

010322

SOUTHWEST RESEARCH INSTITUTE

NUCLEAR PROJECT

CLIENT: Division 20

TASK ORDER: 040706-3

SRR: 26134

SDG: 247108

CASE: CNWRA

VTSR: July 02, 2004

PROJECT#: 10542.02.002

Certificates of Analysis

010323

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

Catalog No. A509

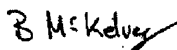
Lot No: 1104010

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/RADCHEM LABS
 DATE RECEIVED: 06/10/04
 DATE EXPIRED: 01/01/2007
 DATE OPENED: 06/10/04
 INDRG: 4580-4585 PO: F53393

010324

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

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.

B. McKelvey

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/RADCHEM LABS
 DATE RECEIVED: 05/05/04
 DATE EXP. IRED: 01/01/2007
 DATE OPENED: 05/05/04
 INORG: A508-4557 PO: F533373

010325

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

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.

B. McKelvey

Dr. B. McKelvey
QA/QC Manager

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



INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 06/21/04
DATE EXPIRED: 01/20/2007
DATE OPENED: 06/21/04
INSTR: 4586-4591 PO: F53393

INORGANIC LABS/RADCHEM LABS
 DATE RECEIVED: 12/15/03
 DATE EXPIRED: 12/31/04
 DATE OPENED: 11/15/03
 INORG: 4306
 PO: P5001
 DR

SPEXertificate™ 010326

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

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.



010328

SPXertificate™

Certificate of Reference Material

Catalog Number: ICAL-1 **Lot No.:** 25-176AS
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: SEP - 2003 Certifying Officer: N. Kocherakota

INORGANIC LABS/RADIATION LABS
 DATE RECEIVED: 09/15/03
 DATE EXPIRED: 09/15/04
 DATE OPENED: 09/15/03
 INDRG: 3945 PU: E53938

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

010329

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.



010330

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 Scandium IN 5% HNO₃ (abs)**

Catalog Number: CGSC1-1and CGSC1-5

Lot Number: **W-SC02055**

Starting Material:
 Starting Material Purity:
 Starting Material Lot No:

Sc₂O₃
 99.99%
 632-5721

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 09/04/03
 DATE EXPIRED: 10/01/2004 V03
 DATE OPENED: 09/24/03
 INORG: 4201 PO: E52030

CERTIFIED CONCENTRATION: 1000 ± 5 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: 1000 ± 5 µg/mL
 Method: EDTA Titration vs NIST SRM 928 Lead Nitrate.

Instrument Analysis: 995 ± 6 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 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 <0.070	<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 <0.000050	<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 0.0028
<u>M</u> Be <0.000050	<u>M</u> Ga <0.00010	<u>O</u> Hg i	<u>M</u> Ru <0.00020	<u>M</u> Tm <0.000040
<u>M</u> Bi 0.0043	<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>O</u> B <0.020	<u>M</u> Au <0.00030	<u>M</u> Nd <0.00020	<u>s</u> Sc	<u>M</u> Ti <0.0050
<u>M</u> Cd <0.00030	<u>M</u> Hf 0.0030	<u>O</u> Ni <0.084	<u>O</u> Se <0.67	<u>M</u> W <0.0010
<u>O</u> Ca 0.016	<u>M</u> Ho <0.000050	<u>M</u> Nb <0.000050	<u>O</u> Si <0.034	<u>M</u> U <0.00020
<u>M</u> Ce <0.00050	<u>M</u> In <0.00010	<u>n</u> Os	<u>M</u> Ag 0.0050	<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 <0.16	<u>M</u> Yb <0.00010
<u>M</u> Cr <0.00050	<u>O</u> Fe <0.16	<u>O</u> P i	<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 0.0075
<u>M</u> Cu <0.00060	<u>M</u> Pb 0.00050	<u>O</u> K <5.01	<u>M</u> Ta <0.00070	<u>M</u> Zr 0.032

M - checked by ICP-MS

O - checked by ICP-OES

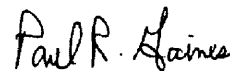
i - spectral interference

n - not checked for

s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.038 g/mL

QA:KL Rev.021303JTS



Quality Assurance Manager

Expires:

EXPIRES
 01 22 04

010331

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 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 μ 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

010332

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% HNO₃ (abs)**

Catalog Number: CGSC10-1and CGSC10-5

Lot Number: **T-SC02053**

Starting Material: Sc₂O₃
 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: F52232

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 ULPA-Filtered Clean Room.
 An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

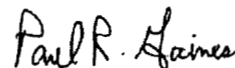
<u>Q</u> Al <0.070	<u>M</u> Dy <0.0060	<u>M</u> Li <0.010	<u>M</u> Pr <0.00030	<u>M</u> Te <0.030
<u>M</u> Sb <0.00050	<u>M</u> Er <0.0050	<u>M</u> Lu <0.00040	<u>M</u> Re <0.0010	<u>M</u> Tb <0.00030
<u>M</u> As <0.010	<u>M</u> Eu <0.0030	<u>M</u> Mg <0.030	<u>M</u> Rh <0.0010	<u>M</u> Tl <0.0010
<u>M</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>Q</u> B <0.034	<u>M</u> Au <0.0030	<u>M</u> Nd <0.0020	<u>g</u> Sc	<u>n</u> Ti
<u>M</u> Cd <0.0030	<u>M</u> Hf 0.030	<u>Q</u> Ni <0.084	<u>Q</u> Se <0.67	<u>M</u> W <0.010
<u>Q</u> Ca 0.17	<u>M</u> Ho <0.00050	<u>M</u> Nb <0.00050	<u>Q</u> Si <0.034	<u>M</u> U <0.0020
<u>M</u> Ce <0.0050	<u>M</u> In <0.0010	<u>n</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>Q</u> Na <0.16	<u>M</u> Yb <0.0010
<u>M</u> Cr <0.0050	<u>Q</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>n</u> S	<u>M</u> Zn 0.075
<u>M</u> Cu <0.0060	<u>M</u> Pb 0.0050	<u>Q</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.021203DN



Quality Assurance Manager

Expires:

EXPIRES
 01 22 00 4

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 μ 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

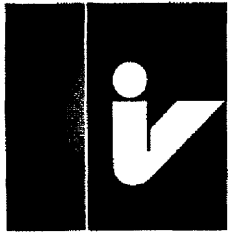
The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 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

010334


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
 Catalog Number: CGSC1-1 and CGSC1-5

1000 µg/mL Scandium IN 5% HNO₃ (abs)

Lot Number: **W-SC02058**

INORGANIC LABS/RADCHEM LABS

Starting Material: Sc₂O₃
 Starting Material Purity: 99.99%
 Starting Material Lot No: 632-5721

DATE RECEIVED: 07/01/04
 DATE EXPIRED: 08/01/2005 V03
 DATE OPENED: 07/01/04
 INORG: 4629 PO: F53406

CERTIFIED CONCENTRATION: 1005 ± 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:

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

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

(\bar{x}) = mean x_i = individual results n = number of measurements $\sum s_i$ = The summation of all significant estimated errors.

Classical Wet Assay: 1007 ± 3 µg/mL
 Method: EDTA Titration vs NIST SRM 928 Lead Nitrate.

Instrument Analysis: 1005 ± 2 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 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 <0.070	<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 <0.000050	<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 0.0028
<u>M</u> Be <0.000050	<u>M</u> Ga <0.00010	<u>Q</u> Hg i	<u>M</u> Ru <0.00020	<u>M</u> Tm <0.000040
<u>M</u> Bi 0.0043	<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>Q</u> B <0.020	<u>M</u> Au <0.00030	<u>M</u> Nd <0.00020	<u>s</u> Sc	<u>M</u> Ti <0.0050
<u>M</u> Cd <0.00030	<u>M</u> Hf 0.0030	<u>Q</u> Ni <0.084	<u>Q</u> Se <0.67	<u>M</u> W <0.0010
<u>Q</u> Ca 0.016	<u>M</u> Ho <0.000050	<u>M</u> Nb <0.000050	<u>Q</u> Si <0.034	<u>M</u> U <0.00020
<u>M</u> Ce <0.00060	<u>M</u> In <0.00010	<u>n</u> Os	<u>M</u> Ag 0.0050	<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>Q</u> Na <0.16	<u>M</u> Yb <0.00010
<u>M</u> Cr <0.00050	<u>Q</u> Fe <0.16	<u>Q</u> P i	<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 0.0075
<u>M</u> Cu <0.00060	<u>M</u> Pb 0.00050	<u>Q</u> K <5.01	<u>M</u> Ta <0.00070	<u>M</u> Zr 0.032

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): 1.038 g/mL

QA:KL Rev.010804DN

Paul R. Gaines

Quality Assurance Manager

Expires:

EXPIRES
 01/2005

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

- 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 μ 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

010336

SPEXcertificate™

Certificate of Reference Material

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

Lot No. 10-119B

Description: 1000 mg/L Boron

Matrix: H₂O

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: +/- 3.0 mg/L

Certified Value is Traceable to: NIST SRM 3107

The CRM is prepared gravimetrically using high purity (NH₄)₂B₄O₇·4H₂O 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 +/-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/PADDOHEM LABS
 DATE RECEIVED: 5/27/04
 DATE EXPIRED: 4/30/05
 DATE OPENED: 5/11/04
 INORG: 4564
 PO: F53371
 DR

Report of Certification

010337

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.



SPEXTM Certificate

Certificate of Reference Material

Catalog Number: PLLI2-2X/2Y **Lot No.** 10-12LI

Description: 1000 mg/L Lithium

Matrix: 2% HNO₃

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: 997.5 mg/L

Uncertainty Associated with Measurement: +/- 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 Li₂SO₄.

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 +/-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 PD: F50306

Report of Certification

010339

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:

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.



010340

SPEXTM Certificate

Certificate of Reference Material

Catalog Number: PLMO9-2X/2Y/2T **Lot No.** 10-74MO
Description: 1000 mg/L Molybdenum
Matrix: H₂O

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: +/-3.0mg/L
Certified Value is Traceable to: NIST SRM #3134

The CRM is prepared gravimetrically using high purity (NH₄)₆Mo₇(O)₂₄ 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 MoO₂ (C₉H₆NO)₂.

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 +/-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: Certifying Officer: N. Kocherakota

DATE RECEIVED: 01/23/04
DATE EXPired: 01/30/2005 NOS
DATE OPENED: 01/23/04
INORG: 4440 PD: F52396

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 $u_m = \sqrt{\sum u_i^2}$

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:

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
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010342

INORGANIC LABS/RADCHEM LABS
 DATE RECEIVED: 10/31/03
 DATE EXPIRED: 11/30/04
 DATE OPENED: 11/3/03
 INORG: 4307 PO: F52061

SPEXTM Certificate

Certificate of Reference Material

Catalog Number: PLP9-2X/2Y/2T **Lot No.** 9-150P
Description: 1000 mg/L Phosphorus
Matrix: H₂O

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 3139a

The CRM is prepared gravimetrically using high purity (NH₄)H₂(PO₄) 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 Mg₂P₂O₇.

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

CRMSales@spexcsp.com • www.spexcsp.com

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010344

SPEXTM Certificate Certificate of Reference Material

Catalog Number: PLSI9-2X/2Y/2T **Lot No.** 10-07SI
Description: 1000 mg/L Silicon
Matrix: H2O / 0.4% 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: 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 (NH4)2SiF6 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 (C9H7ON)4(H4)[Si(Mo12O40)]

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/RADCHEM LABS
DATE RECEIVED: 09/05/03
DATE EXPIRED: 08/30/2004
DATE OPENED: 09/05/03
INDRG: 4238 P.O.: 55005

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 $u_{cm} = \sqrt{\sum u_i^2}$

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.



010346

SPEXcertificate™

Certificate of Reference Material

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

Lot No. 10-38TI

Description: 1000 mg/L Titanium

Matrix: H₂O/ 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 (NH₄)₂TiF₆ 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 TiO₂.

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 EXPIRES: 08/30/2004 M03
 DATE OPENED: 09/05/03
 INORG: 7034 PU: F52205

Report of Certification

010347

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.



010348

INORGANIC LABS/RADIOCHEM LABS
 DATE RECEIVED: 10/31/03
 DATE EXPIRED: 10/31/04
 DATE OPENED: 11/15/03
 INORG: 4308 P.O. # 550041
 NR

SPEXTM Certificate

Certificate of Reference Material

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

Description: 1000 mg/L Strontium in 2% HNO₃

Matrix: 2% HNO₃

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(NO₃)₂ 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



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CRMSales@spexcsp.com • www.spexcsp.com

Always Providing Superior Quality . . . Unparalleled Service™

SPEXTM 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[®] 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: +/-3.0mg/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 SnO₂.

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 +/-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/RADIATION LABS
 DATE RECEIVED: 5/3/04
 DATE EXP. DATE: 4/30/05
 DATE OPENED: 5/11/04
 INORG: 4565 PO: F5333H

Report of Certification

010351

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.



010352

SPEXTM Certificate

Certificate of Reference Material

Catalog Number: PLBI4-2X/2Y

Lot No. 10-68BI

Description: 1000 mg/L Bismuth

Matrix: 10% HNO₃

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 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(NO₃)₂ 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 +/-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

INDIANAN U. LABS/RAUCHER LABS
 DATE RECEIVED: 02/25/04
 DATE EXPIRED: 02/28/2005
 DATE OPENED: 02/25/04
 INORG: WTS
 PO: F52322

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 $k_p = s^2 m$ 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_p = 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.



SPEXTM Certificate

Certificate of Reference Material

Catalog Number: PLLA2-2X/2Y **Lot No.** 10-27LA

Description: 1000 mg/L Lanthanum

Matrix: 2% HNO₃

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(NO₃)₃·6H₂O 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(NO₃)₂ 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	0.003	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. Kocherakota

INFORMATION: LITHIUM/INDUSTRIAL GRADE
 DATE RECEIVED: 01/30/04
 DATE EXPIRED: 01/30/2005 VDS
 DATE OPENED: 01/23/04
 INDRG: 4438 PU: 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.



SPEXTM Certificate

Certificate of Reference Material

Catalog Number: PLY2-2X/2Y/2T **Lot No.** 9-152Y
Description: 1,000 mg/L Yttrium
Matrix: 2% HNO₃

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: 1001.5 mg/L
Uncertainty Associated with Measurement: +/- 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(NO₃)₂ 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 +/-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: 01/30/2005
DATE OPENED: 01/23/04
INDORG: 4441 FID: F52306

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.



010358

SPEXcertificate™

Certificate of Reference Material

Catalog Number: PLPD3-2X/2Y **Lot No.** 10-108PD
Description: 1000 mg/L Palladium
Matrix: 10% HCl

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 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 Pd(C4H7O2N2)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 +/-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/RADDOHEN LABS
 DATE RECEIVED: 01/13/04
 DATE EXPIRED: 01/15/2005
 DATE OPENED: 01/13/04
 INORG: 4417 PD: F52299

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

010359

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.



SPEXTM Certificate

Certificate of Reference Material

010360

Catalog Number: PLS9-2X/2Y/2T **Lot No.** 10-122S
Description: 1000 mg/L Sulfur
Matrix: H2O

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 #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: 1002 mg/L

Method: Precipitation using Barium Chloride. Filter, ignite and weigh as BaSO4.

Instrumental Analysis by ICP spectrometer: 1000 mg/L

Uncertified Properties:

Density: 1.001 @ 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	<0.001	Cu	<0.001	Pb	<0.001
As	0.003	Fe	0.014	Rb	<0.001
Ag	<0.001	Ga	<0.001	Re	<0.001
B	<0.001	In	<0.001	Si	0.003
Ba	<0.001	K	<0.10	Sr	<0.001
Be	<0.001	Li	<0.001	Sb	<0.001
Bi	<0.001	Mg	0.005	Ti	<0.001
Ca	0.012	Mn	<0.002	Tl	<0.001
Cr	<0.001	Mo	<0.001	V	<0.001
Cd	<0.001	Na	0.01	Zr	<0.001
Co	<0.001	Ni	<0.001	Zn	<0.002

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/RADCHEM LABS
 DATE RECEIVED: 06/25/04
 DATE EXP. DATED: 06/30/2005 105
 DATE OPENED: 06/29/04
 INORG: 4617 PO: F53398

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.

010361



SPEXcertificate™

Certificate of Reference Material

010362

Catalog Number: PLTH2-2X/2Y **Lot No.** 10-24TH
Description: 1000 mg/L Thorium
Matrix: 2% HNO₃

INORGANIC LABS/CAULHEIM LABS
 DATE RECEIVED: 09/05/03
 DATE EXPIRED: 08/30/2004
 DATE OPENED: 09/05/03
 INDIRS: 4233 F.O: F52225

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: 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(NO₃)₄·4H₂O 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(NO₃)₂ 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

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

010363

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.



