,3	7,8 ± 0,4	—	—
Co	6,93 ± 0,15	5,20 ± 0,14	—	—
Cr	9,81 ± 0,20	12,4 ± 0,7	—	—
Mg	29,1 ± 1,3	36,1 ± 1,2	—	—
P	12,9 ± 1,0	7,2 ± 0,7	—	—
Pb	11,3 ± 0,5	23,4 ± 1,2	10,8 ± 0,8	9,69 ± 0,83
S	31,3 ± 1,5	21,9 ± 2,1	—	—
Sb	19,9 ± 0,8	31,2 ± 1,1	—	—
Se	7,2 ± 0,5	11,6 ± 0,3	—	—
Si	(7,2 ± 1,5)	(14,3 ± 4,3)	—	—
Sn	18,0 ± 0,9	28,3 ± 0,8	30,1 ± 1,2	**0,857% ± 0,011%**
Te	10,0 ± 0,4	38,3 ± 0,9	—	—
Ti	3,83 ± 0,17	33,1 ± 1,3	—	—
Zr	(< 7)	(8,9 ± 1,7)	—	—

(Values in parenthesis are indicative values)

Copper
Discs

Mass fraction in µg/g ± 95%-confidence interval

CRM-No.	**BAM-373/1**	**BAM-373/2**	**BAM-373/3**
Description	E-Cu	E-Cu	E-Cu
Year of issue	1995	1995	1995
Cu	**(matrix)**	**(matrix)**	**(matrix)**
P	33,8 ± 1,2	226,5 ± 1,7	455,7 ± 1,7

(Values in parenthesis are indicative values)

The samples 373/1, 373/2 and 373/3 are only available in a set of all three samples. The cylinders are 3 cm high and about 5 cm in diameter.

Oxygen in copper
Discs

Mass fraction in µg/g ± uncertainty

CRM-No.	**BAM-379/1**	**BAM-379/2**	**BAM-379/3**
Description	Pure copper	Pure copper	Pure copper
Cu	**(matrix)**	**(matrix)**	**(matrix)**
O	38 ± 4	212 ± 8	378 ± 12

(Values in parenthesis are indicative values)

The samples 379/1 to 379/3 (year of issue: 2000) are available individually as well as in a set of all three samples. Each cylinder is 3 cm high and about 4 cm in diameter.

These samples are not certified reference materials as defined in the relevant standards because during certification analysis calibration was done using existing reference materials instead of pure chemicals or stoichiometric compounds.

Tin-lead solder – Granulated powder

Mass fraction in % ± 95%-confidence interval

CRM-No.	**BNM 010**
Description	Sn63Pb37
Year of issue	1991
Sn	63,40 ± 0,07
Pb	36,47 ± 0,17
Bi	0,0245 ± 0,0010
Cd	0,0016 ± 0,0002
Cu	0,0417 ± 0,0014
Ni	0,0021 ± 0,0002
Sb	0,0488 ± 0,0008
Ag	(0,014)
As	(0,012)
Au	(< 0,001)
Fe	(0,0020)
In	(< 0,001)
Zn	(< 0,0001)

(Values in parenthesis are indicative values)

Potassiumdicyanoaurate(I)

Mass fraction in g/kg ± 95%-confidence interval

CRM-No.	**BAM-501**
Description	$K[Au(CN)_2]$
Year of issue	1997
Au	682,23 ± 0,25

Zinc

Discs

Mass fraction in µg/g ± 95%-confidence interval

CRM-No.	**BAM-M601**
Description	Pure zinc
Year of issue	2005
Cd	0,55 ± 0,06
Fe	2,20 ± 0,09
Cu	1,89 ± 0,11
Tl	2,25 ± 0,09
Pb	15,7 ± 0,3
Al	< 0,5
In	< 0,05

Lead-alloy

Discs

Mass fraction in % ± 95%-confidence interval (bold in mg/kg)

CRM-No.	**ERM®-EB101 (BAM-101)**	**ERM®-EB102 (BAM-102)**	**ERM®-EB103**
Description	PbCaSnAl	PbCaSn	PbSb1,6AsSnSe
Year of issue	1999	1999	2006
Ca	0,1436 ± 0,0016	0,0705 ± 0,0011	—
Sn	0,293 ± 0,007	0,895 ± 0,011	0,183 ± 0,026*
Al	0,0257 ± 0,0006	0,0124 ± 0,0004	—
Ag	0,00288 ± 0,00007	0,00248 ± 0,00007	—
Bi	0,0165 ± 0,0007	0,0148 ± 0,0005	0,0158 ± 0,0004*
Cu	0,00173 ± 0,00018	0,00109 ± 0,00007	**9,7 mg/kg ± 0,9 mg/kg***
Sb	—	—	1,64 ± 0,06*
As	—	—	0,097 ± 0,004*
Se	—	—	0,0180 ± 0,0010*
Ag	—	—	0,0066 ± 0,0006*
Tl	—	—	**15,2 mg/kg ± 0,7 mg/kg***
Ni	—	—	**3,02 mg/kg ± 0,27 mg/kg***
Cd	—	—	**0,20 mg/kg ± 0,08 mg/kg***
S	—	—	**(5,4 mg/kg ± 1,2 mg/kg*)**
Te	—	—	**(1,9 mg/kg ± 0,6 mg/kg*)**

(Values in parenthesis are indicative values)
*Estimated expanded uncertainty (*k*=2) according to GUM (1995)

Special materials

The CRMs in the field of **high tech ceramics** and of **refractory metals** were produced and certified by BAM in collaboration with the Working Group "Special Materials" of the Committee of Chemists of the Gesellschaft für Bergbau, Metallurgie, Rohstoff- und Umwelttechnik (GDMB). The analyses were carried out in BAM and in national and international laboratories of producers and users of these materials and of research institutes.

The powder samples are supplied in tightly closed glass bottles containing 50 g or 100 g each.

The **glass** CRMs were produced and certified by BAM in collaboration with the Technical Committee 2 of the International Commission on Glass (ICG, TC-2). The analyses were carried out in BAM and in the laboratories of international members of ICG, TC-2 and some other laboratories. All laboratories are from glass making industry or from glass research institutes. The crushed glass sample (BAM-S004) is supplied in glass bottles containing 50 g each. The polished plates for XRF analysis (BAM-S005A and BAM-S005B) are supplied as one disc in one specimen.

The **pure substances** are intended for analyte calibration and matrix simulation of atomic spectrometric methods, especially for X-ray fluorescence analysis (XRF). The samples were prepared and certified by Arbeitsgemeinschaft “Zertifiziertes Referenzmaterial Eisen und Stahl” (BAM, VDEh, MPI für Eisenforschung), Working Group "Primary substances for calibration". They can be ordered in polyethylene bottles with a unit size of 100 g. Each sample is distributed together with a certificate which contains the certified values together with their uncertainties (95%-level, if necessary extended by contributions from sample inhomogeneity) and the indicative values. The mean values of the accepted data sets, their standard deviations and the standard deviations of the mean values of laboratories are also given in the certificate together with the laboratories participating in the certification campaign and the analytical methods used for determination of element mass fractions or other parameters.

High tech ceramics

Silicon nitride powder

ERM®-ED101 (BAM-S001)

Element	**Mass fraction**	**Uncertainty**	**Unit of mass fraction**
Al	469	± 12	mg/kg
Ca	14,1	± 0,5	mg/kg
Co	43,5	± 0,8	mg/kg
Fe	79,5	± 1,3	mg/kg
Mg	4,3	± 0,4	mg/kg
Na	7,59	± 0,27	mg/kg
W	41,3	± 1,3	mg/kg
C	0,162	± 0,024	%
N	38,1	± 0,2	%
O	(1,91)	(± 0,07)	%
ß-phase	7,43	± 0,09	%

(Values in parenthesis are indicative values)

Silicon carbide powder (green micro F 800)
BAM-S003

Analyt	Mass fraction in mg/kg	Uncertainty in mg/kg
Al	372	20
B	63	7
Ca	29,4	1,8
Cr	3,5	0,4
Cu	1,5	0,4
Fe	149	10
Mg	6,3	0,6
Mn	1,44	0,17
Na	17,7	0,8
Ni	32,9	2,7
Ti	79	4
V	41,4	2,8
Zr	25,2	2,0
C_{free}	493	79
O	910	35
N	(93)	(22)
$SiO_{2\ free}$	(600)	(148)
Si_{free}	(481)	(223)
	Mass fraction in %	**Uncertainty in %**
C_{total}	29,89	0,07

(Values in parenthesis are indicative values)

Refractory metals Tungsten metal powder
BAM-S002

Element	Mass fraction in mg/kg	Uncertainty in mg/kg
Al	29,4	0,9
Ca	46	4
Co	45	6
Cr	47,0	1,4
Cu	28,4	2,9
Fe	53	5
K	40,0	1,8
Mg	38,8	2,7
Mn	16,7	1,9
Mo	59	4
Na	41	5
Ni	29	4
(P)	(7,2)	(1,3)
Si	106	10
Sn	42	6

(Values in parenthesis are indicative values)

Glass containing hexavalent chromium
BAM-S004

Analyt	Mass fraction	Uncertainty in mg/kg
Mass fraction in mg/kg		
Cr-(VI)	94	5
Cr-total	471	25
Mass fraction in %		
SiO_2	(70,9)	
Na_2O	(14,5)	
CaO	(9,4)	
Al_2O_3	(2,15)	
BaO	(1,2)	
MgO	(0,90)	
ZnO	(0,33)	
SO_2	(0,17)	
K_2O	(0,16)	
Cr_2O_3	(0,07)	
Fe_2O_3	(0,06)	
CuO	(0,04)	

(Values in parenthesis are informative values)

Multielement glass for XRF analysis – type A – type B

	BAM-S005A			BAM-S005B	
Parameter	Mass fraction in mg/kg			Mass fraction in mg/kg	
	Certified value [1]	Uncertainty [2]		Certified value [1]	Uncertainty [2]
Arsenic (III) oxide	132	8		132	8
Barium oxide	115	9		115	5
Cadmium oxide	62	4		62	3
Cerium (IV) oxide	105	6		105	5
Chloride	247	33		247	24
Cobalt oxide	49,4	2,4		49,4	2,3
Chromium (III) oxide	15,6	2,4		15,2	1,2
Copper (II) oxide	112	5		112	4
Iron (III) oxide	422	11		422	10
Manganese (II) oxide	124	5		124	5
Molybdenum (VI) oxide	343	12		343	12
Nickel (II) oxide	59,0	2		59,0	1,9
Lead (II) oxide	202	8		202	7
Antimony (III) oxide	132	7		132	6
Selenium	19,6	1,7		19,6	1,2
Tin (IV) oxide	100	7		100	7
Sulfur trioxide	1942	85		1942	57
Strontium oxide	151	7		151	7
Titanium (IV) oxide	164	9		163	7
Vanadium (V) oxide	350	22		349	22
Zinc oxide	203	10		203	6
Zirconium (IV) oxide	842	125		842	76
	Mass fraction in %			Mass fraction in %	
Silicon (IV) oxide	(71)			(71)	
Sodium oxide	(13,7)			(13,7)	
Calcium oxide	(10,5)			(10,5)	
Magnesium oxide	(2,3)			(2,3)	
Aluminium oxide	(1,1)			(1,1)	
Potassium oxide	(0,7)			(0,7)	

(Values in parenthesis are indicative values)

[1] The certified values are the means of 11-25 series of results (depending on the parameter) obtained by different laboratories. 3 up to 9 different analytical methods were used for the measurement of one parameter. The calibration of the methods applied for determination of element mass fractions were calibrated using pure substances of definite stoichiometry or by solutions prepared from them, thus achieving traceability to SI unit.

