7400-SRC-0189

Certification Date: Sept. 4, 1994

ADMIN RECORD
SW-A-004076

Nuclide	U-238	U-234	Pu-239	Am-241	Total Alpha
Energy (MeV)	4.20	4.77	5.15	5.49	3 - 8 MeV
Counting time (sec)	73693				
Background count time (sec)	1146265				
Detector Efficiency (%) *	21.2 ± 0.6				
Gross counts	26344 ± 162	25687 ± 160	26662 ± 163	26836 ± 164	106877 ± 327
Gross count rate (cpm)	21.45 ± 0.13	20.91 ± 0.13	21.71 ± 0.13	21.85 ± 0.13	87.02 ± 0.27
Background count rate (cpm)	0.0059 ± 0.0006	0.0095 ± 0.0007	0.0215 ± 0.0011	0.1026 ± 0.0023	0.2527 ± 0.0036
Net std count rate	21.44 ± 0.2590	20.90 ± 0.2558	21.69 ± 0.2606	21.75 ± 0.2615	86.77 ± 0.5218
Standard activity (dpm)	**101.1 ± 3.1**	**98.6 ± 3.0**	**102.3 ± 3.1**	**102.6 ± 3.2**	**409.3 ± 11.8**
Uncertainty at 95% level (%)	**3.1%**	**3.1%**	**3.1%**	**3.1%**	**2.9%**

*Calibrated by NIST-certified standard via attached calibration certificate

Y20

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TEST

for

Florida State University
Tallahassie, Florida

Radionuclide	^{210}Po, ^{234}U, ^{235}U, ^{238}U, ^{239}Pu and ^{241}Am
Source identification	FSU
2π alpha-particle counting rate	3.369 s^{-1} (1)*
Overall uncertainty	1.8 percent (2)
Relative activity	
^{210}Po	0.005 (± 26 percent)
^{234}U	0.949 (± 1.6 percent)
^{235}U	0.037 (± 4.6 percent)
^{238}U	0.954 (± 1.6 percent)
^{239}Pu	0.961 (± 1.6 percent)
^{241}Am	1.000 percent (3),(4)
Reference time	March 3, 1993
Measuring instruments	NIST $2\pi\alpha$ proportional counter and Si surface-barrier detector

For the Director,

J.M.R. Hutchinson, Acting Group Leader
Radioactivity Group
Physics Laboratory

Gaithersburg, MD 20899
March, 1993

2

National Institute of Standards & Technology

Certificate

Standard Reference Material 4322B
Alpha-Particle Solution Standard

Radionuclide	Americium-241
Source identification	SRM 4322B
Source description	Liquid in NIST borosilicate-glass ampoule [1]*
Source mass	Approximately 5.2 grams
Solution composition	Americium-241 in 1 molar nitric acid [2]
Reference time	1200 EST September 9, 1991
Radioactivity concentration	39.24 Bq g^{-1}
Overall uncertainty	0.95 percent [3]
Alpha-particle-emitting impurities	None observed [4]
Photon-emitting impurities (Radioactivity concentration at reference time)	$^{233}Pa/^{241}Am$: $(8.1 \pm 1.6) \times 10^{-6}$ [5]
Half life	432.2 ± 0.5 years [6]
Measuring instrument	$4\pi\alpha$ liquid-scintillation counter

This standard reference material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD
October, 1991

William P. Reed, Chief
Standard Reference Materials Program

*Notes on back

3

NOTES

(1) Approximately five milliliters of solution. Ampoule specifications:

body diameter	16.5 ± 0.5 mm
wall thickness	0.60 ± 0.04 mm
barium content	less than 2.5 percent
lead oxide content	less than 0.02 percent
other heavy elements	trace quantities

(2) The density 1.025 ± 0.002 g/mL at 20.8 °C.

(3) The overall uncertainty was formed by taking three times the quadratic combination of standard deviations of the mean, or assumed approximations thereof, for the following:

a) alpha-particle emission-rate measurements	0.01 percent
b) gravimetric measurements	0.20 percent
c) dead time	0.10 percent
d) background	0.01 percent
e) detection efficiency	0.20 percent
f) count-rate-vs-energy extrapolation to zero energy	0.03 percent
g) radionuclidic impurities	0.10 percent

(4) Limits of detection for alpha-particle-emitting impurities is 0.1 percent for energies less than 5 MeV or greater than 5.5 MeV.

(5) The limit of detection as a percentage of the gamma-ray-emission rate of the 59.9-keV gamma rays emitted in the decay of americium-241 is

0.01 percent between 100 and 1900 keV.

(6) NCRP Report No. 58, 2nd edition, 1985, p. 365.

