

National Bureau of Standards

Standard Reference Material 4370-B

Radioactivity Standard

Europium-152

This Standard Reference Material consists of europium-152 in _____ grams of carrier solution in a flame-sealed borosilicate-glass ampoule. The solution, which contains 278 micrograms of europium per gram of approximately 1 M hydrochloric acid, has a density of 1.016 ± 0.002 g/mL at 21°C.

The radioactivity concentration of the europium-152 at 1100 EST June 15, 1979, was

$$*1.773 \times 10^5 \text{ s}^{-1}\text{g}^{-1} \pm 1.53\%*$$

Accurately weighed and dried aliquants of a master solution were measured, by photon counting, in the National Bureau of Standards 4 π , 20.32-cm-diameter, NaI(Tl) well crystals. The solution from which this Standard Reference Material was prepared is a quantitative dilution of the master solution.

The uncertainty in the radioactivity concentration, 1.53 percent, is the linear sum of 0.09 percent, which is the limit of the random error of the NaI(Tl) well-crystal measurements at the 99-percent confidence level ($4.032 S_m$, where S_m is the standard error computed from six measurements) and 1.44 percent, which is the sum of the estimated upper limits of conceivable systematic errors.

The photon spectrum was examined with Ge(Li) and pure Ge spectrometers and the material was found to contain europium-154 and gadolinium-153 whose activities, as of the calibration date, were 0.36 percent and 0.45 percent, respectively, of the europium-152 activity. No other photon-emitting impurities were observed. The limit of the photon-emission rate at any given energy due to other impurities is estimated to be less than 0.1 percent of the emission rate of the 1408-keV gamma ray of europium-152, provided that the impurity photons are separated in energy by 5 keV or more from photons of equal or greater intensity emitted by europium-152, europium-154, or gadolinium-153.

The europium-152 activity, A , was obtained using the formula

$$A = T / [e_1 + f_2 \cdot e_2 + f_3 \cdot e_3],$$

where T is the total count rate, derived from an extrapolation to zero energy, f_2 (= 0.0036) and f_3 (= 0.0045) are the ratios of the activities of europium-154 and gadolinium-153, respectively, to that of europium-152, and e_1 (= 0.959), e_2 (= 0.885) and e_3 (= 0.874) are the total detection efficiencies for europium-152, europium-154 and gadolinium-153, respectively, calculated using the known decay schemes and the experimentally determined total efficiency curve for the 20.32-cm-diameter well crystals.

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

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