



Eckert & Ziegler

Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION MIXED ALPHA STANDARD SOURCE

| | | | |
|---------------------|---------------------------------|-----------------|----------------------|
| Radionuclide: | Pu-239 | Customer: | TEXAS A&M UNIVERSITY |
| Radionuclide: | Am-241 | P.O. No.: | P100210 |
| Radionuclide: | Cm-244 | Catalog No.: | AF-COMP |
| Radionuclide: | Gd-148 | Reference Date: | 1-Dec-10 12:00 PST |
| Half-life (Pu-239): | (2.411 ± 0.003)E+04 years | Source No.: | 1451-68-3 |
| Half-life (Am-241): | 432.17 ± 0.66 years | | |
| Half-life (Cm-244): | 18.11 ± 0.02 years | | |
| Half-life (Gd-148): | 75 ± 3 years | | |

Contained Radioactivity:

| | | | | | | | | | |
|---------|-------|------|-------|----|-----------------|-------|------|-------|----|
| Pu-239: | 11.33 | nCi, | 419.2 | Bq | Cm-244: | 8.193 | nCi, | 303.1 | Bq |
| Am-241: | 9.530 | nCi, | 352.6 | Bq | Total Activity: | 38.81 | nCi, | 1436 | Bq |
| Gd-148: | 9.758 | nCi, | 361.0 | Bq | | | | | |

Physical Description:

- A. Capsule type: A-1
- B. Nature of active deposit: Electrodeposited and diffusion bonded oxide
- C. Active diameter/volume: 5mm
- D. Backing: Platinum
- E. Cover: None

**CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA**

Radioimpurities: None detected for Am-241; None detected for Gd-148; See Technical Data Sheets for Pu-239 and Cm-244

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were determined using an alpha spectrometry surface barrier detector.

Uncertainty of Measurement:

| | Pu-239 | Am-241 | Cm-244 | Gd-148 |
|---|---------|---------|---------|---------|
| A. Type A (random) uncertainty: | ± 0.9 % | ± 0.9 % | ± 0.9 % | ± 0.9 % |
| B. Type B (systematic) uncertainty: | ± 3.0 % | ± 3.0 % | ± 3.0 % | ± 3.0 % |
| C. Uncertainty in aliquot weighing: | ± 0.0 % | ± 0.0 % | ± 0.0 % | ± 0.0 % |
| D. Total uncertainty at the 99% confidence level: | ± 3.1 % | ± 3.1 % | ± 3.1 % | ± 3.1 % |

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP participates in a 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).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 43370 α/min in 2π on 5 Nov 10.

Daniel James Van Dalsen
Quality Control

18-NOV-10
Date

EZIP Ref. No.: 1451-68

ISO 9001 CERTIFIED

THE LEAK TEST(S) INDICATED BY THE CHECKED BOX(ES) WAS(WERE) APPLIED TO DETERMINE THE INTEGRITY OF THE SOURCE(S) DESCRIBED ON THE FRONT SIDE. THE LEAK TEST(S) INDICATED BELOW WERE EITHER TAKEN DIRECTLY FROM ISO 9978:1992 OR DERIVED FROM THE LEAK TEST METHODS LISTED IN ISO 9978:1992 WHEN AN APPROPRIATE TEST WAS NOT SPECIFICALLY LISTED.

Standard Wipe Test

The source was wiped over its entire surface with a moistened filter paper disk. After drying, the disk was checked for activity using a scintillation detector. There was <0.001 μCi beta-gamma and <0.0001 μCi alpha of removable activity.

Special Wipe Test

The source was wiped over its entire surface with moistened polystyrene. The polystyrene was then dissolved in a liquid scintillation cocktail and counted in a liquid scintillation counter. There was <0.001 μCi beta-gamma and <0.0001 μCi alpha of removable activity.

