

National Bureau of Standards

Certificate

Standard Reference Material 4275B

MIXED-RADIONUCLIDE POINT-SOURCE STANDARD
for the
EFFICIENCY CALIBRATION OF GERMANIUM-SPECTROMETER SYSTEMS

Antimony-125-Tellurium-125m
Europium-154
Europium-155

Source identification	SRM-4275B-
Source description	Point source on polyester tape (1)*
Reference time	1200 EST May 1, 1983

This standard is intended for use in measuring the full-energy-peak efficiencies of spectrometer systems for x and gamma rays from 27 to 1596 keV, provided that the responses to radiations approximately 5 keV apart can be resolved. Emission rates are specified at 18 energies for photon radiations from a mixture of antimony-125-tellurium-125m, europium-154, and europium-155. Uncertainties are estimated and combined at a level corresponding to a standard deviation of the mean, with the intent that the user can propagate this uncertainty along with the other uncertainties in the spectrometer calibration. For a more conservative overall uncertainty corresponding to that given on other NBS radioactivity certificates, multiply the combined uncertainty by three.

Table 1 gives the energies, emission rates, and uncertainties for selected radiations. A footnote indicates how emission rates will change with time. If there are any changes in measured emission rates that would correspond to an emission rate 0.5 percent different from that calculated from Table 1, or in measured half lives that would cause a corresponding difference after five years, notification will be sent to purchasers of the standard.

Table 2 lists the estimates of component uncertainties which have been added in quadrature to give the combined uncertainty in each emission rate.

Notes on the use of this standard are appended. One of the tables in the supplemental notes gives relative emission rates for radiations close in energy to the certified radiations; for spectrometer systems of poorer resolution, it may be necessary to use a combined emission rate for some multiple peaks.

This Standard Reference Material was prepared in the Center for Radiation Research, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD 20899
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Stanley D. Rasberry, Chief
Office of Standard Reference Materials

TABLE 2

Estimates of the Component Uncertainties for
Photon-Emission-Rate Values for SRM 4275B

TYPICAL UNCERTAINTY COMPONENTS (%)

Photon Energy (keV)	Number of Determinations	Std. Dev. of the Mean	Efficiency	Peak Analysis	Pile-up Compensation	Geometry	Other*	Combined Uncertainty**
27.4	6	0.3	1.0	0.7	0.3	0.1	0.2	1.31
42.8	6	0.06	1.0	0.7	0.1	0.1	0.5	1.3
86.6	6	0.12	0.65	0.3	0.1	0.1	0.05	0.74
105.3	6	0.09	1.0	0.3	0.1	0.1	0.05	1.1
123.1	6	0.08	0.6	0.4	0.1	0.08	0.05	0.74
176.4	6	0.09	0.5	0.2	0.2	0.1	0.05	0.59
248.0	6	0.04	0.5	0.3	0.1	0.08	0.05	0.60
427.9	6	0.23	0.7	0.2	0.2	0.08	0.05	0.79
463.4	7	0.22	0.58	0.2	0.2	0.08	0.05	0.69
591.7	6	0.12	0.45	0.3	0.1	0.08	0.05	0.57
600.6	7	0.20	0.42	0.4	0.2	0.08	0.05	0.65
635.9	6	0.19	0.42	0.2	0.2	0.08	0.05	0.55
723.3	6	0.05	0.54	0.2	0.1	0.08	0.05	0.59
873.2	5	0.12	0.63	0.3	0.1	0.08	0.05	0.72
996.4	5	0.11	0.54	0.75	0.1	0.08	0.05	0.94
1004.8	5	0.06	0.54	0.4	0.1	0.08	0.05	0.69
1274.4	5	0.06	0.45	0.1	0.1	0.08	0.05	0.48
1596.5	6	0.43	0.40	0.1	0.2	0.15	0.05	0.64

* Includes contributions for the half lives for the Te x ray, for the decay schemes for Gd x ray, and for gravimetric factors in the source preparation.

** Components of the uncertainty have been added in quadrature. This is the overall uncertainty for a typical detector, and some of the values are slightly greater than those given in the last column in Table 1.

NOTES

- (1) This source consists of a dried deposit of the chlorides and sulfides, on a 0.3-cm diameter circle of cation exchange paper, on polyester tape 0.006-cm thick and covered by another layer of the same tape. The tape is supported by an aluminum annulus which is 0.1-cm thick with an inner diameter of 3.8 cm and an outer diameter of 5.4 cm.
- (2) These values are based on gamma-ray spectrometry measurements made at the National Bureau of Standards, which are described in the reference: B.M. Coursey, D.D. Hoppes, and F.J. Schima, "Determination of the Photon Emission Rates of the NBS Long-Lived Mixed-Radionuclide Standard", Nuclear Instruments and Methods 193, 1 (1982).
- (3) Emission rates at later times can be calculated using the following evaluated half-life values and decay constants:

	<u>Half Life</u>	<u>Decay Constant</u>
^{125}Sb	1008 ± 2 days	$6.876 \times 10^{-4} \text{ days}^{-1}$
^{154}Eu	3140 ± 12 days	$2.207 \times 10^{-4} \text{ days}^{-1}$
^{155}Eu	1739 ± 4 days	$3.986 \times 10^{-4} \text{ days}^{-1}$

- (4) For the 42.8-keV Gd K_{α} x rays, the emission rate N_t is given by

$$N_t = N_0 \times (0.6724 e^{-2.207 \times 10^{-4} t} + 0.3276 e^{-3.986 \times 10^{-4} t}),$$

where N_0 is the emission rate given in Table 1, and t is the time in days from 1200 EST May 1, 1983.

For further information contact Dr. F.J. Schima (301) 975-5537 or Dr. D.D. Hoppes (301) 975-5532.

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