

## 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:     | THERMO-5A                           |            |
| Lot Number:         | S2-MEB702277                        |            |
| Matrix:             | 2.5% (v/v) HNO <sub>3</sub>         |            |
| Value / Analyte(s): | 35 µg/L ea:                         |            |
|                     | Beryllium,                          |            |
|                     | 20 µg/L ea:                         |            |
|                     | Zinc,                               |            |
|                     | 15 µg/L ea:                         |            |
|                     | Copper,                             | Nickel,    |
|                     | 10 µg/L ea:                         |            |
|                     | Magnesium,                          | Gallium,   |
|                     | Aluminum,                           |            |
|                     | 8 µg/L ea:                          |            |
|                     | Cobalt,                             | Lithium,   |
|                     | Scandium,                           |            |
|                     | 6 µg/L ea:                          |            |
|                     | Silver,                             | Manganese, |
|                     | 5 µg/L ea:                          |            |
|                     | Strontium,                          |            |
|                     | 4 µg/L ea:                          |            |
|                     | Thallium,                           | Barium,    |
|                     | 3 µg/L ea:                          |            |
|                     | Bismuth,                            | Cerium,    |
|                     | Holmium,                            | Indium,    |
|                     | Rhodium,                            | Cesium,    |
|                     | Uranium,                            | Yttrium,   |
|                     | Tantalum,                           | Terbium    |

## 3.0 CERTIFIED VALUES AND UNCERTAINTIES

| <b>ANALYTE</b> | <b>CERTIFIED VALUE</b> | <b>ANALYTE</b> | <b>CERTIFIED VALUE</b> |
|----------------|------------------------|----------------|------------------------|
| Aluminum, Al   | 10.00 ± 0.06 µg/L      | Barium, Ba     | 4.000 ± 0.027 µg/L     |
| Beryllium, Be  | 35.00 ± 0.23 µg/L      | Bismuth, Bi    | 3.000 ± 0.022 µg/L     |
| Cerium, Ce     | 3.000 ± 0.018 µg/L     | Cesium, Cs     | 3.000 ± 0.018 µg/L     |
| Cobalt, Co     | 8.00 ± 0.04 µg/L       | Copper, Cu     | 15.00 ± 0.10 µg/L      |
| Gallium, Ga    | 10.00 ± 0.06 µg/L      | Holmium, Ho    | 3.000 ± 0.020 µg/L     |
| Indium, In     | 3.000 ± 0.018 µg/L     | Lithium, Li    | 8.00 ± 0.05 µg/L       |
| Magnesium, Mg  | 10.00 ± 0.06 µg/L      | Manganese, Mn  | 6.000 ± 0.036 µg/L     |
| Nickel, Ni     | 15.00 ± 0.09 µg/L      | Rhodium, Rh    | 3.000 ± 0.020 µg/L     |
| Scandium, Sc   | 8.00 ± 0.06 µg/L       | *Silver, Ag    | 6.000 ± 0.045 µg/L     |
| Strontium, Sr  | 5.000 ± 0.033 µg/L     | *Tantalum, Ta  | 3.000 ± 0.018 µg/L     |
| Terbium, Tb    | 3.000 ± 0.018 µg/L     | Thallium, Tl   | 4.000 ± 0.030 µg/L     |
| Uranium, U     | 3.000 ± 0.015 µg/L     | Yttrium, Y     | 3.000 ± 0.020 µg/L     |
| Zinc, Zn       | 20.00 ± 0.13 µg/L      |                |                        |

