

National Bureau of Standards Certificate

Standard Reference Material 4402L-C Radioactivity Standard

Radionuclide	Tin-113-indium-113m
Source identification	4402L-C-
Source description	Liquid in NBS borosilicate-glass ampoule (1)*
Solution composition	Approximately 2 micrograms of tin per gram of 4 molar hydrochloric acid (2)
Mass	grams
Indium-113m gamma-ray emission rate	$7.954 \times 10^5 \text{ } \gamma\text{s}^{-1}\text{g}^{-1}$ (3)
Reference time	1400 EST October 15, 1980
Random uncertainty	0.02 percent (4)
Systematic uncertainty	3.09 percent (5)
Total uncertainty (Random plus systematic)	3.11 percent
Photon-emitting impurities (Activity ratios at reference time)	$^{114\text{m}}\text{In}/^{113}\text{Sn}: 0.036 \pm 0.007$ (6) $^{125}\text{Sb}/^{113}\text{Sn}: 0.0012 \pm 0.0002$
Half life	115.1 ± 0.2 days (7)
Measuring instrument	NBS pressurized "4 π " γ ionization chamber calibrated by NaI(Tl)- and Ge(Li)-spectrometer systems.

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

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FOOTNOTES

(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 1.066 ± 0.002 g/ml at 22.8°C.

(3) Assuming a probability per decay of 64.90 percent for the 392 keV gamma ray of indium-113m the corresponding radioactivity concentration would be $1.226 \times 10^6 \text{ s}^{-1}\text{g}^{-1}$.

(4) Half the 99-percent confidence interval of the mean (2.898 times the standard error computed from 18 ionization-chamber measurements).

(5) Linear sum of estimated uncertainty limits due to

a) photon-emitting impurities 0.7 percent

b) calibration of the pressurized "4π"γ ionization chamber, which is the linear sum of estimated uncertainty limits due to

1) NaI(Tl)- and Ge(Li)-spectrometer measurements 2.23 percent

2) half the 99-percent confidence interval of the mean of the ionization-chamber measurements 0.05 percent

3) gravimetric measurements 0.1 percent

4) half life 0.01 percent

(6) Limits of detection as a percentage of the gamma-ray-emission rate of the 392-keV gamma rays emitted in the decay of indium-113m are

0.1 percent between 20 and 387 keV

0.01 percent between 397 and 1900 keV

provided that impurity photons are separated in energy by five keV or more from photons emitted in the decay of indium-113m.

(7) NCRP Report No. 58, 1978, p.368-9. NBS-measured half-life value is 115.06 ± 0.09 days.

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