



National Institute of Standards & Technology

Certificate

Standard Reference Material 4321B Alpha-Particle Solution Standard

Radionuclide	Natural Uranium
Source identification	SRM 4321B
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.3 grams
Solution composition	Natural uranium in 1-molar nitric acid
Uranium concentration	0.01998 g g ⁻¹
Reference time	1200 EST January 1, 1992
Radioactivity concentration	U-238: 246.7 Bq g ⁻¹ U-235: 11.35 Bq g ⁻¹ U-234: 237.6 Bq g ⁻¹
Overall uncertainty	U-238: 0.87 percent ⁽¹⁾ * U-235: 0.96 percent U-234: 1.86 percent
Measuring instrument	Mass spectrometer, silicon surface-barrier detector, and 4 π (α + β) liquid-scintillation counter ⁽²⁾
Half life	U-238: (4.468 $\pm$ 0.005) x 10 ⁹ years ⁽³⁾ U-235: (7.037 $\pm$ 0.011) x 10 ⁸ years U-234: (2.454 $\pm$ 0.006) x 10 ⁵ years

This standard reference material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD
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NOTES

- ⁽¹⁾ Individual uncertainties have the significance of one standard deviation of the mean, or an approximation thereof. The combined uncertainty is the individual uncertainties shown below added in quadrature. The overall uncertainty is taken to be three times the combined uncertainty.

SOURCE OF UNCERTAINTY	UNCERTAINTY (%)		
	U-238	U-235	U-234
a) uranium assay of SRM 960	0.02	0.02	0.02
b) uranium atom ratio	0.01	0.07	0.50
c) quantitative dissolution	0.25	0.25	0.25
d) gravimetric measurements	0.10	0.10	0.10
e) half life	0.11	0.16	0.24
Combined uncertainty	0.29	0.32	0.62
	x 3	x 3	x 3
Overall uncertainty	0.87	0.96	1.86

- ⁽²⁾ SRM 4321 was prepared by quantitatively dissolving a carefully cleaned and weighed piece of well-characterized natural uranium metal. This natural uranium metal was formerly issued by the National Bureau of Standards as SRM 960. The solution in SRM 4321B was carefully examined using thermal-ionization mass spectrometry, silicon surface-barrier alpha-particle spectrometry, and $4\pi(\alpha+\beta)$ liquid-scintillation counting. The values that we recommend for the U-234/U-238 atom ratio and alpha-particle-emission-rate ratio in SRM 4321B are $(5.29 \pm 0.02) \times 10^{-5}$ and 0.963 ± 0.003 , respectively. (See the Information for Users of SRM 4321 and SRM 4321B, Natural Uranium Solution.)
- ⁽³⁾ Table of Radioactive Isotopes, E. Browne and R.B. Firestone, John Wiley and Sons, Inc., New York (1986).

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SRM 4321B