Distilled Water Soak Test

The source was immersed in distilled water and maintained at $50^\circ\text{C} \pm 5^\circ\text{C}$ for a minimum of four hours or room temperature ($20^\circ\text{C} \pm 5^\circ\text{C}$) for 24 hours. After removal of the source, the liquid was **a**) checked for activity using a liquid scintillation counter, or **b**) evaporated in a planchet and the residue checked for activity using a windowless proportional counter or end-window G.M. tube. There was <0.001 μCi beta-gamma and <0.0001 μCi alpha of removable activity.

Liquid Scintillation Soak Test

The source was immersed for a minimum of 3 hours at room temperature in a liquid scintillation cocktail, which does not attack the source's outer surface material. The source was stored away from light to avoid photoluminescence. The sealed source was then removed and the activity of the liquid scintillation cocktail was measured. There was <0.001 μCi beta-gamma and <0.0001 μCi alpha of removable activity.

Gas Source Test

The source was placed in a vacuum desiccator and maintained at a pressure of <10 mm Hg for not less than 12 hours. The activity was checked by introducing air into the desiccator and monitoring the air with an end-window G.M. tube. There was <0.001 μCi beta-gamma of removable activity.

Ampoule Leak Test

The ampoule was kept in an inverted position on a filter paper disk or polystyrene wipe for a minimum of 16 hours. The wipe was then checked for activity using a scintillation detector or liquid scintillation counter. There was <0.001 μCi beta-gamma and <0.0001 μCi alpha of removable activity.

Bubble Leak Test

The container was pressurized to its fill pressure; then soapy water was applied over its valve and neck or, the valve and neck of the vessel were immersed in water. If no growing bubbles were observed, the container was considered leak free.

Wipe Test for Industrial Ni-63 Sources

The sources were wipe tested by an approved sampling plan, which called for either 100% of the batch to be individually wipe tested, or, a subset thereof. The wipe test(s) used to test for removable contamination and the results of those tests are recorded on the front of this form.

Pressure Test for Triotech Kr-85 Sources

Prior to filling the vessel with Kr-85 gas, the vessel was evacuated to <5 mm Hg, the gas manifold system shut off and the system allowed to stand for a minimum of 30 minutes. A vacuum difference not greater than the known vacuum loss of the manifold system itself signified the vessel did not leak.



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 or special wipe test depending on the nuclide. There was <0.001 μCi beta-gamma and <0.0001 μCi alpha of removable activity.



Other Leak Test



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Pu-239 Technical Data

The Pu-239 used to prepare your order was taken from Eckert & Ziegler Isotope Products Lot #119503 and had the following composition as of 23 Aug 07:

| <u>Nuclide</u> | <u>Atom%</u> | <u>Activity %</u> | <u>α-Activity%</u> |
|----------------|--------------|-------------------|--------------------------------------|
| Pu-238 | 0.0013 | 0.322 | 0.350 |
| Pu-239 | 97.938 | 85.187 | 92.521 |
| Pu-240 | 2.0538 | 6.564 | 7.129 |
| Pu-241 | 0.0054 | 7.927 | n/a |
| Pu-242 | 0.0010 | 0.000056 | 0.000061 |

Am-241 was separated on 17 Aug 07

Isotopic composition provided by Oak Ridge National Laboratory.

If you have any questions, please contact Eckert & Ziegler
Isotope Products Technical Service: 661-309-1010

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Special Wipe Test

The source was wiped over its entire surface with moistened polystyrene. The polystyrene was then dissolved in a liquid scintillation cocktail and counted in a liquid scintillation counter. There was <0.001 µCi beta-gamma and <0.0001 µCi alpha of removable activity.

Distilled Water Soak Test

The source was immersed in distilled water and maintained at 50°C ± 5°C for a minimum of four hours or room temperature (20°C ± 5°C) for 24 hours. After removal of the source, the liquid was **a)** checked for activity using a liquid scintillation counter, or **b)** evaporated in a planchet and the residue checked for activity using a windowless proportional counter or end-window G.M. tube. There was <0.001 µCi beta-gamma and <0.0001 µCi alpha of removable activity.

