

## Certificate

# Standard Reference Material 4205 Gamma-Ray Standard Thorium-228-Thallium-208

This standard consists of thorium-228, in equilibrium with its daughters, deposited as the nitrate on 0.0019-centimeter thick gold foil to which was cemented another layer of similar gold foil. The gold-covered source is sandwiched between two double layers of 0.036-centimeter thick polyurethane-film type.

The number of 2.615-MeV gamma rays of thallium-208 emitted per second at 1400 EST August 16, 1968, was

$$* \quad \pm 2.2_0\%*$$

This standard 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, to a polonium-210 standard.

In calculating the gamma-ray-emission rate certified above,  $36.00 \pm 0.03$  percent was used as the fraction of bismuth-212 which decays to thallium-208 (J. Walker and T. Salgir, Proc. Phys. Soc., 1965, Vol. 86, pp. 423-425).

The uncertainty, 2.2<sub>0</sub> percent, is the sum of:

- 1) 0.5<sub>4</sub> percent, which is the standard error, at the 99 percent confidence level, associated with the gamma-ray emission-rate measurements, and
- 2) 0.1<sub>0</sub> percent, which is the maximum uncertainty due to assessable systematic errors in the gamma-ray emission-rate measurements, and
- 3) 1.4<sub>1</sub> percent, which is the standard error, at the 99 percent confidence level, associated with the calibration of the working standard, and
- 4) 0.1<sub>5</sub> percent, which is the maximum uncertainty due to assessable systematic errors in the calibration of the working standard.

The gamma-ray spectrum of the material from which this standard was prepared was examined using a lithium-drifted germanium detector and no impurities were observed.

A half life of  $1.910 \pm 0.009$  years is suggested. This value is based on twenty-six sets of  $4\pi\gamma$  ionization chamber measurements using samples of the material from which this standard was prepared. The uncertainty, 0.009 year, is one standard error.

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

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