

## 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: TUNE F-X-SERIES  
Lot Number: J2-MEB603027  
Matrix: 2% (v/v) HNO<sub>3</sub>  
tr. HF

Value / Analyte(s):	1 250 ng/mL ea:		
	Selenium,		
	1 000 ng/mL ea:		
	Calcium,	Phosphorus,	Silicon,
	500 ng/mL ea:		
	Beryllium,	Tellurium,	Titanium,
	250 ng/mL ea:		
	Arsenic,		
	200 ng/mL ea:		
	Boron,		
	150 ng/mL ea:		
	Copper,	Germanium,	Nickel,
	Zinc,		
	100 ng/mL ea:		
	Cadmium,	Lithium,	Molybdenum,
	Palladium,		
	50 ng/mL ea:		
	Aluminum,	Barium,	Magnesium,
	45 ng/mL ea:		
	Gallium,	Gadolinium,	Neodymium,
	Samarium,	Tin,	
	40 ng/mL ea:		
	Silver,	Chromium+3,	Sodium,
	Antimony,	Vanadium,	
	35 ng/mL ea:		
	Cobalt,	Potassium,	Zirconium,
	30 ng/mL ea:		
	Rubidium,	Scandium,	
	25 ng/mL ea:		
	Dysprosium,	Tungsten,	Ytterbium,
	20 ng/mL ea:		
	Iron,	Manganese,	Niobium,
	Strontium,		
	15 ng/mL ea:		
	Cesium,	Erbium,	Hafnium,
	Rhenium,	Yttrium,	
	10 ng/mL ea:		
	Cerium,	Europium,	Indium,
	Lanthanum,	Lead,	Praseodymium,
	Thallium,		
	5 ng/mL ea:		
	Bismuth,	Holmium,	Lutetium,
	Tantalum,	Terbium,	Thorium,
	Thulium,	Uranium	

### 3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	50.02 ± 0.36 ng/mL	Antimony, Sb	40.00 ± 0.33 ng/mL
Arsenic, As	249.9 ± 1.9 ng/mL	Barium, Ba	49.97 ± 0.29 ng/mL
Beryllium, Be	499.7 ± 3.2 ng/mL	Bismuth, Bi	5.000 ± 0.036 ng/mL
Boron, B	199.9 ± 1.5 ng/mL	Cadmium, Cd	99.9 ± 0.6 ng/mL
Calcium, Ca	1 000 ± 5 ng/mL	Cerium, Ce	10.00 ± 0.06 ng/mL
Cesium, Cs	15.00 ± 0.12 ng/mL	Chromium+3, Cr3	39.97 ± 0.30 ng/mL
Cobalt, Co	35.01 ± 0.22 ng/mL	Copper, Cu	150.0 ± 1.3 ng/mL
Dysprosium, Dy	24.99 ± 0.19 ng/mL	Erbium, Er	14.99 ± 0.11 ng/mL
Europium, Eu	10.00 ± 0.07 ng/mL	Gadolinium, Gd	45.00 ± 0.32 ng/mL
Gallium, Ga	44.99 ± 0.25 ng/mL	Germanium, Ge	149.9 ± 1.1 ng/mL
Hafnium, Hf	15.00 ± 0.10 ng/mL	Holmium, Ho	5.000 ± 0.041 ng/mL
Indium, In	10.00 ± 0.07 ng/mL	Iron, Fe	20.00 ± 0.15 ng/mL
Lanthanum, La	10.00 ± 0.06 ng/mL	Lead, Pb	9.99 ± 0.08 ng/mL
Lithium, Li	100.0 ± 0.7 ng/mL	Lutetium, Lu	5.000 ± 0.041 ng/mL
Magnesium, Mg	49.98 ± 0.36 ng/mL	Manganese, Mn	19.98 ± 0.17 ng/mL
Molybdenum, Mo	100.0 ± 0.6 ng/mL	Neodymium, Nd	45.00 ± 0.23 ng/mL
Nickel, Ni	150.0 ± 1.3 ng/mL	Niobium, Nb	19.99 ± 0.14 ng/mL
Palladium, Pd	100.0 ± 0.7 ng/mL	Phosphorus, P	1 000 ± 6 ng/mL
Potassium, K	34.97 ± 0.22 ng/mL	Praseodymium, Pr	10.00 ± 0.08 ng/mL
Rhenium, Re	14.99 ± 0.11 ng/mL	Rubidium, Rb	29.99 ± 0.21 ng/mL
Samarium, Sm	45.00 ± 0.33 ng/mL	Scandium, Sc	29.98 ± 0.25 ng/mL
Selenium, Se	1 249 ± 9 ng/mL	Silicon, Si	1 000 ± 7 ng/mL
Silver, Ag	40.01 ± 0.29 ng/mL	Sodium, Na	39.96 ± 0.26 ng/mL
Strontium, Sr	20.00 ± 0.16 ng/mL	Tantalum, Ta*	5.000 ± 0.041 ng/mL
Tellurium, Te	499.8 ± 2.9 ng/mL	Terbium, Tb	5.000 ± 0.041 ng/mL
Thallium, Tl	10.00 ± 0.07 ng/mL	Thorium, Th	5.000 ± 0.043 ng/mL
Thulium, Tm	5.000 ± 0.041 ng/mL	Tin, Sn	45.00 ± 0.35 ng/mL
Titanium, Ti	499.9 ± 3.7 ng/mL	Tungsten, W	24.99 ± 0.22 ng/mL
Uranium, U	5.000 ± 0.039 ng/mL	Vanadium, V	39.98 ± 0.30 ng/mL
Ytterbium, Yb	24.99 ± 0.18 ng/mL	Yttrium, Y	14.99 ± 0.11 ng/mL
Zinc, Zn	150.0 ± 1.0 ng/mL	Zirconium, Zr	35.00 ± 0.26 ng/mL