Liquid Scintillation Soak Test

The source was immersed for a minimum of 3 hours at room temperature in a liquid scintillation cocktail, which does not attack the source's outer surface material. The source was stored away from light to avoid photoluminescence. The sealed source was then removed and the activity of the liquid scintillation cocktail was measured. There was <0.001 µCi beta-gamma and <0.0001 µCi alpha of removable activity.

Gas Source Test

The source was placed in a vacuum desiccator and maintained at a pressure of <10 mm Hg for not less than 12 hours. The activity was checked by introducing air into the desiccator and monitoring the air with an end-window G.M. tube. There was <0.001 µCi beta-gamma of removable activity.

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Bubble Leak Test

The container was pressurized to its fill pressure; then soapy water was applied over its valve and neck or, the valve and neck of the vessel were immersed in water. If no growing bubbles were observed, the container was considered leak free.

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Other Leak Test



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Cm-244 technical data

The Cm-244 used to prepare your order was taken from Eckert & Ziegler Isotope Products Lot #121701 and had the following composition as of 10 Aug 09:

| <u>Nuclide</u> | <u>Weight %</u> | <u>Activity %</u> |
|----------------|-----------------|-------------------|
| Cm-243 | 0.0179 | 0.0134 |
| Cm-244 | 80.498 | 99.903 |
| Cm-245 | 2.984 | 0.0078 |
| Cm-246 | 16.08 | 0.0756 |
| Cm-247 | 0.268 | 0.0000004 |
| Cm-248 | 0.151 | 0.00001 |

Calculated contents of Pu-240: 0.1967 % of Cm-244

Calculated contents of Am-243: 0.00762% of Cm-244

Calculated contents of Am-241: 0.000384% of Cm-244

Date of last actinide separation: 6 Dec 1995

Isotopic composition provided by Oak Ridge National Laboratory.

If you have any questions, please contact EZIP Technical Service:
(661) 309-1010.