SPEXTM Certificate

010364

Certificate of Reference Material

Catalog Number: PLU2-2X/2Y

Lot No. 10-127U

Description: 1000 mg/L Uranium

Matrix: 2% HNO₃

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: +/- 3.0 mg/L

Certified Value is Traceable to: NIST SRM #3164

The CRM is prepared gravimetrically using high purity Uranium(V,VI) 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: 1004 mg/L

Method: Evaporate to dryness. Ignite and weigh as U₃O₈.

Instrumental Analysis by ICP spectrometer: 1005 mg/L

Uncertified Properties:

Density: 1.010 @ 21.6 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	0.01	Pb	0.008
As	0.04	Fe	0.41	Rb	<0.001
Ag	<0.001	Ga	<0.001	Re	<0.001
B	<0.003	In	<0.001	Si	0.03
Ba	<0.001	K	0.022	Sr	0.003
Be	<0.001	Li	<0.001	Sb	0.003
Bi	<0.001	Mg	0.002	Ti	<0.001
Ca	0.09	Mn	0.003	Tl	<0.001
Cr	<0.002	Mo	0.004	V	0.004
Cd	<0.001	Na	0.08	Zr	0.002
Co	<0.001	Ni	<0.001	Zn	0.06

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. Kocherlakota

INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 06/05/04
DATE EXPIRED: 06/30/2005 V05
DATE OPENED: 06/09/04
INORG: 4619
PO: F53398

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 $u_m = \sqrt{\sum u_i^2}$

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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010365



INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 08/11/03
DATE EXPIRED: 08/15/2004
DATE OPENED: 08/13/03
INORG: 4212
PO: F52218

SPEXTM Certificate of Reference Material

010366

Catalog Number: PLW9-2X/2Y **Lot No.** 9-177W
Description: 1000 mg/L Tungsten
Matrix: H2O

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 WO3.

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

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
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CRMSales@spexcsp.com • www.spexcsp.com
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SPEXcertificate™

Certificate of Reference Material

010368

INORGANIC LABS/RADCHEN LABS
 DATE RECEIVED: 5/7/04
 DATE EXPIRED: 4/30/05
 DATE OPENED: 5/11/04
 INHIBIT: 4566
 PO: F53321
 DR

Catalog Number: PLZR2-2X/2Y/2T **Lot No.** 10-05ZR
Description: 1000 mg/L Zirconium
Matrix: 2% HNO₃

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: +/- 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 ZrO₂.

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 +/-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

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.

010369



SPEXTM Certificate

Certificate of Reference Material

010370

Catalog Number: PLNA2-3X/3Y **Lot No.** U8-128NA
Description: 10,000 mg/L Sodium
Matrix: 5% HNO₃

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: 9998 mg/L
Uncertainty Associated with Measurement: +/- 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 Na₂SO₄.

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 +/-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: 01/29/04
 DATE EXPIRED: 01/29/05
 DATE OPENED: 01/29/04
 INDRG: 4443 PO: ES308

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 $u_{cr} = \sqrt{\sum u_i^2}$

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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CertiPrep



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CRMSales@spexcsp.com • www.spexcsp.com

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010372

SPEX Certificate™

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: NOV -- 2003 Certifying Officer: N. Kocherakota

INORGANIC LABS/RADIATION LABS
DATE RECEIVED: 1/29/03
DATE EXPIRED: 1/30/04
DATE OPENED: 1/21/03
INORG: 4328 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.

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010374

SPEXertificate™

Certificate of Reference Material

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

Lot No. 10-43SB

Description: 1000 mg/L Antimony

Matrix: H₂O/0.6Tart.Acid/tr.HNO₃

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 Sb₂O₄.

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/RADIOCHEM LABS
 DATE RECEIVED: 11/20/03
 DATE EXPIRED: 11/20/04
 DATE OPENED: 11/21/03
 INDRG: 4329
 PO: F52278

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 Certificate™

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 2003 Certifying Officer: N. Kocherakota

INORGANIC LABS/KADACHEN LABS
 DATE RECEIVED: 11/20/03
 DATE EXPIRED: 11/30/2004 N05
 DATE OPENED: 11/21/03
 INORG: 4330 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 $u_{cm} = \sqrt{\sum u_i^2}$

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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010378



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 Aluminum in 5% (abs) HNO₃

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) HNO₃

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2
 DATE RECEIVED: 08/26/03
 DATE EXPIRED: 09/01/2004 V05
 DATE OPENED: 08/26/03
 INDRG: 4220 PQ: 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:

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

(\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 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>O</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>O</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>O</u> Be < 0.00017	<u>M</u> Ga < 0.00449	<u>O</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>O</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> Tl < 0.22454
<u>M</u> Cd < 0.01347	<u>M</u> Hf < 0.00898	<u>O</u> Ni < 0.00600	<u>M</u> Se < 0.03593	<u>M</u> W < 0.04491
<u>O</u> Ca 0.01903	<u>M</u> Ho < 0.00225	<u>M</u> Nb < 0.00225	<u>O</u> Si 0.07389	<u>M</u> U < 0.00898
<u>M</u> Ce < 0.02245	<u>O</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>O</u> Na 0.03359	<u>M</u> Yb < 0.00449
<u>O</u> Cr 0.00336	<u>O</u> Fe 0.00493	<u>O</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>O</u> S < 0.10000	<u>M</u> Zn < 0.08982
<u>M</u> Cu < 0.02695	<u>M</u> Pb < 0.01347	<u>O</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 HCl, HNO_3 , HF and H_2SO_4 . Avoid neutral media. Soluble in strongly basic 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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO_3 / LDPE container.

Al Containing Samples (Preparation and Solution) - Metal (Best dissolved in HCl / HNO_3); α - Al_2O_3 (Na_2CO_3 fusion in Pt°); γ - Al_2O_3 (Soluble in acids such as HCl); Ores (Carbonate fusion in Pt° followed by HCl dissolution); Organic Matrices (sulfuric/peroxide digestion or nitric / sulfuric / perchloric acid decomposition, or 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 λ lines)
ICP-OES 394.401 nm	0.05 / 0.006 $\mu\text{g}/\text{mL}$	1	atom	<u>U</u> , Ce
ICP-OES 396.152 nm	0.03 / 0.006 $\mu\text{g}/\text{mL}$	1	atom	<u>Mo</u> , Zr, Ce
ICP-OES 167.078 nm	0.1 / 0.009 $\mu\text{g}/\text{mL}$	1	ion	Fe
ICP-MS 27 amu	30 ppt	n/a	M'	$^{13}\text{C}^{14}\text{N}$, $^{13}\text{C}^{15}\text{N}$, $^{14}\text{C}^{14}\text{N}$, $^{15}\text{N}^{16}\text{O}$, $^{52}\text{Cr}^{52}$, $^{56}\text{Fe}^{56}$

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: 08/26/03
DATE EXPIRED: 09/01/2004 VDS
DATE OPENED: 08/26/03
INORG: 4220 PD: F52224

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 13, 2003

Expiration Date:

EXPIRES
1 FEB 2004

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

John Struthers

Certificate Approved By: Katalin Le, QC Supervisor

Katalin Le

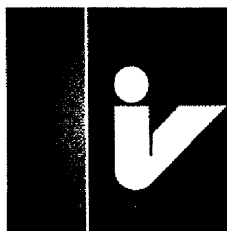
Certifying Officer: Paul Galnes, Chemist, Senior Technical Director

Paul Galnes

010382

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 Calcium in 1.4% (abs) HNO₃

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) HNO₃

INORGANIC LABS/RADCHEM LABS By 2 of 2
 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

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

($\sum s_i^2$) = 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** 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 HNO_3 . Avoid H_2SO_4 , HF, H_3PO_4 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_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10% HNO_3 / LDPE container.

Ca Containing Samples (Preparation and Solution) - Metal (best dissolved in diluted HNO_3) Ores (Carbonate fusion in Pt^{\dagger} followed by HCl dissolution); Organic Matrices (dry ash and dissolution in dilute HCl. Do not heat when dissolving to avoid precipitation of SiO_2). The oxide, hydroxide, carbonate, phosphate, and fluoride of calcium are soluble in % levels of HCl or HNO_3 . The sulfates (gypsum, anhydrite, etc.), certain silicates and complex compounds require fusion with Na_2CO_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
ICP-OES 393.366 nm	0.0002 / 0.00004 $\mu\text{g}/\text{mL}$	1	ion	U, Ce
ICP-OES 398.847 nm	0.0005 / 0.00006 $\mu\text{g}/\text{mL}$	1	ion	Th
ICP-OES 422.673 nm	0.01 / 0.001 $\mu\text{g}/\text{mL}$	1	atom	Ge
ICP-MS 44 amu	1200 ppt	n/a	M	^{40}O , ^{12}C , $^{28}\text{Si}^{16}\text{O}$, $^{87}\text{Sr}^2$

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: 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

010385



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**
1E 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

010386

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 Iron in 3.5% (abs) HNO₃

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) HNO₃

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 PU: 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

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

$\sum s_i$ = 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 10,031 ± 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> Tl < 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 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 - 55.847; +3; 6; $\text{Fe}(\text{H}_2\text{O})_6^{3+}$

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

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

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

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

Technique/Line	Estimated D.L.	Order	Type	Interferences (underlined indicates severe at λ lines)
ICP-OES 238.204 nm	0.005 / 0.001 $\mu\text{g/mL}$	1	ion	Ru, Co
ICP-OES 239.562 nm	0.005 / 0.001 $\mu\text{g/mL}$	1	ion	Co, W, 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'	$^{40}\text{Ar}^{39}\text{N}^1\text{H}$, $^{40}\text{Ar}^{39}\text{O}$, $^{39}\text{Ar}^{39}\text{O}^1\text{H}$, $^{39}\text{Ar}^{39}\text{O}$, $^{37}\text{Cl}^{36}\text{O}^1\text{H}$, $^{40}\text{Ca}^{39}\text{O}$

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

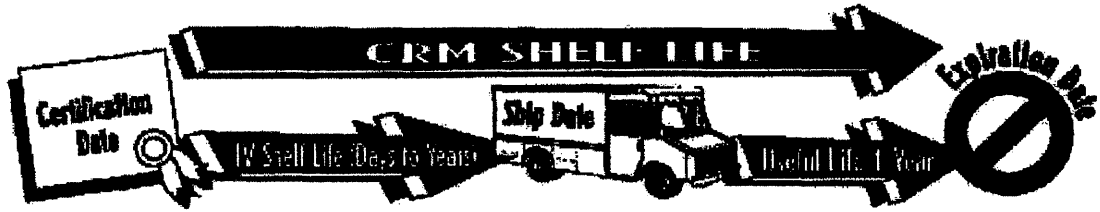
- Domestic Licensing of Production and Utilization Facilities

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 V03
 DATE OPENED: 02/25/04
 INORG: 4470 PU: 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
1/2/05

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

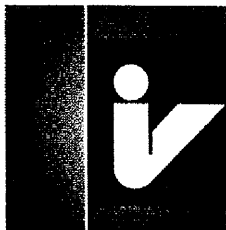
JoAnn Struthers

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 10000 µg/mL Potassium In 1.4% (abs) HNO₃

Catalog Number: CGK10-1, CGK10-2, and CGK10-5

Lot Number: W-K02111

Starting Material: KNO₃

Starting Material Purity (%): 99.997230

Starting Material Lot No K18J19

Matrix: 1.4% (abs) HNO₃

INORGANIC LABS/RADCHEM LABS
 DATE RECEIVED: 11/5/03 1/12
 DATE EXPIRED: 12/1/2004 OF
 DATE OPENED: 11/5/03
 INORG: 4320 PO: FS 2256

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 ± 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 - 29.0963; +1; (6); K⁺(aq)
(Coordination Number in parentheses is assumed, not certain.)

Chemical Compatibility - Soluble in HCl, HNO₃, H₂SO₄, and HF aqueous matrices. Avoid use of HClO₄ due to insolubility of the perchlorate. Stable with all metals and inorganic anions except ClO₄⁻.

Stability - 2-100 ppb levels stable for months in 1% HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ / LDPE container.

K Containing Samples (Preparation and Solution) - Metal (Dissolves very rapidly in water); Ores (Sodium carbonate fusion in P1^o 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 600nm)
ICP-OES 766.490 nm	0.4 / 0.001 µg/mL	1	atom	2 nd order radiation from R.E.s on some optical designs
ICP-OES 771.531 nm	1.0 / 0.03 µg/mL	1	atom	2 nd 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, Ce</u>
ICP-MS 39 amu	10 ppt	n/b	M ⁺	³⁹ ArH, ³⁹ Na ¹⁶ O, ¹³⁶ Se 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)**

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 29/2
DATE EXPIRED: 12/1/04 DL
DATE OPENED: 11/5/03
INORG: 4326 PO: 252258

Certification Date: January 30, 2003

Expiration Date:

EXPIRES
12/2004

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

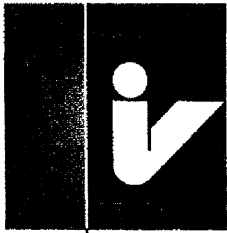
JoAnn Struthers

Certificate Approved By: Katalin Le, QC Supervisor

Katalin Le

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines



inorganic 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) HNO₃

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) HNO₃

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: 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:

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

$\sum S_i$ = 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.)

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

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 928 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 Tl 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 HCl, HNO_3 , and H_2SO_4 , avoid HF, H_3PO_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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-10% HNO_3 / LDPE container.

Mg Containing Samples (Preparation and Solution) - Metal (Best dissolved in diluted HNO_3); Oxide (Readily soluble in above compatible aqueous acidic solutions); Ores (Carbonate fusion in Pt followed by HCl dissolution); Organic Matrices (Sulfuric / peroxide digestion or nitric / sulfuric / perchloric acid decomposition, or 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 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 Li ⁺ , ⁴⁵ Ti ⁺ , ⁴⁰ 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 (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 VSD
 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.

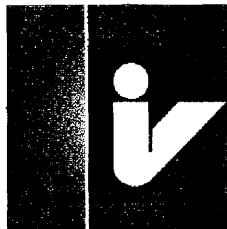
Certification Date: August 28, 2002

Expiration Date: **EXPIRES**
01 22 03

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



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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 10000 µg/mL Sodium in 1.4% (abs) HNO₃

Catalog Number: CGNA10-1, CGNA10-2, and CGNA10-5

Lot Number: T-NA03006

Starting Material: Na₂CO₃

Starting Material Purity (%): 99.999936

Starting Material Lot No 42095

Matrix: 1.4% (abs) HNO₃

INORGANIC LABS/RADCHEM LABS Pg 1 of 2
 DATE RECEIVED: 07/31/03
 DATE EXPIRED: 08/01/2004 ver
 DATE OPENED: 08/01/03
 INORG: 4805 PO: 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

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

n = number of measurements
 $\sum s_i$ = 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 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 - 22.98977; +1; (6); Na¹(aq) largely ionic in nature (Coordination Number in parentheses is assumed, not certain.)

Chemical Compatibility - Soluble in HCl, HNO₃, H₂SO₄, and HF aqueous matrices. Stable with all metals and inorganic anions.

Stability - 2-100 ppb levels stable for months in 1% HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ / LDPE container.

