

**1.0 ACCREDITATION / REGISTRATION**

**INORGANIC VENTURES** is accredited to ISO 17034, "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 (QSR Certificate Number QSR-1034).



**2.0 PRODUCT DESCRIPTION**

Product Code: Multi Analyte Custom Grade Solution  
 Catalog Number: VAR-CAL-2  
 Lot Number: R2-MEB694856  
 Matrix: 7% (v/v) HNO3  
 Value / Analyte(s): 100 µg/mL ea:  
 Silver, Aluminum,  
 Arsenic, Barium,  
 Beryllium, Cadmium,  
 Cobalt, Chromium,  
 Copper, Manganese,  
 Nickel, Lead,  
 Selenium, Thorium,  
 Thallium, Uranium,  
 Vanadium, Zinc

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	100.0 ± 0.4 µg/mL	Arsenic, As	100.0 ± 0.8 µg/mL
Barium, Ba	100.0 ± 0.4 µg/mL	Beryllium, Be	100.0 ± 0.7 µg/mL
Cadmium, Cd	100.0 ± 0.4 µg/mL	Chromium, Cr	100.0 ± 0.6 µg/mL
Cobalt, Co	100.0 ± 0.5 µg/mL	Copper, Cu	100.0 ± 0.4 µg/mL
Lead, Pb	100.0 ± 0.5 µg/mL	Manganese, Mn	100.0 ± 0.4 µg/mL
Nickel, Ni	100.1 ± 0.5 µg/mL	Selenium, Se	100.0 ± 0.8 µg/mL
Silver, Ag	100.0 ± 0.4 µg/mL	Thallium, Tl	100.0 ± 0.7 µg/mL
Thorium, Th	100.0 ± 0.5 µg/mL	Uranium, U	100.0 ± 0.7 µg/mL
Vanadium, V	100.0 ± 0.4 µg/mL	Zinc, Zn	100.0 ± 0.4 µg/mL

Density: 1.042 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	160729
Ag	Volhard	999c	999c
Al	ICP Assay	3101a	140903
Al	EDTA	928	928
As	ICP Assay	3103a	100818
Ba	ICP Assay	3104a	140909
Ba	Gravimetric		See Sec. 4.2
Be	ICP Assay	3105a	090514
Cd	ICP Assay	3108	130116
Cd	EDTA	928	928
Co	ICP Assay	3113	190630
Co	EDTA	928	928
Cr	ICP Assay	3112a	170630
Cu	ICP Assay	3114	121207
Cu	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Se	ICP Assay	3149	100901
Th	EDTA	928	928
Tl	ICP Assay	3158	151215
U	ICP Assay	3164	080521
V	ICP Assay	3165	160906
V	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/RM by Two or More Methods

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

$$X_{CRM/RM} = \sum(w_i) (X_i)$$

$X_i$  = mean of Assay Method  $i$  with standard uncertainty  $u_{char i}$

$w_i$  = the weighting factors for each method calculated using the inverse square of the variance:

$$w_i = (1/u_{char i}^2) / (\sum(1/u_{char i}^2))$$

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

$k$  = coverage factor = 2

$u_{char}$  =  $[\sum(w_i)^2 (u_{char i}^2)]^{1/2}$  where  $u_{char i}$  are the errors from each characterization method

$u_{bb}$  = bottle to bottle homogeneity standard uncertainty

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

$u_{ts}$  = transport stability standard uncertainty

#### 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:

$$X_{CRM/RM} = (X_a) (u_{char a})$$

$X_a$  = mean of Assay Method A with

$u_{char a}$  = the standard uncertainty of characterization Method A

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

$k$  = coverage factor = 2

$u_{char a}$  = the errors from characterization

$u_{bb}$  = bottle to bottle homogeneity standard uncertainty

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

$u_{ts}$  = transport stability standard uncertainty

#### Certified Abundance:

##### IV's Certified Abundance

Isotope	Atom %
Uranium 238U	99.8 ± 0.1
Uranium 235U	0.19 ± 0.05

#### 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**

- Store between approximately 4° - 30° C while in sealed TCT bag.

- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.

- After opening the sealed TCT bag, keep cap tightly sealed when not in use and store between 4° - 24° C to minimize the effects of transpiration. Use at 20° ± 4° C to minimize volumetric dilution error when using the reported density. Do not pipette from the container. Do not return removed aliquots to container.

- For more information, visit [www.inorganicventures.com/TCT](http://www.inorganicventures.com/TCT)

### **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 ISO 9001 Quality Management System Registration**

- QSR Certificate Number QSR-1034

#### **10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"**

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

### 10.3 ISO 17034 "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, LOT EXPIRATION, PERIOD OF VALIDITY AND REVISION HISTORY

### 11.1 Certification Issue Date

July 14, 2020

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

### 11.2 Lot Expiration Date

- **July 14, 2024**

- The date after which this CRM/RM should not be used.

- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

### 11.3 Period of Validity

- Sealed TCT Bag Open Date: \_\_\_\_\_

- This CRM/RM should not be used longer than one year (or six months in the case of a 30 mL bottle) from the date of opening the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being stored and handled in accordance with the instructions given in Sec. 7.1.

### 11.4 Revision Status

- Revision 1 - Revised on Wednesday, Oct 14, 2020 by utruong. Revision was made for the following reason: Added missing isotopic abundance for Uranium..

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

### Certificate Approved By:

Michael Booth  
Director, Quality Control



### Certifying Officer:

Paul Gaines  
Chairman / Senior Technical Director