For further information please contact Dr. L.L. Lucas, (301) 975-5546; or J.M. Calhoun, (301) 975-5538.

National Institute of Standards & Technology

Certificate

Standard Reference Material 4330A
Plutonium-239 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive plutonium-239 nitrate and nitric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of alpha-particle counting instruments and for the monitoring of radiochemical procedures.

Radiological Hazard

The SRM ampoule contains plutonium-239 with a total activity of approximately 210 Bq. Plutonium-239 decays by alpha-particle emission. None of the alpha particles escape from the SRM ampoule. During the decay process X-rays and gamma rays with energies from 10 keV to 1 MeV are also emitted. Most of these photons escape from the SRM ampoule but their intensities are so small that they do not represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard

The SRM ampoule contains nitric acid (HNO_3) with a concentration of 3 moles per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least December 2005.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) both because of the radioactivity and because of the strong acid.

Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M.R. Hutchinson, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas of the Radioactivity Group.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

Gaithersburg, Maryland 20899
January 1996

Thomas E. Gills, Chief
Standard Reference Materials Program

*Notes and references are on pages 5 and 6.

5

Recommended Procedure for Opening the SRM Ampoule

1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.

2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood. In addition to the radioactive material, the solution contains strong acid and is corrosive.

3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.

4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.

5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.

6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.

7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.

8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.

9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

*Notes and references are on pages 5 and 6.

6

PROPERTIES OF SRM 4330A
(Certified values are shown in bold type)

Source identification number	NIST SRM 4330A		
Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter Wall Thickness Barium content Lead-oxide content Other heavy elements	(16.5 ± 0.5) mm (0.60 ± 0.04) mm Less than 2.5% Less than 0.02% Trace quantities	
Solution density	**(1.0895 ± 0.002) g•mL^{-1} at 24.9 °C** [b]*		
Solution mass	Approximately 5.5 g		
Chemical Properties:			
Solution composition	Chemical Formula	Concentration (mol•L^{-1})	Mass Fraction (g•g^{-1})
	H_2O	51	0.84
	HNO_3	2.8	0.16
	HCl	0.02	0.0007
	$^{239}Pu^{+6}$	8×10^{-8}	2×10^{-8}
Radiological Properties:			
Radionuclide	**Plutonium-239**		
Reference time	**1200 EST, 4 December 1995**		
Massic activity of the solution [c]	**37.90 Bq•g^{-1}**		
Relative expanded uncertainty (k=2)	**0.72%** [d] [e]		
Alpha-particle-emitting impurities	None detected [f]		
Photon-emitting impurities	None detected [g]		
Half lives used in the decay corrections	Plutonium-239: (24119 ± 26) a [h]		
Calibration method	NIST "0.1π"α defined-solid-angle counter with scintillation detector and two 4πα liquid-scintillation counting systems		

*Notes and references are on pages 5 and 6.

67

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [d]*

Input Quantity x_i, the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [i]	Relative Sensitivity Factor, $\lvert\partial y/\partial x_i\rvert \cdot (x_i/y)$ [j]	Relative Uncertainty Of Output Quantity, $u_i(y)/y$, (%) [k]
Massic alpha-particle emission rate, corrected for background and decay	Standard deviation of the mean for 10 sets of "0.1π"α measurements and 15 sets of 4πα liquid-scintillation measurements (A)	0.05	1.0	0.05
Decay correction for plutonium-239	Standard uncertainty of the half life (A)	0.11 [m]	0.0005 [n]	0.00005
Decay-scheme data	Standard uncertainty of the probability of decay by alpha-particle emission (A)	0.001	1.0	0.001
Extrapolation of alpha-particle-count-rate-versus-energy to zero energy	Estimated (B)	0.25	1.0	0.25
Gravimetric measurements	Estimated (B)	0.10	1.0	0.10
Live-time [p]	Estimated (B)	0.10	1.0	0.10
Alpha-particle detection efficiency of scintillators	Estimated (B)	0.10	1.0	0.10
Geometry of "0.1π"α counter	Estimated (B)	0.25	0.4	0.10
Alpha-particle-emitting impurities	Limit of detection (B) [q]	100.	0.001	0.10
Photon-emitting impurities	Limit of detection (B) [q]	100.	0.001	0.10
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.36
Coverage Factor, k				x 2
Relative Expanded Uncertainty of the Output Quantity, U/y, (%)				0.72

*Notes and references are on pages 5 and 6.

NOTES

[a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.

Distance from Ampoule (cm):	1	30	100
Approximate Dose Rate (μSv/h):	<0.1	-	-

[b] The stated uncertainty is two times the standard uncertainty.

