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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:	TUNE F-X-SERIES
Lot Number:	T2-MEB726349
Matrix:	2% (v/v) HNO ₃ tr. HF

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

5 ng/mL ea:

Thulium,
Thorium,
Terbium,
Holmium,

Uranium,
Tantalum,
Lutetium,
Bismuth

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ANALYTE	CERTIFIED VALUE	ANALYTE	CERTIFIED VALUE
Aluminum, Al	50.00 ± 0.18 ng/mL	Antimony, Sb	40.00 ± 0.34 ng/mL
Arsenic, As	250.0 ± 1.5 ng/mL	Barium, Ba	50.00 ± 0.28 ng/mL
Beryllium, Be	500.0 ± 3.1 ng/mL	Bismuth, Bi	5.000 ± 0.038 ng/mL
Boron, B	200.1 ± 1.4 ng/mL	Cadmium, Cd	100.0 ± 0.6 ng/mL
Calcium, Ca	1 000 ± 6 ng/mL	Cerium, Ce	10.00 ± 0.06 ng/mL
Cesium, Cs	15.00 ± 0.09 ng/mL	Chromium, Cr	40.00 ± 0.28 ng/mL
Cobalt, Co	35.00 ± 0.20 ng/mL	Copper, Cu	150.1 ± 1.0 ng/mL
Dysprosium, Dy	25.00 ± 0.15 ng/mL	Erbium, Er	15.00 ± 0.11 ng/mL
Europium, Eu	10.00 ± 0.06 ng/mL	Gadolinium, Gd	45.00 ± 0.26 ng/mL
Gallium, Ga	45.00 ± 0.25 ng/mL	Germanium, Ge	150.1 ± 1.2 ng/mL
Hafnium, Hf	15.00 ± 0.10 ng/mL	Holmium, Ho	5.000 ± 0.028 ng/mL
Indium, In	10.00 ± 0.06 ng/mL	Iron, Fe	20.00 ± 0.12 ng/mL
Lanthanum, La	10.00 ± 0.06 ng/mL	Lead, Pb	10.00 ± 0.06 ng/mL
Lithium, Li	100.0 ± 0.6 ng/mL	Lutetium, Lu	5.000 ± 0.028 ng/mL
Magnesium, Mg	50.00 ± 0.28 ng/mL	Manganese, Mn	20.00 ± 0.12 ng/mL
Molybdenum, Mo	100.1 ± 0.6 ng/mL	Neodymium, Nd	45.00 ± 0.24 ng/mL
Nickel, Ni	150.1 ± 1.0 ng/mL	Niobium, Nb	20.00 ± 0.14 ng/mL
Palladium, Pd	100.0 ± 0.7 ng/mL	Phosphorus, P	1 001 ± 6 ng/mL
Potassium, K	35.00 ± 0.19 ng/mL	Praseodymium, Pr	10.00 ± 0.06 ng/mL
Rhenium, Re	15.00 ± 0.09 ng/mL	Rubidium, Rb	30.00 ± 0.17 ng/mL
Samarium, Sm	45.00 ± 0.24 ng/mL	Scandium, Sc	30.00 ± 0.17 ng/mL
Selenium, Se	1 250 ± 10 ng/mL	Silicon, Si	1 001 ± 7 ng/mL
Silver, Ag	40.00 ± 0.22 ng/mL	Sodium, Na	40.00 ± 0.22 ng/mL
Strontium, Sr	20.00 ± 0.14 ng/mL	Tantalum, Ta*	5.000 ± 0.041 ng/mL
Tellurium, Te	500.1 ± 3.1 ng/mL	Terbium, Tb	5.000 ± 0.031 ng/mL
Thallium, Tl	10.00 ± 0.08 ng/mL	Thorium, Th	5.000 ± 0.031 ng/mL
Thulium, Tm	5.000 ± 0.028 ng/mL	Tin, Sn	45.00 ± 0.35 ng/mL
Titanium, Ti	500.2 ± 4.0 ng/mL	Tungsten, W	25.00 ± 0.22 ng/mL
Uranium, U	5.000 ± 0.026 ng/mL	Vanadium, V	40.00 ± 0.22 ng/mL
Ytterbium, Yb	25.00 ± 0.14 ng/mL	Yttrium, Y	15.00 ± 0.09 ng/mL
Zinc, Zn	150.0 ± 0.8 ng/mL	Zirconium, Zr	35.00 ± 0.26 ng/mL

Density: 1.009 g/mL (measured at 20 ± 4 °C)

Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	160729
Ag	Volhard	999c	999c
Ag	Calculated		See Sec. 4.2
Al	ICP Assay	3101a	140903
Al	EDTA	928	928
Al	Calculated		See Sec. 4.2
As	ICP Assay	3103a	100818
As	Calculated		See Sec. 4.2
B	ICP Assay	3107	190605
B	Calculated		See Sec. 4.2
Ba	ICP Assay	3104a	140909
Be	ICP Assay	3105a	090514
Be	Calculated		See Sec. 4.2
Bi	ICP Assay	3106	180815
Bi	Calculated		See Sec. 4.2
Ca	ICP Assay	3109a	130213
Ca	EDTA	928	928
Ca	Calculated		See Sec. 4.2
Cd	ICP Assay	3108	130116
Cd	EDTA	928	928
Cd	Calculated		See Sec. 4.2
Ce	ICP Assay	3110	160830
Ce	EDTA	928	928
Co	ICP Assay	3113	190630
Co	EDTA	928	928
Co	Calculated		See Sec. 4.2
Cr	ICP Assay	3112a	170630
Cs	IC Assay	3111a	130228
Cs	Calculated		See Sec. 4.2
Cs	Gravimetric		See Sec. 4.2
Cu	ICP Assay	3114	120618
Cu	EDTA	928	928
Cu	Calculated		See Sec. 4.2
Dy	EDTA	928	928
Dy	ICP Assay	3115a	990504
Er	ICP Assay	3116a	170906
Er	EDTA	928	928
Er	Calculated		See Sec. 4.2
Eu	ICP Assay	3117a	120705
Eu	EDTA	928	928
Fe	ICP Assay	3126a	140812
Fe	EDTA	928	928
Fe	Calculated		See Sec. 4.2
Ga	ICP Assay	3119a	140124
Ga	EDTA	928	928
Ga	Calculated		See Sec. 4.2
Gd	EDTA	928	928
Gd	ICP Assay	3118a	992004
Gd	Calculated		See Sec. 4.2

Ge	ICP Assay	3120a	080429
Ge	Calculated		See Sec. 4.2
Hf	ICP Assay	3122	000406
Ho	ICP Assay	3123a	090408
Ho	EDTA	928	928
Ho	Calculated		See Sec. 4.2
In	ICP Assay	3124a	110516
In	EDTA	928	928
In	Calculated		See Sec. 4.2
K	ICP Assay	3141a	140813
K	Calculated		See Sec. 4.2
K	Gravimetric		See Sec. 4.2
La	ICP Assay	3127a	151030
La	EDTA	928	928
La	Calculated		See Sec. 4.2
Li	ICP Assay	3129a	100714
Li	Calculated		See Sec. 4.2
Li	Gravimetric		See Sec. 4.2
Lu	ICP Assay	3130a	100503
Lu	EDTA	928	928
Lu	Calculated		See Sec. 4.2
Mg	ICP Assay	3131a	140110
Mg	EDTA	928	928
Mg	Calculated		See Sec. 4.2
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Mn	Calculated		See Sec. 4.2
Mo	ICP Assay	3134	891307
Mo	Calculated		See Sec. 4.2
Na	ICP Assay	3152a	200413
Na	Calculated		See Sec. 4.2
Na	Gravimetric		See Sec. 4.2
Nb	ICP Assay	3137	080502Nb
Nb	Calculated		See Sec. 4.2
Nd	ICP Assay	3135a	140527
Nd	EDTA	928	928
Nd	Calculated		See Sec. 4.2
Ni	ICP Assay	3136	120619
Ni	EDTA	928	928
P	ICP Assay	3139a	060717
P	Acidimetric	84L	84L
P	Calculated		See Sec. 4.2
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Pd	ICP Assay	3138	180115
Pr	EDTA	928	928
Pr	ICP Assay	3142a	990501
Pr	Calculated		See Sec. 4.2
Rb	IC Assay	3145a	150622

Rb	Calculated		See Sec. 4.2
Rb	Gravimetric		See Sec. 4.2
Re	ICP Assay	3143	140825
Re	Calculated		See Sec. 4.2
Sb	ICP Assay	3102A	061229
Sb	Calculated		See Sec. 4.2
Sc	ICP Assay	3148a	100701
Sc	EDTA	928	928
Se	ICP Assay	3149	100901
Si	ICP Assay	Traceable to 3150	S2-SI702546
Sm	ICP Assay	3147a	140115
Sm	EDTA	928	928
Sm	Calculated		See Sec. 4.2
Sn	ICP Assay	3161a	070330
Sn	Calculated		See Sec. 4.2
Sr	EDTA	928	928
Sr	ICP Assay	Traceable to 3153a	K2-SR650985
Sr	Calculated		See Sec. 4.2
Ta	ICP Assay	3155	080502
Ta	Calculated		See Sec. 4.2
Tb	ICP Assay	3157a	100518
Tb	EDTA	928	928
Tb	Calculated		See Sec. 4.2
Te	ICP Assay	3156	140830
Th	EDTA	928	928
Th	Calculated		See Sec. 4.2
Ti	ICP Assay	3162a	130925
Ti	ICP Assay	3158	151215
Ti	Calculated		See Sec. 4.2
Tm	ICP Assay	3160a	790912
Tm	EDTA	928	928
Tm	Calculated		See Sec. 4.2
U	ICP Assay	3164	080521
U	Calculated		See Sec. 4.2
V	ICP Assay	3165	160906
V	EDTA	928	928
W	ICP Assay	3163	080331
W	Calculated		See Sec. 4.2
Y	ICP Assay	3167a	120314
Y	EDTA	928	928
Y	Calculated		See Sec. 4.2
Yb	ICP Assay	3166a	140114
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/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_{bb} = bottle to bottle homogeneity standard uncertainty

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

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

u_{Its} = 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 tuning of analytical instruments. Can be used for calibration and validation of analytical methods as appropriate (see Ta 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

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

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

***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.

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 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

November 15, 2022

- 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

- **November 15, 2027**

- 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.

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Approved By:

Thomas Kozikowski
Manager, Quality Control



Certifying Officer:

Paul Gaines
Chairman / Senior Technical Director