[2] The certified uncertainty is the expanded uncertainty estimated in accordance with the Guide to the Expression of Uncertainty in Measurements (GUM) with a coverage factor k = 2.

Water in soda lime glass - determination by nuclear reaction analysis and infrared spectroscopy

BAM-S106

The reference material BAM-S106 is a soda lime glass with certified molar concentration of water. Principally it may be used for characterisation of infrared spectrometers for absolute determinations of the water content.

Certified quantity	Certified value c_{H_2O} [mol·l^{-1}]	Expanded Uncertainty u(c_{H_2O}) [mol·l^{-1}] ***
Molar concentration of water determined by NRA*	0,033	0,005
Molar concentration of water determined by IR**	0,0349	0,0021

* Molar concentration of water determined by means of nuclear reaction analysis (NRA) assuming that all of the measured hydrogen represents water

** Molar concentration of water determined by means of infrared spectroscopy (IR) is a method-specific value, since it is based on the used extinction coefficients

*** Expanded uncertainty for k=2

Informative values

Main components: 70 w.-% SiO_2, 15 w.-% Na_2O, 7 w.-% CaO, 4 w.-% MgO

Dimensions: (15 x 15 x 1) mm^3

Density: ρ = 2,487 ± 0,001 g·cm^{-3}

Pure substances

Mass fraction in µg/g (bold in %) ± 95%-confidence interval

CRM-No.	**RS 1**	**RS 2**	**RS 3**	**RS 4**	**RS 5**	**RS 6A**	**RS 6B**
Type	SiO_2[1)] >99,99 %	Al_2O_3[2)] 99,76 %	$CaCO_3$[3)] 99,79 %	Ni[4)] 99,995 %	NiO[5)]	MgO[6)] 100-350 µm	MgO[6)] 50-100 µm
Year	1991	1994	1994	1996	1996	1998	1998
CO_2	—	—	**43,95 %**	—	—	—	—
H_2O	—	**0,22 %**	0,13 %	—	**0,015 %**	110	283
Ag	—	—	—	< 1	< 1	—	—
Al	8,7 ± 0,7	—	(< 5)	< 1	(< 15)	45 ± 9	49 ± 8
As	< 0,1	(< 0,5)	—	< 0,5	< 0,2	—	—
B	—	(< 5)	(< 0,2)	(< 2)	—	—	—
Ba	—	—	45,3 ± 1,7	—	< 1	(< 10)	(< 20)
Be	—	(< 0,2)	—	—	—	—	—
C	—	—	—	9,4 ± 2,0	14 ± 8	(< 50)	(< 210)
Ca	0,42 ± 0,09	3,1 ± 0,4	—	< 1	2,2 ± 0,9	994 ± 93	956 ± 149
Cd	< 0,05	(< 0,5)	(< 0,5)	< 0,2	< 0,2	—	—
Ce	—	(< 0,1)	—	—	—	—	—
Cl	—	(< 10)	—	—	—	—	—
Co	—	< 1	—	< 1	< 2	(< 5)	(< 5)
Cr	0,062 ±0,021	< 1,5	< 1	< 0,5	16,1 ± 2,0	9,2	8,1
Cu	< 0,1	< 2,5	< 1	< 2	1,53± 0,18	(< 6)	(< 6)
Fe	0,62 ± 0,12	3,3 ± 1,6	< 5	4,2 ± 1,6	41± 7	72	71
Ga	—	(< 2)	(< 1,5)	< 0,2	< 0,5	—	—
Ge	< 1	—	—	—	—	—	—
Hg	< 0,05	—	—	(< 1)	—	—	—
In	—	(< 0,5)	—	(< 0,2)	(< 1)	—	—
K	0,48 ± 0,27	(< 5)	(< 30)	—	< 2	—	—
La	—	(< 0,3)	(< 0,5)	—	—	—	—
Li	0,25 ± 0,14	< 1	—	—	(< 2)	—	—
Mg	< 0,5	< 3	183± 5	< 0,8	< 1	**60,19 %**	**60,17 %**
Mn	< 0,2	< 1,5	3,0± 0,5	< 0,5	< 1	5,4	5,2
Mo	—	(< 1)	—	(< 0,2)	< 5	(< 10)	(< 10)
N	—	—	—	2,5 ± 1,0	—	—	—
Na	< 2	< 15	47,5± 2,7	(< 1)	< 2	—	—
Ni	< 0,2	< 10	(< 3)	**99,995%±0,003%**	**78,57% ± 0,06%**	3,9	3,3
O	—	—	—	(29)	**21,41% ± 0,06%**	—	—
Pb	< 0,15	—	(< 0,1)	< 1	< 2	(< 5)	(< 5)
S	—	—	—	(< 2)	(4)	—	—
Sb	—	—	—	< 0,2	(< 0,1)	—	—
Se	—	—	—	< 1	< 1	—	—
Si	—	< 20	(< 20)	(< 2)	(< 5)	—	—

(Values in parenthesis are indicative values)

- continued -

Pure substances (continued)

CRM-No.	**RS 1**	**RS 2**	**RS 3**	**RS 4**	**RS 5**	**RS 6A**	**RS 6B**
Type	SiO_2[1)] > 99,99 %	Al_2O_3[2)] 99,76 %	$CaCO_3$[3)] 99,79 %	Ni[4)] 99,995 %	NiO[5)]	MgO[6)] 100-350 µm	MgO[6)] 50-100 µm
Year	1991	1994	1994	1996	1996	1998	1998
Sn	—	(< 1)	(< 1)	< 0,3	(< 1)	—	—
Sr	—	—	173 ± 8	—	(< 1)	2,0	2,1
Te	—	—	—	(< 0,2)	(< 0,2)	—	—
Ti	1,3 ± 0,4	< 2	(< 0,5)	—	(< 2)	1,3	1,2
Tl	—	—	—	< 0,2	(< 0,5)	—	—
V	—	(< 1)	—	(< 0,2)	< 1	8,4	7,8
W	—	—	—	(< 0,1)	(< 1)	—	—
Zn	< 1,3	< 2	< 2	< 4	3,4 ± 0,7	(< 6)	(< 6)
Zr	< 0,1	3,2 ± 1,3	(< 0,2)	—	(< 1)	(< 20)	(< 105)

(Values in parenthesis are indicative values)

1) α-quartz, mean particle size: 150 µm
2) α-aluminium oxide, average surface: 5,6 m^2/g, bulk density: ca. 1,1 kg/L
3) Pure calcite, the CO_2-content is given for the water free sample. It is 99,96 % of the theoretical value.
4) Pure electrolytic nickel, the weight of one particle after milling is about 2 – 4 mg.
5) Powdered nickel(II)oxide made by oxidation of powdered nickel (made by thermal decomposition of nickel carbonyl) with a particle size of 5 – 20 µm.
6) Crystalline magnesium oxide with two different particle sizes

Primary pure substances

By agreement with Physikalisch Technische Bundesanstalt (PTB) the materials in this group are the National Standards for Element Analysis in Germany. They are available only to the signatories (National Measurement Institutes) and designated laboratories as listed in the Mutual Recognition Arrangement MRA [http://www.bipm.org/en/convention/mra/].

The substances are of high purity, and certified for the mass fraction of the matrix element by considering all possible impurities with other chemical elements. They are intended for gravimetrical preparation of calibration solutions for analyte calibration with small combined uncertainty and enable to establish traceability to the international system of units (SI).

The material is supplied in glass bottles together with the certificate, which includes the prescribed procedure for etching before use and the informative values for the individual impurities. The certification reports are available on request.

Identifier	Description	Mass fraction *w*	Uncertainty *U* (with *k*=2)	Unit	Form	Unit size
BAM-Y001	high purity copper	0,999 970	± 0,000 010	kg/kg	compact material	0,5 g
BAM-Y002	high purity iron	0,999 862	± 0,000 044	kg/kg	compact material	0,5 g
BAM-Y003	high purity silicon	0,999 91	± 0,000 07	kg/kg	cubes 3×3×3 mm	0,5 g
BAM-Y004	high purity lead	0,999 92	± 0,000 06	kg/kg	compact material	0,5 g
BAM-Y005	high purity tin	0,999 91	± 0,000 06	kg/kg	compact material	0,5 g
BAM-Y006	high purity tungsten	0,999 81	± 0,000 10	kg/kg	compact material	0,5 g
BAM-Y007	high purity bismuth	0,999 90	± 0,000 07	kg/kg	compact material	0,5 g
BAM-Y008	high purity gallium	0,999 92	± 0,000 07	kg/kg	compact material	0,5 g
BAM-Y009	high purity sodium chloride	0,999 84	± 0,000 09	kg/kg	crystalline powder	0,5 g
BAM-Y010	high purity potassium chloride	0,999 83	± 0,000 10	kg/kg	crystalline powder	0,5 g

Environment and food

Polychlorinated biphenyls in transformer oil

BAM CRM 5001

Certification of the content of polychlorinated biphenyls in transformer oil calibration with a PCB-free transformer oil according to DIN EN 12766-1:2000 and DIN EN 12766-2:2001

PCB (IUPAC-No.)	Certified value[1)]	Standard uncertainty [2)]	Half-width of the 95% confidence-interval
44	240	30	60
52	790	50	120
101+84	1430	80	170
118	860	40	100
138+163	800	20	50
149	650	30	70
153	700	20	50
180	110	10	20

All values are given in µg/kg

1) Mean of means
2) Standard deviation of the mean of the means

Calibration standard for the determination of mineral oil hydrocarbons in environmental matrices using gas chromatography

BAM-K010

Diesel oil / lubricating oil (1:1)

Certified property	Certified value g/g	Expanded uncertainty* g/g	Relative expanded uncertainty %
Mass ratio of components – diesel oil and lubricating base oil (both additive free)	1,00003	0,00006	0,006
Mass fraction of the boiling range C_{10} –C_{40}	0,967	0,018	1,83

* *k*=2

Application range: Calibration standard for the determination of mineral oil hydrocarbons in water, soil and waste by gas chromatography (GC-FID) according to

ISO 9377-2:2000 (water quality)
ISO 16703:2004 (soil quality)
EN 14039:2004 (characterization of waste)

BAM-K008

Diesel oil

Certified property	**Certified value** **g/g**	**Expanded uncertainty*** **g/g**	**Relative expanded uncertainty** **%**
Mass fraction of the boiling range C_{10} –C_{40}	0,936	0,013	1,44

* *k=2*

Application range: Calibration standard (type A) for the determination of mineral oil hydrocarbons in water, soil and waste by gas chromatography (GC-FID) according to

ISO 9377-2:2000 (water quality)
ISO 16703:2004 (soil quality)
EN 14039:2004 (characterization of waste)

BAM-K009

Lubricating oil

Certified property	**Certified value** **g/g**	**Expanded uncertainty*** **g/g**	**Relative expanded uncertainty** **%**
Mass fraction of the boiling range C_{10} –C_{40}	0,995	+ 0,005 - 0,006	+ 0,53 - 0,61

* *k*=2

Application range: Calibration standard (type B) for the determination of mineral oil hydrocarbons in water, soil and waste by gas chromatography (GC-FID) according to

ISO 9377-2:2000 (water quality)
ISO 16703:2004 (soil quality)
EN 14039:2004 (characterization of waste)

Organochloropesticides (OCP) in soil

ERM®-CC007 (BAM-U007)

Certification of the content of five DDT, DDE and HCH isomers in industrial soil.
Use of CRM for the validation and checking of the accuracy of analytical procedures for the quantitative determination of the contents of selected relevant organochloropesticides in soil by gas chromatography.

