

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: **IQ/OQ/PQ Kit for Ion Chromatography**

Product No.: 12674 Lot: BCBR6012V

Composition: This kit contains six bromide standards with nominal concentrations of 5, 10, 20, 50, 100 and 1000 mg/kg. The standards were produced under clean room conditions with high-purity sodium bromide and high-purity water (18.2 MΩ·cm, 0.22 μm filtered) in accordance with ISO Guide 34^[2]

Intended use: Qualification of an ion chromatography system at the time of installation (IQ), as operation qualification (OQ) or performance qualification (PQ) tests. The standards can be used for testing detector linearity, injector precision and injector carry-over. We highly recommend following the procedures or guidelines of your instrument manufacturer.

Storing and handling: These certified standards shall be stored between 5 °C and 30 °C whereas the certified value is guaranteed when the long-term storage temperature will not exceed 25 °C. The bottle's temperature must be room temperature and shaken well before every use. 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: **JAN 2018** (unopened bottle)

Certificate issue date: 10 MAR 2016

Bottle opening date: 

Bromide values are traceable to SI and certified according to ISO/IEC 17025 ^[3] . Uncertainty according to ISO Guide 35 ^[4] and Eurachem/CITAC Guide ^[5]		
Constituent	Certified value	Expanded uncertainty [$U = k u_c$; $k = 2$]
Bromide Standard 1 (no. 50692)	5.00 mg kg⁻¹	0.02 mg kg⁻¹
Bromide Standard 2 (no. 01868)	10.00 mg kg⁻¹	0.04 mg kg⁻¹
Bromide Standard 3 (no. 94435)	20.00 mg kg⁻¹	0.08 mg kg⁻¹
Bromide Standard 4 (no. 56181)	50.00 mg kg⁻¹	0.20 mg kg⁻¹
Bromide Standard 5 (no. 75029)	100.00 mg kg⁻¹	0.40 mg kg⁻¹
Bromide Standard 6 (no. 53277)	1000.0 mg kg⁻¹	4.0 mg kg⁻¹

1. CONCEPT OF CERTIFICATION AND TRACEABILITY STATEMENT

To guarantee top reliability of the values for these **TraceCERT**[®] certified reference materials three independent procedures were followed. The values have to agree in the range of their uncertainties, but the impurity corrected value from the gravimetric preparation has been chosen as certified value^[6]:

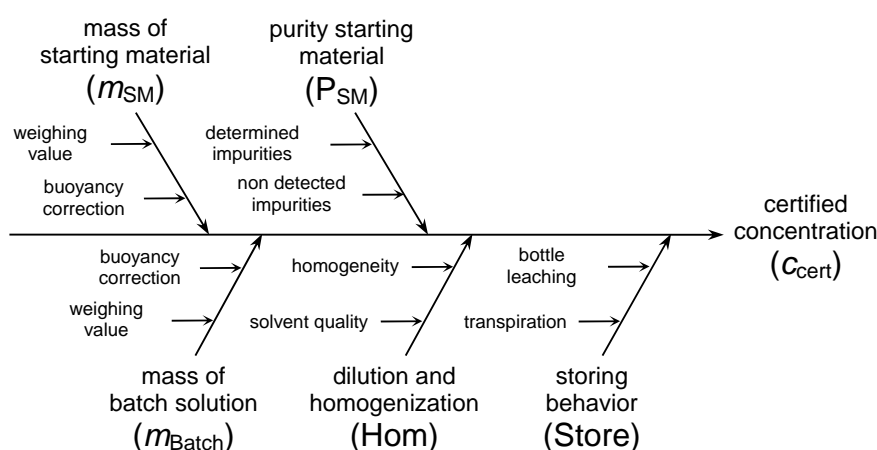
1. Gravimetric preparation using pure materials is a practical realization of concentration units, through conversion of mass to amount of substance^[6]. If the purity of the materials is demonstrated and if contamination and loss of material is strictly prevented this approach allows highest accuracy and small uncertainties. The certified value of **TraceCERT**[®] reference materials is based on this approach and directly traceable to the SI unit kilogram.

Therefore comprehensively characterized materials of high purity are used. All balances are certified by DKD and calibrated with OIML Class E2 (up to 12 kg) and F2 (up to 64 kg) weights.

- The starting material (NaBr) is measured against the NIST Standard Reference Material 999 (using argentometric titration) followed by gravimetric preparation using balances calibrated with SI-traceable weights. Consequently the value calculated by this unbroken chain of comparisons is traceable to the reference to which the starting material is compared.
- To underpin the certified gravimetric value the bottled *TraceCERT*[®] solution is compared to a second reference material (NaCl, certified by BAM, Sigma-Aldrich No. 71387) by argentometric titration.

2. UNCERTAINTY EVALUATION FOR BROMIDE STANDARDS

The uncertainties of the certified bromide standard are calculated according to Eurachem/CITAC Guide^[3] and reported as combined uncertainties at the 95% confidence level. For gravimetric preparation the uncertainty contributions are illustrated by the following cause-effect diagram^[7]:



Typical contributions:

$u(m_{SM})$	< 0.01 %
$u(m_{Batch})$	< 0.01 %
$u(P_{SM})$	< 0.10 %
$u(Hom)$	< 0.03 %
$u(Store)$	< 0.18 %

Combined uncertainty^[8]:

$U_c(C_{cert})$	< 0.2 %
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Expanded uncertainty:

$U(C_{cert})$	< 0.4 %
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3. COEFFICIENT OF DETERMINATION

The certified standards no. 1 to no. 5 (5 mg kg^{-1} to 100 mg kg^{-1}) are used to check detector linearity whereas the Coefficient of Determination can be calculated from the certified concentrations and the measured signals.

Coefficient of Determination is the square of the product-moment correlation between two variables (r^2). It expresses the amount of common variation between the two variables. The most widely-used type of correlation coefficient is *Pearson (r)*, also called linear or product-moment correlation.

The (theoretical) coefficient of determination for the standards (no. 1 to no. 5) is calculated using the certified values of the standards (x_i) and their nominal values (y_i).

Coefficient of Determination (r^2): 1.0000

CRM operations:	 <hr style="border-top: 1px dashed black;"/> S. Matt			
Certification body:	 <hr style="border-top: 1px dashed black;"/> K.-D. Schmidt, Ph.D.	ISO Guide 34	ISO/IEC 17025	ISO 9001

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