U. S. Department of Commerce
Maurice H. Stans
Secretary

National Bureau of Standards
L. M. Branscomb, Director

Certificate

Standard Reference Material 4228

Radioactivity Standard

Selenium-75

This standard consists of selenium-75 and carrier in 4.590 ± 0.012* grams of solution in a flame-sealed glass ampoule. The carrier solution contains 330 milligrams of H_2SeO_3 per liter of 1 *N* HNO_3.

*The uncertainty, 0.012 gram, is the statistical tolerance limit computed from 20 samples with 95 percent probability for coverage of 95 percent of the population. See Experimental Statistics, Nat. Bur. Stand. (U.S.), Handbook 91 (1963), pp 1-14, 1-15, and T-11.

The activity in nuclear transformations per second per gram of solution as of 1000 EST March 31, 1971, was

$$*2.54_1 \times 10^5 \pm 2.3_2\%* .$$

The activity of the solution from which this standard was prepared was determined by comparing it with NBS working standards of selenium-75. The working standards were calibrated by x-γ coincidence counting, assuming that the ratio of K-x-rays arising from internal conversion to those arising from capture is 0.1119/0.880 (Nuclear Data Tables A8, 1-198, 1970). If this ratio were to change by 10 percent, the certified value would be changed in inverse proportion by 1.15 percent.

The uncertainty in the activity, 2.3_2 percent, is the sum of: 0.1_4 percent, which is the limit of the random error at the 99 percent confidence level (i.e., 3.36 S_m, where S_m is the standard error computed from 9 coincidence measurements); 0.4_4 percent, which is the intercomparison error; 0.6_3 percent, which is the maximum uncertainty due to the estimated systematic errors in the measurements; and 1.1_1 percent, the uncertainty attributable to the decay-scheme data available for the radionuclide.

The gamma-ray spectrum of this material was examined with a Ge(Li)-spectrometer and no impurities were observed.

A half-life of 119.68 ± 0.14 days is suggested. This value is the weighted mean of 17 sets of $4\pi\gamma$ ionization-chamber measurements on each of two different samples of the material that was used to prepare working standards of selenium-75. The uncertainty, 0.14 day, is the weighted standard error (each of the standard errors was computed at the 99 percent confidence level). Half-life measurements and gamma-ray spectrum analyses will be made periodically on the material from which this standard was prepared, and users will be notified if the measurements indicate departure from the previously found results.

This standard was prepared and calibrated in the NBS Center for Radiation Research, Nuclear Radiation Division, Radioactivity Section, W. B. Mann, Chief.

Washington, D. C. 20234
April, 1971

J. Paul Cali, Chief
Office of Standard Reference Materials

NOTES ON THE USE OF SRM 4228, SELENIUM-75

Selenium-75, SRM 4228, although designed mainly as a radioactivity standard for nuclear medicine, is also very useful for determining the shape of the peak-efficiency curve at lower energies for Ge(Li) detectors, as there are several conveniently spaced lines of adequate abundance. Care must be taken to avoid incorrect results caused by summing, in the detector, of groups of low-energy γ rays that together can give exactly the same total energy as that of a single higher-energy γ ray. The degree of summing can be estimated by performing the calibration measurements at two or more source-to-detector distances.

The 0.40064-MeV γ-ray intensity, which was determined during the calibration of SRM 4228 to be 0.125 per transition, agrees well with similar measurements performed by other groups.

It is recommended that any diluent for this solution contain a concentration of carrier at least as great as that shown on the Certificate.

[1] Martin, M. J., and Blichert-Toft, P. H., Nuclear Data Tables, **A8**, 50-51, 1970.

[2] Gehrke, R. J., Cline, J. E., and Heath, R. L., Nuclear Instruments and Methods **91**, 349, (1971).