Compound	Certified value [1)]	Uncertainty [2)]
α-HCH	32	± 6
β-HCH	386	± 40
p,p'-DDE	56	± 6
o,p'-DDT	36	± 7
p,p'-DDT	153	± 15

All values are given in µg/kg

1) The certified value is the mean of 5 laboratory means using GC-ECD and GC-MS including IDMS. The values are traceable to the SI (Système International d'Unités) via calibration using sufficiently pure substances.

2) Estimated expanded uncertainty 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, 1995.

Pentachlorophenol (PCP) in soil

ERM®-CC008 (BAM-U008), ERM®-CC009 (BAM-U009)

Certification of the content of PCP in two industrial soils.
Use of CRMs for the validation and checking of the accuracy of analytical procedures for the quantitative determination of the content of pentachlorophenol in soil.

CRM	Certified value [1)]	Uncertainty [2)]
ERM®-CC008	2,04	± 0,18
ERM®-CC009	2,91	± 0,23

All values are given in mg/kg

1) Unweighted mean value of 5 laboratory means using three different chromatographic methods combined with four detection principles (see below). The values are traceable to the SI (Système International d'Unités) via calibration using sufficiently pure substances.

2) Estimated expanded uncertainty 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, 1995.

Adsorbable organically bound halogens (AOX) in soil

ERM®-CC010 (BAM-U010), ERM®-CC011 (BAM-U011), ERM®-CC012 (BAM-U012)

Certified properties: Content of AOX in industrial soil
Application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of AOX contents in soil

CRM	Certified value [1)]	Uncertainty [2)]
ERM®-CC010	1349	± 59
ERM®-CC011	80	± 7
ERM®-CC012	102	± 8

All values are given in mg/kg

1) The certified value is the mean of laboratory means (analytical procedure according to DIN 38414 Teil 18, Nov 1989).

2) Estimated expanded uncertainty 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, 1995.

Polycyclic aromatic hydrocarbons in soil

ERM®-CC013a

Certified properties: Contents of 13[1)] of priority pollutant polycyclic aromatic hydrocarbons (PAHs) according to EPA in industrial soil

Application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of the contents of PAHs in soil or similar solid matrices

Compound	**Certified value [2)]**	**Uncertainty [3)]**
Naphthalene	2,4	± 0,5
Fluorene	1,14	± 0,11
Phenanthrene	12,0	± 0,6
Anthracene	1,41	± 0,22
Fluoranthene	12,9	± 0,7
Pyrene	9,6	± 0,3
Benzo[a]anthracene	5,6	± 0,5
Chrysene	5,3	± 0,8
Benzo[b]fluoranthene	7,1	± 1,0
Benzo[k]fluoranthene	3,4	± 0,4
Benzo[a]pyrene	4,9	± 0,7
Benzo[ghi]perylene	4,6	± 0,5
Indeno[1,2,3-cd]pyrene	5,2	± 1,0

All values are given as mass fractions in mg/kg

1) The mass fractions of acenaphthene (0,75 mg/kg), acenaphthylene (0,77 mg/kg) and dibenz[*ah*]anthracene (1,1 mg/kg) are given as not certified indicative values without an uncertainty statement.

2) The certified values are the means of six laboratory means using HPLC/DAD/F or GC/MS. The values are traceable to the SI (Système International d'Unités) via calibration using sufficiently pure substances.

3) Estimated expanded uncertainty with a coverage factor of k=2, corresponding to a level of confidence of about 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1995.

Mineral oil contaminated sediment

ERM®-CC015a

Certified properties: Mineral oil content or total petrol hydrocarbon (TPH) in sediment to be determined by GC/FID

Application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of mineral oil content in sediment and soil by gas chromatography (GC-FID) according to ISO 16703:2004 (soil quality)

CRM	**Certified value [1)]**	**Standard uncertainty [2)]**
ERM®-CC015a	1820	± 130

All values are given in mg/kg.

1) Unweighted mean value of 11 laboratory means using gas chromatography with flame ionisation detection (GC/FID) according to ISO 16703:2004.

2) Estimated expanded uncertainty with a coverage factor of k=2, corresponding to a level of confidence of 95 %, as defined in the Guide to the Expression of Uncertainty in Measurement, ISO, 1995.

Trace elements in contaminated soil

BAM-U110

Certified properties: Total and aqua regia extractable (ISO 11466) mass fractions

The material is intended for the verification of analytical results obtained by standardised procedures as well as for the validation of modified or new analytical procedures. Furthermore, it can be used for quality control or calibration purposes if X-ray fluorescence spectrometry or other methods of direct solid state analysis are applied.

Element	Total mass fractions		Aqua regia extractable mass fractions	
	Certified value	**Uncertainty [1)]**	**Certified value**	**Uncertainty [1)]**
As	15,8	± 1,4	13,0	± 1,1
Cd	7,3	± 0,6	7,0	± 0,4
Co	16,2	± 1,6	14,5	± 0,8
Cr	230	± 13	190	± 9
Cu	263	± 12	262	± 9
Hg	51,5	± 4,1	49,3	± 2,9
Mn	621	± 20	580	± 19
Ni	101	± 5	95,6	± 4,0
Pb	197	± 14	185	± 8
Zn	1000	± 50	990	± 40

All values are given in mg/kg.

1) Estimated expanded uncertainty with a coverage factor of k=2, corresponding to a level of confidence of about 95 %, as defined in the Guide to the expression of uncertainty in measurement (GUM), ISO, 1995.

Acrylamide in crispbread

ERM®-BD272

Compound	Certified value [1)]	Uncertainty [2)]
Acrylamide	0,98	± 0,09

All values are given as mass fractions in mg/kg

1) Unweighted mean of accepted mean values, independently obtained by 15 laboratories using different analytical methods.

2) Estimated expanded uncertainty with a coverage factor of k=2, corresponding to a level of confidence of about 95 %, as defined in the Guide to the expression of uncertainty in measurement (GUM), ISO, 1995.
Uncertainty contributions arising from characterisation as well as from homogeneity and stability testing were taken into account.

Gas mixtures

Certified reference gas mixtures

The following certified reference gas mixtures (CRGMs) are prepared by BAM or industrial partners under mandate of BAM.

These CRGMs are offered and distributed by BAM exclusively.

CRGMs are prepared individually from pure gases according to ISO 6142 ”Gas analysis - Preparation of calibration gases - Gravimetric Method”.

For the preparation of CRGMs with minor components pre-mixtures are used. The molar fraction of the components are certified according to ISO 6143 ”Gas analysis - Determination of composition of calibration gas mixtures - Comparison methods” using primary reference gas mixtures (national primary standards of gas composition).

At request, calibration gas mixtures prepared by industrial customers and accepted by BAM can be certified by comparison with corresponding primary reference gas mixtures. These BAM-certified calibration gas mixtures are then used as reference standards, providing traceability to primary reference gas mixtures maintained at BAM. The stability is generally guaranteed over a period of two years.

Uncertainties are reported as expanded uncertainties (coverage factor *k*=2) according to GUM.

Binary certified reference gas mixtures

CRM-No.	**Main component**	**Analyte**	**Range of molar fraction mol/mol**	**Range of uncertainty % rel**
BAM-G010	Nitrogen (N_2)	Helium (He)	0,01 to 0,5	0,8 to 0,5
BAM-G012	Synth. air	Helium (He)	0,005 to 0,5	2,0 to 0,5
BAM-G020	Nitrogen (N_2)	Hydrogen (H_2)	0,01 to 0,2	0,8 to 0,5
BAM-G030	Nitrogen (N_2)	Oxygen (O_2)	0,01 to 0,2	0,5 to 0,5
BAM-G039	Helium (He)	Oxygen (O_2)	0,01 to 0,20	1,0 to 0,5
BAM-G040	Nitrogen (N_2)	Carbon monoxide (CO)	0,00001 to 0,1	1,0 to 0,3
BAM-G042	Synth. air	Carbon monoxide (CO)	0,0001 to 0,01	1,0 to 0,5
BAM-G050	Nitrogen (N_2)	Carbon dioxide (CO_2)	0,00001 to 0,5	0,5 to 0,3
BAM-G052	Synth. air	Carbon dioxide (CO_2)	0,0001 to 0,20	1,0 to 0,3
BAM-G055	Methane (CH_4)	Carbon dioxide (CO_2)	0,005 to 0,10	0,5
BAM-G060	Nitrogen (N_2)	Methane (CH_4)	0,00001 to 0,5	1,0 to 0,3
BAM-G062	Synth. air	Methane (CH_4)	0,0001 to 0,001	1,0 to 0,5
BAM-G070	Nitrogen (N_2)	Propane (C_3H_8)	0,00005 to 0,01	1,0 to 0,5
BAM-G072	Synth. air	Propane (C_3H_8)	0,0001 to 0,001	1,0 to 0,5
BAM-G080	Nitrogen (N_2)	Hexane (C_6H_{14})	0,0001 to 0,001	2,0 to 0,8
BAM-G090	Nitrogen (N_2)	di-Nitrogen oxide (N_2O)	0,000005 to 0,001	2,0 to 0,5

Certified reference gas mixtures for vehicle exhaust emission measurements

CRM-No.	Main component	Analyte		Molar fraction mol/mol	Uncertainty % rel
BAM-G200	Nitrogen (N_2)	Carbon monoxide	(CO)	0,02	0,5
BAM-G210	Nitrogen (N_2)	Carbon monoxide	(CO)	0,045	0,5
BAM-G220	Nitrogen (N_2)	Carbon monoxide Carbon dioxide Propane	(CO) (CO_2) (C_3H_8)	0,005 0,06 0,0002	0,5 0,3 0,8
BAM-G225	Nitrogen (N_2)	Carbon monoxide Carbon dioxide Propane	(CO) (CO_2) (C_3H_8)	0,015 0,11 0,0006	0,5 0,3 0,5
BAM-G230	Nitrogen (N_2)	Carbon monoxide Carbon dioxide Propane	(CO) (CO_2) (C_3H_8)	0,035 0,14 0,002	0,5 0,3 0,5

