

010222

**SOUTHWEST RESEARCH INSTITUTE**

**NUCLEAR PROJECT**

**CLIENT: Division 20**

**TASK ORDER: 040617-9**

**SRR: 26058**

**SDG: 246146**

**CASE: CNWRA**

**VTSR: June 16, 2004**

**PROJECT#: 10542.02.002**

## **Certificates of Analysis**

010223

**FISHER SCIENTIFIC  
TRACEMETAL GRADE NITRIC ACID  
CERTIFICATE OF ANALYSIS**

Catalog No. A509

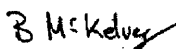
Lot No: 1104010

Release Date: January, 2004

Expiry Date: January, 2007

Tests	Units	Value
Assay	%	70%
Color	APHA	<10
Aluminum	ppb	<0.5
Antimony	ppb	<0.1
Arsenic	ppb	<0.1
Barium	ppb	<0.1
Beryllium	ppb	<0.1
Bismuth	ppb	<0.1
Boron	ppb	<1
Cadmium	ppb	<0.1
Calcium	ppb	<1
Chromium	ppb	<0.2
Cobalt	ppb	<0.1
Copper	ppb	<0.1
Iron	ppb	<1
Lead	ppb	<0.1
Lithium	ppb	<0.1
Magnesium	ppb	<0.2
Manganese	ppb	<0.1
Mercury	ppb	<0.2
Molybdenum	ppb	<0.1
Nickel	ppb	<0.1
Potassium	ppb	<0.2
Selenium	ppb	<0.1
Silver	ppb	<0.1
Sodium	ppb	<0.2
Strontium	ppb	<0.1
Thorium	ppb	<0.1
Tin	ppb	<0.1
Titanium	ppb	<0.1
Uranium	ppb	<0.1
Vanadium	ppb	<0.1
Zinc	ppb	<0.2
Zirconium	ppb	<0.1

Element concentrations are at the point of bottling.  
Concentrations of some elements in particular, Ca, Si,  
K, Na, B, Al, Mg & Mn will increase due to storage in  
glass bottles.



Dr. B. McKelvey  
QA/QC Manager

Fisher Scientific Chemical Division  
Pittsburgh, PA, 15275 Phone (412) 490-8300



**Fisher Chemical**

A Fisher Scientific Company

INORGANIC LABS/RADIOCHEM LABS  
 DATE RECEIVED: 06/10/04  
 DATE EXPIRED: 01/01/2007  
 DATE OPENED: 06/10/04  
 INORG: 4580-4585 PO: F53393



010224

**FISHER SCIENTIFIC  
TRACEMETAL GRADE NITRIC ACID  
CERTIFICATE OF ANALYSIS**

Catalog No. A509

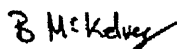
Lot No: 1104020

Release Date: February, 2004

Expiry Date: February, 2007

Tests	Units	Value
Assay	%	70%
Color	APHA	<10
Aluminum	ppb	<0.5
Antimony	ppb	<0.1
Arsenic	ppb	<0.1
Barium	ppb	<0.1
Beryllium	ppb	<0.1
Bismuth	ppb	<0.1
Boron	ppb	<1
Cadmium	ppb	<0.1
Calcium	ppb	<1
Chromium	ppb	<0.2
Cobalt	ppb	<0.1
Copper	ppb	<0.1
Iron	ppb	<1
Lead	ppb	<0.1
Lithium	ppb	<0.1
Magnesium	ppb	<0.2
Manganese	ppb	<0.1
Mercury	ppb	<0.2
Molybdenum	ppb	<0.1
Nickel	ppb	<0.1
Potassium	ppb	<0.2
Selenium	ppb	<0.1
Silver	ppb	<0.1
Sodium	ppb	<0.2
Strontium	ppb	<0.1
Thorium	ppb	<0.1
Tin	ppb	<0.1
Titanium	ppb	<0.1
Uranium	ppb	<0.1
Vanadium	ppb	<0.1
Zinc	ppb	<0.2
Zirconium	ppb	<0.1

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INORGANIC LABS/RADCHEM LABS  
DATE RECEIVED: 05/05/04  
DATE EXPIRED: 09/09/07  
DATE OPENED: 05/05/04  
INORG: 4558-4563 PO: FS3373

010225

**FISHER SCIENTIFIC**  
**TRACEMETAL GRADE HYDROCHLORIC ACID**

**CERTIFICATE OF ANALYSIS**

Catalog No. A508

Lot No: 4103101

Release Date: January, 2004

Expiry Date: January, 2007

Tests	Units	Value
Assay	%	35%
Color	APHA	<10
Aluminum	ppb	<0.5
Antimony	ppb	<0.1
Arsenic	ppb	<0.1
Barium	ppb	<0.1
Beryllium	ppb	<0.1
Bismuth	ppb	<0.1
Boron	ppb	<0.5
Cadmium	ppb	<0.1
Calcium	ppb	<0.5
Chromium	ppb	<0.1
Cobalt	ppb	<0.1
Copper	ppb	<0.1
Iron	ppb	<0.5
Lead	ppb	<0.1
Lithium	ppb	<0.1
Magnesium	ppb	<0.5
Manganese	ppb	<0.1
Mercury	ppb	<0.2
Molybdenum	ppb	<0.1
Nickel	ppb	<0.1
Potassium	ppb	<0.1
Selenium	ppb	<0.1
Silver	ppb	<0.1
Sodium	ppb	<0.5
Strontium	ppb	<0.1
Thorium	ppb	<0.1
Tin	ppb	<0.1
Titanium	ppb	<0.1
Uranium	ppb	<0.1
Vanadium	ppb	<0.1
Zinc	ppb	<0.5
Zirconium	ppb	<0.1

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 Na, B, Al, Mg & Mn will increase due to storage in glass  
 bottles.

*B. McKelvey*

Dr. B. McKelvey  
 QA/QC Manager

Fisher Scientific Chemical Division  
 Pittsburgh, PA., 15275 Phone (412) 490-8300



**Fisher Chemical**

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INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 06/21/04  
 DATE EXPIRED: 01/21/2007  
 DATE OPENED: 06/21/04  
 INORG: 4586-4591 PO: F53393

010226

**FISHER SCIENTIFIC**  
**TRACEMETAL GRADE HYDROCHLORIC ACID**

**CERTIFICATE OF ANALYSIS**

Catalog No. A508

Lot No: 4103101

Release Date: January, 2004

Expiry Date: January, 2007

Tests	Units	Value
Assay	%	35%
Color	APHA	<10
Aluminum	ppb	<0.5
Antimony	ppb	<0.1
Arsenic	ppb	<0.1
Barium	ppb	<0.1
Beryllium	ppb	<0.1
Bismuth	ppb	<0.1
Boron	ppb	<0.5
Cadmium	ppb	<0.1
Calcium	ppb	<0.5
Chromium	ppb	<0.1
Cobalt	ppb	<0.1
Copper	ppb	<0.1
Iron	ppb	<0.5
Lead	ppb	<0.1
Lithium	ppb	<0.1
Magnesium	ppb	<0.5
Manganese	ppb	<0.1
Mercury	ppb	<0.2
Molybdenum	ppb	<0.1
Nickel	ppb	<0.1
Potassium	ppb	<0.1
Selenium	ppb	<0.1
Silver	ppb	<0.1
Sodium	ppb	<0.5
Strontium	ppb	<0.1
Thorium	ppb	<0.1
Tin	ppb	<0.1
Titanium	ppb	<0.1
Uranium	ppb	<0.1
Vanadium	ppb	<0.1
Zinc	ppb	<0.5
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 QA/QC Manager

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 Pittsburgh, PA, 15275 Phone (412) 490-8300



**Fisher Chemical**

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INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 05/05/04  
 DATE EXPIRED: 01/01/2007  
 DATE OPENED: 05/05/04  
 INORG: 4552-4557 PO: F53373

010227

**SPEX**ertificate™

## Certificate of Reference Material

**Catalog Number:** SPIKE-1 **Lot No.:** 25-23AS  
**Description:** Spike Sample Standard 1  
**Matrix:** 5% Nitric Acid/tr Tartaric Acid - HF

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

The CRM is prepared from high purity single element concentrates of individual elements using Class A laboratory ware to give precise concentration.

Refer to side 2 for details of measurement uncertainties.

**Instrumental Analysis by ICP Spectrometer:**

Element	Labeled (mg/L)	Measured (mg/L)	NIST SRM	Element	Labeled (mg/L)	Measured (mg/L)	NIST SRM
Al	200	199.51	3101a	Pb	50	49.98	3128
As	200	199.89	3103a	Sb	50	50.02	3102a
Ba	200	199.68	3104a	V	50	49.95	3165
Se	200	200.10	3149	Zn	50	50.02	3168a
TL	200	200.07	3158	Cu	25	25.34	3114
Fe	100	99.91	3126a	Cr	20	20.04	3112a
Co	50	50.25	3113	Ag	5	5.00	3151
Mn	50	49.98	3132	Be	5	5.00	3105a
Ni	50	50.11	3136	Cd	5	4.99	3108

Spex Reference Multi: Lot #2-61BD, 17-55AS, 19-85ASREF

Balances are calibrated regularly with weight sets traceable to NIST#s 32856, 32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% on the average of all the certified concentrations with no single component exceeding +/- 2%. This guarantee is valid for a period of one year from the date of certification only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: OCT - - 2003 Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 12/31/03  
 DATE EXPIRED: 12/31/04  
 DATE OPENED: 11/3/03  
 INORG: 4306  
 PO: P53361  
 PK

# Report of Certification

010228

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010229

**SPEX**ertificate™

Certificate of Reference Material

**Catalog Number:** ICAL-1      **Lot No.:** 25-178AS  
**Description:** Instrument Calibration Standard 1  
**Matrix:** 5% Nitric Acid

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

The CRM is prepared from high purity single element concentrates of individual elements using Class A laboratory ware to give precise concentration.

Refer to side 2 for details of measurement uncertainties.

**Instrumental Analysis by ICP Spectrometer:**

Element	Labeled (mg/L)	Measured (mg/L)	NIST SRM
Ca	5,000	4,984.92	3109a
K	5,000	4,990.26	3141a
Mg	5,000	4,991.82	3131a
Na	5,000	4,998.07	3152a

Spex Reference Multi: Lot #10-100AS, 12-113AS, 5-198VY, 6-28VY-REF

Balances are calibrated regularly with weight sets traceable to NIST#s 32856, 32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% on the average of all the certified concentrations with no single element exceeding +/-2%. This includes uncertainty of measurements and other effects, such as transpiration losses. This guarantee is valid for a period of one year from the date of certification only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: MAR 22 2004      Certifying Officer: N. Kocherlakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 03/20/04  
 DATE EXPIRED: 03/20/05  
 DATE OPENED: 03/20/04  
 INORG: 4514      PO: F53361

## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### **Instructions for Use:**

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### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

<b>ISO 9001</b> <b>CERTIFIED</b>
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010231

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis****CUSTOM-GRADE SOLUTION****10,000 µg/mL Scandium IN 5% HNO<sub>3</sub> (abs)**

Catalog Number: CGSC10-1and CGSC10-5

Lot Number: **T-SC02053**

Starting Material: Sc<sub>2</sub>O<sub>3</sub>  
 Starting Material Purity: 99.999%  
 Starting Material Lot No: 632-5721

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 09/24/03  
 DATE EXPIRED: 10/01/2004 V03  
 DATE OPENED: 09/24/03  
 INORG: 4262 PO: E50030

**CERTIFIED CONCENTRATION: 10,047 ± 29 µg/mL**

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

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

( $\bar{x}$ ) = mean $x_i$  = individual results

n = number of measurements

 $\sum s_i$  = The summation of all significant estimated errors.**Classical Wet Assay: 10,047 ± 29 µg/mL**

Method: EDTA Titration vs NIST SRM 928 Lead Nitrate.

**Instrument Analysis: 9994 ± 41 µg/mL**

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3148a.

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

**TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:**

Custom-Grade solutions tested for trace metallic impurities by ICP-MS were analyzed in an UPLA-Filtered Clean Room.  
 An UPLA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

<u>O</u> Al <0.070	<u>M</u> Dy <0.0060	<u>M</u> Li <0.010	<u>M</u> Pr <0.00030	<u>M</u> Te <0.030
<u>M</u> Sb <0.00050	<u>M</u> Er <0.0050	<u>M</u> Lu <0.00040	<u>M</u> Re <0.0010	<u>M</u> Tb <0.00030
<u>M</u> As <0.010	<u>M</u> Eu <0.0030	<u>M</u> Mg <0.030	<u>M</u> Rh <0.0010	<u>M</u> Tl <0.0010
<u>M</u> Ba <0.010	<u>M</u> Gd <0.0010	<u>M</u> Mn <0.0040	<u>M</u> Rb <0.0010	<u>M</u> Th 0.028
<u>M</u> Be <0.00050	<u>M</u> Ga <0.0010	<u>i</u> Hg	<u>M</u> Ru <0.0020	<u>M</u> Tm <0.00040
<u>M</u> Bi 0.043	<u>M</u> Ge <0.0060	<u>M</u> Mo <0.0020	<u>M</u> Sm <0.0010	<u>M</u> Sn <0.0050
<u>O</u> B <0.034	<u>M</u> Au <0.0030	<u>M</u> Nd <0.0020	<u>i</u> Sc	<u>i</u> Ti
<u>M</u> Cd <0.0030	<u>M</u> Hf 0.030	<u>O</u> Ni <0.084	<u>O</u> Se <0.67	<u>M</u> W <0.010
<u>O</u> Ca 0.17	<u>M</u> Ho <0.00050	<u>M</u> Nb <0.00050	<u>O</u> Si <0.034	<u>M</u> U <0.0020
<u>M</u> Ce <0.0050	<u>M</u> In <0.0010	<u>i</u> Os	<u>M</u> Ag 0.0050	<u>M</u> V <0.0020
<u>M</u> Cs <0.00030	<u>M</u> Ir <0.0050	<u>M</u> Pd <0.0050	<u>O</u> Na <0.16	<u>M</u> Yb <0.0010
<u>M</u> Cr <0.0050	<u>O</u> Fe <0.16	<u>i</u> P	<u>M</u> Sr <0.00050	<u>M</u> Y <0.040
<u>M</u> Co <0.0030	<u>M</u> La <0.00050	<u>M</u> Pt <0.0020	<u>i</u> S	<u>M</u> Zn 0.075
<u>M</u> Cu <0.0060	<u>M</u> Pb 0.0050	<u>O</u> K <5.01	<u>M</u> Ta <0.0070	<u>M</u> Zr 0.32

M - checked by ICP-MS

O - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

**ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.073 g/mL**

(over)

QA:KL Rev.021.2000N

Paul R. Gaines

Quality Assurance Manager

Expires:

**EXPIRES**

01/02/04



**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)

Members of IQ Net : Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JOA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland(PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)



2. ISO/IEC Guide 34-2000 "General Requirements for the Competence of Reference Material Producers" - Reference Materials Production - Accredited A2LA Certificate 883.02
  3. ISO/IEC17025-1999 "General Requirements for the Competence of Testing and Calibration" - Chemical Testing - Accredited A2LA Certificate 883.01
  4. MIL-STD-45662A
  5. 10CFR50 Appendix B - Nuclear Regulatory Commission - Domestic Licensing of Production and Utilization Facilities
  6. 10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance
- Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION**

<b>Shelf Life -</b>	<u>The length of time that a properly stored and packaged standard will remain within the specified uncertainty.</u> Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.
<b>Expiration Date -</b>	<u>The date after which a standard solution should not be used.</u> A one year expiration date is recommended by most state and federal regulatory agencies. Transpiration issues and repeated use of solutions over a one year period may adversely affect the integrity of the standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 4283598 and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799 INT'L 1-732-901-1900 FAX 1-732-901-1903 E-MAIL [IVtech@ivstandards.com](mailto:IVtech@ivstandards.com)

010233

# SPEXcertificate™

## Certificate of Reference Material

Catalog Number: PLB9-2X/2Y/2T

Lot No. 10-119B

Description: 1000 mg/L Boron

Matrix: H<sub>2</sub>O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1001 mg/L

Uncertainty Associated with Measurement:  $\pm 3.0$  mg/L

Certified Value is Traceable to: NIST SRM 3107

The CRM is prepared gravimetrically using high purity (NH<sub>4</sub>)<sub>2</sub>B<sub>4</sub>O<sub>7</sub>·4H<sub>2</sub>O Lot# 08001E. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1001 mg/L

**Method:** Titration with Sodium Hydroxide using Phenolphthalein as indicator. Sodium Hydroxide standardized against Potassium Biphthalate NIST SRM #84k

Instrumental Analysis by ICP spectrometer: 1001 mg/L

Uncertified Properties:

Density: 1.001 @ 22.3 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.06	Cu	<0.001	Pb	<0.001
As	<0.001	Fe	0.001	Re	<0.001
Ag	0.002	Ga	<0.001	Rb	<0.001
Ba	<0.001	In	<0.001	Sr	<0.001
Be	<0.001	K	<0.06	Sb	<0.001
Bi	0.03	Li	<0.001	Si	0.01
Cd	<0.001	Mn	<0.001	Ti	<0.001
Co	<0.001	Mo	<0.001	Tl	<0.001
Ca	0.001	Mg	<0.001	V	0.003
Cr	<0.001	Na	0.01	Zr	<0.001
		Ni	0.001	Zn	0.004

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: APR '04      Certifying Officer: N. Kocherakota

INORGANIC LABS / RADCHEM LABS  
 DATE RECEIVED: 5/14/04  
 DATE EXP. 4/30/05  
 DATE OPENED: 5/11/04  
 INORG: 4564  
 PO: F5337L

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010235

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLLI2-2X/2Y

Lot No. 10-12LI

Description: 1000 mg/L Lithium

Matrix: 2% HNO<sub>3</sub>

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 997.5 mg/L

Uncertainty Associated with Measurement:  $\pm 3$  mg/L

Certified Value is Traceable to: NIST SRM 3129a

The CRM is prepared gravimetrically using high purity Lithium Carbonate Lot# 03021A. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 997 mg/L

Method: Evaporate to dryness. Fume with Sulfuric Acid. Ignite and weigh as Li<sub>2</sub>SO<sub>4</sub>.

Instrumentation Analysis By ICP spectrometer: 998 mg/L

Uncertified Properties:

Density: 1.014 @ 22.2 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.001	Cu	<0.001	Pb	<0.001
As	<0.001	Fe	0.007	Re	<0.001
Ag	<0.003	Ga	<0.001	Rb	<0.001
B	<0.008	In	<0.001	Sr	<0.001
Ba	0.001	K	0.20	Sb	<0.001
Be	<0.001	Mn	<0.001	Si	0.007
Bi	<0.001	Mo	<0.001	Ti	<0.001
Ca	0.017	Mg	<0.001	Tl	<0.001
Cr	<0.001	Na	0.01	V	<0.001
Cd	0.008	Ni	<0.001	Zr	<0.001
Co	<0.001			Zn	0.035

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JAN '04 Certifying Officer: N. Kocherakota

DATE RECEIVED: 01/23/04  
 DATE EXPIRED: 01/29/2005  
 DATE OPENED: 01/23/04  
 INORG: 4439  
 PO: F52306

## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

<b>ISO 9001</b> <b>CERTIFIED</b>
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# SPEXcertificate™

## Certificate of Reference Material

Catalog Number: PLMO9-2X/2Y/2T

Lot No. 10-74MO

Description: 1000 mg/L Molybdenum

Matrix: H<sub>2</sub>O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 998 mg/L

Uncertainty Associated with Measurement:  $\pm 3.0$  mg/L

Certified Value is Traceable to: NIST SRM #3134

The CRM is prepared gravimetrically using high purity (NH<sub>4</sub>)<sub>6</sub>Mo<sub>7</sub>(O)<sub>24</sub> Lot# 03011C. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis. Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 998 mg/L

Method: Precipitation using 8 Hydroxy Quinoline, filter, dry and weigh as MoO<sub>2</sub> (C<sub>9</sub>H<sub>6</sub>NO)<sub>2</sub>.

Instrumental Analysis by ICP spectrometer: 999 mg/L

Uncertified Properties:

Density: 0.9989 @ 23.7 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.002	Cu	0.003	Pb	0.002
As	0.04	Fe	<0.10	Re	0.03
Ag	<0.001	Ga	<0.001	Rb	<0.001
B	<0.006	In	<0.001	Sr	<0.001
Ba	0.001	K	0.01	Sb	0.005
Be	<0.01	Li	<0.001	Si	<0.50
Bi	<0.001	Mg	0.10	Ti	0.004
Ca	0.01	Mn	0.001	Tl	<0.001
Cr	<0.002	Na	0.007	V	0.003
Cd	<0.10	Ni	<0.001	Zr	<0.001
Co	0.002			Zn	0.009

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JAN 04

Certifying Officer: N. Kocherakota

DATE RECEIVED: 01/30/04  
 DATE EXPIRED: 01/30/2005  
 DATE OPENED: 01/30/04  
 INORG: 4440  
 PO: F5A396

## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2/m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.





010239

INORGANIC LABS/ECAD/CHEM LABS  
 DATE RECEIVED: 10/3/03  
 DATE EXPIRED: 10/3/2004  
 DATE OPENED: 11/3/03  
 INORG: 4307 PO: F52261

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLP9-2X/2Y/2T

Lot No. 9-150P

Description: 1000 mg/L Phosphorus

Matrix: H<sub>2</sub>O

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1002.5 mg/L

Uncertainty Associated with Measurement: +/- 3 mg/L

Certified Value is Traceable to: NIST SRM 3139a

The CRM is prepared gravimetrically using high purity (NH<sub>4</sub>)H<sub>2</sub>(PO<sub>4</sub>) Lot# W1002B. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis. Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1003 mg/L

Method: Precipitation using Magnesia Mixture. Filter, ignite, and weigh as Mg<sub>2</sub>P<sub>2</sub>O<sub>7</sub>.

Instrumentation Analysis By ICP spectrometer: 1002 mg/L

**Uncertified Properties:**

Density: 0.9996 @ 24.0 Degrees Celsius

**Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:**

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.002	Cu	<0.001	Pb	<0.001
As	0.001	Fe	<0.001	Rb	<0.001
Ag	<0.002	Ga	<0.001	Re	<0.001
B	<0.002	In	<0.001	Sn	<0.001
Ba	<0.001	K	0.006	Sr	<0.001
Be	<0.001	Li	<0.001	Sb	0.004
Bi	<0.001	Mg	<0.001	Ti	0.004
Ca	0.004	Mn	<0.001	Tl	<0.001
Cr	<0.008	Mo	<0.001	V	<0.006
Cd	<0.001	Na	0.003	Zr	<0.001
Co	<0.001	Ni	<0.001	Zn	0.07

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: OCT - - 2003

Certifying Officer: N. Kocherakota



## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

ISO 9001

CERTIFIED

**SPEX**  
**CertiPrep**

203 Norcross Avenue • Metuchen, NJ 08840 USA  
732-549-7144 • 1-800-LAB-SPEX • Fax: 732-603-9647

CRMSales@spexcsp.com • www.spexcsp.com

Always Providing Superior Quality ... Unparalleled Service™

010241

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

**Catalog Number:** PLSI9-2X/2Y/2T**Lot No.** 10-07SI**Description:** 1000 mg/L Silicon**Matrix:** H<sub>2</sub>O / 0.4% F-

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 998.5 mg/L**Uncertainty Associated with Measurement:** +/- 3 mg/L**Certified Value is Traceable to:** NIST SRM #3150

The CRM is prepared gravimetrically using high purity (NH<sub>4</sub>)<sub>2</sub>SiF<sub>6</sub> Lot# 02021D. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 997 mg/L

**Method:** Precipitation using Ammonium Molybdate and 8-Hydroxy Quinoline. Filter, dry, and weigh as (C<sub>9</sub>H<sub>7</sub>ON)<sub>4</sub>(H<sub>4</sub>)[Si(Mo<sub>12</sub>O<sub>40</sub>)]

**Instrumentation Analysis By ICP spectrometer:** 1000 mg/L**Uncertified Properties:****Density:** 1.010 @ 26.5 Degrees Celsius**Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:**

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.002	Cu	<0.001	Pb	<0.001
As	<0.001	Fe	0.020	Rb	<0.001
Ag	<0.001	Ga	<0.001	Re	<0.001
B	<0.003	In	<0.001	Sr	<0.001
Ba	<0.001	K	<0.010	Sb	0.03
Be	<0.001	Li	<0.001	Ti	<0.001
Bi	<0.001	Mg	<0.001	Tl	<0.001
Ca	0.018	Mn	<0.001	V	<0.001
Cr	<0.002	Mo	<0.001	Zr	0.05
Cd	<0.001	Na	0.02	Zn	0.06
Co	<0.001	Ni	0.001		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: AUG '03

Certifying Officer: N. Kocherakota

INORGANIC LABS/RADIOCHEM LABS

DATE RECEIVED: 09/05/03

DATE EXPIRED: 08/30/2004

DATE OPENED: 09/05/03

INORG: 4232

PO: 552225

## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010243

# SPEXcertificate™

## Certificate of Reference Material

Catalog Number: PLTI9-2X/2Y/2T

Lot No. 10-38TI

Description: 1000 mg/L Titanium

Matrix: H<sub>2</sub>O/ 0.24% F-

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1001 mg/L

Uncertainty Associated with Measurement: 3.0mg/L

Certified Value is Traceable to: NIST SRM #3162a

The CRM is prepared gravimetrically using high purity (NH<sub>4</sub>)<sub>2</sub>TiF<sub>6</sub> Lot# 02021E. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1003 mg/L

Method: Precipitation using Ammonium Hydroxide. Filter, ignite, and weigh as TiO<sub>2</sub>.

Instrumentation Analysis By ICP spectrometer: 999 mg/L

Uncertified Properties:

Density: 1.001 @ 22.5 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.006	Cu	<0.10	Pb	<0.001
As	<0.001	Fe	<0.01	Rb	<0.001
Ag	<0.001	Ga	<0.001	Re	<0.001
B	0.003	In	<0.001	Si	0.52
Ba	<0.001	K	<0.01	Sr	0.001
Be	<0.001	Li	<0.001	Sb	<0.001
Bi	<0.001	Mg	<0.001	Tl	<0.001
Ca	0.013	Mn	<0.001	V	<0.001
Cr	<0.003	Mo	<0.001	Zr	0.01
Cd	<0.001	Na	0.02	Zn	0.03
Co	0.002	Ni	<0.001		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: AUG '03

Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 09/05/03  
 DATE EXPIRED: 08/30/2004  
 DATE OPENED: 09/05/03  
 INORG: 1034  
 PU: F53905

## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010245

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 10/31/03  
 DATE EXPIRED: 10/31/04  
 DATE OPENED: 11/3/03  
 INORG: 4308  
 PO: F50061

# SPExertificate™

## Certificate of Reference Material

**Catalog Number:** PLSR2-2X/2Y/2T **Lot No.** 9-166SR

**Description:** 1000 mg/L Strontium in 2% HNO<sub>3</sub>

**Matrix:** 2% HNO<sub>3</sub>

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 1002.5 mg/L

**Uncertainty Associated with Measurement:** +/- 3 mg/L

**Certified Value is Traceable to:** NIST SRM 3153a

The CRM is prepared gravimetrically using high purity Strontium Carbonate Lot# 02001B. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 1002 mg/L

**Method:** EDTA titration using Methyl Thymol Blue as indicator. EDTA standardized against Pb(NO<sub>3</sub>)<sub>2</sub> NIST SRM #928.

**Instrumentation Analysis By ICP spectrometer:** 1003 mg/L

**Uncertified Properties:**

**Density:** 1.010 @ 22.7 Degrees Celsius

**Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:**

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.02	Cu	<0.001	Pb	<0.001
As	<0.001	Fe	0.001	Rb	<0.001
Ag	<0.002	Ga	<0.001	Re	<0.001
B	<0.003	In	<0.001	Si	0.043
Ba	0.008	K	0.10	Sb	<0.001
Be	<0.001	Li	0.007	Ti	<0.002
Bi	<0.001	Mg	<0.003	Tl	<0.001
Ca	0.014	Mn	<0.001	V	<0.001
Cr	0.001	Mo	<0.001	Zr	<0.001
Cd	<0.001	Na	0.01	Zn	0.04
Co	<0.001	Ni	<0.001		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

**Date of Certification:** OCT -- 2003 **Certifying Officer:** N. Kocherakota

## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

ISO 9001  
CERTIFIED

**SPEX**  
**CertiPrep**

203 Norcross Avenue • Metuchen, NJ 08840 USA  
732-549-7144 • 1-800-LAB-SPEX • Fax: 732-603-9647  
CRMSales@spexcsp.com • www.spexcsp.com

Always Providing Superior Quality ... Unparalleled Service™



010247

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLSN5-2X/2Y/2T

Lot No. 10-87SN

Description: 1000 mg/L Tin

Matrix: 20% HCL

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1003 mg/L

Uncertainty Associated with Measurement:  $\pm 3.0$  mg/L

Certified Value is Traceable to: NIST SRM 3161a

The CRM is prepared gravimetrically using high purity Tin Metal Lot# 05021C. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1004 mg/L

Method: Precipitation using Ammonium Hydroxide. Filter, ignite, and weigh as SnO<sub>2</sub>.

Instrumental Analysis by ICP spectrometer: 1001 mg/L

Uncertified Properties:

Density: 1.034 @24.8C Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.003	Cu	0.001	Pb	0.004
As	<0.20	Fe	0.18	Rb	<0.001
Ag	0.006	Ga	<0.001	Re	<0.001
B	<0.002	In	0.05	Si	0.20
Ba	0.004	K	<0.20	Sr	<0.001
Be	<0.001	Li	<0.001	Sb	0.003
Bi	<0.001	Mg	0.004	Ti	0.009
Ca	0.02	Mn	0.003	Tl	<0.001
Cr	0.02	Mo	<0.001	V	<0.40
Cd	0.002	Na	0.02	Zr	<0.001
Co	0.007	Ni	0.06	Zn	0.05

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: APR '04 Certifying Officer: N. Kocherakota

INORGANIC LABS/KADCHEM LABS  
 DATE RECEIVED: 5/3/04  
 DATE EXPIRED: 4/30/05  
 DATE OPENED: 5/11/04  
 INORG: 4565  
 PO: F333H



## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_x$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_x$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010249

# SPEXcertificate™

## Certificate of Reference Material

Catalog Number: PLBI4-2X/2Y

Lot No. 10-68BI

Description: 1000 mg/L Bismuth

Matrix: 10% HNO<sub>3</sub>

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below

Certified Value: 1001 mg/L

Uncertainty Associated with Measurement:  $\pm 3.0$  mg/L

Certified Value is Traceable to: NIST SRM 3106

The CRM is prepared gravimetrically using high purity Bismuth Metal Lot# 04941B. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1000 mg/L

Method: EDTA titration using Xylenol Orange as indicator. EDTA standardized against Pb(NO<sub>3</sub>)<sub>2</sub> NIST SRM #928.

Instrumental Analysis by ICP spectrometer: 1002 mg/L

Uncertified Properties:

Density: 1.052@23.1 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.006	Cu	0.002	Pb	0.009
As	<0.001	Fe	0.001	Re	<0.001
Ag	<0.001	Ga	<0.001	Rb	<0.001
B	<0.003	In	<0.001	Sr	<0.001
Ba	<0.001	K	0.002	Sb	0.002
Be	<0.001	Li	<0.001	Si	<0.01
Cd	<0.001	Mn	<0.001	Ti	<0.001
Co	<0.001	Mo	<0.001	Tl	<0.001
Ca	0.006	Mg	0.002	V	<0.001
Cr	<0.001	Na	0.009	Zr	<0.001
		Ni	0.001	Zn	0.01

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: FEB '04

Certifying Officer: N. Kocherakota

INORGANIC LABS/RAUCHEM LABS  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 02/28/2005  
 DATE OPENED: 02/25/04  
 INORG: WTS  
 PO: F52322

# Report of Certification

010250

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

ISO 9001

CERTIFIED

010251

# SPEXcertificate™

## Certificate of Reference Material

**Catalog Number:** PLLA2-2X/2Y

**Lot No.** 10-27LA

**Description:** 1000 mg/L Lanthanum

**Matrix:** 2% HNO<sub>3</sub>

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 1000 mg/L

**Uncertainty Associated with Measurement:** +/-3.0mg/L

**Certified Value is Traceable to:** NIST SRM #3127a

The CRM is prepared gravimetrically using high purity La(NO<sub>3</sub>)<sub>3</sub>·6H<sub>2</sub>O Lot# 03951B. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 1000 mg/L

**Method:** EDTA titration using Methyl Thymol Blue as indicator. EDTA standardized against Pb(NO<sub>3</sub>)<sub>2</sub> NIST SRM #928.

**Instrumentation Analysis By ICP spectrometer:** 999 mg/L

**Uncertified Properties:**

**Density:** 1.010 @ 22.3 Degrees Celsius

**Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:**

Element	mg/L	Element	mg/L	Element	mg/L
Ce	0.02	Lu	<0.001	Th	<0.001
Ca	0.029	Mn	<0.001	Tm	<0.001
Dy	<0.001	Mo	<0.001	Ti	<0.001
Er	<0.001	Nd	<0.001	Tb	<0.001
Eu	<0.001	Ni	<0.001	Ta	<0.001
Fe	0.005	Na	0.01	Tl	<0.001
Gd	<0.001	Pr	<0.001	V	<0.001
Ga	<0.001	Rb	<0.001	W	<0.001
Hf	<0.001	Sc	0.002	Y	<0.001
Ho	<0.001	Sm	<0.001	Yb	<0.001
In	<0.001			Zr	<0.001

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

**Date of Certification:** JAN '04

**Certifying Officer:** N. Kocherlakota

INFORMANT: LINDA/INFORMANT: LINDA  
DATE RECEIVED: 01/30/04  
DATE EXPIRED: 01/30/05 V05  
DATE OPENED: 01/30/04  
INORG: 4438  
PO: F52306

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLY2-2X/2Y/2T

Lot No. 9-152Y

Description: 1,000 mg/L Yttrium

Matrix: 2% HNO<sub>3</sub>

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1001.5 mg/L

Uncertainty Associated with Measurement:  $\pm 3$  mg/L

Certified Value is Traceable to: NIST SRM 3167a.

The CRM is prepared gravimetrically using high purity Yttrium Oxide Lot# 08001A. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1002 mg/L

Method: EDTA titration using Methyl Thymol Blue as indicator. EDTA standardized against Pb(NO<sub>3</sub>)<sub>2</sub> NIST SRM #928.

Instrumentation Analysis By ICP spectrometer: 1001 mg/L

**Uncertified Properties:**

Density: 1.010 @ 24.8 Degrees Celsius

**Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:**

Element	mg/L	Element	mg/L	Element	mg/L
Ce	<0.001	La	<0.001	Tb	<0.001
Ca	0.007	Lu	<0.001	Tm	<0.001
Dy	<0.001	Mn	<0.001	Tl	<0.001
Er	<0.001	Mo	<0.001	Th	<0.001
Eu	<0.001	Nd	<0.001	Ta	<0.001
Fe	0.003	Ni	<0.001	Ti	<0.001
Gd	<0.001	Na	0.005	V	<0.001
Ga	<0.001	Pr	<0.001	W	<0.001
Hf	<0.001	Rb	<0.001	Yb	<0.001
Ho	<0.001	Sc	<0.001	Zr	0.003
In	<0.001	Sm	<0.001		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JAN 04

Certifying Officer: N. Kocherakota

DATE RECEIVED: 01/30/04  
 DATE EXPIRED: 01/30/05  
 DATE OPENED: 01/30/04  
 INORG: 4441  
 PD: F50306

## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 35: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact the certifying organization.

### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 35, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The uncertainty of the certified value listed on the reverse of this document is the total uncertainty  $U$ .

$$U = 2U_c + B \text{ mg/L}$$

Where  $U_c$  = combined uncertainty components associated with volumetric and gravimetric factors,  $B$  is the uncertainty component of two independent methods of analysis (including the systematic and random uncertainties)

$$95\% \text{ confidence limits} = X \pm t_{0.05} \sqrt{\Sigma U_c^2}$$

where  $X$  = grand mean

$t_{0.05}$  = the percentile of the student's  $t$  distribution for  $(k-1)$  degrees of freedom.

### **Certification Traveler Report:**

All certified values reported were derived from the Traveler Report identified by the lot number of this CRM. For further information contact the certifying organization.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.





010255

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLPD3-2X/2Y

Lot No. 10-108PD

Description: 1000 mg/L Palladium

Matrix: 10% HCl

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1002.5 mg/L

Uncertainty Associated with Measurement:  $\pm 3$  mg/L

Certified Value is Traceable to: NIST SRM 3138

The CRM is prepared gravimetrically using high purity Palladium Powder Lot# 01021A. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1002 mg/L

Method: Precipitation using Glyoxime. Filter, dry, and weigh as  $\text{Pd}(\text{C}_4\text{H}_7\text{O}_2\text{N}_2)_2$ 

Instrumental Analysis by ICP spectrometer: 1003 mg/L

Uncertified Properties:

Density: 1.017 @ 23.6 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.01	Fe	0.024	Re	<0.001
Au	0.003	Ga	<0.001	Rh	0.001
Ag	0.005	Ir	<0.001	Rb	<0.001
B	<0.002	In	<0.001	Ru	<0.001
Be	<0.003	Mg	0.008	Sn	0.007
Bi	<0.001	Mn	<0.001	Te	<0.002
Ca	0.014	Na	0.02	Ti	<0.001
Cd	<0.001	Ni	<0.001	W	<0.001
Co	0.004	Pb	0.002	Zr	<0.001
Cr	<0.003	Pt	<0.001	Zn	1.0
Cu	0.001				

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JAN '04

Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 01/13/04  
 DATE EXPIRED: 01/15/2005  
 DATE OPENED: 01/13/04  
 INORG: 4417  
 PO: F52299



This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

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# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

**Catalog Number:** PLS9-2X/2Y/2T  
**Description:** 1000 mg/L Sulfur  
**Matrix:** H<sub>2</sub>O

**Lot No.** 8-74S

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 1003 mg/L

**Uncertainty Associated with Measurement:** +/- 3 mg/L

**Certified Value is Traceable to:** NIST SRM 3154

The CRM is prepared gravimetrically using high purity Ammonium Sulfate Lot# 05891M. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 1003 mg/L

**Method:** Precipitation using barium chloride, filter, ignite and weigh as BaSO<sub>4</sub>.

**Instrumentation Analysis By ICP spectrometer:** 1003 mg/L

**Uncertified Properties:**

**Density:** 1.007 @ 23.6 Degrees Celsius

**Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:**

Element	mg/L	Element	mg/L	Element	mg/L
Al	<0.001	Cu	<0.001	Pb	0.002
As	<0.001	Fe	0.008	Rb	<0.001
Ag	<0.001	Ga	<0.001	Re	<0.001
B	<0.004	In	<0.001	Sn	<0.001
Ba	<0.001	K	<0.001	Sr	<0.001
Be	<0.001	Li	<0.001	Sb	<0.001
Bi	<0.001	Mg	0.005	Ti	<0.002
Ca	0.009	Mn	<0.001	Tl	<0.001
Cr	<0.004	Mo	<0.001	V	<0.001
Cd	<0.001	Na	0.02	Zr	<0.001
Co	<0.001	Ni	<0.001	Zn	0.0075

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

**Date of Certification:** JUN '03

**Certifying Officer:** N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 06/30/03  
 DATE EXPIRED: 06/30/04  
 DATE OPENED: 06/30/03  
 INDRG: 440 PO: F59379

## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2/m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as  $X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

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ISO 9001

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**SPEX**  
**CertiPrep**

203 Norcross Avenue • Metuchen, NJ 08840 USA  
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CRMSales@spexcsp.com • www.spexcsp.com  
Always Providing Superior Quality... Unparalleled Service™

010259

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLTH2-2X/2Y

Lot No. 10-24TH

Description: 1000 mg/L Thorium

Matrix: 2% HNO<sub>3</sub>

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 999 mg/L

Uncertainty Associated with Measurement: +/- 3.0 mg/L

Certified Value is Traceable to: NIST SRM #3159

The CRM is prepared gravimetrically using high purity Th(NO<sub>3</sub>)<sub>4</sub>·4H<sub>2</sub>O Lot# 01851R. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1000 mg/L

Method: EDTA titration using Xylenol Orange as indicator. EDTA standardized against Pb(NO<sub>3</sub>)<sub>2</sub> NIST SRM #928.

Instrumentation Analysis By ICP spectrometer: 998 mg/L

Uncertified Properties:

Density: 1.010 @ 22.0 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Ce	0.01	La	0.003	Tb	<0.001
Ca	0.27	Lu	<0.001	Tm	<0.001
Dy	<0.001	Mn	<0.001	Ti	<0.002
Er	<0.001	Mo	<0.001	Ta	<0.001
Eu	<0.001	Nd	0.003	Tl	<0.001
Fe	<0.01	Ni	<0.001	V	<0.001
Gd	<0.001	Na	0.04	W	<0.001
Ga	<0.001	Pr	<0.001	Y	0.002
Hf	<0.001	Rb	<0.001	Yb	<0.001
Ho	<0.001	Sc	<0.03	Zr	<0.001
In	<0.001	Sm	<0.001		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: AUG '03

Certifying Officer: N. Kocherakota

INORGANIC LABS/KAULHEIM LABS  
 DATE RECEIVED: 09/05/03  
 DATE EXPIRED: 08/30/2004  
 DATE OPENED: 09/05/03  
 INORG: 4233  
 PO: F52225

## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010261

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLU2-2X/2Y

Lot No. 9-179U

Description: 1000 mg/L Uranium

Matrix: 2% HNO<sub>3</sub>

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 999.5 mg/L

Uncertainty Associated with Measurement: +/- 3 mg/L

Certified Value is Traceable to: NIST SRM 3164.

The CRM is prepared gravimetrically using high purity Uranium Oxide Lot# 04001D. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 999 mg/L

Method: Evaporate to dryness. Ignite and weigh as U<sub>3</sub>O<sub>8</sub>.

Instrumentation Analysis By ICP spectrometer: 1000 mg/L

Uncertified Properties:

Density: 1.010 @ 23.6 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.005	Cu	0.02	Pb	0.004
As	0.06	Fe	0.011	Rb	<0.001
Ag	<0.001	Ga	<0.001	Re	<0.001
B	<0.005	In	<0.001	Si	<0.10
Ba	0.004	K	0.008	Sr	0.003
Be	<0.001	Li	<0.001	Sb	0.003
Bi	<0.001	Mg	0.003	Ti	<0.001
Ca	0.012	Mn	0.003	Tl	<0.001
Cr	<0.010	Mo	0.006	V	<0.003
Cd	<0.001	Na	0.10	Zr	<0.001
Co	<0.001	Ni	<0.001	Zn	0.008

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JUN '03

Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 06/30/03  
 DATE EXPIRED: 06/30/2004  
 DATE OPENED: 06/23/03  
 INDRG: 4132 PO: F52370

## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



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010263

# SPExertificate™

## Certificate of Reference Material

Catalog Number: PLW9-2X/2Y

Lot No. 9-177W

Description: 1000 mg/L Tungsten

Matrix: H<sub>2</sub>O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1,000 mg/L

Uncertainty Associated with Measurement: +/- 3 mg/L

Certified Value is Traceable to: NIST SRM 3163

The CRM is prepared gravimetrically using high purity Ammonium Tungstate Lot# 02001H. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1000 mg/L

Method: Fume with Sulfuric Acid to dryness. Ignite and weigh as WO<sub>3</sub>.

Instrumentation Analysis By ICP spectrometer: 1000 mg/L

Uncertified Properties:

Density: 0.9979 @ 23.7 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.002	Cu	<0.001	Pb	<0.001
As	0.01	Fe	<0.01	Rb	<0.001
Ag	<0.003	Ga	<0.001	Re	0.004
B	<0.005	In	<0.001	Si	.56
Ba	<0.001	K	0.05	Sr	<0.001
Be	<0.001	Li	<0.001	Sb	0.001
Bi	<0.001	Mg	<0.001	Ti	<0.001
Ca	0.009	Mn	<0.001	Tl	<0.001
Cr	<0.001	Mo	0.005	V	0.001
Cd	<0.001	Na	0.03	Zr	<0.001
Co	0.001	Ni	<0.001	Zn	0.01

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: AUG '03

Certifying Officer: N. Kocherakota

INORGANIC LABS/KADUHEM LABS  
 DATE RECEIVED: 08/10/03  
 DATE EXPIRED: 08/15/2004  
 DATE OPENED: 08/13/03  
 INORG: 4212  
 PO: F52218



## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



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# SPEXcertificate™

## Certificate of Reference Material

Catalog Number: PLZR2-2X/2Y/2T

Lot No. 10-05ZR

Description: 1000 mg/L Zirconium

Matrix: 2% HNO<sub>3</sub>

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 997 mg/L

Uncertainty Associated with Measurement:  $\pm 3.0$  mg/L

Certified Value is Traceable to: NIST SRM 3169

The CRM is prepared gravimetrically using high purity Zirconyl Nitrate Lot# 11011C. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 997 mg/L

Method: Evaporate to dryness. Fume with Sulfuric Acid. Ignite and weigh as ZrO<sub>2</sub>.

Instrumentation Analysis By ICP spectrometer: 997 mg/L

Uncertified Properties:

Density: 1.010 @ 23.6 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.03	Cu	0.002	Pb	0.002
As	<0.001	Fe	0.017	Rb	<0.001
Ag	<0.05	Ga	<0.001	Re	<0.001
B	<0.004	In	<0.001	Si	0.10
Ba	<0.001	K	0.10	Sr	<0.001
Be	<0.001	Li	0.002	Sb	<0.001
Bi	<0.001	Mg	0.003	Ti	<0.001
Ca	0.11	Mn	<0.001	Tl	<0.001
Cr	<0.009	Mo	<0.001	V	<0.001
Cd	0.004	Na	0.04	Zn	0.02
Co	<0.001	Ni	<0.001		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: APR 04      Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEN LABS  
 DATE RECEIVED: 5/7/04  
 DATE EXPIRED: 4/30/05  
 DATE OPENED: 5/16/04  
 INCHES: 45.66      PU: F53321

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

#### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

#### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

#### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

#### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

#### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

#### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

#### **Legal Notice:**

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ISO 9001  
CERTIFIED

010267

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: PLNA2-3X/3Y

Lot No. U8-128NA

Description: 10,000 mg/L Sodium

Matrix: 5% HNO<sub>3</sub>

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 9998 mg/L

Uncertainty Associated with Measurement:  $\pm 30$  mg/L

Certified Value is Traceable to: NIST SRM 3152a.

