

# Certificate

Produced in double accredited  
laboratory fulfilling  
**ISO/IEC 17025** and  
**ISO Guide 34**

This certificate is designed in accordance with ISO Guide 31<sup>[1]</sup>.

Object of certification: **Benzoate standard for IC**  
 Product no.: **40497**  
 Lot no. **BCBP1527V**  
 Composition: Benzoic acid (high purity quality) in high-purity water (18.2 MΩ·cm, 0.22 μm filtered).  
 The bottled solution is filtered through a 0.2 μm membrane.  
 Intended use: Calibration of ion chromatography or any other analytical technique.  
 Storing and handling: This reference material shall be stored between 5°C and 30°C. Before every use of the material the bottle must be shaken well and its temperature has to be 20°C. If storage of a partially used bottle is necessary, the cap should be tightly sealed and the bottle should be stored at reduced temperature (e.g. refrigerator) to minimize transpiration rate.  
 Expiry date: **NOV 2017**  
 Certificate issue date: 07 JAN 2015  
 Bottle opening date: -----

The certified values and uncertainties are according to ISO Guide 35<sup>[2]</sup> and Eurachem/CITAC Guide<sup>[3]</sup>

Constituent	Certified value at 20°C and expanded uncertainty [ $U = k u_c; k = 2$ ]	
<b>Benzoate</b>	<b>1'002 mg kg<sup>-1</sup> ± 4 mg kg<sup>-1</sup></b>	<b>1'000 mg L<sup>-1</sup> ± 4 mg L<sup>-1</sup></b>
Traceability <sup>[4]</sup>	NIST SRM 350b, benzoic acid	

Measurand	Certified value and expanded uncertainty [ $U = k u_c; k = 2$ ]
<b>Density at 20°C</b>	<b>0.9985 g mL<sup>-1</sup> ± 0.0005 g mL<sup>-1</sup></b>

CRM operations: <i>S. Matt</i>	  
S. Matt	
Certification body: <i>Klaus D. Schmidt, Ph.D.</i>	<b>ISO Guide 34</b> <b>ISO/IEC 17025</b> <b>ISO 9001</b>
K.-D. Schmidt, Ph.D.	

# 1. CONCEPT OF CERTIFICATION

The certified concentrations and expanded uncertainties of the analyte are based on the results obtained from gravimetric production and from the analytical results determined using acid-base titration.

Gravimetric preparation using well defined and pure materials is a practical realization of concentration units, through conversion of mass to amount of substance<sup>[4]</sup>. All high-precision balances are periodically calibrated by a third party and certified according to DAkkS guidelines (DAkkS = Deutsche Akkreditierungsstelle GmbH, which is the national accreditation body for the Federal Republic of Germany).

Production and certification of this CRM are performed under double-accreditation in accordance with ISO/IEC 17025<sup>[5]</sup> and also ISO Guide 34<sup>[6]</sup>. Storage stability, leaching and homogeneity tests are also considered for certification.

# 2. STARTING MATERIAL CONTENT BY TITRATION

The content of the starting material (benzoic acid, P/N 12353, Lot BCBL8817V) is performed by volumetric acid-base titrations with carbonate free 1 mol/L NaOH-solution using a combined pH-electrode.

Twenty-five starting material samples and six reference material samples are prepared separately and then titrated in one set. All results are traced gravimetrically to National Bureau of Standards (NIST) Standard Reference Material 350b, benzoic acid.

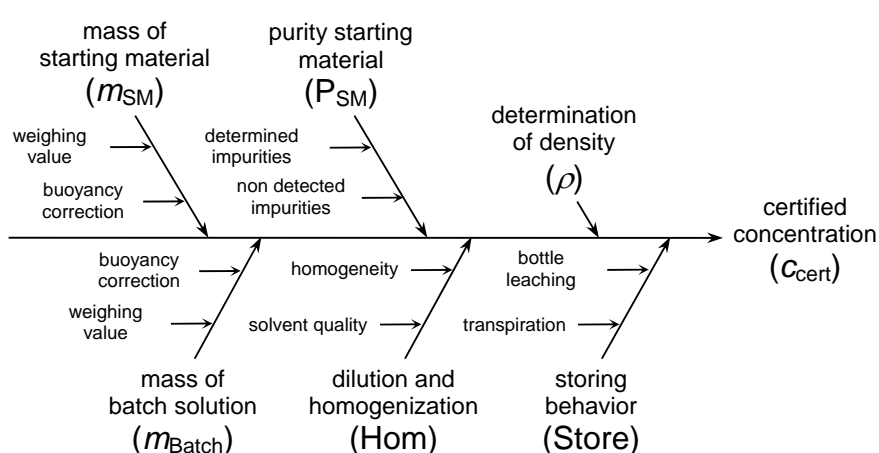
Content of starting material: 99.982 %  
Expanded uncertainty ( $k=2$ ): 0.058 %

# 3. DENSITY MEASUREMENT

The density measurement is carried out according to ISO 15212-1<sup>[7]</sup> and using the digital density meter DMA 4500M from Anton Paar with an oscillating U-tube installed. The measurement uncertainty is calculated according to Eurachem/CITAC Guide and reported as combined expanded uncertainty at the 95% confidence level.

# 4. UNCERTAINTY EVALUATION

All uncertainties are calculated according to Eurachem/CITAC Guide<sup>[3]</sup> and reported as combined expanded uncertainties at the 95% confidence level. For gravimetric preparation the uncertainty contributions are illustrated by the following cause-effect diagram<sup>[8]</sup>:



Typical contributions:

$u(m_{SM}) < 0.01\%$   
 $u(m_{Batch}) < 0.01\%$   
 $u(P_{SM}) < 0.03\%$   
 $u(Hom) < 0.03\%$   
 $u(Store) < 0.20\%$   
 $u(\rho) < 0.05\%$

Combined uncertainty<sup>[9]</sup>:

$u_c(C_{cert}) < 0.2\%$

Expanded uncertainty:

$U(C_{cert}) < 0.4\%$

## References

- [1] ISO Guide 31:2000, "Reference materials - Contents of certificates and labels"
- [2] ISO Guide 35:2006, "Reference materials - General and statistical principles for certification"
- [3] Eurachem/CITAC Guide, 3<sup>rd</sup> Ed. (2012), "Quantifying uncertainty in analytical measurement"
- [4] Eurachem/CITAC Guide, 1<sup>st</sup> Ed. (2003) "Traceability in chemical measurement"
- [5] ISO/IEC 17025, 2<sup>nd</sup> Ed. (2005), "General requirements for the competence of testing and calibration laboratories"
- [6] ISO Guide 34:2009, "General requirements for the competence of reference material producers"
- [7] DIN EN ISO 15212-1:1998, Oscillation-type density meters - Part 1: Laboratory instruments
- [8] Reichmuth, A., Wunderli, S., Weber, M., Meyer, V. R. (2004), "The uncertainty of weighing data obtained with electronic analytical balances", Microchimica Acta 148: 133-141.
- [9] Calculated by combination of the squared contribution values