

# National Bureau of Standards

## Certificate

### Standard Reference Material 4206-C

#### Gamma-Ray Point-Source Standard

Radionuclide	Thorium-228/Thallium-208 (1)*
Source identification	4206-C-
Gamma-ray-emission rate at 2.615 MeV	$\times 10^4 \text{ s}^{-1}$ (2)
Reference time	1200 EST, November 15, 1980
Half life	$1.9131 \pm 0.0009$ years (3)
Measuring instrument	Silicon surface-barrier detector (4)
Random uncertainty	0.28 percent (5)
Systematic uncertainty	1.72 percent (6)
Total uncertainty (Random plus Systematic)	2.00 percent

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

Washington, D.C. 20234  
November, 1980

George A. Uriano, Chief  
Office of Standard Reference Materials

\*Notes on back

## FOOTNOTES

- (1) Thorium-228, in equilibrium with its progeny, including thallium-208, deposited as the nitrate on 0.0028-cm-thick gold foil which is covered with a layer of 0.0022-cm-thick aluminum foil. The covered source is sandwiched between polyester tape approximately 0.006-cm thick. The tape is supported on an aluminum annulus 3.8-cm inside diameter and 5.4-cm outside diameter.
- (2) Based on alpha-particle measurements and the following data relating them to the emission rate of the 2.615-MeV gamma ray from the decay of thallium-208: gamma-ray probability per decay of  $0.99790 \pm 0.00010$ , (D.C. Kocher, ORNL/NUREG/TM-102, p. 74 (1977)); an alpha-particle branching ratio for bismuth-212 of  $0.3593 \pm 0.0006$  (ibid., p. 76); and  $1.0053 \pm 0.0001$  for the ratio of the bismuth-212 activity to that of thorium-228 in equilibrium.
- (3) Kocher (ibid., p. 84).
- (4) Calibrated by comparison, using alpha-particle-emission rate measurements, with an americium-241 working standard which had been calibrated in the NBS medium-geometry alpha-particle system.
- (5) Half the 99-percent confidence interval of the mean (4.60 times the standard error computed from 5 measurements).
- (6) Linear sum of estimated uncertainty limits due to:
  - a) calibration of the silicon surface-barrier detector system 1.08 percent
  - b) probability of 2.615-MeV gamma ray per decay 0.02 percent
  - c) alpha-particle branching ratio for  $^{212}\text{Bi}$  0.30 percent
  - d) equilibrium of  $^{224}\text{Ra}$  0.02 percent
  - e) half life 0.10 percent
  - f) system live time 0.10 percent
  - g) count-rate vs. energy extrapolation to zero energy 0.10 percent

For further information please call J.M.R. Hutchinson (301) 921-2396 or P.A. Mullen (301) 921-2383.