Certified reference gas mixtures for gas calorimeters

CRM-No.	Main component	Analyte		Molar fraction mol/mol	Uncertainty % rel
BAM-G300	Methane (CH_4)	Ethane	(C_2H_6)	0,123	0,3
BAM-G310	Methane (CH_4)	Ethane	(C_2H_6)	0,065	0,3
BAM-G320	Methane (CH_4)	Nitrogen	(N_2)	0,07	0,3
BAM-G330	Methane (CH_4)	Nitrogen	(N_2)	0,087	0,3
BAM-G340	Methane (CH_4)	Nitrogen	(N_2)	0,117	0,3
BAM-G350	Methane (CH_4)	Nitrogen	(N_2)	0,175	0,3
BAM-G360	Methane (CH_4)	Nitrogen Hydrogen	(N_2) (H_2)	0,17 0,49	0,3 0,5

Multi component certified reference gas mixtures

CRM-No.	Main component	Analyte		Molar fraction mol/mol	Uncertainty % rel
BAM-G501	Nitrogen (N_2)	Oxygen Argon	(O_2) (Ar)	0,20 0,01	0,5 0,5
BAM-G530	Nitrogen (N_2)	Hydrogen Oxygen	(H_2) (O_2)	0,10 0,015	0,5 0,5
BAM-G610	Sulfur hexafluoride (SF_6)	Nitrogen (N_2) + oxygen (O_2) Tetrafluoromethane	 (CF_4)	0,01 0,010	2,0 2,0
BAM-G810	Helium (He)	Hydrogen Carbon monoxide Carbon dioxide Oxygen Argon Nitrogen Methane Xenon Krypton	(H_2) (CO) (CO_2) (O_2) (Ar) (N_2) (CH_4) (Xe) (Kr)	0,000005 0,000005 0,000005 0,000005 0,000005 0,000005 0,000005 0,000005 0,000005	1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0

Certified reference gas mixtures for process gas chromatographs

CRM-No.	Main component	Analyte		Molar fraction mol/mol	Uncertainty % rel
BAM-G400	Methane (CH_4)	Nitrogen	(N_2)	0,004	0,5
		Carbon dioxide	(CO_2)	0,018	0,3
		Ethane	(C_2H_6)	0,094	0,3
		Propane	(C_3H_8)	0,034	0,3
		n-Butane	(C_4H_{10})	0,01	0,5
BAM-G401	Methane (CH_4)	Nitrogen	(N_2)	0,14	0,3
		Carbon dioxide	(CO_2)	0,01	0,5
		Ethane	(C_2H_6)	0,03	0,4
		Propane	(C_3H_8)	0,005	0,5
		n-Butane	(C_4H_{10})	0,001	0,8
BAM-G410	Methane (CH_4)	Nitrogen	(N_2)	0,12	0,3
		Carbon dioxide	(CO_2)	0,045	0,3
		Ethane	(C_2H_6)	0,0075	0,5
		Propane	(C_3H_8)	0,003	0,8
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
BAM-G411	Methane (CH_4)	Nitrogen	(N_2)	0,103	0,3
		Carbon dioxide	(CO_2)	0,01	0,5
		Ethane	(C_2H_6)	0,04	0,4
		Propane	(C_3H_8)	0,013	0,4
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
BAM-G412	Methane (CH_4)	Nitrogen	(N_2)	0,01	0,5
		Carbon dioxide	(CO_2)	0,009	0,5
		Ethane	(C_2H_6)	0,01	0,4
		Propane	(C_3H_8)	0,0025	0,8
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
BAM-G413	Methane (CH_4)	Nitrogen	(N_2)	0,04	0,3
		Carbon dioxide	(CO_2)	0,015	0,3
		Ethane	(C_2H_6)	0,082	0,3
		Propane	(C_3H_8)	0,02	0,3
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
BAM-G420	Methane (CH_4)	Oxygen	(O_2)	0,005	0,5
		Nitrogen	(N_2)	0,04	0,5
		Carbon dioxide	(CO_2)	0,015	0,3
		Ethane	(C_2H_6)	0,04	0,4
		Propane	(C_3H_8)	0,01	0,4
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8

Certified reference gas mixtures for process gas chromatographs (continued)

CRM-No.	**Main component**	**Analyte**		**Molar fraction mol/mol**	**Uncertainty % rel**
BAM-G430	Methane (CH_4)	Nitrogen	(N_2)	0,04	0,3
		Carbon dioxide	(CO_2)	0,015	0,3
		Ethane	(C_2H_6)	0,04	0,4
		Propane	(C_3H_8)	0,01	0,4
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8
BAM-G431	Methane (CH_4)	Nitrogen	(N_2)	0,014	0,4
		Carbon dioxide	(CO_2)	0,0036	0,3
		Ethane	(C_2H_6)	0,004	0,5
		Propane	(C_3H_8)	0,002	0,8
		n-Butane	(C_4H_{10})	0,001	0,8
		2-Methyl-propane	(C_4H_{10})	0,001	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8
BAM-G432	Methane (CH_4)	Nitrogen	(N_2)	0,0095	0,5
		Carbon dioxide	(CO_2)	0,015	0,3
		Ethane	(C_2H_6)	0,09	0,3
		Propane	(C_3H_8)	0,03	0,3
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8
BAM-G433	Methane (CH_4)	Nitrogen	(N_2)	0,025	0,4
		Carbon dioxide	(CO_2)	0,01	0,5
		Ethane	(C_2H_6)	0,065	0,3
		Propane	(C_3H_8)	0,013	0,4
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,0025	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,00025	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8
BAM-G434	Methane (CH_4)	Nitrogen	(N_2)	0,11	0,3
		Carbon dioxide	(CO_2)	0,0155	0,3
		Ethane	(C_2H_6)	0,0075	0,5
		Propane	(C_3H_8)	0,003	0,5
		n-Butane	(C_4H_{10})	0,001	0,8
		2-Methyl-propane	(C_4H_{10})	0,001	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8
BAM-G435	Methane (CH_4)	Nitrogen	(N_2)	0,012	0,5
		Carbon dioxide	(CO_2)	0,008	0,5
		Ethane	(C_2H_6)	0,11	0,3
		Propane	(C_3H_8)	0,045	0,4
		n-Butane	(C_4H_{10})	0,001	0,8
		2-Methyl-propane	(C_4H_{10})	0,001	0,8
		n-Pentane	(C_5H_{12})	0,00035	0,8
		2-Methyl-butane	(C_5H_{12})	0,00035	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0002	0,8

Certified reference gas mixtures for process gas chromatographs (continued)

CRM-No.	Main component	Analyte		Molar fraction mol/mol	Uncertainty % rel
BAM-G436	Methane (CH_4)	Nitrogen	(N_2)	0,092	0,3
		Carbon dioxide	(CO_2)	0,018	0,3
		Ethane	(C_2H_6)	0,03	0,3
		Propane	(C_3H_8)	0,005	0,5
		n-Butane	(C_4H_{10})	0,001	0,8
		2-Methyl-propane	(C_4H_{10})	0,001	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8
BAM-G437	Methane (CH_4)	Nitrogen	(N_2)	0,008	0,5
		Carbon dioxide	(CO_2)	0,01	0,5
		Ethane	(C_2H_6)	0,01	0,5
		Propane	(C_3H_8)	0,005	0,5
		n-Butane	(C_4H_{10})	0,001	0,8
		2-Methyl-propane	(C_4H_{10})	0,001	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,001	0,8
BAM-G440	Methane (CH_4)	Helium	(He)	0,005	1,0
		Oxygen	(O_2)	0,005	0,5
		Nitrogen	(N_2)	0,05	0,3
		Carbon dioxide	(CO_2)	0,01	0,5
		Carbon monoxide	(CO)	0,005	0,5
		Hydrogen	(H_2)	0,01	0,8
		Ethene	(C_2H_4)	0,005	0,8
		Ethane	(C_2H_6)	0,025	0,4
		Propene	(C_3H_6)	0,005	0,8
		Propane	(C_3H_8)	0,01	0,5
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0006	0,8
BAM-G450	Methane (CH_4)	Helium	(He)	0,005	1,0
		Oxygen	(O_2)	0,005	0,5
		Nitrogen	(N_2)	0,05	0,3
		Carbon dioxide	(CO_2)	0,01	0,5
		Carbon monoxide	(CO)	0,005	0,5
		Hydrogen	(H_2)	0,01	1,0
		Ethene	(C_2H_4)	0,005	0,8
		Ethane	(C_2H_6)	0,025	0,4
		Propene	(C_3H_6)	0,005	0,8
		Propane	(C_3H_8)	0,01	0,5
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0006	0,8

Certified reference gas mixtures for process gas chromatographs (continued)

CRM-No.	Main component	Analyte		Molar fraction mol/mol	Uncertainty % rel
BAM-G460	Methane (CH_4)	Helium	(He)	0,005	0,8
		Nitrogen	(N_2)	0,12	0,3
		Carbon dioxide	(CO_2)	0,04	0,3
		Ethane	(C_2H_6)	0,0075	0,5
		Propane	(C_3H_8)	0,003	0,5
		n-Butane	(C_4H_{10})	0,002	0,8
		2-Methyl-propane	(C_4H_{10})	0,002	0,8
		n-Pentane	(C_5H_{12})	0,0005	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0005	0,8
		n-Hexane	(C_6H_{14})	0,0005	0,8
BAM-G490	Methane (CH_4)	Nitrogen	(N_2)	0,125	0,3
		Carbon dioxide	(CO_2)	0,04	0,3
		Ethane	(C_2H_6)	0,045	0,3
		Propane	(C_3H_8)	0,022	0,3
		n-Butane	(C_4H_{10})	0,0120	0,5
		2-Methyl-propane	(C_4H_{10})	0,007	0,5
BAM-G491	Methane (CH_4)	Nitrogen	(N_2)	0,075	0,3
		Carbon dioxide	(CO_2)	0,05	0,3
		Ethane	(C_2H_6)	0,115	0,3
		Propane	(C_3H_8)	0,05	0,3
		n-Butane	(C_4H_{10})	0,006	0,6
		2-Methyl-propane	(C_4H_{10})	0,0035	0,8
BAM-G492	Methane (CH_4)	Nitrogen	(N_2)	0,150	0,3
		Carbon dioxide	(CO_2)	0,06	0,3
		Ethane	(C_2H_6)	0,14	0,3
		Propane	(C_3H_8)	0,005	0,5
		n-Butane	(C_4H_{10})	0,004	0,8
		2-Methyl-propane	(C_4H_{10})	0,012	0,5
BAM-G496	Methane (CH_4)	Nitrogen	(N_2)	0,005	0,5
		Carbon dioxide	(CO_2)	0,001	0,6
		Ethane	(C_2H_6)	0,001	0,6
		Propane	(C_3H_8)	0,0005	0,8
		n-Butane	(C_4H_{10})	0,0003	0,8
		2-Methyl-propane	(C_4H_{10})	0,0003	0,8
		n-Pentane	(C_5H_{12})	0,001	0,8
		2-Methyl-butane	(C_5H_{12})	0,001	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,00025	0,8
		n-Hexane	(C_6H_{14})	0,00025	0,8
BAM-G497	Methane (CH_4)	Nitrogen	(N_2)	0,010	0,3
		Carbon dioxide	(CO_2)	0,029	0,3
		Ethane	(C_2H_6)	0,02	0,3
		Propane	(C_3H_8)	0,042	0,3
		n-Butane	(C_4H_{10})	0,008	0,5
		2-Methyl-propane	(C_4H_{10})	0,005	0,6
		n-Pentane	(C_5H_{12})	0,00025	0,8
		2-Methyl-butane	(C_5H_{12})	0,0005	0,8
		2,2-di-Methyl-propane	(C_5H_{12})	0,0001	0,8
		n-Hexane	(C_6H_{14})	0,0001	0,8
BAM-G901	Natural Gas	Carbon dioxide	(CO_2)	0,002 to 0,2	0,5 to 0,3

Elastomeric materials

Standard reference elastomers (SRE) from vulcanized rubbers

Standard Reference Elastomers (SRE) are characterized by standardized and controlled properties. One application area is the calibration of scientific and technical test apparatuses and methods (E001 and E003). They enable the exact determination of material data if the method of measuring by itself cannot give absolute measured values. They can further be used as part of a measuring device (E002, E004 to E007). The SRE E001, E003 to E007 consist of natural rubber (NR).