**Certified Density:** 1.009 g/mL (measured at 20 ± 1 °C)

**Assay Information:**

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999b	999b
Al	ICP Assay	3101a	060502
Al	EDTA	928	928
As	ICP Assay	3103a	100818
As	Calculated		See Sec. 4.2
B	ICP Assay	3107	070514
B	Calculated		See Sec. 4.2
Ba	ICP Assay	3104a	070222
Ba	Gravimetric		See Sec. 4.2
Be	ICP Assay	3105a	090514
Be	Calculated		See Sec. 4.2
Bi	ICP Assay	3106	991212
Bi	Calculated		See Sec. 4.2
Ca	ICP Assay	3109a	050825
Ca	EDTA	928	928
Cd	ICP Assay	3108	060531
Cd	EDTA	928	928
Ce	ICP Assay	3110	090504
Ce	EDTA	928	928
Co	ICP Assay	3113	000630 Co
Co	EDTA	928	928
Cr3	ICP Assay	3112a	030730
Cr3	Calculated		See Sec. 4.2
Cs	IC Assay	3111a	050614
Cs	Gravimetric		See Sec. 4.2
Cu	ICP Assay	3114	011017
Cu	EDTA	928	928
Dy	EDTA	928	928
Dy	ICP Assay	3115a	990504
Er	ICP Assay	3116a	000831
Er	EDTA	928	928
Eu	EDTA	928	928
Eu	ICP Assay	3117a	991307
Fe	ICP Assay	3126a	051031
Fe	EDTA	928	928
Ga	ICP Assay	3119a	890709
Ga	EDTA	928	928
Gd	EDTA	928	928
Gd	ICP Assay	3118a	992004
Ge	ICP Assay	3120a	080429
Ge	Calculated		See Sec. 4.2
Hf	ICP Assay	3122	000406
Ho	ICP Assay	3123a	790812
Ho	EDTA	928	928
In	ICP Assay	3124a	110516
In	EDTA	928	928
K	ICP Assay	3141a	051220
K	Gravimetric		See Sec. 4.2