[c] **Massic activity** is the preferred name for the quantity activity per unit mass. See reference [1].

[d] The reported value, y, of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \ldots x_n)$, where f is a mathematical function derived from the assumed model of the measurement process.

The value, x_i, used for each input quantity i has a **standard uncertainty**, $u(x_i)$, that generates a corresponding uncertainty in y, $u_i(y) \equiv |\partial y/\partial x_i| \cdot u(x_i)$, called a **component of combined standard uncertainty** of y.

The **combined standard uncertainty** of y, $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty.

The combined standard uncertainty is multiplied by a **coverage factor** of $k = 2$ to obtain U, the **expanded uncertainty** of y.

Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.

For further information on the expression of uncertainties, see references [2] and [3].

[e] The value of each standard uncertainty component, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic count rate is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).

[f] Estimated limits of detection for alpha-particle-emitting impurities are:
0.04 $\alpha \cdot s^{-1} \cdot g^{-1}$ for energies less than 4.9 MeV and
0.001 $\alpha \cdot s^{-1} \cdot g^{-1}$ for energies greater than 5.2 MeV.

From mass-spectrometric measurements performed by the supplier, the massic activities of other detected radionuclides (in $Bq \cdot g^{-1}$ at the reference time) are:
^{240}Pu: 0.002; ^{241}Pu: ≈0.02; ^{242}Pu: ≈0.000003; ^{241}Am: ≈0.0009
From the photon measurements below, we have ^{241}Am: ≤0.0006

[g] Estimated limits of detection for photon-emitting impurities are:
0.000200 $\gamma \cdot s^{-1} \cdot g^{-1}$ for energies between 42.5 and 90 keV,
0.000080 $\gamma \cdot s^{-1} \cdot g^{-1}$ for energies between 102 and 125 keV,
0.000030 $\gamma \cdot s^{-1} \cdot g^{-1}$ for energies between 133 and 1456 keV, and
0.000008 $\gamma \cdot s^{-1} \cdot g^{-1}$ for energies between 1465 and 3500 keV,
provided that the photons are separated in energy by 4 keV or more from photons emitted in the decay of plutonium-239.

[h] The stated uncertainty is the standard uncertainty. See reference [5].

[i] Relative standard uncertainty of the input quantity x_i.

[j] The relative change in the output quantity y divided by the relative change in the input quantity x_i. If $|\partial y/\partial x_i| \cdot (x_i/y) = 1.0$, then a 1% change in x_i results in a 1% change in y. If $|\partial y/\partial x_i| \cdot (x_i/y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y.

[k] Relative component of combined standard uncertainty of output quantity y, rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y \equiv |\partial y/\partial x_i| \cdot u(x_i)/y = |\partial y/\partial x_i| \cdot (x_i/y) \cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i| \cdot (x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.

[m] The relative standard uncertainty of $\lambda \cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.

[n] $|\partial y/\partial x_i| \cdot (x_i/y) = |\lambda \cdot t|$

[p] The live time is determined by counting the pulses from a gated oscillator.

[q] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i = 100\%$. $|\partial y/\partial x_i| \cdot (x_i/y) = \{$(response per Bq of impurity)/(response per Bq of Pu-239)$\} \cdot \{$(Bq of impurity)/(Bq of Pu-239)$\}$. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a massic activity equal to the estimated limit of detection.

REFERENCES

[1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900.

[2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900. (Listed under ISO miscellaneous publications as "ISO Guide to the Expression 1993".)

[3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1993. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.

[4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.

[5] Evaluated Nuclear Structure Data File (ENSDF), December 1995.

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

RSO#-45017

Radionuclide	Pu-242	Customer:	TEXAS A&M RESEARCH FOUNDATION
Half Life:	(3.76 ± 0.02) x 10^5 years	P.O. No.:	K002605
Catalog No.:	7242-100N	Reference Date:	1 Aug 97 12:00 PST.
Source No.:	572-6	Contained Radioactivity:	Pu-242: 98.19 nCi
		Contained Radioactivity:	Pu-242: 3633 Bq

Description of Solution

a. Mass of solution:	5.63826 g in 5 ml flame sealed ampoule
b. Chemical form:	Plutonium nitrate in 4M HNO3
c. Carrier content:	None added
d. Density:	1.1296 g/ml @ 20°C.

Radioimpurities

See technical data sheet.

Radioactive Daughters

See technical data sheet.