SRE made from nitrile rubber (NBR), hydrogenated nitrile rubber (HNBR), ethylene-propylene diene rubber (EPDM), polyacrylate rubber (ACM), silicone rubber (MVQ) and fluoropolymer rubber (FKM) are meant to determine the effect of mineral oils, lubricants, hydraulic liquids and other service fluids on vulcanizates made from the mentioned rubbers which are used for seals, hoses etc. They are different in their degree of swelling (E008 to E020).

The following SRE from vulcanized rubbers and for testing of vulcanized rubber products (E002) are produced and offered:

BAM-E001	**Rubber test sheet** for determination of abrasion resistance of vulcanized rubber according to DIN 53516 and ISO 4649-2002 reference compound no. 1
BAM-E002	**Abrasive paper sheet** - according to DIN 53516 and ISO 4649-2002; Annex A
BAM-E003	**Rubber test sheet** for determination of abrasion resistance of vulcanized rubber according to ISO 4649-2002 reference compound no. 2
BAM-E004	**Rubber sole sheet** for measuring the electrostatic charging of floor by a walking test
BAM-E005	**Rubber base ring** for the portable tester for measuring the surface roughness of streets (Efflux meter according to MOORE)
BAM-E006/ BAM-E007	**Rubber slider** for the British portable tester for measuring the surface grip property of streets (skid resistance tester; SRT) according to ASTM E 303-93 and for the friction measuring device for the determination of the PSV-value (polished stone value)
BAM-E008	**Elastomer** DIN 53538 SRE-NBR 1 / ISO 13226 SRE-NBR 28/PX designated for hydraulic area (vulcanized with peroxide, low elongation at break)
BAM-E009	**Elastomer** DIN 53538 SRE-NBR 28 / ISO 13226 SRE-NBR 28/SX designated for automotive area (vulcanized with thiurame, high elongation at break)
BAM-E010	**Elastomer** DIN 53538 SRE-NBR 34 / ISO 13226 SRE-NBR 34/SX designated for automotive area (vulcanized with thiurame, high elongation at break)
BAM-E011	**Elastomer** DIN 53538 SRE-HNBR 19 / ISO 13226 SRE-HNBR/1X designated for hydraulic and automotive area (vulcanized with peroxide)
BAM-E012	**Elastomer** DIN 53538 SRE-ACM / ISO 13226 SRE-ACM/1X designated for hydraulic and automotive area
BAM-E013	**Elastomer** DIN 53538 SRE-MVQ / ISO 13226 SRE-VMQ/1X designated for hydraulic and automotive area (vulcanized with peroxide)
BAM-E014	**Elastomer** ISO 13226 SRE-FKM/2X / ISO 6072 FKM 2 designated for hydraulic and automotive area
BAM-E015	**Elastomer** ISO 6072 NBR 1 designated for hydraulic and automotive area
BAM-E016	**Elastomer** ISO 6072 NBR 2 designated for hydraulic and automotive area
BAM-E017	**Elastomer** ISO 13226 SRE-NBR L designated for hydraulic and automotive area (vulcanized with thiurame, low content of acrylonitrile)
BAM-E018	**Elastomer** ISO 13226 SRE-NBR M designated for hydraulic and automotive area (vulcanized with thiurame, medium content of acrylonitrile)
BAM-E019	**Elastomer** ISO 6072 EPDM 1 designated for hydraulic and automotive area
BAM-E020	**Elastomer** ISO 6072 HNBR 1 designated for hydraulic and automotive area

In addition to the described applications, these SRE can generally be used in all cases in which elastomers with defined and reproducible properties are needed.

Optical properties

Test colour sets for specifying colour reproduction

BAM-V003

VIII.1E....

Field of application:

Specification of quality of colour reproduction in different techniques such as television, colour photography, multicolour printing. The reproduction of a test colour set is colorimetrically compared to the original and a difference parameter used for quality specification.

Five different sets are available:

- **ISO/CIE + DIN set: 14 + 3** test colour samples (reference: CIE Publ. 13.2 (1974) + 3 greys from DIN 6169)
- **EBU set: 6** test colour samples (reference: EBU = European Broadcasting Union)
- **T14 set: 23** test colour samples of pos. 1 + pos. 2 (reference: „Technische Pflichtenhefte der öffentlich-rechtlichen Rundfunkanstalten in der Bundesrepublik Deutschland“)
- **EBU/CAM set: 15** test colour samples (reference: EBU document Tech. 3237)
- **Grey set: 6** neutral test colour samples with luminance factors of approximately 3, 8, 21, 37, 58, and 89

All test colour samples have a matt finish and are mounted on a stiff cardboard backing sheet sized 40 mm x 100 mm. The test colour set of pos. 4 can also be delivered with samples mounted in 50 mm x 50 mm standard slide frames ready for use on carousel projectors as described in EBU document Tech. 3237. All test colour samples are prepared using two-component acrylic lacquer with very good light fastness.

Certified optical properties:

Spectral radiance factors of each sample according to DIN 5033

45/0 measuring geometry

380 nm to 720 nm, step width and optical bandwidth 10 nm

traced back to calibration of white reference material by PTB

tristimulus values for standard illuminant D65 and CIE 1931 standard colorimetric observer

Other colour co-ordinates or other type of colorimetric evaluation on request.

Expanded uncertainty of spectral radiance factors: ± 1 % (coverage factor k =2)

Materials with integral optical properties

CRM-No.	**BAM-V001** **VIII.1E...**	**BAM-V002** **VIII.1E...**
Optical property	specular gloss	coefficient of retroreflection
Method for estimating the certified value	DIN 67530, ISO 2318	DIN 67520, CIE-Pub. 54
Essential parameters for measurement	illumination angle: 20°, 60°, 85°	observation angle 0,1° to 2°, entrance angle: -60° to +60°, rotation angle 0° to 360°
Certified value	about 95 units	10 to 500 cd/(lx*m*m) [customer defined]
Uncertainty (*k*=2)	0,3 units	5%
Validity of the certified value	1 year	1 year
Traceability to	PTB	PTB
Description of the material	polished black glass	commercial retroreflective film used for traffic signs
Size of the material	about 100 mm x 100 mm	about 100 mm x 100 mm
Delivery of the material	typically by the customer	typically by the customer

Materials with spectral optical properties

CRM-No.	**BAM-V004/5**[1)] **VIII.1E...**	**BAM-V007** **VIII.1E...**	**BAM-V006** **VIII.1E...**	**BAM-V008** **VIII.1E...**
Optical property	spectral radiance factor	spectral transmittance factor	bispectral transition factor	total radiance factor
Method for estimating the certified value	DIN 5033	DIN 5033	Two- Monochromator-Method[2)]	DIN 5033
Measuring geometry	45/0, d/8, or 8/d in- or excluding specular reflection	0/0	45/0	45/0
Wavelength region	380 nm - 720 nm	300 nm - 2500 nm	300 nm - 800 nm	300 nm - 800 nm
Stepwidth and optical bandwidth	10 nm	10 nm	10 nm	10 nm
Calculated spectral properties			total, fluorescent, and reflected radiance factor	
Calculated colorimetric properties	*X*, *Y*, *Z* *L**,*a**,*b** or others		*X*, *Y*, *Z* *L**,*a*,**b** or others	*X*, *Y*, *Z* *L**,*a*,**b** or others
Uncertainty (*k*=2)	1%	1% to 2%	1% to 2%	2%
Validity of the certified value	1 year	1 year	1 year	1 year
Traceability to	PTB	PTB	PTB	PTB
Description of the material	reflecting non-fluorescent reference object	transparent reference object	reflecting fluorescent reference object	reflecting fluorescent reference object
Size of the material	typical 50 mm x 50 mm	typical 50 mm x 50 mm	typical 50 mm x 50 mm	typical 50 mm x 50 mm
Delivery of the material	typically by the customer	typically by the customer	typically by the customer	typically by the customer

[1)] BAM-V004 is used for white reference objects, BAM-V005 is used for chromatic reference objects
[2)] according to Gundlach (1985/86)

X-ray film step tablet

Calibrated X-ray film step tablet of 15 steps

Covered optical density range: 0,25 – 5,0

Film type: Agfa - Gevaert Structurix D4

Photometric and colorimetric reference materials

ISO/IEC- and DIN-Test Charts for colour image reproduction, colour workflow and colour Management

Fields of application for the material

The test charts serve for the specification of image reproduction properties in colour reproduction processes. The table includes analog DIN- and ISO/IEC-test charts in A4 size for reflective and transparent mode. The analog test charts serve as reference for different reproduction processes. The reference transparent test charts consist of the upper part of the test charts. Two 16-step grey scales in the upper BAM-reference part and the lower part on the monitor (produced by software) must be made equally spaced in CIELAB.

Photometric and colorimetric properties of test charts

according to ISO/IEC 15775:1999 and DIN 33866-1 to -5:2000

Physical mode	CRM-No.	Application condition
Reflectance	X87E00FA	Reference for printer output
Transmittance	A87E01FA	Reference for monitor output with 0,0 % room reflection
Transmittance	B87E01FA	Reference for monitor output with 2,5 % room reflection
Transmittance	C87E01FA	Reference for monitor output with 5,0 % room reflection
Transmittance	D87E01FA	Reference for monitor output with 7,5 % room reflection

The test chart colours are equally spaced in CIELAB lightness *L** between black and white. The measured *L** values have an uncertainty of +/-2. There is a traceability to PTB. The CIE measurement geometry is 45/0 for reflectance mode and 0/0 for transmittance mode. The CIELAB *L** data are for the CIE 2 degree observer and for CIE illuminant D65.