La	ICP Assay	3127a	890402
La	EDTA	928	928
Li	ICP Assay	3129a	100714
Li	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
Mo	ICP Assay	3134	891307
Mo	Calculated		See Sec. 4.2
Na	ICP Assay	3152a	120715
Na	Gravimetric		See Sec. 4.2
Nb	ICP Assay	3137	080502Nb
Nb	Calculated		See Sec. 4.2
Nd	EDTA	928	928
Nd	ICP Assay	3135a	992803
Ni	ICP Assay	3136	000612
Ni	EDTA	928	928
P	ICP Assay	3139a	060717
P	Acidimetric	84L	84L
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Pd	ICP Assay	3138	090629
Pd	Calculated		See Sec. 4.2
Pr	EDTA	928	928
Pr	ICP Assay	3142a	990501
Rb	IC Assay	3145a	891203
Rb	Gravimetric		See Sec. 4.2
Re	ICP Assay	3143	010816
Re	Calculated		See Sec. 4.2
Sb	ICP Assay	3102A	061229
Sb	Calculated		See Sec. 4.2
Sc	ICP Assay	3148a	792111
Sc	EDTA	928	928
Se	ICP Assay	3149	100901
Se	Calculated		See Sec. 4.2
Si	ICP Assay	3150	071204
Si	Calculated		See Sec. 4.2
Sm	ICP Assay	3147a	892911
Sm	EDTA	928	928
Sn	ICP Assay	3161a	070330
Sn	Calculated		See Sec. 4.2
Sr	EDTA	928	928
Sr	ICP Assay	3153a	990906
Ta	ICP Assay	3155	080502
Ta	Calculated		See Sec. 4.2
Tb	ICP Assay	3157a	891603

Tb	EDTA	928	928
Te	ICP Assay	3156	892901
Te	Calculated		See Sec. 4.2
Th	EDTA	928	928
Th	ICP Assay	Traceable to SRM 3159	Lot# 992912
Ti	ICP Assay	3162a	060808
Tl	ICP Assay	3158	993012
Tl	Calculated		See Sec. 4.2
Tm	ICP Assay	3160a	790912
Tm	EDTA	928	928
U	ICP Assay	3164	891509
U	Calculated		See Sec. 4.2
V	EDTA	928	928
V	ICP Assay	3165	992706
W	ICP Assay	3163	080331
W	Calculated		See Sec. 4.2
Y	ICP Assay	3167a	790412
Y	EDTA	928	928
Yb	ICP Assay	3166a	790512
Yb	EDTA	928	928
Zn	ICP Assay	3168a	120629
Zn	EDTA	928	928
Zr	ICP Assay	3169	071226
Zr	Calculated		See Sec. 4.2

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

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

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

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

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

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

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

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

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

$u_{\text{char a\&b}}$  =  $[(w_a)^2 (u_{\text{char a}})^2 + (w_b)^2 (u_{\text{char b}})^2]^{1/2}$  where  $u_{\text{char a}}$  and  $u_{\text{char b}}$  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

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

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

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

**Certified Abundance:**

##### IV's Certified Abundance

###### Isotope

Uranium 238U

Uranium 235U

###### Atom %

99.8 ± 0.1

0.29 ± 0.05

##### 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:

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

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

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

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

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

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

$u_{\text{sts}}$  = 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

- 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. Store and use at 20° ± 4° C. 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 Stability Note:** Stability studies indicate Ta 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.

**HF Note:** This standard should not be prepared or stored in glass.

**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/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"**

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

**11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY**

**11.1 Certification Issue Date**

October 28, 2015

- 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**

- **October 28, 2018**

- 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 from the date of removal from the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being handled and stored in accordance with the instructions given in Sec 7.1.

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**

**Certificate Prepared By:**

James King Jr  
Product Documentation Supervisor



**Certificate Approved By:**

Michael Booth  
QC Supervisor



**Certifying Officer:**

Paul Gaines  
PhD., Senior Technical Director