The CRM is prepared gravimetrically using high purity Sodium Carbonate Lot# 02021A. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis. Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 9998 mg/L

Method: Evaporate to dryness. Fume with Sulfuric Acid. Ignite and weigh as Na<sub>2</sub>SO<sub>4</sub>.

Instrumentation Analysis By ICP spectrometer: 9998 mg/L

**Uncertified Properties:**

Density: 1.049 @ 23.9 Degrees Celsius

**Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:**

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.02	Cu	0.003	Pb	<0.001
As	<0.003	Fe	0.03	Re	<0.001
Ag	<0.03	Ga	<0.001	Rb	<0.001
B	<0.03	In	<0.001	Sr	<0.002
Ba	0.03	K	0.14	Sb	<0.001
Be	<0.02	Li	<0.002	Sn	<0.001
Bi	<0.001	Mg	0.30	Ti	<0.004
Ca	0.52	Mn	0.008	Tl	<0.001
Cr	<0.004	Mo	<0.001	V	<0.001
Cd	<0.001	Ni	<0.002	Zr	<0.001
Co	<0.001			Zn	<0.03

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JAN '04

Certifying Officer: N. Kocherakota

INORGANIC LABS/REDOX LABS  
 DATE RECEIVED: 01/29/04  
 DATE EXPIRED: 01/29/05  
 DATE OPENED: 01/29/04  
 INORG: 4413  
 PO: ES2308

## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

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### **Instructions for Use:**

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### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$S$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

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ISO 9001

CERTIFIED

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CertiPrep

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732-549-7144 • 1-800-LAB-SPEX • Fax: 732-603-9647

CRMSales@spexcsp.com • www.spexcsp.com

*Always Providing Superior Quality... Unparalleled Service™*

010269

**SPEX**ertificate™

Certificate of Reference Material

**Catalog Number:** ICV-2A      **Lot No.:** 24-84AS  
**Description:** Initial Calibration Verification Standard II  
**Matrix:** 5% Nitric Acid

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

The CRM is prepared from high purity single element concentrates of individual elements using Class A laboratory ware to give precise concentration.

Refer to side 2 for details of measurement uncertainties.

**Instrumental Analysis by ICP Spectrometer:**

Element	Labeled (mg/L)	Measured (mg/L)	NIST SRM	Element	Labeled (mg/L)	Measured (mg/L)	NIST SRM
Ca	2,000	2,005.40	3109a	Ni	500	500.58	3136
K	2,000	1,997.89	3141a	V	500	504.23	3165
Mg	2,000	1,992.26	3131a	Cr	200	203.21	3112a
Na	2,000	1,992.99	3152a	Cu	200	199.75	3114
Al	1,000	1,005.90	3101a	Ag	100	100.46	3151
Ba	1,000	1,001.51	3104a	Be	100	100.04	3105a
Fe	1,000	1,003.17	3126a	Mn	100	100.64	3132
Co	500	505.10	3113	Zn	100	100.52	3168a

Spex Reference Multi: Lot #4-63BD, 14-125AS

Balances are calibrated regularly with weight sets traceable to NIST#s 32856, 32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% on the average of all the certified concentrations with no single component exceeding +/- 2%. This guarantee is valid for a period of one year from the date of certification only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: NGV -- 2003      Certifying Officer: N. Kocherakota

INORGANIC LABS/EA003JEM LABS  
 DATE RECEIVED: 11/30/03  
 DATE EXPIRED: 11/30/04  
 DATE OPENED: 11/21/03  
 MOBILE: 4338  
 PO: F52278

## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

ISO 9001  
CERTIFIED

**SPEX**  
**CertiPrep**

203 Norcross Avenue • Metuchen, NJ 08840 USA  
732-549-7144 • 1-800-LAB-SPEX • Fax: 732-603-9647  
CRMSales@spexcsp.com • www.spexcsp.com  
Always Providing Superior Quality... Unparalleled Service™



# SPEXcertificate™

## Certificate of Reference Material

Catalog Number: PLSB7-2X/2Y/2T

Lot No. 10-43SB

Description: 1000 mg/L Antimony

Matrix: H<sub>2</sub>O/0.6Tart.Acid/tr.HNO<sub>3</sub>

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1004 mg/L

Uncertainty Associated with Measurement: +/-3.0mg/L

Certified Value is Traceable to: NIST SRM 3102a

The CRM is prepared gravimetrically using high purity Antimony Metal Lot# 04021A. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1005 mg/L

Method: Evaporate to dryness. Fume with Nitric Acid. Ignite and weigh as Sb<sub>2</sub>O<sub>4</sub>.

Instrumental Analysis by ICP spectrometer: 1002 mg/L

Uncertified Properties:

Density: 1.046 @ 25.5 Degrees Celsius

Trace Metallic Impurities in the Actual Solution via ICP / ICPMS Analysis:

Element	mg/L	Element	mg/L	Element	mg/L
Al	0.03	Cu	0.002	Pb	0.009
As	<0.001	Fe	0.03	Rb	<0.001
Ag	<0.001	Ga	<0.001	Re	<0.001
B	<0.004	In	<0.001	Sr	<0.001
Ba	<0.001	K	0.01	Si	<0.01
Be	<0.001	Li	<0.001	Ti	<0.003
Bi	0.002	Mg	0.005	Tl	<0.001
Ca	0.14	Mn	<0.001	V	<0.001
Cr	<0.002	Mo	<0.001	Zr	<0.001
Cd	<0.001	Na	0.005	Zn	0.02
Co	<0.001	Ni	<0.001		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: NOV -- 2003

Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 11/29/03  
 DATE EXPIRED: 11/29/04  
 DATE OPENED: 11/21/03  
 INORG: 4329 PO: F52278



## *Report of Certification*

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### **Material Source:**

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### **Instructions for Use:**

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

### **Method of Preparation:**

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### **Homogeneity:**

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### **Statistical estimator and Confidence limits:**

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

### **Certification Traveler Report:**

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### **Legal Notice:**

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

**ISO 9001**

**CERTIFIED**

010273

**SPEXertificate™***Certificate of Reference Material*

**Catalog Number:** ICV-2C **Lot No.:** 24-85AS  
**Description:** Initial Calibration Verification Standard II  
**Matrix:** 5% Nitric Acid

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICPOES, DCP, AA, ICPMS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

The CRM is prepared from high purity single element concentrates of individual elements using Class A laboratory ware to give precise concentration.

Refer to side 2 for details of measurement uncertainties.

**Instrumental Analysis by ICP Spectrometer:**

Element	Labeled (mg/L)	Measured (mg/L)	NIST SRM
As	500	497.85	3103a
Pb	500	495.41	3128
Se	500	501.98	3149
TL	500	501.89	3158
Cd	100	99.77	3108

Spex Reference Multi: Lot #4-51BDREF, 15-39AS, 11-173AS

Balances are calibrated regularly with weight sets traceable to NIST#s 32856, 32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% on the average of all the certified concentrations with no single element exceeding +/- 2%. This includes uncertainty of measurements and other effects, such as transpiration losses. This guarantee is valid for a period of one year from the date of certification only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: NOV 22 2003 Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 11/20/03  
 DATE EXPIRED: 11/20/2004  
 DATE OPENED: 11/21/03  
 INORG: 4330 PO: F52078

## Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

### Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

### Instructions for Use:

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### Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

### Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

### Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_{cr} = \sqrt{\sum u_i^2}$

### Certification Traveler Report:

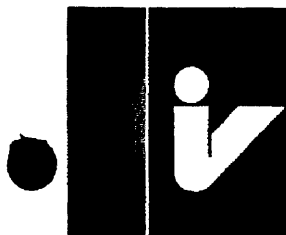
All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

### Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



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**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer. Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 **DESCRIPTION OF CRM** Custom-Grade 10000 µg/mL Aluminum in 5% (abs) HNO<sub>3</sub>

Catalog Number: CGAL10-1 and CGAL10-5  
 Lot Number: W-AL04008  
 Starting Material: Al metal  
 Starting Material Purity (%): 99.998460  
 Starting Material Lot No: 607116  
 Matrix: 5% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 08/26/03  
 DATE EXPIRED: 09/01/2004  
 DATE OPENED: 08/26/03  
 INORG: 4220 PO: F52224

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 10070 ± 31 µg/mL

**Certified Density:** 1.059 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum s_i^2$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 **Assay Method #1** 10006 ± 55 µg/mL

ICP Assay NIST SRM 3101a Lot Number: 992003

**Assay Method #2** 10070 ± 31 µg/mL

EDTA NIST SRM 928 Lot Number: 880710

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>S</u> Al	<u>M</u> Dy < 0.02695	<u>Q</u> Li 0.00011	<u>M</u> Pr < 0.00135	<u>M</u> Te < 0.13473
<u>M</u> Sb < 0.00225	<u>M</u> Er < 0.02245	<u>M</u> Lu < 0.00180	<u>M</u> Re < 0.00449	<u>M</u> Tb < 0.00135
<u>M</u> As < 0.04491	<u>M</u> Eu < 0.01347	<u>Q</u> Mg 0.00470	<u>M</u> Rh < 0.00449	<u>M</u> Tl < 0.00449
<u>M</u> Ba < 0.04491	<u>M</u> Gd < 0.00449	<u>M</u> Mn < 0.01796	<u>M</u> Rb < 0.00449	<u>M</u> Th < 0.00449
<u>Q</u> Be < 0.00017	<u>M</u> Ga < 0.00449	<u>Q</u> Hg < 0.00700	<u>M</u> Ru < 0.00898	<u>M</u> Tm < 0.00180
<u>M</u> Bi < 0.00180	<u>M</u> Ge < 0.02695	<u>M</u> Mo < 0.00898	<u>M</u> Sm < 0.00449	<u>M</u> Sn < 0.02245
<u>Q</u> B 0.01164	<u>M</u> Au < 0.01347	<u>M</u> Nd < 0.00898	<u>M</u> Sc < 0.04491	<u>M</u> Ti < 0.22454
<u>M</u> Cd < 0.01347	<u>M</u> Hf < 0.00898	<u>Q</u> Ni < 0.00600	<u>M</u> Se < 0.03593	<u>M</u> W < 0.04491
<u>Q</u> Ca 0.01903	<u>M</u> Ho < 0.00225	<u>M</u> Nb < 0.00225	<u>Q</u> Si 0.07389	<u>M</u> U < 0.00898
<u>M</u> Ce < 0.02245	<u>Q</u> In < 0.03000	<u>n</u> Os	<u>M</u> Ag < 0.00898	<u>M</u> V < 0.00898
<u>M</u> Cs < 0.00135	<u>M</u> Ir < 0.02245	<u>M</u> Pd < 0.02245	<u>Q</u> Na 0.03359	<u>M</u> Yb < 0.00449
<u>Q</u> Cr 0.00336	<u>Q</u> Fe 0.00493	<u>Q</u> P < 0.03000	<u>M</u> Sr < 0.00225	<u>M</u> Y < 0.17963
<u>M</u> Co < 0.01347	<u>M</u> La < 0.00225	<u>M</u> Pt < 0.00898	<u>Q</u> S < 0.10000	<u>M</u> Zn < 0.08982
<u>M</u> Cu < 0.02695	<u>M</u> Pb < 0.01347	<u>Q</u> K 0.02911	<u>M</u> Ta < 0.03144	<u>M</u> Zr < 0.02245

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 26.98154; +3 6;  $\text{Al}(\text{H}_2\text{O})_6^{3+}$

**Chemical Compatibility** - Soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{HF}$  and  $\text{H}_2\text{SO}_4$ . Avoid neutral media. Soluble in strongly basic  $\text{NaOH}$  forming the  $\text{Al}(\text{OH})_4(\text{H}_2\text{O})_2^-$  species. Stable with most metals and inorganic anions. The phosphate is insoluble in water and only slightly soluble in acid.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5%  $\text{HNO}_3$  / LDPE container.

**All Containing Samples (Preparation and Solution)** - Metal (Best dissolved in  $\text{HCl}$  /  $\text{HNO}_3$ ,  $\gamma$  -  $\text{Al}_2\text{O}_3$  ( $\text{Na}_2\text{CO}_3$  fusion in  $\text{Pt}^{\text{th}}$ );  $\gamma$  -  $\text{Al}_2\text{O}_3$  (Soluble in acids such as  $\text{HCl}$ ); Ores (Carbonate fusion in  $\text{Pt}^{\text{th}}$  followed by  $\text{HCl}$  dissolution); Organic Matrices (sulfuric/peroxide digestion or nitric / sulfuric / perchloric acid decomposition, or dry ash and dissolution in dilute  $\text{HCl}$ ).

**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 at 10ppm)
ICP-OES 394.401 nm	0.05 / 0.006 $\mu\text{g/mL}$	1	atom	U, Ce
ICP-OES 396.152 nm	0.03 / 0.006 $\mu\text{g/mL}$	1	atom	<u>Mo</u> , Zr, Ce
ICP-OES 167.078 nm	0.1 / 0.009 $\mu\text{g/mL}$	1	ion	<u>Fe</u>
ICP-MS 27 amu	30 ppt	n/a	M	$^{13}\text{C}^{14}\text{N}$ , $^{13}\text{C}^{15}\text{N}$ , $^{14}\text{C}^{14}\text{N}$ , $^{14}\text{C}^{15}\text{N}$ , $^{15}\text{C}^{14}\text{N}$ , $^{15}\text{C}^{15}\text{N}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

## 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of **IQ Net International Certification Network**:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

## 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



## 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RVA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

## 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

## 10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 08/26/03  
 DATE EXPIRED: 09/01/2005  
 DATE OPENED: 08/26/03  
 INORG: 4020 PO: F52224

# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010278



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** February 13, 2003

**Expiration Date:**

**EXPIRES**  
1/1/2004

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

**Certificate Prepared By:** JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

**Certificate Approved By:** Katalin Le, QC Supervisor

*Katalin Le*

**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

**inorganic ventures / iv labs**

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 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 DESCRIPTION OF CRM Custom-Grade 10000 µg/mL Calcium in 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGCA10-1, CGCA10-2, and CGCA10-5  
 Lot Number: W-CA03022  
 Starting Material: CaO  
 Starting Material Purity (%): 99.999389  
 Starting Material Lot No: C27L01  
 Matrix: 1.4% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 01/20/04  
 DATE EXPIRED: 02/01/2005 V03  
 DATE OPENED: 01/20/04  
 INORG: 4436 PO: F52303

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 9968 ± 18 µg/mL

Certified Density: 1.038 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(s)}{(n)^{1/2}}$$

$s$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 9968 ± 18 µg/mL

ICP Assay NIST SRM 3109a Lot Number: 000622

Assay Method #2 9973 ± 25 µg/mL

EDTA NIST SRM 928 Lot Number: 880710



- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00013	<u>M</u> Dy < 0.03067	<u>Q</u> Li 0.00011	<u>M</u> Pr < 0.00153	<u>M</u> Te < 0.15333
<u>M</u> Sb < 0.00256	<u>M</u> Er < 0.02556	<u>M</u> Lu < 0.00204	<u>M</u> Re < 0.00511	<u>M</u> Tb < 0.00153
<u>M</u> As < 0.05111	<u>M</u> Eu < 0.01533	<u>Q</u> Mg 0.03453	<u>M</u> Rh < 0.00511	<u>M</u> Tl < 0.00511
<u>Q</u> Ba 0.00063	<u>M</u> Gd < 0.00511	<u>Q</u> Mn < 0.00030	<u>M</u> Rb < 0.00511	<u>M</u> Th < 0.00511
<u>Q</u> Be < 0.00009	<u>M</u> Ga < 0.00511	<u>Q</u> Hg < 0.01100	<u>M</u> Ru < 0.01022	<u>M</u> Tm < 0.00204
<u>M</u> Bi < 0.00204	<u>M</u> Ge < 0.03067	<u>M</u> Mo < 0.01022	<u>M</u> Sm < 0.00511	<u>M</u> Sn < 0.02556
<u>Q</u> B < 0.00054	<u>M</u> Au < 0.01533	<u>M</u> Nd < 0.01022	<u>Q</u> Sc < 0.00002	<u>M</u> Ti < 0.25555
<u>Q</u> Cd < 0.00450	<u>M</u> Hf < 0.01022	<u>Q</u> Ni < 0.00230	<u>Q</u> Se < 0.00620	<u>M</u> W < 0.05111
<u>S</u> Ca	<u>M</u> Ho < 0.00256	<u>M</u> Nb < 0.00256	<u>Q</u> Si 0.00253	<u>M</u> U < 0.01022
<u>M</u> Ce < 0.02556	<u>Q</u> In < 0.00200	<u>n</u> Os	<u>M</u> Ag < 0.01022	<u>Q</u> V < 0.00090
<u>M</u> Cs < 0.00153	<u>M</u> Ir < 0.02556	<u>M</u> Pd < 0.02556	<u>Q</u> Na < 0.00010	<u>M</u> Yb < 0.00511
<u>Q</u> Cr 0.00183	<u>Q</u> Fe < 0.00110	<u>Q</u> P < 0.00480	<u>Q</u> Sr 0.02021	<u>M</u> Y < 0.20444
<u>Q</u> Co < 0.00120	<u>M</u> La < 0.00256	<u>M</u> Pt < 0.01022	<u>Q</u> S 0.01053	<u>Q</u> Zn 0.02232
<u>Q</u> Cu < 0.00400	<u>M</u> Pb < 0.01533	<u>Q</u> K < 0.00170	<u>M</u> Ta < 0.03578	<u>M</u> Zr < 0.02556

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 40.078; +2; 6;  $\text{Ca}(\text{H}_2\text{O})_6^{2+}$

**Chemical Compatibility** - Soluble in HCl and  $\text{HNO}_3$ . Avoid  $\text{H}_2\text{SO}_4$ , HF,  $\text{H}_3\text{PO}_4$ , and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicate, carbonate, phosphate, and fluoride of calcium are soluble in % levels of HCl or  $\text{HNO}_3$ . Tungstate in neutral aqueous media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10%  $\text{HNO}_3$  / LDPE container.

**Ca Containing Samples (Preparation and Solution)** - Metal ( best dissolved in diluted  $\text{HNO}_3$  ), Ores ( Carbonate fusion in  $\text{PbO}$  followed by HCl dissolution); Organic Matrices (dry ash and dissolution in dilute HCl. Do not heat when dissolving to avoid precipitation of  $\text{SiO}_2$  ). The oxide, hydroxide, carbonate, phosphate, and fluoride of calcium are soluble in % levels of HCl or  $\text{HNO}_3$ . The sulfates (gypsum, anhydrite, etc.), certain silicates and complex compounds require fusion with  $\text{Na}_2\text{CO}_3$  followed by HCl / water dissolution. Contamination is a very real problem when analyzing for trace levels.

**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 at concs.)
ICP-OES 393.366 nm	0.0002 / 0.00004 $\mu\text{g/mL}$	1	ion	U, Ce
ICP-OES 396.847 nm	0.0005 / 0.00006 $\mu\text{g/mL}$	1	ion	Th
ICP-OES 422.673 nm	0.01 / 0.001 $\mu\text{g/mL}$	1	atom	Ge
ICP-MS 44 amu	1200 ppt	n/a	M	$^{16}\text{O}$ , $^{12}\text{C}$ , $^{28}\text{Si}$ , $^{16}\text{O}$ , $^{32}\text{S}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (OQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland(PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 01/20/04  
DATE EXPIRED: 02/01/2005 vps  
DATE OPENED: 01/20/04  
INORG: 4436 PO: F52303

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: July 23, 2003

Expiration Date:

**EXPIRES**  
1E2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

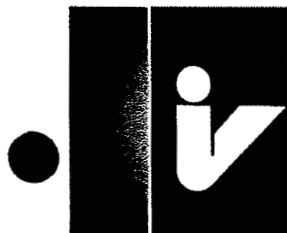
*JoAnn Struthers*

Certificate Approved By: Katalin Le, QC Supervisor

*Katalin Le*

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*



# inorganic ventures / iv labs

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 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: **Certificate #883-02**. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 **DESCRIPTION OF CRM** Custom-Grade 10000 µg/mL Iron in 3.5% (abs) HNO<sub>3</sub>

Catalog Number: CGFE10-1, CGFE10-2, and CGFE10-5  
 Lot Number: **W-FE03030**  
 Starting Material: Fe metal  
 Starting Material Purity (%): 99.999569  
 Starting Material Lot No: 23166  
 Matrix: 3.5% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 v03  
 DATE OPENED: 02/25/04  
 INORG: 4470 PD: F52323

- 3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 10,016 ± 25 µg/mL

**Certified Density:** 1.050 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\sum S$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

### 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 **Assay Method #1** 10,031 ± 33 µg/mL  
 ICP Assay NIST SRM 3126a Lot Number: 000606  
**Assay Method #2** 10,016 ± 25 µg/mL  
 EDTA NIST SRM 928 Lot Number: 880710

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00270	<u>M</u> Dy < 0.02413	<u>Q</u> Li < 0.00003	<u>M</u> Pr < 0.00121	<u>M</u> Te < 0.12066
<u>M</u> Sb < 0.00201	<u>M</u> Er < 0.02011	<u>M</u> Lu < 0.00161	<u>M</u> Re < 0.00402	<u>M</u> Tb < 0.00121
<u>M</u> As < 0.04022	<u>M</u> Eu < 0.01207	<u>Q</u> Mg < 0.00006	<u>M</u> Rh < 0.00402	<u>M</u> Tl < 0.00402
<u>M</u> Ba < 0.04022	<u>M</u> Gd < 0.00402	<u>Q</u> Mn < 0.02000	<u>M</u> Rb < 0.00402	<u>M</u> Th < 0.00402
<u>Q</u> Be < 0.00005	<u>M</u> Ga < 0.00402	<u>Q</u> Hg < 0.01100	<u>M</u> Ru < 0.00804	<u>M</u> Tm < 0.00161
<u>M</u> Bi < 0.00161	<u>i</u> Ge	<u>M</u> Mo < 0.00804	<u>M</u> Sm < 0.00402	<u>M</u> Sn < 0.02011
<u>Q</u> B < 0.00090	<u>M</u> Au < 0.01207	<u>M</u> Nd < 0.00804	<u>M</u> Sc < 0.04022	<u>M</u> Ti < 0.20109
<u>M</u> Cd < 0.01207	<u>M</u> Hf < 0.00804	<u>Q</u> Ni < 0.05000	<u>M</u> Se < 0.03218	<u>M</u> W < 0.04022
<u>Q</u> Ca < 0.00291	<u>M</u> Ho < 0.00201	<u>M</u> Nb < 0.00201	<u>Q</u> Si < 0.01000	<u>M</u> U < 0.00804
<u>M</u> Ce < 0.02011	<u>M</u> In < 0.04022	<u>n</u> Os	<u>M</u> Ag < 0.00804	<u>M</u> V < 0.00804
<u>M</u> Cs < 0.00121	<u>M</u> Ir < 0.02011	<u>M</u> Pd < 0.02011	<u>Q</u> Na < 0.00776	<u>M</u> Yb < 0.00402
<u>M</u> Cr < 0.02011	<u>s</u> Fe	<u>i</u> P	<u>M</u> Sr < 0.00201	<u>M</u> Y < 0.16087
<u>Q</u> Co < 0.00110	<u>M</u> La < 0.00201	<u>M</u> Pt < 0.00804	<u>Q</u> S < 0.07200	<u>M</u> Zn < 0.04876
<u>M</u> Cu < 0.02413	<u>M</u> Pb < 0.01207	<u>Q</u> K < 0.00170	<u>M</u> Ta < 0.02815	<u>M</u> Zr < 0.02011

M - Checked by ICP-MS    Q - 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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . 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;  $\text{Fe}(\text{H}_2\text{O})_6^{3+}$

**Chemical Compatibility** - Stable in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HF}$  and  $\text{H}_3\text{PO}_4$ . Avoid basic media. Stable with most metals and inorganic anions in acidic media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1.5%  $\text{HNO}_3$  / LDPE container.

**Fe Containing Samples (Preparation and Solution)** - Metal (Soluble in  $\text{HCl}$ ); Oxides (If the oxide has been at a high temperature then  $\text{Na}_2\text{CO}_3$  fusion in  $\text{Pt}$  followed by  $\text{HCl}$  dissolution otherwise dissolve in dilute  $\text{HCl}$ ); 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 at $\lambda$ Doncs.)
ICP-OES 238.204 nm	0.005 / 0.001 $\mu\text{g/mL}$	1	ion	Ru, Co
ICP-OES 238.562 nm	0.005 / 0.001 $\mu\text{g/mL}$	1	ion	Co, VV, Cr
ICP-OES 259.940 nm	0.006 / 0.001 $\mu\text{g/mL}$	1	ion	Hf, Nb
ICP-MS 56 amu	970 ppt	n/a	M	$^{40}\text{Ar}^{16}\text{N}^+\text{H}$ , $^{40}\text{Ar}^{16}\text{O}$ , $^{36}\text{Ar}^{16}\text{O}^+\text{H}$ , $^{36}\text{Ar}^{16}\text{O}$ , $^{35}\text{Cl}^{16}\text{O}^+\text{H}$ , $^{40}\text{Ca}^{16}\text{O}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (QAS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland(PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 VOS  
 DATE OPENED: 02/25/04  
 INORG: 4470 PO: F52323

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** March 20, 2003

**Expiration Date:**

**EXPIRES**

1X2805

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

**Certificate Prepared By:** JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

**Certificate Approved By:** Katalin Le, QC Supervisor

*Katalin Le*

**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

010287

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 **DESCRIPTION OF CRM** Custom-Grade 10000 µg/mL Potassium In 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGK10-1, CGK10-2, and CGK10-5

Lot Number: W-K02111

Starting Material: KNO<sub>3</sub>

Starting Material Purity (%): 99.997230

Starting Material Lot No K18J19

Matrix: 1.4% (abs) HNO<sub>3</sub>

INDORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 11/5/03 142  
 DATE EXPIRED: 12/1/2004 OF  
 DATE OPENED: 11/5/03  
 INORG: 4320 PO: FS2256

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 9930 ± 9 µg/mL

**Certified Density:** 1.024 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\sum S$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 **Assay Method #1** 9926 ± 62 µg/mL

ICP Assay NIST SRM 3141a Lot Number: 891312

**Assay Method #2** 9930 ± 9 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2



- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>O</u> Al < 0.00090	<u>M</u> Dy < 0.02400	<u>O</u> Li < 0.00003	<u>M</u> Pr < 0.00120	<u>M</u> Te < 0.11998
<u>M</u> Sb < 0.00200	<u>M</u> Er < 0.02000	<u>M</u> Lu < 0.00160	<u>M</u> Re < 0.00400	<u>M</u> Tb < 0.00120
<u>M</u> As < 0.03999	<u>M</u> Eu < 0.01200	<u>O</u> Mg 0.00100	<u>M</u> Rh < 0.00400	<u>M</u> Tl < 0.00400
<u>M</u> Ba < 0.03999	<u>M</u> Gd < 0.00400	<u>O</u> Mn < 0.00003	<u>M</u> Rb 0.49948	<u>M</u> Th < 0.00400
<u>O</u> Be < 0.00020	<u>M</u> Ga < 0.00400	<u>O</u> Hg < 0.01500	<u>M</u> Ru < 0.00800	<u>M</u> Tm < 0.00160
<u>M</u> Bi < 0.00160	<u>O</u> Ge < 0.00150	<u>M</u> Mo < 0.00800	<u>M</u> Sm < 0.00400	<u>M</u> Sn < 0.02000
<u>O</u> B < 0.00060	<u>O</u> Au < 0.00300	<u>M</u> Nd < 0.00800	<u>O</u> Sc < 0.00002	<u>O</u> Ti < 0.00070
<u>M</u> Cd < 0.01200	<u>M</u> Hf < 0.00800	<u>O</u> Ni < 0.00230	<u>O</u> Se < 0.05000	<u>M</u> W < 0.03999
<u>O</u> Ca 0.00075	<u>M</u> Ho < 0.00200	<u>M</u> Nb < 0.00200	<u>O</u> Si < 0.00340	<u>M</u> U < 0.00800
<u>M</u> Ce < 0.02000	<u>M</u> In < 0.03999	<u>n</u> Os	<u>M</u> Ag < 0.00800	<u>O</u> V < 0.00090
<u>M</u> Cs < 0.00120	<u>M</u> Ir < 0.02000	<u>M</u> Pd < 0.02000	<u>O</u> Na 0.21730	<u>M</u> Yb < 0.00400
<u>M</u> Cr < 0.02000	<u>O</u> Fe 0.00212	<u>O</u> P < 0.00250	<u>M</u> Sr < 0.00200	<u>M</u> Y < 0.15998
<u>M</u> Co < 0.01200	<u>M</u> La < 0.00200	<u>M</u> Pt < 0.00800	<u>O</u> S < 0.07200	<u>O</u> Zn 0.00050
<u>M</u> Cu < 0.02400	<u>M</u> Pb < 0.01200	<u>S</u> K	<u>M</u> Ta < 0.02800	<u>M</u> Zr < 0.02000

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 29.083; +1; (6); K'(aq)  
(Coordination Number in parentheses is assumed, not certain.)

**Chemical Compatibility** - Soluble in HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, and HF aqueous matrices. Avoid use of HClO<sub>4</sub> due to insolubility of the perchlorate. Stable with all metals and inorganic anions except ClO<sub>4</sub><sup>-</sup>.

**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 1-5% HNO<sub>3</sub> / LDPE container.

**K Containing Samples (Preparation and Solution)** - Metal (Dissolves very rapidly in water). Ores (Sodium carbonate fusion in P1<sup>2</sup> followed by HCl dissolution-blank levels of K in sodium carbonate critical). Organic Matrices (Sulfuric/peroxide digestion)

**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 at $\lambda$ D.L.s.)
ICP-OES 766.490 nm	0.4 / 0.001 µg/mL	1	atom	2 <sup>nd</sup> order radiation from R.E.s on some optical designs
ICP-OES 771.531 nm	1.0 / 0.03 µg/mL	1	atom	2 <sup>nd</sup> order radiation from R.E.s on some optical designs
ICP-OES 404.721 nm	1.1 / 0.05 µg/mL	1	atom	<u>U</u> , <u>Ce</u>
ICP-MS 39 amu	10 ppt	na	M'	<sup>39</sup> ArH, <sup>39</sup> Na <sup>18</sup> O, <sup>39</sup> Se <sup>2</sup>

- 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 procedure IV-MPM-004 and is guaranteed to be homogeneous.
- 10.0 **QUALITY STANDARD DOCUMENTATION**

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

**Recognized by:**

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**

10.6 **MIL-STD-45662A (Obsolete/Observed)**

11.0 **DATE OF CERTIFICATION AND PERIOD OF VALIDITY**



11.1 **IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 11/5/03  
 DATE EXPIRED: 12/1/04  
 DATE OPENED: 11/5/03  
 INORG: 4326 PO: ES2258

Certification Date: January 30, 2003

Expiration Date:

**EXPIRES**  
 122004

010220

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

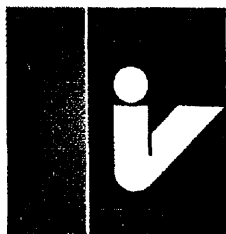
Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*  
*Katalin Le*

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*



# inorganic ventures / iv labs

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

**1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02.** The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

**2.0 DESCRIPTION OF CRM** Custom-Grade 10000 µg/mL Magnesium In 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGMG10-1 and CGMG10-5

Lot Number: T-MG03006

Starting Material: Mg metal

Starting Material Purity (%): 99.9968

Starting Material Lot No RML91191

Matrix: 1.4% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 07/31/03  
 DATE EXPIRED: 08/01/2004 V08  
 DATE OPENED: 08/01/03  
 INORG: 4204 PD: F52391

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

Certified Concentration: 9921 ± 20 µg/mL

Certified Density: 1.050 g/mL (measured at 22° C)

The Certified Value is the instrument analysis value. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum s_i^2$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

**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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

**4.1 Assay Method #1** 9998 ± 20 µg/mL

EDTA NIST SRM 92B Lot Number: 880710

**Assay Method #2** 9921 ± 20 µg/mL

ICP Assay NIST SRM 3131a Lot Number: 991107

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

Q Al	0.02454	M Dy	< 0.02455	Q Li	0.00797	M Pr	< 0.00123	M Te	< 0.12275
M Sb	0.00306	M Er	< 0.02046	M Lu	< 0.00164	M Re	< 0.00409	M Tb	< 0.00123
M As	< 0.04092	M Eu	< 0.01228	S Mg		M Rh	< 0.00409	M Tl	< 0.00409
M Ba	< 0.04092	M Gd	< 0.00409	M Mn	< 0.01637	M Rb	< 0.00409	M Th	< 0.00409
Q Be	< 0.00017	M Ga	< 0.00409	Q Hg	< 0.00900	M Ru	< 0.00818	M Tm	< 0.00164
M Bi	< 0.00164	M Ge	< 0.02455	M Mo	< 0.00818	M Sm	< 0.00409	M Sn	< 0.02046
Q B	0.00871	M Au	< 0.01228	M Nd	< 0.00818	M Sc	< 0.04092	Q Ti	0.10206
M Cd	< 0.01228	M Hf	< 0.00818	Q Ni	0.01404	M Se	< 0.03273	M W	< 0.04092
Q Ca	0.01070	M Ho	< 0.00205	M Nb	< 0.00205	Q Si	0.03186	M U	< 0.00818
M Ce	< 0.02046	M In	< 0.04092	n Os		M Ag	< 0.00818	M V	< 0.00818
M Cs	< 0.00123	M Ir	< 0.02046	M Pd	< 0.02046	Q Na	0.01817	M Yb	< 0.00409
Q Cr	0.02315	Q Fe	0.02467	Q P	< 0.01600	M Sr	< 0.00205	M Y	< 0.16367
M Co	< 0.01228	M La	< 0.00205	M Pt	< 0.00818	n S		Q Zn	0.01892
Q Cu	0.00672	Q Pb	0.03236	Q K	< 0.05000	M Ta	< 0.02864	M Zr	< 0.02046

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 24.305; +2; 6;  $\text{Mg}(\text{H}_2\text{O})_6^{2+}$

**Chemical Compatibility** - Soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$ ; avoid  $\text{HF}$ ,  $\text{H}_3\text{PO}_4$ , and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicates, carbonates, hydroxides, oxides, and tungstates in neutral and slightly acidic media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10%  $\text{HNO}_3$  / LDPE container.

**Mg Containing Samples (Preparation and Solution)** - Metal (Best dissolved in diluted  $\text{HNO}_3$ ); Oxide (Readily soluble in above compatible aqueous acidic solutions); Ores (Carbonate fusion in  $\text{P}t^*$  followed by  $\text{HCl}$  dissolution); Organic Matrices (Sulfuric / peroxide digestion or nitric / sulfuric / perchloric acid decomposition, or dry ash and dissolution in dilute  $\text{HCl}$ ).

**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 at $\mu$ concs.)
ICP-OES 279.553 nm	0.0002 / 0.00003 $\mu\text{g}/\text{mL}$	1	ion	Th
ICP-OES 280.270 nm	0.0003 / 0.00005 $\mu\text{g}/\text{mL}$	1	ion	U, V
ICP-OES 285.213 nm	0.002 / 0.00003 $\mu\text{g}/\text{mL}$	1	atom	U, Hf, Cr, Zr
ICP-MS 24 amu	42 ppt	n/a	M'	$^7\text{Li}^{+}$ , $^{41}\text{Ti}^{+}$ , $^{40}\text{Ca}^{+}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

## 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of **IQ Net International Certification Network**:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

## 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



## 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SVEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

## 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

## 10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
 DATE RECEIVED: 07/31/03  
 DATE EXPIRED: 08/01/2004 VPS  
 DATE OPENED: 08/01/03  
 INORG: 4204 PO: E52391

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: August 28, 2002

Expiration Date: **EXPIRES**  
01/22/04

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Debbie Newman, QA Administrator

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Debbie Newman*  
*Katalin Le*  
*Paul Gaines*

010295

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02.** The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

**2.0 DESCRIPTION OF CRM** Custom-Grade 10000 µg/mL Sodium in 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGNA10-1, CGNA10-2, and CGNA10-5

Lot Number: T-NA03006

Starting Material: Na<sub>2</sub>CO<sub>3</sub>

Starting Material Purity (%): 99.999936

Starting Material Lot No 42095

Matrix: 1.4% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg 1 of 2  
 DATE RECEIVED: 07/31/03  
 DATE EXPIRED: 08/01/2004 yes  
 DATE OPENED: 08/01/03  
 INORG: 4205 PD: F52391

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 10,005 ± 7 µg/mL

**Certified Density:** 1.032 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

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

$\sum s_i$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

**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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

**4.1 Assay Method #1** 10,067 ± 75 µg/mL

ICP Assay NIST SRM 3152a Lot Number: 990907

**Assay Method #2** 10,005 ± 7 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2



- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00090	<u>M</u> Dy < 0.02499	<u>Q</u> Li < 0.00003	<u>M</u> Pr < 0.00125	<u>M</u> Te < 0.12494
<u>M</u> Sb < 0.00208	<u>M</u> Er < 0.02082	<u>M</u> Lu < 0.00167	<u>M</u> Re < 0.00417	<u>M</u> Tb < 0.00125
<u>M</u> As < 0.04165	<u>M</u> Eu < 0.01249	<u>Q</u> Mg 0.00015	<u>M</u> Rh < 0.00417	<u>M</u> Tl < 0.00417
<u>M</u> Ba < 0.04165	<u>M</u> Gd < 0.00417	<u>Q</u> Mn < 0.00003	<u>M</u> Rb < 0.00417	<u>M</u> Th < 0.00417
<u>Q</u> Be < 0.00020	<u>M</u> Ga < 0.00417	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00833	<u>M</u> Tm < 0.00167
<u>M</u> Bi < 0.00167	<u>Q</u> Ge < 0.00150	<u>M</u> Mo < 0.00833	<u>M</u> Sm < 0.00417	<u>M</u> Sn < 0.02082
<u>Q</u> B < 0.00060	<u>Q</u> Au < 0.00300	<u>M</u> Nd < 0.00833	<u>Q</u> Sc < 0.00002	<u>Q</u> Ti < 0.00070
<u>M</u> Cd < 0.01249	<u>M</u> Hf < 0.00833	<u>Q</u> Ni < 0.00230	<u>Q</u> Se < 0.05000	<u>M</u> W < 0.04165
<u>Q</u> Ca 0.00160	<u>M</u> Ho < 0.00208	<u>M</u> Nb < 0.00208	<u>Q</u> Si < 0.00340	<u>M</u> U < 0.00833
<u>M</u> Ce < 0.02082	<u>M</u> In < 0.04165	<u>n</u> Os	<u>M</u> Ag < 0.00833	<u>Q</u> V < 0.00090
<u>M</u> Cs 0.00104	<u>M</u> Ir < 0.02082	<u>M</u> Pd < 0.02082	<u>S</u> Na	<u>M</u> Yb < 0.00417
<u>M</u> Cr < 0.02082	<u>Q</u> Fe < 0.00110	<u>Q</u> P < 0.04000	<u>M</u> Sr < 0.00208	<u>M</u> Y < 0.16658
<u>M</u> Co < 0.01249	<u>M</u> La < 0.00208	<u>M</u> Pt < 0.00833	<u>Q</u> S < 0.07200	<u>Q</u> Zn 0.00130
<u>Q</u> Cu < 0.00140	<u>M</u> Pb < 0.01249	<u>Q</u> K 0.00873	<u>M</u> Ta < 0.02915	<u>M</u> Zr < 0.02082

M - Checked by ICP-MS    Q - 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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

## 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** - 22.98977; +1; (6); Na<sup>+</sup>(aq) largely ionic in nature (Coordination Number in parentheses is assumed, not certain.)

**Chemical Compatibility** - Soluble in HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, and HF aqueous matrices. Stable with all metals and inorganic anions.

**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 1-5% HNO<sub>3</sub> / LDPE container.

**Na Containing Samples (Preparation and Solution)** - Metal (Dissolves very rapidly in water). Ores (Lithium carbonate fusion in graphite crucible followed by HCl dissolution - blank levels of Na in lithium carbonate critical). Organic Matrices (Sulfuric / peroxide digestion or nitric/sulfuric/perchloric acid decomposition).

**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 at all concs.)
ICP-OES 588.595 nm	0.07 / 0.00009 µg/mL	1	atom	2 <sup>nd</sup> order radiation from R.E.s on some optical designs
ICP-OES 588.995 nm	0.03 / 0.006 µg/mL	1	atom	2 <sup>nd</sup> order radiation from R.E.s on some optical designs
ICP-OES 330.237 nm	2.0 / 0.09 µg/mL	1	atom	<u>Pd</u> , <u>Zn</u>
ICP-MS 23 amu	310 ppt	n/a	M <sup>+</sup>	<sup>45</sup> Ti <sup>12</sup> , <sup>44</sup> Ca <sup>12</sup>

- 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 procedure IV-MPM-004 and is guaranteed to be homogeneous.
- 10.0 **QUALITY STANDARD DOCUMENTATION**

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

**Recognized by:**

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (Bmwa), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**

10.6 **MIL-STD-45662A (Obsolete/Observed)**

11.0 **DATE OF CERTIFICATION AND PERIOD OF VALIDITY**



11.1 **IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: January 24, 2003

Expiration Date: **EXPIRES** 01/22/04

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
 DATE RECEIVED: 07/31/03  
 DATE EXPIRED: 08/01/2004 W3  
 DATE OPENED: 08/01/03  
 INORG: 4205 PO: F52391

010298

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

**Certificate Prepared By:** Debbie Newman, LIMS Administrator

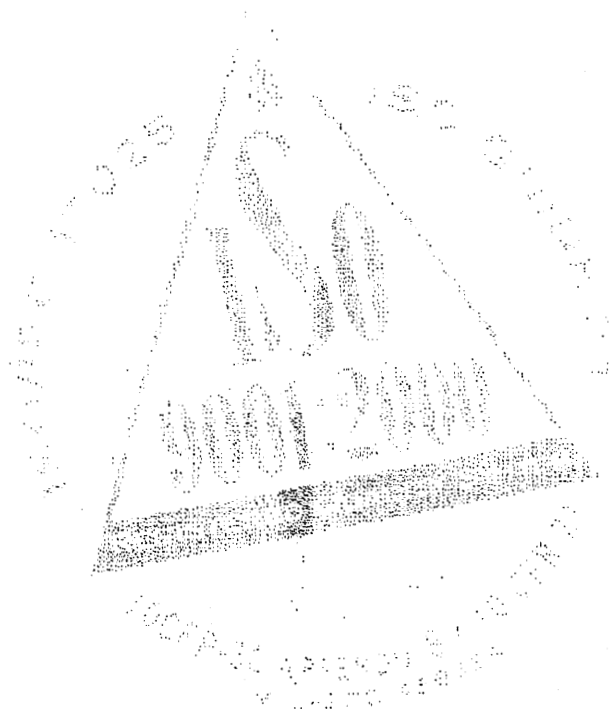
Heidi Newman  
Kathleen de

**Certificate Approved By:** Katalin Le, QC Supervisor

Kontrollieren Sie

**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

Paul Haine



010299



# Certificate of Analysis

**CUSTOM-GRADE SOLUTION**
**1000 µg/mL Lithium in 0.1% HNO<sub>3</sub> (abs)**

Catalog Number: CGLI1-1, CGLI1-2 and CGLI1-5

 Lot Number: **W-LI02066**

Starting Material:

 Li<sub>2</sub>CO<sub>3</sub>

Starting Material Purity:

99.999%

Starting Material Lot No:

1053

INORGANIC LABS/RADCHEM LABS

 DATE RECEIVED: 06/20/03

 DATE EXPIRED: 07/01/2004

 DATE OPENED: 06/23/03

 INDRG: 4149 PID: F52370
**CERTIFIED CONCENTRATION: 998 ± 2 µg/mL**

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum S_i^2)^{1/2}}{(n)^{1/2}}$$

 ( $\bar{x}$ ) = mean

 x<sub>i</sub> = individual results

n = number of measurements

 ΣS<sub>i</sub> = The summation of all significant estimated errors.

**Classical Wet Assay: 998 ± 2 µg/mL**

Method: Gravimetric as the Sulfate vs NIST weights #822/254143-94.

**Instrument Analysis: 1000 ± 4 µg/mL**

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3129a.

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

**TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:**

Custom Grade solutions tested for trace metallic impurities 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.