Calibration kit
Spectral fluorescence standards

BAM-F001, BAM-F002, BAM-F003, BAM-F004, BAM-F005

For the determination of the relative spectral responsivity of fluorescence instruments, and control of the long term stability of fluorescence instruments, and for the determination of corrected, i.e., instrument-independent emission spectra.

Five spectral fluorescence standards ready-made from Sigma-Aldrich GmbH (former Fluka GmbH), which cover the spectral region of 300 nm to 770 nm as a set. The corresponding product numbers from Sigma-Aldrich GmbH are 72594, 23923, 96158, 74245, and 94053 for the (individually available) kit components and 97003-1KT-F for the calibration kit including solvent and software. Addition of aliquots of 10 ml of ethanol to each solid dye yields a solution that can be measured without additional dilution steps.

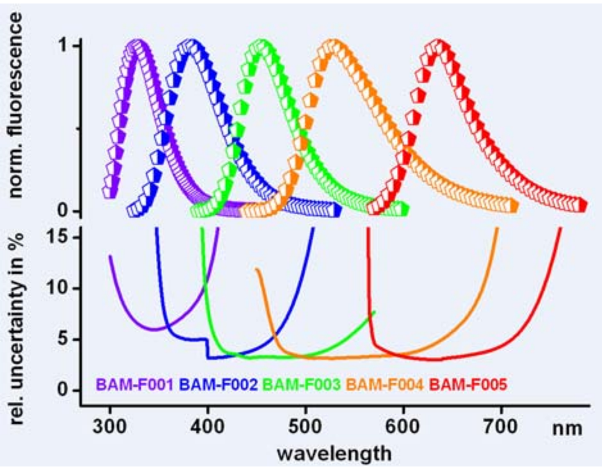
Solvent ethanol

Corrected emission spectra of BAM-F001 - BAM-F005 certified with different spectral bandpasses and corresponding wavelength-dependent expanded relative uncertainties. Certification was performed according to ISO Guide 35 and calculation of the wavelength-dependent uncertainties according to the Guide to the Expression of Uncertainty (GUM).

CD with the certificate files BAM507Mx.CTF, the data evaluation software LINKCORR developed by BAM, and instructions for use of BAM-F001 - BAM-F005 and LINKCORR.

Certified properties

Normalized corrected emission spectra of BAM-F001 - BAM-F005 in ethanol for T = 25 °C. The emission spectra are traceable to the spectral radiance realized and disseminated in Germany by the Physikalisch-Technische Bundesanstalt (PTB).



Certified normalized corrected emission spectra of

← BAM-F001 – BAM-F005

and

← expanded relative uncertainties

Porous materials

CRMs for the gas adsorption method

CRM-No.	**BAM-PM-101**	**BAM-PM-102**	**BAM-PM-103**	**BAM-PM-104**	**ERM®-FD107 (BAM-P107)**
Description	SiO_2	alpha-Al_2O_3	Al_2O_3 type 60	Al_2O_3 type150	Faujasite type zeolite
	Powder	Powder	Powder	Powder	Pellets
Sorptive	Krypton	Nitrogen	Nitrogen	Nitrogen	Nitrogen
Year of issue	1996	1996	1996	1996	2000
BET-Specific surface area (m^2/g)	0,177 ± 0,014	5,41 ± 0,24	156,0 ± 7,2	79,8 ± 2,0	—
Specific pore volume (cm^3/g) p/p_o=0,99	—	—	0,250± 0,008	0,210 ± 0,009	—
Mean pore radius (nm)	—	—	3,18 ± 0,08	5,31 ± 0,24	—
Most frequent pore radius (nm)	—	—	1,93 ± 0,18	3,23 ± 0,23	—
Specific micropore volume (cm^3/g)	—	—	—	—	0,217 ± 0,002
Median pore width (nm)	—	—	—	—	0,86 ± 0,02

Note: The uncertainty is ± 1 s (standard deviation of the laboratory means) in BAM-PM-101 to 104; in the case of ERM®-FD107 the expanded uncertainty with a coverage factor k = 2

The reference materials are intended for the calibration and checking of instruments for the determination of the specific surface area, the specific pore volume, and the pore radius (pore width) by means of the gas adsorption method according DIN 66131 (replaced by DIN ISO 9277), DIN 66134, and DIN 66135-Part 4.

CRMs for the mercury intrusion method

High pressure range between 0,1 and 400 MPa

Certified properties:

A) Pressure-volume curve (mercury intrusion curve) between 0,1 MPa and 400 MPa
B) Diameter-volume curve (cumulative pore volume curve) between 3,7 nm and 14708 nm (for A and B see certificate)
C) (i) Pore volume values at selected intrusion pressure points;
(ii) Values for the pore diameter (see the table below)

CRM-No.	**ERM®-FD120 (BAM-PM-120)**	**ERM®-FD121 (BAM-PM-121)**	**ERM®-FD122 (BAM-PM-122)**	**BAM-P127***
Description	alpha-Alumina	Porous glass	Porous glass	Alumina
	Beads	Beads	Beads	Beads
Year of issue	2000	2000	2000	2002
Pore volume (in mm^3/g) at 50 MPa	—	—	—	69,4 ± 8,0
Pore volume (in mm^3/g) at 100 MPa	545,0 ± 12,2	425,0 ± 47,1	919,7 ± 16,8	625,4 ± 13,6
Pore volume (in mm^3/g) at 195 MPa	546,7 ± 12,7	621,9 ± 12,9	922,5 ± 17,5	637,1 ± 14,4
Pore volume (in mm^3/g) at 200 MPa	546,8 ± 12,7	621,9 ± 12,9	922,6 ± 17,5	—
Pore volume (in mm^3/g) at 395 MPa	548,1 ± 13,1	624,6 ± 13,4	924,4 ± 17,2	638,6 ± 21,6
Mean pore diameter d_{50} (nm)	228,0 ± 5,9	15,1 ± 0,2	139,0 ± 3,7	24,2 ± 1,0
Most frequent pore diameter $d_{p,m}$ (nm)	232,2 ± 8,8	15,3 ± 0,2	140,2 ± 3,9	23,9 ± 2,8

*1st CRM jointly developed by NIST and BAM (identical with NIST SRM 1917)

Note: All certified pore volumes are normalized values $V'_p = V_p(p_{Hg}) - V_p(0,1 \text{ MPa})$
The uncertainty is the expanded uncertainty for the selected intrusion pressure points for ERM®-FD120, ERM®-FD121, and ERM®-FD122 and for BAM-P127
These reference materials are intended for the calibration and checking of porosimeters by means of the whole pressure volume curves of the Hg intrusion method.

Pressure range between 0,28 and 1,41 MPa

ERM®-FD123 (BAM-P123)

Certified properties:

A) Pressure volume curve (mercury intrusion curve) between 0,28 and 1,41 MPa with simultaneous confidence and prediction bands at the significance level 0,8; 0,9 and 0,95

B) Curve characteristics y_1, y_2 and y_3

Certified curve characteristics

Quantity	Certified values αm	0,9-confidence-interval	0,95-confidence-interval	0,99-confidence-interval	Unit
$\boldsymbol{y_1}$ $\boldsymbol{V_{p,\ 1,41\ MPa}}$ **specific pore volume at 1,41 MPa**	99,52	± 2,88	3,44	4,54	mm^3g^{-1}
$\boldsymbol{y_2}$ $\boldsymbol{y_3}$	0,4966 0,2151	± 0,0151 ± 0,0131	0,0180 0,0156	0,0238 0,0206	MPa MPa
$\boldsymbol{p_{50}}$	0,4829	± 0,0200	0,0239	0,0315	MPa
$\boldsymbol{d_{50}}$	3,0520	± 0,1285	0,1533	0,2021	µm

Pressure range between 0,24 and 1,55 MPa

BAM-P124

Certified properties:

A) Pressure volume curve (mercury intrusion curve) between 0,24 and 1,55 MPa with simultaneous prediction bands at the significance level 0,95

B) Curve characteristics y_1, y_2 and y_3

Certified curve characteristics

Quantity	Certified values α_m	0,95-prediction interval	Unit
$\boldsymbol{y_1}$ $\boldsymbol{V_{p,\ 1,55\ MPa}}$ **specific pore volume at 1,55 MPa**	158,1	150,8- 165,4	mm^3g^{-1}
$\boldsymbol{y_2}$ $\boldsymbol{y_3}$	0,5021 0,2616	0,474-0,530 0,223-0,300	MPa MPa
$\boldsymbol{p_{50}}$	0,4795	0,451-0,508	MPa
$\boldsymbol{d_{50}}$	3,074	2,89-3,26	µm

Pressure range between 0,12 and 0,88 MPa

BAM-P125

Certified properties:

A) Pressure volume curve (mercury intrusion curve) between 0,12 and 0,88 MPa with simultaneous prediction bands at the significance level 0,8; 0,9 and 0,95

B) Curve characteristics y_1; y_2 and y_3

Certified curve characteristics

Quantity	Certified values αm	0,9-prediction interval	0,95-prediction interval	0,99-prediction interval	Unit
$\boldsymbol{y_1}$ $\boldsymbol{V_{p,\ 0,88\ MPa}}$ **specific pore volume at 0,88 MPa**	207,9	199,5 - 216,3	197,8 - 218,0	194,6 - 221,2	mm^3g^{-1}
$\boldsymbol{y_2}$ $\boldsymbol{y_3}$	0,2646 0,1366	0,2533 - 0,2760 0,1216 - 0,1516	0,2511 - 0,2782 0,1187 - 0,1546	0,2467 - 0,2825 0,1130 - 0,1603	MPa MPa
$\boldsymbol{p_{50}}$	0,2554	0,2476 - 0,2633	0,2460 - 0,2649	0,2430 - 0,2679	MPa
$\boldsymbol{d_{50}}$	5,796	5,616 - 5,977	5,581 - 6,012	5,512 - 6,081	µm

Pressure range between 0,55 and 2,1 MPa

BAM-P126

Certified properties:

A) Pressure volume curve (mercury intrusion curve) between 0,55 and 2,1 MPa with simultaneous prediction bands at the significance level 0,95.

B) Curve characteristics y_1; y_2 and y_3

Certified curve characteristics

Quantity	Certified values α_m	0,95-prediction interval	Unit
$\boldsymbol{y_1}$ $\boldsymbol{V_{p,\ 2,1\ Mpa}}$ **specific pore volume at 2,1 MPa**	110,9	102,4- 119,4	mm^3g^{-1}
$\boldsymbol{y_2}$ $\boldsymbol{y_3}$	0,8682 0,2965	0,8274-0,9091 0,2660-0,3271	MPa MPa
$\boldsymbol{p_{50}}$	0,8441	0,8025-0,8856	MPa
$\boldsymbol{d_{50}}$	1,746	1,661-1,832	µm

Note: The confidence intervals result from the variance analytical investigation of the p-v curve characteristics y_1, y_2, and y_3.

y_1: intruded volume at the saturation point 1,41 MPa (ERM®-FD123), 1,55 MPa (BAM-P124), 0,88 MPa (BAM-P125), 2,1 MPa (BAM-P126); saturation value

y_2: pressure at 57,5 % of the saturation value

y_3: difference of the pressures at which the smoothed curve has got 87,5 % and 25 % of the saturation value

The transformation of the intrusion pressure data p_{Hg} into pore diameter values d_p according to the Washburn equation $d_p = -4\ \gamma \cos\theta / p_{Hg}$ (assuming a cylindric pore model) has to be carried out using the following values of the parameters: $\gamma = 0,48\ Nm^{-1}$ (surface tension of mercury) and

$\theta = 140°$ (contact angle of mercury) in accordance with DIN 66133.

