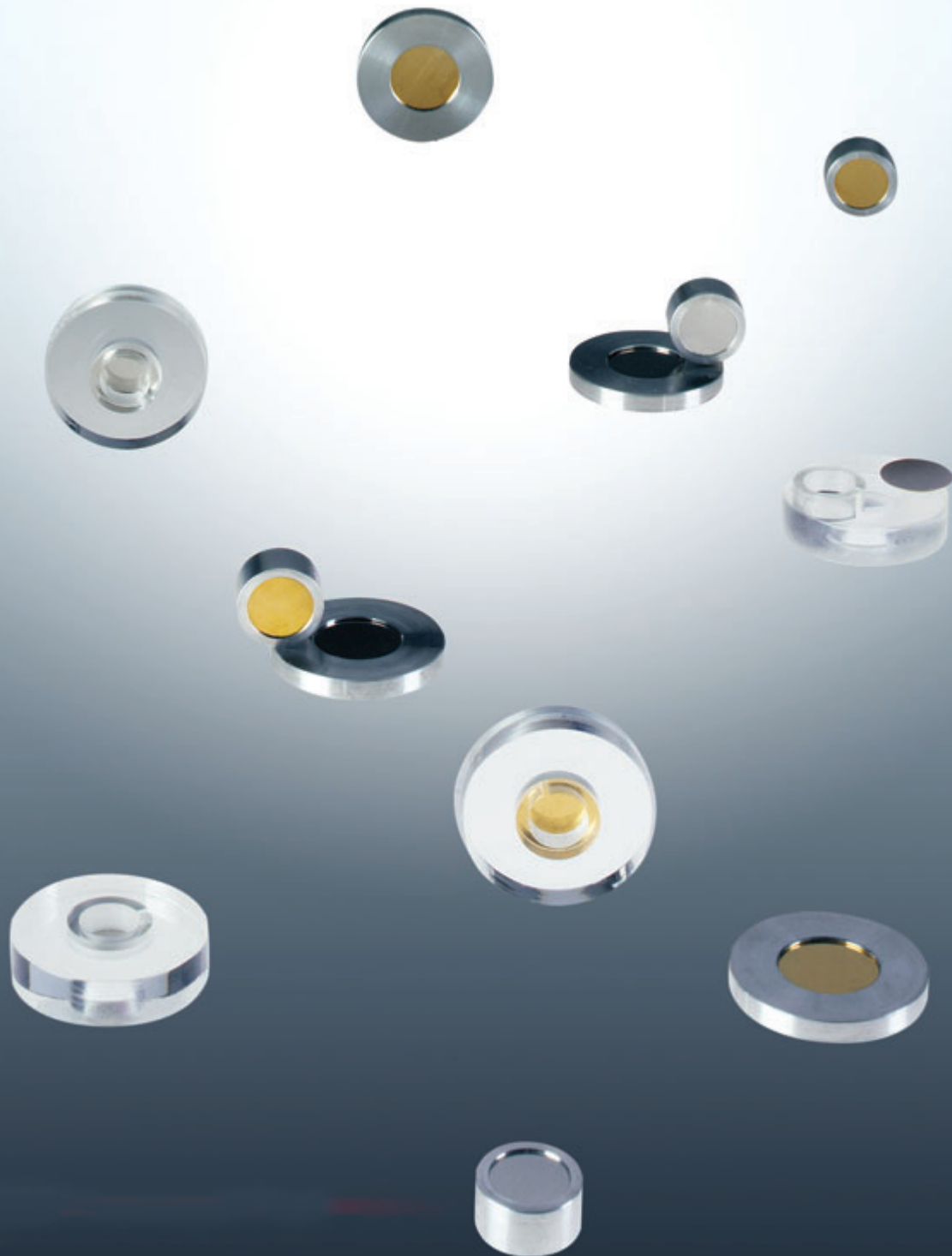


# Alpha Particle Standards



The majority of alpha standards listed on pages 36–39 are spectroscopy grade and are suitable for the most exacting research requirements as well as for routine counting room applications. Standards that emit radon gas, most notably Th-228 and Ra-226, should not be used in gross alpha applications. Most sources are prepared by electrodeposition of the desired nuclide on a mirror finish platinum surface foil and are fixed to the surface by diffusion-bonding. These sources exhibit narrow line widths, generally less than 20 keV FWHM for high specific activity nuclides such as Po-210 and Am-241. Calibration methods are described on page 5.

Even the lowest intensity uncovered alpha source may deteriorate with time, showing signs of removable activity as well as decreased spectral resolution. This is caused by the migration of the active material into the substrate and by the accumulation of dust and grime.