Q Al <0.010	M Dy <0.00060	S Li	M Pr <0.000030	Q Te <0.0090
M Sb <0.000050	M Er <0.00050	M Lu <0.000040	M Re <0.00010	M Tb <0.000030
Q As <0.044	M Eu <0.00030	Q Mg <0.00010	M Rh <0.00010	M Tl <0.00010
M Ba <0.0010	M Gd <0.00010	Q Mn <0.00020	M Rb <0.00010	M Th <0.00010
Q Be <0.000050	M Ga <0.00010	Q Hg <0.0070	M Ru <0.00020	M Tm <0.000040
M Bi <0.000040	M Ge <0.00060	M Mo <0.00020	M Sm <0.00010	M Sn <0.00050
Q B <0.0060	Q Au <0.010	M Nd <0.00020	M Sc <0.0010	Q Ti <0.00030
Q Cd <0.0018	M Hf <0.00020	Q Ni <0.0040	Q Se <0.020	M W <0.0010
Q Ca 0.051	M Ho <0.000050	M Nb <0.000050	Q Si 0.023	M U <0.00020
M Ce <0.00050	Q In <0.030	n Os	Q Ag <0.0040	Q V <0.0010
M Cs 0.0018	M Ir <0.00050	M Pd <0.00050	Q Na <0.10	M Yb <0.00010
Q Cr <0.0020	Q Fe <0.0020	Q P <0.030	Q Sr <0.0010	M Y <0.0040
M Co <0.00030	M La <0.000050	M Pt <0.00020	Q S <0.050	Q Zn <0.030
M Cu <0.00060	M Pb <0.00030	Q K 0.0070	M Ta <0.00070	M Zr <0.00050

M - checked by ICP-MS

Q - checked by ICP-OES

I - spectral interference

n - not checked for

s - solution standard element

**ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.004 g/mL**

(over)

QA:KL Rev.022403DN

**Inorganic Ventures, Inc.**

195 Lehigh Avenue • Suite 4 • Lakewood, NJ 08701

Orders: 800-669-6799 • FAX (732) 901-1903

Technical Support: 800-569-6799

Quality Assurance Manager

**EXPIRES**

01/22/04

**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)  
 Members of IQ Net : Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Aviner), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JOA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland(PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)
  2. ISO/IEC Guide 34-2000 "General Requirements for the Competence of Reference Material Producers" - Reference Materials Production - Accredited A2LA Certificate 883.02
  3. ISO/IEC17025-1999 "General Requirements for the Competence of Testing and Calibration" - Chemical Testing - Accredited A2LA Certificate 883.01
  4. MIL-STD-45662A
  5. 10CFR50 Appendix B - Nuclear Regulatory Commission - Domestic Licencing of Production and Utilization Facilities
  6. 10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance
- Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION**

- Shelf Life -** The length of time that a properly stored and packaged standard will remain within the specified uncertainty. Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.
- Expiration Date -** The date after which a standard solution should not be used. A one year expiration date is recommended by most state and federal regulatory agencies. Transpiration issues and repeated use of solutions over a one year period may adversely affect the integrity of the standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799    INT'L 1-732-901-1900    FAX 1-732-901-1903    E-MAIL IVtech@ivstandards.com



inorganic ventures / iv labs

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phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Cadmium in 2% (abs) HNO<sub>3</sub>

Catalog Number: CGCD1-1, CGCD1-2, and CGCD1-5  
Lot Number: W-CD01127  
Starting Material: Cd shot  
Starting Material Purity (%): 99.998904  
Starting Material Lot No: C14M30  
Matrix: 2% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
DATE RECEIVED: 02/25/04  
DATE EXPIRED: 03/01/2005 V03  
DATE OPENED: 02/25/04  
INORG: 4467 PQ: F52323

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1007 ± 2 µg/mL

Certified Density: 1.014 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(s_{\bar{x}})}{(n)^{1/2}}$$

$s_{\bar{x}}$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 1007 ± 2 µg/mL  
EDTA NIST SRM 928 Lot Number: 880710  
Assay Method #2 1005 ± 5 µg/mL  
ICP Assay NIST SRM 3108 Lot Number: 890312

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00090	<u>M</u> Dy < 0.01191	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00060	<u>Q</u> Te < 0.00700
<u>M</u> Sb 0.00039	<u>M</u> Er < 0.00993	<u>M</u> Lu < 0.00079	<u>M</u> Re < 0.00199	<u>M</u> Tb < 0.00060
<u>M</u> As < 0.01985	<u>M</u> Eu < 0.00596	<u>Q</u> Mg 0.00002	<u>M</u> Rh < 0.00199	<u>M</u> Tl < 0.00199
<u>M</u> Ba < 0.01985	<u>M</u> Gd < 0.00199	<u>M</u> Mn < 0.00794	<u>M</u> Rb < 0.00199	<u>M</u> Th < 0.00199
<u>M</u> Be < 0.00099	<u>M</u> Ga < 0.00199	<u>Q</u> Hg < 0.01200	<u>M</u> Ru < 0.00397	<u>M</u> Tm < 0.00079
<u>M</u> Bi < 0.00079	<u>M</u> Ge < 0.01191	<u>M</u> Mo < 0.00397	<u>M</u> Sm < 0.00199	<u>M</u> Sn < 0.00993
<u>Q</u> B < 0.00900	<u>M</u> Au < 0.00596	<u>M</u> Nd < 0.00397	<u>M</u> Sc < 0.01985	<u>M</u> Ti < 0.09925
<u>s</u> Cd	<u>M</u> Hf < 0.00397	<u>Q</u> Ni < 0.00300	<u>M</u> Se < 0.01588	<u>M</u> W < 0.01985
<u>Q</u> Ca 0.00378	<u>M</u> Ho < 0.00099	<u>M</u> Nb < 0.00099	<u>Q</u> Si < 0.00340	<u>M</u> U < 0.00397
<u>M</u> Ce < 0.00993	<u>Q</u> In < 0.00200	<u>n</u> Os	<u>M</u> Ag < 0.00397	<u>M</u> V < 0.00397
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.00993	<u>M</u> Pd 0.00691	<u>M</u> Na < 0.19849	<u>M</u> Yb < 0.00199
<u>M</u> Cr < 0.00993	<u>Q</u> Fe < 0.00110	<u>Q</u> P < 0.00300	<u>M</u> Sr < 0.00099	<u>M</u> Y < 0.07940
<u>M</u> Co < 0.00596	<u>M</u> La < 0.00099	<u>M</u> Pt < 0.00397	<u>Q</u> S < 0.03000	<u>Q</u> Zn 0.00040
<u>M</u> Cu < 0.01191	<u>M</u> Pb < 0.00596	<u>Q</u> K 0.00015	<u>M</u> Ta < 0.01389	<u>M</u> Zr < 0.00993

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

010303

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 112.41; +2; 4;  $\text{Cd}_2(\text{OH})_2(\text{aq})^{2+}$  and  $\text{Cd}(\text{OH})_2(\text{aq})^{2+}$

**Chemical Compatibility** - Stable in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HF}$ . Avoid basic media forming insoluble carbonate and hydroxide.

Stable with most metals and inorganic anions in acidic media. The sulfide, carbonate, oxalate, phosphate, and cyanide are insoluble in water and soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{NH}_4\text{OH}$ . The chloride, bromide and iodide are soluble in water. CdI<sub>2</sub> is one of the few iodides soluble in ethanol. All compounds of Cd are soluble in excess NaI, due to the formation of the complex ion,  $\text{CdI}_4^{2-}$ .

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 %  $\text{HNO}_3$  / LDPE container.

**Cd Containing Samples (Preparation and Solution)** - Metal (soluble in  $\text{HNO}_3$ ); Oxides (Soluble in  $\text{HCl}$  or  $\text{HNO}_3$ ); Ores (Dissolve in  $\text{HCl}$  /  $\text{HNO}_3$ , then take to fumes with  $\text{H}_2\text{SO}_4$ . The silica and lead sulfate are filtered off after addition of water.); Organic based (dry ash at  $450^\circ\text{C}$  and dissolve ash in  $\text{HCl}$ ) (sulfuric/peroxide acid digestion).

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

Technique/Line	Estimated D.L.	Order	Type	Interferences
ICP-OES 214.438 nm	0.003 / 0.0003 $\mu\text{g/mL}$	1	ion	Pt, Ir
ICP-OES 228.802 nm	0.003 / 0.0003 $\mu\text{g/mL}$	1	atom	Co, Ir, As, Pt
ICP-OES 226.502 nm	0.003 / 0.0003 $\mu\text{g/mL}$	1	ion	Ir
ICP-MS 111 amu	11 ppt	n/a	M <sup>+</sup>	<sup>108</sup> Mo <sup>4+</sup> O

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

## 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

## 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



## 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

## 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

## 10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 02/25/04

DATE EXPIRED: 03/01/2005 v05

DATE OPENED: 02/25/04

INORG: 4467 PO: F52323



## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010304



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** April 24, 2003

**Expiration Date:** **EXPIRES**  
12/2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

**Certificate Prepared By:** JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

**Certificate Approved By:** Katalin Le, QC Supervisor

*Katalin Le*

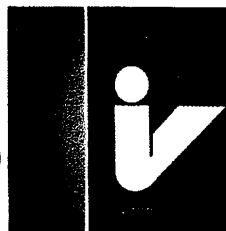
**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

010305

**inorganic ventures / iv labs**

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**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Cobalt in 2% (abs) HNO<sub>3</sub>

Catalog Number: CGCO1-1, CGCO1-2, and CGCO1-5  
 Lot Number: **W-QC001114**  
 Starting Material: Co powder  
 Starting Material Purity (%): 99.995670  
 Starting Material Lot No: 22897  
 Matrix: 2% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/31/2005  
 DATE OPENED: 02/25/04  
 INORG: 4468 PU: F52323

- 3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1002 ± 3 µg/mL  
**Certified Density:** 1.016 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum s_i^2$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

- 4.1 **Assay Method #1** 998 ± 4 µg/mL  
 ICP Assay NIST SRM 3181 Lot Number: 000630  
**Assay Method #2** 1002 ± 3 µg/mL  
 EDTA NIST SRM 928 Lot Number: 880710

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00025	<u>M</u> Dy < 0.02419	<u>Q</u> Li 0.00001	<u>M</u> Pr < 0.00121	<u>M</u> Te < 0.12097
<u>M</u> Sb < 0.00202	<u>M</u> Er < 0.02016	<u>M</u> Lu < 0.00161	<u>M</u> Re < 0.00403	<u>M</u> Tb < 0.00121
<u>Q</u> As < 0.10000	<u>M</u> Eu < 0.01210	<u>Q</u> Mg 0.00045	<u>M</u> Rh < 0.00403	<u>M</u> Tl < 0.00403
<u>M</u> Ba < 0.04032	<u>M</u> Gd < 0.00403	<u>Q</u> Mn 0.00003	<u>M</u> Rb < 0.00403	<u>M</u> Th < 0.00403
<u>M</u> Be < 0.00202	<u>M</u> Ga < 0.00403	<u>Q</u> Hg < 0.05000	<u>M</u> Ru < 0.00807	<u>M</u> Tm < 0.00161
<u>M</u> Bi < 0.00161	<u>M</u> Ge < 0.02419	<u>M</u> Mo < 0.00807	<u>M</u> Sm < 0.00403	<u>M</u> Sn < 0.02016
<u>Q</u> B < 0.04000	<u>M</u> Au < 0.01210	<u>M</u> Nd < 0.00807	<u>M</u> Sc < 0.04032	<u>M</u> Ti < 0.20162
<u>M</u> Cd < 0.01210	<u>M</u> Hf < 0.00807	<u>Q</u> Ni < 0.02000	<u>M</u> Se < 0.03226	<u>M</u> W < 0.04032
<u>Q</u> Ca 0.00325	<u>M</u> Ho < 0.00202	<u>M</u> Nb < 0.00202	<u>Q</u> Si < 0.00400	<u>M</u> U < 0.00807
<u>M</u> Ce < 0.02016	<u>M</u> In < 0.04032	<u>n</u> Os	<u>M</u> Ag < 0.00807	<u>M</u> V < 0.00807
<u>M</u> Cs < 0.00121	<u>M</u> Ir < 0.02016	<u>M</u> Pd < 0.02016	<u>Q</u> Na 0.00138	<u>M</u> Yb < 0.00403
<u>M</u> Cr < 0.02016	<u>Q</u> Fe 0.00875	<u>n</u> P	<u>M</u> Sr < 0.00202	<u>M</u> Y < 0.16129
<u>s</u> Co	<u>M</u> La < 0.00202	<u>M</u> Pt < 0.00807	<u>n</u> S	<u>M</u> Zn < 0.08065
<u>M</u> Cu < 0.02419	<u>M</u> Pb < 0.01210	<u>Q</u> K 0.03000	<u>M</u> Ta < 0.02823	<u>M</u> Zr < 0.02016

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 58.9332; +2; 6;  $\text{Co}(\text{H}_2\text{O})_6^{2+}$

**Chemical Compatibility** - Stable in HCl,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , HF,  $\text{H}_3\text{PO}_4$ . Avoid basic media. Stable with most metals and inorganic anions in acidic media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5%  $\text{HNO}_3$  / LDPE container.

**Co Containing Samples (Preparation and Solution)** - Metal (soluble in  $\text{HNO}_3$ ); Oxides (Soluble in HCl); Ores (Dissolve in HCl /  $\text{HNO}_3$ ).

**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 at 100ppb)
ICP-OES 238.892 nm	0.01/0.002 µg/mL	1	ion	Eg. W, Ta
ICP-OES 228.616 nm	0.01/0.001 µg/mL	1	ion	
ICP-OES 237.862 nm	0.01/0.002 µg/mL	1	ion	W, Re, Al, Ta
ICP-MS 59 amu	2 ppt	n/a	M	$^{44}\text{Ca}^{16}\text{O}^+$ , $^{46}\text{Ar}^{16}\text{O}^+$ , $^{40}\text{Ar}^{19}\text{F}^+$ , $^{40}\text{Ca}^{16}\text{O}^+$ , $^{24}\text{Mg}^{16}\text{C}^+$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

### 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

### 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



### 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

### 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

### 10.6 MIL-STD-45662A (Obsolete/Observed)

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 **IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** August 28, 2003

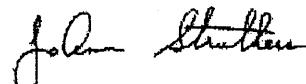
**Expiration Date:**

**EXPIRES**  
12/2005

INDORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
DATE RECEIVED: 02/25/04  
DATE EXPIRED: 03/01/2005 v03  
DATE OPENED: 02/25/04  
INDORG: 4468 PO: F52323

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**

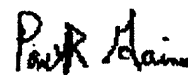
Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant



Certificate Approved By: Katalin Le, QC Supervisor



Certifying Officer: Paul Gaines, Chemist, Senior Technical Director



010309

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Manganese in 2% (abs) HNO<sub>3</sub>

Catalog Number: CGMN1-1, CGMN1-2, and CGMN1-5  
 Lot Number: **W-MN02036**  
 Starting Material: Mn pieces  
 Starting Material Purity (%): 99.995300  
 Starting Material Lot No: 21563  
 Matrix: 2% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg 1 of 2  
 DATE RECEIVED: 01/20/04  
 DATE EXPIRED: 02/01/2005 V03  
 DATE OPENED: 01/20/04  
 INORG: 4434 PO: F52301

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1000 ± 2 µg/mL  
**Certified Density:** 1.014 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2t(\alpha/2, n-1)S}{(n)^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$S$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 **Assay Method #1** 1000 ± 2 µg/mL  
 ICP Assay NIST SRM 3132 Lot Number: 890903  
**Assay Method #2** 1003 ± 3 µg/mL  
 EDTA NIST SRM 928 Lot Number: 880710

- 4.2 **BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 **THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 **GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

## 5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP/MS AND ICP-OES IN $\mu\text{g/mL}$

Custom-Grade 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  $\mu\text{m}$ .

<u>Q</u> Al 0.00221	<u>M</u> Dy < 0.02471	<u>Q</u> Li 0.00020	<u>M</u> Pr < 0.00124	<u>M</u> Te < 0.12355
<u>M</u> Sb < 0.00206	<u>M</u> Er < 0.02059	<u>M</u> Lu < 0.00165	<u>M</u> Re < 0.00412	<u>M</u> Tb < 0.00124
<u>M</u> As < 0.04118	<u>M</u> Eu < 0.01236	<u>Q</u> Mg 0.03350	<u>M</u> Rh < 0.00412	<u>M</u> Tl < 0.00412
<u>M</u> Ba < 0.04118	<u>M</u> Gd < 0.00412	<u>s</u> Mn	<u>M</u> Rb < 0.00412	<u>M</u> Th < 0.00412
<u>M</u> Be < 0.00206	<u>Q</u> Ga < 0.05000	<u>i</u> Hg	<u>M</u> Ru < 0.00824	<u>M</u> Tm < 0.00165
<u>M</u> Bi < 0.00165	<u>Q</u> Ge < 0.00300	<u>M</u> Mo < 0.00824	<u>M</u> Sm < 0.00412	<u>M</u> Sn < 0.02059
<u>Q</u> B 0.00295	<u>M</u> Au < 0.01236	<u>M</u> Nd < 0.00824	<u>M</u> Sc < 0.04118	<u>M</u> Ti < 0.20592
<u>M</u> Cd < 0.01236	<u>M</u> Hf < 0.00824	<u>M</u> Ni < 0.03295	<u>M</u> Se < 0.03295	<u>M</u> W < 0.04118
<u>Q</u> Ca 0.00340	<u>M</u> Ho < 0.00206	<u>M</u> Nb < 0.00206	<u>Q</u> Si 0.00275	<u>M</u> U < 0.00824
<u>M</u> Ce < 0.02059	<u>M</u> In < 0.04118	<u>n</u> Os	<u>M</u> Ag < 0.00824	<u>M</u> V < 0.00824
<u>M</u> Cs < 0.00124	<u>M</u> Ir < 0.02059	<u>M</u> Pd < 0.02059	<u>Q</u> Na 0.00225	<u>M</u> Yb < 0.00412
<u>M</u> Cr < 0.02059	<u>Q</u> Fe < 0.01000	<u>i</u> P	<u>M</u> Sr < 0.00206	<u>M</u> Y < 0.16474
<u>M</u> Co < 0.01236	<u>M</u> La < 0.00206	<u>M</u> Pt < 0.00824	<u>i</u> S	<u>Q</u> Zn 0.00250
<u>M</u> Cu < 0.02471	<u>M</u> Pb < 0.01236	<u>Q</u> K 0.00105	<u>M</u> Ta < 0.02883	<u>M</u> Zr < 0.02059

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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 54.9380; +2; 6;  $\text{Mn}(\text{H}_2\text{O})_6^{2+}$

**Chemical Compatibility** - Stable in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HF}$ ,  $\text{H}_3\text{PO}_4$ . Avoid basic media. Stable with most metals and inorganic anions in acidic media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5 %  $\text{HNO}_3$  LDPE container.

**Mn Containing Samples (Preparation and Solution)** - Metal (Soluble in dilute acids); Oxides (Soluble in dilute acids); Ores (Dissolve with  $\text{HCl}$ . If silica is present add  $\text{HF}$  and then turn off silica by adding  $\text{H}_2\text{SO}_4$  and heat to  $\text{SO}_3$  fumes - dense white fumes).

**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 effects)
ICP-OES 257.610nm	0.0014 / 0.00002 $\mu\text{g/mL}$	1	ion	Ce, VV, Re
ICP-OES 259.373 nm	0.0016 / 0.00002 $\mu\text{g/mL}$	1	ion	U, Ta, Mo, Fe, Nb
ICP-OES 260.569 nm	0.0021 / 0.00002 $\mu\text{g/mL}$	1	ion	Co
ICP-MS 55 amu	10 ppt	n/a	M'	$^{40}\text{Ar}^{14}\text{N}^{16}\text{O}$ , $^{39}\text{K}^{16}\text{O}$ , $^{35}\text{Cl}^{16}\text{O}$ , $^{40}\text{Ar}^{14}\text{N}$ , $^{39}\text{Ar}^{16}\text{O}$ , $^{39}\text{Ar}^{18}\text{O}^{16}\text{H}$ , $^{39}\text{Ar}^{16}\text{O}^{16}\text{H}$ , $^{35}\text{Cl}^{16}\text{O}^{16}\text{H}$ , $^{23}\text{Na}^{25}\text{S}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

## 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

## 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



## 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

## 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

## 10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 01/20/04

DATE EXPIRED: 02/01/2005 VRS

DATE OPENED: 01/20/04

INORG: 4434 PG: F52301



## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: August 04, 2003

Expiration Date:

**EXPIRES**

12/2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

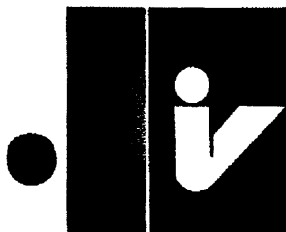
Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*

*Katalin Le*

*Paul Gaines*



inorganic ventures / iv labs

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

010313

# certificate of analysis

## CUSTOM-GRADE SOLUTION

1000 µg/mL Vanadium in 1.4% HNO<sub>3</sub> (abs)

Catalog Number: CGV1-1, CGV1-2 and CGV1-5

Lot Number: T-V02032

Starting Material:  
Starting Material Purity:  
Starting Material Lot No:

Vanadium Pentoxide  
99.999%  
46

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 11/5/03  
DATE EXPIRED: 12/1/2004 *OR*  
DATE OPENED: 11/5/03  
INORG: 4321 PO: F52258

## CERTIFIED CONCENTRATION: 990 ± 2 µg/mL

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

n = number of measurements

$\sum s_i$  = The summation of all significant estimated errors.

Classical Wet Assay: 993 ± 4 µg/mL

Method: EDTA Titration vs NIST SRM 928 Lead Nitrate.

Instrument Analysis: 990 ± 2 µg/mL

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3165.

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

## TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:

Custom-Grade solutions tested for trace metallic impurities 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	Al	0.0095	M	Dy	<0.00060	M	Li	<0.0010	M	Pr	<0.000030	M	Te	<0.0030
M	Sb	0.042	M	Er	<0.00050	M	Lu	<0.000040	M	Re	<0.00010	M	Tb	<0.000030
M	As	<0.0010	M	Eu	<0.00030	M	Mg	0.0089	M	Rh	<0.00010	M	Ti	<0.00010
M	Ba	<0.0010	M	Gd	<0.00010	i	Mn		M	Rb	<0.00010	M	Th	<0.00010
M	Be	<0.000050	M	Ga	<0.00010	i	Hg		M	Ru	<0.00020	M	Tm	<0.000040
M	Bi	<0.000040	M	Ge	<0.00060	M	Mo	0.016	M	Sm	<0.00010	M	Sn	<0.00050
M	B	<0.0070	M	Au	<0.00030	M	Nd	<0.00020	M	Sc	<0.0010	M	Tl	<0.0050
M	Cd	<0.00030	M	Hf	<0.00020	Q	Ni	<0.050	Q	Se	<0.40	M	W	0.00055
Q	Ca	<0.010	M	Ho	<0.000050	M	Nb	0.00024	Q	Si	<0.030	M	U	0.0011
M	Ce	<0.00050	Q	In	<0.070	i	Os		M	Ag	0.00044	s	V	
M	Cs	<0.000030	M	Ir	<0.00050	M	Pd	<0.00050	Q	Na	<0.090	M	Yb	<0.00010
Q	Cr	<0.020	Q	Fe	<0.050	i	P		M	Sr	<0.000050	M	Y	<0.0040
Q	Co	<0.050	M	La	<0.000050	M	Pt	<0.00020	i	S		M	Zn	0.0041
M	Cu	<0.00060	M	Pb	<0.00030	i	K		M	Ta	<0.00070	M	Zr	<0.00050

M - checked by ICP-MS

Q - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.015 g/mL

(over)

QA:KLRev.081202DK

*Paul R. Gaines*

Quality Assurance Manager

**EXPIRES**

Expires: 122004

**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001 QMI Registered Quality System (Certificate Number 010105)



**Members of IQ Net :** Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

2. ISO Guide 25 A2LA Accredited (Certificate Number 0883-01)

3. MIL-STD-45662A

4. 10CFR50 Appendix B

5. 10CFR21

Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION****Shelf Life -**

The length of time that a properly stored and packaged standard will remain within the specified uncertainty. Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.

**Expiration Date -**

The date after which a standard solution should not be used. A one year expiration date is recommended by most state and federal regulatory agencies. Transpiration issues and repeated use of solutions over a one year period may adversely affect the integrity of the standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

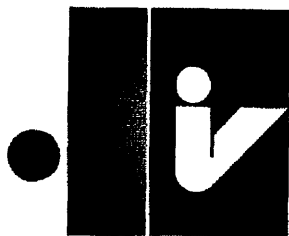
All customers are encouraged to contact us for technical support for the proper use of our products.

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**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Zinc in 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGZN1-1, CGZN1-2, and CGZN1-5

Lot Number: W-ZN02018

Starting Material: Zn shot

Starting Material Purity (%): 99.999889

Starting Material Lot No J17L26

Matrix: 1.4% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 11/5/03 11/5/03

DATE EXPIRED: 12/1/2004

DATE OPENED: 11/5/03

INORG: 4319 PD: F55258

- 3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1006 ± 3 µg/mL

Certified Density: 1.011 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$(\bar{x})$  = mean

$x_i$  = individual results

$n$  = number of measurements

$\Sigma S$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

$$\text{Uncertainty } (\pm) = \frac{2(\Sigma S)}{(n)^{1/2}}$$

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1

1002 ± 6 µg/mL

ICP Assay NIST SRM 3168a Lot Number: 001402

Assay Method #2

1006 ± 3 µg/mL

EDTA NIST SRM 928 Lot Number: 880710

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00200	<u>M</u> Dy < 0.02440	<u>Q</u> Li 0.00001	<u>M</u> Pr < 0.00122	<u>M</u> Te < 0.12198
<u>M</u> Sb < 0.00203	<u>M</u> Er < 0.02033	<u>M</u> Lu < 0.00163	<u>M</u> Re < 0.00407	<u>M</u> Tb < 0.00122
<u>M</u> As < 0.04066	<u>M</u> Eu < 0.01220	<u>Q</u> Mg 0.00011	<u>M</u> Rh < 0.00407	<u>M</u> Tl < 0.00407
<u>M</u> Ba < 0.04066	<u>M</u> Gd < 0.00407	<u>M</u> Mn < 0.01826	<u>M</u> Rb < 0.00407	<u>M</u> Th < 0.00407
<u>M</u> Be < 0.00203	<u>M</u> Ga < 0.00407	<u>Q</u> Hg < 0.01000	<u>M</u> Ru < 0.00813	<u>M</u> Tm < 0.00163
<u>M</u> Bi < 0.00163	<u>M</u> Ge < 0.02440	<u>M</u> Mo < 0.00813	<u>M</u> Sm < 0.00407	<u>M</u> Sn < 0.02033
<u>Q</u> B 0.00015	<u>M</u> Au < 0.01220	<u>M</u> Nd < 0.00813	<u>M</u> Sc < 0.04066	<u>M</u> Ti < 0.20331
<u>M</u> Cd < 0.01220	<u>M</u> Hf < 0.00813	<u>Q</u> Ni 0.00009	<u>M</u> Se < 0.03253	<u>M</u> W < 0.04066
<u>Q</u> Ca 0.00022	<u>M</u> Ho < 0.00203	<u>M</u> Nb < 0.00203	<u>Q</u> Si < 0.00400	<u>M</u> U < 0.00813
<u>M</u> Ce < 0.02033	<u>M</u> In < 0.04066	<u>n</u> Os	<u>M</u> Ag < 0.00813	<u>M</u> V < 0.00813
<u>M</u> Cs < 0.00122	<u>M</u> Ir < 0.02033	<u>M</u> Pd < 0.02033	<u>Q</u> Na 0.00055	<u>M</u> Yb < 0.00407
<u>Q</u> Cr < 0.00100	<u>Q</u> Fe 0.00005	<u>Q</u> P < 0.00300	<u>M</u> Sr < 0.00203	<u>M</u> Y < 0.16264
<u>M</u> Co < 0.01220	<u>M</u> La < 0.00203	<u>M</u> Pt < 0.00813	<u>Q</u> S < 0.02000	<u>s</u> Zn
<u>Q</u> Cu < 0.00050	<u>M</u> Pb < 0.01220	<u>Q</u> K 0.00018	<u>M</u> Ta < 0.02846	<u>M</u> Zr < 0.02033

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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 65.39; +2; 4;  $\text{Zn}(\text{OH})(\text{aq})^{2+}$

**Chemical Compatibility** - Stable in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HF}$ ,  $\text{H}_3\text{PO}_4$ . Avoid basic media that promotes the formation of insoluble carbonate and hydroxide. Stable with most metals and inorganic anions in acidic media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5%  $\text{HNO}_3$  / LDPE container.

**Zn Containing Samples (Preparation and Solution)** - Metal (Soluble in  $\text{HNO}_3$ ); Oxides (Soluble in  $\text{HCl}$ ); Ores (Dissolve in  $\text{HCl}$  /  $\text{HNO}_3$ ); Organic based (Dry ash at  $450^\circ\text{C}$  and dissolve ash in  $\text{HCl}$ ) (Sulfuric/peroxide acid digestion)

**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 interferences.)
ICP-OES 213.856 nm	0.002 / 0.0004 $\mu\text{g/mL}$	1 atom	Ni, Cu, V	
ICP-OES 202.548 nm	0.004 / 0.0002 $\mu\text{g/mL}$	1 ion	Nb, Cu, Co, Hf	
ICP-OES 206.200 nm	0.006 / 0.0006 $\mu\text{g/mL}$	1 ion	Sb, Ta, Bi, Os	
ICP-MS 66 amu	7 ppt	n/a	M	$^{44}\text{Ti}^{4+}$ , $^{52}\text{Cr}^{6+}$ , $^{51}\text{V}^{5+}$ , $^{33}\text{S}^{4+}$ , $^{34}\text{S}^{4+}$ , $^{36}\text{S}^{4+}$ , $^{37}\text{Cl}^{3+}$ , $^{39}\text{K}^{3+}$ , $^{40}\text{Ca}^{2+}$ , $^{41}\text{Ca}^{2+}$ , $^{42}\text{Ca}^{2+}$ , $^{43}\text{Ca}^{2+}$ , $^{44}\text{Ca}^{2+}$ , $^{46}\text{Ca}^{2+}$ , $^{48}\text{Ca}^{2+}$ , $^{49}\text{Ti}^{4+}$ , $^{50}\text{Ti}^{4+}$ , $^{51}\text{V}^{5+}$ , $^{52}\text{Cr}^{6+}$ , $^{53}\text{Cr}^{3+}$ , $^{54}\text{Cr}^{3+}$ , $^{56}\text{Fe}^{3+}$ , $^{57}\text{Fe}^{3+}$ , $^{58}\text{Fe}^{3+}$ , $^{60}\text{Ni}^{2+}$ , $^{61}\text{Ni}^{2+}$ , $^{62}\text{Ni}^{2+}$ , $^{64}\text{Ni}^{2+}$ , $^{66}\text{Ni}^{2+}$ , $^{68}\text{Ni}^{2+}$ , $^{70}\text{Ni}^{2+}$ , $^{72}\text{Ni}^{2+}$ , $^{74}\text{Ni}^{2+}$ , $^{76}\text{Ni}^{2+}$ , $^{78}\text{Ni}^{2+}$ , $^{80}\text{Ni}^{2+}$ , $^{82}\text{Ni}^{2+}$ , $^{84}\text{Ni}^{2+}$ , $^{86}\text{Ni}^{2+}$ , $^{88}\text{Ni}^{2+}$ , 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$^{810}\text{Ni}^{2+}$ , $^{812}\text{Ni}^{2+}$ , $^{814}\text{Ni}^{2+}$ , $^{816}\text{Ni}^{2+}$ , $^{818}\text{Ni}^{2+}$ , $^{820}\text{Ni}^{2+}$ , $^{822}\text{Ni}^{2+}$ , $^{824}\text{Ni}^{2+}$ , $^{826}\text{Ni}^{2+}$ , $^{828}\text{Ni}^{2+}$ , $^{830}\text{Ni}^{2+}$ , $^{832}\text{Ni}^{2+}$ , $^{834}\text{Ni}^{2+}$ , $^{836}\text{Ni}^{2+}$ , $^{838}\text{Ni}^{2+}$ , $^{840}\text{Ni}^{2+}$ , $^{842}\text{Ni}^{2+}$ , $^{844}\text{Ni}^{2+}$ , $^{846}\text{Ni}^{2+}$ , $^{848}\text{Ni}^{2+}$ , $^{850}\text{Ni}^{2+}$ , $^{852}\text{Ni}^{2+}$ , $^{854}\text{Ni}^{2+}$ , $^{856}\text{Ni}^{2+}$ , $^{858}\text{Ni}^{2+}$ , $^{860}\text{Ni}^{2+}$ , $^{862}\text{Ni}^{2+}$ , $^{864}\text{Ni}^{2+}$ , $^{866}\text{Ni}^{2+}$ , $^{868}\text{Ni}^{2+}$ , $^{870}\text{Ni}^{2+}$ , $^{872}\text{Ni}^{2+}$ , $^{874}\text{Ni}^{2+}$ , $^{876}\text{Ni}^{2+}$ , $^{878}\text{Ni}^{2+}$ , $^{880}\text{Ni}^{2+}$ , $^{882}\text{Ni}^{2+}$ , $^{884}\text{Ni}^{2+}$ , $^{886}\text{Ni}^{2+}$ , $^{888}\text{Ni}^{2+}$ , $^{890}\text{Ni}^{2+}$ , $^{892}\text{Ni}^{2+}$ , $^{894}\text{Ni}^{2+}$ , $^{896}\text{Ni}^{2+}$ , $^{898}\text{Ni}^{2+}$ , $^{900}\text{Ni}^{2+}$ , $^{902}\text{Ni}^{2+}$ , $^{904}\text{Ni}^{2+}$ , $^{906}\text{Ni}^{2+}$ , $^{908}\text{Ni}^{2+}$ , $^{910}\text{Ni}^{2+}$ , $^{912}\text{Ni}^{2+}$ , $^{914}\text{Ni}^{2+}$ , $^{916}\text{Ni}^{2+}$ , $^{918}\text{Ni}^{2+}$ , $^{920}\text{Ni}^{2+}$ , $^{922}\text{Ni}^{2+}$ , $^{924}\text{Ni}^{2+}$ , $^{926}\text{Ni}^{2+}$ , $^{928}\text{Ni}^{2+}$ , $^{930}\text{Ni}^{2+}$ , $^{932}\text{Ni}^{2+}$ , $^{934}\text{Ni}^{2+}$ , $^{936}\text{Ni}^{2+}$ , $^{938}\text{Ni}^{2+}$ , $^{940}\text{Ni}^{2+}$ , $^{942}\text{Ni}^{2+}$ , $^{944}\text{Ni}^{2+}$ , $^{946}\text{Ni}^{2+}$ , $^{948}\text{Ni}^{2+}$ , $^{950}\text{Ni}^{2+}$ , $^{952}\text{Ni}^{2+}$ , $^{954}\text{Ni}^{2+}$ , $^{956}\text{Ni}^{2+}$ , $^{958}\text{Ni}^{2+}$ , $^{960}\text{Ni}^{2+}$ , $^{962}\text{Ni}^{2+}$ , $^{964}\text{Ni}^{2+}$ , $^{966}\text{Ni}^{2+}$ , $^{968}\text{Ni}^{2+}$ , $^{970}\text{Ni}^{2+}$ , $^{972}\text{Ni}^{2+}$ , $^{974}\text{Ni}^{2+}$ , $^{976}\text{Ni}^{2+}$ , $^{978}\text{Ni}^{2+}$ , $^{980}\text{Ni}^{2+}$ , $^{982}\text{Ni}^{2+}$ , $^{984}\text{Ni}^{2+}$ , $^{986}\text{Ni}^{2+}$ , $^{988}\text{Ni}^{2+}$ , $^{990}\text{Ni}^{2+}$ , $^{992}\text{Ni}^{2+}$ , $^{994}\text{Ni}^{2+}$ , $^{996}\text{Ni}^{2+}$ , $^{998}\text{Ni}^{2+}$ , $^{1000}\text{Ni}^{2+}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of **IQ Net International Certification Network**:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**

10.6 **MIL-STD-45662A (Obsolete/Observed)**

# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010318



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** May 02, 2003

**Expiration Date:**

**EXPIRES**  
12/2004

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

**Certificate Prepared By:** JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

**Certificate Approved By:** Katalin Le, QC Supervisor

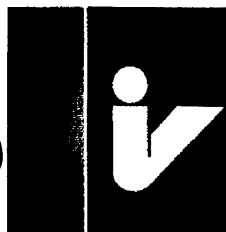
*Katalin Le*

**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

INORGANIC LABS/RADCHEM LABS  
DATE RECEIVED: 11/5/03 242  
DATE EXPIRED: 12/1/2004 QR  
DATE OPENED: 11/5/03  
INORG: 4319 PO: F52258

010319



inorganic ventures / iv labs

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

CUSTOM-GRADE SOLUTION 1000 µg/mL Silver in 3.5% HNO<sub>3</sub> (abs)

Catalog Number: CGAG1-1, CGAG1-2 and CGAG1-5

Lot Number: T-AG02015

Starting Material:  
 Starting Material Purity:  
 Starting Material Lot No:

Silver Metal  
 99.999%  
 F15102

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 08/26/03  
 DATE EXPIRED: 09/01/2004 V03  
 DATE OPENED: 08/26/03  
 INORG: 4222 PO: F52224

## CERTIFIED CONCENTRATION: 1001 ± 2 µg/mL

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

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

(\bar{x}) = mean

x<sub>i</sub> = individual results

n = number of measurements

Σs<sub>i</sub> = The summation of all significant estimated errors.

Classical Wet Assay: 1004 ± 3 µg/mL

Method: Volhard Titration vs NIST SRM 999a Potassium Chloride

Instrument Analysis: 1001 ± 2 µg/mL

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3151.

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

## TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:

Custom-Grade solutions tested for trace metallic impurities 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.

Q	Al	<0.00010	M	Dy	<0.00060	Q	Li	<0.000030	M	Pr	<0.000030	Q	Te	<0.030
M	Sb	<0.000050	M	Er	<0.00060	M	Lu	<0.000040	M	Re	<0.00010	M	Tb	<0.000030
Q	As	<0.0050	M	Eu	<0.00030	Q	Mg	<0.000040	M	Rh	<0.00010	M	Tl	<0.00010
M	Ba	<0.0010	M	Gd	<0.00010	Q	Mn	<0.00030	M	Rb	<0.00010	M	Th	<0.00010
Q	Be	<0.00050	M	Ga	<0.00010	Q	Hg	0.00090	M	Ru	<0.00020	M	Tm	<0.000040
M	Bi	<0.000040	M	Ge	<0.00060	M	Mo	<0.00020	M	Sr	<0.00010	M	Sn	<0.00050
Q	B	<0.0020	Q	Au	<0.012	M	Nd	<0.00020	M	Sc	<0.0010	Q	Ti	<0.00070
Q	Cd	<0.0020	M	Hf	<0.00020	Q	Ni	<0.0070	Q	Se	<0.036	M	W	<0.0010
Q	Ce	<0.000050	M	Ho	<0.000050	M	Nb	<0.000050	Q	Si	<0.0030	M	U	<0.00020
M	Ce	<0.00050	Q	In	<0.020	n	Os		z	Ag		M	V	<0.00020
M	Cs	<0.000030	M	Ir	<0.00050	M	Pd	<0.00050	Q	Na	<0.090	M	Yb	<0.00010
Q	Cr	<0.0020	Q	Fe	<0.00070	Q	P	<0.030	M	Sr	<0.000050	M	Y	<0.0040
M	Co	<0.00030	M	La	<0.000050	M	Pt	<0.00020	Q	S	<0.020	Q	Zn	<0.0010
M	Cu	<0.00060	M	Pb	<0.00030	Q	K	<0.0060	M	Ta	<0.00070	M	Zr	<0.00050

M - checked by ICP-MS

O - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.024 g/mL

QA:KL Rev. 002102200

Quality Assurance Manager

Expires:

**EXPIRES**  
 1/2004



**QUALITY STANDARD DOCUMENTATION****1.ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)**

Members of IQ Net : Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter) , Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland(PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

**2.ISO/IEC Guide 34-2000 "General Requirements for the Competence of Reference Material Producers" - Reference Materials Production - Accredited A2LA Certificate 883.02****3.ISO/IEC17025-1999 "General Requirements for the Competence of Testing and Calibration" - Chemical Testing - Accredited A2LA Certificate 883.01****4.MIL-STD-45662A****5.10CFR50 Appendix B - Nuclear Regulatory Commission - Domestic Licencing of Production and Utilization Facilities****6.10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance**

Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION**

**Shelf Life** -The length of time that a properly stored and packaged standard will remain within the specified uncertainty. Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.

**Expiration Date** -The date after which a standard solution should not be used. A one year expiration date is recommended by most state and federal regulatory agencies. Transpiration issues and repeated use of solutions over a one year period may adversely affect the integrity of the standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799 INT'L 1-732-901-1900 FAX 1-732-901-1903

E-MAIL IVtech@ivstandards.com

010321

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Arsenic in 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGAS1-1, CGAS1-2, and CGAS1-5  
 Lot Number: W-AS02022  
 Starting Material: POLYCRYSTALLINE LUMP  
 Starting Material Purity (%): 99.998994  
 Starting Material Lot No 23115  
 Matrix: 1.4% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg 1 of 2

DATE RECEIVED: 01/30/04

DATE EXPIRED: 02/01/2005 VMS

DATE OPENED: 01/30/04

INORG: 4433 PU: F52301

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

Certified Concentration: 1014 ± 3 µg/mL

Certified Density: 1.012 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(s)}{n^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$s$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 1014 ± 3 µg/mL (Avg 2 runs)

ICP Assay NIST SRM 3103a Lot Number: 891003

Assay Method #2 1008 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00038	<u>M</u> Dy < 0.01596	<u>Q</u> Li 0.00009	<u>M</u> Pr < 0.00080	<u>M</u> Te < 0.07978
<u>Q</u> Sb < 0.01000	<u>M</u> Er < 0.01330	<u>M</u> Lu < 0.00106	<u>Q</u> Re < 0.01000	<u>M</u> Tb < 0.00080
<u>s</u> As	<u>M</u> Eu < 0.00798	<u>Q</u> Mg 0.00009	<u>M</u> Rh < 0.00266	<u>M</u> Tl < 0.00266
<u>M</u> Ba < 0.02660	<u>M</u> Gd < 0.00266	<u>Q</u> Mn < 0.00003	<u>M</u> Rb < 0.00266	<u>M</u> Th < 0.00266
<u>M</u> Be < 0.00133	<u>M</u> Ga < 0.00266	<u>Q</u> Hg < 0.01200	<u>M</u> Ru < 0.00532	<u>M</u> Tm < 0.00106
<u>M</u> Bi < 0.00106	<u>M</u> Ge < 0.01596	<u>M</u> Mo < 0.00532	<u>M</u> Sm < 0.00266	<u>Q</u> Sn 0.00049
<u>Q</u> B < 0.01200	<u>M</u> Au < 0.00798	<u>M</u> Nd < 0.00532	<u>M</u> Sc < 0.02660	<u>M</u> Ti < 0.13297
<u>M</u> Cd < 0.00798	<u>M</u> Hf < 0.00532	<u>M</u> Ni < 0.02128	<u>M</u> Se < 0.02128	<u>M</u> W < 0.02660
<u>Q</u> Ca 0.00189	<u>M</u> Ho < 0.00133	<u>Q</u> Nb < 0.00200	<u>Q</u> Si 0.00415	<u>M</u> U < 0.00532
<u>M</u> Ce < 0.01330	<u>M</u> In < 0.02660	<u>n</u> Os	<u>M</u> Ag < 0.00532	<u>M</u> V < 0.00532
<u>M</u> Cs < 0.00080	<u>M</u> Ir < 0.01330	<u>M</u> Pd < 0.01330	<u>Q</u> Na 0.00159	<u>M</u> Yb < 0.00266
<u>M</u> Cr < 0.01330	<u>Q</u> Fe < 0.00110	<u>Q</u> P < 0.00260	<u>M</u> Sr < 0.00133	<u>M</u> Y < 0.10638
<u>M</u> Co < 0.00798	<u>M</u> La < 0.00133	<u>M</u> Pt < 0.00532	<u>Q</u> S < 0.02500	<u>Q</u> Zn 0.00057
<u>M</u> Cu < 0.01596	<u>M</u> Pb < 0.00798	<u>Q</u> K 0.00132	<u>M</u> Ta < 0.01862	<u>M</u> Zr < 0.01330

M - Checked by ICP-MS    Q - 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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 74.9216; mix of +3 and +5; 6;  $\text{H}_3\text{AsO}_4$  and  $\text{HAsO}_2$ .

**Chemical Compatibility** - Arsenic has no cationic chemistry. It is soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HF}$  aqueous matrices water and  $\text{NH}_4\text{OH}$ . It is stable with most inorganic anions (forms arsenate when boiled with chromate) but many cationic metals form the insoluble arsenates under pH neutral conditions. When fluorinated and / or under acidic conditions arsenate formation is typically not a problem at moderate to low concentrations.

**Stability** - 2-100 ppb levels stable for months alone or mixed with other elements at equivalent levels in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5%  $\text{HNO}_3$  / LDPE container.

**As Containing Samples (Preparation and Solution)** -  $\text{As}^0$  (soluble in 1:1  $\text{H}_2\text{O}$  /  $\text{HNO}_3$ ). Oxides (the oxide exists in crystalline and amorphous forms where the amorphous form is more water soluble. The oxides typically dissolve in dilute acidic solutions when boiled). Minerals (One gram of powdered sample is fused in a  $\text{Ni}^0$  crucible with 10 grams of a 1:1 mix of  $\text{K}_2\text{CO}_3$  and  $\text{KNO}_3$  and the melt extracted with hot water); Organic Matrices (0.2 to 0.5 grams of the sample are fused with 15 grams of a 1:1  $\text{Na}_2\text{CO}_3$  /  $\text{Na}_2\text{O}_2$  mix in a  $\text{Ni}^0$  crucible. The fuseate is extracted with water and acidified with  $\text{HNO}_3$ ).