Layer and surface reference materials

Antimony implanted in silicon

ERM®-EG001 (BAM-L001 / IRMM-302)

Certified quantity	**Certified value**	**Uncertainty U_{CRM}**
Areal density of Sb atoms / 10^{16} cm^{-2}	4,81	0,06
Isotope amount ratio $n(^{121}Sb) / n(^{123}Sb)$	1,435	0,006

Informative values

Areal density of the sum of Si, O and Sb atoms in the oxide layer — $(5{,}9 \pm 0{,}7) \cdot 10^{17}$ cm^{-2}

Areal density of the sum of Si, O and Sb atoms in the layer corresponding to the projected range of the Sb distribution — $(9{,}9 \pm 1{,}1) \cdot 10^{17}$ cm^{-2}

Areal density of the sum of Sb and Si atoms in the layer corresponding to the width of the Sb distribution (full width at half maximum) — $(6{,}5 \pm 0{,}8) \cdot 10^{17}$ cm^{-2}

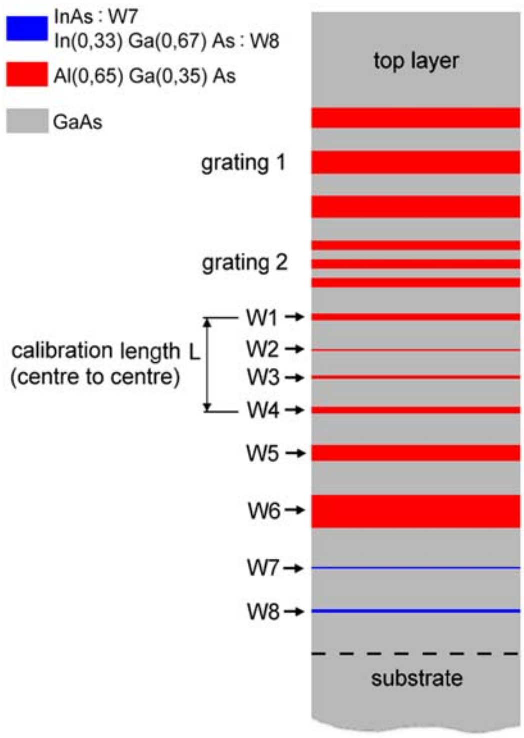
Uncertainties quoted are expanded uncertainties with a coverage factor of k = 2

Nanoscale strip pattern for length calibration and testing of lateral resolution

BAM-L002

The nanoscale strip pattern enables the calibration and the regular quality control for methods of surface analysis. It supports the calibration of length scale, the estimation of lateral resolution and the determination of beam shape and diameter.

Characteristic	**Certified value**	**Expanded (k=2) uncertainty U_{CRM}**
Calibration length *L* (centre to centre)	964 nm	35 nm
Strip width in grating 1	288 nm	16 nm
Strip width in grating 2	74 nm	6 nm
Strip width W5	145 nm	9 nm
Strip width W6	478 nm	25 nm



Non-certified values (for information only)

Strip width W1	(48 ± 5) nm
Strip width W2	0,5 nm
Strip width W3	(5 ± 1) nm
Strip width W4	(48 ± 5) nm
Strip width W7	0,4 nm
Strip width W8	5 nm

Materials for thin film and surface technology

CRM	Layer		Substrate		Certified quantity
	Material	Nominal layer thickness [nm]	Material	Substrate dimensions [mm]	
BAM-L100	Ti/Al multilayer	5 x (100/250)	100Cr6 steel	∅ 30 x 5	total layer thickness *
BAM-L101	TiO_2/SiO_2 multilayer	5 x (100/100)	BK7 glass	30 x 30 x 1	total layer thickness *
BAM-L102	TiN single layer	2500	100Cr6 steel	∅ 30 x 5	layer thickness *
BAM-L103	VN single layer	2500	100Cr6 steel	∅ 30 x 5	layer thickness *
BAM-L104	TiC single layer	2500	100Cr6 steel	∅ 30 x 5	layer thickness *
BAM-L105	VC single layer	2500	100Cr6 steel	∅ 30 x 5	layer thickness *

* individually certified for each CRM

Surfactant reference materials

ERM®-FA052, ERM®-FA053, ERM®-FA054 and ERM®-FA055

(range: 30-75 mN/m)

CRM			Certified value 1)	Uncertainty 2)
	Measuring conditions		Surface tension in mN/m	
ERM-FA052	plate	20 °C	72,73	± 0,80
ERM-FA052	ring	20 °C	72,05	± 0,65
ERM-FA052	plate	30 °C	71,36	± 0,79
ERM-FA052	ring	30 °C	70,55	± 0,64
ERM-FA052	plate	40 °C	69,92	± 0,77
ERM-FA053	plate	30 °C	37,96	± 0,57
ERM-FA053	ring	30 °C	37,29	± 0,45
ERM-FA054	plate	40 °C	39,08	± 0,63
ERM-FA055	plate	20 °C	30,97	± 0,17
ERM-FA055	ring	20 °C	30,28	± 0,15
ERM-FA055	plate	30 °C	29,80	± 0,17
ERM-FA055	ring	30 °C	29,19	± 0,14
ERM-FA055	plate	40 °C	28,85	± 0,16
ERM-FA055	ring	40 °C	28,13	± 0,14

1) Unweighted mean of means of 3 replicates each, determined using a validated reference method, implemented on 2 qualified reference equipments. The values are directly traceable to the SI (Système International d'Unités) given the convention as defined by DIN EN 14370.

2) Estimated expanded uncertainty with a coverage factor of *k*=2, corresponding to a level of confidence of 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO, 1995, evaluated on the basis of a thorough validation study of the reference method including an national ILC.

Expiry date at the end-user's side of 20 weeks (from the delivery, and under specified storage conditions). The minimum sample size for one determination is 50 g.

Polymer materials

CRMs for the determination of the molecular weight

CRM-No.	**BAM-P001**	**BAM-P002**	**BAM-P003**	**BAM-P004**	**BAM-P005**
Description	Polystyrene	Polystyrene	PMMA	PEO	Polystyrene
	Amorphous material	Pellets	Crystalline material	Crystalline material	Pellets
Year of issue	2002	2002	2002	2002	2003
Weight-average molecular weight (*M_w*) by light scattering (LS) g/mol	87600 ± 2,91	205600 ± 1,49	107050 ± 2,33	—	349800 ± 2,77
Intrinsic viscosity by viscometry mL/g	42,37 ± 1,96	68,38 ± 1,16	31,48 ± 3,85	14,28 ± 3,74	104,28 ± 2,20
Average molecular weights (M_w and M_n) g/mol	— —	— —	— —	6065 ± 1,46 5960 ± 1,02	— —
and					
polydispersity M_w/M_n by MALDI-TOF-mass spectrometry	—	—	—	1,02 ± 0,98	—

CRM-No.	**BAM-P006**	**BAM-P007**	**BAM-P008**	**BAM-P009**	**BAM-P010**
Description	PMMA	PMMA	PEO	Poly(lactide)	Poly(lactide)
	Amorphous material	Crystalline material	Crystalline material	Granulate	Crystalline powder
Year of issue	2003	2003	2003	2003	2003
Weight-average molecular weight (M_w) by light scattering (LS) g/mol	365500 ± 2,96	360200 ± 2,73	—	77450 ± 2,16	225200 ± 5,98
Intrinsic viscosity by viscometry mL/g	90,63 ± 1,16	84,80 ± 2,14	20,91± 5,37	61,19 ± 2,62	125,29 ± 2,43
Average molecular weights (M_w and M_n) g/mol	— —	— —	11400 ± 1,16 11300 ± 0,95	— —	— —
and					
polydispersity M_w/M_n by MALDI-TOF-mass spectrometry	—	—	1,01 ± 0,0	—	—

Note: The certified mean value ± the confidence interval (in %) is given

The reference materials are intended for the calibration of instruments for the determination of the molecular weight and molecular weight distribution of polymers. The samples are supplied in plastic bottles containing 1, 2, 5, and 10 g each.

Isotopic reference materials

CRMs certified for the isotopic composition of boron

Certified quantity: Isotopic composition of boron in an aqueous solution of boric acid, certified with expanded relative uncertainties of less than 0,12%.

Application: Calibration and validation of ICP-MS procedures used for the determination of boron isotope amount ratios. Boron isotope amount ratios have to be determined within the surveillance of the primary cooling circuit in nuclear power plants equipped with a pressurized water reactor. They also have to be determined in container materials, which are doped with boron serving as a neutron shield.

	ERM®-AE101 (BAM-I001)	**ERM®-AE102 (BAM-I002)**	**ERM®-AE103 (BAM-I003)**	**ERM®-AE104 (BAM-I004)**
Isotope amount ratio $n(^{10}B)/n(^{11}B)$	0,28197 (40)	0,42485 (60)	0,9895 (14)	0,45966 (62)
Amount fraction x 100				
$n(^{10}B)/n(B)$	21,995 (24)	29,817 (30)	49,737 (34)	31,491 (29)
$n(^{11}B)/n(B)$	78,005 (24)	70,183 (30)	50,263 (34)	68,509 (29)
Mass fraction x 100				
$m(^{10}B)/m(B)$	20,411 (22)	27,871 (28)	47,368 (34)	29,481 (28)
$m(^{11}B)/m(B)$	79,589 (22)	72,129 (28)	52,632 (34)	70,519 (28)
Molar mass $M(B)$ **in** $g\cdot mol^{-1}$	10,79015 (24)	10,71222 (30)	10,51374 (34)	10,69554 (29)
	Informative value			
Mass fraction in solution $w(B)$ **in** $mg\cdot kg^{-1}$	1000 (20)	999 (20)	1000 (20)	999 (20)

All uncertainties indicated are expanded uncertainties $U=k\cdot u$ where k=2 and u is the combined standard uncertainty calculated according EURACHEM and ISO guidelines. They are given in parenthesis and apply to the last two digits of the value.

