

Certificate

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

This certificate is designed in accordance with ISO Guide 31^[1].

Object of certification: **Lithium standard for IC**
 Product No.: **59878**
 Lot: **BCBP7010V**
 Composition: Lithium carbonate (pure material) in 0.1% HNO₃ (prepared with HNO₃ suitable for trace analysis and high purity water, 18.2 MΩ·cm, 0.22 μm filtered).
 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: **APR 2018**
 Certificate issue date: 09 JUL 2015
 Bottle opening date: -----

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

Constituent	Certified value at 20°C and expanded uncertainty [$U = k u_c$; $k = 2$]	
Lithium	995 mg kg⁻¹ ± 7 mg kg⁻¹	1'000 mg L⁻¹ ± 7 mg L⁻¹
Traceability ^[4]	NIST SRM 3129a, Lithium Standard Solution	

Measurand	Certified value and expanded uncertainty [$U = k u_c$; $k = 2$]
Density at 20°C	1.005 g mL⁻¹ ± 0.0005 g mL⁻¹

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

1. CERTIFICATION

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

1.1 HP-ICP-OES MEASUREMENT

The certified value of the content (mg/kg) is determined using high-performance inductively coupled plasma optical emission spectrometry (HP-ICP-OES). To obtain performance comparable to isotope dilution and classical methods (titration and gravimetric analysis) the HP-ICP-OES measurement is performed using an internal standard and a drift correction procedure [7].

The mean value is based on 20 measurements (two samples and 10 measurements per sample). All measurements are traced gravimetrically to an internationally accepted reference material e.g. from NIST (USA) or BAM (Germany).

1.2 DENSITY MEASUREMENT

The density measurement is carried out according to ISO 15212-1 [8] 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.

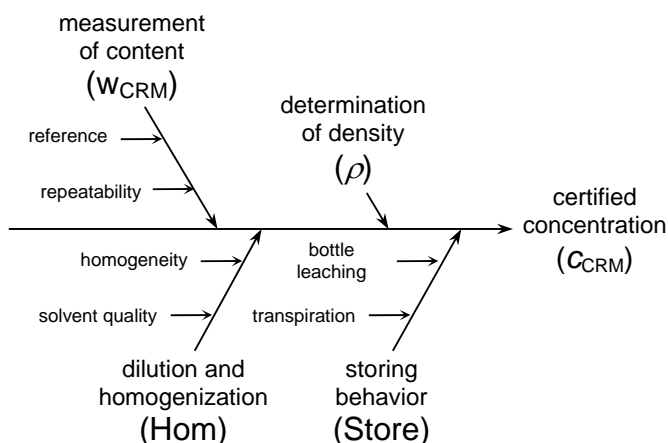
1.3 UNCERTAINTY EVALUATION

All uncertainties are calculated according to Eurachem/CITAC Guide [3] and reported as combined expanded uncertainties at the 95% confidence level. The main uncertainty contributions are illustrated by the following cause-effect diagram.

Typical relative contributions are:

$u(w_{\text{CRM}})$	0.1 - 0.3 %
$u(\text{Store})$	< 0.1 %
$u(\rho)$	< 0.05 %
$u(\text{Hom})$	< 0.03 %

The combined uncertainty u_c is calculated by combination of the squared contribution values.



2. TRACE IMPURITIES IN BOTTLED SOLUTION

The following metals were measured as possible impurities (in $\mu\text{g kg}^{-1}$, <X = below detection limit, m = matrix):

Ba	Ca	Cd	Co	Cu	K	Li	Mg	Mn	Na	Ni	Pb	Sr	Zn
<5	13	<5	<5	<10	<50	m	<5	<5	<50	<10	<25	<5	<10

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, 3rd Ed. (2012), "Quantifying uncertainty in analytical measurement"
- [4] Eurachem/CITAC Guide, 1st Ed. (2003) "Traceability in chemical measurement"
- [5] ISO/IEC 17025, 2nd 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] Marc L. Salit et al., Anal. Chem. 2001, 73, 4821-4829, "Single-Element Solution Comparisons with a High-Performance Inductively Coupled Plasma Optical Emission Spectrometric Method"
- [8] DIN EN ISO 15212-1:1998, Oscillation-type density meters - Part 1: Laboratory instruments