For these reasons the source should be stored in a closed container when not in use. The inside of the container should be checked periodically for free activity. EZIP considers the useful life of alpha sources with long half-lives to be two years. We recommend a program of scheduled replacement for these sources.

Cf-252 sources are all supplied with a 100 µg/cm<sup>2</sup> gold cover. Please note that the gold will not prevent the loss of fission fragments and EZIP suggests the following procedures be followed when handling any Cf-252 source:

- The container should be opened and handled in a hood, glove box, or other well-ventilated enclosure and only by qualified personnel.
- If possible, when not in use, the source should be stored under vacuum or in inert atmosphere to prevent corrosion. These sources are not warranted as suitable for any specific application nor is EZIP liable for any damage or contamination to facilities or equipment resulting from their use.

All activities of Ra-226 and Th-228 standards are supplied with a 100 µg/cm<sup>2</sup> gold cover which is sufficient to prevent loss of radioactive recoil daughter products.

The general warranty does not apply to any open source of Cf-252, Th-228, or Ra-226. Additional gold covering up to 200 µg/cm<sup>2</sup> is available upon request.

All electroplated sources are prepared +/- 30% of nominal activity.

#### Activities for U-235, U-238 and Th-232

Capsule Type	Active Diameter	U-235 dpm	U-235 nCi	U-238 (Natural) dpm	U-238 (Natural) nCi	U-238 (Depleted) dpm	U-238 (Depleted) nCi	Th-232 dpm	Th-232 nCi
A-1	5 mm	1000	0.45	140	0.063	70	0.032	15	0.007
A-2	5 mm	1000	0.45	140	0.063	70	0.032	15	0.007
PM	5 mm	1000	0.45	140	0.063	70	0.032	15	0.007

- 1) Activities are for total alpha activity.
- 2) Individual uranium isotopes specified on Technical Data Sheets supplied with source certificates.
- 3) Due to low specific activity of these isotopes, these AF sources are not spectral grade sources.
- 4) Multiply nCi\*37 to convert to Bq.

#### Weight% vs. Activity% for Uranium Nuclides

	Weight %				Activity %			
	U-234	U-235	U-236	U-238	U-234	U-235	U-236	U-238
Natural Uranium (0.72%)	0.0055	0.720	—	99.274	49.501	2.250	—	48.249
Depleted Uranium (0.017%)	0.0002	0.0173	0.0000	99.982	2.875	0.108	0.0019	97.015
Enriched Uranium (97.66%)	1.658	97.663	0.1497	0.5296	97.904	2.003	0.0918	0.00169

# Alpha Particle Standards

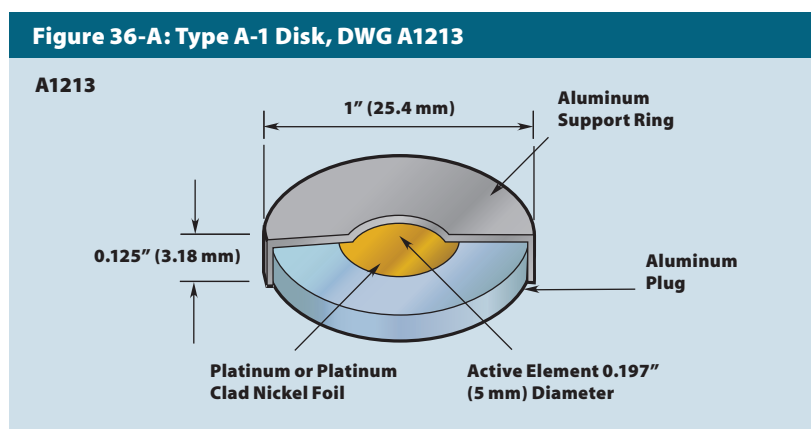
## Alpha Particle Standards—Type A-1

The type A-1 source is permanently fixed in an aluminum holder 1" diameter x 0.125" high (25.4 mm x 3.18 mm). The active diameter is 0.197" (5.0 mm).

All alpha standards are offered as spectral grade sources up to the activity and active diameters listed unless otherwise noted. All electroplated alpha standards are manufactured to a tolerance of +/-30% of the nominal activity. All AF type sources are delicate surface sources; the active surface of the source must not be wipe tested or touched.