Experts

Iron and steel products and non ferrous metals

Dr. Sebastian Recknagel
phone: +49 (0)30 8104-1111
fax: +49 (0)30 8104-1117
email: sebastian.recknagel@bam.de

Pure substances

Dr. Siegfried Noack
phone: +49 (0)30 8104-1113
fax: +49 (0)30 8104-1117
email: siegfried.noack@bam.de

Primary pure substances

Dr. Heinrich Kipphardt
phone: +49 (0)30 8104-1116
fax.: +49 (0)30 8104-1117
email: heinrich.kipphardt@bam.de

Non - metallic materials special materials

Dr. Ralf Matschat
phone: +49 (0)30 8104-1110
fax: +49 (0)30 8104-1117
email: ralf.matschat@bam.de

Environment and food

Prof. Dr. Irene Nehls (organic analytes)
phone: +49 (0)30 8104-1120
fax: +49 (0)30 8104-1127
email: irene.nehls@bam.de

Dr. Holger Scharf (inorganic analytes)
phone: +49 (0)30 8104-1114
fax: +49 (0)30 8104-5569
email: holger.scharf@bam.de

Primary reference gas mixtures

Dipl.-Ing. Hans-Joachim Heine
phone: +49 (0)30 8104-3434
fax: +49 (0)30 8104-3207
email: hans-joachim.heine@bam.de

Elastomeric materials

Dr. Wolfgang Stark
phone: +49 (0)30 8104-1614
fax: +49 (0)30 8104-3328
email: wolfgang.stark@bam.de

Optical materials

Dipl.-Phys. Klaus-Peter Gründer
phone: +49 (0)30 8104-3633
fax: +49 (0)30 8115-3047
email: klaus-peter.gruender@bam.de

Ing. Peter Otto
phone: +49 (0)30 8104-3584
fax: +49 (0)30 8115-3047
email: peter.otto@bam.de

Dipl.-Math. Bernd Muschik
phone: +49 (0)30 8104-3587
fax: +49 (0)30 8104-1807
email: bernd.muschik@bam.de

X-ray film step tablet

Dipl.-Ing. Hans-Joachim Malitte
phone: +49 (0)30 8104-3657
fax: +49 (0)30 8104-1837
email: hans-joachim.malitte@bam.de

Porous materials

Dr. Peter Klobes
phone: +49 (0)30 8104-5825
fax: +49 (0)30 8104-1137
email: peter.klobes@bam.de

Spectral fluorescence standards

Dr. Ute Resch-Genger
phone: +49 (0)30 8104-1134
fax: +49 (0)30 8104-1107
email: ute.resch@bam.de

X-ray powder diffraction

Dr. Burkhard Peplinski
phone: +49 (0)30 8104-5846
fax: +49 (0)30 8104-5817
email: burkhard.peplinski@bam.de

Dr. Ralf Müller
phone: +49 (0)30 6392-5914
fax: +49 (0)30 6392-5976
email: ralf.mueller@bam.de

Surface and layer reference materials

Dipl.-Phys. Uwe Reinholz
phone: +49 (0)30 8104-4110
fax: +49 (0)30 8104-1147
email: uwe.reinholz@bam.de

Dr. Uwe Beck
phone: +49 (0)30 8104-1821
fax: +49 (0)30 8104-1827
email: uwe.beck@bam.de

Dr. Michael Griepentrog
phone: +49 (0)30 8104-3555
fax: +49 (0)30 8104-1827
email: michael.griepentrog@bam.de

Dr. Mathias Senoner
phone: +49 (0)30 8104-3564
fax: +49 (0)30 8104-1827
email: mathias.senoner@bam.de

Polymer materials

Dr. Steffen Weidner
phone: +49 (0)30 8104-1633
fax: +49 (0)30 8104-1137
email: steffen.weidner@bam.de

Isotopic reference materials

Dr. Jochen Vogl
phone: +49 (0)30 8104-1144
fax: +49 (0)30 8104-1147
email: jochen.vogl@bam.de

CRMs under development

Iron and steel products

ECRM 687-1 Iron oxide, powder

Certified properties: Element contents of Al, Ca, Cl, Cr, Cu, Na, K, Si, Mn, Ti, Co, Fe, Mg, Mo, Ni, P, Pb, Sn, Zn
(Cl water soluble as indicative value)

Fields of application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of element contents in iron oxides.

Completion date: 2007

ECRM 299-1 Ferritic electric heating steel (21% Cr, 5% Al), chips and discs

Certified properties: Element contents of C, Si, Mn, P, S, Cr, Mo, Ni, Al, Co, Cu, N, Ti, V, Zr

Fields of application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of element contents in highly alloyed steel; calibration of analytical instruments (C/S-analyzer, O/N-analyzer, spark emission spectrometer).

Completion date: 2007

ECRM 129-3 Low alloy steel (1% Al, 1,5% Cr), chips and discs

Certified properties: Element contents of C, Si, Mn, P, S, Cr, Mo, Ni, Al, Co, Cu, N, Sn, Ti, As

Fields of application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of element contents in highly alloyed steel; calibration of analytical instruments (C/S-analyzer, O/N-analyzer, spark emission spectrometer).

Completion date: 2007

ECRM 187-2 Low alloy steel, chips and discs

Certified properties: Element contents of C, Si, Mn, P, S, Cr, Mo, Ni, Al, As, B, Co, Cu, N, Sn

Fields of application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of element contents in highly alloyed steel; calibration of analytical instruments (C/S-analyzer, O/N-analyzer, spark emission spectrometer).

Completion date: 2008

Non ferrous metals

BAM-M389 CuNi25, discs

Certified properties: Element contents of Cu, Ni, Al, C, Co, Cr, Fe, Mg, Mn, P, Pb, S, Si, Sn, Ti, Zn, Zr

Fields of application: Calibration and recalibration of spark emission spectrometers and X-ray fluorescence spectrometers.

Completion date: 2007

BAM-M390 – M392: pure copper, discs

Certified properties: Element contents of P, Zn, Fe, Sn

Fields of application: Calibration and recalibration of spark emission spectrometers and X-ray fluorescence spectrometers.

Completion date: 2008

BAM-M504: car catalyst

Certified properties: Element contents of Pt, Pd, Rh

Fields of application: Validation and checking of the accuracy of analytical procedures for the determination of precious metals in car catalysts.

Completion date: 2007

X-ray diffraction

Stoichiometric, fine-grained α- cordierite powder

Certified properties: Phase purity
Relative intensity of X–ray powder diffraction reflections
in the angular range 10°- 40° (2Θ - Cukα)

Fields of application: Validation of quantitative phase analyses and lattice parameter refinements of mineralogical and high–tech materials containing cordierite or cordierite - like solid solutions
Proficiency testing of X–ray powder diffractometers
(intensity calibrant for the low diffraction angles region)

Completion date: 2010

Environment and food reference materials

Nitro aromatic compounds in soil

Certified properties: Nitro aromatic compounds in soil to be certified by different methods

Fields of application: Validation and checking of the accuracy of analytical procedures for the quantitative determination of nitro aromatic compounds in soil.

Completion date: 2010

ERM-CC016: Mineral oil in waste

Certified properties: Mineral oil hydrocarbon content (mass fraction)

Fields of application: Environmental (waste and soil) analysis, lab internal quality control

Completion date: 2007

Mineral oil calibration standard (in n-heptane)

Certified properties: Mineral oil hydrocarbon concentration

Fields of application: Calibration standard for gas chromatographic determination of mineral oil hydrocarbons

Completion date: 2007

ERM®-BD274 Acrylamide in rusk

Certified properties: Acrylamide in rusk

Fields of application: Validation of analytical methods; low concentration level

Completion date: 2007

Ochratoxin A in roasted coffee

Certified properties:	Ochratoxin A content (mass fraction)
Fields of application:	Food/Mycotoxin analysis, CRM for lab internal quality control
Completion date:	2008

Isotopic reference materials

Cadmium isotopic reference materials, certified for the isotopic composition of cadmium

Certified quantity:	Isotopic composition of cadmium in a) cadmium metal and b) in an aqueous solution The certified isotopic abundances of cadmium will reflect the natural isotopic composition and will be certified by means of synthetic isotope mixtures.
Fields of application:	Calibration of cadmium isotope ratio measurements, e.g. IDMS analysis for Cd, determination of isotopic variations; anchoring of the δ-scale for cadmium
Completion date:	2007

Sulphur in fossil fuel, matrix reference material, certified for the sulphur amount content in fossil fuel

Certified quantity:	Sulphur amount content in fossil fuel
Fields of application:	Calibration and validation of routine analytical procedures, reflects the current and/or future sulphur limit in fossil fuels
Completion date:	2007

Primary reference materials for element analysis

Category A

Elements of high purity in compact form, such as Au, Mo, Ni and Zn

Certified property:	Mass fraction of the matrix element with very small combined uncertainty, established by summing-up the mass fraction of all relevant impurities.
Fields of application:	Establishing calibrations solutions with SI-traceable values and small combined uncertainty for element analysis. Relevant for co-operation with National Measurement Institutes and producers of calibration solutions.
Completion date:	2007 - 2009 (depending on element)

Category B

Elements of ultra-high purity in compact or powder form, such as Cu and Fe

Certified property:	Mass fraction of all “metallic” impurities at ultra trace level
Examples:	BAM-B-primary-Cu-1 with statements on the mass fraction of 65 trace elements (metals).
Fields of application:	Establishing calibrations solutions with SI-traceable values and small combined uncertainty for element analysis. Relevant for co-operation with National Measurement Institutes and producers of calibration solutions.
Completion date:	2008 - 2009 (depending on element)

A Brief History of BAM

1870 The Prussian Ministry of Commerce, Trade and Public Works announces the establishment of a Mechanical and Technical Research Institute. Its task is to perform experiments of general scientific and public interest and to test the strength of components.

1904 The Royal Materials Testing Office is established in Berlin-Dahlem following the merger of the Royal Mechanical Testing Institute with the Royal Testing Station for Building Materials (founded in 1875) and the Royal Chemical Technical Testing Office (founded in 1877).

1919 Renamed the Public Materials Testing Office (MPA), the institute is responsible to the Prussian Ministry of Science, Fine Arts and Public Education; from 1936 on the Public X-ray Investigation Office is included.

1920 The State Chemical Technical Institute (CTR) is established under the State Ministry of the Interior from the Military Testing Office, established in 1889 as the Central Research Office for Explosives.

1945 MPA and CTR are united and operate under the jurisdiction of Berlin City Council.

1954 The Federal Republic of Germany takes over responsibility for MPA/CTA as Federal Institute for Mechanical and Chemical Testing (BAM), renamed the Federal Institute for Materials Testing in 1956. In addition BAM takes over responsibility for public materials testing for the state of Berlin.

1969 Under the Statute on Explosive Substances BAM is granted the status of senior federal authority; an amendment to the law in 1986 adds the word “research“ to BAM’s title.

1975 Under the Statute on the Transport of Hazardous Goods BAM is given greater responsibility in the field of public technical safety.

1990 German reunification and a recommendation from the German Scientific Council strengthen BAM’s function as a federal chemical technical institute. Its personnel is increased by staff gained from the defunct Office for Standardisation, Measurements and Product Testing (ASMW) and Academy of Sciences in the former GDR. Responsibility for public testing for Berlin is gradually ended.

1995 Following an external evaluation and extensive reorganisation, under a decree from the Federal Ministry of Economics BAM is given a new statute, revised management structures and methods and a future-oriented profile as an essential element of the technical and scientific infrastructure of the Federal Republic of Germany.

2006 After further external appraisal (by the German Scientific Council among others) BAM's profile was further developed as a departmental research establishment of the German Federal Republic for safety in technology and chemistry.