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CERTIFICATE OF ANALYSIS

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1.0 **INORGANIC VENTURES** is an ISO Guide 34 "General Requirements for the Competence of Reference Material Producers" and ISO 9001 registered manufacturer. Our manufacturing laboratory is accredited to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories."

ACCREDITED Testing Laboratory Certificate 883.01

ACCREDITED Reference Material Producer Certificate 883.02

2.0 DESCRIPTION OF CRM **1000 µg/mL Iron in 2% (v/v) HNO3**

Catalog Number:	CGFE1-1, CGFE1-2, and CGFE1-5
Lot Number:	**G2-FE04030**
Starting Material:	Fe pieces
Starting Material Purity (%):	99.9977
Starting Material Lot No:	1762
Matrix:	2% (v/v) HNO3

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration:	999 ± 4 µg/mL weighted mean
Certified Density:	1.010 g/mL (measured at 20 ± 1°C)

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 interval using a coverage factor of k = 2.

Characterization of CRM by two independent methods	**Characterization of CRM by one method**
Certified Value, X_{CRM}, where two methods of characterization are used, is the weighted mean of the two results = $[(w_a)(X_a) + (w_b)(X_b)]$ X_a is the mean of Assay Method A with standard uncertainty $U_{char\ a}$. X_b is the 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 Expanded Uncertainty (±) = $U_{CRM} = k\ (U^2_{char\ a\&b} + u^2_{bb} + u^2_{lts} + u^2_{sts})^{½}$** $U_{char\ a\&b} = [(w_a)^2 (U_{char\ a})^2 + (w_b)^2 (U_{char\ b})^2]^{0.5}$; $U_{char\ a}$ and $U_{char\ b}$ are the square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume; **k**, coverage factor = 2 in all cases at Inorganic Ventures; 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 Value, X_{CRM}, where one method of characterization is used, is the mean of individual results:** X_a = Mean X_a is the mean of Assay Method A with standard uncertainty $U_{char\ a}$. **CRM Expanded Uncertainty (±) = $U_{CRM} = k\ (U^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{sts})^{½}$** $U_{char\ a}$ is the square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume; **k**, coverage factor = 2 in all cases at Inorganic Ventures; 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 AND VALUES OBTAINED BY INDEPENDENT METHODS

· "Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (ISO VIM, 2nd ed., 1993, definition 6.10)

· 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 uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRMs are available, the term 'in-house std.' is specified.

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a NIST SRM/RM. See section 4.2 for balance traceability.

4.1 **Assay Method #1** **999 ± 3 µg/mL**
ICP Assay NIST SRM 3126a Lot Number: 051031

Assay Method #2 **999 ± 3 µg/mL**
EDTA NIST SRM 928 Lot Number: 928

4.2 **BALANCE CALIBRATION -** All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 **THERMOMETER CALIBRATION -** All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 **GLASSWARE CALIBRATION -** An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

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

CRM's solutions are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

O	Al	< 0.002700	M	Dy	< 0.037772	O	Li	< 0.000030	M	Pr	< 0.001889	M	Te	< 0.188859
M	Sb	0.004415	M	Er	< 0.031476	M	Lu	< 0.002518	M	Re	< 0.006295	M	Tb	< 0.001889
M	As	< 0.062953	M	Eu	< 0.018886	O	Mg	< 0.000060	M	Rh	< 0.006295	M	Tl	< 0.006295
O	Ba	0.000018	M	Gd	< 0.006295	M	Mn	0.010034	M	Rb	< 0.006295	M	Th	< 0.006295
O	Be	< 0.000050	M	Ga	< 0.006295	O	Hg	< 0.011000	M	Ru	< 0.012591	M	Tm	< 0.002518
M	Bi	< 0.002518	i	Ge		M	Mo	< 0.012591	M	Sm	< 0.006295	M	Sn	< 0.031476
O	B	< 0.020000	M	Au	< 0.018886	M	Nd	< 0.012591	M	Sc	< 0.062953	M	Ti	< 0.314765
M	Cd	< 0.018886	M	Hf	< 0.012591	M	Ni	0.002007	M	Se	< 0.050362	M	W	< 0.062953
O	Ca	0.001594	M	Ho	< 0.003148	M	Nb	< 0.003148	O	Si	< 0.010000	M	U	< 0.012591
M	Ce	< 0.031476	M	In	< 0.062953	n	Os		M	Ag	< 0.012591	M	V	< 0.012591
M	Cs	< 0.001889	M	Ir	< 0.031476	M	Pd	< 0.031476	O	Na	0.001594	M	Yb	< 0.006295
O	Cr	0.000574	s	Fe		i	P		M	Sr	< 0.003148	M	Y	< 0.251812
O	Co	0.002072	M	La	< 0.003148	M	Pt	< 0.012591	i	S		M	Zn	0.002207
M	Cu	0.002207	M	Pb	< 0.018886	O	K	< 0.001700	M	Ta	< 0.044067	M	Zr	< 0.031476

M - Checked by ICP-MS O - Checked by ICP-OES i - Spectral Interference n - Not Checked For s - Solution Standard Element

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Eletrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep tightly sealed when not in use. Store and use at 20 ± 4°C. Do not pipet from container. Do not return portions removed for pipetting to container.

Atomic Weight; Valence; Coordination Number; Chemical Form in Solution - 55.847; +3; **6**; $Fe(H_2O)_6^{3+}$

Chemical Compatibility - Stable in HCl, HNO_3, H_2SO_4 ,HF and H_3PO_4. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Fe Containing Samples (Preparation and Solution) - Metal (Soluble in HCl); Oxides (If the oxide has been at a high temperature then Na_2CO_3 fusion in Pt0 followed by HCl dissolution otherwise dissolve in dilute HCl); Ores (See Oxides above using only the fusion approach).

Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):

Technique/Line	Estimated D.L.	Order	Type	Interferences (underlined indicates severe)
ICP-OES 238.204 nm	0.005 / 0.001 µg/mL	1	ion	Ru, Co
ICP-OES 239.562 nm	0.005 / 0.001 µg/mL	1	ion	Co, W, Cr
ICP-OES 259.940 nm	0.006 / 0.001 µg/mL	1	ion	Hf, Nb
ICP-MS 56 amu	970 ppt	n/a	M+	40Ar15N1H, 40Ar16O, 36Ar17O1H , 38Ar18O, 37Cl18O1H, 40Ca16O

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 enclosed Material Safety Data sheet for information regarding this CRM.

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

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

Certification Date: September 04, 2013

Expiration Date:

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By:	Zach Saunders Product Documentation Technician	
Certificate Approved By:	Brian Alexander PhD., Technical Process Director	
Certifying Officer:	Paul Gaines PhD., Senior Technical Director