Gamma-Ray Standards

Analytics' Mixed-Gamma-Ray Standards provide efficiency calibrations for germanium gamma-ray-spectrometer systems over a wide energy range. These radionuclide mixtures provide the most accurate calibrations available for modern, high-efficiency germanium detectors.

All custom-made, gamma-ray calibration standards must pass Analytics' quality-control requirements as follows:

Calibrations utilizing Analytics' standards demonstrate traceability to NIST. Analytics' participation in the NIST/ Nuclear Energy Institute (NIST/NEI) Measurements Assurance Program for the Nuclear Power Industry satisfies the requirements of the United States' Nuclear Regulatory Commission's Regulatory Guide 4.15, Revision 1, 1979, and ANSI N42.22-1995 American National Standard – Traceability of Radioactive Sources to the National Institute of Standards and Technology (NIST) and Associated Instrument Quality Control.

Each standard is prepared gravimetrically with a calibrated balance.

After preparation, each standard is counted with a calibrated, germanium spectrometer system.

The counting efficiencies at each primary energy are compared to the counting efficiency of at least one independent standard and agreement must be within Analytics' stated uncertainty. For the quality-control testing of custom-geometry gamma-ray standards, Analytics maintains a current database including efficiencies from more than 40,000 individual standards in over 600 geometries.

Mixed Gamma Standard (Basic 8-isotope mixture): Advantages

The Mixed Gamma Standard contains carefully selected radionuclides for minimum spectral interference.

The use of multiple gamma-ray-emitting radionuclides with simple spectra (single or at most twin gamma-ray emissions) allows the activities of each component to be adjusted to give approximately equal counting statistics across the entire energy range. The result is that all regions of the energy-versus-efficiency curve will have equal precision.

This mixture minimizes coincident summing effects, which is particularly important when counting close to large, high-efficiency, germanium detectors. For more information on problems with coincidence summing consult "The Counting Room: Special Edition," Radioact. Radiochem., McFarland, T., Ed; Caretaker Communications, 1994; pp 67-86.

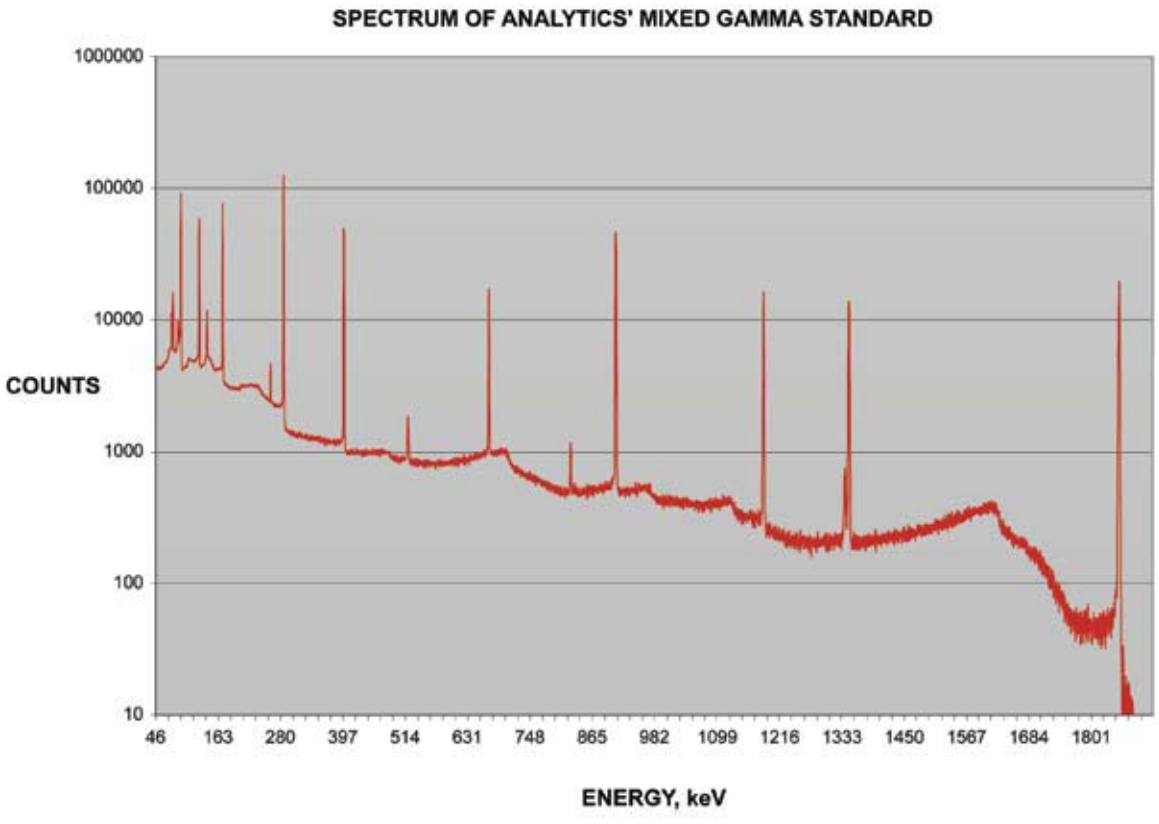
The calibration is performed by germanium spectrometry on the final mixture. This procedure provides verifiable final calibrations and uncertainty values for each component. Typical uncertainties are in the range of 3 - 4%, relative expanded uncertainty (k=2).

