

# National Bureau of Standards

## Certificate

### Standard Reference Material 4420L-B

#### Radioactivity Standard

Radionuclide	Lead-203
Source identification	4420L-B-
Source description	Liquid in NBS borosilicate-glass ampoule (1)*
Solution composition	Approximately 25 $\mu\text{g}$ $\text{PbCl}_2$ per gram of approximately 0.5 molar hydrochloric acid (2)
Mass	grams
Radioactivity concentration	$4.300 \times 10^6 \text{ Bq g}^{-1}$
Reference time	1000 EST November 26, 1984
Overall uncertainty	0.97 percent (3)
Photon-emitting impurities (Activity ratios at reference time)	$^{200}\text{Tl}/^{203}\text{Pb}$ : $(5.47 \pm 0.66) \times 10^{-4}$ (4) $^{201}\text{Tl}/^{203}\text{Pb}$ : $(2.34 \pm 0.23) \times 10^{-2}$ $^{201}\text{Pb}/^{203}\text{Pb}$ : $(3.56 \pm 0.71) \times 10^{-6}$ $^{202}\text{Tl}/^{203}\text{Pb}$ : $(4.47 \pm 0.45) \times 10^{-5}$
Half life	$51.92 \pm 0.04$ hours (5)
Measuring instrument	NBS pressurized $4\pi$ $\gamma$ ionization chamber calibrated by $4\pi(e,x)-\gamma$ coincidence efficiency-extrapolation technique

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

Gaithersburg, MD 20899  
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Stanley D. Rasberry, Chief  
Office of Standard Reference Materials

\*Notes on back

NOTES

- (1) Approximately five milliliters of solution. Ampoule specifications:

body diameter	16.5 ± 0.5 mm
wall thickness	0.60 ± 0.04 mm
barium content	less than 2.5 percent
lead oxide content	less than 0.02 percent
other heavy elements	trace quantities

- (2) Solution density 1.007 ± 0.002 g/ml at 21.7°C.

- (3) The overall uncertainty was formed by taking three times the quadratic combination of standard deviations of the mean, or approximations thereto, for the following:

a) 12 ionization-chamber measurements on this solution	0.01 percent
b) photon-emitting impurities in this solution	0.14 percent
c) dead time	0.05 percent
d) resolving time	0.02 percent
e) efficiency extrapolation	0.05 percent
f) photon-emitting impurities in original calibration	0.20 percent
g) half life	0.10 percent
h) gravimetric measurements	0.05 percent
i) six coincidence measurements	0.10 percent
j) gamma background	0.03 percent
k) beta background	0.10 percent
l) coincidence background	0.01 percent
m) original ionization-chamber measurements	0.01 percent
n) radium 200 to radium 1000 reference sources ratio	0.08 percent

- (4) Limits of detection as a percentage of the gamma-ray-emission rate of the 279-keV gamma rays emitted in the decay of lead-203 are

0.1 percent between 15 and 274 keV  
0.01 percent between 284 and 1900 keV,

provided that the impurity photons are separated in energy by five keV or more from photons emitted in the decay of lead-203.

- (5) NBS-measured half-life value. NCRP Report No. 58, 2nd edition, in preparation, lists a half-life value of 51.88 ± 0.01 hours.