Not 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 589.595 nm	0.07 / 0.00009 µg/mL	1	atom	2 nd order radiation from R.E.s on some optical designs
ICP-OES 588.995 nm	0.03 / 0.006 µg/mL	1	atom	2 nd 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, Zn</u>
ICP-MS 23 amu	310 ppt	n/a	M ⁺	⁴⁸ Ti ¹² , ⁴⁸ Ca ¹²

- 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**
01/24/04

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2
DATE RECEIVED: 07/31/03
DATE EXPIRED: 08/01/2004 WOS
DATE OPENED: 08/01/03
INORG: 4205 PO: F52391

010401

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

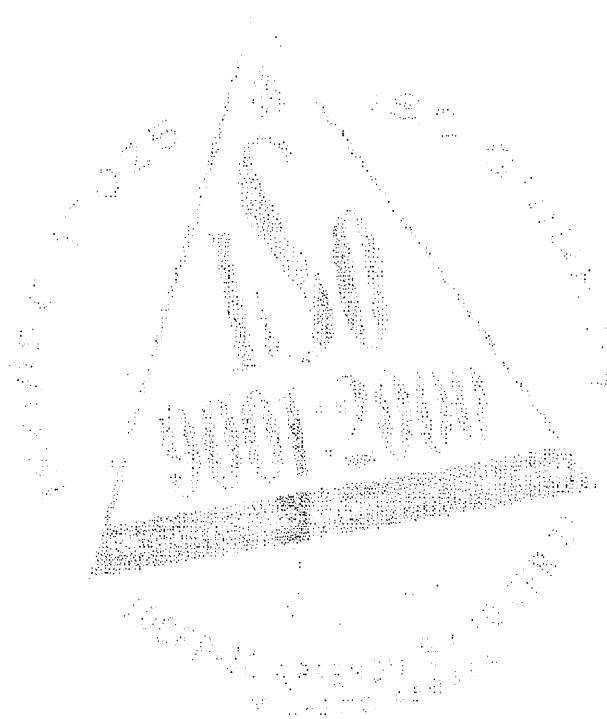
Certificate Prepared By: Debbie Newman, LIMS Administrator

Debbie Newman
Katalin Le

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines



010402



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 Lithium in 0.1% (abs) HNO₃

Catalog Number: CGLI1-1 and CGLI1-5
 Lot Number: **W-LI02073**
 Starting Material: Li₂CO₃
 Starting Material Purity (%): 99.997165
 Starting Material Lot No 1123
 Matrix: 0.1% (abs) HNO₃

INDORGANIC LABS/RADCHEM LABS Pg. 4 of 6
 DATE RECEIVED: 07/01/04
 DATE EXPIRED: 08/01/2005 v03
 DATE OPENED: 07/01/04
 INDRG: 4628 PO: F53406

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 995 ± 2 µg/mL

Certified Density: 1.004 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 #1 995 ± 2 µg/mL

ICP Assay NIST SRM 3129a Lot Number: 000505

Assay Method #2 995 ± 6 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 0.00120	<u>M</u> Dy < 0.01199	<u>S</u> Li	<u>M</u> Pr < 0.00060	<u>M</u> Te < 0.05994
<u>M</u> Sb < 0.00100	<u>M</u> Er < 0.00999	<u>M</u> Lu < 0.00080	<u>M</u> Re < 0.00200	<u>M</u> Tb < 0.00060
<u>M</u> As < 0.01998	<u>M</u> Eu < 0.00599	<u>Q</u> Mg 0.00650	<u>M</u> Rh < 0.00200	<u>M</u> Tl < 0.00200
<u>M</u> Ba < 0.01998	<u>M</u> Gd < 0.00200	<u>Q</u> Mn 0.00006	<u>M</u> Rb < 0.00200	<u>M</u> Th < 0.00200
<u>Q</u> Be < 0.00020	<u>M</u> Ga < 0.00200	<u>Q</u> Hg < 0.01500	<u>M</u> Ru < 0.00400	<u>M</u> Tm < 0.00080
<u>M</u> Bi < 0.00080	<u>M</u> Ge < 0.01199	<u>M</u> Mo < 0.00400	<u>M</u> Sm < 0.00200	<u>Q</u> Sn < 0.00600
<u>Q</u> B 0.00020	<u>M</u> Au < 0.00599	<u>M</u> Nd < 0.00400	<u>M</u> Sc < 0.01998	<u>Q</u> Ti < 0.00070
<u>M</u> Cd < 0.00599	<u>M</u> Hf < 0.00400	<u>Q</u> Ni < 0.00230	<u>M</u> Se < 0.01598	<u>Q</u> W < 0.00400
<u>Q</u> Ca 0.04050	<u>M</u> Ho < 0.00100	<u>M</u> Nb < 0.00100	<u>Q</u> Si 0.04650	<u>M</u> U < 0.00400
<u>M</u> Ce < 0.00999	<u>Q</u> In < 0.00400	<u>n</u> Os	<u>M</u> Ag < 0.00400	<u>Q</u> V 0.00009
<u>M</u> Cs < 0.00060	<u>M</u> Ir < 0.00999	<u>M</u> Pd < 0.00999	<u>Q</u> Na 0.03200	<u>M</u> Yb < 0.00200
<u>M</u> Cr < 0.00999	<u>Q</u> Fe 0.00200	<u>Q</u> P < 0.00250	<u>Q</u> Sr 0.00026	<u>M</u> Y < 0.07992
<u>M</u> Co < 0.00599	<u>M</u> La < 0.00100	<u>M</u> Pt < 0.00400	<u>Q</u> S 0.01250	<u>Q</u> Zn 0.00145
<u>Q</u> Cu 0.00100	<u>M</u> Pb < 0.00599	<u>Q</u> K 0.00950	<u>M</u> Ta < 0.01399	<u>M</u> Zr < 0.00999

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 - 6.941; +1; (6) Li^(aq) large effective radius due to hydration sphere (Coordination Number in parentheses is assumed, not certain.)

Chemical Compatibility - Soluble in HCl, HNO₃, H₂SO₄ and HF aqueous matrices. Stable with all metals and inorganic anions. **Stability** - 2-100 ppb levels stable for months in 1% HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ / LDPE container.

Li Containing Samples (Preparation and Solution) - Metal (Dissolves very rapidly in water); Ores (Sodium carbonate fusion in Pt^o followed by HCl dissolution-blank levels of Li in sodium 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 various concentrations.)
ICP-OES 670.784 nm	0.002 / 0.00002 µg/mL	1	atom	2 nd order radiation from R.E.s on some optical designs
ICP-OES 460.286 nm	0.9 / 0.04 µg/mL	1	atom	Zr, Th
ICP-OES 323.261 nm	1.1 / 0.05 µg/mL	1	atom	<u>Sb, Th, Ni</u>
ICP-MS 7 amu	10 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)

INORGANIC LABS/RADCHEM LABS 9.2 of 2

DATE RECEIVED: 07/01/04
 DATE EXPIRED: 03/01/2005
 DATE OPENED: 07/01/04
 INORG: 4628 PO: F53406

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010405



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 12, 2003

Expiration Date: **EXPIRES**
01/2005

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

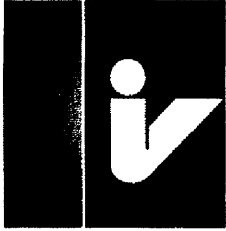
Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

010406

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% HNO₃ (abs)

Catalog Number: CGAG1-1, CGAG1-2 and CGAG1-5

Lot Number: T-AG02015

Starting Material: Silver Metal
 Starting Material Purity: 99.999%
 Starting Material Lot No: 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_i = individual results n = number of measurements $\sum s_i^2$ = 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	<0.00030	M	Pr	<0.00030	Q	Te	<0.030
M	Sb	<0.00050	M	Er	<0.00050	M	Lu	<0.00040	M	Re	<0.00010	M	Tb	<0.00030
Q	As	<0.0050	M	Eu	<0.00030	Q	Mg	<0.00040	M	Rh	<0.00010	M	Ti	<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	<0.00040
M	Bi	<0.00040	M	Ge	<0.00060	M	Mo	<0.00020	M	Sm	<0.00010	M	Sn	<0.00050
Q	B	<0.0020	Q	Au	<0.012	M	Nd	<0.00020	M	Sc	<0.0010	Q	Tl	<0.00070
Q	Cd	<0.0020	M	Hf	<0.00020	Q	Ni	<0.0070	Q	Se	<0.036	M	W	<0.0010
Q	Ca	<0.00050	M	Ho	<0.00050	M	Nb	<0.00050	Q	Si	<0.0030	M	U	<0.00020
M	Ce	<0.00050	Q	In	<0.020	n	Os		g	Ag		M	V	<0.00020
M	Cs	<0.00030	M	Ir	<0.00050	Q	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	<0.00050	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 Q - checked by ICP-OES i - spectral interference n - not checked for s - solution standard element

ANALYZED DENSITY OF SOLUTION (measured at 22°C): 1.024 g/mL

QA:KL Rev. 08210220

Quality Assurance Manager

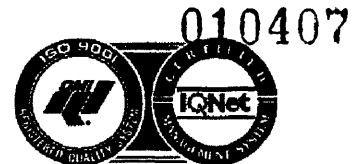
Expires:

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 (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/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 μ 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

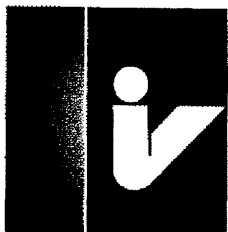
The thermometers used in the determination of the final densities are calibrated vs standard thermometer No. 903-2680 which was certified in accordance with the procedures outlined by ASTM E77-87 and NIST Monograph 150 using NIST Test Nos. and Std Nos.: 769543, 217368/769543, 217368/P14452, 176240/P14452, 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 Arsenic in 1.4% (abs) HNO₃

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) HNO₃

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: 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:

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

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

$\sum (e_i)^2$ = 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 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 $\mu\text{g/mL}$

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 μm .

<u>O</u> Al 0.00038	<u>M</u> Dy < 0.01596	<u>O</u> Li 0.00009	<u>M</u> Pr < 0.00080	<u>M</u> Te < 0.07978
<u>O</u> Sb < 0.01000	<u>M</u> Er < 0.01330	<u>M</u> Lu < 0.00106	<u>O</u> Re < 0.01000	<u>M</u> Tb < 0.00080
<u>s</u> As	<u>M</u> Eu < 0.00798	<u>O</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>O</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>O</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>O</u> Sn 0.00049
<u>O</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>O</u> Ca 0.00189	<u>M</u> Ho < 0.00133	<u>O</u> Nb < 0.00200	<u>O</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>O</u> Na 0.00159	<u>M</u> Yb < 0.00266
<u>M</u> Cr < 0.01330	<u>O</u> Fe < 0.00110	<u>O</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>O</u> S < 0.02500	<u>O</u> Zn 0.00057
<u>M</u> Cu < 0.01596	<u>M</u> Pb < 0.00798	<u>O</u> K 0.00132	<u>M</u> Ta < 0.01862	<u>M</u> Zr < 0.01330

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 - 74.9216; mix of +3 and +5; 6; H_3AsO_4 and HAsO_2

Chemical Compatibility - Arsenic has no cationic chemistry. It is soluble in HCl , HNO_3 , H_2PO_4 , H_2SO_4 , and HF aqueous matrices water and NH_4OH . 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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

As Containing Samples (Preparation and Solution) - As^0 (soluble in 1:1 H_2O / 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 Ni^0 crucible with 10 grams of a 1:1 mix of K_2CO_3 and 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 Na_2CO_3 / Na_2O_2 mix in a Ni^0 crucible. The fuseate is extracted with water and acidified with 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 ∞ ions)
ICP-OES 189.042 nm	0.05 / 0.005 $\mu\text{g}/\text{mL}$	1	atom	Cr
ICP-OES 193.696 nm	0.1 / 0.01 $\mu\text{g}/\text{mL}$	1	atom	V, Ge
ICP-OES 228.812 nm	0.1 / 0.01 $\mu\text{g}/\text{mL}$	1	atom	Cd, Pt, Ir, Co
ICP-MS 75 amu	20 ppt	n/a	M ⁺	$^{35}\text{Ar}^{35}\text{Cl}$, $^{54}\text{Co}^{54}\text{O}$, $^{39}\text{Ar}^{39}\text{H}$, $^{37}\text{Ar}^{37}\text{Cl}$, $^{39}\text{Ar}^{39}\text{K}$, $^{148}\text{Nd}^{148}$, $^{150}\text{Sm}^{150}$

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 V03
DATE OPENED: 01/20/04
INORG: 4433 PO: F52301

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010411



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

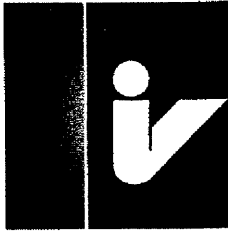
Expiration Date: **EXPIRES**
11 2005

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



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) HNO₃

Catalog Number: CGPB1-1, CGPB1-2, and CGPB1-5
Lot Number: **W-PB02114**
Starting Material: Pb(NO₃)₂
Starting Material Purity (%): 99.999974
Starting Material Lot No: 22150
Matrix: 0.35% (abs) HNO₃

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

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

$\sum S$ = 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 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 HNO_3 . Avoid H_2SO_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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO_3 / LDPE container.

Pb Containing Samples (Preparation and Solution) - Metal (Best dissolved in 1:1 H_2O / HNO_3); Oxides (The many different Pb oxides are soluble in HNO_3 with the exception of PbO_2 which is soluble in HCl or HF); Ores and Alloys (Best attacked using 1:1 H_2O / 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 μm	5 ppt	n/a	M ⁺	²⁰² Pt ⁺ , ¹⁸⁷ Os ⁺

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 2 of 2
 DATE RECEIVED: 11/3/03
 DATE EXPIRED: 11/1/04 DL
 DATE OPENED: 11/3/03
 INORG: 4313 PO: F52058

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

John Struthers

Certificate Approved By: Katalin Le, QC Supervisor

Katalin Le

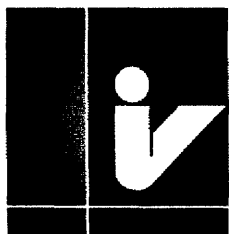
Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines

010416

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) HNO₃ / 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) HNO₃ / 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

ΣS = 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.)

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

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: 03/07/2005 VMS
 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 UHPA-Filtered Clean Room. An UHPA-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 < 0.00016	<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 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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-2% HNO_3 / LDPE container.

Sb Containing Samples (Preparation and Solution) - Metal and alloys (Soluble in H_2O / HF / HNO_3 mixture); Oxides (Soluble in HCl and tartaric acid or H_2O / HF / HNO_3 mixtures); Ores (Fusion with Na_2CO_3 in Pt^{st} followed by dissolving the fuseate in a H_2O / HF / 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 400ppm)
ICP-OES 206.833 nm	0.03 / 0.003 $\mu\text{g}/\text{mL}$	1	atom	<u>Ta</u> , Cr, Ge, Hf
ICP-OES 217.581 nm	0.05 / 0.005 $\mu\text{g}/\text{mL}$	1	atom	<u>Nb</u> , W, Re, Fe,
ICP-OES 231.147 nm	0.06 / 0.006 $\mu\text{g}/\text{mL}$	1	atom	Ni, Co, Pt
ICP-MS 121 amu	5 ppt	n/a	M'	<u>$^{107}\text{Pd}^{10}$</u> , <u>$^{109}\text{Y}^{10}$</u>

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 (BrwA), 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

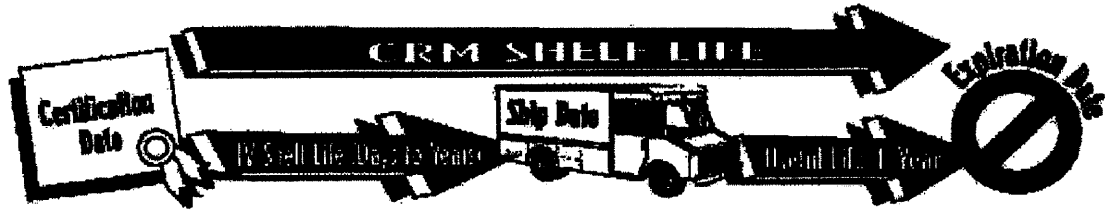
- Domestic Licensing of Production and Utilization Facilities

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: 02/01/2005 MS
 DATE OPENED: 02/25/04
 INDRG: 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

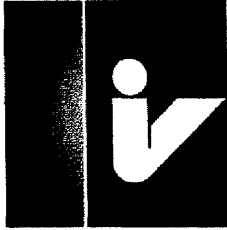
JoAnn Struthers

Certificate Approved By: Katalin Le, QC Supervisor

Katalin Le

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines



inorganic ventures / iv labs

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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 Selenium in 1.4% (abs) HNO₃

Catalog Number: CGSE1-1, CGSE1-2, and CGSE1-5
 Lot Number: X-QSE01091
 Starting Material: Se shot
 Starting Material Purity (%): 99.997834
 Starting Material Lot No: I20L45
 Matrix: 1.4% (abs) HNO₃

INORGANIC LABS/RADCHEM LABS 8-102
 DATE RECEIVED: 07/01/04
 DATE EXPIRED: 08/01/2005 VES
 DATE OPENED: 07/01/04
 INORG: 4630 PO: F53406

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1005 ± 2 µg/mL

Certified Density: 1.009 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

$\sum S$ = 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 3149 Lot Number: 992106

Assay Method #2 1004 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 0.00030	<u>M</u> Dy < 0.01196	<u>Q</u> Li < 0.00003	<u>M</u> Pr < 0.00060	<u>M</u> Te < 0.05982
<u>M</u> Sb < 0.00100	<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 0.00021	<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 0.01054	<u>Q</u> Ru < 0.00700	<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 0.00060	<u>M</u> Hf < 0.00399	<u>Q</u> Ni 0.00028	<u>S</u> Se	<u>M</u> W < 0.01994
<u>Q</u> Ca 0.00100	<u>M</u> Ho < 0.00100	<u>Q</u> Nb < 0.00400	<u>Q</u> Si < 0.00300	<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 < 0.00399	<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 0.00402	<u>M</u> Yb < 0.00199
<u>M</u> Cr 0.00080	<u>Q</u> Fe 0.00271	<u>Q</u> P < 0.00300	<u>M</u> Sr < 0.00100	<u>M</u> Y < 0.07976
<u>M</u> Co < 0.00598	<u>M</u> La < 0.00100	<u>M</u> Pt < 0.00399	<u>Q</u> S < 0.04000	<u>M</u> Zn 0.00400
<u>M</u> Cu 0.00130	<u>M</u> Pb < 0.00598	<u>Q</u> K 0.00060	<u>M</u> Ta < 0.01396	<u>Q</u> Zr 0.00005

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

010422

Storage & Handling - Kept 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 - 78.96; +4; 6; H₂SeO₃

Chemical Compatibility - Soluble in HCl, HNO₃, H₃PO₄, H₂SO₄ and 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 % HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ / LDPE container.

