

**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: Single Analyte Mass Spec Solution  
 Catalog Number: MSGE-100PPM  
 Lot Number: J2-GE01119  
 Matrix: tr. HF  
 tr. HNO3  
 Value / Analyte(s): 100 µg/mL ea:  
 Ge  
 Starting Material: Ge pieces  
 Starting Material Lot#: 1636  
 Starting Material Purity: 99.9821%

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Value:** 100.05 ± 0.59 µg/mL  
**Certified Density:** 0.999 g/mL (measured at 20 ± 1 °C)

**Assay Information:**

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Ge	ICP Assay	3120a	080429

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 Methods**

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

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

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

$X_b$  = 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:

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

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

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

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

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

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

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

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

**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:

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

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

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

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

$u_{bb}$  = 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**

- 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)**

CRM/RMs 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.

M Ag	0.000238	M Eu	< 0.006053	O Na	0.000077	O Se	< 0.023602	O Zn	< 0.003933
O Al	< 0.011801	O Fe	< 0.003933	O Nb	< 0.003933	O Si	0.006768	O Zr	< 0.004327
O As	< 0.021242	O Ga	< 0.019669	M Nd	< 0.004035	M Sm	< 0.002017		
M Au	< 0.006053	M Gd	< 0.002017	M Ni	< 0.016143	M Sn	< 0.010089		
O B	< 0.039338	s Ge	<	n Os	<	O Sr	< 0.013374		
M Ba	< 0.020179	M Hf	< 0.004035	O P	< 0.010227	O Ta	< 0.039338		
M Be	< 0.001008	O Hg	< 0.047205	M Pb	< 0.006053	M Tb	< 0.000605		
M Bi	< 0.000807	M Ho	< 0.001008	O Pd	< 0.011801	M Te	< 0.060537		
O Ca	0.000483	M In	0.010515	M Pr	< 0.000605	M Th	< 0.002017		
M Cd	< 0.006053	M Ir	< 0.010089	M Pt	< 0.004035	M Ti	< 0.100895		
M Ce	< 0.010089	O K	< 0.007080	M Rb	< 0.002017	M Tl	< 0.002017		
M Co	< 0.006053	M La	< 0.001008	M Re	< 0.002017	M Tm	< 0.000807		
M Cr	< 0.010089	O Li	< 0.000078	M Rh	< 0.002017	M U	< 0.004035		
M Cs	< 0.000605	M Lu	< 0.000807	M Ru	< 0.004035	M V	< 0.004035		
O Cu	< 0.003933	O Mg	0.000015	O S	< 0.098345	O W	< 0.078676		
M Dy	< 0.012107	M Mn	< 0.008071	M Sb	< 0.001008	O Y	< 0.003933		
M Er	< 0.010089	M Mo	< 0.004035	M Sc	< 0.020179	M Yb	< 0.002017		

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 and validation of analytical methods as appropriate.

## 7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

### 7.1 Storage and Handling Recommendations

- Keep cap tightly sealed when not in use. Store and use at  $20 \pm 4^\circ \text{C}$ . Do not pipette from the container. Do not return removed aliquots to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** -  $72.59 +4 6 \text{ Ge(OH)}_x(\text{F})_y2-$   
**Chemical Compatibility** - Stable in HCl, HF,  $\text{H}_3\text{PO}_4$   $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  as the  $\text{Ge(OH)}_x(\text{F})_y2-$ . Avoid neutral to basic media. Unstable at ppm levels with metals that would pull F- away (i.e. Do not mix with Alkaline or Rare Earths or high levels of transition elements unless they are fluorinated). Stable with most inorganic anions with a tendency to hydrolyze .

**Stability** - 2-100 ppb levels - stability unknown alone or mixed with all other metals as the  $\text{Ge(OH)}_x(\text{F})_y2-$ . 1-10,000 ppm single element solutions as the  $\text{Ge(OH)}_x(\text{F})_y2-$  chemically stable for years in 2-5%  $\text{HNO}_3$  / trace HF in a LDPE container.

**Ge Containing Samples (Preparation and Solution)** - Metal (Soluble in 1:1:1  $\text{H}_2\text{O}$  / HF /  $\text{HNO}_3$ ); Oxide -  $\text{GeO}$  (Readily soluble in HCl or NaOH),  $\text{GeO}_2$  (fuse in Pt0with  $\text{Na}_2\text{CO}_3$  followed by HCl solution of the fuseate); Geological Samples ( fuse in Pt0with  $\text{Na}_2\text{CO}_3$  followed by HCl solution of the fuseate); Organic Matrices (Dry ash at 450EC in Pt0 and dissolve by gently warming with 1:1:1  $\text{H}_2\text{O}$  / HF /  $\text{H}_2\text{SO}_4$  or fuse ash with  $\text{Na}_2\text{CO}_3$  and dissolve fuseate with HCl /  $\text{H}_2\text{O}$ ).

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

Technique/Line	Estimated D.L.	Order	Interferences (underlined indicates severe)
ICP-MS 72 amu	20	n/a	36Ar2,37Cl17O18O, 37Cl35Cl,36S18O2, 36S2,36Ar36S,56Fe 16O,40Ar16O2,40C a16O2,40Ar32S,144 Nd2+,44Sm2+
ICP-OES 164.919 nm	0.01 / 0.001 $\mu\text{g/mL}$	1	Co, Fe, Cu
ICP-OES 219.871 nm	0.06 / 0.009 micro;g/mL	1	W, Ir, Re, Co
ICP-OES 265.117 nm	0.05 / 0.009 micro;g/mL	1	Ta, Pt, Mn, Rh, Ce, Nb, Hf

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

## 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, EXPIRATION AND PERIOD OF VALIDITY**

**11.1 Certification Issue Date**

July 21, 2015

**11.2 Expiration Date**

**11.3 Period of Validity**

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is handled and stored in accordance with instructions given in Sec 7.0 and used prior to the date given in Sec 11.2. This certification is nullified if the CRM/RM is damaged, contaminated, or otherwise modified.

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**


**Certificate Prepared By:**

Brenda Francis  
Product Documentation Technician



**Certificate Approved By:**

Brian Alexander  
PhD., Technical Process Director



**Certifying Officer:**

Paul Gaines  
PhD., Senior Technical Director