**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 at $\lambda$ Doncs.)
ICP-OES 189.042 nm	0.05 / 0.005 $\mu\text{g/mL}$	1	atom	Cr
ICP-OES 193.696 nm	0.1 / 0.01 $\mu\text{g/mL}$	1	atom	V, Ge
ICP-OES 228.812 nm	0.1 / 0.01 $\mu\text{g/mL}$	1	atom	Cd, Pt, Ir, Co
ICP-MS 75 amu	20 ppt	n/a	M	$^{20}\text{Ar}^{18}\text{Cl}$ , $^{35}\text{Co}^{18}\text{O}$ , $^{37}\text{Ar}^{18}\text{H}$ , $^{39}\text{Ar}^{18}\text{Cl}$ , $^{39}\text{Ar}^{18}\text{K}$ , $^{140}\text{Nd}^{21}$ , $^{150}\text{Sm}^{21}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 01/20/04

DATE EXPIRED: 02/01/2005 103

DATE OPENED: 01/20/04

INORG: 4433 PO: F52301

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: May 01, 2003

Expiration Date: **EXPIRES**  
11/2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

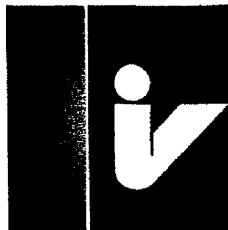
Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*  
*Katalin Le*  
*Paul Gaines*

010325

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Lead in 0.35% (abs) HNO<sub>3</sub>

Catalog Number: CGPB1-1, CGPB1-2, and CGPB1-5  
 Lot Number: W-PB02114  
 Starting Material: Pb(NO<sub>3</sub>)<sub>2</sub>  
 Starting Material Purity (%): 99.999974  
 Starting Material Lot No: 22150  
 Matrix: 0.35% (abs) HNO<sub>3</sub>

- 3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1006 ± 2 µg/mL

**Certified Density:** 1.002 g/mL (measured at 22° C)

The Certified Value is the wet assay value. The following equations are used in the calculations of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum S$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

$$\text{Uncertainty } (\pm) = \frac{2(\sum S)^{1/2}}{(n)^{1/2}}$$

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

- 4.1 **Assay Method #1** 1005 ± 2 µg/mL  
 ICP Assay NIST SRM 3128 Lot Number: 991504
- Assay Method #2** 1006 ± 2 µg/mL  
 EDTA NIST SRM 928 Lot Number: 880710

INORGANIC LABS/RADCHEM LABS 162  
 DATE RECEIVED: 11/3/03  
 DATE EXPIRED: 11/1/04  
 DATE OPENED: 11/3/03  
 INORG: 4313  
 PO: F52258

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00270	<u>M</u> Dy < 0.01193	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00060	<u>M</u> Te < 0.05965
<u>M</u> Sb < 0.00099	<u>M</u> Er < 0.00994	<u>M</u> Lu < 0.00080	<u>M</u> Re < 0.00199	<u>M</u> Tb < 0.00060
<u>M</u> As < 0.01989	<u>M</u> Eu < 0.00597	<u>Q</u> Mg 0.00008	<u>Q</u> Rh < 0.00900	<u>Q</u> Tl 0.00130
<u>M</u> Ba < 0.01989	<u>M</u> Gd < 0.00199	<u>M</u> Mn < 0.00795	<u>M</u> Rb < 0.00199	<u>M</u> Th < 0.00199
<u>M</u> Be < 0.00099	<u>M</u> Ga < 0.00199	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00398	<u>M</u> Tm < 0.00080
<u>Q</u> Bi < 0.02000	<u>M</u> Ge < 0.01193	<u>M</u> Mo < 0.00398	<u>M</u> Sm < 0.00199	<u>M</u> Sn < 0.00994
<u>Q</u> B < 0.04000	<u>M</u> Au < 0.00597	<u>M</u> Nd < 0.00398	<u>M</u> Sc < 0.01989	<u>M</u> Ti < 0.09942
<u>M</u> Cd < 0.00597	<u>M</u> Hf < 0.00398	<u>M</u> Ni < 0.01591	<u>M</u> Se < 0.01591	<u>M</u> W < 0.01989
<u>Q</u> Ca 0.00009	<u>M</u> Ho < 0.00099	<u>M</u> Nb < 0.00099	<u>Q</u> Si < 0.00340	<u>M</u> U < 0.00398
<u>M</u> Ce < 0.00994	<u>M</u> In < 0.01989	<u>n</u> Os	<u>M</u> Ag < 0.00398	<u>M</u> V < 0.00398
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.00994	<u>M</u> Pd < 0.00994	<u>Q</u> Na < 0.00600	<u>M</u> Yb < 0.00199
<u>M</u> Cr < 0.00994	<u>Q</u> Fe 0.00011	<u>Q</u> P < 0.00500	<u>M</u> Sr < 0.00099	<u>M</u> Y < 0.07954
<u>M</u> Co < 0.00597	<u>M</u> La < 0.00099	<u>M</u> Pt < 0.00398	<u>Q</u> S < 0.10000	<u>M</u> Zn < 0.03977
<u>M</u> Cu < 0.01193	<u>s</u> Pb	<u>Q</u> K < 0.00180	<u>M</u> Ta < 0.01392	<u>M</u> Zr < 0.00994

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 207.2; +2; 6;  $\text{Pb}(\text{H}_2\text{O})_6^{2+}$

**Chemical Compatibility** - Soluble in HCl, HF and  $\text{HNO}_3$ . Avoid  $\text{H}_2\text{SO}_4$ . Stable with most metals and inorganic anions forming insoluble carbonate, borate, sulfate, sulfite, sulfide, phosphate, oxalate, chromate, tannate, iodate, and cyanide in neutral aqueous media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5%  $\text{HNO}_3$  / LDPE container.

**Pb Containing Samples (Preparation and Solution)** - Metal (Best dissolved in 1:1  $\text{H}_2\text{O}$  /  $\text{HNO}_3$ ); Oxides (The many different Pb oxides are soluble in  $\text{HNO}_3$  with the exception of  $\text{PbO}_2$  which is soluble in HCl or HF); Ores and Alloys (Best attacked using 1:1  $\text{H}_2\text{O}$  /  $\text{HNO}_3$ ); Organic Matrices (Dry ash and dissolve in dilute HCl).

**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 at $\mu\text{g/L}$ concs.)
ICP-OES 168.215 nm	0.03 / 0.003 $\mu\text{g/mL}$	1	ion	Co
ICP-OES 220.353 nm	0.04 / 0.006 $\mu\text{g/mL}$	1	ion	Bi, Nb
ICP-OES 217.000 nm	0.09 / 0.03 $\mu\text{g/mL}$	1	atom	W, Ir, Hf, Sb, Th
ICP-MS 208 amu	5 ppt	n/a	M	$^{235}\text{Pt}^{18}\text{O}$ , $^{235}\text{Os}^{18}\text{O}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

## 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

## 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



## 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (Bmwa), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

## 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

## 10.6 MIL-STD-45662A (Obsolete/Observed)



# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010328



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

INORGANIC LABS/RADCHEM LABS 2 of 2  
DATE RECEIVED: 11/3/03  
DATE EXPIRED: 11/1/04 DL  
DATE OPENED: 11/3/03  
INORG: 4313 PO: F52258

Certification Date: January 23, 2003

Expiration Date: **EXPIRES**  
1/2004

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*  
*Katalin Le*  
*Paul Gaines*

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Antimony in 0.7% (abs) HNO<sub>3</sub> / 3% Tartaric Acid

Catalog Number: CGSB1-1, CGSB1-2 and CGSB1-5  
 Lot Number: W-SB02078  
 Starting Material: Sb shot  
 Starting Material Purity (%): 99.989188  
 Starting Material Lot No: D17L24  
 Matrix: 0.7% (abs) HNO<sub>3</sub> / 3% Tartaric Acid

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

Certified Concentration: 1005 ± 2 µg/mL  
 Certified Density: 1.019 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

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

$\sum s_i$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 **Assay Method #1** 1005 ± 2 µg/mL (Avg 2 runs)  
 ICP Assay NIST SRM 3102a Lot Number: 990707  
**Assay Method #2** 1000 µg/mL  
 Gravimetric NIST SRM Lot Number: See Sec. 4.2

INORGANIC LABS/RADCHEM LABS Pg 1 of 2  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 V103  
 DATE OPENED: 02/25/04  
 INORG: 4464 PO: F52323

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.04519	<u>M</u> Dy < 0.00597	<u>Q</u> Li 0.00004	<u>M</u> Pr < 0.00030	<u>M</u> Te < 0.02983
<u>S</u> Sb	<u>M</u> Er < 0.00497	<u>M</u> Lu < 0.00040	<u>M</u> Re < 0.00099	<u>M</u> Tb < 0.00030
<u>M</u> As < 0.00994	<u>M</u> Eu < 0.00298	<u>Q</u> Mg 0.00171	<u>M</u> Rh < 0.00099	<u>M</u> Tl 0.00040
<u>Q</u> Ba 0.00003	<u>M</u> Gd < 0.00099	<u>Q</u> Mn 0.00321	<u>M</u> Rb < 0.00099	<u>M</u> Th < 0.00099
<u>Q</u> Be < 0.00001	<u>M</u> Ga < 0.00099	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00199	<u>M</u> Tm < 0.00040
<u>M</u> Bi 0.00170	<u>M</u> Ge < 0.00597	<u>M</u> Mo < 0.00199	<u>M</u> Sm < 0.00099	<u>M</u> Sn 0.00050
<u>Q</u> B 0.00100	<u>M</u> Au < 0.00298	<u>M</u> Nd < 0.00199	<u>Q</u> Sc < 0.00018	<u>Q</u> Ti 0.00131
<u>M</u> Cd < 0.00298	<u>M</u> Hf < 0.00199	<u>Q</u> Ni 0.00100	<u>M</u> Se < 0.49711	<u>M</u> W < 0.00994
<u>Q</u> Ca 0.00884	<u>M</u> Ho < 0.00050	<u>M</u> Nb < 0.00050	<u>Q</u> Si 0.00502	<u>M</u> U < 0.00199
<u>Q</u> Ce < 0.00300	<u>M</u> In < 0.00994	<u>n</u> Os	<u>M</u> Ag < 0.00199	<u>M</u> V < 0.00199
<u>M</u> Cs < 0.00030	<u>M</u> Ir < 0.00497	<u>M</u> Pd < 0.00497	<u>Q</u> Na 0.00362	<u>M</u> Yb < 0.00099
<u>Q</u> Cr 0.00954	<u>Q</u> Fe 0.01306	<u>Q</u> P < 0.04000	<u>M</u> Sr < 0.00050	<u>M</u> Y < 0.03977
<u>M</u> Co < 0.00298	<u>Q</u> La < 0.00120	<u>M</u> Pt < 0.00199	<u>i</u> S	<u>Q</u> Zn 0.00141
<u>Q</u> Cu 0.00321	<u>M</u> Pb 0.00060	<u>Q</u> K 0.01004	<u>M</u> Ta < 0.00696	<u>M</u> Zr < 0.00497

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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 121.75; +3;  $\text{Sb}(\text{O})\text{C}_2\text{H}_3\text{O}_4^-$

**Chemical Compatibility** - Stable in concentrated HCl, dilute or concentrated HF. Stable in dilute  $\text{HNO}_3$  as the fluoride or tartrate complex. Avoid basic media. Stable with most metals and inorganic anions in acidic media as the tartrate provided the acidity is not too high or the acid is oxidizing causing loss of the stabilizing tartrate ion. The fluoride complex of antimony is stable in strong acid but you should only mix with other metals that are fluorinated.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-2%  $\text{HNO}_3$  / LDPE container.

**Sb Containing Samples (Preparation and Solution)** - Metal and alloys (Soluble in  $\text{H}_2\text{O}$  / HF /  $\text{HNO}_3$  mixture); Oxides (Soluble in HCl and tartaric acid or  $\text{H}_2\text{O}$  / HF /  $\text{HNO}_3$  mixtures); Ores (Fusion with  $\text{Na}_2\text{CO}_3$  in  $\text{Pt}$  followed by dissolving the fuseate in a  $\text{H}_2\text{O}$  / HF /  $\text{HNO}_3$  mixture); Organic based (Sulfuric acid / hydrogen peroxide digestion)

**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 at $\lambda$ or $\nu$ )
ICP-OES 206.833 nm	0.03 / 0.003 $\mu\text{g/mL}$	1	atom	Ta, Cr, Ge, Hf
ICP-OES 217.581 nm	0.05 / 0.005 $\mu\text{g/mL}$	1	atom	Nb, W, Re, Fe,
ICP-OES 231.147 nm	0.06 / 0.006 $\mu\text{g/mL}$	1	atom	Ni, Co, Pt
ICP-MS 121 amu	5 ppt	na	M'	$^{107}\text{Pd}^{+}$ , $^{171}\text{Y}^{+}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)



INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
 DATE RECEIVED: 03/25/04  
 DATE EXPIRED: 03/01/2005 VOS  
 DATE OPENED: 03/25/04  
 INORG: 4464 PO: F52323

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: July 23, 2003

Expiration Date: **EXPIRES**  
1/23/05

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

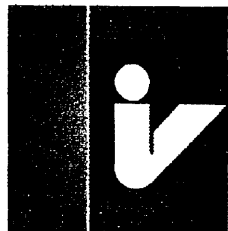
*JoAnn Struthers*

Certificate Approved By: Katalin Le, QC Supervisor

*Katalin Le*

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*


**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

**1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02.** The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

**2.0 DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Selenium in 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGSE1-1, CGSE1-2, and CGSE1-5

Lot Number: T-SE01102

Starting Material: Se shot

Starting Material Purity (%): 99.9971

Starting Material Lot No C09L08

Matrix: 1.4% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 06/20/03  
 DATE EXPIRED: 07/01/2004  
 DATE OPENED: 06/23/03  
 INORG: 4152 PO: T52370

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

Certified Concentration: 995 ± 3 µg/mL

Certified Density: 1.010 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2((\sum s_i^2)^{1/2})}{(n)^{1/2}}$$

$\sum s_i^2$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

**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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

**4.1 Assay Method #1 995 ± 3 µg/mL (Avg. 2 runs)**

ICP Assay NIST SRM 3149 Lot Number: 992106

**Assay Method #2 1002 µg/mL**

Gravimetric NIST SRM Lot Number: See Sec. 4.2

**4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.

**4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00017	<u>M</u> Dy < 0.01196	<u>Q</u> Li < 0.00003	<u>M</u> Pr < 0.00060	<u>M</u> Te < 0.05981
<u>M</u> Sb 0.00160	<u>M</u> Er < 0.00997	<u>M</u> Lu < 0.00080	<u>Q</u> Re < 0.00900	<u>M</u> Tb < 0.00060
<u>Q</u> As < 0.00500	<u>M</u> Eu < 0.00598	<u>Q</u> Mg < 0.00003	<u>M</u> Rh < 0.00199	<u>M</u> Tl < 0.00199
<u>M</u> Ba < 0.01994	<u>M</u> Gd < 0.00199	<u>M</u> Mn < 0.00798	<u>M</u> Rb < 0.00199	<u>M</u> Th < 0.00199
<u>Q</u> Be < 0.00009	<u>M</u> Ga < 0.00199	<u>Q</u> Hg 0.01950	<u>Q</u> Ru 0.00220	<u>M</u> Tm < 0.00080
<u>M</u> Bi < 0.00080	<u>M</u> Ge < 0.01196	<u>Q</u> Mo < 0.00400	<u>M</u> Sm < 0.00199	<u>M</u> Sn < 0.00997
<u>Q</u> B < 0.00006	<u>M</u> Au < 0.00598	<u>M</u> Nd < 0.00399	<u>M</u> Sc < 0.01994	<u>M</u> Ti < 0.09969
<u>M</u> Cd < 0.00598	<u>M</u> Hf < 0.00399	<u>Q</u> Ni < 0.00090	<u>S</u> Se	<u>M</u> W < 0.01994
<u>Q</u> Ca 0.00200	<u>M</u> Ho < 0.00100	<u>Q</u> Nb < 0.00400	<u>Q</u> Si 0.00055	<u>M</u> U < 0.00399
<u>M</u> Ce < 0.00997	<u>M</u> In < 0.01994	<u>n</u> Os	<u>M</u> Ag 0.00070	<u>M</u> V < 0.00399
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.00997	<u>M</u> Pd < 0.00997	<u>Q</u> Na 0.00355	<u>M</u> Yb < 0.00199
<u>M</u> Cr < 0.00997	<u>Q</u> Fe 0.00060	<u>Q</u> P < 0.00300	<u>M</u> Sr < 0.00100	<u>M</u> Y < 0.07975
<u>M</u> Co < 0.00598	<u>M</u> La < 0.00100	<u>M</u> Pt < 0.00399	<u>Q</u> S 0.00500	<u>M</u> Zn < 0.03988
<u>M</u> Cu < 0.01196	<u>M</u> Pb < 0.00598	<u>Q</u> K 0.00070	<u>M</u> Ta < 0.01396	<u>Q</u> Zr < 0.00040

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 78.96; +4; 6;  $\text{H}_2\text{SeO}_4$

**Chemical Compatibility** - Soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HF}$  aqueous matrices and water. It is stable with most inorganic anions but many cationic metals form the insoluble selenites under pH neutral conditions. When fluorinated and/or under acidic conditions precipitation is typically not a problem at moderate to low concentrations.

**Stability** - 2-100 ppb levels - stable for months alone or mixed with other elements at equivalent levels - in 1 %  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5%  $\text{HNO}_3$  / LDPE container.

**Se Containing Samples (Preparation and Solution)** - Metal (Soluble in  $\text{HNO}_3$ ); Oxides (Readily soluble in water); Minerals and alloys (Acid digestion with  $\text{HNO}_3$  or  $\text{HNO}_3$  /  $\text{HF}$ ); Organic Matrices (Acid digestion with hot concentrated  $\text{H}_2\text{SO}_4$  accompanied by the careful dropwise addition of  $\text{H}_2\text{O}_2$  until clear)

**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 at 1000s.)
ICP-OES 196.026 nm	0.08 / 0.006 $\mu\text{g/mL}$	1	atom	Fe
ICP-OES 203.985 nm	0.2 / 0.05 $\mu\text{g/mL}$	1	atom	Sb, Ir, Cr, Ta
ICP-OES 206.279 nm	0.3 / 0.16 $\mu\text{g/mL}$	1	atom	Cr, Pt
ICP-MS 82 amu	200 ppt	n/a	M'	$^{13}\text{C}=^{12}\text{C}_2$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (CONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RVA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**

10.6 **MIL-STD-45662A (Obsolete/Observed)**

INORGANIC LABS/RADCHEM LABS 2 of 2  
 DATE RECEIVED: 06/20/03  
 DATE EXPIRED: 07/01/2004 v03  
 DATE OPENED: 06/23/03  
 INORG: 4152 P.O: F52370



## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: November 27, 2002

Expiration Date: **EXPIRES**

01/22/04

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Debbie Newman, QA Administrator

*Debbie Newman*

Certificate Approved By: Katalin Le, QC Supervisor

*Katalin Le*

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

010337

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Thallium in 0.5% (abs) HNO<sub>3</sub>

Catalog Number: CGTL1-1, CGTL1-2, and CGTL1-5  
 Lot Number: W-QTL01094  
 Starting Material: TLNO3  
 Starting Material Purity (%): 99.996539  
 Starting Material Lot No: 22928  
 Matrix: 0.5% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 01/20/04  
 DATE EXPIRED: 02/01/2005 v03  
 DATE OPENED: 01/20/04  
 INORG: 4435 PO: F52301

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1001 ± 4 µg/mL  
 Certified Density: 1.002 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\sum s_i^2$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 1001 ± 4 µg/mL (Avg 2 runs)  
 ICP Assay NIST SRM 3158 Lot Number: 993012  
 Assay Method #2 1000 µg/mL  
 Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>M</u> Al < 0.01000	<u>M</u> Dy < 0.00600	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00030	<u>M</u> Te < 0.03000
<u>M</u> Sb < 0.00050	<u>M</u> Er < 0.00500	<u>M</u> Lu < 0.00040	<u>M</u> Re < 0.00100	<u>M</u> Tb < 0.00030
<u>M</u> As < 0.01000	<u>M</u> Eu < 0.00300	<u>Q</u> Mg 0.00012	<u>M</u> Rh < 0.00100	<u>s</u> Tl
<u>M</u> Ba < 0.01000	<u>M</u> Gd < 0.00100	<u>M</u> Mn < 0.00400	<u>M</u> Rb < 0.00100	<u>M</u> Th < 0.00100
<u>M</u> Be < 0.00050	<u>M</u> Ga < 0.00100	<u>Q</u> Hg < 0.01200	<u>M</u> Ru < 0.00200	<u>M</u> Tm < 0.00040
<u>M</u> Bi < 0.00040	<u>M</u> Ge < 0.00600	<u>M</u> Mo < 0.00200	<u>M</u> Sm < 0.00100	<u>M</u> Sn < 0.00500
<u>Q</u> B < 0.00140	<u>M</u> Au < 0.00300	<u>M</u> Nd < 0.00200	<u>M</u> Sc < 0.01000	<u>M</u> Ti < 0.05000
<u>Q</u> Cd 0.00150	<u>M</u> Hf < 0.00200	<u>M</u> Ni < 0.00800	<u>M</u> Se < 0.00800	<u>M</u> W < 0.01000
<u>Q</u> Ca 0.00085	<u>M</u> Ho < 0.00050	<u>M</u> Nb < 0.00050	<u>Q</u> Si < 0.00340	<u>M</u> U < 0.00200
<u>M</u> Ce < 0.00500	<u>M</u> In < 0.01000	<u>n</u> Os	<u>M</u> Ag 0.04000	<u>M</u> V < 0.00200
<u>M</u> Cs < 0.00030	<u>M</u> Ir < 0.00500	<u>M</u> Pd < 0.00500	<u>Q</u> Na 0.00050	<u>M</u> Yb < 0.00100
<u>M</u> Cr < 0.00500	<u>Q</u> Fe 0.00030	<u>Q</u> P < 0.00260	<u>M</u> Sr < 0.00050	<u>M</u> Y < 0.04000
<u>M</u> Co < 0.00300	<u>M</u> La < 0.00050	<u>M</u> Pt < 0.00200	<u>Q</u> S < 0.03000	<u>Q</u> Zn 0.00110
<u>M</u> Cu < 0.00600	<u>M</u> Pb 0.00210	<u>Q</u> K < 0.00180	<u>M</u> Ta < 0.00700	<u>M</u> Zr < 0.00500

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 204.383; +1; 6;  $\text{Ti}(\text{H}_2\text{O})_6^{3+}$ .

**Chemical Compatibility** - Soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$ . Stable with most metals and inorganic anions. The sulfite, thiocyanate and oxalate are moderately soluble; the phosphate and arsenite are slightly soluble and the sulfide is insoluble.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5%  $\text{HNO}_3$  / LDPE container.

**Ti Containing Samples (Preparation and Solution)** - Metal (Best dissolved in  $\text{HNO}_3$  which forms chiefly the  $\text{Ti}^{3+}$  ion.); Oxide (The thallic oxide is readily soluble in water. The thallic oxide requires high levels of acid); Ores (Carbonate fusion in  $\text{P}^{1+}$  followed by  $\text{HCl}$  dissolution); Organic Matrices (Sulfuric/peroxide digestion or dry ash and dissolution in  $\text{HCl}$ ).

**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 at $\lambda$ lines)
ICP-OES 190.864 nm	0.04 / 0.004 $\mu\text{g/mL}$	1	ion	V, Ti
ICP-OES 276.787 nm	0.1 / 0.01 $\mu\text{g/mL}$	1	atom	Ta, V, Fe, Cr
ICP-OES 351.924 nm	0.2 / 0.02 $\mu\text{g/mL}$	1	atom	Th, Ce, Zr
ICP-MS 205 amu	2 ppt	n/a	M <sup>+</sup>	$^{132}\text{Os}^{16}\text{O}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (OQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS 2 of 2

DATE RECEIVED: 01/20/04  
 DATE EXPIRED: 02/01/2005 v05  
 DATE OPENED: 01/20/04  
 INDRG: 4435 PU: F52301

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: December 09, 2003

Expiration Date: **EXPIRES**  
12 2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Debbie Newman, Production Manager

Certificate Approved By: Katalin Le, QC Manager

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Debbie Newman*  
*Katalin Le*  
*Paul Gaines*

010341



# Certificate of Analysis

**CUSTOM-GRADE SOLUTION**
**1000 µg/mL Lanthanum in 1.4% HNO<sub>3</sub> (abs)**

Catalog Number: CGLA1-1 and CGLA1-5

Lot Number: T-QLA01057

 Starting Material:  
 Starting Material Purity:  
 Starting Material Lot No:

 Lanthanum Oxide  
 99.999%  
 LA-0-5-017

INORGANIC LABS/RADCHEM LABS

 DATE RECEIVED: 08/26/03  
 DATE EXPIRED: 09/01/2004  
 DATE OPENED: 08/26/03  
 INORG: 4221 PO: F52224

**CERTIFIED CONCENTRATION: 1002 ± 3 µg/mL**

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

 $\bar{x}$  = mean  $x_i$  = individual results

n = number of measurements

 $\sum s_i$  = The summation of all significant estimated errors.

**Classical Wet Assay: 1002 ± 3 µg/mL**

Method: EDTA Titration vs NIST SRM 928 Lead Nitrate.

**Instrument Analysis: 1007 ± 3 µg/mL**

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3127a.

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

**TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:**

Custom-Grade solutions tested for trace metallic impurities 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.

<u>Q</u> Al <0.040	<u>M</u> Dy <0.00060	<u>M</u> Li <0.0010	<u>Q</u> Pr <0.020	<u>M</u> Te <0.0030
<u>M</u> Sb <0.000050	<u>M</u> Er 0.0010	<u>M</u> Lu 0.000040	<u>M</u> Re <0.00010	<u>M</u> Tb <0.000030
<u>M</u> As <0.0010	<u>M</u> Eu <0.00030	<u>M</u> Mg <0.0030	<u>M</u> Rh <0.00010	<u>M</u> Tl <0.00010
<u>Q</u> Ba <0.020	<u>M</u> Gd 0.039	<u>M</u> Mn <0.00040	<u>M</u> Rb <0.00010	<u>M</u> Th <0.00010
<u>M</u> Be <0.000050	<u>M</u> Ga <0.00010	<u>Q</u> Hg <0.030	<u>M</u> Ru <0.00020	<u>M</u> Tm <0.000040
<u>M</u> Bi <0.000040	<u>M</u> Ge <0.00060	<u>M</u> Mo <0.00020	<u>M</u> Sm 0.00040	<u>M</u> Sn <0.00050
<u>Q</u> B <0.020	<u>M</u> Au <0.00030	<u>M</u> Nd 0.00020	<u>M</u> Sc <0.0010	<u>M</u> Ti <0.0050
<u>M</u> Cd <0.00030	<u>M</u> Hf <0.00020	<u>Q</u> Ni <0.050	<u>Q</u> Se <0.40	<u>M</u> W <0.0010
<u>Q</u> Ca <0.010	<u>M</u> Ho 0.00010	<u>M</u> Nb <0.000050	<u>Q</u> Si <0.020	<u>M</u> U <0.00020
<u>i</u> Ce	<u>Q</u> In <0.030	<u>n</u> Os	<u>M</u> Ag <0.00020	<u>M</u> V <0.00020
<u>n</u> Cs	<u>M</u> Ir <0.00050	<u>M</u> Pd <0.00050	<u>Q</u> Na <0.090	<u>M</u> Yb <0.00010
<u>M</u> Cr <0.00050	<u>Q</u> Fe <0.050	<u>Q</u> P <0.050	<u>M</u> Sr <0.000050	<u>M</u> Y <0.0040
<u>M</u> Co <0.00030	<u>s</u> La	<u>M</u> Pt <0.00020	<u>n</u> S	<u>M</u> Zn <0.0020
<u>M</u> Cu <0.00060	<u>M</u> Pb <0.00030	<u>n</u> K	<u>M</u> Ta <0.00070	<u>M</u> Zr <0.00050

M - checked by ICP-MS

Q - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

**ANALYZED DENSITY OF SOLUTION** (measured at 22°C): 1.009 g/mL

(over)

QA:KSL Rev.121702DM

**Inorganic Ventures, Inc.**

195 Lehigh Avenue • Suite 4 • Lakewood, NJ 08701

Orders: 800-669-6799 • FAX (732) 901-1903

Technical Support: 800-569-6799

Quality Assurance Manager

**EXPIRES**  
 12/2004

**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)  
**Members of IQ Net :** Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter) , Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland(PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)
  2. ISO/IEC Guide 34-2000 "General Requirements for the Competence of Reference Material Producers" - Reference Materials Production - Accredited A2LA Certificate 883.02
  3. ISO/IEC 17025-1999 "General Requirements for the Competence of Testing and Calibration" - Chemical Testing - Accredited A2LA Certificate 883.01
  4. MIL-STD-45662A
  5. 10CFR50 Appendix B - Nuclear Regulatory Commission - Domestic Licencing of Production and Utilization Facilities
  6. 10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance
- Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION**

- Shelf Life -** The length of time that a properly stored and packaged standard will remain within the specified uncertainty. Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.
- Expiration Date -** The date after which a standard solution should not be used. A one year expiration date is recommended by most state and federal regulatory agencies. Transpiration issues and repeated use of solutions over a one year period may adversely affect the integrity of the standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799 INT'L 1-732-901-1900 FAX 1-732-901-1903 E-MAIL IVtech@ivstandards.com



## inorganic ventures / iv labs

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Palladium in 3.3% (abs) HCL

Catalog Number: CGPD1-1 and CGPD1-5  
 Lot Number: W-PD02019  
 Starting Material: Pd(NO<sub>3</sub>)<sub>2</sub>  
 Starting Material Purity (%): 99.999248  
 Starting Material Lot No: 11974A-00  
 Matrix: 3.3% (abs) HCL

INORGANIC LABS/RADCHEM LABS Pg. 4 of 2  
 DATE RECEIVED: 03/01/04  
 DATE EXPIRED: 03/01/2005 YDS  
 DATE OPENED: 03/01/04  
 INORG: 4477 PO: F52323

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 994 ± 3 µg/mL

Certified Density: 1.022 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

n = number of measurements

$\sum s_i^2$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

- 4.1 Assay Method #1 994 ± 3 µg/mL (Avg 2 runs)  
 ICP Assay NIST SRM 3138 Lot Number: 990207  
 Assay Method #2 1000 µg/mL  
 Gravimetric NIST SRM Lot Number: See Sec. 4.2



- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00400	<u>M</u> Dy < 0.00060	<u>Q</u> Li < 0.04000	<u>M</u> Pr < 0.00003	<u>Q</u> Te < 0.01300
<u>Q</u> Sb < 0.00500	<u>M</u> Er < 0.00050	<u>M</u> Lu < 0.00004	<u>M</u> Re < 0.00010	<u>M</u> Tb < 0.00003
<u>Q</u> As < 0.01400	<u>M</u> Eu < 0.00030	<u>Q</u> Mg < 0.01100	<u>Q</u> Rh < 0.00600	<u>M</u> Tl < 0.00010
<u>M</u> Ba < 0.00100	<u>M</u> Gd < 0.00010	<u>Q</u> Mn < 0.00650	<u>M</u> Rb < 0.00010	<u>M</u> Th < 0.00010
<u>Q</u> Be < 0.00009	<u>M</u> Ga < 0.00010	<u>Q</u> Hg < 0.01100	<u>Q</u> Ru < 0.00200	<u>M</u> Tm < 0.00004
<u>M</u> Bi < 0.00004	<u>M</u> Ge < 0.00060	<u>M</u> Mo < 0.00020	<u>M</u> Sm < 0.00010	<u>Q</u> Sn < 0.00700
<u>Q</u> B < 0.00090	<u>Q</u> Au < 0.00300	<u>M</u> Nd < 0.00020	<u>Q</u> Sc < 0.00009	<u>Q</u> Ti < 0.00100
<u>Q</u> Cd < 0.00600	<u>M</u> Hf < 0.00020	<u>Q</u> Ni 0.01800	<u>M</u> Se < 0.00080	<u>M</u> W < 0.00100
<u>Q</u> Ca 0.00700	<u>M</u> Ho < 0.00005	<u>M</u> Nb < 0.00005	<u>Q</u> Si 0.00600	<u>M</u> U < 0.00020
<u>M</u> Ce < 0.00050	<u>Q</u> In < 0.03300	<u>n</u> Os	<u>Q</u> Ag < 0.00670	<u>M</u> V < 0.00020
<u>M</u> Cs < 0.00003	<u>M</u> Ir < 0.00050	<u>S</u> Pd	<u>Q</u> Na 0.01500	<u>M</u> Yb < 0.00010
<u>Q</u> Cr 0.00450	<u>Q</u> Fe 0.04600	<u>Q</u> P 0.00600	<u>M</u> Sr < 0.00005	<u>M</u> Y < 0.00400
<u>M</u> Co < 0.00030	<u>M</u> La < 0.00005	<u>Q</u> Pt < 0.00600	<u>Q</u> S < 0.02500	<u>Q</u> Zn < 0.00060
<u>Q</u> Cu 0.00360	<u>M</u> Pb < 0.00030	<u>Q</u> K < 0.02000	<u>M</u> Ta < 0.00070	<u>M</u> Zr < 0.00050

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

## 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** - 106.42; +2; 6; Pd(H<sub>2</sub>O)<sub>4</sub><sup>2+</sup>

**Chemical Compatibility** - Stable in HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, HF, H<sub>3</sub>PO<sub>4</sub>. Avoid basic media. Stable with most metals and inorganic anions in acidic media. Avoid contact with water soluble organics such as aldehydes since Pd<sup>2+</sup> is easily reduced.

**Stability** - 2-100 ppb levels. 2ppb Pd is stable for 1 day in 1% HNO<sub>3</sub> / LDPE container. 10 ppb is stable for 3 days in 1% HNO<sub>3</sub> / LDPE container. 100 ppb is stable for 6 months in 1% HNO<sub>3</sub> / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO<sub>3</sub> / LDPE container.

**Pd Containing Samples (Preparation and Solution)** - Metal (Soluble in HNO<sub>3</sub> or Aqua Regia) Oxides (Soluble in HCl) Ores (Dissolve in HCl / HNO<sub>3</sub>).

**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 at all concs.)
ICP-OES 340.458 nm	0.04 / 0.003 µg/mL	1 atom	Ce, Th, Zr	
ICP-OES 368.470 nm	0.05 / 0.007 µg/mL	1 atom		
ICP-OES 229.651 nm	0.07 / 0.004 µg/mL	1 ion	Co	
ICP-MS 105 amu	2 ppt	n/a	M'	<sup>63</sup> Ar <sup>63</sup> Cu, <sup>88</sup> Y <sup>88</sup> O

- 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 procedure IV-MPM-004 and is guaranteed to be homogeneous.
- 10.0 **QUALITY STANDARD DOCUMENTATION**

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

**Recognized by:**

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)



**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (Bmwa), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**

10.6 **MIL-STD-45662A (Obsolete/Observed)**

11.0 **DATE OF CERTIFICATION AND PERIOD OF VALIDITY**



11.1 **IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** March 14, 2003

**Expiration Date:**

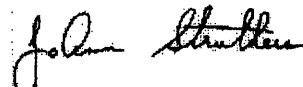
**EXPIRES**

01/12/05

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
 DATE RECEIVED: 03/01/04  
 DATE EXPIRED: 03/01/2005 VO  
 DATE OPENED: 03/01/04  
 INORG: 4477 PO: F52323

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**

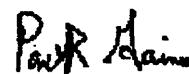
Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant



Certificate Approved By: Katalin Le, QC Supervisor



Certifying Officer: Paul Gaines, Chemist, Senior Technical Director



010347

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Sulfur in H<sub>2</sub>O

Catalog Number: CGS1-1 and CGS1-5  
 Lot Number: W-QS01098  
 Starting Material: H<sub>2</sub>SO<sub>4</sub>  
 Starting Material Purity (%): 99.999965  
 Starting Material Lot No: N38818  
 Matrix: H<sub>2</sub>O

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 11/5/03 1 of 2  
 DATE EXPIRED: 12/1/2004 DR  
 DATE OPENED: 11/5/03  
 INORG: 4317 PO: F52258

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1010 ± 2 µg/mL

Certified Density: 1.000 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i)^2}{(n)^{1/2}}$$

$\sum s_i$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 998 ± 8 µg/mL  
 ICP Assay NIST SRM 3154 Lot Number: 892205  
 Assay Method #2 1010 ± 2 µg/mL  
 Acidimetric NIST SRM 84k Lot Number: 84k

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00025	<u>M</u> Dy < 0.01197	<u>Q</u> Li < 0.00016	<u>M</u> Pr < 0.00060	<u>M</u> Te < 0.05984
<u>M</u> Sb < 0.00100	<u>M</u> Er < 0.00997	<u>M</u> Lu < 0.00080	<u>M</u> Re < 0.00200	<u>M</u> Tb < 0.00060
<u>M</u> As < 0.01995	<u>M</u> Eu < 0.00598	<u>Q</u> Mg < 0.00004	<u>M</u> Rh < 0.00200	<u>M</u> Tl < 0.00200
<u>M</u> Ba < 0.01995	<u>M</u> Gd < 0.00200	<u>M</u> Mn < 0.00798	<u>M</u> Rb < 0.00200	<u>M</u> Th < 0.00200
<u>Q</u> Be < 0.00200	<u>M</u> Ga < 0.00200	<u>Q</u> Hg < 0.01100	<u>M</u> Ru < 0.00399	<u>M</u> Tm < 0.00080
<u>M</u> Bi < 0.00080	<u>M</u> Ge < 0.01197	<u>M</u> Mo < 0.00399	<u>M</u> Sm < 0.00200	<u>M</u> Sn < 0.00997
<u>Q</u> B < 0.00990	<u>M</u> Au < 0.00598	<u>M</u> Nd < 0.00399	<u>M</u> Sc < 0.01995	<u>M</u> Ti < 0.09974
<u>M</u> Cd < 0.00598	<u>M</u> Hf < 0.00399	<u>Q</u> Ni < 0.00230	<u>Q</u> Se < 0.00620	<u>M</u> W < 0.01995
<u>Q</u> Ca 0.00020	<u>M</u> Ho < 0.00100	<u>M</u> Nb < 0.00100	<u>Q</u> Si < 0.00410	<u>M</u> U < 0.00399
<u>M</u> Ce < 0.00997	<u>M</u> In < 0.01995	<u>n</u> Os	<u>M</u> Ag < 0.00399	<u>M</u> V < 0.00399
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.00997	<u>M</u> Pd < 0.00997	<u>Q</u> Na < 0.00010	<u>M</u> Yb < 0.00200
<u>M</u> Cr < 0.00997	<u>Q</u> Fe 0.00015	<u>Q</u> P < 0.00480	<u>M</u> Sr < 0.00100	<u>M</u> Y < 0.07979
<u>M</u> Co < 0.00598	<u>M</u> La < 0.00100	<u>M</u> Pt < 0.00399	<u>s</u> S	<u>Q</u> Zn 0.00125
<u>M</u> Cu < 0.01197	<u>M</u> Pb < 0.00598	<u>Q</u> K < 0.00170	<u>M</u> Ta < 0.01396	<u>M</u> Zr < 0.00997

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 32.066; +6; 6 ( $\text{O}=\text{S}(\text{OH})_2$ ).

**Chemical Compatibility** - Soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{PO}_4$  and  $\text{HF}$  aqueous matrices water and  $\text{NH}_4\text{OH}$ . Stable with all metals and inorganic anions at low to moderate ppm levels under acidic conditions except Ba and Pb and to a lesser extent Sr, and Ca.

**Stability** - 2-100 ppb levels - stability unknown - in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in LDPE container.

**S Containing Samples (Preparation and Solution)** - We most often get questions about the determination of S in Rocks, Silicates and insoluble sulfates (the finely powdered sample is fused in a Pt\* crucible with 60 times its weight of  $\text{Na}_2\text{CO}_3$  + 0.5 grams  $\text{KNO}_3$ . The fuseate is extracted with water. Any  $\text{BaSO}_4$  present in the sample is transposed by the carbonate fusion to the  $\text{BaCO}_3$ , which is left behind in the water-insoluble residue. If  $\text{PbSO}_4$  is present the fuseate should be boiled with a sodium carbonate saturated with  $\text{CO}_2$  solution for 1 hour or more where the  $\text{PbSO}_4$  will be transposed to the water insoluble carbonate which can be filtered off. Boiling the fuseate with a saturated carbonate solution is good insurance for samples containing Ba, Sr, and Ca. The Ba, Pb, Sr, Ca, free filtrate can be acidified and measured by ICP.)

**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 at $\mu\text{g/L}$ concs.)
ICP-OES 166.669nm	0.2 / 0.19 $\mu\text{g/mL}$	1	atom	<u>Si</u> , B
ICP-OES 182.034 nm	0.3 / 0.024 $\mu\text{g/mL}$	1	atom	
ICP-OES 143.328 nm	0.4 / 0.035 $\mu\text{g/mL}$	1	atom	
ICP-MS 32 amu	30,000 ppt	n/a	M	$^{16}\text{O}_2$ , $^{14}\text{N}^{16}\text{O}$ , $^{14}\text{N}^{17}\text{O}$ , $^{15}\text{N}^{16}\text{O}$ , $^{15}\text{N}^{17}\text{O}$ , $^{13}\text{C}^{16}\text{O}$

**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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

**10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

**10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01

**10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

**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**

**10.6 MIL-STD-45662A (Obsolete/Observed)**



010350

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 11/5/03 *242*  
 DATE EXPIRED: 12/1/2004 *DR*  
 DATE OPENED: 11/5/03  
 INORG: 4317 PO: F52258

Certification Date: August 27, 2003

Expiration Date: **EXPIRES**  
 12/2004

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*  
*Katalin Le*  
*Paul Gaines*



# Certificate of Analysis



## CUSTOM-GRADE SOLUTION

Catalog Number: CGTH1-1 and CGTH1-5

1000 µg/mL Thorium in 3% HNO<sub>3</sub> (abs)

Lot Number: T-TH01059

Starting Material:  
Starting Material Purity:  
Starting Material Lot No:

Thorium Nitrate  
99.999%  
C01L32

INORGANIC LABS/RADCHEM LABS  
DATE RECEIVED: 10/08/03  
DATE EXPIRED: 11/01/2004 V03  
DATE OPENED: 10/08/03  
INORG: 4283 PO: F52240

## CERTIFIED CONCENTRATION: 1001 ± 3 µg/mL

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum s_i$  = The summation of all significant estimated errors.

Classical Wet Assay: 1001 ± 3 µg/mL  
Method: EDTA Titration vs NIST SRM Lead Nitrate.

Instrument Analysis: 1002 ± 4 µg/mL  
Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3159.

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

## TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:

Custom-Grade solutions tested for trace metallic impurities 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.

Q Al <0.00090	M Dy 0.0062	Q Li <0.000030	M Pr 0.00037	Q Te <0.031
M Sb <0.000050	M Er <0.00050	M Lu <0.000040	M Re <0.00010	M Tb <0.000030
Q As <0.014	M Eu <0.00030	Q Mg <0.000060	M Rh <0.00010	M Tl <0.00010
M Ba 0.0050	M Gd 0.0054	Q Mn <0.0000030	M Rb <0.00010	s Th
Q Be <0.00020	M Ga <0.00010	Q Hg	M Ru <0.00020	M Tm <0.000040
M Bi <0.000040	M Ge <0.00060	M Mo <0.00020	M Sm 0.0095	M Sn <0.00050
Q B <0.00060	M Au <0.00030	M Nd 0.0026	M Sc <0.0010	Q Ti <0.00092
Q Cd <0.0045	M Hf <0.00020	Q Ni <0.0023	M Se <0.010	M W <0.0010
Q Ca <0.030	M Ho 0.00022	M Nb <0.000050	Q Si <0.0034	M U 0.074
M Ce <0.00050	Q In <0.0020	n Os	M Ag <0.00020	M V <0.00020
M Cs <0.000030	M Ir <0.00050	M Pd <0.00050	Q Na <0.00010	M Yb <0.00010
Q Cr <0.00080	Q Fe <0.0011	i P	M Sr <0.000050	M Y <0.0040
M Co <0.00030	M La <0.000050	M Pt <0.00020	Q S <0.072	Q Zn <0.00058
M Cu <0.00060	M Pb <0.00030	Q K <0.0017	M Ta <0.00070	M Zr 0.0085

M - checked by ICP-MS

Q - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.022 g/mL

QA:KL Rev. 050802DN

(over)

### Inorganic Ventures, Inc.

195 Lehigh Avenue • Suite 4 • Lakewood, NJ 08701

Orders: 800-669-6799 • FAX (732) 901-1903

Technical Support: 800-569-6799

Paul R. Gaines

Quality Assurance Manager

EXPIRES  
01/02/04



**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)  
**Members of IQ Net :** Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQI), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)
  2. ISO/IEC Guide 34-2000 "General Requirements for the Competence of Reference Material Producers" - Reference Materials Production - Accredited A2LA Certificate 883.02
  3. ISO/IEC17025-1999 "General Requirements for the Competence of Testing and Calibration" - Chemical Testing - Accredited A2LA Certificate 883.01
  4. MIL-STD-45662A
  5. 10CFR50 Appendix B - Nuclear Regulatory Commission - Domestic Licencing of Production and Utilization Facilities
  6. 10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance
- Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION**

- Shelf Life -** The length of time that a properly stored and packaged standard will remain within the specified uncertainty. Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.
- Expiration Date -** The date after which a standard solution should not be used. A one year expiration date is recommended by most state and federal regulatory agencies. Transpiration issues and repeated use of solutions over a one year period may adversely affect the integrity of the standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799 INT'L 1-732-901-1900 FAX 1-732-901-1903 E-MAIL IVtech@ivstandards.com



inorganic ventures / iv labs

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195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Uranium In 1% (abs) HNO<sub>3</sub>

Catalog Number: CGU1-1 and CGU1-5  
Lot Number: W-U01059  
Starting Material: UO<sub>2</sub>(NO<sub>3</sub>)2.6H<sub>2</sub>O  
Starting Material Purity (%): 99.994419  
Starting Material Lot No: RB0018  
Matrix: 1% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
DATE RECEIVED: 02/25/04  
DATE EXPIRED: 03/01/2005 V05  
DATE OPENED: 02/25/04  
INORG: 4473 PO: F52323

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 997 ± 2 µg/mL

Certified Density: 1.021 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(s)}{(n)^{1/2}}$$

$s$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 997 ± 2 µg/mL

ICP Assay NIST SRM 3164 Lot Number: 891509

Assay Method #2 1000 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 **BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 **THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 **GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>M</u> Al 0.05166	<u>M</u> Dy < 0.01494	<u>M</u> Li < 0.02490	<u>M</u> Pr < 0.00075	<u>M</u> Te < 0.07470
<u>M</u> Sb < 0.00125	<u>M</u> Er < 0.01245	<u>M</u> Lu < 0.00100	<u>M</u> Re < 0.00249	<u>M</u> Tb 0.00003
<u>M</u> As < 0.02490	<u>M</u> Eu < 0.00747	<u>M</u> Mg < 0.07470	<u>M</u> Rh < 0.00249	<u>M</u> Tl < 0.00249
<u>M</u> Ba < 0.02490	<u>M</u> Gd 0.00310	<u>M</u> Mn 0.00083	<u>M</u> Rb < 0.00249	<u>M</u> Th < 0.00249
<u>M</u> Be < 0.00125	<u>M</u> Ga < 0.00249	i Hg	<u>M</u> Ru < 0.00498	<u>M</u> Tm < 0.00100
<u>M</u> Bi < 0.00100	<u>M</u> Ge < 0.01494	<u>M</u> Mo 0.00093	<u>M</u> Sm 0.00010	<u>Q</u> Sn < 0.10000
<u>M</u> B < 0.17429	<u>M</u> Au < 0.00747	<u>M</u> Nd < 0.00498	<u>M</u> Sc < 0.02490	<u>M</u> Ti 0.00258
<u>M</u> Cd 0.00103	<u>M</u> Hf < 0.00498	<u>M</u> Ni < 0.01992	<u>M</u> Se < 0.01992	<u>M</u> W < 0.02490
<u>Q</u> Ca 0.05395	<u>M</u> Ho 0.00052	<u>M</u> Nb < 0.00125	i Si	s U
<u>M</u> Ce 0.00010	<u>M</u> In < 0.02490	n Os	<u>M</u> Ag < 0.00498	<u>M</u> V < 0.00498
<u>M</u> Cs < 0.00075	<u>M</u> Ir < 0.01245	<u>M</u> Pd < 0.01245	<u>Q</u> Na 0.00664	<u>M</u> Yb < 0.00249
<u>M</u> Cr < 0.01245	<u>M</u> Fe < 0.49798	i P	<u>M</u> Sr < 0.00125	<u>M</u> Y 0.00062
<u>M</u> Co < 0.00747	<u>M</u> La 0.00145	<u>M</u> Pt < 0.00498	i S	<u>M</u> Zn 0.00114
<u>M</u> Cu 0.00072	<u>M</u> Pb 0.00217	i K	<u>M</u> Ta < 0.01743	<u>M</u> Zr < 0.01245

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

010355

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 238.0289; +6; 8;  $\text{UO}_2^{2+}$  (uranyl)

**Chemical Compatibility** - Soluble in  $\text{HCl}$  and  $\text{HNO}_3$ . Avoid  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HF}$  matrices should not be a problem depending upon [U]. Although the  $\text{UO}_2^{2+}$  ion is distinctly basic, any  $\text{U}^{4+}$  will precipitate in basic media.  $\text{UO}_2^{2+}$  salts are generally soluble in water and  $\text{UO}_2^{2+}$  is stable with most metals and inorganic anions. The uranyl phosphate is insoluble in water.  $\text{UF}_4$  and  $\text{UF}_6$  are water soluble.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5%  $\text{HNO}_3$  / LDPE container.

