

# CERTIFICATE OF ANALYSIS

## ERM<sup>®</sup>-AE122

Boric acid in water		
Certified quantity <sup>1)</sup>	Certified value <sup>1)</sup>	Uncertainty <sup>2)</sup>
$\delta^{11}\text{B}_{\text{NIST 951}}$ in ‰	39.7	0.6

1)  $\delta^{11}\text{B}$  is a measure for the isotope variation. It is expressed as the shift of the isotopic composition relative to an internationally accepted standard given in per mill. It is calculated according to the following equation, with NIST SRM 951 (isotope reference material for boron) being used as reference:  $\delta^{11}\text{B} = ((R_{\text{sample}}/R_{\text{reference}})-1)$ . This certified reference material (CRM) is traceable to the international  $\delta$ -scale for boron with the origin being represented by NIST SRM 951.

2) Expanded uncertainty  $U$  with a coverage factor of  $k = 2$ , as defined in the Guide to the Expression of Uncertainty in Measurement (GUM), including the repeatability of the measurement and of the determination of correction factors for systematic errors as well as contributions from certified values.

This certificate is valid for 10 years for units with unbroken seal stored under required conditions. This validity may be extended as further evidence of stability becomes available.

### NOTE

European Reference Material ERM<sup>®</sup>-AE122 was produced and certified under the responsibility of BAM Bundesanstalt für Materialforschung und –prüfung according to the principles laid down in the technical guidelines of the European Reference Materials<sup>®</sup> co-operation agreement between BAM-LGC-IRMM.

Accepted as an ERM<sup>®</sup>, Berlin, October 2010

#### Amendment:

The units no. 51 to 99 were bottled in June 2020 and have a minimum validity until June 2030. For details see the amended certification report.

Berlin, September 2020

*(certificate revision history on last page)*

Dr. S. Richter  
Committee for Certification

Dr. J. Vogl  
Project Coordinator

<b>Indicative Values</b>		
Quantity	Indicative value <sup>1)</sup>	Uncertainty <sup>2)</sup>
Isotope amount ratio $n(^{10}\text{B})/n(^{11}\text{B})$	0.23782	0.00031
Isotope amount ratio $n(^{11}\text{B})/n(^{10}\text{B})$	4.205	0.006
Isotope amount fraction $n(^{10}\text{B})/n(\text{B})$	0.19213	0.00020
Isotope amount fraction $n(^{11}\text{B})/n(\text{B})$	0.80787	0.00020
Molar mass of Boron in solution $M(\text{B})$ , in $\text{g}\cdot\text{mol}^{-1}$	10.81787	0.00020
Mass fraction of boron in solution, $w(\text{B})$ in $\text{mg}\cdot\text{kg}^{-1}$	100.0	2.0
<p>1) The isotopic composition is being determined by TIMS and is given as indicative value. The boron mass fraction was determined by isotope dilution mass spectrometry and gravimetry and is considered as indicative value only. It is traceable to the International System of units (SI) in the shortest possible way. Every measurement and correction is being calibrated using SI traceable calibrators.</p> <p>2) Expanded uncertainty <math>U</math> with a coverage factor of <math>k=2</math>, as defined in the Guide to the Expression of Uncertainty in Measurement (GUM) and includes the repeatability of the measurement and of the determination of correction factors for systematic errors as well as contributions from certified values. The uncertainty value is traceable to the SI.</p>		

## DESCRIPTION OF THE SAMPLE

ERM-AE122 is composed of an aqueous boric acid solution and is filled in PFA-bottles of approximately 20 mL, sealed in a plastic bag. It is designed for calibration and validation of all procedures (e.g. TIMS, ICPMS) being used for the determination of  $\delta^{11}\text{B}$ -values.

The atomic weights used in the calculation, are the following ones:

$^{10}\text{B}$ : 10.0129371 (3)

$^{11}\text{B}$ : 11.0093055 (4)

The certified values with their combined standard uncertainties ( $k = 1$ ) are given in the following table:

Certified quantity	Certified value	Standard uncertainty
$\delta^{11}\text{B}_{\text{NIST 951}}$ in ‰	39.71	0.30

## ANALYTICAL METHOD USED FOR CERTIFICATION

The certified values are determined by TIMS using the  $\text{Na}_2\text{BO}_2^+$  as well as the  $\text{Cs}_2\text{BO}_2^+$ /graphite technique. The measurements were calibrated by using the primary boron isotope reference materials IRMM-011 and NIST SRM 951. More details can be obtained from the certification report, which can be requested from BAM.

## **PARTICIPANTS**

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

## **SAFETY INFORMATION**

The usual laboratory safety precautions apply.

## **INSTRUCTIONS FOR USE**

The solution should be withdrawn by pouring in another bottle or container and never by pipettes and the like. Any contamination will result in a bias of the  $\delta^{11}\text{B}$  value.

## **STORAGE**

This CRM should be stored under cool ( $5 \pm 3$ ) °C and dark conditions to reduce evaporation effects.

However, BAM cannot be held responsible for changes that happen during storage of the material at the customer's premises, especially of opened samples.

## **LEGAL NOTICE**

Neither BAM, its contractors nor any person acting on their behalf:

- (a) make any warranty or representation, express or implied, that the use of any information, material, apparatus, method or process disclosed in this document does not infringe any privately owned intellectual property rights; or
- (b) assume any liability with respect to, or for damages resulting from, the use of any information, material, apparatus, method or process disclosed in this document save for loss or damage arising solely and directly from the negligence of BAM.

## **TECHNICAL REPORT**

A detailed technical report describing the production, characterisation as well as the analytical procedures applied and the treatment of the analytical data used to certify ERM®-AE122 is available on request or can be downloaded from BAM website ([www.bam.de](http://www.bam.de)).

---

## **CERTIFICATE REVISION HISTORY**

September 2020 (validity and shelf life of 2<sup>nd</sup> batch, editorial)

October 2010 (original certificate issue)

---

Supply of this Reference Material by:

Bundesanstalt für Materialforschung und –prüfung (BAM)

Richard-Willstätter-Str. 11, D-12489 Berlin, Germany

Phone: +49 30 8104 2061

E-mail: [sales.crm@bam.de](mailto:sales.crm@bam.de)

Fax: +49 30 8104 72061

Internet: [www.bam.de](http://www.bam.de)