**Figure 36-A: Type A-1 Disk, DWG A1213**



### Overall Dimensions

Overall Diameter	Active Diameter	Height
1"	0.197"	0.125"
25.4 mm	5 mm	3.18 mm

### Window & Exceptions

Window	Exceptions
None	Cf-252, Ra-226, and Th-228: 100 µg/cm <sup>2</sup> gold Po-210: 100 µg acrylic/cm <sup>2</sup> only

## Alpha Particle Standards—Type A-1

Catalog Number	Nuclide	Half-Life	Significant Alpha Energies (keV)	Nature of Active Material	Available Activities
AF-241-A1	Americium-241	432.2 y	5388, 5443, 5486	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-252-A1	Californium-252	2.645 y	6076, 6118	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-244-A1	Curium-244	18.11 y	5763, 5805	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-148-A1	Gadolinium-148	75 y	3184	On Request	—
AF-237-A1	Neptunium-237 <sup>(1)</sup>	2.140 x 10 <sup>6</sup> y	4640-4873	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-210-A1	Polonium-210	138.376 d	5304	Electroless Deposition onto Silver Substrate	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-238P-A1	Plutonium-238	87.74 y	5456, 5499	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-239-A1	Plutonium-239	2.411 x 10 <sup>4</sup> y	5105, 5143, 5156	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-226-A1	Radium-226 <sup>(2,3)</sup>	1,600 y	4601, 4784 Daughters 5489 thru 7687	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-228-A1	Thorium-228 <sup>(2,4)</sup>	698.2 d	5341, 5423 Daughters 5449 thru 8784	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-230-A1	Thorium-230	7.54 x 10 <sup>4</sup> y	4621, 4688	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-232-A1	Thorium-232 <sup>(1,2)</sup>	1.405 x 10 <sup>10</sup> y	3952, 4010	Electroplated onto Platinum Surface	0.007 nCi (0.26 Bq)
AF-235-A1	Uranium-235 <sup>(1,2)</sup>	7.037 x 10 <sup>8</sup> y	4215-4597	Electroplated onto Aluminum Foil	Max. Activity 0.4 nCi (14.8 Bq)
AF-238(Nat)-A1	Uranium-238(Nat) <sup>(1,2)</sup>	4.468 x 10 <sup>9</sup> y	4147, 4196	Electroplated onto Aluminum Foil	Max. Activity 0.05 nCi (1.85 Bq)
AF-238D-A1	Uranium-238D <sup>(1,2)</sup>	4.468 x 10 <sup>9</sup> y	4147, 4196	Electroplated onto Aluminum Foil	Max. Activity 0.032 nCi

1) Not supplied as spectroscopy grade sources.

2) Not necessarily in equilibrium with daughters at time of shipment.

3) Radium-226 will leak Rn-222 gas.

4) Thorium-228 will leak Rn-220 gas.

## Alpha Particle Standards—Type A-2

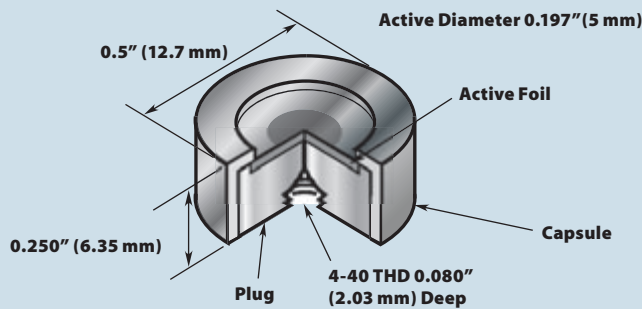
The type A-2 source is permanently fixed in an aluminum holder 0.5" diameter x 0.250" high (12.7 mm x 6.35 mm). The active diameter is 0.197" (5.0 mm).

All alpha standards are offered as spectral grade sources up to the activity and active diameters listed unless otherwise noted. All electroplated alpha standards are manufactured to a tolerance of +/-30% of the nominal activity.



**Figure 37-A: Type A-2 Disk**

**A1204**



### Overall Dimensions

Overall Diameter	Active Diameter	Height
0.5"	0.197"	0.250"
12.7 mm	5 mm	6.35 mm

### Window & Exceptions

Window	Exceptions
None	Cf-252, Ra-226, and Th-228: 100 µg/cm <sup>2</sup> gold  Po-210: 100 µg acrylic/cm <sup>2</sup> only