**U Containing Samples (Preparation and Solution)** - Metal (Dissolves rapidly in  $\text{HCl}$  and  $\text{HNO}_3$ ), Oxide (Soluble in  $\text{HNO}_3$ ), Ores (Digest for 1-2 hours with 1 gram of ore to 30 mL 1:1  $\text{HNO}_3$ . Silica insolubles are removed by filtration after bringing the sample to fumes with conc.  $\text{H}_2\text{SO}_4$ .)

**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 at $\text{a} = 0.005$ )
ICP-OES 365.958 nm	0.3 / 0.01 $\mu\text{g/mL}$	1	ion	Th, Fe
ICP-OES 367.007 nm	0.3 / 0.02 $\mu\text{g/mL}$	1	ion	Th, Ce
ICP-OES 263.553 nm	0.3 / 0.01 $\mu\text{g/mL}$	1	ion	Ce, Ir, Th, Rh, W, Zr, Ta, Ti, V, Hf, Fe, Re, Ru
ICP-MS 238 amu	2 ppt	n/a	M'	$^{238}\text{Pb}^{16}\text{O}_2$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

### 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

### 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



### 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

### 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

### 10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg 2 of 2

DATE RECEIVED: 02/25/04

DATE EXPIRED: 03/01/2005

DATE OPENED: 02/25/04

INORG: 4473 PO: F52323

**\*NOTICE TO ICP-MS USERS:** The  $^{235}\text{U}$  in this standard is depleted. The certified abundances in Atom % are as follows:

	Isotope	Natural Abundance	IV's Certified Abundance
		Atom %	Atom %
Uranium	$^{238}\text{U}$	99.3	$99.8 \pm 0.1$
	$^{235}\text{U}$	0.70	$0.204 \pm 0.002$

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: June 10, 2003

Expiration Date:

**EXPIRES**  
1<sup>st</sup> 2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*

*Katalin Le*

*Paul Gaines*

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**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: **Certificate 1883-02.** The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Tungsten In 1% (abs) HNO<sub>3</sub>/1% (abs) HF

Catalog Number:	CGW1-1 and CGW1-5	INORGANIC LABS/RADCHEM LABS Pg. 1 of 2
Lot Number:	W-W01080	DATE RECEIVED: 07/31/03
Starting Material:	W Powder	DATE EXPIRED: 08/01/2004
Starting Material Purity (%):	99.990703	DATE OPENED: 08/01/03
Starting Material Lot No	21418, C31H46, D02J21, E03K06, D11F29	INORG: 4203 PO: E52283
Matrix:	1% (abs) HNO <sub>3</sub> /1% (abs) HF	

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1001 ± 2 µg/mL

**Certified Density:** 1.006 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$\bar{x}$  = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\sum s_i^2$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1	Assay Method #1	1001 ± 2 µg/mL (Avg 2 runs)
		ICP Assay NIST SRM 3163 Lot Number: 990209
	Assay Method #2	1000 µg/mL
		Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.01792	<u>M</u> Dy < 0.00595	<u>Q</u> Li < 0.00008	<u>M</u> Pr < 0.00030	<u>M</u> Te < 0.02974
<u>M</u> Sb < 0.00050	<u>M</u> Er < 0.00496	<u>M</u> Lu < 0.00040	<u>i</u> Re	<u>M</u> Tb < 0.00030
<u>M</u> As < 0.00991	<u>M</u> Eu < 0.00297	<u>Q</u> Mg 0.00120	<u>M</u> Rh < 0.00099	<u>M</u> Tl < 0.00099
<u>M</u> Ba < 0.00991	<u>M</u> Gd < 0.00099	<u>M</u> Mn < 0.00397	<u>M</u> Rb < 0.00099	<u>M</u> Th < 0.00099
<u>M</u> Be < 0.00050	<u>M</u> Ga < 0.00099	<u>Q</u> Hg < 0.04778	<u>M</u> Ru < 0.00198	<u>M</u> Tm < 0.00040
<u>M</u> Bi < 0.00040	<u>M</u> Ge < 0.00595	<u>M</u> Mo 0.00050	<u>M</u> Sm < 0.00099	<u>M</u> Sn < 0.00496
<u>Q</u> B < 1.19460	<u>M</u> Au < 0.00297	<u>M</u> Nd < 0.00198	<u>Q</u> Sc < 0.00036	<u>M</u> Ti 0.00198
<u>M</u> Cd < 0.00297	<u>M</u> Hf < 0.00198	<u>M</u> Ni < 0.00793	<u>M</u> Se < 0.00793	<u>S</u> W
<u>Q</u> Ca 0.00080	<u>M</u> Ho < 0.00050	<u>Q</u> Nb < 0.06371	<u>Q</u> Si < 0.01354	<u>M</u> U < 0.00198
<u>M</u> Ce < 0.00496	<u>M</u> In < 0.00991	<u>n</u> Os	<u>M</u> Ag < 0.00198	<u>M</u> V < 0.00198
<u>M</u> Cs < 0.00030	<u>M</u> Ir < 0.00496	<u>M</u> Pd < 0.00496	<u>Q</u> Na 0.04778	<u>M</u> Yb < 0.00099
<u>M</u> Cr < 0.00496	<u>Q</u> Fe < 0.03982	<u>n</u> P	<u>M</u> Sr < 0.00050	<u>M</u> Y < 0.03965
<u>M</u> Co < 0.00297	<u>M</u> La < 0.00050	<u>M</u> Pt < 0.00198	<u>n</u> S	<u>M</u> Zn < 0.01983
<u>M</u> Cu < 0.00595	<u>M</u> Pb 0.00080	<u>Q</u> K 0.03146	<u>Q</u> Ta < 0.39820	<u>M</u> Zr 0.00079

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 183.85; +6; 6, 7, 8, 9 WOF,  $\text{WOF}_6$  (chemical form as received)

**Chemical Compatibility** - W is very readily hydrolyzed requiring 0.1 to 1% HF solutions for stable acidic solutions. The  $\text{WOF}_6$  is soluble in % levels of HCl and  $\text{HNO}_3$ , provided it is in the  $\text{WOF}_6$  form. Stable at ppm levels with some metals provided it is fluorinated. Do not mix with Alkaline or Rare Earths. Is best to be mixed only with other fluorinated metals (Ti, Zr, Hf, Nb, Ta, Mo, Si, Sn, Ge). Look for yellow  $\text{WO}_3$  precipitate if mixed with other transition elements at higher levels indicating instability. The yellow  $\text{WO}_3$  will form over a period of weeks even in trace HF, therefore, HF levels of W multi-element blends should be ~ 1 %.

**Stability** - 2-100 ppb levels stable (Alone or mixed with all other metals that are at comparable levels) as the  $\text{WOF}_6$  for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm single element solutions as the  $\text{WOF}_6$  chemically stable for years in 1% HF in an LDPE container.

**W Containing Samples (Preparation and Solution)** - Metal (Soluble in HF /  $\text{HNO}_3$ ); Oxide (Soluble in HF or  $\text{NH}_4\text{OH}$ ); Organic Matrices (Dry ash at  $450^\circ\text{C}$  in  $\text{Pt}$  and dissolve oxide with HF).

**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 at $\text{WOF}_6$ )
ICP-OES 207.911 nm	0.03 / 0.001 $\mu\text{g/mL}$	1	ion	Ru, In
ICP-OES 224.875 nm	0.05 / 0.005 $\mu\text{g/mL}$	1	ion	Co, Rh, Ag
ICP-OES 209.475 nm	0.05 / 0.005 $\mu\text{g/mL}$	1	ion	Mo
ICP-MS 182 amu	5 ppt	n/a	M	$^{140}\text{Er}^{+4}$

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

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**

10.6 **MIL-STD-45662A (Obsolete/Observed)**



INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
 DATE RECEIVED: 07/31/03  
 DATE EXPIRED: 08/01/2004 v0  
 DATE OPENED: 08/01/03  
 INORG: 4203 PO: F52383



## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: February 10, 2003

Expiration Date: **EXPIRES**  
12/2004

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*

*Katalin Le*

*Paul Gaines*

010361

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**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Yttrium in 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGY1-1, CGY1-2, and CGY1-5  
 Lot Number: X-QY01101  
 Starting Material: Y2O3  
 Starting Material Purity (%): 99.999727  
 Starting Material Lot No 9918901OYL  
 Matrix: 1.4% (abs) HNO<sub>3</sub>

- 3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1006 ± 2 µg/mL

Certified Density: 1.010 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum S$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

$$\text{Uncertainty } (\pm) = \frac{2(\sum S)}{(n)^{1/2}}$$

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

- 4.1 Assay Method #1 1004 ± 4 µg/mL  
 ICP Assay NIST SRM 3167a Lot Number: 790412  
 Assay Method #2 1006 ± 2 µg/mL  
 EDTA NIST SRM 928 Lot Number: 880710

INORGANIC LABS/RADCHEM LABS P. 1 of 2

DATE RECEIVED: 03/30/04  
 DATE EXPIRED: 04/01/2005 Y00  
 DATE OPENED: 03/30/04  
 INORG: 4513 PO: F53361

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00024	<u>M</u> Dy < 0.00595	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00030	<u>M</u> Te < 0.02976
<u>Q</u> Sb < 0.01000	<u>M</u> Er < 0.00496	<u>M</u> Lu < 0.00040	<u>M</u> Re < 0.00099	<u>M</u> Tb < 0.00030
<u>M</u> As < 0.00992	<u>M</u> Eu < 0.00298	<u>Q</u> Mg 0.00015	<u>M</u> Rh < 0.00099	<u>M</u> Tl < 0.00099
<u>M</u> Ba < 0.00992	<u>M</u> Gd < 0.00099	<u>Q</u> Mn < 0.00002	<u>M</u> Rb < 0.00099	<u>M</u> Th < 0.00099
<u>M</u> Be < 0.00050	<u>M</u> Ga < 0.00099	<u>Q</u> Hg < 0.02000	<u>M</u> Ru < 0.00198	<u>M</u> Tm < 0.00040
<u>M</u> Bi < 0.00040	<u>M</u> Ge < 0.00595	<u>M</u> Mo < 0.00198	<u>M</u> Sm < 0.00099	<u>M</u> Sn < 0.00496
<u>Q</u> B 0.00013	<u>M</u> Au < 0.00298	<u>M</u> Nd < 0.00198	<u>Q</u> Sc < 0.00003	<u>M</u> Ti < 0.04959
<u>M</u> Cd < 0.00298	<u>M</u> Hf < 0.00198	<u>M</u> Ni < 0.00794	<u>M</u> Se < 0.00794	<u>M</u> W < 0.00992
<u>Q</u> Ca 0.00100	<u>M</u> Ho < 0.00050	<u>M</u> Nb < 0.00050	<u>Q</u> Si 0.00170	<u>M</u> U < 0.00198
<u>M</u> Ce < 0.00496	<u>M</u> In < 0.00992	<u>n</u> Os	<u>Q</u> Ag < 0.02000	<u>Q</u> V < 0.00080
<u>M</u> Cs < 0.00030	<u>M</u> Ir < 0.00496	<u>Q</u> Pd < 0.10000	<u>Q</u> Na < 0.05000	<u>M</u> Yb < 0.00099
<u>M</u> Cr < 0.00496	<u>Q</u> Fe 0.00070	<u>Q</u> P < 0.07000	<u>Q</u> Sr < 0.00004	<u>s</u> Y
<u>M</u> Co < 0.00298	<u>M</u> La < 0.00050	<u>M</u> Pt < 0.00198	<u>Q</u> S < 0.04300	<u>Q</u> Zn 0.00025
<u>M</u> Cu < 0.00595	<u>M</u> Pb < 0.00298	<u>Q</u> K < 0.10000	<u>M</u> Ta < 0.00694	<u>Q</u> Zr < 0.00070

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 88.9059; +3; 6;  $\text{Y}(\text{OH})(\text{H}_2\text{O})_5^{3+}$

**Chemical Compatibility** - Soluble in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3$ . Avoid  $\text{HF}$ ,  $\text{H}_3\text{PO}_4$ , 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%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5%  $\text{HNO}_3$  / LDPE container.

**Y Containing Samples (Preparation and Solution)** - Metal (Soluble in acids), Oxide (Dissolve by heating in  $\text{H}_2\text{O}/\text{HNO}_3$ ), Ores (Carbonate fusion in  $\text{Pt}^*$  followed by  $\text{HCl}$  dissolution), Organic Matrices (Dry ash and dissolve in 1:1  $\text{H}_2\text{O}/\text{HCl}$  or  $\text{HNO}_3$ ).

**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 at $\mu\text{g/L}$ concs.)
ICP-OES 360.073 nm	0.005 / 0.000036 $\mu\text{g/mL}$	1	ion	Ce, Th
ICP-OES 371.030 nm	0.004 / 0.00007 $\mu\text{g/mL}$	1	ion	Ce
ICP-OES 377.433 nm	0.005 / 0.0009 $\mu\text{g/mL}$	1	ion	Ta, Th
ICP-MS 89 amu	0.8 ppt	n/a	M'	$^{10}\text{Ge}^{16}\text{O}$ , $^{17}\text{Hf}^{16}\text{O}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland(PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg 2 of 2

DATE RECEIVED: 03/30/04  
DATE EXPIRED: 04/01/2005 v03  
DATE OPENED: 03/30/04  
INORG: 4513 PO: F53361

# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010364



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** February 24, 2004

**Expiration Date:**

**EXPIRES**  
1/2/2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

**Certificate Prepared By:** JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

**Certificate Approved By:** Katalin Le, QC Manager

*Katalin Le*

**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

010365

**inorganic ventures / iv labs**

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 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Zirconium in H<sub>2</sub>O tr. HNO<sub>3</sub> tr. HF

Catalog Number: CGZR1-1 and CGZR1-5  
 Lot Number: W-ZR01056  
 Starting Material: ZrO<sub>2</sub>  
 Starting Material Purity (%): 99.994542  
 Starting Material Lot No: 22855  
 Matrix: H<sub>2</sub>O tr. HNO<sub>3</sub> tr. HF

INORGANIC LABS/RADCHEM LABS Pg 1 of 2  
 DATE RECEIVED: 01/23/04  
 DATE EXPIRED: 08/01/2005 v03  
 DATE OPENED: 01/23/04  
 INORG: 4442 PO: F52306

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1004 ± 2 µg/mL

Certified Density: 0.999 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\sum S$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 1004 ± 2 µg/mL (Avg 2 runs)

ICP Assay NIST SRM 3169 Lot Number: 990109

Assay Method #2 1000 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.01416	<u>M</u> Dy < 0.01188	<u>Q</u> Li < 0.00012	<u>M</u> Pr < 0.00059	<u>M</u> Te < 0.05942
<u>M</u> Sb < 0.00099	<u>M</u> Er < 0.00990	<u>M</u> Lu < 0.00079	<u>M</u> Re < 0.00198	<u>M</u> Tb < 0.00059
<u>M</u> As < 0.01981	<u>M</u> Eu < 0.00594	<u>Q</u> Mg < 0.00012	<u>M</u> Rh < 0.00198	<u>M</u> Tl < 0.00198
<u>M</u> Ba < 0.01981	<u>M</u> Gd < 0.00198	<u>Q</u> Mn < 0.00401	<u>M</u> Rb < 0.00198	<u>M</u> Th < 0.00198
<u>Q</u> Be < 0.40048	<u>M</u> Ga < 0.00198	<u>Q</u> Hg < 0.04405	<u>M</u> Ru < 0.00396	<u>M</u> Tm < 0.00079
<u>M</u> Bi < 0.00079	<u>M</u> Ge < 0.01188	<u>Q</u> Mo < 0.40048	<u>M</u> Sm < 0.00198	<u>M</u> Sn < 0.00990
<u>M</u> B < 0.13864	<u>M</u> Au < 0.00594	<u>M</u> Nd < 0.00396	<u>Q</u> Sc < 0.00064	<u>Q</u> Ti < 0.16019
<u>Q</u> Cd < 0.02123	<u>M</u> Hf 0.04403	<u>Q</u> Ni 0.01214	<u>M</u> Se < 0.01585	<u>M</u> W < 0.01981
<u>Q</u> Ca 0.00809	<u>M</u> Ho < 0.00099	<u>Q</u> Nb < 0.08010	<u>Q</u> Si < 0.80096	<u>M</u> U < 0.00396
<u>M</u> Ce < 0.00990	<u>M</u> In < 0.01981	<u>n</u> Os	<u>Q</u> Ag < 0.40048	<u>M</u> V < 0.00396
<u>M</u> Cs < 0.00059	<u>M</u> Ir < 0.00990	<u>M</u> Pd < 0.00990	<u>Q</u> Na < 0.02803	<u>M</u> Yb < 0.00198
<u>Q</u> Cr < 0.00881	<u>Q</u> Fe 0.00344	<u>Q</u> P < 0.01922	<u>M</u> Sr < 0.00099	<u>Q</u> Y < 0.00401
<u>M</u> Co < 0.00594	<u>M</u> La < 0.00099	<u>M</u> Pt < 0.00396	<u>Q</u> S < 0.28033	<u>Q</u> Zn < 0.04005
<u>M</u> Cu < 0.01188	<u>M</u> Pb < 0.00594	<u>Q</u> K < 0.00681	<u>M</u> Ta < 0.01386	<u>s</u> Zr

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 91.224; +4; 6, 7, 8,  $\text{Zr}(\text{F})_6^{2-}$

**Chemical Compatibility** - Soluble in concentrated  $\text{HCl}$ ,  $\text{HF}$ ,  $\text{H}_2\text{SO}_4$  (very hot) and  $\text{HNO}_3$ . Avoid  $\text{H}_3\text{PO}_4$  and neutral to basic media. Unstable at ppm levels with metals that would pull F<sup>-</sup> 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 but precipitation with phosphate, oxalate, and tartrate with a tendency to hydrolyze forming the hydrated oxide in all dilute acids except  $\text{HF}$ .

**Stability** - 2-100 ppb levels stable (alone or mixed with all other metals that are at comparable levels) as the  $\text{Zr}(\text{F})_6^{2-} + \text{Zr}(\text{OH})_2\text{F}_2^{2-}$  for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm single element solutions as the  $\text{Zr}(\text{F})_6^{2-}$  chemically stable for years in 2-5%  $\text{HNO}_3$  / trace  $\text{HF}$  in an LDPE container.

**Zr Containing Samples (Preparation and Solution)** - Metal (Soluble in  $\text{H}_2\text{O}$  /  $\text{HF}$  /  $\text{HNO}_3$ ); Oxide - unlike  $\text{TiO}_2$ , the  $\text{ZrO}_2$  is best fused in one of the following ways ( $\text{Na}_2\text{O}$ , in  $\text{Ni}^*$ ,  $\text{Na}_2\text{CO}_3$  in  $\text{Pt}^*$  or Borax in  $\text{Pt}^*$ ); Organic Matrices (Dry ash at  $450^\circ\text{C}$  in  $\text{Pt}^*$  and dissolve by fusing with  $\text{Na}_2\text{CO}_3$  and dissolving in  $\text{HF}$  /  $\text{HNO}_3$  /  $\text{H}_2\text{O}$ ).

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

Technique/Line	Estimated D.L.	Order	Type	Interferences (underlined indicates severe at $\lambda$ Doncs.)
ICP-OES 343.823 nm	0.007 / 0.0004 $\mu\text{g/mL}$	1	ion	Hf, Nb
ICP-OES 339.198 nm	0.008 / 0.0007 $\mu\text{g/mL}$	1	ion	Th, Mo
ICP-OES 272.261 nm	0.018 / 0.001 $\mu\text{g/mL}$	1	ion	Cr, V, Th, W
ICP-MS 90 amu	2 ppt	n/a	M <sup>+</sup>	<sup>90</sup> Ge <sup>+</sup> O, <sup>90</sup> Se <sup>+</sup> O, [ <sup>90</sup> X <sup>+</sup> ] (where X = Hf, Ta, W)

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

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (Bmwa), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 01/23/04  
 DATE EXPIRED: 08/31/2005  
 DATE OPENED: 01/23/04  
 INORG: 4442 PO: F52306



# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010368



- 11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.
- 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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: March 19, 2003

Expiration Date:

**EXPIRES**  
01/02/05

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*John Struthers*  
*Katalin Le*  
*Paul Gaines*


**inorganic ventures / iv labs**

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**certificate of analysis**

- 1.0** Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

**2.0 DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Barium in 0.1% (abs) HNO<sub>3</sub>

Catalog Number: CGBA1-1, CGBA1-2, and CGBA1-5  
 Lot Number: **W-BA02023**  
 Starting Material: Ba(NO<sub>3</sub>)<sub>2</sub>  
 Starting Material Purity (%): 99.999730  
 Starting Material Lot No: 21879  
 Matrix: 0.1% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2

DATE RECEIVED: 02/25/04

DATE EXPIRED: 03/31/2005 V03

DATE OPENED: 02/25/04

INORG: 4465 PO: F52333

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1001 ± 1 µg/mL

**Certified Density:** 0.999 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum S$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

$$\text{Uncertainty } (\pm) = \frac{2(\sum S)^{1/2}}{(n)^{1/2}}$$

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

**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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

**4.1 Assay Method #1** 998 ± 4 µg/mL

ICP Assay NIST SRM 3104a Lot Number: 992907

**Assay Method #2** 1001 ± 1 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 **BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 **THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 **GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00011	<u>M</u> Dy < 0.01269	<u>Q</u> Li < 0.00400	<u>M</u> Pr < 0.00063	<u>M</u> Te < 0.06343
<u>M</u> Sb < 0.00106	<u>M</u> Er < 0.01057	<u>M</u> Lu < 0.00085	<u>M</u> Re < 0.00211	<u>Q</u> Tb < 0.00390
<u>M</u> As < 0.02114	<u>Q</u> Eu < 0.00040	<u>Q</u> Mg 0.00009	<u>M</u> Rh < 0.00211	<u>M</u> Tl < 0.00211
<u>s</u> Ba	<u>Q</u> Gd < 0.00052	<u>M</u> Mn < 0.00846	<u>M</u> Rb < 0.00211	<u>M</u> Th < 0.00211
<u>M</u> Be < 0.00106	<u>M</u> Ga < 0.00211	<u>Q</u> Hg < 0.01200	<u>M</u> Ru < 0.00423	<u>M</u> Tm < 0.00085
<u>M</u> Bi < 0.00085	<u>M</u> Ge < 0.01269	<u>M</u> Mo < 0.00423	<u>Q</u> Sm < 0.00071	<u>M</u> Sn < 0.01057
<u>M</u> B < 0.14800	<u>M</u> Au < 0.00634	<u>Q</u> Nd < 0.00330	<u>M</u> Sc < 0.02114	<u>M</u> Ti < 0.10571
<u>M</u> Cd < 0.00634	<u>M</u> Hf < 0.00423	<u>M</u> Ni < 0.01691	<u>M</u> Se < 0.01691	<u>M</u> W < 0.02114
<u>Q</u> Ca 0.00072	<u>M</u> Ho < 0.00106	<u>M</u> Nb < 0.00106	<u>Q</u> Si < 0.00340	<u>M</u> U < 0.00423
<u>M</u> Ce < 0.01057	<u>M</u> In < 0.02114	<u>n</u> Os	<u>M</u> Ag < 0.00423	<u>M</u> V < 0.00423
<u>M</u> Cs < 0.00063	<u>M</u> Ir < 0.01057	<u>M</u> Pd < 0.01057	<u>M</u> Na < 0.21142	<u>M</u> Yb < 0.00211
<u>M</u> Cr < 0.01057	<u>Q</u> Fe 0.00062	<u>Q</u> P < 0.00260	<u>Q</u> Sr 0.00379	<u>Q</u> Y 0.00040
<u>M</u> Co < 0.00634	<u>M</u> La < 0.00106	<u>M</u> Pt < 0.00423	<u>Q</u> S < 0.02500	<u>Q</u> Zn < 0.00039
<u>M</u> Cu < 0.01269	<u>M</u> Pb 0.00020	<u>Q</u> K < 0.00180	<u>Q</u> Ta < 0.00690	<u>M</u> Zr < 0.01057

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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

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

010371

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 137.33, +2; 6,  $\text{Ba}(\text{H}_2\text{O})_6^{2+}$

**Chemical Compatibility** - Soluble in HCl, and  $\text{HNO}_3$ . Avoid  $\text{H}_2\text{SO}_4$ , HF and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicate, carbonate, hydroxide, oxide, fluoride, sulfate, oxalate, chromate, arsenate, iodate, molybdate, sulfite and tungstate in neutral aqueous media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1 -10,000 ppm solutions chemically stable for years in 1-3.5%  $\text{HNO}_3$  / LDPE container.

**Ba Containing Samples (Preparation and Solution)** - Metal (is best dissolved in diluted  $\text{HNO}_3$ ). Ores (Carbonate fusion in  $\text{Pt}^0$  followed by HCl dissolution. If sulfate is present dissolve the fuseate using HCl / tartaric acid to prevent  $\text{BaSO}_4$  precipitate.) Organic Matrices (dry ash and dissolve in dilute HCl.)

**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 at $\lambda$ ions.)
ICP-OES 455.403 nm	0.002 / 0.0001 $\mu\text{g/mL}$	1	ion	Zr, U
ICP-OES 233.527 nm	0.004 / 0.0003 $\mu\text{g/mL}$	1	ion	
ICP-OES 230.424 nm	0.004 / 0.0005 $\mu\text{g/mL}$	1	ion	Mo, Ir, Co
ICP-MS 138 amu	1 ppt	n/a	M'	$^{121}\text{Sn}^{10}\text{O}$ , $^{127}\text{Te}^{10}\text{O}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

10.0 **QUALITY STANDARD DOCUMENTATION**10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (OQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**10.6 **MIL-STD-45662A (Obsolete/Observed)**

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 VOS  
 DATE OPENED: 02/25/04  
 INORG: 4465 PO: F52323

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010372



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: July 28, 2003

Expiration Date:

**EXPIRES**  
12/2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*  
*Katalin Le*  
*Paul Gaines*

010373

**inorganic ventures / iv labs**

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 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Beryllium in 2% (abs) HNO<sub>3</sub>

Catalog Number: CGBE1-1, CGBE1-2, and CGBE1-5  
 Lot Number: W-BE01104  
 Starting Material: Be(OOCCH<sub>3</sub>)<sub>2</sub>  
 Starting Material Purity (%): 99.999897  
 Starting Material Lot No: 01-10-01  
 Matrix: 2% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS<sup>®</sup> 3-1062  
 DATE RECEIVED: 06/01/04  
 DATE EXPIRED: 06/01/2005 V05  
 DATE OPENED: 06/01/04  
 INORG: 4592 PO: F53393

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1007 ± 4 µg/mL

**Certified Density:** 1.023 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i)^{1/2}}{(n)^{1/2}}$$

$\sum S$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 **Assay Method #1** 1007 ± 4 µg/mL

ICP Assay NIST SRM 3105a Lot Number: 892707

**Assay Method #2** 1002 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 **BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 **THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 **GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00800	<u>M</u> Dy < 0.01305	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00065	<u>M</u> Te < 0.06525
<u>M</u> Sb < 0.00109	<u>M</u> Er < 0.01087	<u>M</u> Lu < 0.00087	<u>M</u> Re < 0.00218	<u>M</u> Tb < 0.00065
<u>M</u> As < 0.02175	<u>M</u> Eu < 0.00652	<u>Q</u> Mg < 0.00003	<u>M</u> Rh < 0.00218	<u>M</u> Tl < 0.00218
<u>M</u> Ba < 0.02175	<u>M</u> Gd < 0.00218	<u>Q</u> Mn < 0.00002	<u>M</u> Rb < 0.00218	<u>M</u> Th < 0.00218
<u>s</u> Be	<u>M</u> Ga < 0.00218	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00435	<u>M</u> Tm < 0.00087
<u>M</u> Bi < 0.00087	<u>M</u> Ge < 0.01305	<u>M</u> Mo < 0.00435	<u>M</u> Sm < 0.00218	<u>M</u> Sn < 0.01087
<u>Q</u> B < 0.01200	<u>M</u> Au < 0.00652	<u>M</u> Nd < 0.00435	<u>Q</u> Sc < 0.00009	<u>M</u> Ti < 0.10874
<u>M</u> Cd < 0.00652	<u>M</u> Hf < 0.00435	<u>M</u> Ni < 0.65245	<u>M</u> Se < 0.01740	<u>M</u> W < 0.02175
<u>Q</u> Ca 0.00164	<u>M</u> Ho < 0.00109	<u>M</u> Nb < 0.00109	<u>Q</u> Si 0.00649	<u>M</u> U < 0.00435
<u>M</u> Ce < 0.01087	<u>M</u> In < 0.02175	<u>n</u> Os	<u>M</u> Ag < 0.00435	<u>M</u> V < 0.00435
<u>M</u> Cs < 0.00065	<u>M</u> Ir < 0.01087	<u>M</u> Pd < 0.01087	<u>Q</u> Na 0.00368	<u>M</u> Yb < 0.00218
<u>Q</u> Cr < 0.00900	<u>Q</u> Fe 0.00268	<u>n</u> P	<u>M</u> Sr < 0.00109	<u>M</u> Y < 0.08699
<u>M</u> Co < 0.00652	<u>M</u> La < 0.00109	<u>M</u> Pt < 0.00435	<u>i</u> S	<u>M</u> Zn < 0.04350
<u>M</u> Cu < 0.01305	<u>M</u> Pb < 0.00652	<u>Q</u> K < 0.10000	<u>M</u> Ta < 0.01522	<u>M</u> Zr < 0.01087

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

## 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** - 9.01218; +2; 4; Be<sup>+</sup>(H<sub>2</sub>O)<sub>4</sub>.<sup>12</sup>

**Chemical Compatibility** - Soluble in HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, and HF aqueous matrices. Stable with all metals and inorganic anions.

**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 5-10 % HNO<sub>3</sub> / LDPE container.

**Be Containing Samples (Preparation and Solution)** - Meta l (is best dissolved in diluted H<sub>2</sub>SO<sub>4</sub> ). BeO (boiling nitric, hydrochloric, or sulfuric acids or KHSO<sub>4</sub> fusion). Ores (H<sub>2</sub>SO<sub>4</sub> /HF digestion or carbonate fusion in Pt<sup>+</sup>). Organic Matrices (sulfuric/peroxide digestion or nitric/sulfuric/perchloric acid decomposition, or dry ash and dissolution according to the BeO procedure above).

**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 at concs.)
ICP-OES 313.042 nm	0.0003 / 0.00009 µg/mL	1	ion	V, Ce, U
ICP-OES 234.861 nm	0.0003 / 0.00016 µg/mL	1	atom	Fe, Ta, Mo
ICP-OES 313.107 nm	0.0007 / 0.0005 µg/mL	1	ion	Ce, Th, Tm
ICP-MS 9 amu	4 ppt	n/a	M'	

- 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 procedure IV-MPM-004 and is guaranteed to be homogeneous.
- 10.0 **QUALITY STANDARD DOCUMENTATION**

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

**Recognized by:**

Registrar Accreditation Board (ANSI-RAB)  
Standards Council of Canada (SCC)  
Dutch Council for Accreditation (RVA)  
Entidad Mexicana de Acreditacion, a.c.(EMA)



**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

11.0 **DATE OF CERTIFICATION AND PERIOD OF VALIDITY**



11.1 **IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** January 08, 2004

**Expiration Date:**

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
DATE RECEIVED: 06/01/04  
DATE EXPIRED: 06/01/2005 vds  
DATE OPENED: 06/01/04  
INORG: 4592 PO: F53393

**EXPIRES**  
1/8/2005



12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

010376

Certificate Prepared By: Debbie Newman, Production Manager

*Debbie Newman*  
*Katalin Le*

Certificate Approved By: Katalin Le, QC Manager

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

010377

## inorganic ventures / iv labs

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

CUSTOM-GRADE SOLUTION 1000 µg/mL Chromium<sup>+3</sup> in 1.4% HNO<sub>3</sub> (abs)

Catalog Number: CGCR(3)1-1, CGCR(3)1-2 and CGCR(3)1-5

Lot Number: W-QCR02033

Starting Material:  
 Starting Material Purity:  
 Starting Material Lot No:

Chromium Metal  
 99.995%  
 F16122

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 11/5/03  
 DATE EXPIRED: 12/1/04  
 DATE OPENED: 11/5/03  
 INORG: 4318 PD: FS2258

## CERTIFIED CONCENTRATION: 995 ± 3 µg/mL

The Certified Value is the instrument analysis value. The following equations are used in the calculation of the certified value and the uncertainty:

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

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

n = number of measurements

$\sum S_i$  = The summation of all significant estimated errors.

Instrument Analysis: 995 ± 3 µg/mL (Avg of 3 runs)

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3112a.

Calculated Value: 1002 µg/mL

Method: Calculated, based on starting material.

## TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:

Custom-Grade solutions tested for trace metallic impurities 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.

Q	Al	0.0028	M	Dy	<0.00060	M	Li	<0.0010	M	Pr	<0.000030	M	Te	<0.0030
M	Sb	<0.000050	M	Er	<0.00050	M	Lu	<0.000040	M	Re	<0.00010	M	Tb	<0.000030
M	As	<0.0010	M	Eu	<0.00030	Q	Mg	<0.010	M	Rh	<0.00010	M	Ti	<0.00010
M	Ba	<0.0010	M	Gd	<0.00010	Q	Mn	<0.050	M	Rb	0.0066	M	Th	<0.00010
M	Be	<0.000050	M	Ga	0.00070	Q	Hg	<0.10	M	Ru	0.017	M	Tm	<0.000040
M	Bi	<0.000040	M	Ge	<0.00080	M	Mo	<0.00020	M	Sm	<0.00010	M	Sn	<0.00050
M	B	<0.0070	M	Au	<0.00030	M	Nd	<0.00020	M	Sc	<0.0010	M	Tl	<0.0050
M	Cd	<0.00030	M	Hf	<0.00020	Q	Ni	<0.10	I	Se		M	W	<0.0010
Q	Ce	0.0011	M	Ho	<0.000050	M	Nb	<0.000050	Q	Si	<0.10	M	U	<0.00020
M	Ce	<0.00050	Q	In	<0.10	n	Os		M	Ag	0.00070	I	V	
M	Cs	<0.000030	M	Ir	<0.00050	M	Pd	<0.00050	Q	Na	0.016	M	Yb	<0.00010
s	Cr		Q	Fe	<0.10	i	P		M	Sr	<0.000050	M	Y	<0.0040
Q	Co	<0.10	M	La	<0.000050	M	Pt	<0.00020	n	S		Q	Zn	<0.10
M	Cu	<0.00060	M	Pb	0.00039	n	K		M	Te	<0.00070	M	Zr	<0.00050

M - checked by ICP-MS

Q - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.010 g/mL

(over)

QA:KSL Rev 080403JTS

Paul R. Gaines

Quality Assurance Manager

Expires:

EXPIRES  
11/2004

**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)  
 Members of IQ Net : Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)
  2. ISO/IEC Guide 34-2000 "General Requirements for the Competence of Reference Material Producers" - Reference Materials Production - Accredited A2LA Certificate 883.02
  3. ISO/IEC17025-1999 "General Requirements for the Competence of Testing and Calibration" - Chemical Testing - Accredited A2LA Certificate 883.01
  4. MIL-STD-45662A
  5. 10CFR50 Appendix B - Nuclear Regulatory Commission - Domestic Licencing of Production and Utilization Facilities
  6. 10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance
- Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION**

**Shelf Life -** The length of time that a properly stored and packaged standard will remain within the specified uncertainty. Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.

**Expiration Date -** The date after which a standard solution should not be used. A one year expiration date recommended by most state and federal regulatory agencies. Transpiration issues repeated use of solutions over a one year period may adversely affect the integrity of the standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

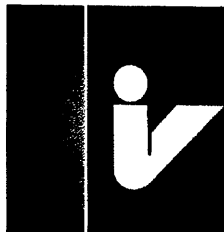
**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799 INT'L 1-732-901-1900 FAX 1-732-901-1903 E-MAIL IVtech@ivstandards.com

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0** Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

**2.0 DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Copper In 2% (abs) HNO<sub>3</sub>

Catalog Number: CGCU1-1, CGCU1-2, and CGCU1-5  
 Lot Number: W-CU02064  
 Starting Material: Cu shot  
 Starting Material Purity (%): 99.999437  
 Starting Material Lot No: K09C13  
 Matrix: 2% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2

DATE RECEIVED: 02/25/04

DATE EXPIRED: 03/01/2005 V03

DATE OPENED: 02/25/04

INORG: 4469 PO: F52323

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1005 ± 2 µg/mL

**Certified Density:** 1.014 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\sum S$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

**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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

**4.1 Assay Method #1** 1005 ± 2 µg/mL

ICP Assay NIST SRM 3114 Lot Number: 891811

**Assay Method #2** 1005 ± 2 µg/mL

EDTA NIST SRM 928 Lot Number: 880710

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00090	<u>M</u> Dy < 0.03027	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00151	<u>M</u> Te < 0.15134
<u>M</u> Sb < 0.00252	<u>M</u> Er < 0.02522	<u>M</u> Lu < 0.00202	<u>M</u> Re < 0.00504	<u>M</u> Tb < 0.00151
<u>M</u> As < 0.05045	<u>M</u> Eu < 0.01513	<u>Q</u> Mg 0.00001	<u>M</u> Rh < 0.00504	<u>M</u> Tl < 0.00504
<u>M</u> Ba < 0.05045	<u>M</u> Gd < 0.00504	<u>M</u> Mn < 0.02018	<u>M</u> Rb < 0.00504	<u>M</u> Th < 0.00504
<u>M</u> Be < 0.00252	<u>M</u> Ga < 0.00504	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.01009	<u>M</u> Tm < 0.00202
<u>M</u> Bi < 0.00202	<u>M</u> Ge < 0.03027	<u>M</u> Mo < 0.01009	<u>M</u> Sm < 0.00504	<u>Q</u> Sn 0.00439
<u>M</u> B < 0.35312	<u>M</u> Au < 0.01513	<u>M</u> Nd < 0.01009	<u>M</u> Sc < 0.05045	<u>M</u> Ti < 0.25223
<u>M</u> Cd < 0.01513	<u>M</u> Hf < 0.01009	<u>M</u> Ni < 0.04036	<u>M</u> Se < 0.04036	<u>M</u> W < 0.05045
<u>Q</u> Ca 0.00011	<u>M</u> Ho < 0.00252	<u>M</u> Nb < 0.00252	<u>Q</u> Si < 0.00340	<u>M</u> U < 0.01009
<u>M</u> Ce < 0.02522	<u>M</u> In < 0.05045	<u>n</u> Os	<u>M</u> Ag < 0.01009	<u>Q</u> V < 0.00300
<u>M</u> Cs < 0.00151	<u>M</u> Ir < 0.02522	<u>M</u> Pd < 0.02522	<u>Q</u> Na 0.00044	<u>M</u> Yb < 0.00504
<u>M</u> Cr < 0.02522	<u>Q</u> Fe 0.00054	<u>Q</u> P < 0.00260	<u>M</u> Sr < 0.00252	<u>M</u> Y < 0.20178
<u>M</u> Co < 0.01513	<u>M</u> La < 0.00252	<u>M</u> Pt < 0.01009	<u>n</u> S	<u>M</u> Zn < 0.10089
<u>s</u> Cu	<u>M</u> Pb 0.00050	<u>Q</u> K < 0.00180	<u>M</u> Ta < 0.03531	<u>M</u> Zr < 0.02522

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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

010381

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 63.546, +2;  $6 \text{ Cu}(\text{H}_2\text{O})_6^{2+}$

**Chemical Compatibility** - Stable in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HF}$ ,  $\text{H}_3\text{PO}_4$ . Avoid basic media. Stable with most metals and inorganic anions in acidic media.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5%  $\text{HNO}_3$  / LDPE container.

**Cu Containing Samples (Preparation and Solution)** - Metal (soluble in  $\text{HNO}_3$ ); Oxides (Soluble in  $\text{HCl}$ ); Ores (Dissolve in  $\text{HCl}$  /  $\text{HNO}_3$ ).

**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 at $\lambda$ lines)
ICP-OES 324.754 nm	0.06/0.01 $\mu\text{g/mL}$	1	atom	Nb, U, Th, Mo, Hf
ICP-OES 224.700 nm	0.01/0.01 $\mu\text{g/mL}$	1	ion	Pb, Ir, Ni, W
ICP-OES 219.958 nm	0.01/0.02 $\mu\text{g/mL}$	1	atom	Th, Ta, Nb, U, Hf
ICP-MS 63 amu	10 ppt	n/a	M	$^{40}\text{Ar}^{23}\text{Na}$ , $^{47}\text{Ti}^{16}\text{O}$ , $^{51}\text{V}^{12}\text{C}^{37}\text{Cl}$ , $^{52}\text{Cr}^{35}\text{Cl}$ , $^{44}\text{Ca}^{16}\text{O}$ , $^{23}\text{Na}^{40}\text{Ca}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (OQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (CONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

10.4 **10CFR50 Appendix B - Nuclear Regulatory Commission**

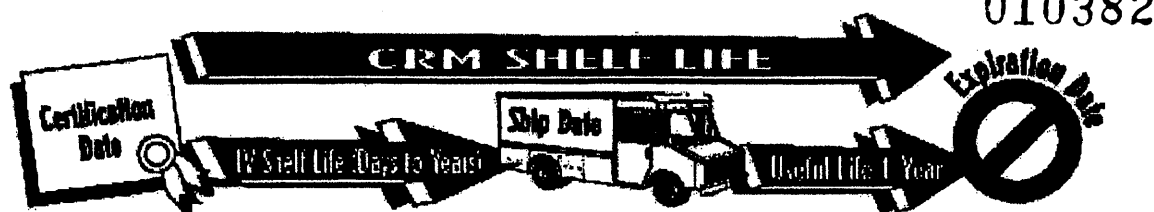
- Domestic Licensing of Production and Utilization Facilities

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

10.6 **MIL-STD-45662A (Obsolete/Observed)**

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 403  
 DATE OPENED: 02/25/04  
 INORG: 4469 PO: F52323

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



- 11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.
- 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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: May 02, 2003

Expiration Date:

**EXPIRES**

1/2/05

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*  
*Katalin Le*  
*Paul Gaines*

010383

**inorganic ventures / iv labs**

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 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0** Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0** **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Nickel in 1.4% (abs) HNO<sub>3</sub>

Catalog Number: CGNI1-1, CGNI1-2, and CGNI1-5  
 Lot Number: W-NI02030  
 Starting Material: Ni pieces  
 Starting Material Purity (%): 99.999371  
 Starting Material Lot No: L06L02  
 Matrix: 1.4% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS B-102  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 VDS  
 DATE OPENED: 02/25/04  
 INORG: 4472 PO: F52323

- 3.0** **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 1002 ± 2 µg/mL

**Certified Density:** 1.011 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$\bar{C}$  = mean

$x_i$  = individual results

$n$  = number of measurements

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

$\sum s_i$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

**4.1** **Assay Method #1** 999 ± 5 µg/mL  
 ICP Assay NIST SRM 3136 Lot Number: 000612

**Assay Method #2** 1002 ± 2 µg/mL  
 EDTA NIST SRM 928 Lot Number: 880710



- 010384
- 4.2 **BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 **THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 **GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

Q Al < 0.00938	M Dy < 0.06577	Q Li < 0.00006	M Pr < 0.00329	M Te < 0.32886
M Sb < 0.00548	M Er < 0.05481	M Lu < 0.00439	M Re < 0.01096	M Tb < 0.00329
Q As < 0.01689	M Eu < 0.03289	Q Mg 0.00002	M Rh < 0.01096	M Tl < 0.01096
M Ba < 0.10962	M Gd < 0.01096	M Mn < 0.04385	M Rb < 0.01096	M Th < 0.01096
Q Be < 0.00626	M Ga < 0.01096	Q Hg < 0.03441	M Ru < 0.02192	M Tm < 0.00439
M Bi < 0.00439	M Ge < 0.06577	M Mo < 0.02192	M Sm < 0.01096	M Sn < 0.05481
Q B < 0.03097	M Au < 0.03289	M Nd < 0.02192	M Sc < 0.10962	M Ti < 0.54811
M Cd < 0.03289	M Hf < 0.02192	S Ni	Q Se < 0.01877	M W < 0.10962
Q Ca < 0.01157	M Ho < 0.00548	M Nb < 0.00548	Q Si 0.00188	M U < 0.02192
M Ce < 0.05481	M In < 0.10962	n Os	M Ag < 0.02192	M V < 0.02192
M Cs < 0.00329	M Ir < 0.05481	M Pd < 0.05481	Q Na 0.00102	M Yb < 0.01096
M Cr < 0.05481	Q Fe 0.00156	Q P < 0.31280	M Sr < 0.00548	M Y < 0.43849
Q Co 0.00182	M La < 0.00548	M Pt < 0.02192	Q S < 0.07820	M Zn 0.00189
M Cu < 0.06577	M Pb < 0.03289	Q K 0.00043	M Ta < 0.07674	M Zr < 0.05481

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

## 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** - 58.69; +2; 6; Ni(H<sub>2</sub>O)<sub>6</sub><sup>2+</sup>

**Chemical Compatibility** - Stable in HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, HF, H<sub>3</sub>PO<sub>4</sub>. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

**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 1-5% HNO<sub>3</sub> / LDPE container.

**Ni Containing Samples (Preparation and Solution)** - Metal (Soluble in HNO<sub>3</sub>) ; Oxides (Soluble in HCl) ; Ores (Dissolve in HCl / HNO<sub>3</sub>).

