



CERTIFICATE OF ANALYSIS

VHG Labs Quality Product

Multi-Element Aqueous CRM

ICAL Solution

Product #: VHG-ISUSPCTICAL-250

Matrix: 2% HNO₃/2% HCl

Lot #: 1050376-1

| Element | Certified Concentration & Uncertainty | Element | Certified Concentration & Uncertainty | Element | Certified Concentration & Uncertainty |
|---------|---------------------------------------|---------|---------------------------------------|---------|---------------------------------------|
| Be | 2.01 ± 0.01 µg/mL | Li | 2.01 ± 0.01 µg/mL | Si | 9.98 ± 0.05 µg/mL |
| Ca | 1.00 ± 0.01 µg/mL | Mn | 5.00 ± 0.03 µg/mL | Sr | 2.02 ± 0.01 µg/mL |
| Ce | 10.00 ± 0.05 µg/mL | Mo | 5.00 ± 0.03 µg/mL | Ti | 10.00 ± 0.05 µg/mL |
| Cu | 10.01 ± 0.05 µg/mL | Na | 5.02 ± 0.03 µg/mL | V | 10.02 ± 0.05 µg/mL |
| Eu | 10.01 ± 0.05 µg/mL | Ni | 10.02 ± 0.05 µg/mL | Y | 10.03 ± 0.05 µg/mL |
| Fe | 10.01 ± 0.05 µg/mL | P | 10.00 ± 0.05 µg/mL | Zr | 9.99 ± 0.05 µg/mL |
| In | 10.00 ± 0.05 µg/mL | S | 50.02 ± 0.25 µg/mL | | |
| K | 9.99 ± 0.05 µg/mL | Sc | 5.01 ± 0.03 µg/mL | | |

Intended Use: This solution is intended for use as a certified reference material (CRM) or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), flame or furnace atomic absorption spectroscopy (AA or GFAA), and other techniques for elemental analysis.

Certification & Traceability: VHG Labs CRMs are manufactured, processed, and certified under a quality management system that is registered/accredited to **ISO 9001**, **ISO 17034**, and **ISO/IEC 17025**. This CRM was prepared to the certified concentrations shown above by gravimetric methods, using single-element concentrates that were certified using the "High Performance ICP-OES" protocol developed by NIST and are directly traceable to **NIST SRMs (see reverse side)**. The solution was stabilized using high purity nitric acid (HNO₃), hydrochloric acid (HCl) and diluted with filtered (0.22 µm), 18 M-ohm deionized water. The balances used in the preparation of VHG CRMs are calibrated regularly with traceability to NIST, using a calibration provider that is accredited to ISO/IEC 17025 by a mutually recognized accreditation body. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined by VHG based upon gravimetric procedures. Secondary verification of the certified concentrations was performed by VHG using ICP-OES that was calibrated and/or referenced against **NIST SRMs (see reverse side)**. The uncertainty associated with each certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

Instructions for Use: We recommend that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy, the analyst should: (1) use only pre-cleaned containers and transferware, (2) not pipette directly from the CRM's original container, (3) never pour used product back into the original container, (4) make dilutions using calibrated balances or certified class A volumetric flasks and pipettes, (5) use a minimum sub-sample size of 500 µL, and (6) dilute with the same matrix as the original CRM or other chemically suitable matrix. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or immerse the bottle or its contents, and avoid exposure to direct sunlight or moisture.

Period of Validity: LGC ensures the accuracy of this solution for **12 months** from the certification date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

Chuck Goudreau, Certifying Officer

See Exp. Date on Container
Certification Date

LGC waives all responsibility for any damages resulting from the usage and/or implementation of the products/data described herein.



Health and Safety Information: Refer to the Safety Data Sheet (SDS), which can be obtained at www.lgcstandards.com.

Homogeneity: This solution was determined to be homogeneous by procedures consistent with the requirements of ISO Guide 34 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with VHG QSP 6-13 Assessment of Homogeneity and Stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.

Quality Manual Rev: No. 5, 03/01/2013

Further Information: Please contact LGC for further information about this CRM.

Quality Certifications: This CRM was prepared under a quality management system that is registered/accredited to the following:

- ISO 9001 – Quality Management Systems – Requirements (Registrar: TUV NORD)
- ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories
- ISO Guide 34 – General Requirements for the Competence of Reference Material Producers
 - ISO Guide 34 references additional requirements specified in ISO Guide 31 and ISO Guide 35.

VHG CRMs are traceable to the following NIST SRMs:

| Analyte | Aq. SRM | MO SRM | Analyte | Aq. SRM | MO SRM | Analyte | Aq. SRM | MO SRM |
|---------|---------|--------|-------------------------------|---------|--------|-------------------------------|---------|--------|
| Ag | 3151 | 1077a | Hf | 3122 | — | S | 3154 | 2770 |
| Al | 3101a | 1075a | Hg | 3133 | 3133 | Sb | 3102a | 3102a |
| As | 3103a | 3103a | Ho | 3123a | — | Sc | 3148a | 3148a |
| Au | 3121 | — | In | 3124a | 3124a | Se | 3149 | 3149 |
| B | 3107 | 3107 | K | 3141a | 3141a | Si | 3150 | 1066a |
| Ba | 3104a | 1051b | La | 3127a | 3127a | Sm | 3147a | — |
| Be | 3105a | 3105a | Li | 3129a | 3129a | Sn | 3161a | 1057b |
| Bi | 3106 | 3106 | Lu | 3130a | — | SO ₄ ²⁻ | 3181 | — |
| Br | 3184 | — | Mg | 3131a | 3131a | Sr | 3153a | 3153a |
| Ca | 3109a | 3109a | Mn | 3132 | 3132 | Ta | 3155 | — |
| Cd | 3108 | 1053a | Mo | 3134 | 3134 | Tb | 3157a | — |
| Ce | 3110 | 3110 | Na | 3152a | 3152a | Te | 3156 | — |
| Cl | 3182 | 1818a | Nb | 3137 | — | Th | 3159 | — |
| Co | 3113 | 3113 | Nd | 3135a | — | Ti | 3162a | 3162a |
| Cr | 3112a | 1078b | Ni | 3136 | 1065b | Tl | 3158 | 3158 |
| Cs | 3111a | — | NO ₃ ⁻ | 3185 | — | Tm | 3160a | — |
| Cu | 3114 | 1080a | P | 3139a | 3139a | U | 3164 | — |
| Dy | 3115a | — | Pb | 3128 | 3128 | V | 3165 | 1052b |
| Er | 3116a | — | Pd | 3138 | — | W | 3163 | 3163 |
| Eu | 3117a | — | PO ₄ ³⁻ | 3186 | — | Y | 3167a | 3167a |
| F | 3183 | — | Pr | 3142a | — | Yb | 3166a | — |
| Fe | 3126a | 1079b | Pt | 3140 | 3140 | Zn | 3168a | 3168a |
| Ga | 3119a | — | Rb | 3145a | — | Zr | 3169 | 3169 |
| Gd | 3118a | — | Re | 3143 | — | | | |
| Ge | 3120a | — | Rh | 3144 | 3144 | | | |