

1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Inorganic Ventures is also an ISO 9001 registered manufacturer (SAI Global File Number 010105).



2.0 PRODUCT DESCRIPTION

Product Code:	Multi Analyte Custom Grade Solution		
Catalog Number:	IV-STOCK-51		
Lot Number:	K2-MEB620063		
Matrix:	5% (v/v) HNO3		
Value / Analyte(s):	20 µg/mL ea:	Arsenic, Zinc, 10 µg/mL ea: Magnesium, 5 µg/mL ea: Aluminum, Cobalt, Indium, Manganese, Strontium, Uranium, 2.5 µg/mL ea: Yttrium,	Beryllium, Nickel, Barium, Chromium+3, 6-Lithium, Sodium, Thorium, Vanadium, Ytterbium
			Cadmium, Lead, Bismuth, Copper, Lutetium, Scandium, Thallium,

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
6-Lithium, Li6	5.006 ± 0.018 µg/mL	Aluminum, Al	5.000 ± 0.029 µg/mL
Arsenic, As	20.00 ± 0.10 µg/mL	Barium, Ba	5.000 ± 0.029 µg/mL
Beryllium, Be	20.00 ± 0.12 µg/mL	Bismuth, Bi	4.999 ± 0.034 µg/mL
Cadmium, Cd	20.00 ± 0.09 µg/mL	Chromium+3, Cr3	5.000 ± 0.025 µg/mL
Cobalt, Co	5.000 ± 0.022 µg/mL	Copper, Cu	5.001 ± 0.029 µg/mL
Indium, In	4.999 ± 0.025 µg/mL	Lead, Pb	10.00 ± 0.04 µg/mL
Lutetium, Lu	5.000 ± 0.025 µg/mL	Magnesium, Mg	10.00 ± 0.04 µg/mL
Manganese, Mn	5.000 ± 0.025 µg/mL	Nickel, Ni	10.00 ± 0.04 µg/mL
Scandium, Sc	4.999 ± 0.034 µg/mL	Sodium, Na	5.000 ± 0.029 µg/mL
Strontium, Sr	4.999 ± 0.029 µg/mL	Thallium, Tl	5.000 ± 0.034 µg/mL
Thorium, Th	5.000 ± 0.025 µg/mL	Uranium, U	5.001 ± 0.025 µg/mL
Vanadium, V	5.000 ± 0.029 µg/mL	Ytterbium, Yb	2.500 ± 0.011 µg/mL
Yttrium, Y	2.499 ± 0.015 µg/mL	Zinc, Zn	20.00 ± 0.08 µg/mL

Certified Density: 1.027 g/mL (measured at 20 ± 1 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Al	ICP Assay	3101a	060502
Al	EDTA	928	928
As	ICP Assay	3103a	100818
As	Calculated		See Sec. 4.2
Ba	ICP Assay	3104a	070222
Ba	Gravimetric		See Sec. 4.2
Be	ICP Assay	3105a	090514
Bi	ICP Assay	3106	991212
Bi	Calculated		See Sec. 4.2
Cd	ICP Assay	3108	060531
Cd	EDTA	928	928
Co	ICP Assay	3113	000630 Co
Co	EDTA	928	928
Cr3	ICP Assay	3112a	030730
Cr3	Calculated		See Sec. 4.2
Cu	ICP Assay	3114	121207
Cu	EDTA	928	928
In	ICP Assay	3124a	110516
In	EDTA	928	928
Li6	Calculated		See Sec. 4.2
Li6	Gravimetric		See Sec. 4.2
Lu	ICP Assay	3130a	100503
Lu	EDTA	928	928
Mg	ICP Assay	3131a	050302
Mg	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Sc	ICP Assay	3148a	100701
Sc	EDTA	928	928
Sr	EDTA	928	928
Sr	ICP Assay	3153a	990906
Th	EDTA	928	928
Tl	ICP Assay	3158	993012
U	ICP Assay	3164	080521
U	Calculated		See Sec. 4.2
V	EDTA	928	928
V	ICP Assay	3165	992706
Y	ICP Assay	3167a	120314
Y	EDTA	928	928
Yb	ICP Assay	3166a	790512
Yb	EDTA	928	928
Zn	ICP Assay	3168a	120629
Zn	EDTA	928	928

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Characterization of CRM by two independent methods

Characterization of CRM by one method

Characterization of CRM/RM by Two Methods

Certified Value, $X_{CRM/RM}$, where two methods of characterization are used is the weighted mean of the two results:

$$X_{CRM/RM} = [(w_a)(X_a) + (w_b)(X_b)]$$

X_a = mean of Assay Method A with standard uncertainty $u_{char a}$

X_b = mean of Assay Method B with standard uncertainty $u_{char b}$

w_a and w_b = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{char a})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$w_b = (1/u_{char b})^2 / ((1/u_{char a})^2 + (1/u_{char b})^2)$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a\&b}^2 + u_{bb}^2 + u_{lts}^2 + u_{sts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a\&b} = [(w_a)^2 (u_{char a})^2 + (w_b)^2 (u_{char b})^2]^{1/2}$ where $u_{char a}$ and $u_{char b}$ are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{sts} = short term stability standard uncertainty (transportation)

Certified Abundance:

IV's Certified Abundance

<u>Isotope</u>	<u>Atom %</u>
Uranium 238U	99.6 ± 0.1
Uranium 235U	0.37 ± 0.05

Characterization of CRM/RM by One Method

Certified Value, $X_{CRM/RM}$, where one method of characterization is used is the mean of individual results:

$$X_{CRM/RM} = \text{mean of Assay Method A with standard uncertainty } u_{char a}$$

$$CRM/RM \text{ Expanded Uncertainty } (\pm) = U_{CRM/RM} = k (u_{char a}^2 + u_{bb}^2 + u_{lts}^2 + u_{sts}^2)^{1/2}$$

k = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char a}$ = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

u_{bb} = bottle to bottle homogeneity standard uncertainty

u_{lts} = long term stability standard uncertainty (storage)

u_{sts} = short term stability standard uncertainty (transportation)

4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

N/A

6.0 INTENDED USE

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

7.1 Storage and Handling Recommendations

- Keep cap tightly sealed when not in use. Store and use at 20 ± 4° C. Do not pipette from the container. Do not return removed aliquots to container.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0

8.0 HAZARDOUS INFORMATION

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

9.0 HOMOGENEITY

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 10CFR50 Appendix B - Nuclear Regulatory Commission

- Domestic Licensing of Production and Utilization Facilities

10.2 10CFR21 - Nuclear Regulatory Commission

- Reporting defects and Non-Compliance

10.3 ISO 9001 Quality Management System Registration

- SAI Global File Number 010105

10.4 ISO/IEC Guide 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

10.5 ISO Guide 34 "General Requirements for the Competence of Reference Material Producers"

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

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11.0 CERTIFICATION, EXPIRATION AND PERIOD OF VALIDITY

11.1 Certification Issue Date

February 10, 2016

11.2 Expiration Date

11.3 Period of Validity

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is handled and stored in accordance with instructions given in Sec 7.0 and used prior to the date given in Sec 11.2. This certification is nullified if the CRM/RM is damaged, contaminated, or otherwise modified.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By:

Joseph Burns
TSG Technician

Handwritten signature of Joseph Burns in black ink on a light background.

Certificate Approved By:

Michael Booth
QC Supervisor

Handwritten signature of Michael Booth in black ink.

Certifying Officer:

Paul Gaines
PhD., Senior Technical Director

Handwritten signature of Paul Gaines in black ink.