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Medical Imaging Laboratory

24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory

1800 North Keystone Street Burbank, California 91504

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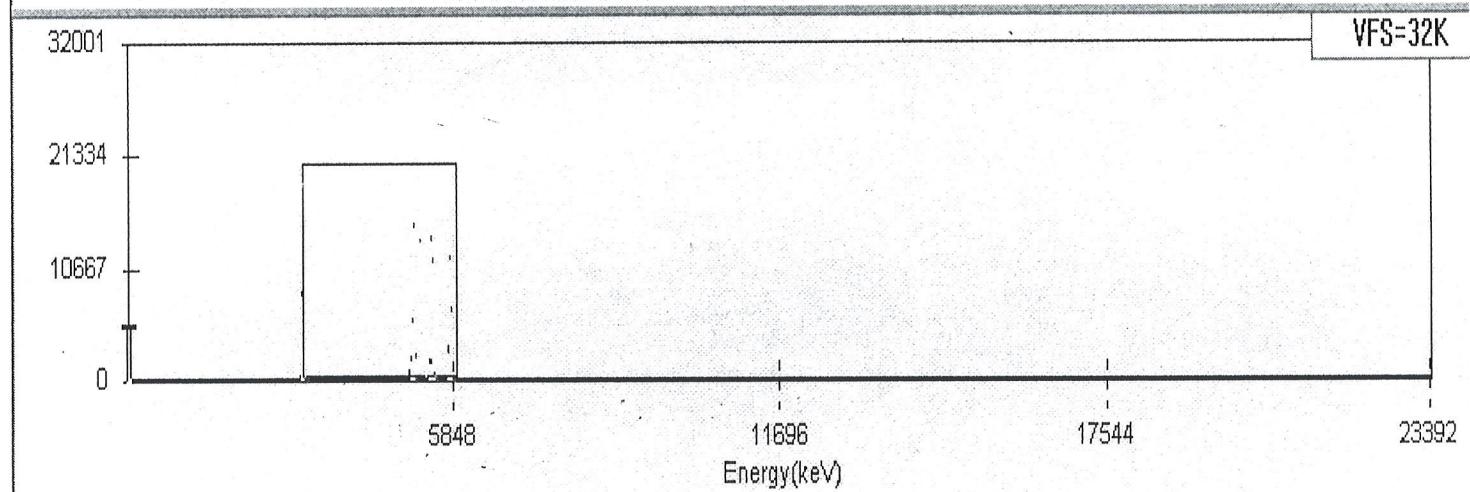
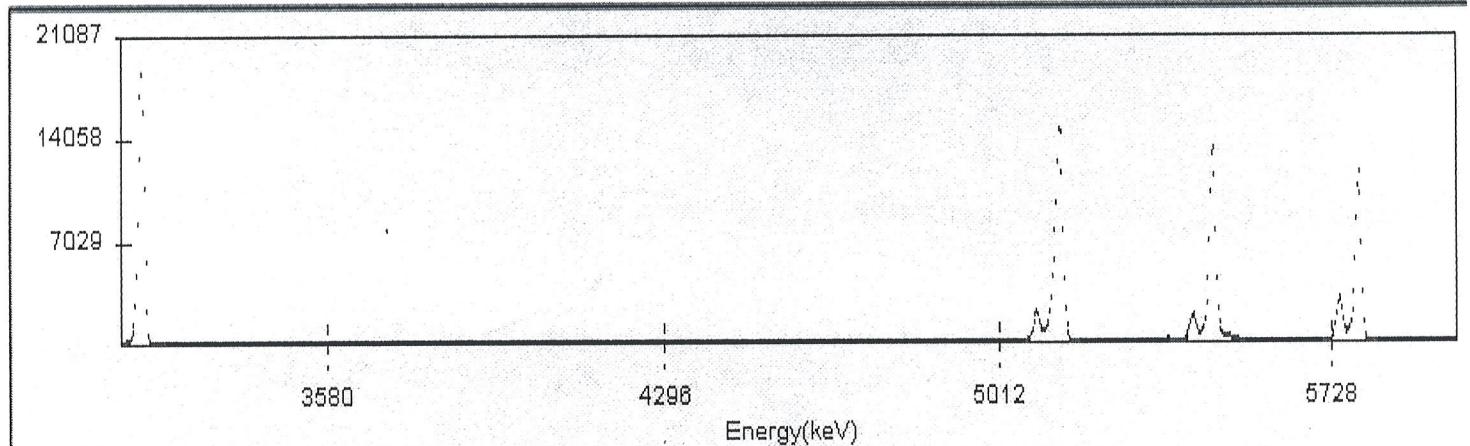
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Other Leak Test

Alpha Comp Spectrum

S/N: 1451-68-3

Acquisition Started: 11/5/10 11:45:27 AM
 Elapsed Live Time: 5000.00 sec
 Elapsed True Time: 5008.42 sec
 Dead Time: 0.17 %
 Geometry: SBD#3 - 25mm from the detector



REGION OF INTEREST REPORT

| ROI # | From (keV) | To (keV) | Integral | % Error | Peak (keV) | FWHM (keV) |
|-------|------------|-----------|----------|---------|------------|------------|
| 1 | 3119.01 | - 3224.64 | 107114 | 0.80 | 3174.22 | 14.49 |
| 2 | 5071.60 | - 5182.93 | 124308 | 0.75 | 5135.91 | 17.87 |
| 3 | 5382.75 | - 5539.76 | 104597 | 0.94 | 5468.34 | 15.42 |
| 4 | 5713.89 | - 5828.08 | 90117 | 0.88 | 5779.78 | 14.88 |

Errors are quoted at 2.580 sigma