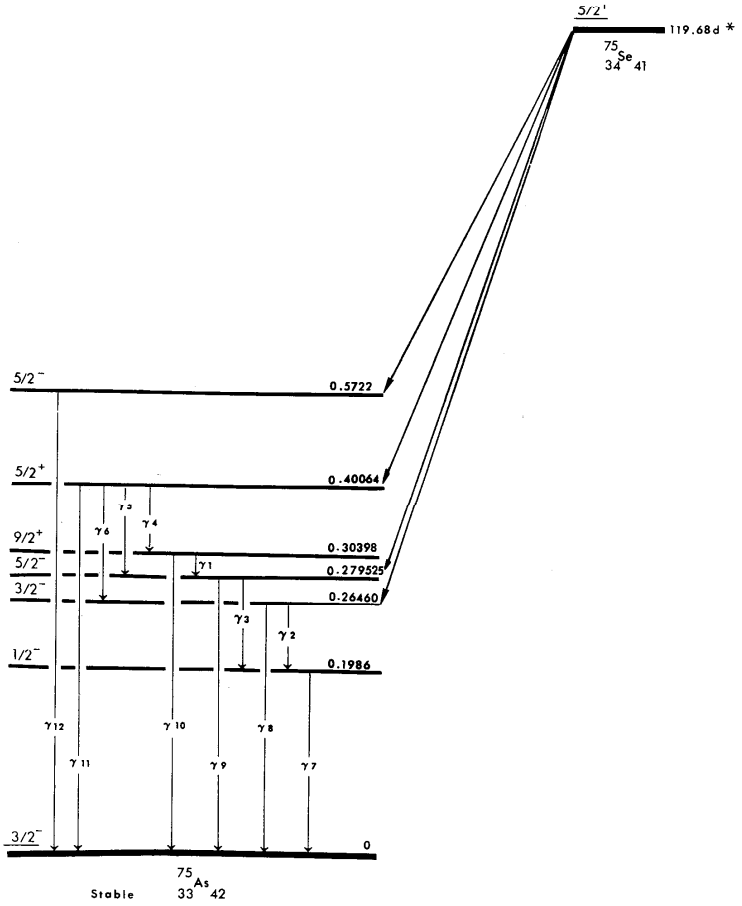

Figure 1. Decay Scheme of Selenium-75 [1,2].
*Half life is NBS suggested value.

Radiation (X or γ)	Energy (MeV)	Relative Intensity	Reference
X_L	0.00128	$\approx$2.4	1
X_K	.01066	92.0	1
γ_1	.02448	0.044	1
γ_2	.066048	1.77	2
γ_3	.08091	0.03	1
γ_4	.096732	5.60	2
γ_5	.121113	28.19	2
γ_6	.135998	98.25	2
γ_7	.198600	2.43	2
γ_8	.264651	100.00	2
γ_9	.279525	43.22	2
γ_{10}	.303895	2.31	2
γ_{11}	.400640	19.56	2

Table 1. Gamma-ray Energies and Relative Intensities.

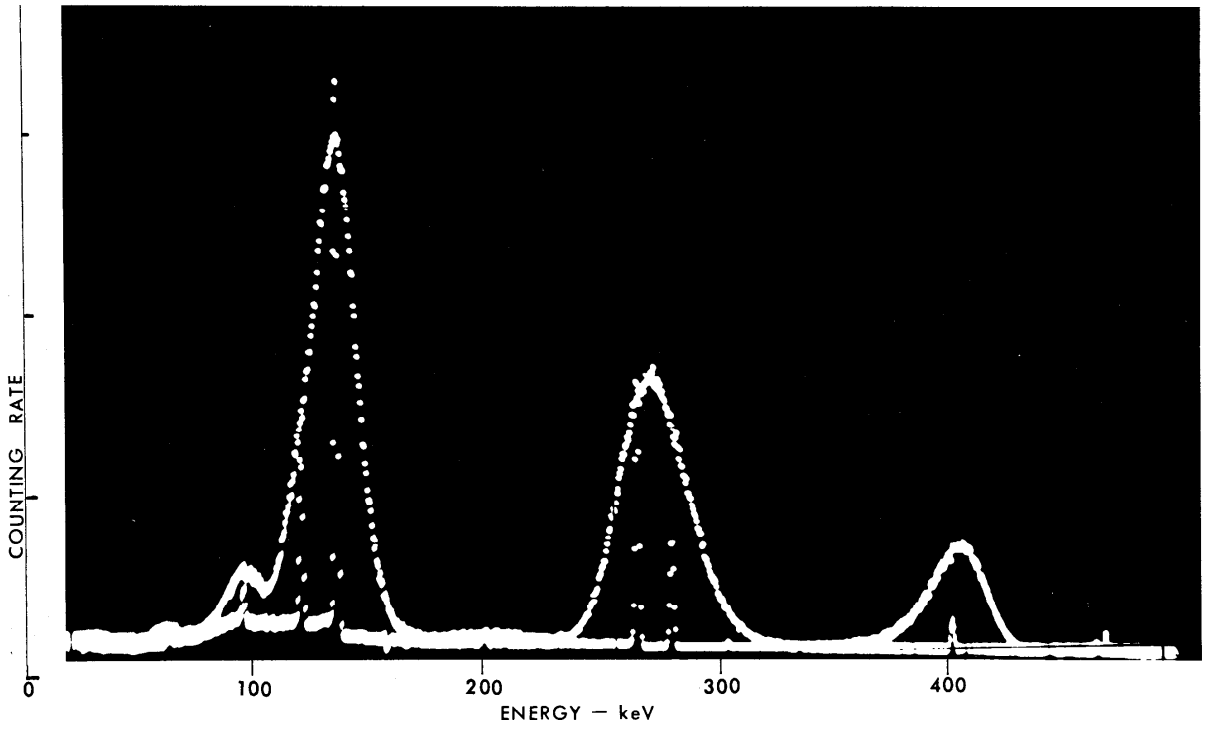

Figure 2. Gamma-ray spectra using a 3-in by 3-in NaI(Tl) and a 20 cm^3 Ge(Li) detector. The two spectra are superimposed.