**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 at all concs.)
ICP-OES 221.647 nm	0.01 / 0.0009 µg/mL	1	ion	Si
ICP-OES 232.003 nm	0.02 / 0.006 µg/mL	1	atom	Cr, Re, Os, Nb, Ag, Pt, Fe
ICP-OES 231.604 nm	0.02 / 0.002 µg/mL	1	ion	Sb, Ta, Co
ICP-MS 60 amu	100 ppt	n/a	M'	<sup>44</sup> Ca <sup>18</sup> O <sup>1</sup> H, <sup>44</sup> Ca <sup>18</sup> O, <sup>23</sup> Na <sup>37</sup> Cl

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

### 10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

#### Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

#### Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

### 10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



### 10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

#### A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

### 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

### 10.6 MIL-STD-45662A (Obsolete/Observed)

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 **IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** July 23, 2003

**Expiration Date:**

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 V03  
 DATE OPENED: 02/25/04  
 INORG: 4472 PU: F52323

**EXPIRES**  
 1/2/2005

010386

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

Certificate Approved By: Katalin Le, QC Supervisor

*Katalin Le*

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

010387

**inorganic ventures / iv labs**

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 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: **Certificate #883-02**. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

2.0 **DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Boron In H<sub>2</sub>O

Catalog Number: CGB1-1, CGB1-2, and CGB1-5  
 Lot Number: **W-B02042**  
 Starting Material: H<sub>3</sub>BO<sub>3</sub>  
 Starting Material Purity (%): 99.999998  
 Starting Material Lot No: OV0133  
 Matrix: H<sub>2</sub>O

INORGANIC LABS/RADCHEM LABS **PS-1002**  
 DATE RECEIVED: 07/31/03  
 DATE EXPIRED: 08/01/2004 **V03**  
 DATE OPENED: 08/01/03  
 INORG: 4001 PO: E50383

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 999 ± 2 µg/mL

**Certified Density:** 1.001 g/mL (measured at 22° C)

The Certified Value is the instrument analysis value. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\bar{x}$  = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum s_i^2$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 **999 ± 2 µg/mL (Avg 2 runs)**

ICP Assay NIST SRM 3107 Lot Number: 991907

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.00090	<u>M</u> Dy < 0.00600	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00030	<u>M</u> Te < 0.03000
<u>M</u> Sb < 0.00050	<u>M</u> Er < 0.00500	<u>M</u> Lu < 0.00040	<u>M</u> Re < 0.00100	<u>M</u> Tb < 0.00030
<u>M</u> As < 0.01000	<u>M</u> Eu < 0.00300	<u>Q</u> Mg < 0.00006	<u>M</u> Rh < 0.00100	<u>M</u> Tl < 0.00100
<u>Q</u> Ba < 0.00010	<u>M</u> Gd < 0.00100	<u>Q</u> Mn < 0.00002	<u>M</u> Rb < 0.00100	<u>M</u> Th < 0.00100
<u>Q</u> Be < 0.00017	<u>Q</u> Ga < 0.00160	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00200	<u>M</u> Tm < 0.00040
<u>M</u> Bi < 0.00040	<u>M</u> Ge < 0.00600	<u>M</u> Mo < 0.00200	<u>M</u> Sm < 0.00100	<u>M</u> Sn < 0.00500
<u>s</u> B	<u>M</u> Au < 0.00300	<u>M</u> Nd < 0.00200	<u>Q</u> Sc < 0.00002	<u>M</u> Ti < 0.05000
<u>M</u> Cd < 0.00300	<u>M</u> Hf < 0.00200	<u>Q</u> Ni < 0.00230	<u>Q</u> Se < 0.00620	<u>M</u> W < 0.01000
<u>Q</u> Ca < 0.00007	<u>M</u> Ho < 0.00050	<u>M</u> Nb < 0.00050	<u>Q</u> Si < 0.00067	<u>M</u> U < 0.00200
<u>Q</u> Ce < 0.00300	<u>M</u> In < 0.01000	<u>n</u> Os	<u>M</u> Ag < 0.00200	<u>Q</u> V < 0.00083
<u>M</u> Cs < 0.00030	<u>M</u> Ir < 0.00500	<u>M</u> Pd < 0.00500	<u>Q</u> Na < 0.00010	<u>M</u> Yb < 0.00100
<u>M</u> Cr < 0.00500	<u>Q</u> Fe < 0.00110	<u>Q</u> P < 0.00250	<u>M</u> Sr < 0.00050	<u>M</u> Y < 0.04000
<u>Q</u> Co < 0.00110	<u>M</u> La < 0.00050	<u>M</u> Pt < 0.00200	<u>Q</u> S < 0.10000	<u>Q</u> Zn < 0.00019
<u>M</u> Cu < 0.00600	<u>M</u> Pb < 0.00300	<u>Q</u> K < 0.00300	<u>M</u> Ta < 0.00700	<u>M</u> Zr < 0.00500

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 10.811; +3; 4;  $\text{B}(\text{OH})_3$  and  $\text{B}(\text{OH})_4^-$

**Chemical Compatibility** - Moderately soluble in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HF}$  aqueous matrices and very soluble in  $\text{NH}_4\text{OH}$ . Stable with all metals and inorganic anions at low to moderate ppm levels.

**Stability** - 2-100 ppb levels stable for months in 1%  $\text{HNO}_3$  / LDPE container. 1-1,000 ppm solutions chemically stable for years in 1%  $\text{HNO}_3$  / LDPE container. 1000 -10,000 ppm stable for years in dilute  $\text{NH}_4\text{OH}$  / LDPE container.

**B Containing Samples (Preparation and Solution)** - Metal (Crystalline form is scarcely attacked by acids or alkaline solutions; amorphous form is soluble in conc.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ );  $\text{B}(\text{OH})_3$  (water soluble). Ores (avoid acid digestions and use caustic fusions in  $\text{Pt}$  or Organic Matrices (dry ash mixed with  $\text{Na}_2\text{CO}_3$  in  $\text{Pt}$  at  $450^\circ\text{C}$  then increase heat to  $1000^\circ\text{C}$  to fuse; or perform a  $\text{Na}_2\text{O}_2$  fusion in a  $\text{Ni}$ -crucible / Parr bomb).

**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 at $\lambda$ above)
ICP-OES 249.773 nm	0.003 / 0.001 $\mu\text{g/mL}$	1	atom	W, Ce, Co, Th, Ta, Mn, Mo, Fe
ICP-OES 249.678 nm	0.004 / 0.003 $\mu\text{g/mL}$	1	atom	Os, W, Co, Cr, Hf
ICP-OES 208.959 nm	0.007 / 0.0005 $\mu\text{g/mL}$	1	atom	Mo
ICP-MS 11amu	700 ppt	n/a	M'	

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c. (EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (OQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 07/31/03

DATE EXPIRED: 08/01/2004 VOS

DATE OPENED: 08/01/03

INORG: 4201 PO: F52383

# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010390



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: March 21, 2003

Expiration Date: **EXPIRES**  
12/2004

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*  
*Katalin Le*  
*Paul Gaines*

010391

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Molybdenum in H<sub>2</sub>O tr. NH<sub>4</sub>OH

Catalog Number: CGMO1-1, CGMO1-2, and CGMO1-5  
 Lot Number: **W-MO01132**  
 Starting Material: (NH<sub>4</sub>)<sub>6</sub>Mo<sub>7</sub>O<sub>24</sub>·xH<sub>2</sub>O  
 Starting Material Purity (%): 99.995947  
 Starting Material Lot No: 21410  
 Matrix: H<sub>2</sub>O tr. NH<sub>4</sub>OH

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 02/25/04  
 DATE EXPIRED: 03/01/2005 v05  
 DATE OPENED: 02/25/04  
 INORG: 4471 PO: F52323

- 3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1004 ± 2 µg/mL

Certified Density: 0.998 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$\bar{x}$  = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

$\sum S$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

- 4.1 Assay Method #1 1004 ± 2 µg/mL (Avg 2 runs)

ICP Assay NIST SRM 3134 Lot Number: 891307

- Assay Method #2 1008 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2



- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al < 0.05000	<u>M</u> Dy < 0.01198	<u>Q</u> Li < 0.01000	<u>Q</u> Pr < 0.10000	<u>i</u> Te
<u>M</u> Sb 0.00939	<u>M</u> Er < 0.00998	<u>M</u> Lu < 0.00080	<u>M</u> Re < 0.00200	<u>M</u> Tb < 0.00060
<u>M</u> As < 0.01997	<u>M</u> Eu < 0.00599	<u>Q</u> Mg < 0.05000	<u>M</u> Rh < 0.00200	<u>M</u> Tl < 0.00200
<u>M</u> Ba < 0.01997	<u>M</u> Gd < 0.00200	<u>M</u> Mn < 0.00799	<u>M</u> Rb 0.02445	<u>M</u> Th < 0.00200
<u>M</u> Be < 0.00100	<u>M</u> Ga < 0.00200	<u>i</u> Hg	<u>M</u> Ru < 0.00399	<u>M</u> Tm < 0.00080
<u>M</u> Bi < 0.00080	<u>M</u> Ge < 0.01198	<u>s</u> Mo	<u>M</u> Sm < 0.00200	<u>M</u> Sn < 0.00998
<u>Q</u> B < 0.50000	<u>M</u> Au < 0.00599	<u>Q</u> Nd < 0.05000	<u>Q</u> Sc < 0.05000	<u>Q</u> Ti < 0.00500
<u>Q</u> Cd < 0.50000	<u>M</u> Hf < 0.00399	<u>M</u> Ni < 0.01597	<u>M</u> Se < 0.01597	<u>M</u> W 0.05576
<u>Q</u> Ca 0.00026	<u>M</u> Ho < 0.00100	<u>Q</u> Nb < 0.10000	<u>Q</u> Si < 0.10000	<u>M</u> U < 0.00399
<u>Q</u> Ce < 0.05000	<u>M</u> In 0.00235	<u>n</u> Os	<u>M</u> Ag < 0.00399	<u>M</u> V < 0.00399
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.00998	<u>M</u> Pd < 0.00998	<u>Q</u> Na < 0.10000	<u>M</u> Yb < 0.00200
<u>M</u> Cr < 0.00998	<u>Q</u> Fe < 0.50000	<u>i</u> P	<u>M</u> Sr < 0.00100	<u>M</u> Y < 0.07987
<u>M</u> Co < 0.00599	<u>M</u> La < 0.00100	<u>M</u> Pt < 0.00399	<u>i</u> S	<u>M</u> Zn < 0.03993
<u>M</u> Cu < 0.01198	<u>M</u> Pb < 0.00599	<u>Q</u> K 0.00980	<u>M</u> Ta < 0.01398	<u>M</u> Zr < 0.00998

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 95.94; +6; 6,7,8,9;  $[\text{MoO}_4]^{2-}$  (chemical form as received)

**Chemical Compatibility** - Mo is received in a  $\text{NH}_4\text{OH}$  matrix giving the operator the option of using  $\text{HCl}$  or  $\text{HF}$  to stabilize acidic solutions. The  $[\text{MoO}_4]^{2-}$  is soluble in concentrated  $\text{HCl}$   $[\text{MoOCl}_4]^-$ , dilute  $\text{HF}$  /  $\text{HNO}_3$ ,  $[\text{MoOF}_4]^-$  and basic media  $[\text{MoO}_4]^{2-}$ . Stable at ppm levels with some metals provided it is fluorinated. Do not mix with Alkaline or Rare Earths when  $\text{HF}$  is present. Stable with most inorganic anions provided it is in the  $[\text{MoO}_4]^{2-}$  chemical form.

**Stability** - 2-100 ppb levels stable (alone or mixed with all other metals that are at comparable levels) as the  $[\text{MoOF}_4]^-$  for months in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm single element solutions as the  $[\text{MoO}_4]^{2-}$  chemically stable for years in 1%  $\text{NH}_4\text{OH}$  in a LDPE container.

**Mo Containing Samples (Preparation and Solution)** - Metal (Soluble in  $\text{HF}$  /  $\text{HNO}_3$  or hot dilute  $\text{HCl}$ ); Oxide (soluble in  $\text{HF}$  or  $\text{NH}_4\text{OH}$ ); Organic Matrices (Dry ash at  $450^\circ\text{C}$  in  $\text{Pt}$  and dissolve oxide with  $\text{HF}$  or  $\text{HCl}$ ).

**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 at $\lambda$ ions.)
ICP-OES 202.030 nm	0.008 / 0.0002 $\mu\text{g/mL}$	1	ion	Os, Hf
ICP-OES 203.844 nm	0.012 / 0.002 $\mu\text{g/mL}$	1	ion	
ICP-OES 204.598 nm	0.012 / 0.001 $\mu\text{g/mL}$	1	ion	Ir, Ta
ICP-MS 95 amu	3 ppt	n/a	M <sup>+</sup>	<sup>40</sup> Ar <sup>+</sup> , <sup>39</sup> K <sup>+</sup> , <sup>40</sup> Ar <sup>+</sup> , <sup>79</sup> Br <sup>+</sup> , <sup>80</sup> Br <sup>+</sup> , <sup>136</sup> Xe <sup>+</sup> , <sup>137</sup> Xe <sup>+</sup>

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS, Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 02/25/04

DATE EXPIRED: 03/01/2005 v03

DATE OPENED: 02/25/04

INORG: 4471 PO: F52323

# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010394



- 11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.
- 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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: July 23, 2003

Expiration Date:

**EXPIRES**  
1/23/2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

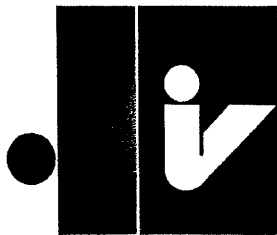
Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*

*Katalin Le*

*Paul Gaines*



# inorganic ventures / iv labs

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

### CUSTOM-GRADE SOLUTION

1000 µg/mL Phosphorus in H<sub>2</sub>O

Catalog Number: CGP1-1, CGP1-2 and CGP1-5

Lot Number: **W-P01123**

Starting Material:  
 Starting Material Purity:  
 Starting Material Lot No:

Phosphoric Acid  
 99.999%  
 J18804

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 06/01/04  
 DATE EXPIRED: 06/01/2005 VOS  
 DATE OPENED: 06/01/04  
 INORG: 4593 PO: E53393

### CERTIFIED CONCENTRATION: 1006 ± 4 µg/mL

The Certified Value is the wet assay value. The following equations are used in the calculation of the certified value and the uncertainty:

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

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

n = number of measurements

$\sum s_i$  = The summation of all significant estimated errors.

Classical Wet Assay: 1006 ± 4 µg/mL

Method: Acidimetric Titration vs NIST SRM 84k KHP.

Instrument Analysis: 1002 ± 4 µg/mL

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3139a.

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

### TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:

Custom-Grade solutions tested for trace metallic impurities 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.

<u>O</u> Al <0.040	<u>M</u> Dy <0.00060	<u>M</u> Li <0.0010	<u>M</u> Pr <0.000030	<u>M</u> Te <0.0030
<u>M</u> Sb 0.012	<u>M</u> Er <0.00050	<u>M</u> Lu <0.000040	<u>M</u> Re <0.00010	<u>M</u> Tb <0.000030
<u>M</u> As <0.0010	<u>M</u> Eu <0.00030	<u>M</u> Mg <0.0030	<u>M</u> Rh <0.00010	<u>M</u> Tl <0.00010
<u>M</u> Ba <0.0010	<u>M</u> Gd <0.00010	<u>M</u> Mn <0.00040	<u>M</u> Rb <0.00010	<u>M</u> Th <0.00010
<u>M</u> Be <0.000050	<u>M</u> Ga 0.00070	<u>O</u> Hg <0.020	<u>M</u> Ru <0.00020	<u>M</u> Tm <0.000040
<u>M</u> Bi <0.000040	<u>M</u> Ge <0.00060	<u>M</u> Mo <0.00020	<u>M</u> Sm <0.00010	<u>M</u> Sn <0.00050
<u>M</u> B <0.0070	<u>M</u> Au <0.00030	<u>M</u> Nd <0.00020	<u>n</u> Sc	<u>n</u> Ti
<u>M</u> Cd <0.00030	<u>M</u> Hf <0.00020	<u>O</u> Ni <0.050	<u>O</u> Se <0.40	<u>M</u> W <0.0010
<u>O</u> Ca <0.010	<u>M</u> Ho <0.000050	<u>M</u> Nb <0.000050	<u>O</u> Si <0.020	<u>M</u> U <0.00020
<u>M</u> Ce <0.00050	<u>M</u> In <0.030	<u>n</u> Os	<u>M</u> Ag <0.00020	<u>M</u> V <0.00020
<u>M</u> Cs <0.000030	<u>M</u> Ir <0.00050	<u>M</u> Pd <0.00050	<u>O</u> Na <0.090	<u>M</u> Yb <0.00010
<u>M</u> Cr <0.00050	<u>O</u> Fe <0.050	<u>s</u> P	<u>M</u> Sr <0.000050	<u>M</u> Y <0.0040
<u>M</u> Co <0.00030	<u>M</u> La <0.000050	<u>M</u> Pt <0.00020	<u>n</u> S	<u>M</u> Zn 0.0035
<u>M</u> Cu 0.080	<u>M</u> Pb <0.00030	<u>n</u> K	<u>M</u> Ta <0.00070	<u>M</u> Zr <0.00050

M - checked by ICP-MS

O - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.001 g/mL

(over)

QA:KL Rev.0108040N

Paul R. Gaines  
 Quality Assurance Manager

Expires:

**EXPIRES**  
 12/2005

**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)  
**Members of IQ Net :** Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)
  2. ISO/IEC Guide 34-2000 "General Requirements for the Competence of Reference Material Producers" - Reference Materials Production - Accredited A2LA Certificate 883.02
  3. ISO/IEC17025-1999 "General Requirements for the Competence of Testing and Calibration" - Chemical Testing - Accredited A2LA Certificate 883.01
  4. MIL-STD-45662A
  5. 10CFR50 Appendix B - Nuclear Regulatory Commission - Domestic Licencing of Production and Utilization Facilities
  6. 10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance
- Please contact our Quality Assurance Department for further information and copies of documents pertaining to our Quality Standard certifications.

**STABILITY/ EXPIRATION DOCUMENTATION**

<b>Shelf Life -</b>	<u>The length of time that a properly stored and packaged standard will remain within the specified uncertainty.</u> Shelf life is affected by chemical stability and transpiration issues. Inorganic Ventures' Standard Solutions are chemically stable indefinitely. Transpiration loss is linear with time and limits the time a standard can be used with confidence. The smaller the bottle the higher the rate of transpiration. Inorganic Ventures' studies indicate that the shelf life of our 500 mL bottle is 4 years and the shelf life of our 125 mL bottle is 21 months.
<b>Expiration Date -</b>	<u>The date after which a standard solution should not be used.</u> A one year expiration date is recommended by most state and federal regulatory agencies. Transpiration issues and repeated use of solutions over a one year period may adversely affect the integrity of standard.

**PACKAGING DOCUMENTATION**

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

**GLASSWARE CALIBRATION**

In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799 INT'L 1-732-901-1900 FAX 1-732-901-1903 E-MAIL IVtech@ivstandards.com



inorganic ventures / iv labs

010397

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
e-mail: lvsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Silicon in H<sub>2</sub>O tr. HNO<sub>3</sub> tr. HF

Catalog Number: CGSI1-1, CGSI1-2, and CGSI1-5  
Lot Number: W-SI02082  
Starting Material: SiO<sub>2</sub>  
Starting Material Purity (%): 99.996367  
Starting Material Lot No: C05310C  
Matrix: H<sub>2</sub>O tr. HNO<sub>3</sub> tr. HF

INORGANIC LABS/RADCHEM LABS 1 of 2  
DATE RECEIVED: 01/20/04  
DATE EXPIRED: 02/01/2005 v03  
DATE OPENED: 01/20/04  
INORG: 4437 PO: F52303

- 3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1000 ± 5 µg/mL

Certified Density: 1.002 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$$\text{Uncertainty } (\pm) = \frac{2(s)}{(n)^{1/2}}$$

$s$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

- 4.1 Assay Method #1 1000 ± 5 µg/mL (Avg 2 runs)

ICP Assay NIST SRM 3150 Lot Number: 991108

- Assay Method #2 1001 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.02730	<u>M</u> Dy < 0.01358	<u>Q</u> Li < 0.00009	<u>M</u> Pr < 0.00068	<u>M</u> Te < 0.06791
<u>M</u> Sb < 0.00113	<u>M</u> Er < 0.01132	<u>M</u> Lu < 0.00091	<u>M</u> Re < 0.00226	<u>M</u> Tb < 0.00068
<u>M</u> As < 0.02264	<u>M</u> Eu < 0.00679	<u>Q</u> Mg < 0.04991	<u>M</u> Rh < 0.00226	<u>M</u> Tl < 0.00226
<u>M</u> Ba < 0.02264	<u>M</u> Gd < 0.00226	<u>M</u> Mn < 0.00906	<u>M</u> Rb < 0.00226	<u>M</u> Th < 0.00226
<u>Q</u> Be < 0.00091	<u>M</u> Ga < 0.00226	<u>Q</u> Hg < 0.04991	<u>M</u> Ru < 0.00453	<u>M</u> Tm < 0.00091
<u>M</u> Bi < 0.00091	<u>M</u> Ge < 0.01358	<u>M</u> Mo < 0.00453	<u>M</u> Sm < 0.00226	<u>M</u> Sn < 0.01132
<u>Q</u> B 0.02409	<u>M</u> Au < 0.00679	<u>M</u> Nd < 0.00453	<u>Q</u> Sc < 0.00091	<u>Q</u> Ti 0.01325
<u>M</u> Cd < 0.00679	<u>M</u> Hf < 0.00453	<u>Q</u> Ni < 0.01044	<u>M</u> Se < 0.01811	<u>M</u> W < 0.02264
<u>Q</u> Ca 0.00135	<u>M</u> Ho < 0.00113	<u>M</u> Nb < 0.00113	<u>s</u> Si	<u>M</u> U < 0.00453
<u>M</u> Ce < 0.01132	<u>M</u> In < 0.02264	<u>n</u> Os	<u>M</u> Ag < 0.00453	<u>Q</u> V < 0.00408
<u>M</u> Cs < 0.00068	<u>M</u> Ir < 0.01132	<u>M</u> Pd < 0.01132	<u>Q</u> Na 0.02008	<u>M</u> Yb < 0.00226
<u>Q</u> Cr < 0.00681	<u>Q</u> Fe < 0.00499	<u>Q</u> P < 0.02269	<u>Q</u> Sr < 0.00032	<u>M</u> Y < 0.09055
<u>M</u> Co < 0.00679	<u>M</u> La < 0.00113	<u>M</u> Pt < 0.00453	<u>Q</u> S < 0.11342	<u>M</u> Zn < 0.04528
<u>Q</u> Cu < 0.00454	<u>M</u> Pb < 0.00679	<u>Q</u> K < 0.00771	<u>M</u> Ta 0.00200	<u>M</u> Zr < 0.01132

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 28.0855; +4; 6;  $\text{Si}(\text{OH})_4(\text{F})_2^+$

**Chemical Compatibility** - Soluble in  $\text{HCl}$ ,  $\text{HF}$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3$  as the  $\text{Si}(\text{OH})_4(\text{F})_2^+$ . Avoid neutral to basic media. Unstable at ppm levels with metals that would pull F<sup>-</sup> 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 forming silicic acid (silicic acid is soluble up to ~100 ppm in water) in all dilute acids except  $\text{HF}$ .

**Stability** - 2-100 ppb levels - stability unknown - (alone or mixed with all other metals) as the  $\text{Si}(\text{OH})_4(\text{F})_2^+$ . 1-10,000 ppm single element solutions as the  $\text{Si}(\text{OH})_4(\text{F})_2^+$  chemically stable for years in 2-5%  $\text{HNO}_3$  / trace  $\text{HF}$  in a LDPE container.

**Si Containing Samples (Preparation and Solution)** - Metal (Soluble in 1:1:1  $\text{H}_2\text{O}$  /  $\text{HF}$  /  $\text{HNO}_3$ ) Oxide -  $\text{SiO}_2$ , amorphous (Dissolve by heating in 1:1:1  $\text{H}_2\text{O}$  /  $\text{HF}$  /  $\text{HNO}_3$ ) Oxide - quartz (Fuse in  $\text{Pt}^*$  with  $\text{Na}_2\text{CO}_3$ ); Geological Samples (Fuse in  $\text{Pt}^*$  with  $\text{Na}_2\text{CO}_3$ , followed by  $\text{HCl}$  solution of the fuseate); Organic Matrices containing silicates and non volatile silicon compounds (Dry ash at  $450^\circ\text{C}$  in  $\text{Pt}^*$  and dissolve by gently warming with 1:1:1  $\text{H}_2\text{O}$  /  $\text{HF}$  /  $\text{H}_2\text{SO}_4$  or fuse / ash with  $\text{Na}_2\text{CO}_3$  and dissolve fuseate with  $\text{HCl}$  /  $\text{H}_2\text{O}$ ); Silicone Oils - dimethyl silicones depolymerize to form volatile monomer units when heated (Measure directly in alcoholic  $\text{KOH}$  / xylene mixture where sample is treated first with the  $\text{KOH}$  at  $60-100^\circ\text{C}$  to "unzip" the Si-O-Si polymeric structure or digest with concentrated  $\text{H}_2\text{SO}_4/\text{H}_2\text{O}_2$  followed by cooling and dissolution of the dehydrated silica with  $\text{HF}$ .) Note that the direct analysis of silicone oils in an organic solvent will result in false high results due to high vapor pressure of volatile monomer units like hexamethylcyclotrisiloxane. The  $\text{KOH}$  forms the  $\text{K}_2\text{Si}(\text{CH}_3)_2\text{O}^+$  salt which is not volatile at room temperature.

**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 at $\lambda$ concs.)
ICP-OES 251.611 nm	0.012 / 0.003 $\mu\text{g/mL}$	1	Ion	Ta, U, Zn, Th
ICP-OES 212.412 nm	0.02 / 0.01 $\mu\text{g/mL}$	1	Ion	Hf, Os, <u>Mg</u> , Ta
ICP-OES 266.158 nm	0.03 / 0.004 $\mu\text{g/mL}$	1	Ion	Ta, Ce, Cr, Cd, Th
ICP-MS 28 amu	4000 - 8000 ppt	n/a	M	<sup>14</sup> N <sub>2</sub> , <sup>13</sup> C <sup>18</sup> O

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

**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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

**10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditación, a.c.(EMA)

Members of IQ Net International Certification Network:

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (CONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

**10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**

- Chemical Testing - Accredited A2LA Certificate Number 883.01



**10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

A2LA Mutual Recognition Agreement Partners:

Australia (NATA), Austria (Bmwa), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

**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**

**10.6 MIL-STD-45662A (Obsolete/Observed)**

INORGANIC LABS/RADCHEM LABS Pg 2 of 2

DATE RECEIVED: 01/20/04  
 DATE EXPIRED: 02/01/2005 VOS  
 DATE OPENED: 01/20/04  
 INORG: 4437 PD: F52303



# 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010400



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** February 24, 2003

**Expiration Date:** **EXPIRES**  
12 2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

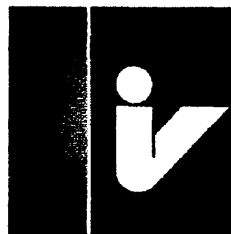
**Certificate Prepared By:** JoAnn Struthers, QA Administrative Assistant

**Certificate Approved By:** Katalin Le, QC Supervisor

**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

*JoAnn Struthers*  
*Katalin Le*  
*Paul Gaines*

010401



inorganic ventures / iv labs

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

## CUSTOM-GRADE SOLUTION

1000 µg/mL Titanium in 1.4% HNO<sub>3</sub> (abs) tr. HF

Catalog Number: CGT11-1, CGT11-2 and CGT11-5

This standard should not be prepared or stored in glass.

Lot Number: T-TI02039

INORGANIC LABS/RADCHEM LABS

Starting Material:

Titanium Metal

DATE RECEIVED: 11/24/03

Starting Material Purity:

99.999%

DATE EXPIRED: 12/01/2004

Starting Material Lot No:

F29114

DATE OPENED: 11/25/03

INORG: 4330 PO: F52279

## CERTIFIED CONCENTRATION: 1010 ± 3 µg/mL

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

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

(x̄) = mean

x<sub>i</sub> = individual results

n = number of measurements

ΣS<sub>i</sub> = The summation of all significant estimated errors.

Calculated Value: 1002 µg/mL

Method: Calculated, based on starting material.

Instrument Analysis: 1010 ± 3 µg/mL (Average of 3 runs)

Method: Inductively Coupled Plasma Spectroscopy (ICP) vs NIST SRM 3162a.

## TRACE METALLIC IMPURITIES DETERMINED BY ICP-MS AND ICP-OES IN µg/mL:

Custom-Grade solutions tested for trace metallic impurities 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.

Q	Al	<0.010	M	Dy	<0.00060	M	Li	<0.0010	M	Pr	<0.000030	M	Ta	<0.0030
M	Sb	<0.000050	M	Er	<0.00050	M	Lu	<0.000040	M	Re	<0.00010	M	Tb	<0.000030
M	As	<0.0010	M	Eu	<0.00030	Q	Mg	<0.020	M	Rh	<0.00010	M	Ti	<0.00010
M	Ba	<0.0010	M	Gd	<0.00010	M	Mn	0.0020	M	Rb	<0.00010	M	Th	<0.00010
M	Be	<0.000050	M	Ge	<0.00010	Q	Hg	<0.050	M	Ru	<0.00020	M	Tm	<0.000040
M	Bi	<0.000040	M	Ge	<0.00060	M	Mo	<0.00020	M	Sm	<0.00010	M	Sn	<0.00050
Q	B	<0.050	M	Au	<0.00030	M	Nd	<0.00020	Q	Sc	<0.0020	S	Ti	
M	Cd	<0.00030	M	Hf	<0.00020	Q	Ni	<0.050	Q	Se	<0.40	M	W	<0.0010
Q	Ca	<0.010	M	Ho	<0.000050	M	Nb	<0.000050	Q	Si	<0.010	M	U	<0.00020
M	Ce	<0.00050	Q	In	<0.020	Q	Os		M	Ag	<0.00020	M	V	<0.00020
M	Cs	<0.000030	M	Ir	<0.00050	M	Pd	<0.00050	Q	Na	0.12	M	Yb	<0.00010
M	Cr	<0.00050	Q	Fe	<0.010	i	P		M	Sr	<0.000050	M	Y	<0.0040
M	Co	<0.00030	M	La	<0.000050	M	Pt	<0.00020	L	S		M	Zn	0.19
Q	Cu	<0.040	M	Pb	<0.00030	Q	K	0.23	M	Ta	<0.00070	M	Zr	<0.00050

M - checked by ICP-MS

O - checked by ICP-OES

i - spectral interference

n - not checked for

s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.011 g/mL

QA:KL Rev.0906020N

(over)

Quality Assurance Manager

Expires:

**EXPIRES**  
 122004

**QUALITY STANDARD DOCUMENTATION**

1. ISO 9001:2000 QMI Registered Quality System (Certificate Number 010105)



Members of IQ Net : Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

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Purified acid, 18 megohm double deionized water that has been filtered through a 0.2  $\mu$ m filter and in-house procedure IV-PACK-001 is used to clean all bottles. Contact us for technical information relating to contamination issues in packaging materials.

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**BALANCE CALIBRATION**

All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 428359B and 454678. The NIST test number is 822/260017-98.

All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-8.

**THERMOMETER CALIBRATION**

The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 238090.

**TECHNICAL SUPPORT**

All customers are encouraged to contact us for technical support for the proper use of our products.

TEL 1-800-569-6799 INT'L 1-732-901-1900 FAX 1-732-901-1903 E-MAIL IVtech@ivstandards.com

**inorganic ventures / iv labs**

195 lehigh avenue, suite 4, lakewood, nj 08701 usa  
 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

**1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02.** The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

**2.0 DESCRIPTION OF CRM** Custom-Grade 1000 µg/mL Strontium in 0.1% (abs) HNO<sub>3</sub>

Catalog Number: CGSR1-1, CGSR1-2, and CGSR1-5

Lot Number: T-SR01123

Starting Material: SrCO<sub>3</sub>

Starting Material Purity (%): 99.9951

Starting Material Lot No 22593

Matrix: 0.1% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 3  
 DATE RECEIVED: 06/20/03  
 DATE EXPIRED: 07/01/2004 V05  
 DATE OPENED: 06/23/03  
 INDRG: 4154 PD: F52370

**3.0 CERTIFIED VALUES AND UNCERTAINTIES**

**Certified Concentration:** 998 ± 2 µg/mL

**Certified Density:** 1.000 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

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

$\sum s_i^2$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

The independent samples t-test was used to determine if there is agreement between the above assay methods at the 95% confidence interval. Both methods were compared and showed agreement within the stated uncertainties. This agreement is a confirmation of the accuracy of this CRM.

**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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

**4.1 Assay Method #1** 998 ± 2 µg/mL

EDTA NIST SRM 928 Lot Number: 880710

**Assay Method #2** 1002 ± 8 µg/mL

ICP Assay NIST SRM 3153a Lot Number: 990906

- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

Q Al < 0.00090	M Dy < 0.00600	Q Li < 0.00003	M Pr < 0.00030	Q Te < 0.10000
M Sb < 0.00050	M Er < 0.00500	M Lu < 0.00040	M Re < 0.00100	M Tb < 0.00030
Q As < 0.00500	M Eu < 0.00300	Q Mg 0.00037	Q Rh < 0.00600	M Tl < 0.00100
M Ba 0.04001	M Gd < 0.00100	Q Mn 0.00018	I Rb	M Th < 0.00100
Q Be < 0.00009	M Ga < 0.00100	Q Hg < 0.01500	Q Ru < 0.00300	M Tm < 0.00040
M Bi < 0.00040	M Ge < 0.00600	M Mo < 0.00200	M Sm < 0.00100	M Sn < 0.00500
Q B < 0.00060	M Au < 0.00300	M Nd < 0.00200	M Sc < 0.01000	M Ti < 0.05001
M Cd < 0.00300	M Hf < 0.00200	Q Ni < 0.00300	Q Se < 0.05000	M W < 0.01000
Q Ca 0.03600	M Ho < 0.00050	M Nb < 0.00050	Q Si 0.00056	M U < 0.00200
M Ce < 0.00500	Q In < 0.00200	n Os	M Ag < 0.00200	M V < 0.00200
M Cs < 0.00030	M Ir < 0.00500	Q Pd < 0.00400	Q Na 0.00520	M Yb < 0.00100
Q Cr < 0.00080	Q Fe 0.00080	Q P < 0.00480	s Sr	Q Y < 0.00004
M Co < 0.00300	M La < 0.00050	M Pt < 0.00200	n S	M Zn < 0.02000
Q Cu < 0.00140	M Pb < 0.00300	Q K < 0.00170	M Ta < 0.00700	M Zr < 0.00500

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:  
 ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP  
 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 IV Technical Staff

## 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** - 87.62; +2; 6; Sr(H<sub>2</sub>O)<sub>8</sub>·12

**Chemical Compatibility** - Soluble in HCl, and HNO<sub>3</sub>. Avoid H<sub>2</sub>SO<sub>4</sub>, HF and neutral to basic media. Stable with most metals and inorganic anions forming insoluble silicate, carbonate, hydroxide, oxide, fluoride, sulfate, oxalate, chromate, arsenate and tungstate in neutral aqueous media.

**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 1-3.5% HNO<sub>3</sub> / LDPE container.

**Sr Containing Samples (Preparation and Solution)** - Metal (Best dissolved in diluted HNO<sub>3</sub>); Ores (Carbonate fusion in P<sub>2</sub>O<sub>5</sub> followed by HCl dissolution); Organic Matrices (Dry ash and dissolution in dilute HCl).

**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 at = concs.)
ICP-OES 407.771 nm	0.0004 / 0.00008 µg/mL	1	ion	U, Ce
ICP-OES 421.552 nm	0.0008 / 0.00004 µg/mL	1	ion	Rb
ICP-OES 460.733 nm	0.07 / 0.003 µg/mL	1	atom	Ce
ICP-MS 88 amu	1200 ppt	n/a	M <sup>+</sup>	<sup>72</sup> Ge <sup>18</sup> O, <sup>176</sup> Yb <sup>2</sup> , <sup>176</sup> Lu <sup>2</sup> , <sup>176</sup> Hf <sup>2</sup>

- 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 procedure IV-MPM-004 and is guaranteed to be homogeneous.
- 10.0 **QUALITY STANDARD DOCUMENTATION**

10.1 **ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105**

**Recognized by:**

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)



10.2 **ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"**  
- Chemical Testing - Accredited A2LA Certificate Number 883.01



10.3 **ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"**  
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

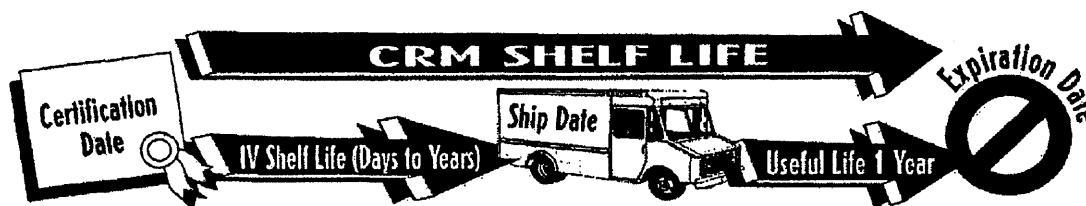
Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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**

10.6 **MIL-STD-45662A (Obsolete/Observed)**

11.0 **DATE OF CERTIFICATION AND PERIOD OF VALIDITY**



11.1 **IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** October 31, 2002

**Expiration Date:** **EXPIRES**

01/22/04

INORGANIC LABS/RADCHEM LABS 79-242  
DATE RECEIVED: 06/20/03  
DATE EXPIRED: 07/01/2004  
DATE OPENED: 06/23/03  
INORG: 4154 PO: F52370

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**

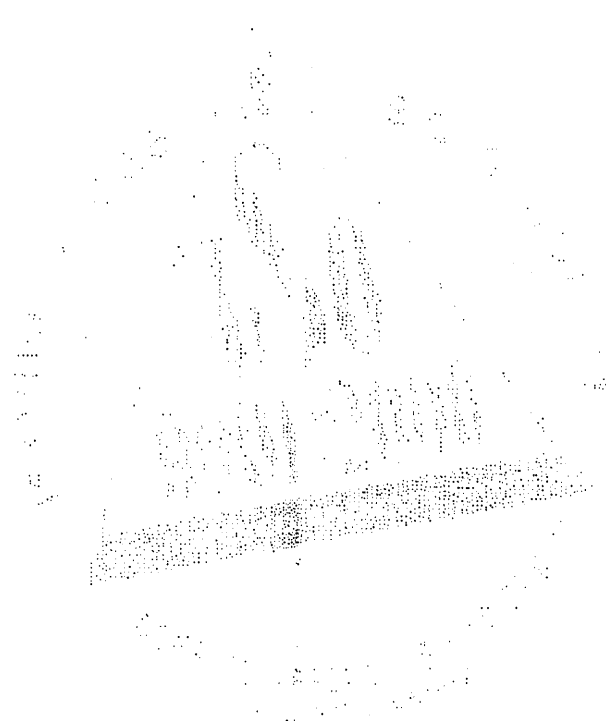
Certificate Prepared By: Debbie Newman, QA Administrator

*Debbie Newman*  
*Katalin Le*

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*





# inorganic ventures / iv labs

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 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

## certificate of analysis

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Tin in H<sub>2</sub>O tr. HNO<sub>3</sub> tr. HF

Catalog Number: CGSN1-1, CGSN1-2, and CGSN1-5  
 Lot Number: X-SN01115  
 Starting Material: Sn Shot  
 Starting Material Purity (%): 99.999438  
 Starting Material Lot No G12M23  
 Matrix: H<sub>2</sub>O tr. HNO<sub>3</sub> tr. HF

### 3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 995 ± 2 µg/mL

Certified Density: 0.998 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

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

$\sum s_i^2$  = The summation of all significant estimated errors

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

### 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

4.1 Assay Method #1 995 ± 2 µg/mL (Avg 2 runs)  
 ICP Assay NIST SRM 3161a Lot Number: 993107  
 Assay Method #2 998 µg/mL  
 Gravimetric NIST SRM Lot Number: See Sec. 4.2

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2

DATE RECEIVED: 03/30/04  
 DATE EXPIRED: 04/01/2005 VOS  
 DATE OPENED: 03/30/04  
 INORG: 4512 PO: F53361



- 4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.
- 4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.
- 4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00050	<u>M</u> Dy < 0.01205	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00060	<u>M</u> Te < 0.06026
<u>Q</u> Sb < 0.01000	<u>M</u> Er < 0.01004	<u>M</u> Lu < 0.00080	<u>M</u> Re < 0.00201	<u>M</u> Tb < 0.00060
<u>M</u> As < 0.02009	<u>M</u> Eu < 0.00603	<u>Q</u> Mg < 0.00003	<u>M</u> Rh < 0.00201	<u>M</u> Tl < 0.00201
<u>Q</u> Ba < 0.00070	<u>M</u> Gd < 0.00201	<u>M</u> Mn < 0.00804	<u>M</u> Rb < 0.00201	<u>M</u> Th < 0.00201
<u>M</u> Be < 0.00100	<u>M</u> Ga < 0.00201	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00402	<u>M</u> Tm < 0.00080
<u>M</u> Bi < 0.00080	<u>M</u> Ge < 0.01205	<u>M</u> Mo < 0.00402	<u>M</u> Sm < 0.00201	<u>s</u> Sn
<u>Q</u> B < 0.01200	<u>M</u> Au < 0.00603	<u>M</u> Nd < 0.00402	<u>M</u> Sc < 0.02009	<u>M</u> Ti < 0.10043
<u>Q</u> Cd 0.00009	<u>M</u> Hf < 0.00402	<u>Q</u> Ni < 0.01000	<u>M</u> Se < 0.01607	<u>M</u> W < 0.02009
<u>Q</u> Ca < 0.00150	<u>M</u> Ho < 0.00100	<u>M</u> Nb < 0.00100	<u>Q</u> Si < 0.00340	<u>M</u> U < 0.00402
<u>M</u> Ce < 0.01004	<u>M</u> In < 0.02009	<u>n</u> Os	<u>M</u> Ag < 0.00402	<u>M</u> V < 0.00402
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.01004	<u>M</u> Pd < 0.01004	<u>Q</u> Na < 0.00010	<u>M</u> Yb < 0.00201
<u>M</u> Cr < 0.01004	<u>Q</u> Fe < 0.00110	<u>Q</u> P < 0.00500	<u>M</u> Sr < 0.00100	<u>M</u> Y < 0.08035
<u>Q</u> Co < 0.00200	<u>M</u> La < 0.00100	<u>M</u> Pt < 0.00402	<u>n</u> S	<u>M</u> Zn < 0.04017
<u>M</u> Cu < 0.01205	<u>M</u> Pb 0.00593	<u>Q</u> K < 0.00200	<u>M</u> Ta < 0.01406	<u>M</u> Zr < 0.01004

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Keep tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 118.710; +4; 4, 5, 6, 7, 8  $\text{Sn}(\text{OH})_4\text{F}_2$

**Chemical Compatibility** - Soluble in HCl and dilute HF /  $\text{HNO}_3$ . Avoid neutral to basic media. Unstable at ppm levels with metals that would pull F<sup>-</sup> 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 provided it is in the chemical form shown above.

**Stability** - 2-100 ppb levels stable (alone or mixed with all other metals that are at comparable levels) as the  $\text{Sn}(\text{OH})_4\text{F}_2$  for 1 year in 1%  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm single element solutions as the  $\text{Sn}(\text{OH})_4\text{F}_2$  chemically stable for years in 2-5%  $\text{HNO}_3$  / trace HF in a LDPE container.

**Sn Containing Samples (Preparation and Solution)** - Metal (Soluble in HF /  $\text{HNO}_3$  or HCl); Oxides -  $\text{SnO}$  (soluble in HCl),  $\text{SnO}_2$  - very resistant to all acids including HF (Fusion with equal parts of  $\text{Na}_2\text{CO}_3$  and S. It is then soluble in water or dilute acids as the stannate.); Alloys (Treat first 0.1 g with 10 mL conc.  $\text{H}_2\text{SO}_4$  to boiling until the alloy disintegrates and nearly all of the sulfuric acid is expelled. Then add 100 mL O<sub>2</sub> free water and 50 mL of conc HCl or transfer to a plastic container and add 1 mL HF in either case warming gently to bring about solution.) Organic Matrices (Volatility and precipitation of the insoluble stannic oxide are problems. Consultation of the literature should be made for individual matrices / Sn compounds.)