Se Containing Samples (Preparation and Solution) - Metal (Soluble in HNO₃); Oxides (Readily soluble in water); Minerals and alloys (Acid digestion with HNO₃ or HNO₃ / HF); Organic Matrices (Acid digestion with hot concentrated H₂SO₄ accompanied by the careful dropwise addition of H₂O₂ 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 400nm)
ICP-OES 196.026 nm	0.08 / 0.006 µg/mL	1	atom	Fe
ICP-OES 203.985 nm	0.2 / 0.05 µg/mL	1	atom	<u>Sb, Ir, Cr, Ia</u>
ICP-OES 206.279 nm	0.3 / 0.16 µg/mL	1	atom	<u>Cr, Pt</u>
ICP-MS 82 amu	200 ppt	n/a	M'	<u>¹³C¹⁸Cl₂</u>

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 8/2/04

DATE RECEIVED: 07/01/04

DATE EXPIRED: 08/01/2005 VRS

DATE OPENED: 07/01/04

INORG: 4630 PO: F53406

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010423



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 23, 2004

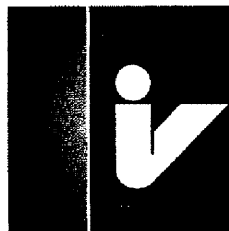
Expiration Date: **EXPIRES**
01:2005

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Manager

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director


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) HNO₃

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) HNO₃

INORGANIC LABS/RADCHEM LABS Pg. 2 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

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

$\sum S$ = 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>i</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 HCl , HNO_3 , and H_2SO_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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% HNO_3 / LDPE container.

Ti Containing Samples (Preparation and Solution) - Metal (Best dissolved in HNO_3 , which forms chiefly the Ti^{3+} ion.) Oxide (The thallic oxide is readily soluble in water. The thallic oxide requires high levels of acid.) Ores (Carbonate fusion in Pt^0 followed by HCl dissolution.) Organic Matrices (Sulfuric/peroxide digestion or dry ash and dissolution in 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 λ ions.)
ICP-OES 190.864 nm	0.04 / 0.004 $\mu\text{g}/\text{mL}$	1	ion	V, Ti
ICP-OES 276.787 nm	0.1 / 0.01 $\mu\text{g}/\text{mL}$	1	atom	Ta, V, Fe, Cr
ICP-OES 351.924 nm	0.2 / 0.02 $\mu\text{g}/\text{mL}$	1	atom	Th, Ce, Zr
ICP-MS 205 amu	2 ppt	n/a	M	$^{130}\text{Os}^{16}\text{O}$

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 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 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

010427



- 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 R. Gaines

010428

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 Boron In H₂O

Catalog Number: CGB1-1, CGB1-2, and CGB1-5
 Lot Number: **W-B02042**
 Starting Material: H3BO3
 Starting Material Purity (%): 99.999998
 Starting Material Lot No: OV0133
 Matrix: H₂O

INORGANIC LABS/RADCHEM LABS
 DATE RECEIVED: 07/31/03
 DATE EXPIRED: 08/01/2004 V03
 DATE OPENED: 08/01/03
 INDRG: 4201 PO: F52383

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:

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

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

$\sum e_i$ = 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** 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

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 - 10.811; +3; 4; $\text{B}(\text{OH})_3$ and $\text{B}(\text{OH})_4^-$

Chemical Compatibility - Moderately soluble in HCl , HNO_3 , H_2SO_4 and HF aqueous matrices and very soluble in NH_4OH . Stable with all metals and inorganic anions at low to moderate ppm levels.

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-1,000 ppm solutions chemically stable for years in 1% HNO_3 / LDPE container. 1000-10,000 ppm stable for years in dilute NH_4OH / 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. HNO_3 or H_2SO_4); $\text{B}(\text{OH})_3$ (water soluble); Ores (avoid acid digestions and use caustic fusions in Pt); Organic Matrices (dry ash mixed with Na_2CO_3 in Pt at 450°C then increase heat to 1000°C to fuse; or perform a Na_2O_2 fusion in a 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 4s) (ppb)
ICP-OES 249.773 nm	0.003 / 0.001 $\mu\text{g}/\text{mL}$	1	atom	<u>W</u> , <u>Ce</u> , <u>Co</u> , <u>Th</u> , <u>Ta</u> , <u>Mn</u> , <u>Mo</u> , <u>Fe</u>
ICP-OES 249.878 nm	0.004 / 0.003 $\mu\text{g}/\text{mL}$	1	atom	<u>Os</u> , <u>W</u> , <u>Co</u> , <u>Cr</u> , <u>Hf</u>
ICP-OES 208.959 nm	0.007 / 0.0005 $\mu\text{g}/\text{mL}$	1	atom	<u>Mo</u>
ICP-MS 11 amu	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 (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**

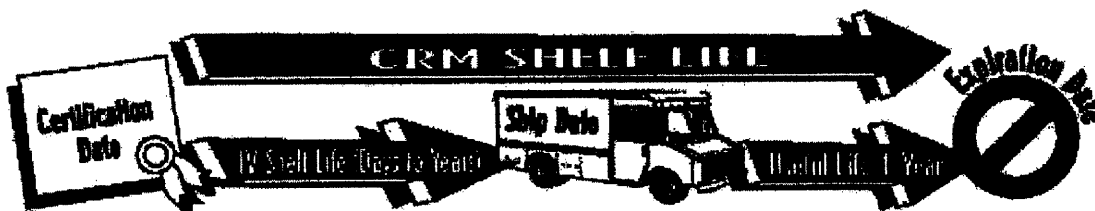
- Domestic Licensing of Production and Utilization Facilities

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: 4201 PO: F52383

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010431



- 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**
122004

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

010432

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 H₂O tr. NH₄OH

Catalog Number: CGMO1-1, CGMO1-2, and CGMO1-5
 Lot Number: **W-MO01132**
 Starting Material: (NH₄)₆Mo₇O₂₄xH₂O
 Starting Material Purity (%): 99.995947
 Starting Material Lot No 21410
 Matrix: H₂O tr. NH₄OH

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: 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

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

$\sum S$ = 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

010434

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 NH_4OH matrix giving the operator the option of using HCl or HF to stabilize acidic solutions. The $[\text{MoO}_4]^{2-}$ is soluble in concentrated HCl $[\text{MoOCl}_4]^-$, dilute HF / HNO_3 , $[\text{MoOF}_6]^{2-}$ 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 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 $[\text{MoOF}_6]^{2-}$ for months in 1% HNO_3 / LDPE container. 1-10,000 ppm single element solutions as the $[\text{MoO}_4]^{2-}$ chemically stable for years in 1% NH_4OH in a LDPE container.

Mo Containing Samples (Preparation and Solution) - Metal (Soluble in HF / HNO_3 or hot dilute HCl); Oxide (soluble in HF or NH_4OH); Organic Matrices (Dry ash at 450°C in Pt and dissolve oxide with HF or 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 5000s)
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	na	M	⁴⁰ Ar, ⁴¹ K, ⁴⁰ Ar, ⁷⁹ Br, ⁸⁰ Br, ¹⁸⁶ Os, ¹⁸⁷ Pt

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 v05

DATE OPENED: 02/25/04

INORG: 4471 PO: F52323

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010435



- 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
1/22/05

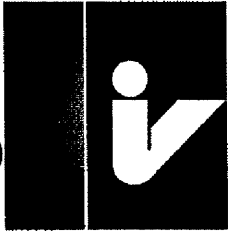
12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

010436



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 H₂O

Catalog Number: CGP1-1, CGP1-2 and CGP1-5

Lot Number: **W-P01123**

Starting Material: Phosphoric Acid
 Starting Material Purity: 99.999%
 Starting Material Lot No: 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.

Q	Al	<0.040	M	Dy	<0.00060	M	Li	<0.0010	M	Pr	<0.000030	M	Te	<0.0030
M	Sb	0.012	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	<0.0030	M	Rh	<0.00010	M	Ti	<0.00010
M	Ba	<0.0010	M	Gd	<0.00010	M	Mn	<0.00040	M	Rb	<0.00010	M	Th	<0.00010
M	Be	<0.000050	M	Ga	0.00070	Q	Hg	<0.020	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	<0.00060
M	B	<0.0070	M	Au	<0.00030	M	Nd	<0.00020	Q	Sc		n	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	<0.020	M	U	<0.00020
M	Ce	<0.00050	M	In	<0.030	n	Os		M	Ag	<0.00020	M	V	<0.00020
M	Cs	<0.000030	M	Ir	<0.00050	M	Pd	<0.00050	Q	Na	<0.090	M	Yb	<0.00010
M	Cr	<0.00050	Q	Fe	<0.050	s	P		M	Sr	<0.000050	M	Y	<0.0040
M	Co	<0.00030	M	La	<0.000050	M	Pt	<0.00020	n	S		M	Zn	0.0035
M	Cu	0.080	M	Pb	<0.00030	n	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): 1.001 g/mL

(over)

QA:KL Rev. 010804DN

Paul R. Gaines
 Quality Assurance Manager

Expires:

EXPIRES
 1/2005

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

- 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 standard.

PACKAGING DOCUMENTATION

Purified acid, 18 megohm double deionized water that has been filtered through a 0.2 μ 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

010438



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 Silicon in H₂O tr. HNO₃ tr. HF

Catalog Number: CGS11-1, CGS11-2, and CGS11-5
 Lot Number: W-SI02082
 Starting Material: SiO₂
 Starting Material Purity (%): 99.996367
 Starting Material Lot No: C05310C
 Matrix: H₂O tr. HNO₃ tr. HF

INORGANIC LABS/RADCHEM LABS Pg. 1 of 3
 DATE RECEIVED: 01/20/04
 DATE EXPIRED: 02/01/2005 v03
 DATE OPENED: 01/20/04
 INORG: 4437 IQ: 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

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

$\sum s_i$ = 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 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 HCl, HF, H_3PO_4 , H_2SO_4 , and 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^- 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 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 % HNO_3 / trace HF in a LDPE container.

Si Containing Samples (Preparation and Solution) - Metal (Soluble in 1:1:1 H_2O / HF / HNO_3) Oxide - SiO_2 , amorphous (Dissolve by heating in 1:1:1 H_2O / HF / HNO_3) Oxide - quartz (Fuse in Pt^{w} with Na_2CO_3); Geological Samples (Fuse in Pt^{w} with Na_2CO_3 followed by HCl solution of the fuseate); Organic Matrices containing silicates and non volatile silicon compounds (Dry ash at 450°C in Pt^{w} and dissolve by gently warming with 1:1:1 H_2O / HF / H_2SO_4 or fuse / ash with Na_2CO_3 and dissolve fuseate with HCl / H_2O); Silicone Oils - dimethyl silicones depolymerize to form volatile monomer units when heated (Measure directly in alcoholic KOH / xylene mixture where sample is treated first with the 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 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 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
ICP-OES 251.611 nm	0.012 / 0.003 $\mu\text{g}/\text{mL}$	1	Ion	Ta, U, Zn, Th
ICP-OES 212.412 nm	0.02 / 0.01 $\mu\text{g}/\text{mL}$	1	Ion	Hf, Os, Mo, Ta
ICP-OES 289.158 nm	0.03 / 0.004 $\mu\text{g}/\text{mL}$	1	Ion	Ta, Ce, Cr, Cd, Th
ICP-MS 28 amu	4000 - 8000 ppt	n/a	M'	$^{14}\text{N}_2$, $^{12}\text{C}^{16}\text{O}$

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 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
 DATE OPENED: 01/20/04
 INORG: 4437 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: February 24, 2003

Expiration Date: **EXPIRES**
1st 2005

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

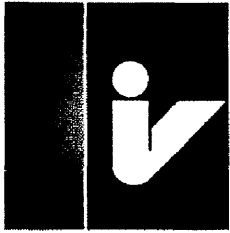
Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

JoAnn Struthers

Katalin Le

Paul Gaines

010442



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

Catalog Number: CGT11-1, CGT11-2 and CGT11-5

1000 µg/mL Titanium in 1.4% HNO₃ (abs) tr. HF

This standard should not be prepared or stored in glass.

Lot Number: **T-TI02039**

Starting Material:
 Starting Material Purity:
 Starting Material Lot No:

Titanium Metal
 99.999%
 F29114

INORGANIC LABS/RADCHEM LABS

DATE RECEIVED: 11/24/03
 DATE EXPIRED: 12/01/2004 *yes*
 DATE OPENED: 11/25/03
 INORG: 4333 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:

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

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

$\sum s_i$ = 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.

<u>Q</u> Al <0.010	<u>M</u> Dy <0.00060	<u>M</u> Li <0.0010	<u>M</u> Pr <0.000030	<u>M</u> Ta <0.0030
<u>M</u> Sb <0.000050	<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>Q</u> Mg <0.020	<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 0.0020	<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 <0.050	<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>Q</u> B <0.050	<u>M</u> Au <0.00030	<u>M</u> Nd <0.00020	<u>Q</u> Sc <0.0020	<u>s</u> Ti
<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 <0.000050	<u>M</u> Nb <0.000050	<u>Q</u> Si <0.010	<u>M</u> U <0.00020
<u>M</u> Ce <0.00060	<u>Q</u> In <0.020	<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>Q</u> Na 0.12	<u>M</u> Yb <0.00010
<u>M</u> Cr <0.00050	<u>Q</u> Fe <0.010	<u>i</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>L</u> S	<u>M</u> Zn 0.19
<u>Q</u> Cu <0.040	<u>M</u> Pb <0.00030	<u>n</u> K 0.23	<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): 1.011 g/mL

QA:KL Rev.0806020N

(over)

Paul R. Gaines
 Quality Assurance Manager

Expires:

EXPIRES
 12/004

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 μ 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.

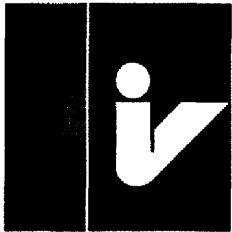
THERMOMETER CALIBRATION

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 Strontium in 0.1% (abs) HNO₃ **010444**

Catalog Number: CGSR1-1, CGSR1-2, and CGSR1-5

Lot Number: **W-SR01124**

Starting Material: SrCO₃

Starting Material Purity (%): 99.996751

Starting Material Lot No 22593, 22878

Matrix: 0.1% (abs) HNO₃

INORGANIC LABS/RADCHEM LABS 1062
DATE RECEIVED: 7/8/04
DATE EXPIRED: 8/1/2005 DR
DATE OPENED: 7/8/04
INORG: 4635 PO: F53408

3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Concentration: 1004 ± 2 µg/mL

Certified Density: 1.001 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 1005 ± 2 µg/mL

ICP Assay NIST SRM 3153a Lot Number: 990906

Assay Method #2 1004 ± 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.