**Density:** 1.011 g/mL (measured at 20 ± 4 °C)

**Assay Information:**

| <b>ANALYTE</b> | <b>METHOD</b> | <b>NIST SRM#</b> | <b>SRM LOT#</b> |
|----------------|---------------|------------------|-----------------|
| Ag             | ICP Assay     | 3151             | 992212          |
| Ag             | Volhard       | 999b             | 999b            |
| Al             | ICP Assay     | 3101a            | 060502          |
| Al             | EDTA          | 928              | 928             |
| 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    |
| Ce             | ICP Assay     | 3110             | 090504          |
| Ce             | EDTA          | 928              | 928             |
| Co             | ICP Assay     | 3113             | 000630 Co       |
| Co             | EDTA          | 928              | 928             |
| Cs             | IC Assay      | 3111a            | 050614          |
| Cs             | Gravimetric   |                  | See Sec. 4.2    |
| Cu             | ICP Assay     | 3114             | 121207          |
| Cu             | EDTA          | 928              | 928             |
| Ga             | ICP Assay     | 3119a            | 140124          |
| Ga             | EDTA          | 928              | 928             |
| Ho             | ICP Assay     | 3123a            | 790812          |
| Ho             | EDTA          | 928              | 928             |
| In             | ICP Assay     | 3124a            | 110516          |
| In             | EDTA          | 928              | 928             |
| Li             | ICP Assay     | 3129a            | 100714          |
| Li             | Calculated    |                  | See Sec. 4.2    |
| Mg             | ICP Assay     | 3131a            | 050302          |
| Mg             | EDTA          | 928              | 928             |
| Mn             | ICP Assay     | 3132             | 050429          |
| Mn             | EDTA          | 928              | 928             |
| Ni             | ICP Assay     | 3136             | 120619          |
| Ni             | EDTA          | 928              | 928             |
| Rh             | ICP Assay     | 3144             | 070619          |
| Sc             | ICP Assay     | 3148a            | 100701          |
| Sc             | EDTA          | 928              | 928             |
| Sr             | EDTA          | 928              | 928             |
| Sr             | ICP Assay     | 3153a            | 990906          |
| Ta             | ICP Assay     | 3155             | 080502          |
| Ta             | Calculated    |                  | See Sec. 4.2    |
| Tb             | ICP Assay     | 3157a            | 100518          |
| Tb             | EDTA          | 928              | 928             |
| Tl             | ICP Assay     | 3158             | 993012          |
| U              | ICP Assay     | 3164             | 080521          |
| U              | Calculated    |                  | See Sec. 4.2    |
| Y              | ICP Assay     | 3167a            | 120314          |
| Y              | 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,  $X_{\text{CRM/RM}}$ , where two or more methods of characterization are used is the weighted mean of the results:

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

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

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

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

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

k = coverage factor = 2

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

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

$u_{\text{Its}}$  = long term stability standard uncertainty (storage)

$u_{\text{ts}}$  = transport stability standard uncertainty

#### Characterization of CRM/RM by One Method

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

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

$X_a$  = mean of Assay Method A with

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

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

k = coverage factor = 2

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

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

$u_{\text{Its}}$  = long term stability standard uncertainty (storage)

$u_{\text{ts}}$  = transport stability standard uncertainty

#### Certified Abundance:

##### IV's Certified Abundance

| <u>Isotope</u> | <u>Atom %</u> |
|----------------|---------------|
| Uranium 238U   | 99.6 ± 0.1    |
| Uranium 235U   | 0.37 ± 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 tuning of analytical instruments. Can be used for calibration and validation of analytical methods as appropriate. (See Ta/Ag Stability Note in Section 7.0).

#### 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)

**\*Ta/Ag Stability:** Stability studies indicate Ta and Ag may not exhibit long term stability (>1 year). This effect has not been observed for any other certified analyte in this product. For additional information please contact Inorganic Ventures.

**Low Silver Note:** This solution contains "LOW" levels of Silver. Please store this entire bottle inside a sealed glass jar.

**Uranium Note:** If uranium is present in this standard, it is natural abundance unless specified in Section 3

## 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 AND PERIOD OF VALIDITY

### 11.1 Certification Issue Date

February 17, 2021

- 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

- **February 17, 2025**

- 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**

-Revision 1: Added uranium note. 10/07/2021UT

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**

**Certificate Approved By:**

Michael Booth  
Director, Quality Control



**Certifying Officer:**

Paul Gaines  
Chairman / Senior Technical Director

