U.S. Department of Commerce
Elliot L. Richardson,
Secretary

National Bureau of Standards
nest Ambler, Acting Director

National Bureau of Standards Certificate

Standard Reference Material 4206-B

Gamma-Ray Standard
Thorium-228-Thallium-208

This Standard Reference Material consists of thorium-228 in equilibrium with its daughters, deposited as the nitrate on 0.0019-cm-thick gold foil which was covered with another layer of similar gold foil. The gold covered source is sandwiched between two double layers of 0.036-cm-thick polyurethane-film tape.

The number of 2.614-MeV gamma rays of thallium-208 emitted per second at 1200 EST December 7, 1976, was

* ± 1.77%*.

This Standard Reference Material was calibrated by comparing its gamma-ray-emission rate, in a reproducible geometry, with that of an NBS working standard of thorium-228. The working standard had been calibrated by comparing it, through alpha-ray emission-rate measurements, using a Si surface barrier detector (see NBS Special Publication 331), with an americium-241 working standard which had been calibrated in the NBS medium geometry alpha counter.

In calculating the gamma-ray-emission rate, (35.93 ± 0.06) percent was used as the fraction of bismuth-212 which decays to thallium-208 [Nuclear Data Sheets, 8, No. 2, 1972].

The uncertainty, 1.77 percent, is the linear sum of:

1. 0.11 percent, which is the limit of the random error at the 99-percent confidence level, of the gamma-ray comparison of this Standard Reference Material with the thorium-228 working standard, and

2. 0.84 percent, which is the estimated upper limit of conceivable systematic errors in the gamma-ray comparison, and

3. 0.32 percent, which is the limit of the random error at the 99-percent confidence level, of the thorium-228 working standard, and

4. 0.50 percent, which is the estimated upper limit of conceivable systematic errors in the calibration of the thorium-228 working standard.

The solution from which this Standard Reference Material was prepared was examined for photon-emitting impurities with a Ge(Li)-spectrometer system and none was observed.

(over)

Photons with energies less than 583 keV and emission rates greater than 0.5 percent of that of the 583-keV gamma ray in the decay of thallium-208 would have been detected if they differed from the energy of any expected gamma ray by more than 10 keV. For photon energies greater than 583 keV, the corresponding limit would be 0.2 percent.

A half life of 698.0 ± 0.5 days is suggested. This value is based on 68 sets of "4π"γ pressure ionization-chamber measurements made over a period of 2478 days, on each of two sources of the material from which the first series of Standard Reference Materials was prepared. The uncertainty, 0.5 day, is the sum of the limit of the random error at the 99-percent confidence level, and the estimated systematic error.

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

J. Paul Cali, Chief
Office of Standard Reference Materials

Washington, D.C.
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