Radionuclide Concentration

Pu-242: 17.42 nCi/g

Method of Calibration

This source was prepared from a weighed aliquot of a calibrated solution whose concentration in µCi/gram was determined by a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±	3.0%
b. Random uncertainty in assay:	±	2.1%
c. Random uncertainty in weighing(s):	±	0.4%
d. Total uncertainty at the 99% confidence level:	±	3.7%

NIST Traceability

This calibration is traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

ISOTOPE PRODUCTS LABORATORIES
1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

QUALITY CONTROL

28-Jul-97
Date Signed

11

THE LEAK TEST(S) INDICATED BY THE CHECKED BOX(ES) WAS(WERE) APPLIED TO DETERMINE THE INTEGRITY OF THE SOURCE DESCRIBED ON THE FRONT SIDE

☒ ***Standard Wipe Test***

The source is wiped over its entire surface with a moistened filter paper disk. After drying, the disk is checked for activity using a windowless proportional counter or end-window G.M. tube. Activity levels exceeding 0.001 μCi beta-gamma or 0.0001 μCi alpha are cause for rejection of the source.

☐ ***Soak Test***

The source is immersed in distilled water and maintained at 50 ± 10°C for a minimum of four hours or at room temperature for a minimum of 12 hours. After removal of the source, the liquid is a) checked for activity using a liquid scintillation counter, or b) evaporated in a planchet and the residue is checked for activity using a windowless proportional counter or end-window G.M. tube. Activity levels exceeding 0.001 μCi beta-gamma or 0.0001 μCi alpha are cause for rejection of the source.

☐ ***Soak Test - Beryllium Window***

The source is immersed in distilled water and maintained at 50 ± 10°C for 20 minutes. The entire surface of the source is then wiped with a moistened cotton swab or filter paper disk. After drying, the swab or disk is checked for activity using a windowless proportional counter or end-window G.M. tube. Activity levels exceeding 0.001 μCi beta-gamma or 0.0001 μCi alpha are cause for rejection of the source.

☐ ***Gas Source Test*** **(Radioactive Gas)**

The source is placed in a vacuum desiccator and maintained at a pressure less than 10 mm Hg for not less than 12 hours. The activity is checked by introducing air into the desiccator and monitoring the air with an end-window G.M. tube. Activity levels exceeding 0.001 μCi are cause for rejection of the source.

☒ ***Ampule Leak Test***

The ampule is kept in an inverted position on a filter paper disk for a minimum of 16 hours. The filter paper disk is then checked for activity using a windowless proportional counter or end-window G.M. tube. Activity levels exceeding 0.001 μCi beta-gamma or 0.0001 μCi alpha are cause for rejection of the source.

☐ ***Leak Test Not Applicable***

The active area of the source is uncovered or is protected by a very thin coating. Although the deposit is adherent, it is not designed or certified to pass a standard leak test. The inactive portions of the source have been checked using the standard wipe test. Levels of removable activity did not exceed 0.001 μCi beta-gamma or 0.0001 μCi alpha at the time of shipment.

☐ ***Bubble Leak Test***

The lecture bottle is pressurized to its fill pressure, then soapy water is applied over its valve and neck. If no growing bubbles are seen, the lecture bottle is considered leak free.

☐ ***Other Leak Test***

ISOTOPE PRODUCTS LABORATORIES

Corporate and Main Laboratory
1800 N. Keystone Street
Burbank, California
91504

818•843-7000
Fax 818•843-6168

Pu-242 TECHNICAL DATA

The Pu-242 used to prepare your order was taken from Isotope Products Laboratories Lot #7202 and had the following composition as of January 1, 1996.

NUCLIDE	ATOM%	ACTIVITY%	% ALPHA
Pu-238	0.004	2.880	14.38356
Pu-239	0.005	0.012	0.063922
Pu-240	0.020	0.188	0.964733
Pu-241	0.018	80.087	_____
Pu-242	99.951	16.516	84.58782
Pu-244	0.000	_____	1.52E-6

Isotopic composition provided by New Brunswick Laboratory.

Am-241 (daughter) removed on 5 Feb 96

No other alpha emitting nuclides were detected.

If you have any questions, please contact Technical Service.

13

Report of Traceability

ANSI/ASTM Class 1

100 gram(s)

S/N: 98-J38748-3 Date: 06/22/98

Type 1

Material: Stainless Steel

Density: 7.85g/cm^3

All Denver Instrument Company weights have been verified using standards of mass traceable to the National Institute of Standards and Technology (NIST) and meet or exceed specifications for type and class.

Primary Set MT55 NIST Test #822/257022-96 6/14/96

Secondary Set # MT50 Date 02/16/98

Signature: RPB

Date Seal Broken: _____

Denver Instrument Company

6542 Fig Street • Arvada, Colorado 80004
303/431-7255 • 1-800-321-1135 • FAX 303-423-4831

LITHO. IN U.S.A.

