

## 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 Custom Grade Solution  
 Catalog Number: CGTB1  
 Lot Number: H2-TB01066R  
 Matrix: 5% (v/v) HNO<sub>3</sub>  
 Value / Analyte(s): 1 000 µg/mL ea:  
 Terbium  
 Starting Material: Tb4O<sub>7</sub>  
 Starting Material Lot#: 1683  
 Starting Material Purity: 99.9995%

## 3.0 CERTIFIED VALUES AND UNCERTAINTIES

**Certified Value:** 1000 ± 4 µg/mL  
**Certified Density:** 1.026 g/mL (measured at 20 ± 1 °C)

### Assay Information:

<b>Assay Method #1</b>	<b>999 ± 3 µg/mL</b> ICP Assay NIST SRM 3157a Lot Number: 100518
<b>Assay Method #2</b>	<b>1001 ± 3 µg/mL</b> EDTA NIST SRM 928 Lot Number: 928

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a National Institute of Standards and Technology (NIST) SRM/RM. See Sec 4.2 for balance traceability.

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.

$$\text{Certified Value } (\bar{x}) = \frac{\sum x_i}{n}$$

( $\bar{x}$ ) = mean  
 $x_i$  = individual results  
 n = number of measurements

$$\text{Uncertainty } (\pm) = 2 \left[ \sum (s_i)^2 \right]^{1/2}$$

2 = the coverage factor.  
 $\left[ \sum (s_i)^2 \right]^{1/2}$  = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability.

## 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 < 0.000502	M Eu < 0.000301	O Na < 0.004000	M Se < 0.003014	M Zn < 0.003014
M Al < 0.005024	O Fe < 0.020000	M Nb < 0.000301	O Si < 0.050000	M Zr < 0.000602
M As < 0.002009	M Ga < 0.000100	M Nd < 0.000301	M Sm < 0.001004	
M Au < 0.000502	M Gd < 0.020099	M Ni < 0.012059	M Sn < 0.005024	
M B < 0.006029	M Ge < 0.000502	n Os <	O Sr < 0.000070	
M Ba < 0.000301	M Hf < 0.001004	i P <	M Ta < 0.000301	
M Be < 0.000100	i Hg <	M Pb < 0.001004	s Tb <	
M Bi < 0.005024	M Ho < 0.000502	M Pd < 0.000502	M Te < 0.030148	
O Ca < 0.030000	M In < 0.005024	M Pr < 0.000100	M Th < 0.000100	
M Cd < 0.000100	M Ir < 0.007034	M Pt < 0.002009	M Ti < 0.002009	
M Ce < 0.000100	O K < 0.004000	M Rb < 0.000100	M Tl < 0.000502	
M Co 0.002409	M La 0.000090	M Re < 0.000200	M Tm < 0.000100	
M Cr < 0.005024	M Li < 0.005024	M Rh < 0.000100	M U < 0.001004	
M Cs 0.000100	i Lu <	M Ru < 0.000100	M V < 0.002009	
M Cu < 0.002009	M Mg < 0.005024	i S <	M W < 0.005024	
M Dy 0.000321	M Mn < 0.000200	M Sb < 0.002009	M Y 0.000251	
M Er 0.000251	M Mo < 0.003014	M Sc < 0.006029	M Yb 0.002209	

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 ± 4° C. Do not pipette from the container. Do not return removed aliquots to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 158.93 +3 6 to 9 or 10 for some compounds  $Tb(OH)_x(H_2O)_y+3-x$

**Chemical Compatibility** -Soluble in HCl, H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub>. Avoid HF, H<sub>3</sub>PO<sub>4</sub> and neutral to basic media. Stable with most metals and inorganic anions forming an insoluble carbonate, oxide, oxalate, and fluoride. Avoid mixing with elements / solutions containing moderate amounts of fluoride.

**Stability** - 2-100 ppb levels stable for months in 1% HNO<sub>3</sub> / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2 - 5% HNO<sub>3</sub> / LDPE container.

**Tb Containing Samples (Preparation and Solution)** -Metal (Soluble in acids); Oxide (Dissolve by heating in H<sub>2</sub>O/ HNO<sub>3</sub>); Ores (Carbonate fusion in Pt0 followed by HCl dissolution); Organic Matrices (dry ash and dissolve in 1:1 H<sub>2</sub>O / HCl or HNO<sub>3</sub> ).

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

<b>Technique/Line</b>	<b>Estimated D.L.</b>	<b>Order</b>	<b>Interferences</b> (underlined indicates severe)
ICP-MS 159 amu	1 ppt	N/A	
ICP-OES 350.917 nm	0.02 / 0.002 µg/mL	1	V, Th, Ce, Zr
ICP-OES 367.635 nm	0.06 / 0.006 µg/mL	1	Ta, Ce, Co, U

## 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

December 12, 2014

### 11.2 Expiration Date

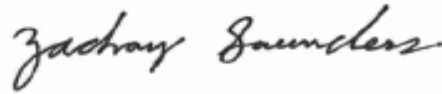
### 11.3 Period of Validity

- 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:**

Zach Saunders  
Product Documentation Technician

Handwritten signature of Zach Saunders in black ink.

**Certificate Approved By:**

Brian Alexander  
PhD., Technical Process Director

Handwritten signature of Brian Alexander in black ink.

**Certifying Officer:**

Paul Gaines  
PhD., Senior Technical Director

Handwritten signature of Paul Gaines in black ink.