## Alpha Particle Standards—Type A-2

Catalog Number	Nuclide	Half-Life	Significant Alpha Energies (keV)	Nature of Active Material	Available Activities
AF-241-A2	Americium-241	432.2 y	5388, 5443, 5486	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-252-A2	Californium-252	2.645 y	6076, 6118	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-244-A2	Curium-244	18.11 y	5763, 5805	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-148-A2	Gadolinium-148	75 y	3184	On Request	—
AF-237-A2	Neptunium-237 <sup>(1)</sup>	2.140 x 10 <sup>6</sup> y	4640-4873	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-210-A2	Polonium-210	138.376 d	5304	Electroless Deposition onto Silver Substrate	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-238P-A2	Plutonium-238	87.74 y	5456, 5499	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-239-A2	Plutonium-239	2.411 x 10 <sup>4</sup> y	5105, 5143, 5156	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-226-A2	Radium-226 <sup>(2,3)</sup>	1,600 y	4601, 4784 Daughters 5489 thru 7687	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-228-A2	Thorium-228 <sup>(2,4)</sup>	698.2 d	5341, 5423 Daughters 5449 thru 8784	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-230-A2	Thorium-230	7.54 x 10 <sup>4</sup> y	4621, 4688	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-232-A2	Thorium-232 <sup>(1,2)</sup>	1.405 x 10 <sup>10</sup> y	3952, 4010	Electroplated onto Platinum Surface	0.007 nCi (0.26 Bq)
AF-235-A2	Uranium-235 <sup>(1,2)</sup>	7.037 x 10 <sup>8</sup> y	4215-4597	Electroplated onto Aluminum Foil	Max. Activity 0.4 nCi (14.8 Bq)
AF-238(Nat)-A2	Uranium-238(Nat) <sup>(1,2)</sup>	4.468 x 10 <sup>9</sup> y	4147, 4196	Electroplated onto Aluminum Foil	Max. Activity 0.05 nCi (1.85 Bq)
AF-238D-A2	Uranium-238D <sup>(1,2)</sup>	4.468 x 10 <sup>9</sup> y	4147, 4196	Electroplated onto Aluminum Foil	Max. Activity 0.032 nCi

1) Not supplied as spectroscopy grade sources.

2) Not necessarily in equilibrium with daughters at time of shipment.

3) Radium-226 will leak Rn-222 gas.

4) Thorium-228 will leak Rn-220 gas.

# Alpha Particle Standards

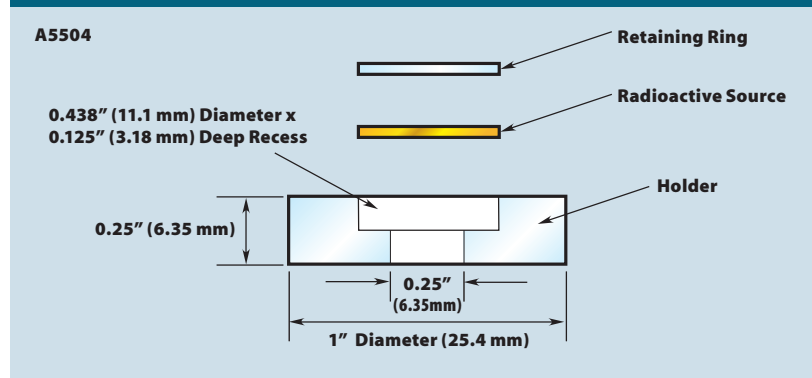
## Alpha Particle Standards—Type PM

The PM source is mounted in a plastic holder from which it can be separated for installation in a counting chamber or device. The holder is 1" diameter x 0.125" high (25.4 mm x 3.18 mm). The removable active foil is 0.438" (11.1 mm) in diameter with the active diameter 0.197" (5.0 mm). The foils are platinum or platinum clad nickel between 0.005" and 0.010" (0.127 mm and 0.254 mm) thick.

All alpha standards are offered as spectral grade sources up to the activity and active diameters listed unless otherwise noted. All electroplated alpha standards are manufactured to an accuracy of +/-30% of the nominal activity.



**Figure 38-A: Type PM Disk**



Overall Dimensions		
Overall Diameter	Active Diameter	Height
1"	0.197"	0.25"
25.4 mm	5 mm	6.35 mm

Window & Exceptions	
Window	Exceptions
None	Cf-252, Ra-226, and Th-228: 100 µg/cm <sup>2</sup> gold Po-210: 100 µg acrylic/cm <sup>2</sup> only