010445

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 < 0.00055	Q Li < 0.00003	M Pr < 0.00003	Q Te < 0.10000
M Sb < 0.00005	M Er < 0.00046	M Lu < 0.00004	M Re < 0.00009	M Tb < 0.00003
Q As < 0.00500	M Eu < 0.00028	Q Mg 0.00030	Q Rh < 0.00600	M Tl < 0.00009
Q Ba 0.02200	M Gd < 0.00009	Q Mn < 0.00003	i Rb	M Th < 0.00009
Q Be < 0.00009	M Ga < 0.00009	Q Hg < 0.01500	Q Ru < 0.00300	M Tm < 0.00004
M Bi < 0.00004	M Ge < 0.00055	M Mo < 0.00018	M Sm < 0.00009	M Sn < 0.00046
Q B < 0.00060	M Au < 0.00028	M Nd < 0.00018	M Sc < 0.00092	M Tl < 0.00459
M Cd < 0.00028	M Hf < 0.00018	Q Ni < 0.00300	Q Se < 0.05000	M W < 0.00092
Q Ca 0.02500	M Ho < 0.00005	M Nb < 0.00005	Q Si < 0.00340	M U < 0.00018
M Ce < 0.00046	Q In < 0.00200	n Os	M Ag < 0.00018	M V < 0.00018
M Cs < 0.00003	M Ir < 0.00046	Q Pd < 0.00400	Q Na 0.00410	M Yb < 0.00009
Q Cr < 0.00080	Q Fe < 0.00110	Q P < 0.00480	s Sr	Q Y < 0.00004
M Co < 0.00028	M La < 0.00005	M Pt < 0.00018	n S	Q Zn 0.00720
Q Cu < 0.00140	M Pb < 0.00028	Q K < 0.00170	M Ta < 0.00064	M Zr < 0.00046

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 ± 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(H₂O)₁₂

Chemical Compatibility - Soluble in HCl, and HNO₃. Avoid H₂SO₄, 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% HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1 - 3.5% HNO₃ / LDPE container.

Sr Containing Samples (Preparation and Solution) - Metal (Best dissolved in diluted HNO₃); Ores (Carbonate fusion in Pt⁴ 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 400nm)
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'	¹³⁶ Ge ⁴⁺ , ¹⁷⁶ Yb ³⁺ , ¹⁷⁴ Lu ³⁺ , ¹⁷⁴ Hf ⁴⁺

- 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**

010446

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 - 1995 "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 2 of 2
 DATE RECEIVED: 7/8/04
 DATE EXPIRED: 8/1/2005
 DATE OPENED: 7/8/04
 INORG: 4635 PO: DR/E53408

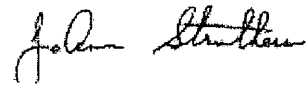
Certification Date: October 22, 2003

Expiration Date:

EXPIRES
 01 2005

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

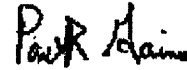
Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant



Certificate Approved By: Katalin Le, QC Supervisor



Certifying Officer: Paul Gaines, Chemist, Senior Technical Director



010447

010448

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 Tin in H₂O tr. HNO₃ 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: H₂O tr. HNO₃ 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

ΣQ = 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.)

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

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 v05
 DATE OPENED: 03/30/04
 INORG: 4512 PG: 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

010450

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 $\text{Sn}(\text{OH})_4^{2+}$

Chemical Compatibility - Soluble in HCl and dilute HF / HNO_3 . Avoid neutral to basic media. Unstable at ppm levels with metals that would pull F⁻ away. (i.e. Do not mix with Alkaline or Rare Earths or high levels of transition elements unless they are fluorinated.) Stable with most inorganic anions 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 $\text{Sn}(\text{OH})_4^{2+}$ for 1 year in 1% HNO_3 / LDPE container. 1-10,000 ppm single element solutions as the $\text{Sn}(\text{OH})_4^{2+}$ chemically stable for years in 2-5% HNO_3 / trace HF in a LDPE container.

Sn Containing Samples (Preparation and Solution) - Metal (Soluble in HF / HNO_3 or HCl); Oxides - SnO (soluble in HCl), SnO_2 - very resistant to all acids including HF (Fusion with equal parts of Na_2CO_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. H_2SO_4 to boiling until the alloy disintegrates and nearly all of the sulfuric acid is expelled. Then add 100 mL O_2 , 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 λ concs.)
ICP-OES 188.989 nm	0.03 / 0.003 $\mu\text{g}/\text{mL}$	1	ion	
ICP-OES 242.949 nm	0.1 / 0.01 $\mu\text{g}/\text{mL}$	1	atom	W, Mo, Rh, Ta, Co
ICP-MS 120 amu	5 ppt	n/a	M ⁺	¹²⁰ Te, ¹²⁰ Ru, ¹²⁰ Pd

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: 03/30/04
 DATE EXPIRED: 04/01/2005
 DATE OPENED: 03/30/04
 INORG: 4510 PD: E53361

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010451



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
1/2005

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Manager

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director



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 Bismuth in 3.5% (abs) HNO₃

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) HNO₃

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: 4000 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:

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

(\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 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> Tl < 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 - 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 - 208.9804; +3, 6; $\text{Bi}(\text{O})(\text{H}_2\text{O})_6^{3+}$

Chemical Compatibility - Stable in HCl, HNO_3 , H_2SO_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, HNO_3 , and HF. The major problem with 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 $\mu\text{g}/\text{mL}$ concentration range

Stability - 2-100 ppb levels stable for months in 1% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 5 - 7% HNO_3 / LDPE container.

Bi Containing Samples (Preparation and Solution) - Metal (soluble in HNO_3); Oxides (Soluble in HNO_3); Alloys (Dissolve in conc. 4:1 HCl/ HNO_3 , Heating may be required.); Organic based (dry ash at 450°C and dissolve ash in 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 100ppb)
ICP-OES 223.061 nm	0.04 / 0.005 $\mu\text{g}/\text{mL}$	1	atom	<u>Th, Ir, Ti</u> Cu
ICP-OES 306.772 nm	0.08 / 0.01 $\mu\text{g}/\text{mL}$	1	atom	<u>Th, U, Zr, Hf, Fe</u>
ICP-OES 222.825 nm	0.1 / 0.02 $\mu\text{g}/\text{mL}$	1	atom	<u>Cr, Hf, Ce, Os</u>
ICP-MS 208 amu	2 ppt	n/a	M ⁺	²⁰⁸ Pb, ²⁰⁸ Tl, ²⁰⁸ 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: 07/21/03

DATE EXPIRED: 08/01/2004 VOS

DATE OPENED: 08/01/03

INORG: 4200 PO: F52383

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010455



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
1/2004

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

010456



Certificate of Analysis

CUSTOM-GRADE SOLUTION
1000 µg/mL Lanthanum in 1.4% HNO₃ (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.121702DN

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/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 μ 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.

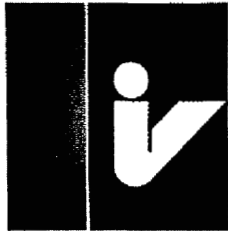
THERMOMETER CALIBRATION

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@lvstandards.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(NO3)2
 Starting Material Purity (%): 99.999248
 Starting Material Lot No: 11974A-00
 Matrix: 3.3% (abs) HCL

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2
 DATE RECEIVED: 03/01/04
 DATE EXPIRED: 03/01/2005 YDS
 DATE OPENED: 03/01/04
 INORG: 4377 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:

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

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

$\sum S$ = 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 #1 994 ± 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.

Q Al 0.00400	M Dy < 0.00060	Q Li < 0.04000	M Pr < 0.00003	Q Te < 0.01300
Q Sb < 0.00500	M Er < 0.00050	M Lu < 0.00004	M Re < 0.00010	M Tb < 0.00003
Q As < 0.01400	M Eu < 0.00030	Q Mg < 0.01100	Q Rh < 0.00600	M Tl < 0.00010
M Ba < 0.00100	M Gd < 0.00010	Q Mn < 0.00650	M Rb < 0.00010	M Th < 0.00010
Q Be < 0.00009	M Ga < 0.00010	Q Hg < 0.01100	Q Ru < 0.00200	M Tm < 0.00004
M Bi < 0.00004	M Ge < 0.00060	M Mo < 0.00020	M Sm < 0.00010	Q Sn < 0.00700
Q B < 0.00090	Q Au < 0.00300	M Nd < 0.00020	Q Sc < 0.00009	Q Ti < 0.00100
Q Cd < 0.00600	M Hf < 0.00020	Q Ni 0.01800	M Se < 0.00080	M W < 0.00100
Q Ca 0.00700	M Ho < 0.00005	M Nb < 0.00005	Q Si 0.00600	M U < 0.00020
M Ce < 0.00050	Q In < 0.03300	n Os	Q Ag < 0.00670	M V < 0.00020
M Cs < 0.00003	M Ir < 0.00050	S Pd	Q Na 0.01500	M Yb < 0.00010
Q Cr 0.00450	Q Fe 0.04600	Q P 0.00600	M Sr < 0.00005	M Y < 0.00400
M Co < 0.00030	M La < 0.00005	Q Pt < 0.00600	Q S < 0.02500	Q Zn < 0.00060
Q Cu 0.00360	M Pb < 0.00030	Q K < 0.02000	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

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(H₂O)₆²⁺

Chemical Compatibility - Stable in HCl, HNO₃, H₂SO₄, HF, H₃PO₄. Avoid basic media. Stable with most metals and inorganic anions in acidic media. Avoid contact with water soluble organics such as aldehydes since Pd²⁺ is easily reduced.

Stability - 2-100 ppb levels. 2ppb Pd is stable for 1 day in 1% HNO₃ /LDPE container. 10 ppb is stable for 3 days in 1% HNO₃ /LDPE container. 100 ppb is stable for 6 months in 1% HNO₃ /LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ /LDPE container.

Pd Containing Samples (Preparation and Solution) - Metal (Soluble in HNO₃ or Aqua Regia) Oxides (Soluble in HCl) Ores (Dissolve in HCl / HNO₃)

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

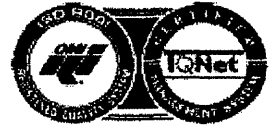
Technique/Line	Estimated D.L.	Order	Type	Interferences (underlined indicates severe at concs.)
ICP-OES 340.458 nm	0.04 / 0.003 µg/mL	1 atom		Ce, Th, Zr
ICP-OES 363.470 nm	0.05 / 0.007 µg/mL	1 atom		
ICP-OES 229.651 nm	0.07 / 0.004 µg/mL	1 ion	Co	
ICP-MS 105 amu	2 ppt	n/a	M'	¹⁰⁷ Ag, ¹⁰⁹ Cu, ¹⁰⁷ Yb, ¹⁰⁶ Mo

- 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: March 14, 2003

Expiration Date:

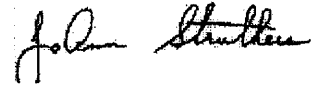
EXPIRES

01/22/05

INORGANIC LABS/RADCHEM LABS Pg. 2 of 2
DATE RECEIVED: 03/01/04
DATE EXPIRED: 03/01/2005 v0
DATE OPENED: 03/01/04
INORG: 4477 PO: F52323

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

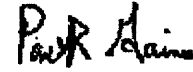
Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

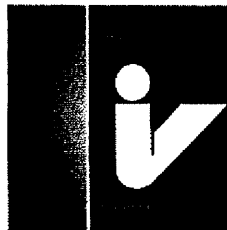


Certificate Approved By: Katalin Le, QC Supervisor



Certifying Officer: Paul Gaines, Chemist, Senior Technical Director




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 H₂O

Catalog Number: CGS1-1 and CGS1-5
 Lot Number: **W-QS01098**
 Starting Material: H₂SO₄
 Starting Material Purity (%): 99.999965
 Starting Material Lot No N38818
 Matrix: H₂O

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 FO: F50058

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

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

$\sum e_i^2$ = 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 ± 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 (O=), S(OH).

Chemical Compatibility - Soluble in HCl, HNO₃, H₂PO₄ and HF aqueous matrices water and NH₄OH. 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% HNO₃ / 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 20 times its weight of Na₂CO₃ + 0.5 grams KNO₃. The fuseate is extracted with water. Any BaSO₄ present in the sample is transposed by the carbonate fusion to the BaCO₃, which is left behind in the water-insoluble residue. If PbSO₄ is present the fuseate should be boiled with a sodium carbonate saturated with CO₂ solution for 1 hour or more where the PbSO₄ 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 λ (D.L.s)
ICP-OES 166.669nm	0.2 / 0.19 $\mu\text{g/mL}$	1	atom	Si, 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*	¹⁸ O, ¹⁴ N ¹⁶ O, ¹⁴ N ¹⁷ O, ¹⁴ N ¹⁸ O, ¹⁵ N ¹⁶ O, ¹⁵ N ¹⁷ O, ¹⁵ N ¹⁸ 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 (BrwA), 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: 11/5/03 ²⁹²
 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

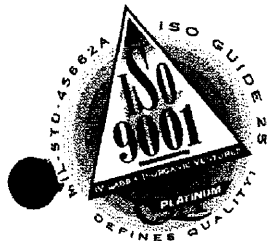
JoAnn Struthers

Certificate Approved By: Katalin Le, QC Supervisor

Katalin Le

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines



Certificate of Analysis

CUSTOM-GRADE SOLUTION

1000 µg/mL Thorium in 3% HNO₃ (abs)

Catalog Number: CGTH1-1 and CGTH1-5

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: F50040

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	i	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	i	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. 0508020H

(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

01/2004

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 μ 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

010468


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 Uranium in 1% (abs) HNO₃

Catalog Number: CGU1-1 and CGU1-5
 Lot Number: W-U01059
 Starting Material: UO₂(NO₃)2.6H₂O
 Starting Material Purity (%): 99.994419
 Starting Material Lot No: RB0018
 Matrix: 1% (abs) HNO₃

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: 4473 PO: F50323

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

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

$\sum e_i^2$ = 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 #1 997 ± 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	j 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

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; UO_2^{2+} (uranyl)

Chemical Compatibility - Soluble in HCl and HNO_3 . Avoid H_2PO_4 , H_2SO_4 , and HF matrices should not be a problem depending upon [U]. Although the UO_2^{2+} ion is distinctly basic, any U^{4+} will precipitate in basic media. UO_2^{2+} salts are generally soluble in water and UO_2^{2+} is stable with most metals and inorganic anions. The uranyl phosphate is insoluble in water. UF_4 and UF_6 are water soluble.

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

U Containing Samples (Preparation and Solution) - Metal (Dissolves rapidly in HCl and HNO_3); Oxide (Soluble in HNO_3); Ores (Digest for 1-2 hours with 1 gram of ore to 30 mL 1:1 HNO_3 . Silica insolubles are removed by filtration after bringing the sample to fumes with conc. H_2SO_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 400nm)
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 ⁺	$^{238}\text{Pb}^{14}\text{O}_2$

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 VOS
 DATE OPENED: 02/25/04
 INDRG: 4473 PO: F52323

***NOTICE TO ICP-MS USERS:** The ^{235}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}U	99.3	99.8 ± 0.1
	^{235}U	0.70	0.204 ± 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
1st 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

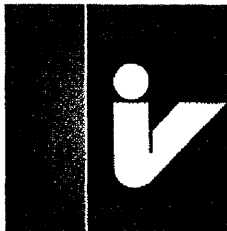
Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines

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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 Tungsten In 1% (abs) HNO₃/1% (abs) HF

Catalog Number:	CGW1-1 and CGW1-5	INORGANIC LABS/RADCHEM LABS B3-1 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 PD: E52383
Matrix:	1% (abs) HNO ₃ /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

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

$\sum s_i$ = 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> Tl 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 0.00060	<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 - 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 - 183.85; +6; 6, 7, 8, 9 WOF_6^{2-} (chemical form as received)

Chemical Compatibility - W is very readily hydrolyzed requiring 0.1 to 1% HF solutions for stable acidic solutions. The WOF_6^{2-} is soluble in % levels of HCl and HNO_3 , provided it is in the WOF_6^{2-} 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 WVO , precipitate if mixed with other transition elements at higher levels indicating instability. The yellow WVO , 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 WOF_6^{2-} for months in 1% HNO_3 / LDPE container. 1-10,000 ppm single element solutions as the WOF_6^{2-} chemically stable for years in 1% HF in an LDPE container.