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14

STATEMENT OF ACCURACY

We certify that the weight/weight set listed below has been verified using mass standards whose calibrations are traceable to the National Institute of Standards and Technology.

As manufactured, the weight/weight set meets or exceeds the specifications for the type, grade and class listed.

Weight Range: 500g

SN: 16541

Date: 2-17-98

Type: ☐ I ☒ II

Grade: ☐ S ☒ S¹ ☐ O ☐ P ☐ N/A

Class:
- Ultra Class ☐
- ANSI/ASTM ☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6
- OIML ☐ E1 ☐ E2 ☐ F1 ☐ F2 ☐ M1 ☐ M2
- NIST ☐ Class F

Material/Density at 20° C:
- ☐ Stainless Steel 7.95g/cm³ Range 50mg-500mg
- ☒ Stainless Steel 7.85g/cm³ Range 1g and larger
- ☐ Stainless Steel 7.95g/cm³ Range 1g and larger
- ☐ Aluminum 2.7g/cm³ Range 30mg and smaller
- ☐ Cast Iron 7.2g/cm³
- ☐ Brass 8.39g/cm³
- ☐ Other _____

TROEMNER

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FAX: 215/724-9663
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email: troemner@troemner.com

ISO 9001 REGISTERED

Dean E. Wilson, Jr.
QC Metrology Manager

Wilbert D. Abele
President

6-059-BF (Rev.10/97)

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Report of Traceability

ANSI/ASTM Class 2

200 gram(s)

S/N: 97-J3607.1-18 Date: 12/17/97

Type 1
Material: Stainless Steel
Density 7.85g/cm^3

All Denver Instrument Company weights have been verified using standards of mass traceable to the National Institute of Standards and Technology (NIST) and meet or exceed specifications for type and class.

Primary Set MT55 NIST Test #822/257022-96 Date 06/14/96

Secondary Set # MT7 Date 08/13/97

Signature: TPB

Date Seal Broken:

Denver Instrument Company

6542 Fig Street • Arvada, Colorado 80004
303/431-7255 • 1-800-321-1135 • FAX 303-423-4831

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16

Report of Traceability

ANSI/ASTM Class 1

100 milligram(s)

S/N: 98-J35936-38 Date: 01/07/98

Type 1

Material: Stainless Steel

Density: 7.85g/cm^3

All Denver Instrument Company weights have been verified using standards of mass traceable to the National Institute of Standards and Technology (NIST) and meet or exceed specifications for type and class.

Primary Set MT55 NIST Test #822/257022-96

Secondary Set # MT53 Date 08/22/97

Signature: PRB

Date Seal Broken:

Denver Instrument Company

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303/431-7255 •1-800-321-1135• FAX 303-423-4831

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17

Report of Traceability

ANSI/ASTM Class 1

10 gram(s)

S/N: 97-J35874-8 Date: 12/01/97

Type: 1

Material: Stainless Steel

Density: 7.85 g/cm^3

All Denver Instrument Company weights have been verified using standards of mass traceable to the National Institute of Standards and Technology (NIST) and meet or exceed specifications for type and class.

Primary Set MT55 NIST Test #822/257022-96 6/14/96

Secondary Set # MT50 Date 08/22/97

Signature: [illegible]

Date Seal Broken:

Denver Instrument Company

6542 Fig Street • Arvada, Colorado 80004
303/431-7255 • 1-800-321-1135 • FAX 303-423-4831

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18

Report of Traceability

ANSI/ASTM Class 1

1 gram(s)

S/N: 98-J36096-50 Date: 02/13/98

Type: 1
Material: Stainless Steel
Density: 7.85g/cm^3

All Denver Instrument Company weights have been verified using standards of mass traceable to the National Institute of Standards and Technology (NIST) and meet or exceed specifications for type and class.

Primary Set MT55 NIST Test #822/257022-96 6/14/96

Secondary Set # MT50 Date 08/22/97

Signature: RPB

Date Seal Broken: 2/19/98 TM

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Report of Traceability

ANSI/ASTM Class 1

10 milligram(s)

S/N: 98-J36192-63 Date: 02/13/98

Type: 1

Material: Stainless Steel

Density: 7.85g/cm^3

All Denver Instrument Company weights have been verified using standards of mass traceable to the National Institute of Standards and Technology (NIST) and meet or exceed specifications for type and class.

Primary Set MT55 NIST Test #822/257022-96

Secondary Set # MT53 Date 08/22/97

Signature: PJB

Date Seal Broken: 2/19/98

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20/20