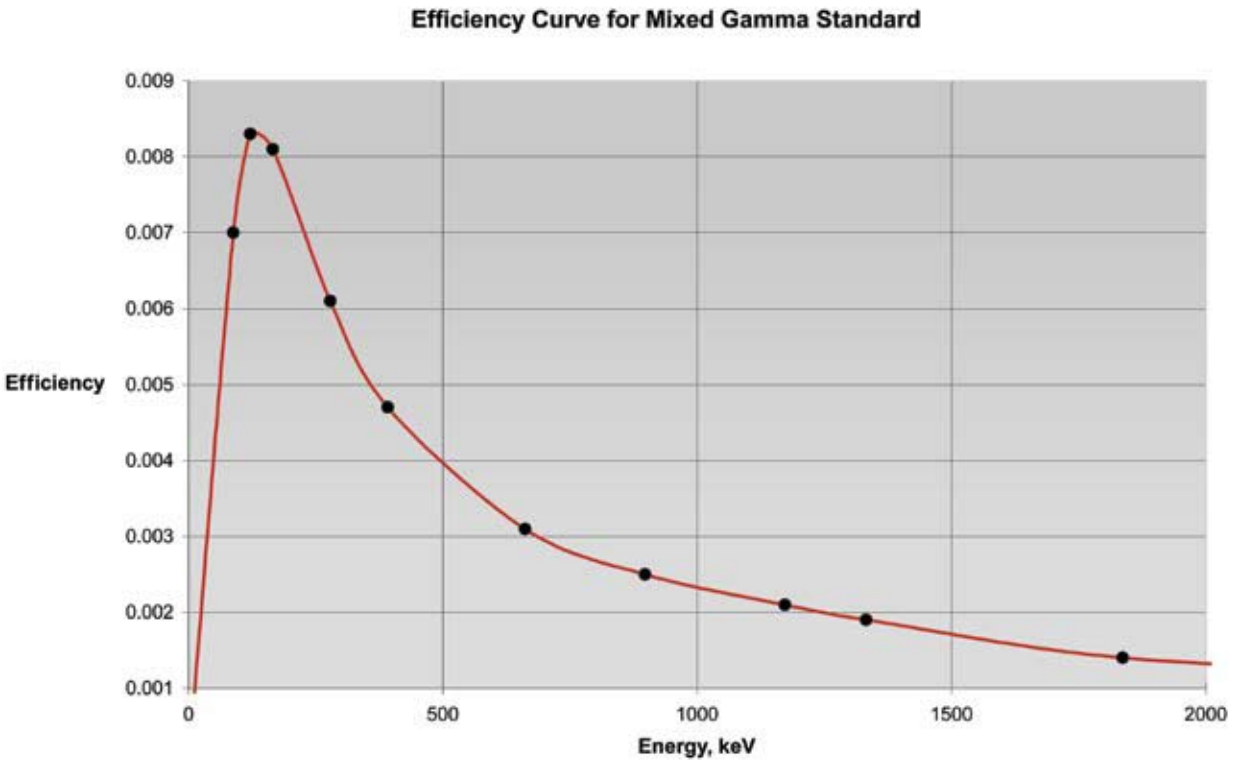
Gamma-Ray Standards

Matrices

Over the past twenty-five years Analytics has prepared custom-made standards in hundreds of different geometries utilizing many different matrices.

