

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 4219-B

Gamma Ray Solution Standard

Cadmium-109-Silver-109m

This Standard Reference Material consists of cadmium-109-silver-109m in grams of carrier solution in a flame-sealed borosilicate-glass ampoule. The solution contains approximately 660 micrograms of cadmium per gram of approximately 1.3 molar hydrochloric acid, and has a density of 1.020 ± 0.005 grams per milliliter at 21°C .

The number of silver-109m gamma rays emitted per second per gram of solution at 1200 EST November 8, 1976, was

$$*1.112 \times 10^5 \pm 2.02%*$$

This Standard Reference Material was measured, relative to a radium-226 reference source, in the National Bureau of Standards " 4π " pressure ionization chamber which had previously been calibrated, in terms of a radium-226 reference source, with cadmium-109-silver-109m solutions from which quantitative sources had been prepared and calibrated in a NaI(Tl) pin-well detector.

The uncertainty in the emission rate, 2.02 percent, is the linear sum of 0.06 percent, which is the limit of the random error at the 99-percent confidence level ($2.878 S_m$, where S_m is the standard error computed from 19 sets of ionization-chamber measurements) and 1.96 percent, which is the estimated upper limit of conceivable systematic error.

Using the total internal conversion coefficient, 25.4 ± 0.5 for the 88.041-keV transition following the decay of cadmium-109, reported by J. Legrand, M. Blondel, and P. Magnier, Nuclear Instruments and Methods, 112, 101 (1973), the activity at 1200 EST November 8, 1976, would have been

$$*2.94 \times 10^6 \text{s}^{-1} \text{g}^{-1} \pm 3.99%*$$

The uncertainty in the activity, 3.99 percent, is the linear sum of 2.02 percent, which is the uncertainty in the gamma-ray-emission rate, and 1.97 percent, which is the error associated with the photon probability per decay.

The solution from which this Standard Reference Material was prepared was purified with respect to zinc-65 and silver-110m, and upon subsequent examination with germanium-spectrometer systems, no photon-emitting impurities were observed. It is estimated that any impurity photon with an energy greater than 88 keV and an emission rate greater than 10^{-4} that of the 88-keV gamma ray of silver-109m would have been detected; the corresponding limit for any impurity photon with an energy less than 88 keV is 10^{-3} .

(over)

(2)

A half life of (464.0 ± 1.0) days is suggested. This value is based on 139 sets of $^{4\pi}\gamma$ ionization-chamber measurements spanning 2.04 half lives. The uncertainty, 1.0 day, is the linear sum of one standard error and the estimated systematic error. Half-life measurements and gamma-ray spectral analyses will be made periodically on the material from which this Standard Reference Material was prepared, and users will be notified if the measurements indicate departure from previously found results.

This Standard Reference Material was prepared and calibrated in the Center for Radiation Research, Radioactivity Section, W. B. Mann, Chief.

J. Paul Cali, Chief
Office of Standard Reference Materials

Washington, D.C. 20234
January, 1977

SRM 4219-B-