**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 at 100ppb)
ICP-OES 189.989 nm	0.03 / 0.003 µg/mL	1	ion	
ICP-OES 242.949 nm	0.1 / 0.01 µg/mL	1	atom	W, Mo, Rh, Ta, Co
ICP-MS 120 amu	5 ppt	n/a	M	<sup>127</sup> Te, <sup>134</sup> Ru, <sup>136</sup> Te, <sup>138</sup> Te, <sup>140</sup> Te, <sup>142</sup> Te, <sup>144</sup> Te, <sup>146</sup> Te, <sup>148</sup> Te, <sup>150</sup> Te, <sup>152</sup> Te, <sup>154</sup> Te, <sup>156</sup> Te, <sup>158</sup> Te, <sup>160</sup> Te, <sup>162</sup> Te, <sup>164</sup> Te, <sup>166</sup> Te, <sup>168</sup> Te, <sup>170</sup> Te, <sup>172</sup> Te, <sup>174</sup> Te, <sup>176</sup> Te, <sup>178</sup> Te, <sup>180</sup> Te, <sup>182</sup> Te, <sup>184</sup> Te, <sup>186</sup> Te, <sup>188</sup> Te, <sup>190</sup> Te, <sup>192</sup> Te, <sup>194</sup> Te, <sup>196</sup> Te, <sup>198</sup> Te, <sup>200</sup> Te, <sup>202</sup> Te, <sup>204</sup> Te, <sup>206</sup> Te, <sup>208</sup> Te, <sup>210</sup> Te, <sup>212</sup> Te, <sup>214</sup> Te, <sup>216</sup> Te, <sup>218</sup> Te, <sup>220</sup> Te, <sup>222</sup> Te, <sup>224</sup> Te, <sup>226</sup> Te, <sup>228</sup> Te, <sup>230</sup> Te, <sup>232</sup> Te, <sup>234</sup> Te, <sup>236</sup> Te, <sup>238</sup> Te, <sup>240</sup> Te, <sup>242</sup> Te, <sup>244</sup> Te, <sup>246</sup> Te, <sup>248</sup> Te, <sup>250</sup> Te, <sup>252</sup> Te, <sup>254</sup> Te, <sup>256</sup> Te, <sup>258</sup> Te, <sup>260</sup> Te, <sup>262</sup> Te, <sup>264</sup> Te, <sup>266</sup> Te, <sup>268</sup> Te, <sup>270</sup> Te, <sup>272</sup> Te, <sup>274</sup> Te, <sup>276</sup> Te, <sup>278</sup> Te, <sup>280</sup> Te, <sup>282</sup> Te, <sup>284</sup> Te, <sup>286</sup> Te, <sup>288</sup> Te, <sup>290</sup> Te, <sup>292</sup> Te, <sup>294</sup> Te, <sup>296</sup> Te, <sup>298</sup> Te, <sup>300</sup> Te, <sup>302</sup> Te, <sup>304</sup> Te, <sup>306</sup> Te, <sup>308</sup> Te, <sup>310</sup> Te, <sup>312</sup> Te, <sup>314</sup> Te, <sup>316</sup> Te, <sup>318</sup> Te, <sup>320</sup> Te, <sup>322</sup> Te, <sup>324</sup> Te, <sup>326</sup> Te, <sup>328</sup> Te, <sup>330</sup> Te, <sup>332</sup> Te, <sup>334</sup> Te, <sup>336</sup> Te, <sup>338</sup> Te, <sup>340</sup> Te, <sup>342</sup> Te, <sup>344</sup> Te, <sup>346</sup> Te, <sup>348</sup> Te, <sup>350</sup> Te, <sup>352</sup> Te, <sup>354</sup> Te, <sup>356</sup> Te, <sup>358</sup> Te, <sup>360</sup> Te, <sup>362</sup> Te, <sup>364</sup> Te, <sup>366</sup> Te, <sup>368</sup> Te, <sup>370</sup> Te, <sup>372</sup> Te, <sup>374</sup> Te, <sup>376</sup> Te, <sup>378</sup> Te, <sup>380</sup> Te, <sup>382</sup> Te, <sup>384</sup> Te, <sup>386</sup> Te, <sup>388</sup> Te, <sup>390</sup> Te, <sup>392</sup> Te, <sup>394</sup> Te, <sup>396</sup> Te, <sup>398</sup> Te, <sup>400</sup> Te, <sup>402</sup> Te, <sup>404</sup> Te, <sup>406</sup> Te, <sup>408</sup> Te, <sup>410</sup> Te, <sup>412</sup> Te, <sup>414</sup> Te, <sup>416</sup> Te, <sup>418</sup> Te, <sup>420</sup> Te, <sup>422</sup> Te, <sup>424</sup> Te, <sup>426</sup> Te, <sup>428</sup> Te, <sup>430</sup> Te, <sup>432</sup> Te, <sup>434</sup> Te, <sup>436</sup> Te, <sup>438</sup> Te, <sup>440</sup> Te, <sup>442</sup> Te, <sup>444</sup> Te, <sup>446</sup> Te, <sup>448</sup> Te, <sup>450</sup> Te, <sup>452</sup> Te, <sup>454</sup> Te, <sup>456</sup> Te, <sup>458</sup> Te, <sup>460</sup> Te, <sup>462</sup> Te, <sup>464</sup> Te, <sup>466</sup> Te, <sup>468</sup> Te, <sup>470</sup> Te, <sup>472</sup> Te, <sup>474</sup> Te, <sup>476</sup> Te, <sup>478</sup> Te, <sup>480</sup> Te, <sup>482</sup> Te, <sup>484</sup> Te, <sup>486</sup> Te, <sup>488</sup> Te, <sup>490</sup> Te, <sup>492</sup> Te, <sup>494</sup> Te, <sup>496</sup> Te, <sup>498</sup> Te, <sup>500</sup> Te, <sup>502</sup> Te, <sup>504</sup> Te, <sup>506</sup> Te, <sup>508</sup> Te, <sup>510</sup> Te, <sup>512</sup> Te, <sup>514</sup> Te, <sup>516</sup> Te, <sup>518</sup> Te, <sup>520</sup> Te, <sup>522</sup> Te, <sup>524</sup> Te, <sup>526</sup> Te, <sup>528</sup> Te, <sup>530</sup> Te, <sup>532</sup> Te, <sup>534</sup> Te, <sup>536</sup> Te, <sup>538</sup> Te, <sup>540</sup> Te, <sup>542</sup> Te, <sup>544</sup> Te, <sup>546</sup> Te, <sup>548</sup> Te, <sup>550</sup> Te, <sup>552</sup> Te, <sup>554</sup> Te, <sup>556</sup> Te, <sup>558</sup> Te, <sup>560</sup> Te, <sup>562</sup> Te, <sup>564</sup> Te, <sup>566</sup> Te, <sup>568</sup> Te, <sup>570</sup> Te, <sup>572</sup> Te, <sup>574</sup> Te, <sup>576</sup> Te, <sup>578</sup> Te, <sup>580</sup> Te, <sup>582</sup> Te, <sup>584</sup> Te, <sup>586</sup> Te, <sup>588</sup> Te, <sup>590</sup> Te, <sup>592</sup> Te, <sup>594</sup> Te, <sup>596</sup> Te, <sup>598</sup> Te, <sup>600</sup> Te, <sup>602</sup> Te, <sup>604</sup> Te, <sup>606</sup> Te, <sup>608</sup> Te, <sup>610</sup> Te, <sup>612</sup> Te, <sup>614</sup> Te, <sup>616</sup> Te, <sup>618</sup> Te, <sup>620</sup> Te, <sup>622</sup> Te, <sup>624</sup> Te, <sup>626</sup> Te, <sup>628</sup> Te, <sup>630</sup> Te, <sup>632</sup> Te, <sup>634</sup> Te, <sup>636</sup> Te, <sup>638</sup> Te, <sup>640</sup> Te, <sup>642</sup> Te, <sup>644</sup> Te, <sup>646</sup> Te, <sup>648</sup> Te, <sup>650</sup> Te, <sup>652</sup> Te, <sup>654</sup> Te, <sup>656</sup> Te, <sup>658</sup> Te, <sup>660</sup> Te, <sup>662</sup> Te, <sup>664</sup> Te, <sup>666</sup> Te, <sup>668</sup> Te, <sup>670</sup> Te, <sup>672</sup> Te, <sup>674</sup> Te, <sup>676</sup> Te, <sup>678</sup> Te, <sup>680</sup> Te, <sup>682</sup> Te, <sup>684</sup> Te, <sup>686</sup> Te, <sup>688</sup> Te, <sup>690</sup> Te, <sup>692</sup> Te, <sup>694</sup> Te, <sup>696</sup> Te, <sup>698</sup> Te, <sup>700</sup> Te, <sup>702</sup> Te, <sup>704</sup> Te, <sup>706</sup> Te, <sup>708</sup> Te, <sup>710</sup> Te, <sup>712</sup> Te, <sup>714</sup> Te, <sup>716</sup> Te, <sup>718</sup> Te, <sup>720</sup> Te, <sup>722</sup> Te, <sup>724</sup> Te, <sup>726</sup> Te, <sup>728</sup> Te, <sup>730</sup> Te, <sup>732</sup> Te, <sup>734</sup> Te, <sup>736</sup> Te, <sup>738</sup> Te, <sup>740</sup> Te, <sup>742</sup> Te, <sup>744</sup> Te, <sup>746</sup> Te, <sup>748</sup> Te, <sup>750</sup> Te, <sup>752</sup> Te, <sup>754</sup> Te, <sup>756</sup> Te, <sup>758</sup> Te, <sup>760</sup> Te, <sup>762</sup> Te, <sup>764</sup> Te, <sup>766</sup> Te, <sup>768</sup> Te, <sup>770</sup> Te, <sup>772</sup> Te, <sup>774</sup> Te, <sup>776</sup> Te, <sup>778</sup> Te, <sup>780</sup> Te, <sup>782</sup> Te, <sup>784</sup> Te, <sup>786</sup> Te, <sup>788</sup> Te, <sup>790</sup> Te, <sup>792</sup> Te, <sup>794</sup> Te, <sup>796</sup> Te, <sup>798</sup> Te, <sup>800</sup> Te, <sup>802</sup> Te, <sup>804</sup> Te, <sup>806</sup> Te, <sup>808</sup> Te, <sup>810</sup> Te, <sup>812</sup> Te, <sup>814</sup> Te, <sup>816</sup> Te, <sup>818</sup> Te, <sup>820</sup> Te, <sup>822</sup> Te, <sup>824</sup> Te, <sup>826</sup> Te, <sup>828</sup> Te, <sup>830</sup> Te, <sup>832</sup> Te, <sup>834</sup> Te, <sup>836</sup> Te, <sup>838</sup> Te, <sup>840</sup> Te, <sup>842</sup> Te, <sup>844</sup> Te, <sup>846</sup> Te, <sup>848</sup> Te, <sup>850</sup> Te, <sup>852</sup> Te, <sup>854</sup> Te, <sup>856</sup> Te, <sup>858</sup> Te, <sup>860</sup> Te, <sup>862</sup> Te, <sup>864</sup> Te, <sup>866</sup> Te, <sup>868</sup> Te, <sup>870</sup> Te, <sup>872</sup> Te, <sup>874</sup> Te, <sup>876</sup> Te, <sup>878</sup> Te, <sup>880</sup> Te, <sup>882</sup> Te, <sup>884</sup> Te, <sup>886</sup> Te, <sup>888</sup> Te, <sup>890</sup> Te, <sup>892</sup> Te, <sup>894</sup> Te, <sup>896</sup> Te, <sup>898</sup> Te, <sup>900</sup> Te, <sup>902</sup> Te, <sup>904</sup> Te, <sup>906</sup> Te, <sup>908</sup> Te, <sup>910</sup> Te, <sup>912</sup> Te, <sup>914</sup> Te, <sup>916</sup> Te, <sup>918</sup> Te, <sup>920</sup> Te, <sup>922</sup> Te, <sup>924</sup> Te, <sup>926</sup> Te, <sup>928</sup> Te, <sup>930</sup> Te, <sup>932</sup> Te, <sup>934</sup> Te, <sup>936</sup> Te, <sup>938</sup> Te, <sup>940</sup> Te, <sup>942</sup> Te, <sup>944</sup> Te, <sup>946</sup> Te, <sup>948</sup> Te, <sup>950</sup> Te, <sup>952</sup> Te, <sup>954</sup> Te, <sup>956</sup> Te, <sup>958</sup> Te, <sup>960</sup> Te, <sup>962</sup> Te, <sup>964</sup> Te, <sup>966</sup> Te, <sup>968</sup> Te, <sup>970</sup> Te, <sup>972</sup> Te, <sup>974</sup> Te, <sup>976</sup> Te, <sup>978</sup> Te, <sup>980</sup> Te, <sup>982</sup> Te, <sup>984</sup> Te, <sup>986</sup> Te, <sup>988</sup> Te, <sup>990</sup> Te, <sup>992</sup> Te, <sup>994</sup> Te, <sup>996</sup> Te, <sup>998</sup> Te, <sup>1000</sup> Te, <sup>1002</sup> Te, <sup>1004</sup> Te, <sup>1006</sup> Te, <sup>1008</sup> Te, <sup>1010</sup> Te, <sup>1012</sup> Te, <sup>1014</sup> Te, <sup>1016</sup> Te, <sup>1018</sup> Te, <sup>1020</sup> Te, <sup>1022</sup> Te, <sup>1024</sup> Te, <sup>1026</sup> Te, <sup>1028</sup> Te, <sup>1030</sup> Te, <sup>1032</sup> Te, <sup>1034</sup> Te, <sup>1036</sup> Te, <sup>1038</sup> Te, <sup>1040</sup> Te, <sup>1042</sup> Te, <sup>1044</sup> Te, <sup>1046</sup> Te, <sup>1048</sup> Te, <sup>1050</sup> Te, <sup>1052</sup> Te, <sup>1054</sup> Te, <sup>1056</sup> Te, <sup>1058</sup> Te, <sup>1060</sup> Te, <sup>1062</sup> Te, <sup>1064</sup> Te, <sup>1066</sup> Te, <sup>1068</sup> Te, <sup>1070</sup> Te, <sup>1072</sup> Te, <sup>1074</sup> Te, <sup>1076</sup> Te, <sup>1078</sup> Te, <sup>1080</sup> Te, <sup>1082</sup> Te, <sup>1084</sup> Te, <sup>1086</sup> Te, <sup>1088</sup> Te, <sup>1090</sup> Te, <sup>1092</sup> Te, <sup>1094</sup> Te, <sup>1096</sup> Te, <sup>1098</sup> Te, <sup>1100</sup> Te, <sup>1102</sup> Te, <sup>1104</sup> Te, <sup>1106</sup> Te, <sup>1108</sup> Te, <sup>1110</sup> Te, <sup>1112</sup> Te, <sup>1114</sup> Te, <sup>1116</sup> Te, <sup>1118</sup> Te, <sup>1120</sup> Te, <sup>1122</sup> Te, <sup>1124</sup> Te, <sup>1126</sup> Te, <sup>1128</sup> Te, <sup>1130</sup> Te, <sup>1132</sup> Te, <sup>1134</sup> Te, <sup>1136</sup> Te, <sup>1138</sup> Te, <sup>1140</sup> Te, <sup>1142</sup> Te, <sup>1144</sup> Te, <sup>1146</sup> Te, <sup>1148</sup> Te, <sup>1150</sup> Te, <sup>1152</sup> Te, <sup>1154</sup> Te, <sup>1156</sup> Te, <sup>1158</sup> Te, <sup>1160</sup> Te, <sup>1162</sup> Te, <sup>1164</sup> Te, <sup>1166</sup> Te, <sup>1168</sup> Te, <sup>1170</sup> Te, <sup>1172</sup> Te, <sup>1174</sup> Te, <sup>1176</sup> Te, <sup>1178</sup> Te, <sup>1180</sup> Te, <sup>1182</sup> Te, <sup>1184</sup> Te, <sup>1186</sup> Te, <sup>1188</sup> Te, <sup>1190</sup> Te, <sup>1192</sup> Te, <sup>1194</sup> Te, <sup>1196</sup> Te, <sup>1198</sup> Te, <sup>1200</sup> Te, <sup>1202</sup> Te, <sup>1204</sup> Te, <sup>1206</sup> Te, <sup>1208</sup> Te, <sup>1210</sup> Te, <sup>1212</sup> Te, <sup>1214</sup> Te, <sup>1216</sup> Te, <sup>1218</sup> Te, <sup>1220</sup> Te, <sup>1222</sup> Te, <sup>1224</sup> Te, <sup>1226</sup> Te, <sup>1228</sup> Te, <sup>1230</sup> Te, <sup>1232</sup> Te, <sup>1234</sup> Te, <sup>1236</sup> Te, <sup>1238</sup> Te, <sup>1240</sup> Te, <sup>1242</sup> Te, <sup>1244</sup> Te, <sup>1246</sup> Te, <sup>1248</sup> Te, <sup>1250</sup> Te, <sup>1252</sup> Te, <sup>1254</sup> Te, <sup>1256</sup> Te, <sup>1258</sup> Te, <sup>1260</sup> Te, <sup>1262</sup> Te, <sup>1264</sup> Te, <sup>1266</sup> Te, <sup>1268</sup> Te, <sup>1270</sup> Te, <sup>1272</sup> Te, <sup>1274</sup> Te, <sup>1276</sup> Te, <sup>1278</sup> Te, <sup>1280</sup> Te, <sup>1282</sup> Te, <sup>1284</sup> Te, <sup>1286</sup> Te, <sup>1288</sup> Te, <sup>1290</sup> Te, <sup>1292</sup> Te, <sup>1294</sup> Te, <sup>1296</sup> Te, <sup>1298</sup> Te, <sup>1300</sup> Te, <sup>1302</sup> Te, <sup>1304</sup> Te, <sup>1306</sup> Te, <sup>1308</sup> Te, <sup>1310</sup> Te, <sup>1312</sup> Te, <sup>1314</sup> Te, <sup>1316</sup> Te, <sup>1318</sup> Te, <sup>1320</sup> Te, <sup>1322</sup> Te, <sup>1324</sup> Te, <sup>1326</sup> Te, <sup>1328</sup> Te, <sup>1330</sup> Te, <sup>1332</sup> Te, <sup>1334</sup> Te, <sup>1336</sup> Te, <sup>1338</sup> Te, <sup>1340</sup> Te, <sup>1342</sup> Te, <sup>1344</sup> Te, <sup>1346</sup> Te, <sup>1348</sup> Te, <sup>1350</sup> Te, <sup>1352</sup> Te, <sup>1354</sup> Te, <sup>1356</sup> Te, <sup>1358</sup> Te, <sup>1360</sup> Te, <sup>1362</sup> Te, <sup>1364</sup> Te, <sup>1366</sup> Te, <sup>1368</sup> Te, <sup>1370</sup> Te, <sup>1372</sup> Te, <sup>1374</sup> Te, <sup>1376</sup> Te, <sup>1378</sup> Te, <sup>1380</sup> Te, <sup>1382</sup> Te, <sup>1384</sup> Te, <sup>1386</sup> Te, <sup>1388</sup> Te, <sup>1390</sup> Te, <sup>1392</sup> Te, <sup>1394</sup> Te, <sup>1396</sup> Te, <sup>1398</sup> Te, <sup>1400</sup> Te, <sup>1402</sup> Te, <sup>1404</sup> Te, <sup>1406</sup> Te, <sup>1408</sup> Te, <sup>1410</sup> Te, <sup>1412</sup> Te, <sup>1414</sup> Te, <sup>1416</sup> Te, <sup>1418</sup> Te, <sup>1420</sup> Te, <sup>1422</sup> Te, <sup>1424</sup> Te, <sup>1426</sup> Te, <sup>1428</sup> Te, <sup>1430</sup> Te, <sup>1432</sup> Te, <sup>1434</sup> Te, <sup>1436</sup> Te, <sup>1438</sup> Te, <sup>1440</sup> Te, <sup>1442</sup> Te, <sup>1444</sup> Te, <sup>1446</sup> Te, <sup>1448</sup> Te, <sup>1450</sup> Te, <sup>1452</sup> Te, <sup>1454</sup> Te, <sup>1456</sup> Te, <sup>1458</sup> Te, <sup>1460</sup> Te, <sup>1462</sup> Te, <sup>1464</sup> Te, <sup>1466</sup> Te, <sup>1468</sup> Te, <sup>1470</sup> Te, <sup>1472</sup> Te, <sup>1474</sup> Te, <sup>1476</sup> Te, <sup>1478</sup> Te, <sup>1480</sup> Te, <sup>1482</sup> Te, <sup>1484</sup> Te, <sup>1486</sup> Te, <sup>1488</sup> Te, <sup>1490</sup> Te, <sup>1492</sup> Te, <sup>1494</sup> Te, <sup>1496</sup> Te, <sup>1498</sup> Te, <sup>1500</sup> Te, <sup>1502</sup> Te, <sup>1504</sup> Te, <sup>1506</sup> Te, <sup>1508</sup> Te, <sup>1510</sup> Te, <sup>1512</sup> Te, <sup>1514</sup> Te, <sup>1516</sup> Te, <sup>1518</sup> Te, <sup>1520</sup> Te, <sup>1522</sup> Te, <sup>1524</sup> Te, <sup>1526</sup> Te, <sup>1528</sup> Te, <sup>1530</sup> Te, <sup>1532</sup> Te, <sup>1534</sup> Te, <sup>1536</sup> Te, <sup>1538</sup> Te, <sup>1540</sup> Te, <sup>1542</sup> Te, <sup>1544</sup> Te, <sup>1546</sup> Te, <sup>1548</sup> Te, <sup>1550</sup> Te, <sup>1552</sup> Te, <sup>1554</sup> Te, <sup>1556</sup> Te, <sup>1558</sup> Te, <sup>1560</sup> Te, <sup>1562</sup> Te, <sup>1564</sup> Te, <sup>1566</sup> Te, <sup>1568</sup> Te, <sup>1570</sup> Te, <sup>1572</sup> Te, <sup>1574</sup> Te, <sup>1576</sup> Te, <sup>1578</sup> Te, <sup>1580</sup> Te, <sup>1582</sup> Te, <sup>1584</sup> Te, <sup>1586</sup> Te, <sup>1588</sup> Te, <sup>1590</sup> Te, <sup>1592</sup> Te, <sup>1594</sup> Te, <sup>1596</sup> Te, <sup>1598</sup> Te, <sup>1600</sup> Te, <sup>1602</sup> Te, <sup>1604</sup> Te, <sup>1606</sup> Te, <sup>1608</sup> Te, <sup>1610</sup> Te, <sup>1612</sup> Te, <sup>1614</sup> Te, <sup>1616</sup> Te, <sup>1618</sup> Te, <sup>1620</sup> Te, <sup>1622</sup> Te, <sup>1624</sup> Te, <sup>1626</sup> Te, <sup>1628</sup> Te, <sup>1630</sup> Te, <sup>1632</sup> Te, <sup>1634</sup> Te, <sup>1636</sup> Te, <sup>1638</sup> Te, <sup>1640</sup> Te, <sup>1642</sup> Te, <sup>1644</sup> Te, <sup>1646</sup> Te, <sup>1648</sup> Te, <sup>1650</sup> Te, <sup>1652</sup> Te, <sup>1654</sup> Te, <sup>1656</sup> Te, <sup>1658</sup> Te, <sup>1660</sup> Te, <sup>1662</sup> Te, <sup>1664</sup> Te, <sup>1666</sup> Te, <sup>1668</sup> Te, <sup>1670</sup> Te, <sup>1672</sup> Te, <sup>1674</sup> Te, <sup>1676</sup> Te, <sup>1678</sup> Te, <sup>1680</sup> Te, <sup>1682</sup> Te, <sup>1684</sup> Te, <sup>1686</sup> Te, <sup>1688</sup> Te, <sup>1690</sup> Te, <sup>1692</sup> Te, <sup>1694</sup> Te, <sup>1696</sup> Te, <sup>1698</sup> Te, <sup>1700</sup> Te, <sup>1702</sup> Te, <sup>1704</sup> Te, <sup>1706</sup> Te, <sup>1708</sup> Te, <sup>1710</sup> Te, <sup>1712</sup> Te, <sup>1714</sup> Te, <sup>1716</sup> Te, <sup>1718</sup> Te, <sup>1720</sup> Te, <sup>1722</sup> Te, <sup>1724</sup> Te, <sup>1726</sup> Te, <sup>1728</sup> Te, <sup>1730</sup> Te, <sup>1732</sup> Te, <sup>1734</sup> Te, <sup>1736</sup> Te, <sup>1738</sup> Te, <sup>1740</sup> Te, <sup>1742</sup> Te, <sup>1744</sup> Te, <sup>1746</sup> Te, <sup>1748</sup> Te, <sup>1750</sup> Te, <sup>1752</sup> Te, <sup>1754</sup> Te, <sup>1756</sup> Te, <sup>1758</sup> Te, <sup>1760</sup> Te, <sup>1762</sup> Te, <sup>1764</sup> Te, <sup>1766</sup> Te, <sup>1768</sup> Te, <sup>1770</sup> Te, <sup>1772</sup> Te, <sup>1774</sup> Te, <sup>1776</sup> Te, <sup>1778</sup> Te, <sup>1780</sup> Te, <sup>1782</sup> Te, <sup>1784</sup> Te, <sup>1786</sup> Te, <sup>1788</sup> Te, <sup>1790</sup> Te, <sup>1792</sup> Te, <sup>1794</sup> Te, <sup>1796</sup> Te, <sup>1798</sup> Te, <sup>1800</sup> Te, <sup>1802</sup> Te, <sup>1804</sup> Te, <sup>1806</sup> Te, <sup>1808</sup> Te, <sup>1810</sup> Te, <sup>1812</sup> Te, <sup>1814</sup> Te, <sup>1816</sup> Te, <sup>1818</sup> Te, <sup>1820</sup> Te, <sup>1822</sup> Te, <sup>1824</sup> Te, <sup>1826</sup> Te, <sup>1828</sup> Te, <sup>1830</sup> Te, <sup>1832</sup> Te, <sup>1834</sup> Te, <sup>1836</sup> Te, <sup>1838</sup> Te, <sup>1840</sup> Te, <sup>1842</sup> Te, <sup>1844</sup> Te, <sup>1846</sup> Te, <sup>1848</sup> Te, <sup>1850</sup> Te, <sup>1852</sup> Te, <sup>1854</sup> Te, <sup>1856</sup> Te, <sup>1858</sup> Te, <sup>1860</sup> Te, <sup>1862</sup> Te, <sup>1864</sup> Te, <sup>1866</sup> Te, <sup>1868</sup> Te, <sup>1870</sup> Te, <sup>1872</sup> Te, <sup>1874</sup> Te, <sup>1876</sup> Te, <sup>1878</sup> Te, <sup>1880</sup> Te, <sup>1882</sup> Te, <sup>1884</sup> Te, <sup>1886</sup> Te, <sup>1888</sup> Te, <sup>1890</sup> Te, <sup>1892</sup> Te, <sup>1894</sup> Te, <sup>1896</sup> Te, <sup>1898</sup> Te, <sup>1900</sup> Te, <sup>1902</sup> Te, <sup>1904</sup> Te, <sup>1906</sup> Te, <sup>1908</sup> Te, <sup>1910</sup> Te, <sup>1912</sup> Te, <sup>1914</sup> Te, <sup>1916</sup> Te, <sup>1918</sup> Te, <sup>1920</sup> Te, <sup>1922</sup> Te, <sup>1924</sup> Te, <sup>1926</sup> Te, <sup>1928</sup> Te, <sup>1930</sup> Te, <sup>1932</sup> Te, <sup>1934</sup> Te, <sup>1936</sup> Te, <sup>1938</sup> Te, <sup>1940</sup> Te, <sup>1942</sup> Te, <sup>1944</sup> Te, <sup>1946</sup> Te, <sup>1948</sup> Te, <sup>1950</sup> Te, <sup>1952</sup> Te, <sup>1954</sup> Te, <sup>1956</sup> Te, <sup>1958</sup> Te, <sup>1960</sup> Te, <sup>1962</sup> Te, <sup>1964</sup> Te, <sup>1966</sup> Te, <sup>1968</sup> Te, <sup>1970</sup> Te, <sup>1972</sup> Te, <sup>1974</sup> Te, <sup>1976</sup> Te, <sup>1978</sup> Te, <sup>1980</sup> Te, <sup>1982</sup> Te, <sup>1984</sup> Te, <sup>1986</sup> Te, <sup>1988</sup> Te, <sup>1990</sup> Te, <sup>1992</sup> Te, <sup>1994</sup> Te, <sup>1996</sup> Te, <sup>1998</sup> Te, <sup>2000</sup> Te, <sup>2002</sup> Te, <sup>2004</sup> Te, <sup>2006</sup> Te, <sup>2008</sup> Te, <sup>2010</sup> Te, <sup>2012</sup> Te, <sup>2014</sup> Te, <sup>2016</sup> Te, <sup>2018</sup> Te, <sup>2020</sup> Te, <sup>2022</sup> Te, <sup>2024</sup> Te, <sup>2026</sup> Te, <sup>2028</sup> Te, <sup>2030</sup> Te, <sup>2032</sup> Te, <sup>2034</sup> Te, <sup>2036</sup> Te, <sup>2038</sup> Te, <sup>2040</sup> Te, <sup>2042</sup> Te, <sup>2044</sup> Te, <sup>2046</sup> Te, <sup>2048</sup> Te, <sup>2050</sup> Te, <sup>2052</sup> Te, <sup>2054</sup> Te, <sup>2056</sup> Te, <sup>2058</sup> Te, <sup>2060</sup> Te, <sup>2062</sup> Te, <sup>2064</sup> Te, <sup>2066</sup>

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010410



**11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

**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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

**Certification Date:** February 11, 2004

**Expiration Date:**

**EXPIRES**  
1/12/2005

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

**Certificate Prepared By:** JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

**Certificate Approved By:** Katalin Le, QC Manager

*Katalin Le*

**Certifying Officer:** Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*

010411

**inorganic ventures / iv labs**

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 phone: 800-669-6799 • 732-901-1900 • fax: 732-901-1903  
 e-mail: ivsales@ivstandards.com • website: www.ivstandards.com

**certificate of analysis**

- 1.0 Inorganic Ventures / IV Labs is an ISO Guide 34-2000 Certified Reference Material (CRM) Manufacturer: Certificate #883-02. The certificate is designed and the certified value(s) and uncertainty(ies) are determined in accordance with ISO Guide 31-2000 (Reference Materials - Contents of certificates and label(s)), ISO Guide 34-2000 "Quality System Guidelines for the Production of Reference Materials," and ISO Guide 35-1989 "Certification of Reference Materials - General and Statistical Principles."

- 2.0 DESCRIPTION OF CRM Custom-Grade 1000 µg/mL Bismuth in 3.5% (abs) HNO<sub>3</sub>

Catalog Number: CGBI1-1 and CGBI1-5  
 Lot Number: W-BI01089  
 Starting Material: Bi needles  
 Starting Material Purity (%): 99.999090  
 Starting Material Lot No: G25L16  
 Matrix: 3.5% (abs) HNO<sub>3</sub>

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2  
 DATE RECEIVED: 07/31/03  
 DATE EXPIRED: 08/01/2004 V03  
 DATE OPENED: 08/01/03  
 INORG: 4300 PO: F52383

- 3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1002 ± 4 µg/mL  
 Certified Density: 1.026 g/mL (measured at 22° C)

The Certified Value is based upon the most precise method used to analyze this CRM. The following equations are used in the calculation of the certified value and the uncertainty:

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

$$\text{Uncertainty } (\pm) = \frac{2(\sum s_i^2)^{1/2}}{(n)^{1/2}}$$

( $\bar{x}$ ) = mean

$x_i$  = individual results

$n$  = number of measurements

$\sum s_i^2$  = The summation of all significant estimated errors.

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST SRM certificate of analysis.)

- 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 IV product is Traceable to NIST via direct comparison to NIST SRMs. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors.

- 4.1 Assay Method #1 1002 ± 4 µg/mL (Avg 2 runs)

ICP Assay NIST SRM 3106 Lot Number: 991212

- Assay Method #2 1002 µg/mL

Gravimetric NIST SRM Lot Number: See Sec. 4.2

**4.2 BALANCE CALIBRATION** - All balances are checked daily using in-house procedure number 6-IMM-001. The weights used for testing are annually compared to Gerhart Scale Corporation's master weights and are traceable to the National Institute of Standards and Technology (NIST). The NIST Traceability numbers are 692476 - Class 1 and 692476A - Class 2. The NIST test number is 822/260017-98. All analytical balances are calibrated every 4 months by Gerhart Scale Corp. of South Amboy. The balances are calibrated with a class 1 and/or class 2 analytical weight set. These weights are tested annually by a NIST / NVLAP accredited calibration lab. The NIST test number is 822/260017-98.

**4.3 THERMOMETER CALIBRATION** - The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 176240. The in-house procedure No. is 2-QC-001. Thermometers which are not calibrated vs standard thermometer No. 903-2680 are traceable to NIST Identification Nos. 92564, 119016, 471047 and NIST test report Nos. 811/258522, 811/2557078, and 236090.

**4.4 GLASSWARE CALIBRATION** - In-house procedure 3-QC-002 is used to calibrate all Class A Glassware used in the manufacture and quality control of Custom Grade Standards.

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

Custom-Grade 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.

<u>Q</u> Al 0.00012	<u>M</u> Dy < 0.01202	<u>Q</u> Li < 0.00002	<u>M</u> Pr < 0.00060	<u>M</u> Te < 0.06008
<u>M</u> Sb < 0.00100	<u>M</u> Er < 0.01001	<u>M</u> Lu < 0.00080	<u>M</u> Re < 0.00200	<u>M</u> Tb < 0.00060
<u>M</u> As < 0.02003	<u>M</u> Eu < 0.00601	<u>Q</u> Mg 0.00070	<u>M</u> Rh < 0.00200	<u>M</u> Tl < 0.00200
<u>M</u> Ba < 0.02003	<u>M</u> Gd < 0.00200	<u>Q</u> Mn < 0.00020	<u>M</u> Rb < 0.00200	<u>M</u> Th < 0.00200
<u>M</u> Be < 0.00100	<u>M</u> Ga < 0.00200	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00401	<u>M</u> Tm < 0.00080
<u>s</u> Bi	<u>M</u> Ge < 0.01202	<u>M</u> Mo < 0.00401	<u>M</u> Sm < 0.00200	<u>M</u> Sn < 0.01001
<u>M</u> B < 0.14018	<u>M</u> Au < 0.00601	<u>M</u> Nd < 0.00401	<u>M</u> Sc < 0.02003	<u>M</u> Ti < 0.10013
<u>Q</u> Cd 0.00017	<u>M</u> Hf < 0.00401	<u>M</u> Ni < 0.01602	<u>M</u> Se < 0.01602	<u>M</u> W < 0.02003
<u>Q</u> Ca 0.00245	<u>M</u> Ho < 0.00100	<u>M</u> Nb < 0.00100	<u>Q</u> Si 0.00105	<u>M</u> U < 0.00401
<u>M</u> Ce < 0.01001	<u>Q</u> In 0.00105	<u>n</u> Os	<u>M</u> Ag < 0.00401	<u>M</u> V < 0.00401
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.01001	<u>Q</u> Pd < 0.00400	<u>Q</u> Na 0.00240	<u>M</u> Yb < 0.00200
<u>Q</u> Cr 0.00020	<u>Q</u> Fe 0.00014	<u>Q</u> P < 0.01000	<u>M</u> Sr < 0.00100	<u>M</u> Y < 0.08011
<u>M</u> Co < 0.00601	<u>M</u> La < 0.00100	<u>M</u> Pt < 0.00401	<u>Q</u> S < 0.03000	<u>Q</u> Zn 0.00008
<u>Q</u> Cu 0.00014	<u>Q</u> Pb 0.00135	<u>Q</u> K 0.00039	<u>M</u> Ta < 0.01402	<u>M</u> Zr < 0.01001

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:

ICP-MS, ICP-OES, FAAS, GFAA, XRF, and DCP

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 IV Technical Staff

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

**Storage & Handling** - Kept tightly sealed when not in use. Store and use at  $20 \pm 4^\circ\text{C}$ . Do not pipet from container. Do not return portions removed for pipetting to container.

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 208.9804; +3, 6;  $\text{Bi}(\text{O})(\text{H}_2\text{O})_5^{3+}$

**Chemical Compatibility** - Stable in HCl,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and HF. Avoid basic media forming insoluble hydroxide. Stable with most metals and inorganic anions in acidic media. Many salts that are insoluble in water are soluble in HCl,  $\text{HNO}_3$ , and HF. The major problem with  $\text{Bi}^{3+}$  is its tendency to hydrolyze at higher concentrations or in dilute acid. Nitric acid solutions should be 5% to hold the Bi in solution in the 100 to 10000  $\mu\text{g/mL}$  concentration range.

**Stability** - 2-100 ppb levels stable for months in 1 %  $\text{HNO}_3$  / LDPE container. 1-10,000 ppm solutions chemically stable for years in 5 - 7%  $\text{HNO}_3$  / LDPE container.

**Bi Containing Samples (Preparation and Solution)** - Metal (soluble in  $\text{HNO}_3$ ); Oxides (Soluble in  $\text{HNO}_3$ ); Alloys (Dissolve in conc. 4:1  $\text{HCl}/\text{HNO}_3$ . Heating may be required.); Organic based (dry ash at  $450^\circ\text{C}$  and dissolve ash in  $\text{HNO}_3$  or acid digestion with conc. hot sulfuric acid adding hydrogen peroxide dropwise and carefully until clear.)

**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 at $\lambda$ )
ICP-OES 223.061 nm	0.04 / 0.005 $\mu\text{g/mL}$	1	atom	Th, Ir, Tl Cu
ICP-OES 308.772 nm	0.08 / 0.01 $\mu\text{g/mL}$	1	atom	Th, U, Zr, Hf, Fe
ICP-OES 222.825 nm	0.1 / 0.02 $\mu\text{g/mL}$	1	atom	Cr, Hf, Ce, Os
ICP-MS 208 amu	2 ppt	n/a	M'	$^{209}\text{Bi}$

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 procedure IV-MPM-004 and is guaranteed to be homogeneous.

## 10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001:2000 Quality Management System Registration - QMI Certificate Number 010105

Recognized by:

Registrar Accreditation Board (ANSI-RAB)

Standards Council of Canada (SCC)

Dutch Council for Accreditation (RVA)

Entidad Mexicana de Acreditacion, a.c.(EMA)

**Members of IQ Net International Certification Network:**

Argentina (IRAM), Australia (QAS), Austria (ÖQS), Belgium (Avinter), Brazil (FCAV), Canada (QMI), Hong Kong (HKQAA), Columbia (ICONTEC), Czech Republic (CQS), Denmark (DS), Finland (SFS), France (AFAQ), Germany (DQS), Greece (ELOT), Hungary (MSZT), Ireland (NSAI), Israel (SII), Italy (CISQ), Japan (JQA), Korea (KSA-QA), Netherlands (KEMA), Norway (NCS), Poland (PCBC), Portugal (APCER), Singapore (PSB), Slovenia (SIQ), Spain (AENOR), Switzerland (SQS)

10.2 ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration"

- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 - 2000 "General Requirements for the Competence of Reference Material Producers"

- Reference Materials Production - Accredited A2LA Certificate Number 883.02

**A2LA Mutual Recognition Agreement Partners:**

Australia (NATA), Austria (BmWA), Belgium (BELTEST) (BKO-OBE), Canada (SCC), Chinese Taipei (CNLA), Czech Republic (NAO), Denmark (DANAK), Finland (FINAS), France (COFRAC), Germany (DAR), Hong Kong (HKAS), Ireland (NAB), Italy (SIT) (SINAL), Japan (JAB) (JNLA), Republic of Korea (KOLAS), The Netherlands (RvA), New Zealand (IANZ), Norway (NA), Portugal (IPQ), Singapore (SAC-SINGLAS), Spain (ENAC), Sweden (SWEDAC), Switzerland (SAS), United Kingdom (UKAS) and United States (NVLAP) (ICBO ES)

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

10.6 MIL-STD-45662A (Obsolete/Observed)



INORGANIC LABS/RADCHEM LABS Pg. 2 of 2

DATE RECEIVED: 07/31/03

DATE EXPIRED: 08/01/2004 VOS

DATE OPENED: 08/01/03

INORG: 4200 PO: F52383

## 11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY



11.1 IV 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. Transpiration studies (P-SP01020) of chemically-stable solutions performed at Inorganic Ventures / IV Labs indicate a CRM shelf-life of four years for solutions packaged in 500-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

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. Inorganic Ventures / IV Labs concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

Certification Date: March 28, 2003

Expiration Date:

**EXPIRES**  
1/2/2004

## 12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

*JoAnn Struthers*

Certificate Approved By: Katalin Le, QC Supervisor

*Katalin Le*

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

*Paul Gaines*



010415

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Tel.: 800-558-9160 • (414) 273-3850  
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e-mail: aldrich@sial.com

## Certificate of Analysis

SOUTHWEST RESEARCH INST  
DANNY RAMIREZ  
6220 CULEBRA RD  
SAN ANTONIO TX 78238

PO NBR: 130686E

INORGANICS LAB 27/28/29/30/34  
DATE RECEIVED: 1/9/2001  
DATE EXPIRED: 1/9/2002 DR  
DATE OPENED: 1/9/2001  
INORG: 2626 PO: 130686E

PRODUCT NUMBER: 236527-500G

LOT NUMBER: 15308EI

PRODUCT NAME: SODIUM HYDROGENCARBONATE, 99.7+%,  
A.C.S. REAGENT

FORMULA:  $\text{NaHCO}_3$ 

FORMULA WEIGHT: 84.01

APPEARANCE	WHITE POWDER
TITRATION	100.3 % (WITH HCL)
ICP ASSAY	CONFIRMS SODIUM COMPONENT
INSOLUBLE MATTER	0.001% *
CALCIUM	0.0050%
CHLORIDE	0.0014% *
IRON	< 0.0001% *
HEAVY METALS	<5PPM (AS PB) *
POTASSIUM	<0.0020 % *
MAGNESIUM	0.00025%
AMMONIUM	<5PPM *
PHOSPHATE	<0.001% *
CALCIUM, MAGNESIUM & R2O3 PRECIPITATE	0.016% *

CONTINUED ON NEXT PAGE

ALDRICH CHEMICAL COMPANY  
DAVID SWESSEL  
JANUARY 5, 2001

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# Certificate of Analysis

THE RIGHT CHEMICALS  
THE RIGHT CHEMISTRY

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 03/27/03

DATE EXPIRED: 03/27/2013 VES

DATE OPENED: 04/10/03

INORG: 4033 PO: 330176E

Sodium carbonate, ACS primary standard, 99.95-100.05% (dried basis) 010416

Stock Number: 33377

Lot Number: L06M34

## Analysis

Test	Limits	Results
Assay (dried basis)	99.95 – 100.05 %	100.0 %
Insoluble	0.01 % max	< 0.01 %
Loss on heating (285°C)	1.0 % max	< 0.05 %
Chloride	0.001 % max	< 0.001 %
Nitrogen compounds	0.001 % max	< 0.001 %
Phosphate	0.001 % max	< 0.001 %
Silica	0.005 % max	< 0.005 %
Sulfur compounds	0.003 % max	< 0.003 %
NH <sub>4</sub> OH precipitate	0.01 % max	< 0.01 %
Potassium	0.005 % max	< 0.001 %
Calcium	0.02 % max	< 0.01 %
Magnesium	0.004 % max	< 0.004 %
Heavy metals (as Pb)	0.0005 % max	< 0.0005 %
Iron	0.0005 % max	< 0.0005 %

Traceable to NIST? Yes

Certified by:

Quality Control:

**Alfa Aesar**  
A Johnson Matthey Company



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010417

**SPEX**ertificate™*Certificate of Reference Material*

Catalog Number: ICMIX2-100 Lot No.: 25-145AS  
 Description: IC Instrument Check Standard 2  
 Matrix: H<sub>2</sub>O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

The CRM is prepared from high purity single ion concentrates of individual elements using Class A laboratory ware to give precise concentration.  
 Refer to side 2 for details of measurement uncertainties.

**Instrumental Analysis by ION Chromatography:**

Analyte	Labeled (mg/L)	Measured (mg/L)	NIST SRM
F <sup>-</sup>	100	100	3183
Cl <sup>-</sup>	200	200	3182
Br <sup>-</sup>	400	399	3184
NO <sub>3</sub> <sup>-</sup>	400	402	3185
HPO <sub>4</sub> <sup>-2</sup>	600	600	3186
SO <sub>4</sub> <sup>-2</sup>	400	399	3181

Spex Reference Multi: Lot #IC6-77VY

Balances are calibrated regularly with weight sets traceable to NIST#s 32856, 32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% on the average of all the certified concentrations with no single component exceeding +/- 2%. This guarantee is valid for a period of one year from the date of certification only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: APR - - 2004 Certifying Officer: N. Kocherlakota

INORGANIC LABS/RADIOCHEM LABS  
 DATE RECEIVED: 04/06/04  
 DATE EXPIRED: 04/15/2005 VDS  
 DATE OPENED: 04/06/04  
 INORG: 4518 PO: E53362

# Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

010418

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

ISO 9001  
CERTIFIED

Work continued from Page

010419

SwRI®

178-01-1C4 Nitrite N, 100 mg/L

0.0493g Sodium nitrite (Fisher, Lot # 944033  
Inorg # 00277) diluted to 100 ml DI H<sub>2</sub>O.

Balance #12.

5

10

15

20

25

30

35

*[Signature]*  
*[Signature]*

7/1/04

6/22/04

FISHER SCIENTIFIC CHEMICAL DIVISION  
One Reagent Lane, Fair Lawn, NJ 07410

## ANALYTICAL CONTROL LABORATORY ANALYSIS

010420

## Name &amp; Grade:

SODIUM NITRITE, A.C.S.

Catalog Number: S347

Lot Number: 944033

P.O./ Other Customer ID:

Date of Testing/Mfg: 07/14/94

This is to certify that units of the above mentioned lot number were tested and found to comply with the specifications of the grade listed. The following are the actual analytical results obtained:

Test	Unit	Result
APPEARANCE	PASS/FAIL	PASS-WHITE CRYSTS W/YEL TINT
ASSAY	%	99.5000
CALCIUM IN %	%	0.0030
CHLORIDE	%	0.0020
FLUORIDE (F)	PPM	0.400
HEAVY METALS	%	0.0003
IDENTIFICATION		PASS
INSOLUBLE MATTER	%	0.0020
IRON	%	0.00030
POTASSIUM	%	0.00100
SULFATE (SO4)	%	0.0020

Approved by: Frederick H. Turk,  
FL Analytical QA Supv.

or

Edgar E. Hess,  
BPF Analytical QA Supv.

Date: 07/18/94 (Signed and dated original is on file)

NOTE: The data listed is valid for all package sizes of this lot of product, expressed as a extension of the catalog number listed above. If there are any questions with this certificate, please call Steven P. Davis, Analytical QA Manager, at (201) 703-3149.

Ref. No. S347..944033.B1.

Location: FL

**SPEX**ertificate™  
Certificate of Reference Material

010421

**Catalog Number:** AS-F9-2X/2Y

**Lot No.** 25-5AS

**Description:** 1000 mg/L Fluoride

**Matrix:** H2O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 998 mg/L

**Uncertainty Associated with Measurement:** +/- 3.0 mg/

**Certified Value is Traceable to:** NIST SRM 3183

The CRM is prepared gravimetrically using high purity Sodium Fluoride Lot# M44142. The certified value listed is the average of values obtained by classical wet assay and Ion Chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 997 mg/L

**Method:** Potentiometric using Fluoride combination electrode

**Instrumentation Analysis By Ion Chromatography:** 999 mg/L

**Uncertified Properties:**

**Trace Ionic Impurities in the Actual Solution via IC Analysis:**

<b>Ion</b>	<b>mg/L</b>	<b>Ion</b>	<b>mg/L</b>
Br	<0.2	NO3	<0.2
Cl	<10	PO4	<1
NO2	<0.2	SO4	<0.5

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

**Date of Certification:** JAN -- 2004

**Certifying Officer:** N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
DATE RECEIVED: 01/06/04  
DATE EXPIRED: 01/15/2005 VPS  
DATE OPENED: 01/06/04  
INORG: 4388 PO: F522992

# Report of Certification

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

010422

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original-matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



**SPEX**<sup>TM</sup>  
*Certificate of Reference Material*

010423

**Catalog Number:** AS-CL9-2X/2Y

**Lot No.** 7-147VY

**Description:** 1000 mg/L Chloride

**Matrix:** H<sub>2</sub>O

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 997 mg/L

**Uncertainty Associated with Measurement:** +/- 3 mg/L

**Certified Value is Traceable to:** NIST SRM 3182

The CRM is prepared gravimetrically using high purity Sodium Chloride Lot# 004723. The certified value listed is the average of values obtained by classical wet assay and Ion Chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 997 mg/L

**Method:** Gravimetry: Precipitation using AgNO<sub>3</sub>, filtering, drying and weighing as AgCl.

**Instrumentation Analysis By Ion Chromatography:** 997 mg/L

**Uncertified Properties:**

**Trace Ionic Impurities in the Actual Solution via IC Analysis:**

Element	mg/L	Element	mg/L
F	<0.05	Br	<0.1
PO <sub>4</sub>	<0.05	NO <sub>3</sub>	<0.1
SO <sub>4</sub>	<0.05	NO <sub>2</sub>	<0.2

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

**Date of Certification:** JAN -- 2004 **Certifying Officer:** N. Kocherakota

LABORATORY LABS/RADCHEM LABS  
DATE RECEIVED: 01/06/04  
DATE EXPIRED: 01/05/2005  
DATE OPENED: 01/06/04  
INFORM: 4387  
PO: F5099A



This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.