- Water-equivalent solid standards are prepared in hundreds of different geometries. These standards are individually traceable and much safer to handle in the counting room than liquid standards. There is no possibility of leakage, spillage or plate-out of the radioactive material. Matrix density is 1.15 g/cc.
- Air filter standards are uniformly deposited to your specifications and sealed in customer supplied counting configurations.
- Charcoal and silver zeolite cartridge standards are prepared in customer supplied cartridges loaded to your specifications.
- Soil or sand standards are prepared in customer supplied counting containers. Matrix density ranging from 1.5 g/cc to 1.7 g/cc.
- High density solids with density range from 1.5 to 2.0 g/cc.
- Vegetation or simulated vegetation standards are prepared in customer supplied counting containers with an approximate density of 0.6 g/cc.
- Simulated gas standards are prepared in customer supplied gas counting containers. These low-density (0.02 g/cc) standards have the same gamma-ray attenuation characteristics as actual gas standards and greatly extend the energy range and useful life of the calibration standard.
- Point sources are mounted in various geometries, again to your specifications.





Other Mixtures

Analytics' Mixed Gamma Standard utilizes the basic eight radionuclides listed as Option 1 in the Mixed Gamma-Ray Standards Table. The approximate gamma-ray emission rate for a 3 microCi (111 kBq) source is given as an example. Option 2 adds ^{241}Am to the mixture to extend the energy range down to 59.5 keV. Option 3 adds ^{85}Sr to give a gamma-ray emission at 514 keV, which is useful in some applications. Option 4 adds both ^{241}Am and ^{85}Sr. To further extend the low-energy range to 46.5 keV, ^{210}Pb can be added to the mixture. In order to measure coincidence-summing effects ^{65}Zn (1115 keV) and ^{54}Mn (835 keV) can be added. Option 5 replaces the ^{203}Hg in the mixture with ^{51}Cr, and adds ^{85}Sr. Option 6, True Coincidence Correction (TCC) mixture, is used with special software to correct for coincidence summing effects. Custom mixtures for other applications such as NaI(Tl) spectrometry can also be prepared. See tables listed for all options.

For additional information consult our technical representatives.

Gamma-Ray Standards

Mixed Gamma-Ray Standards Table

Option 1 Basic Eight Radionuclide Mixture			
Radio-Nuclide	Energy (keV)	Half-Life	Approx Emission Rate*
^{109}Cd	88	462.6 d	2900
^{57}Co	122	271.79 d	1900
^{139}Ce	166	137.6 d	2400
^{203}Hg	279	46.61 d	4500
^{113}Sn	392	115.1 d	3300
^{137}Cs	662	30.07 y	2200
^{88}Y	898	106.6 d	8000
^{60}Co	1173	5.271 y	3800
^{60}Co	1332	5.271 y	3800
^{88}Y	1836	106.6 d	8400

Option 2 Basic Eight Radionuclide Mixture Plus			
Radio-Nuclide	Energy (keV)	Half-Life	Approx Emission Rate*
^{241}Am	59.5 keV	432 y	2200

Option 3 Basic Eight Radionuclide Mixture Plus			
Radio-Nuclide	Energy (keV)	Half-Life	Approx Emission Rate*
^{85}Sr	514 keV	64.84 d	3900

Option 4 Basic Eight Radionuclide Mixture Plus			
Radio-Nuclide	Energy (keV)	Half-Life	Approx Emission Rate*
^{241}Am	59.5 keV	432 y	2200
^{85}Sr	514 keV	64.84 d	3900

* Approximate gamma-ray emission rate (gps) from a 3 microCi (111 kBq) standard. Individual emission rates may vary from batch to batch.

Mixed Gamma-Ray Standards Table (cont.)

Option 5 Basic Eight Radionuclide Mixture Replaces ^{203}Hg with ^{51}Cr and adds ^{85}Sr			
Radio-Nuclide	Energy (keV)	Half-Life	Approx Emission Rate*
^{51}Cr	320.1 keV	27.7 d	4600
^{85}Sr	514 keV	64.84 d	3900

Option 6 True Coincidence Correction Mixture (TCC)			
Radio-Nuclide	Energy (keV)	Half-Life	Approx Emission Rate*
^{241}Am	59.5	432 y	2300
^{109}Cd	88	462.6 d	2100
^{57}Co	122	271.79 d	1300
^{139}Ce	166	137.6 d	1600
^{203}Hg	279	46.61 d	3900
^{113}Sn	392	115.1 d	2100
^{85}Sr	514	64.84 d	4400
^{134}Cs	604.7	754.2 d	7000
^{137}Cs	662	30.07 y	1500
^{134}Cs	795.9	754.2 d	6100
^{54}Mn	834.9	312.1 d	4000
^{88}Y	898	106.6 d	7000
^{65}Zn	1115.6	244.3 d	5400
^{88}Y	1836	106.6 d	7400

* Approximate gamma-ray emission rate (gps) from a 3 microCi (111 kBq) standard. Individual emission rates may vary from batch to batch.