W Containing Samples (Preparation and Solution) - Metal (Soluble in HF / HNO_3); Oxide (Soluble in HF or NH_4OH); Organic Matrices (Dry ash at 450°C in 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 λ concs.)
ICP-OES 207.911 nm	0.03 / 0.001 $\mu\text{g/mL}$	1	ion	<u>Ru, In</u>
ICP-OES 224.875 nm	0.05 / 0.005 $\mu\text{g/mL}$	1	ion	<u>Co, Rh, Ag</u>
ICP-OES 209.475 nm	0.05 / 0.005 $\mu\text{g/mL}$	1	ion	<u>Mo</u>
ICP-MS 182 amu	5 ppt	n/a	M*	<u>¹⁴⁴Er¹⁶O</u>

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 (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: 07/31/03
 DATE EXPIRED: 08/01/2004 v02
 DATE OPENED: 08/01/03
 INORG: 4203 PO: F52383

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010475



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

JoAnn Struthers

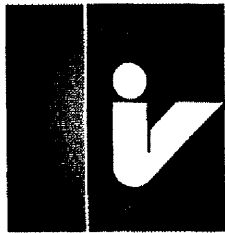
Certificate Approved By: Katalin Le, QC Supervisor

Katalin Le

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines

010476



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 Yttrium in 1.4% (abs) HNO₃

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) HNO₃

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

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

ΣS = 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 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

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 DATE EXPIRED: 04/01/2005 V03
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- 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; $\text{Y}(\text{OH})(\text{H}_2\text{O})_9^{3+}$

Chemical Compatibility - Soluble in HCl , H_2SO_4 , and HNO_3 . Avoid HF , H_3PO_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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 2-5% 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 Pt^* followed by HCl dissolution); Organic Matrices (Dry ash and dissolve in 1:1 $\text{H}_2\text{O}/\text{HCl}$ or 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 λ or ν)
ICP-OES 360.073 nm	0.005 / 0.000036 $\mu\text{g}/\text{mL}$	1	ion	Ce, Th
ICP-OES 371.030 nm	0.004 / 0.00007 $\mu\text{g}/\text{mL}$	1	ion	Ce
ICP-OES 377.433 nm	0.005 / 0.0009 $\mu\text{g}/\text{mL}$	1	ion	Ta, Th
ICP-MS 89 amu	0.8 ppt	n/a	M	$^{100}\text{Ge}^{4+}$, $^{171}\text{Yb}^{3+}$

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 P. 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

010479



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
1/22/05

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

JoAnn Struthers

Certificate Approved By: Katalin Le, QC Manager

Katalin Le

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines

010480

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 Zirconium in H₂O tr. HNO₃ tr. HF

Catalog Number: CGZR1-1 and CGZR1-5
 Lot Number: W-ZR01056
 Starting Material: ZrO₂
 Starting Material Purity (%): 99.994542
 Starting Material Lot No: 22855
 Matrix: H₂O tr. HNO₃ tr. HF

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 DATE RECEIVED: 01/23/04
 DATE EXPIRED: 08/01/2005 V03
 DATE OPENED: 01/23/04
 INORG: 4442 PD: 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:

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

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

(\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 **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> Tl	< 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; $\text{Zr}(\text{F})_6^{4-}$

Chemical Compatibility - Soluble in concentrated HCl, HF, H_2SO_4 (very hot) and HNO_3 . Avoid H_3PO_4 and neutral to basic media. Unstable at ppm levels with metals that would pull F⁻ away (i.e. Do not mix with Alkaline or Rare Earths or high levels of transition elements unless they are fluorinated). Stable with most inorganic anions but precipitation with phosphate, oxalate, and tartrate with a tendency to hydrolyze forming the hydrated oxide in all dilute acids except HF.

Stability - 2-100 ppb levels stable (alone or mixed with all other metals that are at comparable levels) as the $\text{Zr}(\text{F})_6^{4-} + \text{Zr}(\text{OH})_2\text{F}_2^{2-}$ for months in 1% HNO_3 / LDPE container. 1-10,000 ppm single element solutions as the $\text{Zr}(\text{F})_6^{4-}$ chemically stable for years in 2-5% HNO_3 / trace HF in an LDPE container.

Zr Containing Samples (Preparation and Solution) - Metal (Soluble in H_2O / HF / HNO_3); Oxide - unlike TiO_2 , the ZrO_2 is best fused in one of the following ways (Na_2O , in Ni^0 , Na_2CO_3 in Pt^0 or Borax in Pt^0). Organic Matrices (Dry ash at 450°C in Pt^0 and dissolve by fusing with Na_2CO_3 and dissolving in HF / HNO_3 / H_2O).

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 $\mu\text{g}/\text{mL}$ concs.)
ICP-OES 343.823 nm	0.007 / 0.0004 $\mu\text{g}/\text{mL}$	1	ion	Hf, Nb
ICP-OES 339.198 nm	0.008 / 0.0007 $\mu\text{g}/\text{mL}$	1	ion	Th, Mo
ICP-OES 272.261 nm	0.018 / 0.001 $\mu\text{g}/\text{mL}$	1	ion	<u>Cr</u> , V, Th, W
ICP-MS 90 amu	2 ppt	n/a	M ⁺	⁷⁶ Ge ⁺ O, ⁷⁸ Se ⁺ O, [¹¹⁴ X ⁺] (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 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: 01/23/04
 DATE EXPIRED: 08/01/2005 VDS
 DATE OPENED: 01/23/04
 INORG: 4442 PO: F52306

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010483



- 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

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 Barium in 0.1% (abs) HNO₃

Catalog Number: CGBA1-1, CGBA1-2, and CGBA1-5
 Lot Number: **W-BA02023**
 Starting Material: Ba(NO₃)₂
 Starting Material Purity (%): 99.999730
 Starting Material Lot No 21879
 Matrix: 0.1% (abs) HNO₃

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2
 DATE RECEIVED: 02/25/04
 DATE EXPIRED: 03/31/2005 V05
 DATE OPENED: 02/25/04
 INORG: 4465 PO: F52323

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

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

ΣS = 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 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 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 - 137.33; +2; 6; $\text{Ba}(\text{H}_2\text{O})_6^{2+}$

Chemical Compatibility - Soluble in HCl, and HNO_3 . Avoid H_2SO_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% HNO_3 / LDPE container. 1 -10,000 ppm solutions chemically stable for years in 1-3.5% HNO_3 / LDPE container.

Ba Containing Samples (Preparation and Solution) - Metal(s) best dissolved in diluted HNO_3 . Ores(Carbonate fusion in $\text{P}t^*$ followed by HCl dissolution. If sulfate is present dissolve the fuseate using HCl /tartaric acid to prevent 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 $\mu\text{g/l}$ concs.)
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'	$^{122}\text{Sn}^{10}$, $^{122}\text{Te}^{10}$

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 10CFR60 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 WS

DATE OPENED: 02/25/04

INORG: 4465 PO: F59303

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010487



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

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) HNO₃

Catalog Number: CGBE1-1, CGBE1-2, and CGBE1-5
 Lot Number: **W-BE01104**
 Starting Material: Be(OOCCH₃)₂
 Starting Material Purity (%): 99.999897
 Starting Material Lot No 01-10-01
 Matrix: 2% (abs) HNO₃

INORGANIC LABS/RADCHEM LABS^{PS-1 of 2}
 DATE RECEIVED: 06/01/04
 DATE EXPIRED: 06/01/2005 VDS
 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

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

$\sum s_i$ = 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 **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, 217366/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 < 0.00800	M Dy < 0.01305	Q Li < 0.00002	M Pr < 0.00065	M Te < 0.06525
M Sb < 0.00109	M Er < 0.01087	M Lu < 0.00087	M Re < 0.00218	M Tb < 0.00065
M As < 0.02175	M Eu < 0.00652	Q Mg < 0.00003	M Rh < 0.00218	M Tl < 0.00218
M Ba < 0.02175	M Gd < 0.00218	Q Mn < 0.00002	M Rb < 0.00218	M Th < 0.00218
s Be	M Ga < 0.00218	Q Hg < 0.01500	M Ru < 0.00435	M Tm < 0.00087
M Bi < 0.00087	M Ge < 0.01305	M Mo < 0.00435	M Sm < 0.00218	M Sn < 0.01087
Q B < 0.01200	M Au < 0.00652	M Nd < 0.00435	Q Sc < 0.00009	M Ti < 0.10874
M Cd < 0.00652	M Hf < 0.00435	M Ni < 0.65245	M Se < 0.01740	M W < 0.02175
Q Ca 0.00164	M Ho < 0.00109	M Nb < 0.00109	Q Si 0.00649	M U < 0.00435
M Ce < 0.01087	M In < 0.02175	n Os	M Ag < 0.00435	M V < 0.00435
M Cs < 0.00065	M Ir < 0.01087	M Pd < 0.01087	Q Na 0.00368	M Yb < 0.00218
Q Cr < 0.00900	Q Fe 0.00268	n P	M Sr < 0.00109	M Y < 0.08699
M Co < 0.00652	M La < 0.00109	M Pt < 0.00435	i S	M Zn < 0.04350
M Cu < 0.01305	M Pb < 0.00652	Q K < 0.10000	M Ta < 0.01522	M 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(H₂O)₄²⁺

Chemical Compatibility - Soluble in HCl, HNO₃, H₂SO₄, and HF aqueous matrices. Stable with all metals and inorganic anions.

Stability - 2-100 ppb levels stable for months in 1% HNO₃ /LDPE container. 1-10,000 ppm solutions chemically stable for years in 5-10% HNO₃ /LDPE container.

Be Containing Samples (Preparation and Solution) - Meta (is best dissolved in diluted H₂SO₄), BeO (boiling nitric, hydrochloric, or sulfuric acids or KHSO₄ fusion), Ores (H₂SO₄/HF digestion or carbonate fusion in Pt⁰), 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 400nm)
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 v05
DATE OPENED: 06/01/04
INORG: 4592 PD: F53393

EXPIRES
1#2005

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Debbie Newman, Production Manager

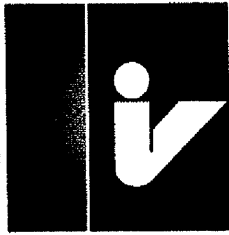
Debbie Newman
Katalin Le

Certificate Approved By: Katalin Le, QC Manager

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines

010492



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⁺³ in 1.4% HNO₃ (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: 12/1/2004 DR
 DATE OPENED: 11/5/03
 INORG: 4318 PO: 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.

<u>Q</u> Al 0.0028	<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 <0.000050	<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>Q</u> Mg <0.010	<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>Q</u> Mn <0.050	<u>M</u> Rb 0.0066	<u>M</u> Th <0.00010
<u>M</u> Be <0.000050	<u>M</u> Ga 0.00070	<u>Q</u> Hg <0.10	<u>M</u> Ru 0.017	<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>M</u> Sc <0.00010	<u>M</u> Ti <0.00050
<u>M</u> Cd <0.00030	<u>M</u> Hf <0.00020	<u>Q</u> Ni <0.10	<u>i</u> Se	<u>M</u> W <0.0010
<u>Q</u> Ce 0.0011	<u>M</u> Ho <0.000050	<u>M</u> Nb <0.000050	<u>Q</u> Si <0.10	<u>M</u> U <0.00020
<u>M</u> Ce <0.00050	<u>Q</u> In <0.10	<u>n</u> Os	<u>M</u> Ag 0.00070	<u>i</u> V
<u>M</u> Cs <0.000030	<u>M</u> Ir <0.00050	<u>M</u> Pd <0.00050	<u>Q</u> Na 0.016	<u>M</u> Yb <0.00010
<u>s</u> Cr	<u>Q</u> Fe <0.10	<u>i</u> P	<u>M</u> Sr <0.000050	<u>M</u> Y <0.0040
<u>Q</u> Co <0.10	<u>M</u> La <0.000050	<u>M</u> Pt <0.00020	<u>n</u> S	<u>Q</u> Zn <0.10
<u>M</u> Cu <0.00060	<u>M</u> Pb 0.00039	<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): 1.010 g/mL

(over)

QA:KSL Rev. 09/02/75

Paul R. Gaines

Quality Assurance Manager

Expires:

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/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 μ 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.

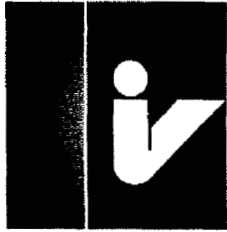
THERMOMETER CALIBRATION

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) HNO₃

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) HNO₃

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 PD: 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

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

n = number of measurements

ΣS = 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 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

010496

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 - 63.546, +2; 6; Cu(H₂O)₆²⁺

Chemical Compatibility - Stable in HCl, HNO₃, H₂SO₄, HF, H₃PO₄. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ / LDPE container.

Cu Containing Samples (Preparation and Solution) - Metal (soluble in HNO₃); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO₃).

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 400nm)
ICP-OES 324.754 nm	0.06/.001 µg/mL	1	atom	Nb, U, Th, Mo, Hf
ICP-OES 224.700 nm	0.01/.001 µg/mL	1	ion	Pb, Ir, Ni, W
ICP-OES 219.956 nm	0.01/.002 µg/mL	1	atom	Th, Ta, Nb, U, Hf
ICP-MS 63 amu	10 ppt	n/a	M'	⁴⁰ Ar ³⁵ Na, ⁴⁷ Ti ⁴⁰ O, ¹⁴ N ¹³ C ³⁵ Cl, ¹⁸ O ³⁵ Cl, ⁴⁴ Ca ⁴⁰ O, ²³ Na ⁴⁰ 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 (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
 INDRG: 4469 PD: 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

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 Nickel in 1.4% (abs) HNO₃

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) HNO₃

INORGANIC LABS/RADCHEM LABS P. 1 of 2
 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:

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

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

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

$\sum e_i^2$ = 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 #1 999 ± 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

- 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	□ 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(H₂O)₆²⁺

Chemical Compatibility - Stable in HCl, HNO₃, H₂SO₄, HF, H₃PO₄. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ / LDPE container.

Ni Containing Samples (Preparation and Solution) - Metal (Soluble in HNO₃); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO₃).

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

Technique/line	Estimated D.L.	Order	Type	Interference
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	r/e	M'	⁴⁴ Ca ¹⁶ O ¹ H, ⁴⁴ Ca ¹⁶ O, ²³ Na ³⁵ Cl

(underlined indicates severe at 100ppm)

- 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 V02
DATE OPENED: 02/25/04
INORG: 4472 PU: F52323

EXPIRES
12/2005

010501

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

010502

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 Cadmium in 2% (abs) HNO₃

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) HNO₃

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2
 DATE RECEIVED: 02/25/04
 DATE EXPIRED: 03/01/2005 V03
 DATE OPENED: 02/25/04
 INDRG: 4467 PO: 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

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

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.)

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 $\mu\text{g/mL}$

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 UHPA-Filtered Clean Room. An UHPA-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> Tl < 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

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 HCl, HNO_3 , H_2SO_4 , and 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 HCl, HNO_3 , and NH_4OH . The chloride, bromide and iodide are soluble in water. Cd, 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, CdI_4^{2-} .

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

Cd Containing Samples (Preparation and Solution) - Metal (soluble in HNO_3); Oxides (Soluble in HCl or HNO_3); Ores (Dissolve in HCl / HNO_3 , then take to fumes with H_2SO_4 . The silica and lead sulfate are filtered off after addition of water.); Organic based (dry ash at 450°C and dissolve ash in 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 at $\mu\text{g/l}$ concs.)
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, <u>As</u> , 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 ⁺	¹¹⁰ Mo ¹⁰ 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: 02/25/04
DATE EXPIRED: 03/01/2005 VOS
DATE OPENED: 02/25/04
INORG: 4467 PO: F52323

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010505



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

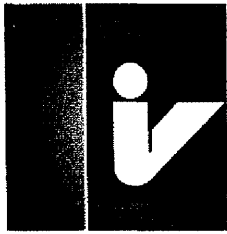
12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

Certificate Approved By: Katalin Le, QC Supervisor

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

010506



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 Cobalt in 2% (abs) HNO₃

Catalog Number: CGCO1-1, CGCO1-2, and CGCO1-5
 Lot Number: W-QCO01114
 Starting Material: Co powder
 Starting Material Purity (%): 99.995670
 Starting Material Lot No: 22897
 Matrix: 2% (abs) HNO₃

INORGANIC LABS/RADCHEM LABS Pg. 1 of 2
 DATE RECEIVED: 02/25/04
 DATE EXPIRED: 03/01/2005
 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:

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

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

$\sum e_i$ = 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 ± 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> Tl < 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 ± 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 - 58.9332; +2; 6; Co(H₂O)₆²⁺

Chemical Compatibility - Stable in HCl, HNO₃, H₂SO₄, HF, H₃PO₄. Avoid basic media. Stable with most metals and inorganic anions in acidic media.

Stability - 2-100 ppb levels stable for months in 1% HNO₃ / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO₃ / LDPE container.

Co Containing Samples (Preparation and Solution) - Metal (soluble in HNO₃); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO₃).