ISO 9001

CERTIFIED

**SPEX**ertificate™  
Certificate of Reference Material

010425

**Catalog Number:** AS-NO2N9-2X/2Y

**Lot No.** 7-158VY

**Description:** 1000 mg/L Nitrite-N

**Matrix:** H2O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 1001.5 mg/L

**Uncertainty Associated with Measurement:** +/- 3.0 mg/L

**Certified Value is Traceable to:** SPEX CRM 0902

The CRM is prepared gravimetrically using high purity Sodium Nitrite Lot# 0791R. The certified value listed is the average of values obtained by classical wet assay and Ion Chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 1000mg/L

**Method:** Titration with KMNO4 that was standardized against Sodium Oxalate NIST SRM 40h.

**Instrumentation Analysis By Ion Chromatography:** 1003 mg/L

**Uncertified Properties:**

**Trace Ionic Impurities in the Actual Solution via IC Analysis:**

Ion	mg/L	Ion	mg/L
Br	<20	NO3	<40
Cl	<20	PO4	<0.8
F	<0.4	SO4	<0.4

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

**Date of Certification:** MAR -- 2001 **Certifying Officer:** N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
DATE RECEIVED: 03/05/04  
DATE EXPIRED: 03/15/2005  
DATE OPENED: 03/05/04  
INORG: 4480 PU: F52327

# Report of Certification

010426

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010427

# SPExertificate™

## Certificate of Reference Material

Catalog Number: AS-BR9-2X/2Y

Lot No. 27-128AS

Description: 1000 mg/L Bromide

Matrix: H2O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1003.5 mg/L

Uncertainty Associated with Measurement:  $\pm 3.0$  mg/L

Certified Value is Traceable to: NIST SRM 3184

The CRM is prepared gravimetrically using high purity Sodium Bromide Lot# 017400. The certified value listed is the average of values obtained by classical wet assay and Ion Chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1003 mg/L:

Method: Precipitation using Silver Nitrate, filter, dry and weigh as AgBr.

Instrumentation Analysis By Ion Chromatography: 1004 mg/L:

**Uncertified Properties:****Trace Ionic Impurities in the Actual Solution via IC Analysis:**

Ion	mg/L	Ion	mg/L
Cl	<1.50	NO3	<0.05
F	<0.02	PO4	<0.20
NO2	<0.05	SO4	<0.05

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to  $\pm 0.5\%$  of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JUN - - 2004

Certifying Officer: N. Kocherakota

INDIANAPOLIS LABS/KALUHEN LABS  
 DATE RECEIVED: 06/15/04  
 DATE EXPIRED: 06/15/05  
 DATE OPENED: 06/15/04  
 INORG: 4603 PO: 55392

# Report of Certification

010428

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



203 Norcross Avenue • Metuchen, NJ 08840 USA

732-549-7144 • 1-800-LAB-SPEX • Fax: 732-603-9647 • CRMSales@spexcsp.com • www.spexcsp.com

# SPEXcertificate™

## Certificate of Reference Material

Catalog Number: AS-NO3N9-2X/2Y

Lot No. 25-65AS

Description: 1000 mg/L Nitrate Nitrogen

Matrix: H2O

This ASSURANCE® certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1003.5 mg/L

Uncertainty Associated with Measurement: +/- 3.0 mg/L

Certified Value is Traceable to: NIST SRM 3185

The CRM is prepared gravimetrically using high purity Sodium Nitrate Lot# M14156. The certified value listed is the average of values obtained by classical wet assay and Ion Chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 1004 mg/L

Method: Precipitate using Nitron Acetate, filter, dry and weigh as C20H16N4HNO3

Instrumentation Analysis By Ion Chromatography: 1003 mg/L

**Uncertified Properties:****Trace Ionic Impurities in the Actual Solution via IC Analysis:**

Ion	mg/L	Ion	mg/L
Br	<0.5	NO2	<0.2
Cl	<0.2	PO4	<2.0
F	<0.05	SO4	<0.5

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JAN -- 2004

Certifying Officer: N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 01/06/04  
 DATE EXPIRED: 01/15/2005  
 DATE OPENED: 01/06/04  
 INDRS: 9389  
 PO: F52292

# Report of Certification

010430

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.





010431

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

**Catalog Number:** AS-PO4P9-2X/2Y      **Lot No.** 7-145VY  
**Description:** 1000 mg/L Phosphate-P  
**Matrix:** H<sub>2</sub>O

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 998 mg/L  
**Uncertainty Associated with Measurement:** +/- 3 mg/L  
**Certified Value is Traceable to:** NIST SRM #318b

The CRM is prepared gravimetrically using high purity KH<sub>2</sub>PO<sub>4</sub> Lot# V35142. The certified value listed is the average of values obtained by classical wet assay and Ion Chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 998 mg/L

**Method:** Precipitation using Magnesia Mixture. Filter, ignite, and weigh as Mg<sub>2</sub>P<sub>2</sub>O<sub>7</sub>

**Instrumentation Analysis By Ion Chromatography:** 998 mg/L

### Uncertified Properties:

#### Trace Ionic Impurities in the Actual Solution via IC Analysis:

Element	mg/L	Element	mg/L
Cl	<3.0	Br	<0.3
F	<0.2	NO <sub>3</sub>	<0.5
NO <sub>2</sub>	<0.3	SO <sub>4</sub>	<0.5

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

**Date of Certification:** JAN -- 2004      **Certifying Officer:** N. Kocherakota

INORGANIC LABS/RADCHEM LABS  
 DATE RECEIVED: 01/06/04  
 DATE EXPIRED: 01/05/2005  
 DATE OPENED: 01/06/04  
 INTRC: 4390 PO: F5a292



# Report of Certification

010432

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$ , where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, Inc. of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this RM shall be greater than the purchase price. In no event shall SPEX CertiPrep, Inc. be liable for any loss of profits or any incidental, special, or consequential damages.



010433

# SPEX<sup>TM</sup> Certificate

## Certificate of Reference Material

Catalog Number: AS-SO4S9-2X/2Y

Lot No. 27-98AS

Description: 1000 mg/L Sulfate-S

Matrix: H<sub>2</sub>O

This ASSURANCE<sup>®</sup> certified reference material, CRM, is intended primarily for use as a calibration standard or quality control standard for Ion Chromatography instrumentation. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

Certified Value: 1000.5 mg/L

Uncertainty Associated with Measurement: +/- 3.0 mg/L

Certified Value is Traceable to: NIST SRM 3181

The CRM is prepared gravimetrically using high purity Potassium Sulfate Lot# X34146. The certified value listed is the average of values obtained by classical wet assay and Ion Chromatography analysis.

Refer to side 2 for details of measurement uncertainties.

Classical Wet Assay: 998 mg/L:

Method: Precipitated using Barium Chloride, filtered, ignited and weighed as BaSO<sub>4</sub>.

Instrumentation Analysis By Ion Chromatography: 1003 mg/L:

**Uncertified Properties:****Trace Ionic Impurities in the Actual Solution via IC Analysis:**

Ion	mg/L	Ion	mg/L
Br	<0.03	NO <sub>3</sub>	<0.03
Cl	<0.03	PO <sub>4</sub>	<0.30
F	<0.02		
NO <sub>2</sub>	<0.03		

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32857 and others. This CRM is guaranteed stable to +/-0.5% of the certified concentration inclusive of uncertainty of measurements and other effects, such as transpiration losses, for a period of one year from the date of certification. This guarantee is valid only when the material is kept tightly capped and transported and stored under laboratory conditions.

Date of Certification: JUN - - 2004

Certifying Officer: N. Kocherakota

INORGANIC LABS/KADUHEM LABS  
 DATE RECEIVED: 06/14/04  
 DATE EXPIRED: 06/15/05  
 DATE OPENED: 06/15/04  
 INORG: 4602 PD: E53392

# Report of Certification

010434

This Certified Reference Material has been prepared and certified under an ISO 9001 system consistent with the following guides:

Guide To The Expression Of Uncertainty In Measurement 1995

EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition

ASTM Guide D6362-98

ISO Guide 34: Quality system guidelines for the production of reference materials.

ISO Guide 17025: Certification of reference materials, general and statistical principles

ISO Guide 31: Contents of certificates of reference materials

NIST Technical Note 1297

ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers

ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9000 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further information contact CRM Sales.

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles, and Class A glassware have been used in all preparations.

## Homogeneity:

The Homogeneity of the CRM has been confirmed by procedures consistent with ISO guide 17025, ISO/REMCO N280 and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed for the certified values by procedures consistent with the intended use of the CRM.

The mathematical expression  $k_s = s^2 m$  is employed to determine the sampling size

$s$  = relative standard deviation in % for one component of the sample. (ie. The sub-sampling uncertainty)

$m$  = the sub-sampling mass

$k_s$  = mass of sub-sample necessary to ensure a relative sub-sampling error of 1% (68% confidence level) in a single determination

## Statistical estimator and Confidence limits:

The certified value 'x' listed on the reverse of this document is at the 95% level of confidence and can be expressed as

$X = x \pm U$  where  $X$  = True value (Labeled Value),  $U$  = Expanded uncertainty

$U = k u_c$  where  $k=2$  is the coverage factor at the 95% confidence level

$u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$  and  $u_m = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from Traveler Report (Spex CertiPrep's traceability documentation) identified by the lot number of this CRM. For further information contact CRM Sales.

## Legal Notice:

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ISO 9001  
CERTIFIED



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010435

**SOUTHWEST RESEARCH INSTITUTE**

**NUCLEAR PROJECT**

**CLIENT: Division 20**

**TASK ORDER: 040617-9**

**SRR: 26058**

**SDG: 246146**

**CASE: CNWRA**

**VTSR: June 16, 2004**

**PROJECT#: 10542.02.002**

## **Pipette Calibrations**

## SwRI - Div. 01, Inorganic Labs' Fixed Volume Pipette Verification Log

(Space provide for Inorganic Laboratories' Fixed Volume Pipette Verification Spreadsheet)

010436

## SwRI - Div. 01, Inorganic Labs' Fixed Volume Pipette Spreadsheet

Eppendorf #	True Value (uL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
Lab30	1000	1.0088	1.0069	1.0055	1.01	100.71
TMA1	1000	1.0043	1.0018	1.0023	1.00	100.28
TMA2	1000	1.0064	1.005	1.0048	1.01	100.54
TMA3	1000	OUT	OF	SERVICE		
TMA6	1000	NOT	FOUND			
TMB1	900	0.9014	0.9018	0.9005	0.90	100.14
TMC1	800	0.7999	0.8004	0.8014	0.80	100.07
TMDD1	750	0.7543	0.7532	0.7538	0.75	100.50
TMD1	700	0.6974	0.6946	0.6936	0.70	99.31
TMD2	700	0.7059	0.7054	0.7058	0.71	100.81
TME1	600	0.5979	0.5961	0.5948	0.60	99.38
TMF2	500	0.5	0.4965	0.4969	0.50	99.50 99.56 05/01/04
TMF5	500	0.5039	0.5035	0.5022	0.50	100.64
ICF1	500	0.4974	0.4971	0.4954	0.50	99.33
L30-500	500	0.5038	0.5015	0.501	0.50	100.42
TMG3	400	0.3941	0.3949	0.3953	0.39	98.69
TMH1	300	OUT	OF	SERVICE		
TMH2	300	0.2974	0.2971	0.2959	0.30	98.93
TMJ1	250	0.2484	0.248	0.2481	0.25	99.27
TMJ2	250	0.2487	0.2484	0.2485	0.25	99.41
TMJ3	250	0.2501	0.2495	0.2491	0.25	99.83
TMK2	200	0.2007	0.2007	0.2006	0.20	100.33
TML1	150	0.1487	0.1488	0.1486	0.15	99.13
TMM1	120	0.1206	0.1206	0.1202	0.12	100.39
TMN3	100	0.1001	0.1	0.1	0.10	100.03
ICN1	100	0.1005	0.1005	0.1009	0.10	100.63
TMQ1	80	0.08	0.0797	0.0799	0.08	99.83
TMR1	70	OUT	OF	SERVICE		
TMS1	60	OUT	OF	SERVICE		
LAB-30A	50	NOT	FOUND			
TMU1	40	0.0398	0.0398	0.0403	0.04	99.92
TMU2	40	0.0397	0.0396	0.0395	0.04	99.00
TMV1	30	0.0297	0.0296	0.0297	0.03	98.89
L30-20	20	0.0203	0.0203	0.0202	0.02	101.33
TMW1	25	0.0253	0.0249	0.025	0.03	100.27
TMY1	15	OUT	OF	SERVICE		

010437

Book/Page 03 032

## SwRI - Div. 01, Inorganic Labs' Fixed Volume Pipette Verification Log

Balance #: 34 Thermometer #: 6011 diH2O Temperature (°C): 21

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)
Lab30	1000	1.0088	1.0069	1.0055
TMA1	1000	1.0043	1.0018	1.0023
TMA2	1000	1.0064	1.005	1.0048
TMA3	1000	Out	OF	Service
TMA6	1000	NOT	FOUND	
TMB1	900	.9014	.9018	.9005
TMC1	800	.7999	.8004	.8014
TMDD1	750	.7543	.7532	.7538
TMD1	700	.6974	.6946	.6936
TMD2	700	.7059	.7054	.7058
TME1	600	.5979	.5961	.5948
TMF2	500	.5000	.4956	.4969
TMF5	500	.5039	.5035	.5022
ICF1	500	.4974	.4971	.4954
L30-500	500	.5038	.5015	.5010
TMG3	400	.3941	.3949	.3953
TMH1	300	Out	OF	Service
TMH2	300	.2974	.2971	.2959
TMJ1	250	.2484	.2480	.2481
TMJ2	250	.2487	.2484	.2485
TMJ3	250	.2501	.2495	.2491
TMK2	200	.2007	.2007	.2006
TML1	150	.1487	.1488	.1486
TMM1	120	.1206	.1206	.1202
TMN3	100	.1001	.1000	.1000
ICN1	100	.1005	.1005	.1009
TMQ1	80	.0800	.0797	.0799
TMR1	70	Out	OF	Service
TMS1	60	Out	OF	Service
LAB-30A	50	NOT	FOUND	
TMU1	40	.0398	.0398	.0403
TMU2	40	.0397	.0394	.0395
TMV1	30	.0297	.0296	.0297
L30-20	20	.0203	.0203	.0202
TMW1	25	.0253	.0249	.0250
TMY1	15	Out	OF	Service

Analyst: John WellsDate: 5-28-04Reviewed by: Walt OepfDate: 07/01/04

**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010438

**SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet**

Eppendorf #	True Value (μL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	20	0.0203	0.0204	0.0201	0.020	101.33
ADJ200-A	100	0.0990	0.0997	0.1001	0.100	99.60
	200	0.1993	0.1991	0.1990	0.199	99.57
	20	0.0202	0.0202	0.0201	0.020	100.83
ADJ200-C	100	0.0991	0.0985	0.0980	0.099	98.53
	200	0.1987	0.1991	0.1991	0.199	99.48
	20	0.0203	0.0202	0.0202	0.020	101.17
ADJ200-D	100	0.0989	0.0996	0.0993	0.099	99.27
	200	0.1989	0.1998	0.1999	0.200	99.77
	20					
ADJ200-G	100					
	200					
	20					
ADJ200-H	100					
	200					
	20					
ADJ200-J	100					
	200					
	20	0.0204	0.0203	0.0200	0.020	101.17
ADJ200-K	100	0.0999	0.0993	0.0998	0.100	99.67
	200	0.2021	0.2001	0.2000	0.201	100.37
	20					
ADJ200	100					
	200					
	20					
ADJ200	100					
	200					

FRM-247a (Rev 4/Apr 04)

FRM-244 (Rev 2/Sept 02)

SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: 34

Thermometer #: G-011

diH2O Temperature (°C) 21

Eppendorf #	True Value (μL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
20 μL – 200 μL	20	.0203	.0204	.0201
	ADJ200-A	100	.0990	.0997
		200	.1993	.1991
	20	.0202	.0202	.0201
	ADJ200-C	100	.0991	.0985
		200	.1987	.1991
	20	.0203	.0202	.0202
	ADJ200-D	100	.0989	.0996
		200	.1989	.1998
	20			
	ADJ200-G	100		
		200		
	20			
	ADJ200-H	100		
		200		
	20			
	ADJ200-J	100		
		200		
	20	.0204	.0203	.0200
	ADJ200-K	100	.0999	.0993
		200	.2021	.2001
	20			
	ADJ200	100		
		200		

Analyst: John Wills

Date: 6-11-04

Reviewed by: Valerie

Date: 06/30/04



**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010440

Wooden A. Naegeli 06/11/04

**SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet**

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	20					
ADJ200-A	100					
	200					
	20					
ADJ200-C	100					
	200					
	20					
ADJ200-D	100					
	200					
	20	0.0201	0.0200	0.0198	0.020	99.83
ADJ200-G	100	0.0985	0.0982	0.0988	0.099	98.50
	200	0.1973	0.1975	0.1996	0.198	99.07
	20	0.0203	0.0204	0.0204	0.020	101.83
ADJ200-H	100	0.0996	0.0989	0.0994	0.099	99.30
	200	0.1992	0.2006	0.1999	0.200	99.95
	20	0.0204	0.0203	0.0203	0.020	101.67
ADJ200-J	100	0.0991	0.0991	0.0985	0.099	98.90
	200	0.1984	0.1985	0.1982	0.198	99.18
	20					
ADJ200	100					
	200					
	20					
ADJ200	100					
	200					
	20					
ADJ200-K	100					
	200					

FRM-247a (Rev 3/Oct 03)

FRM-244 (Rev 2/Sept 02)

## SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

010441

Balance #: \_\_\_\_\_

Thermometer #: \_\_\_\_\_

diH2O Temperature (° C) \_\_\_\_\_

Eppendorf #	True Value (μL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)	
20 μL – 200 μL		20			
	ADJ200-A	100			
		200			
		20			
	ADJ200-C	100			
		200			
		20			
	ADJ200-D	100			
		200			
		20	0.0201	0.0200	0.0198
	ADJ200-G	100	0.0985	0.0982	0.0988
		200	0.1973	0.1975	0.1996
		20	0.0203	0.0204	0.0204
	ADJ200-H	100	0.0996	0.0989	0.0994
		200	0.1992	0.2006	0.1999
		20	0.0204	0.0203	0.0203
	ADJ200-J	100	0.0991	0.0991	0.0985
		200	0.1984	0.1985	0.1982
		20			
	ADJ200-K	100			
		200			
		20			
	ADJ200	100			
		200			

Analyst: William A. NagelReviewed by: William A. NagelDate: 06/11/04Date: 6/21/04

**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010442

**SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet**

Eppendorf #	True Value (μL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	100	0.1019	0.1020	0.1018	0.102	101.90
ADJ1000-C	500	0.4963	0.4968	0.4985	0.497	99.44
	1000	0.9940	0.9957	0.9951	0.995	99.49
	100	0.1006	0.1004	0.0994	0.100	100.13
ADJ1000-D	500	0.4959	0.4991	0.4962	0.497	99.41
	1000	0.9956	1.0002	0.9989	0.998	99.82
	100	0.0998	0.0999	0.0999	0.100	99.87
ADJ1000-E	500	0.4965	0.4994	0.4956	0.497	99.43
	1000	0.9968	0.9942	0.9949	0.995	99.53
	100	0.1008	0.1009	0.1013	0.101	101.00
ADJ1000-F	500	0.4958	0.4962	0.4973	0.496	99.29
	1000	0.9947	0.9952	0.9958	0.995	99.52
	100					
ADJ1000-G	500					
	1000					
	100					
ADJ1000-H	500					
	1000					
	100					
ADJ1000-J	500					
	1000					
	100	0.1011	0.1012	0.1015	0.101	101.27
ADJ1000-K	500	0.4977	0.4974	0.4960	0.497	99.41
	1000	1.0009	1.0002	0.9993	1.000	100.01
	100					
ADJ1000	500					
	1000					

FRM-247b (Rev 3/Apr 04)

FRM-244 (Rev 2/Sept 02)

SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log 010443Balance #: 34Thermometer #: G-011diH<sub>2</sub>O Temperature (° C) 21

Eppendorf #	True Value (μL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
	100	.1019	.1020	.1018
ADJ1000-C	500	.4963	.4968	.4985
	1000	.9940	.9957	.9951
	100	.1006	.1004	.0994
ADJ1000-D	500	.4959	.4991	.4962
	1000	.9956	1.0002	.9989
	100	.0998	.0999	.0999
ADJ1000-E	500	.4965	.4994	.4956
	1000	.9968	.9942	.9949
	100	.1008	.1009	.1013
ADJ1000-F	500	.4958	.4962	.4973
	1000	.9947	.9952	.9958
	100			
ADJ1000-G	500			
	1000			
	100			
ADJ1000-H	500			
	1000			
	100			
ADJ1000-J	500			
	1000			
	100	.1011	.1012	.1015
ADJ1000-K	500	.4977	.4974	.4960
	1000	1.0009	1.0002	.9993
	100			
ADJ1000	500			
	1000			

Analyst: John WillsReviewed by: Valer OjedaDate: 6-11-04Date: 06/30/04

**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010444

*Warden A. Naegel 06/11/04***SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet**

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	100					
ADJ1000-C	500					
	1000					
	100					
ADJ1000-D	500					
	1000					
	100					
ADJ1000-E	500					
	1000					
	100					
ADJ1000-F	500					
	1000					
	100	0.1019	0.1011	0.1020	0.102	101.67
ADJ1000-G	500	0.4943	0.4978	0.5000	0.497	99.47
	1000	1.0098	1.0072	1.0066	1.008	100.79
	100	0.0998	0.1000	0.0992	0.100	99.67
ADJ1000-H	500	0.4918	0.4936	0.4959	0.494	98.75
	1000	0.9820	0.9863	0.9876	0.985	98.53
	100	0.0991	0.1001	0.1003	0.100	99.83
ADJ1000-J	500	0.4967	0.4955	0.4965	0.496	99.25
	1000	0.9927	0.9936	0.9923	0.993	99.29
	100					
ADJ1000	500					
	1000					
	100					
ADJ1000-K	500					
	1000					

FRM-247b (Rev 2/Oct 03)

FRM-244 (Rev 2/Sept 02)

## SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: \_\_\_\_\_

Thermometer #: \_\_\_\_\_

diH2O Temperature (° C) 010445

Eppendorf #	True Value (µL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
100 µL – 1000 µL	100			
	ADJ1000-C	500		
		1000		
	100			
	ADJ1000-D	500		
		1000		
	100			
	ADJ1000-E	500		
		1000		
	100			
	ADJ1000-F	500		
		1000		
	100	0.1019	0.1011	0.1020
	ADJ1000-G	500	0.4943	0.4978
		1000	1.0098	1.0072
	100	0.0998	0.1000	0.0992
	ADJ1000-H	500	0.4918	0.4936
		1000	0.9820	0.9863
	100	0.0991	0.1001	0.1003
	ADJ1000-J	500	0.4967	0.4955
		1000	0.9927	0.9936
	100			
	ADJ1000-K	500		
		1000		
	100			
	ADJ1000	500		
		1000		

Analyst: Wendy A. NagelsDate: 06/11/04Reviewed by: Michael J. NagelsDate: 6/21/04

**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010446

**SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet**

Eppendorf #	True Value (μL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	500	0.4941	0.4940	0.4928	0.494	98.73
ADJ5000-C	2500	2.5032	2.5028	2.5024	2.503	100.11
	5000	5.0334	5.0356	5.0234	5.031	100.62
	500					
ADJ5000-G	2500	OUT	OF	SERVICE		
	5000					
	500					
ADJ5000-H	2500	OUT	OF	SERVICE		
	5000					
	500	0.5089	0.5091	0.5088	0.509	101.79
ADJ5000-I	2500	2.5011	2.5089	2.5092	2.506	100.26
	5000	5.0180	5.0258	5.0274	5.024	100.47
	500					
ADJ5000-J	2500					
	5000					
	500					
ADJ5000-K	2500					
	5000					
	500					
ADJ5000-L	2500					
	5000					
	500	0.5022	0.4980	0.5022	0.501	100.16
ADJ5000-M	2500	2.4911	2.4930	2.4936	2.493	99.70
	5000	5.0187	5.0189	4.9959	5.011	100.22
	500	0.5050	0.5037	0.5028	0.504	100.77
ADJ5000-N	2500	2.5066	2.5033	2.5089	2.506	100.25
	5000	5.0232	5.0266	5.0249	5.025	100.50
	500					
ADJ5000	2500					
	5000					
	500					
ADJ5000	2500					
	5000					

FRM-247c (Rev 3/Apr 04)

FRM-244 (Rev 2/Sept 02)

## SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

010447

Balance #: 34Thermometer #: G011diH2O Temperature (°C) 21

Eppendorf #	True Value (μL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
	500	.4941	.4940	.4928
ADJ5000-C	2500	2.5032	2.5028	2.5024
	5000	5.0334	5.0356	5.0234
	500			
ADJ5000-G	2500	OUT	OF	SERVICE
	5000			
	500			
ADJ5000-H	2500	OUT	OF	SERVICE
	5000			
	500	.5089	.5091	.5088
ADJ5000-I	2500	2.5011	2.5089	2.5092
	5000	5.0180	5.0258	5.0274
	500			
ADJ5000-J	2500			
	5000			
	500			
ADJ5000-K	2500			
	5000			
	500			
ADJ5000-L	2500			
	5000			
	500	.5022	.4980	.5022
ADJ5000-M	2500	2.4911	2.4930	2.4936
	5000	5.0187	5.0189	4.9959
	500	.5050	.5037	.5028
ADJ5000-N	2500	2.5066	2.5033	2.5089
	5000	5.0232	5.0266	5.0249
	500			
ADJ5000	2500			
	5000			
	500			
ADJ5000	2500			
	5000			

Analyst: John WellsDate: 6-11-04Reviewed by: Nabe AghaDate: 06/30/04



## SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010448

Woodan A. Naegeli Dec 11/04

## SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	500					
ADJ5000-C	2500					
	5000					
	500					
ADJ5000-G	2500					
	5000					
	500					
ADJ5000-H	2500					
	5000					
	500					
ADJ5000-I	2500					
	5000					
	500	0.5006	0.5040	0.5058	0.503	100.69
ADJ5000-J	2500	2.4968	2.4974	2.4999	2.498	99.92
	5000	4.9870	4.9977	4.9976	4.994	99.88
	500	0.4948	0.4954	0.4962	0.495	99.09
ADJ5000-K	2500	2.4969	2.4949	2.4960	2.496	99.84
	5000	5.0356	5.0067	5.0094	5.017	100.34
	500	0.5017	0.5005	0.5019	0.501	100.27
ADJ5000-L	2500	2.4897	2.4897	2.4894	2.490	99.58
	5000	4.9800	4.9833	4.9877	4.984	99.67
	500					
ADJ5000	2500					
	5000					
	500					
ADJ5000	2500					
	5000					
	500					
ADJ5000	2500					
	5000					
	500					
ADJ5000-M	2500					
	5000					

FRM-247c (Rev 2/Mar 03)

FRM-244 (Rev 2/Sept 02)

## SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: \_\_\_\_\_

Thermometer #: \_\_\_\_\_

diH2O Temperature (° C) 010449

Eppendorf #	True Value (µL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
500 µL – 5000 µL	500			
	ADJ5000-C	2500		
		5000		
		500		
	ADJ5000-G	2500		
		5000		
		500		
	ADJ5000-H	2500		
		5000		
		500		
	ADJ5000-I	2500		
		5000		
		500		
	ADJ5000-J	2500		
		5000		
		500		
	ADJ5000-K	2500		
		5000		
		500		
	ADJ5000-L	2500		
		5000		
		500		
	ADJ5000-M	2500		
		5000		
		500		
	ADJ5000-N	2500		
		5000		
		500		
	ADJ5000	2500		
		5000		
		500		
	ADJ5000	2500		
		5000		

Analyst: W. NagelDate: 06/11/04Reviewed by: Shirley J. NagelDate: 6/21/04

## SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: 16Thermometer #: C7011diH2O Temperature (°C) 21.010450

Eppendorf #	True Value (μL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
100 μL – 1000 μL	100			
	ADJ1000-C	500		
		1000		
	100			
	ADJ1000-D	500		
		1000		
	100			
	ADJ1000-E	500		
		1000		
	100			
	ADJ1000-F	500		
		1000		
100 μL – 1000 μL	100	0.0987	0.0989	0.0984
	ADJ1000-G	500	0.5034	0.5047
		1000	0.9925	0.9884
	100	0.0990	0.0985	0.0983
	ADJ1000-H	500	0.4938	0.4960
		1000	1.0006	1.0019
	100	0.0986	0.0987	0.0984
	ADJ1000-J	500	0.5005	0.5021
		1000	1.0041	1.0031
	100			
	ADJ1000-K	500		
		1000		
100 μL – 1000 μL	100			
	ADJ1000	500		
		1000		

Analyst: [Signature]Reviewed by: [Signature]Date: 6/21/04Date: 7/7/04

**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

*Michael Hinch*

6/21/04

010452

**SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet**

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	100				0.000	0.00
ADJ1000-C	500				0.000	0.00
	1000				0.000	0.00
	100				0.000	0.00
ADJ1000-D	500				0.000	0.00
	1000				0.000	0.00
	100				0.000	0.00
ADJ1000-E	500				0.000	0.00
	1000				0.000	0.00
	100				0.000	0.00
ADJ1000-F	500				0.000	0.00
	1000				0.000	0.00
	100	0.0987	0.0989	0.0984	0.099	98.67
ADJ1000-G	500	0.5034	0.5047	0.5009	0.503	100.60
	1000	0.9925	0.9884	0.9907	0.991	99.05
	100	0.0990	0.0985	0.0983	0.099	98.60
ADJ1000-H	500	0.4938	0.4960	0.4941	0.495	98.93
	1000	1.0006	1.0019	0.9991	1.001	100.05
	100	0.0986	0.0997	0.0994	0.099	99.23
ADJ1000-J	500	0.5005	0.5021	0.5013	0.501	100.26
	1000	1.0041	1.0031	1.0026	1.003	100.33
	100				0.000	0.00
ADJ1000	500				0.000	0.00
	1000				0.000	0.00
	100				0.000	0.00
ADJ1000	500				0.000	0.00
	1000				0.000	0.00

FRM-247b (Rev 2/Oct 03)

FRM-244 (Rev 2/Sept 02)

010454

Book/page: 06 158

## SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Jew  
4-1904

Balance #: 16

Thermometer #: G011

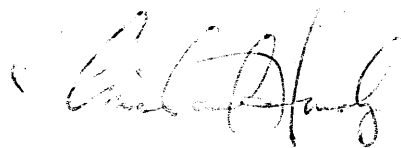
diH2O Temperature (°C) 21

Eppendorf #	True Value (μL)	1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
500 μL – 5000 μL	500			
	ADJ5000-C	2500		
		5000		
		500		
	ADJ5000-G	2500		
		5000		
		500		
	ADJ5000-H	2500		
		5000		
		500		
	ADJ5000-I	2500		
		5000		
	500	0.5044	0.5020	0.5036
	ADJ5000-J	2500	2.5087	2.5031
		5000	5.0316	5.0183
		500	0.4917	0.4959
	ADJ5000-K	2500	2.5066	2.5013
		5000	5.0327	5.0391
		500	0.5047	0.5011
	ADJ5000-L	2500	2.4905	2.4889
		5000	5.0511	5.0481
		500		
	ADJ5000-M	2500		
		5000		
		500		
	ADJ5000-N	2500		
		5000		
		500		
	ADJ5000	2500		
		5000		
		500		
	ADJ5000	2500		
		5000		

Analyst: Christina AndyDate: 6/21/04Reviewed by: R. JonesDate: 7/7/04

**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

 4/21/04
**010456**

## SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
	500				0.000	0.00
ADJ5000-C	2500				0.000	0.00
	5000				0.000	0.00
	500				0.000	0.00
ADJ5000-G	2500				0.000	0.00
	5000				0.000	0.00
	500				0.000	0.00
ADJ5000-H	2500				0.000	0.00
	5000				0.000	0.00
	500				0.000	0.00
ADJ5000-I	2500				0.000	0.00
	5000				0.000	0.00
	500	0.5044	0.5020	0.5036	0.503	100.67
ADJ5000-J	2500	2.5087	2.5021	2.5104	2.507	100.28
	5000	5.0216	5.0183	5.0227	5.021	100.42
	500	0.4917	0.4959	0.4967	0.495	98.95
ADJ5000-K	2500	2.5066	2.5013	2.5039	2.504	100.16
	5000	5.0327	5.0391	5.0283	5.033	100.67
	500	0.5047	0.5011	0.5032	0.503	100.60
ADJ5000-L	2500	2.4905	2.4889	2.4922	2.491	99.62
	5000	5.0511	5.0481	5.0496	5.050	100.99
	500				0.000	0.00
ADJ5000	2500				0.000	0.00
	5000				0.000	0.00
	500				0.000	0.00
ADJ5000	2500				0.000	0.00
	5000				0.000	0.00
	500				0.000	0.00
ADJ5000	2500				0.000	0.00
	5000				0.000	0.00
	500				0.000	0.00
ADJ5000	2500				0.000	0.00
	5000				0.000	0.00
	500				0.000	0.00
ADJ5000	2500				0.000	0.00
	5000				0.000	0.00

FRM-247c (Rev 2/Mar 03)

FRM-244 (Rev 2/Sept 02)

010458

Book/page: 06 038

## SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: 16

Thermometer #: G011

diH2O Temperature (°C) 21

Eppendorf #	True Value (μL)	20 μL – 200 μL		
		1 <sup>st</sup> Reading (g)	2 <sup>nd</sup> Reading (g)	3 <sup>rd</sup> Reading (g)
ADJ200-A	20			
	100			
	200			
ADJ200-C	20			
	100			
	200			
ADJ200-D	20			
	100			
	200			
ADJ200-G	20	0.0205	0.0203	0.0204
	100	0.0996	0.1011	0.1021
	200	0.1986	0.1974	0.2003
ADJ200-H	20			
	100			
	200			
ADJ200-J	20	0.0202	0.0203	0.0202
	100	0.0991	0.1005	0.0989
	200	0.2013	0.2041	0.2027
ADJ200-K	20			
	100			
	200			
ADJ200	20			
	100			
	200			

Analyst:

Reviewed by:

Date:

Date:

**SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log**

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

*Lincoln H. 6/21/04*

010459

**SwRI – Div. 01, Inorganic Laboratory Adjustable Pipette Verification Spreadsheet**

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)	Avg Wt (g)	% of True Value
ADJ200-A	20				0.000	0.00
	100				0.000	0.00
	200				0.000	0.00
ADJ200-C	20				0.000	0.00
	100				0.000	0.00
	200				0.000	0.00
ADJ200-D	20				0.000	0.00
	100				0.000	0.00
	200				0.000	0.00
ADJ200-G	20	0.0205	0.0203	0.0204	0.020	102.00
	100	0.0996	0.1011	0.1021	0.101	100.93
	200	0.1986	0.1974	0.2003	0.199	99.38
ADJ200-H	20				0.000	0.00
	100				0.000	0.00
	200				0.000	0.00
ADJ200-J	20	0.0202	0.0203	0.0202	0.020	101.17
	100	0.0991	0.1005	0.0989	0.100	99.50
	200	0.2013	0.2041	0.2027	0.203	101.35
ADJ200	20				0.000	0.00
	100				0.000	0.00
	200				0.000	0.00
ADJ200	20				0.000	0.00
	100				0.000	0.00
	200				0.000	0.00
ADJ200	20				0.000	0.00
	100				0.000	0.00
	200				0.000	0.00

FRM-247a (Rev 3/Oct 03)

FRM-244 (Rev 2/Sept 02)



**010460**

**SOUTHWEST RESEARCH INSTITUTE**

**NUCLEAR PROJECT**

**CLIENT: Division 20**

**TASK ORDER: 040617-9**

**SRR: 26058**

**SDG: 246146**

**CASE: CNWRA**

**VTSR: June 16, 2004**

**PROJECT#: 10542.02.002**

## **Balance Calibrations**

Southwest Research Institute  
Division 01  
**BALANCE VERIFICATION LOG**

BALANCE #:	LOCATION:	SERIAL #:	TOLERANCE:	COMMENTS:
12	Bldg. 70 Lab 27	1122510787	±0.0005	
Date	Std Wt (g)	Recorded Wt (g)	Operator	
6-17-04	2.0000	2.0000	KE	S.N. 79-J50526-15
6-18-04	2.0000	2.0000	KE	
6-21-04	2.0000	2.0000	KE	
6-22-04	2.0000	2.0001	KE	
6-23-04	2.0000	2.0000	KE	
6-24-04	2.0000	2.0000	KE	
6-25-04	2.0000	1.9999	JW	
6-26-04	2.0000	2.0000	KE	
6-28-04	2.0000	2.0000	JW	
6-29-04	2.0000	2.0000	KE	

If balance is out of limits, clean the balance and re-calibrate using Class "S" weights.

If balance is still out of limits, place a "DO NOT USE" sign on it and call (DQA) for service.

Southwest Research Institute  
Division 01  
**BALANCE VERIFICATION LOG**

BALANCE #	LAB #:	SERIAL #:	TOLERANCE:	COMMENTS:
19	27	0068597	±0.05	
Date	Std Wt (g)	Recorded Wt (g)	Operator	
6-16-04	10.00	10.00	KE	SN: 99-J50624-5
6-16-04	10.01 / 10.00	10.00	KE	SN: 99-J50624-5
6-17-04	10.00	10.00	KE	SN: 99-J50624-5
6-18-04	10.00	10.01	KE	N
6-21-04	10.00	10.00	KE	N
6-22-04	10.00	10.00	KE	N
6-23-04	10.00	10.00	KE	N
6-23-04	10.00 10.01	10.01	KE	N
6-24-04	10.00	10.00	KE	N
6-25-04	10.00	10.00	KE	N

If balance is out of limits, clean the balance and re-calibrate using Class "S" weights.

If balance is still out of limits, place a "DO NOT USE" sign on it and call (x5896) for service.

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FRM-112 (Rev 1/Dec 99)

010462

Southwest Research Institute  
Division 01  
**BALANCE VERIFICATION LOG**

BALANCE #:	LOCATION:	SERIAL #:	TOLERANCE:	COMMENTS:
34	Bldg. 70 Lab 27	1116031935	±0.0005	
Date	Std Wt (g)	Recorded Wt (g)	Operator	
6-10-04	2.0000	2.0000	KE	SN: 99-J50526-15
6-11-04	2.0000	2.0000	KE	"
6-14-04	2.0000	1.9999	Jew	"
6-15-04	2.0000	2.0001	Jew	"
6-16-04	2.0000	2.0000	KE	"
6-17-04	2.0000	2.0000	KE	"
6-18-04	2.0000	2.0000	KE	"
6-21-04	2.0000	2.0000	KE	"
6-22-04	2.0000	2.0000	KE	"
6-23-04	2.0000	2.0000	KE	"

If balance is out of limits, clean the balance and re-calibrate using Class "S" weights.

If balance is still out of limits, place a "DO NOT USE" sign on it and call (DQA) for service.

Southwest Research Institute  
Division 01  
**BALANCE VERIFICATION LOG**

BALANCE #:	LOCATION:	SERIAL #:	TOLERANCE:	COMMENTS:
12	Bldg. 70 Lab 27	1122510787	±0.0005	
Date	Std Wt (g)	Recorded Wt (g)	Operator	
6-17-04	2.0000	2.0000	KE	SN: 79-J50526 75
6-18-04	2.0000	2.0000	KE	"
6-21-04	2.0000	2.0000	KE	"
6-22-04	2.0000	2.0001	KE	"
6-23-04	2.0000	2.0000	KE	"
6-24-04	2.0000	2.0000	KE	"
6-25-04	2.0000	1.9999	JW	"
6-26-04	2.0000	2.0000	KE	"
6-28-04	2.0000	2.0000	JW	"
6-29-04	2.0000	2.0000	KE	"

If balance is out of limits, clean the balance and re-calibrate using Class "S" weights.

If balance is still out of limits, place a "DO NOT USE" sign on it and call (DQA) for service.

**SOUTHWEST RESEARCH INSTITUTE  
NUCLEAR PROJECT**

**CLIENT: Division 20**

**TASK ORDER: 040617-9**

**010465**

**SRR: 26058**

**SDG: 246146**

**CASE: CNWRA**

**VTSR: June 16, 2004**

**PROJECT#: 10542.02.002**

## **DI Water Verification**

# D.I. WATER SYSTEM NOTEBOOK

## SOUTHWEST RESEARCH INSTITUTE

### BUILDING 70

140007

Contact U.S. Filter (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

010466

DATE / TIME	INITIALS	RESISTIVITY MONITOR		QC LIGHTS		USAGE (GALS)	COMMENTS
		(M OHMS)	QC LT.	QC 1	QC 2		
6/17/04 5:38pm	DR	18.04	✓	✓	✓	2190.5	✓
6/18/04 6:30pm	DR	18.06	✓	✓	✓	2199.8	✓
6/21/04 5:21pm	DR	18.05	✓	✓	✓	2239.7	✓
6/22/04 5:31pm	DR	18.05	✓	✓	✓	2263.3	✓
6/23/04 5:56pm	DR	18.05	✓	✓	✓	2307.8	✓
6/24/04 2:45pm	Jew	18.04	✓	✓	✓	2320.8	✓
6/25/04 4:39pm	Jew	18.07	✓	✓	✓	2380.5	✓
6/28/04 3pm	DR	18.05	✓	✓	✓	2522.7	✓
6/29/04 6:12pm	DR	18.04	✓	✓	✓	2607.8	✓
6/30/04 8pm	DR	18.03	✓	✓	✓	2666.7	✓
7/1/04 4:52pm	DR	18.03	✓	✓	✓	2696.6	✓

Legend: Check = Green (OK); X = Red (call for service)

#### LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS		USAGE (GALS)	COMMENTS
		QC 1	QC 2		
6/17/04 5:38pm	DR	✓	(15) ✓	923.3	✓
6/18/04 6:30pm	DR	✓	(15.5) ✓	923.4	✓
6/21/04 5:21pm	DR	✓	(16) ✓	923.6	✓
6/22/04 5:31pm	DR	✓	(16.5) ✓	923.8	✓
6/23/04 5:56pm	DR	X	(17) ✓	929.5	need P.O. call US Filter
6/24/04 2:47pm	Jew	X	(17.5) ✓	930.2	✓ US Filter called (Rec'd P.O.)
6/25/04 4:41pm	Jew	X	(18) ✓	930.4	waiting on U.S. Filter
6/25/04 3pm	DR	✓	(15.5) ✓	935.6	tank exchanged. All OK. ✓
6/29/04 6:13pm	DR	✓	(15.5) ✓	935.8	✓
6/30/04 8pm	DR	✓	(16) ✓	936.1	✓
7/1/04 4:52pm	DR	✓	(16) ✓	936.3	✓

Legend: Check = Green (OK); X = Red (call for service)

# D.I. WATER SYSTEM NOTEBOOK

## SOUTHWEST RESEARCH INSTITUTE

### BUILDING 70

140007

Contact U.S. Filter (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

010467

DATE / TIME	INITIALS	RESISTIVITY MONITOR		QC LIGHTS		USAGE (GALS)	COMMENTS
		(M OHMS)	QC LT.	QC 1	QC 2		
6/17/04 5:38pm	DR	18.04	✓	✓	✓	2190.5	✓
6/18/04 6:30pm	DR	18.06	✓	✓	✓	2199.8	✓
6/21/04 5:21pm	DR	18.05	✓	✓	✓	2239.7	✓
6/22/04 5:31pm	DR	18.05	✓	✓	✓	2263.3	✓
6/23/04 5:56pm	DR	18.05	✓	✓	✓	2307.8	✓
6/24/04 2:45pm	JW	18.04	✓	✓	✓	2320.8	✓
6/25/04 4:39pm	JW	18.07	✓	✓	✓	2380.5	✓
6/28/04 3pm	DR	18.05	✓	✓	✓	2522.7	✓
6/29/04 6:12pm	DR	18.04	✓	✓	✓	2607.8	✓
6/30/04 8pm	DR	18.03	✓	✓	✓	2666.7	✓
7/1/04 4:52pm	DR	18.03	✓	✓	✓	2694.6	✓
7/2/04 7:22pm	DR	18.04	✓	✓	✓	2745.6	✓
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Legend: Check = Green (OK); X = Red (call for service)

#### LOW PURITY SYSTEM (LP)

DATE / TIME	INITIALS	QC LIGHTS		USAGE (GALS)	COMMENTS
		QC 1	QC 2		
6/17/04 5:38pm	DR	✓	(15) ✓	923.3	✓
6/18/04 6:30pm	DR	✓	(15.5) ✓	923.4	✓
6/21/04 5:21pm	DR	✓	(16) ✓	923.6	✓
6/22/04 5:31pm	DR	✓	(16.5) ✓	923.8	✓
6/23/04 5:56pm	DR	X	(17) ✓	929.5	need h.o. call US Filter
6/24/04 2:47pm	JW	X	(17.5) ✓	930.2	✓ H. Filter called (Rec'd)
6/25/04 4:41pm	JW	X	(18) ✓	930.4	waiting on U.S. Filter
6/25/04 3pm	DR	✓	(15.5) ✓	935.6	tank exchanged ALL OK. ✓
6/29/04 6:13pm	DR	✓	(15.5) ✓	935.8	✓
6/30/04 8pm	DR	✓	(16) ✓	936.1	✓
7/1/04 4:52pm	DR	✓	(16) ✓	936.3	✓
7/2/04 7:22pm	DR	✓	(16.5) ✓	955.4	✓
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Legend: Check = Green (OK); X = Red (call for service)

R Smith  
7/6/04