## Alpha Particle Standards—Type A-1

Catalog Number	Nuclide	Half-Life	Significant Alpha Energies (keV)	Nature of Active Material	Available Activities
AF-241-PM	Americium-241	432.2 y	5388, 5443, 5486	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-252-PM	Californium-252	2.645 y	6076, 6118	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-244-PM	Curium-244	18.11 y	5763, 5805	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-148-PM	Gadolinium-148	75 y	3184	On Request	—
AF-237-PM	Neptunium-237 <sup>(1)</sup>	2.140 x 10 <sup>6</sup> y	4640-4873	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-210-PM	Polonium-210	138.376 d	5304	Electroless Deposition onto Silver Substrate	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-238P-PM	Plutonium-238	87.74 y	5456, 5499	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-239-PM	Plutonium-239	2.411 x 10 <sup>4</sup> y	5105, 5143, 5156	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-226-PM	Radium-226 <sup>(2,3)</sup>	1,600 y	4601, 4784 Daughters 5489 thru 7687	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-228-PM	Thorium-228 <sup>(2,4)</sup>	698.2 d	5341, 5423 Daughters 5449 thru 8784	Electroplated onto Platinum Surface	1 nCi-100 nCi (37 Bq-3.7 kBq)
AF-230-PM	Thorium-230	7.54 x 10 <sup>4</sup> y	4621, 4688	Electroplated onto Platinum Surface	1 nCi-10 nCi (37 Bq-370 Bq)
AF-232-PM	Thorium-232 <sup>(1,2)</sup>	1.405 x 10 <sup>10</sup> y	3952, 4010	Electroplated onto Platinum Surface	0.007 nCi (0.26 Bq)
AF-235-PM	Uranium-235 <sup>(1,2)</sup>	7.037 x 10 <sup>8</sup> y	4215-4597	Electroplated onto Aluminum Foil	Max. Activity 0.4 nCi (14.8 Bq)
AF-238(Nat)-PM	Uranium-238(Nat) <sup>(1,2)</sup>	4.468 x 10 <sup>9</sup> y	4147, 4196	Electroplated onto Aluminum Foil	Max. Activity 0.05 nCi (1.85 Bq)
AF-238D-PM	Uranium-238D <sup>(1,2)</sup>	4.468 x 10 <sup>9</sup> y	4147, 4196	Electroplated onto Aluminum Foil	Max. Activity 0.032 nCi

1) Not supplied as spectroscopy grade sources.

2) Not necessarily in equilibrium with daughters at time of shipment.

3) Radium-226 will leak Rn-222 gas.

4) Thorium-228 will leak Rn-220 gas.

### Alpha Source Set

Catalog Number	Overall Dimensions (OD x Height)	Active Diameter	Nature of Active Material	Window	Set Consists Of
AF-0200	1" X 0.125" 25.4 mm X 3.18 mm	0.197" 5 mm	Electroplated onto Platinum Surface	No Window	Am-241 (0.1 µCi/3.7 kBq), Th-228 and Th-230 (0.01 µCi/370 Bq)

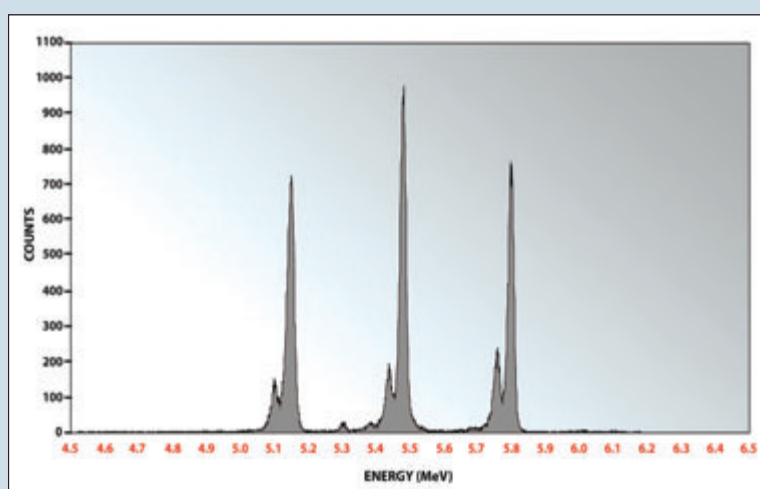
### Composite Alpha Source—AF Comp

The composite alpha source is designed to be used as an energy marker for alpha spectroscopy systems. Pu-239, Am-241 and Cm-244, 0.01 µCi (370 Bq) each, are electroplated onto a polished platinum or platinum clad nickel foil. The active area is 0.197" (5.0 mm). The source is supplied uncovered. These nuclides provide alpha particles from approximately 5100 to 5800 keV and exhibit line widths typically less than 20 keV FWHM. This energy range is wide enough to provide a valid energy calibration for most alpha emitting nuclides.

The source, when purchased as a NIST traceable standard, can also be used to determine detector efficiencies for alpha particles. Total activity and individual activities are provided on the Certificate of Calibration.

The composite alpha source is available in the type A-2, A-1, and PM configurations as described on pages 36–38.

**Figure 39-A:**  
Composite Alpha Source Spectrum Using Silicon Barrier Detector



### Standard Windows

Window Material	FWHM Increase	Energy Decrease
100 µg/cm <sup>2</sup> Gold	15 keV	15 keV