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 600nm)
ICP-OES 238.892 nm	0.01/0.02 µg/mL	1	ion	<u>Fe</u> , <u>V</u> , <u>Ta</u>
ICP-OES 228.616 nm	0.01/0.01 µg/mL	1	ion	
ICP-OES 237.862 nm	0.01/0.02 µg/mL	1	ion	<u>W</u> , <u>Re</u> , <u>Al</u> , <u>Ta</u>
ICP-MS 59 amu	2 ppt	n/a	M	⁴⁴ Ca ⁴⁰ H, ⁴⁰ Ar ⁴⁰ H, ⁴⁰ Ar ³⁹ Na, ⁴⁰ Ca ⁴⁰ O, ⁴⁰ Mg ³⁸ 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: August 28, 2003

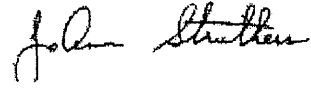
Expiration Date:

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

EXPIRES
1/2005

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

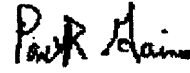
Certificate Prepared By: JoAnn Struthers, QA Administrative Assistant

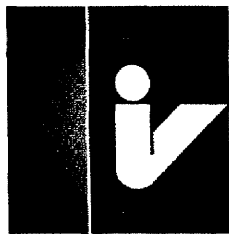


Certificate Approved By: Katalin Le, QC Supervisor



Certifying Officer: Paul Gaines, Chemist, Senior Technical Director





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 Manganese in 2% (abs) HNO₃

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) HNO₃

INORGANIC LABS/RADCHEM LABS Pg 2 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:

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

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

s_{est} = 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 CRM 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 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	0.00221	M Dy	< 0.02471	Q Li	0.00020	M Pr	< 0.00124	M Te	< 0.12355
M Sb	< 0.00206	M Er	< 0.02059	M Lu	< 0.00165	M Re	< 0.00412	M Tb	< 0.00124
M As	< 0.04118	M Eu	< 0.01236	Q Mg	0.03350	M Rh	< 0.00412	M Tl	< 0.00412
M Ba	< 0.04118	M Gd	< 0.00412	s Mn		M Rb	< 0.00412	M Th	< 0.00412
M Be	< 0.00206	Q Ga	< 0.05000	i Hg		M Ru	< 0.00824	M Tm	< 0.00165
M Bi	< 0.00165	Q Ge	< 0.00300	M Mo	< 0.00824	M Sm	< 0.00412	M Sn	< 0.02059
Q B	0.00295	M Au	< 0.01236	M Nd	< 0.00824	M Sc	< 0.04118	M Ti	< 0.20592
M Cd	< 0.01236	M Hf	< 0.00824	M Ni	< 0.03295	M Se	< 0.03295	M W	< 0.04118
Q Ca	0.00340	M Ho	< 0.00206	M Nb	< 0.00206	Q Si	0.00275	M U	< 0.00824
M Ce	< 0.02059	M In	< 0.04118	u Os		M Ag	< 0.00824	M V	< 0.00824
M Cs	< 0.00124	M Ir	< 0.02059	M Pd	< 0.02059	Q Na	0.00225	M Yb	< 0.00412
M Cr	< 0.02059	Q Fe	< 0.01000	i P		M Sr	< 0.00206	M Y	< 0.16474
M Co	< 0.01236	M La	< 0.00206	M Pt	< 0.00824	i S		Q Zn	0.00250
M Cu	< 0.02471	M Pb	< 0.01236	Q K	0.00105	M Ta	< 0.02883	M 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 HCl , HNO_3 , H_2SO_4 , HF , H_3PO_4 . Avoid basic media. Stable with most metals and inorganic anions in acidic media.

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

Mn Containing Samples (Preparation and Solution) - Metal (Soluble in dilute acids); Oxides (Soluble in dilute acids); Ores (Dissolve with HCl . If silica is present add HF and then fume off silica by adding H_2SO_4 and heat to SO_2 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 at all concs.)
ICP-OES 257.610nm	0.0014 / 0.00002 $\mu\text{g}/\text{mL}$	1	ion	Ce, W, Re
ICP-OES 259.373 nm	0.0016 / 0.00002 $\mu\text{g}/\text{mL}$	1	ion	U, Ta, Mo, Fe, Nb
ICP-OES 260.568 nm	0.0021 / 0.00002 $\mu\text{g}/\text{mL}$	1	ion	Co
ICP-MS 55 amu	10 ppt	n/a	M'	$^{40}\text{Ar}^{14}\text{N}^+\text{H}$, $^{39}\text{K}^{16}\text{O}$, $^{35}\text{Cl}^{16}\text{O}$, $^{40}\text{Ar}^{14}\text{N}$, $^{39}\text{Ar}^{16}\text{O}$, $^{37}\text{Ar}^{16}\text{O}^+\text{H}$, $^{39}\text{Ar}^{16}\text{O}^+\text{H}$, $^{35}\text{Cl}^{16}\text{O}^+\text{H}$, $^{23}\text{Na}^{35}\text{S}$

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

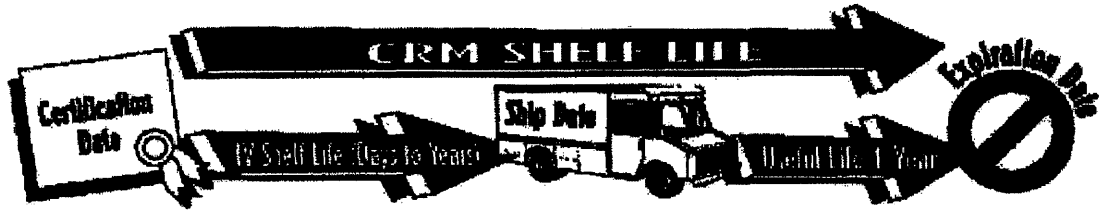
10.5 10CFR21 - Nuclear Regulatory Commission - Reporting Defects and Non-Compliance

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
 DATE OPENED: 01/20/04
 INORG: 4434 PG: 752301

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

JoAnn Struthers

Certificate Approved By: Katalin Le, QC Supervisor

Katalin Le

Certifying Officer: Paul Gaines, Chemist, Senior Technical Director

Paul Gaines

010514

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 Vanadium in 1.4% HNO₃ (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.

<u>M</u> Al	0.0095	<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	0.042	<u>M</u> Er	<0.00050	<u>M</u> Lu	<0.00040	<u>M</u> Re	<0.00010	<u>M</u> Tb	<0.00030
<u>M</u> As	<0.0010	<u>M</u> Eu	<0.00030	<u>M</u> Mg	0.0089	<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>i</u> Mn		<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>i</u> Hg		<u>M</u> Ru	<0.00020	<u>M</u> Tm	<0.00040
<u>M</u> Bi	<0.000040	<u>M</u> Ge	<0.00060	<u>M</u> Mo	0.016	<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>M</u> Sc	<0.0010	<u>M</u> Ti	<0.0050
<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	0.00055
<u>O</u> Ca	<0.010	<u>M</u> Ho	<0.000050	<u>M</u> Nb	0.00024	<u>O</u> Si	<0.030	<u>M</u> U	0.0011
<u>M</u> Ce	<0.00050	<u>O</u> In	<0.070	<u>n</u> Os		<u>M</u> Ag	0.00044	<u>s</u> V	
<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>O</u> Cr	<0.020	<u>O</u> Fe	<0.050	<u>i</u> P		<u>M</u> Sr	<0.000050	<u>M</u> Y	<0.0040
<u>O</u> Co	<0.050	<u>M</u> La	<0.000050	<u>M</u> Pt	<0.00020	<u>n</u> S		<u>M</u> Zn	0.0041
<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	<0.00060

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): 1.015 g/mL**(over)**

QA:KLRev.0822020K

Paul R. Gaine

Quality Assurance Manager

EXPIRESExpires: **12 2004**

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 μ 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.

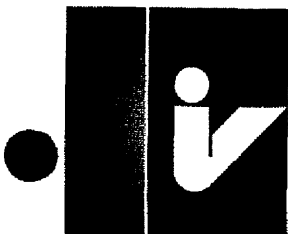
TECHNICAL SUPPORT

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

TEL 1-800-569-6799

FAX 1-732-901-1903

E-MAIL IVtech@lvstandards.com



010516
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 Zinc in 1.4% (abs) HNO₃

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) HNO₃

INORGANIC LABS/RADCHEM LABS
DATE RECEIVED: 11/5/03
DATE EXPIRED: 12/1/2004
DATE OPENED: 11/5/03
INORG: 4319 PO: F52258

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:

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

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

(\bar{x}) = mean

x_i = individual results

n = number of measurements

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

(Most common are the errors from instrumental measurement, weighing, dilution to volume, and the fixed error reported on the NIST CRM 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** 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>O</u> Al < 0.00200	<u>M</u> Dy < 0.02440	<u>O</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>O</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 < 0.01626	<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>O</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>O</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>O</u> Ni 0.00009	<u>M</u> Se < 0.03253	<u>M</u> W < 0.04066
<u>O</u> Ca 0.00022	<u>M</u> Ho < 0.00203	<u>M</u> Nb < 0.00203	<u>O</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>O</u> Na 0.00055	<u>M</u> Yb < 0.00407
<u>O</u> Cr < 0.00100	<u>O</u> Fe 0.00005	<u>O</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>O</u> S < 0.02000	<u>s</u> Zn
<u>O</u> Cu < 0.00050	<u>M</u> Pb < 0.01220	<u>O</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 010518

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 - 65.39; +2; 4; $\text{Zn(OH)}_2(\text{aq})^{2+}$

Chemical Compatibility - Stable in HCl , HNO_3 , H_2SO_4 , HF , H_3PO_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% HNO_3 / LDPE container. 1-10,000 ppm solutions chemically stable for years in 1-5% HNO_3 / LDPE container.

Zn Containing Samples (Preparation and Solution) - Metal (Soluble in HNO_3); Oxides (Soluble in HCl); Ores (Dissolve in HCl / HNO_3); Organic based (Dry ash at 450°C and dissolve ash in 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 at/bonds.)
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'	$^{48}\text{Ti}^{16}\text{O}$, $^{52}\text{Cr}^{16}\text{O}$, $^{51}\text{V}^{16}\text{O}$, $^{33}\text{S}^{16}\text{O}_2$, $^{34}\text{S}^{16}\text{O}_2$, $^{32}\text{S}^{16}\text{O}_2$, $^{34}\text{S}^{16}\text{O}$, $^{32}\text{S}^{16}\text{O}$, $^{34}\text{S}^{16}\text{S}$, $^{32}\text{S}^{16}\text{S}$

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)

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

010519



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
1st 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 2 of 2
DATE EXPIRED: 12/1/2004 DR
DATE OPENED: 11/5/03
INORG: 4319 PO: F52258

010520

SOUTHWEST RESEARCH INSTITUTE

NUCLEAR PROJECT

CLIENT: Division 20

TASK ORDER: 040706-3

SRR: 26134

SDG: 247108

CASE: CNWRA

VTSR: July 02, 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)

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	1.0072	1.0068	1.0054	1.01	100.65
TMA1	1000	1.0059	1.0072	1.0094	1.01	100.75
TMA2	1000	1.0040	1.0039	1.0021	1.00	100.33
TMA3	1000	OUT	OF	SERVICE		
TMA6	1000	1.0093	1.0086	1.0098	1.01	100.92
TMB1	900	0.9033	0.9018	0.9013	0.90	100.24
TMC1	800	0.8002	0.8011	0.8007	0.80	100.08
TMDD1	750	0.7568	0.7521	0.7501	0.75	100.40
TMD1	700	0.7054	0.7018	0.7021	0.70	100.44
TMD2	700	0.7099	0.7058	0.7031	0.71	100.90
TME1	600	0.6027	0.6018	0.6007	0.60	100.29
TMF2	500	0.5011	0.5037	0.5019	0.50	100.45
TMF5	500	0.5058	0.5084	0.5060	0.51	101.35
ICF1	500	0.5054	0.5032	0.5030	0.50	100.77
L30-500	500	0.5013	0.4998	0.4999	0.50	100.07
TMG3	400	0.3946	0.3948	0.3944	0.39	98.65
TMH1	300	OUT	OF	SERVICE		
TMH2	300	0.3031	0.3001	0.3000	0.30	100.36
TMJ1	250	0.2524	0.2504	0.2500	0.25	100.37
TMJ2	250	0.2501	0.2507	0.2502	0.25	100.13
TMJ3	250	0.2525	0.2530	0.2522	0.25	101.03
TMK2	200	0.2015	0.2001	0.2012	0.20	100.47
TML1	150	0.1513	0.1516	0.1504	0.15	100.73
TMM1	120	0.1210	0.1209	0.1203	0.12	100.61
TMN3	100	0.1026	0.1004	0.1004	0.10	101.13
ICN1	100	0.0990	0.1002	0.1001	0.10	99.77
TMQ1	80	0.0806	0.0804	0.0804	0.08	100.58
TMR1	70	OUT	OF	SERVICE		
TMS1	60	OUT	OF	SERVICE		
LAB-30A	50	NOT	FOUND			
TMU1	40	0.0404	0.0402	0.0400	0.04	100.50
TMU2	40	0.0399	0.0400	0.0399	0.04	99.83
TMV1	30	0.0300	0.0300	0.0299	0.03	99.89
L30-20	20	0.0201	0.0202	0.0201	0.02	100.67
TMW1	25	0.0251	0.0250	0.0251	0.03	100.27
TMY1	15	OUT	OF	SERVICE		

FRM-246 (Rev 1/Mar 03)

FRM-243-a (Rev 3/Mar 03)

SwRI - Div. 01, Inorganic Labs' Fixed Volume Pipette Verification Log

Balance #: 34 Thermometer #: G011 diH2O Temperature (°C): 2010522

Eppendorf #	True Value (µL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)
Lab30	1000	1.0072	1.0068	1.0054
TMA1	1000	1.0059	1.0072	1.0094
TMA2	1000	1.0040	1.0039	1.0021
TMA3	1000	OUT	OF	Service
TMA6	1000	NOT 1.0093	1.0086 Found	1.0098
TMB1	900	.9033	.9018	.9013
TMC1	800	.8002	.8011	.8007
TMDD1	750	.7568	.7521	.7501
TMD1	700	.7054	.7018	.7021
TMD2	700	.7099	.7058	.7031
TME1	600	.6027	.6018	.6007
TMF2	500	.5011	.5037	.5019
TMF5	500	.5058	.5084	.5060
ICF1	500	.5054	.5032	.5030
L30-500	500	.5013	.4998	.4999
TMG3	400	.3946	.3948	.3944
TMH1	300	OUT	OF	Service
TMH2	300	.3031	.3001	.3000
TMJ1	250	.2524	.2504	.2500
TMJ2	250	.2501	.2507	.2502
TMJ3	250	.2525	.2530	.2522
TMK2	200	.2015	.2001	.2012
TML1	150	.1513	.1516	.1504
TMM1	120	.1210	.1209	.1203
TMN3	100	.1026	.1004	.1004
ICN1	100	.0990	.1002	.1001
TMQ1	80	.0806	.0804	.0804
TMR1	70	OUT	OF	Service
TMS1	60	OUT	OF	Service
LAB-30A	50	NOT	Found	---
TMU1	40	.0404	.0402	.0400
TMU2	40	.0399	.0400	.0399
TMV1	30	.0300	.0300	.0299
L30-20	20	.0201	.0202	.0201
TMW1	25	.0251	.0250	.0251
TMY1	15	OUT	OF	SERVICE

Found on 7-2-04 JD

Analyst: John White Date: 7-1-04
 Reviewed by: Valle Date: 07/12/04

SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010523

Handwritten signature and date: 7-2-04

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	0.0204	0.0203	0.0203	0.020	101.67
ADJ200-A	100	0.1003	0.1001	0.0996	0.100	100.00
	200	0.2009	0.2017	0.2014	0.201	100.67
	20	0.0202	0.0203	0.0201	0.020	101.00
ADJ200-C	100	0.0998	0.0986	0.0991	0.099	99.17
	200	0.1990	0.1996	0.1989	0.199	99.58
	20	0.0200	0.0200	0.0200	0.020	100.00
ADJ200-D	100	0.0995	0.0999	0.0998	0.100	99.73
	200	0.1989	0.2003	0.1994	0.200	99.77
	20					
ADJ200-G	100					
	200					
	20					
ADJ200-H	100					
	200					
	20					
ADJ200-J	100					
	200					
	20	0.0201	0.0202	0.0204	0.020	101.17
ADJ200-K	100	0.0996	0.1002	0.1008	0.100	100.20
	200	0.2000	0.1998	0.1998	0.200	99.93
	20					
ADJ200	100					
	200					
	20					
ADJ200	100					
	200					

SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: 34 Thermometer #: 6011 diH2O Temperature (°C) 910524

Eppendorf #	True Value (µL)	1 st Reading (g)	2 nd Reading (g)	3 rd Reading (g)
	20	.0204	.0203	.0203
ADJ200-A	100	.1003	.1001	.0996
	200	.2009	.2017	.2014
	20	.0202	.0203	.0201
ADJ200-C	100	.0998	.0986	.0991
	200	.1990	.1996	.1989
	20	.0200	.0200	.0200
ADJ200-D	100	.0995	.0999	.0998
	200	.1989	.2003	.1994
	20			
ADJ200-G	100			
	200			
	20			
ADJ200-H	100			
	200			
	20			
ADJ200-J	100			
	200			
	20	.0201	.0202	.0204
ADJ200-K	100	.0996	.1000 .1002	.1008
	200	.2000	.1998	.1998
	20			
ADJ200	100			
	200			

20 µL - 200 µL

Jed 7-2-04

Analyst: John Wills
 Reviewed by: [Signature]

Date: 7-2-04
 Date: 7/7/04

SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

Richard J. ... 7/16/04

010525

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				0.000	0.00
ADJ200-A	100				0.000	0.00
	200				0.000	0.00
	20				0.000	0.00
ADJ200-C	100				0.000	0.00
	200				0.000	0.00
	20				0.000	0.00
ADJ200-D	100				0.000	0.00
	200				0.000	0.00
	20				0.000	0.00
ADJ200-G	100	0.0204	0.0204	0.0203	0.020	101.83
	200	0.0985	0.0982	0.0996	0.099	98.77
	200	0.1980	0.1978	0.1990	0.198	99.13
ADJ200-H	100	0.0201	0.0200	0.0201	0.020	100.33
	200	0.0988	0.0992	0.0987	0.099	98.90
	200	0.1988	0.1993	0.1984	0.199	99.42
ADJ200-J	100	0.0202	0.0204	0.0204	0.020	101.67
	200	0.0991	0.0994	0.0980	0.099	98.83
	200	0.1991	0.1979	0.1987	0.199	99.28
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

SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: 34

Thermometer #: G011

diH₂O Temperature (°C) 21 010526

Eppendorf #	True Value (μL)	1 st Reading (g)	2 nd Reading (g)	3 rd Reading (g)
ADJ200-A	20	_____	_____	_____
	100			
	200			
ADJ200-C	20	_____	_____	_____
	100			
	200			
ADJ200-D	20	_____	_____	_____
	100			
	200			
ADJ200-G	20	0.0204	0.0204	0.0203
	100	0.0985	0.0982	0.0996
	200	0.1980	0.1978	0.1990
ADJ200-H	20	0.0201	0.0200	0.0201
	100	0.0988	0.0992	0.0987
	200	0.1988	0.1993	0.1984
ADJ200-J	20	0.0202	0.0204	0.0204
	100	0.0991	0.0994	0.0980
	200	0.1991	0.1979	0.1987
ADJ200-K	20	_____	_____	_____
	100			
	200			
ADJ200	20	_____	_____	_____
	100			
	200			

20 μL – 200 μL

7/6/04

7/6/04

Analyst: [Signature]

Reviewed by: [Signature]

Date: 7/6/04

Date: 7/7/07

SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

*John
7-2004*

010527

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	0.1018	0.1020	0.102	101.90
ADJ1000-C	500	0.4980	0.5004	0.4997	0.499	99.87
	1000	1.0011	1.0018	0.9979	1.000	100.03
	100	0.1020	0.1008	0.1018	0.102	101.53
ADJ1000-D	500	0.4934	0.4966	0.4971	0.496	99.14
	1000	1.0012	1.0011	1.0020	1.001	100.14
	100	0.1012	0.1007	0.1004	0.101	100.77
ADJ1000-E	500	0.4946	0.4968	0.4952	0.496	99.11
	1000	0.9938	0.9960	0.9968	0.996	99.55
	100	0.1010	0.1005	0.1001	0.101	100.53
ADJ1000-F	500	0.4994	0.5008	0.4978	0.499	99.87
	1000	0.9966	0.9999	1.0005	0.999	99.90
	100					
ADJ1000-G	500					
	1000					
	100					
ADJ1000-H	500					
	1000					
	100					
ADJ1000-J	500					
	1000					
	100	0.1007	0.1004	0.1001	0.100	100.40
ADJ1000-K	500	0.5022	0.5036	0.5040	0.503	100.65
	1000	1.0001	0.9998	1.0029	1.001	100.09
	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

Balance #: 34

Thermometer #: G011

diH2O Temperature (°C) 20.10528

Eppendorf #	True Value (µL)	1 st Reading (g)	2 nd Reading (g)	3 rd Reading (g)
ADJ1000-C	100	.1019	.1018	.1020
	500	.4980	.5004	.4997
	1000	1.0011	1.0019	.9979
ADJ1000-D	100	.1020	.1008	.1018
	500	.4934	.4966	.4971
	1000	1.0012	1.0011	1.0020
ADJ1000-E	100	.1012	.1007 .0953 ⁷⁻²⁻⁰⁴	.1004
	500	.4946	.4968	.4952
	1000	.9938	.9960	.9968
ADJ1000-F	100	.1010	.1005	.1001
	500	.4994	.5008	.4978
	1000	.9966	.9999	1.0005
ADJ1000-G	100			
	500			
	1000			
ADJ1000-H	100			
	500			
	1000			
ADJ1000-J	100			
	500			
	1000			
ADJ1000-K	100	.1007	.1004	.1001
	500	.5022	.5036	.5040
	1000	1.0001	.9998	1.0029
ADJ1000	100			
	500			
	1000			

100 µL – 1000 µL

[Handwritten signature]
7-2-04

[Handwritten signature]
7-2-04

Analyst: *[Signature]*
Reviewed by: *[Signature]*

Date: 7-2-04
Date: 7/7/04

SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

010529

Michael J. ... 7/6/04

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				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				0.000	0.00
ADJ1000-G	500	0.1013	0.1019	0.1010	0.101	101.40
	1000	0.4939	0.4941	0.4968	0.495	98.99
	100	0.9823	0.9811	0.9832	0.982	98.22
ADJ1000-H	500	0.0990	0.0996	0.0992	0.099	99.27
	1000	0.4925	0.4942	0.4911	0.493	98.52
	100	0.9827	0.9836	0.9856	0.984	98.40
ADJ1000-J	500	0.0991	0.1002	0.1005	0.100	99.93
	1000	0.4962	0.4943	0.4980	0.496	99.23
	100	0.9871	0.9913	0.9889	0.989	98.91
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
	100				0.000	0.00

SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: 34

Thermometer #: G11

diH2O Temperature (°C) 31.0530

100 µL – 1000 µL

Eppendorf #	True Value (µL)	1 st Reading (g)	2 nd Reading (g)	3 rd Reading (g)
	100	_____		
ADJ1000-C	500			
	1000			
	100	_____		
ADJ1000-D	500			
	1000			
	100	_____		
ADJ1000-E	500			
	1000			
	100	_____		
ADJ1000-F	500			
	1000			
	100	0.1013	0.1019	0.1010
ADJ1000-G	500	0.4939	0.4941	0.4968
	1000	0.9823	0.9811	0.9832
	100	0.0990	0.0996	0.0992
ADJ1000-H	500	0.4925	0.4942	0.4911
	1000	0.9827	0.9836	0.9856
	100	0.0991	0.1002	0.1005
ADJ1000-J	500	0.4962	0.4943	0.4980
	1000	0.9871	0.9913	0.9889
	100	_____		
ADJ1000-K	500			
	1000			
	100	_____		
ADJ1000	500			
	1000			

Analyst: *[Signature]*
 Reviewed by: *[Signature]*

Date: 7/6/04
 Date: 7/7/04

SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

J. Williams
7-204

010531

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	0.5056	0.5030	0.5031	0.504	100.78
ADJ5000-C	2500	2.4956	2.4948	2.4948	2.495	99.80
	5000	5.0400	5.0398	5.0421	5.041	100.81
	500					
ADJ5000-G	2500	OUT	OF	SERVICE		
	5000					
	500					
ADJ5000-H	2500	OUT	OF	SERVICE		
	5000					
	500	0.5025	0.4973	0.5040	0.501	100.25
ADJ5000-I	2500	2.5202	2.5176	2.5050	2.514	100.57
	5000	5.0111	5.0140	4.9979	5.008	100.15
	500					
ADJ5000-J	2500					
	5000					
	500					
ADJ5000-K	2500					
	5000					
	500					
ADJ5000-L	2500					
	5000					
	500	0.5061	0.5024	0.5006	0.503	100.61
ADJ5000-M	2500	2.4991	2.4996	2.4980	2.499	99.96
	5000	5.0074	5.0048	5.0011	5.004	100.09
	500	0.5094	0.5046	0.5074	0.507	101.43
ADJ5000-N	2500	2.4984	2.5067	2.5001	2.502	100.07
	5000	5.0254	4.9996	4.9999	5.008	100.17
	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 010532

Balance #: 34

Thermometer #: G-011

diH2O Temperature (° C) 21

Eppendorf #	True Value (µL)	1 st Reading (g)	2 nd Reading (g)	3 rd Reading (g)
ADJ5000-C	500	.5056	.5030	.5031
	2500	2.4956	2.4948	2.4948
	5000	5.0400	5.0398	5.0421
ADJ5000-G	500			
	2500	OUT	OF	SERVICE
	5000			
ADJ5000-H	500			
	2500	OUT	OF	SERVICE
	5000			
ADJ5000-I	500	.5025	.4973	.5040
	2500	2.5202	2.5176	2.5050
	5000	5.0111	5.0140	4.9979
ADJ5000-J	500			
	2500			
	5000			
ADJ5000-K	500			
	2500			
	5000			
ADJ5000-L	500			
	2500			
	5000			
ADJ5000-M	500	.5061	.5024	.5006
	2500	2.4991	2.4996	2.4980
	5000	5.0074	5.0048	5.0011
ADJ5000-N	500	.5094	.5046	.5074
	2500	2.4984	2.5067	2.5001
	5000	5.0254	4.9996	4.9999
ADJ5000	500			
	2500			
	5000			
ADJ5000	500			
	2500			
	5000			

500 µL – 5000 µL

[Signature] 7-2-04

[Signature] 7-2-04

Analyst: *John Wilds*
 Reviewed by: *R. Sprues*

Date: 7-2-04
 Date: 7/7/04

SwRI – Div. 01, Inorganic Labs' Adjustable Volume Pipette Verification Log

(Space provided for Inorganic Laboratories' Adjustable Volume Pipette Verification Spreadsheet)

Richard Hardy 7/6/04

010533

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	0.5068	0.5093	0.5049	0.507	101.40
ADJ5000-J	2500	2.4984	2.4924	2.4972	2.496	99.84
	5000	5.0151	5.0265	5.0194	5.020	100.41
	500	0.5066	0.5026	0.5031	0.504	100.82
ADJ5000-K	2500	2.4946	2.4927	2.4910	2.493	99.71
	5000	4.9937	4.9891	4.9953	4.993	99.85
	500	0.4958	0.4990	0.4981	0.498	99.53
ADJ5000-L	2500	2.4796	2.4792	2.4775	2.479	99.15
	5000	4.9738	4.9633	4.9662	4.968	99.36
	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

SwRI Div. 01 – Inorganic Laboratory Adjustable Pipette Verification Log

Balance #: 34

Thermometer #: Gall

diH2O Temperature (°C) 910534

Eppendorf #	True Value (µL)	1 st Reading (g)	2 nd Reading (g)	3 rd Reading (g)
ADJ5000-C	500			
	2500			
	5000			
ADJ5000-G	500			
	2500			
	5000			
ADJ5000-H	500			
	2500			
	5000			
ADJ5000-I	500			
	2500			
	5000			
ADJ5000-J	500	0.5068	0.5093	0.5049
	2500	2.4984	2.4924	2.4972
	5000	5.0151	5.0265	5.0194
ADJ5000-K	500	0.5066	0.5026	0.5031
	2500	2.4946	2.4927	2.4910
	5000	4.9937	4.9891	4.9953
ADJ5000-L	500	0.4958	0.4990	0.4981
	2500	2.4796	2.4792	2.4775
	5000	4.9738	4.9633	4.9662
ADJ5000-M	500			
	2500			
	5000			
ADJ5000-N	500			
	2500			
	5000			
ADJ5000	500			
	2500			
	5000			
ADJ5000	500			
	2500			
	5000			

500 µL – 5000 µL

7/6/04
WJ

7/6/04
WJ

Analyst: [Signature]
 Reviewed by: [Signature]

Date: 7/6/04
 Date: 7/7/04

SOUTHWEST RESEARCH INSTITUTE 010535
NUCLEAR PROJECT
CLIENT: Division 20
TASK ORDER: 040706-3
SRR: 26134
SDG: 247108
CASE: CNWRA
VTSR: July 02, 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	
6-30-04	2.0000	2.0000	KE	SW: 99-TS0526-15
7-1-04	2.0000	2.0000	KE	"
7-2-04	2.0000	2.0000	KE	"
7-6-04	2.0000	2.0000	Jew	"
7-7-04	2.0000	1.9999	Jew	"
7-8-04	2.0000	2.0000	Jew	"
7-9-04	2.0000	2.0001	Jew	"
7-12-04	2.0000	2.0000	Jew	"

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	
7/6-7-04	10.00	10.00	Jew	SN: 99-35064-5
7/8-8-04	10.00	10.01	Jew	"
7/8-9-04	10.00	10.00	Jew	"
7/10-12-04	10.00	10.01	Jew	"
7/13/04	10.00	10.00	KE	"
7-14-04	10.00	10.00	Jew	"

Jew
+4

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.

010537

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	
6-24-04	2.0000	2.0001	KE	SN: 99-J50526-15
6-25-04	2.0000	2.0000	KE	"
6-28-04	2.0000	2.0000	Jew	"
6-29-04	2.0000	2.0000	KE	"
6-30-04	2.0000	1.9999	KE	"
7-1-04	2.0000	2.0000	KE	"
7-2-04	2.0000	2.0000	KE	"
7-6-04	2.0000	2.0000	Jew	"
7-7-04	2.0000	2.0000	Jew	"
7-8-04	2.0000	2.0000	Jew	"

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:
34	Bldg. 70 Lab 27	1116031935	±0.0005	
Date	Std Wt (g)	Recorded Wt (g)	Operator	
7-9-04	2.0000	2.0000	<i>[Signature]</i>	SN: J5052675
7-12-04	2.0000	2.0000	<i>[Signature]</i>	" "

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.

010539

010540

SOUTHWEST RESEARCH INSTITUTE

NUCLEAR PROJECT

CLIENT: Division 20

TASK ORDER: 040706-3

SRR: 26134

SDG: 247108

CASE: CNWRA

VTSR: July 02, 2004

PROJECT#: 10542.02.002

DI Water Verification

D.I. WATER SYSTEM NOTEBOOK

SOUTHWEST RESEARCH INSTITUTE

BUILDING 70

140008

Contact U.S. Filter (1-800-466-7873) for repairs/exchanges. (Make sure to have a P.O.)

HIGH PURITY SYSTEM (HP)

010541

DATE / TIME	INITIALS	RESISTIVITY MONITOR		QC LIGHTS		USAGE (GALS)	COMMENTS
		(M OHMS)	QC LT.	QC 1	QC 2		
7/6/04 5:20pm	DR	18.04	✓	✓	✓	2785.8	✓
7/7/04 6:01pm	DR	18.03	✓	✓	✓	2798.6	✓
7/8/04 4:30pm	DR	18.04	✓	✓	✓	2803.7	✓
7/9/04 5:05pm	DR	18.03	✓	✓	✓	2819.7	✓
7/12/04 5:05pm	DR	18.04	✓	✓	✓	2845.7	✓

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		
7/6/04 5:20pm	DR	✓	(17) ✓	955.9	✓
7/7/04 6:01pm	DR	✓	(17) ✗	956.1	✓; need P.O. call US Filter
7/8/04 4:30pm	DR	✓	(17.5) ✗	957.0	P.O. received; US Filter called.
7/9/04 5:05pm	DR	✓	(15.5) ✓	957.6	Tank exchange. Back online. ✓
7/12/04 5:05pm	DR	✓	(16) ✓	958.1	✓

Legend: Check = Green (OK); X = Red (call for service)