

National Bureau of Standards

Certificate

Standard Reference Material 4288

Radioactivity Standard

Radionuclide	Technetium-99
Source identification	4288-
Source description	Liquid in NBS borosilicate-glass ampoule
Solution composition	59.31 μg of Tc(VII) as potassium pertechnetate per gram of approximately 0.001 molar KOH (1)*
Mass	grams
Radioactivity concentration	$3.759 \times 10^4 \text{ Bq g}^{-1}$
Reference time	November, 1982
Measuring instrument	Liquid-scintillation counter (2)
Random uncertainty	0.27 percent (3)
Systematic uncertainty	1.35 percent (4)
Total uncertainty (Random plus systematic)	1.62 percent
Photon-emitting impurities	None observed (5)
Half life	$(2.111 \pm 0.036) \times 10^5 \text{ years}$ (6)

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

Washington, D.C. 20234
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George A. Uriano, Chief
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*Notes on back

FOOTNOTES

- (1) The KTCO_4 was prepared by M.W. Heitzmann of the U.S. Food and Drug Administration from NH_4TCO_4 obtained from Oak Ridge National Laboratory. The solution density is 0.998 g cm^{-3} at 21.8°C , and the KTCO_4 concentration is 0.00060 molar. The UV spectrum of this material exhibited only the characteristic doublets at 243 and 287 nm (A).[‡]
- (2) Two liquid-scintillation counters were calibrated using the method of J.A.B. Gibson (B,C,D). Three different radionuclides were used as the standard: ^3H , ^{14}C , and ^{60}Co . The results obtained using the three radionuclides agreed to within 0.32 percent. The ^{14}C result was used for confirmation only. The value given here is the unweighted mean of the ^3H and ^{60}Co results.
- (3) Half the 99-percent confidence interval for the average of the ^3H result and the ^{60}Co result. The standard deviation of the mean of the ^3H result is 0.15 percent based on 6 degrees of freedom, and the standard deviation of the mean of the ^{60}Co result is 0.09 percent based on 9 degrees of freedom.
- (4) The systematic uncertainty is the average of that for the ^3H result, 1.20 percent, and that for the ^{60}Co result, 1.49 percent. These values are linear sums of estimated upper limits of uncertainties due to the following:

	<u>^3H</u>	<u>^{60}Co</u>
a) reference material for standard radionuclide	0.63	0.68
b) source preparation	0.07	0.17
c) theoretical model	0.30	0.20
d) gamma-ray contribution to beta-particle detector		0.24
e) quenching	0.10	0.10
f) interpolation from calibration curve	<u>0.10</u>	<u>0.10</u>
	1.20	1.49

- (5) The master solution from which these standards were prepared was examined with germanium gamma-ray spectrometers and no impurity was found. Limits of detection as a ratio of gamma-ray-emission rate to technetium-99 activity are

1×10^{-6} between 90 and 300 keV
 1×10^{-7} between 300 and 1900 keV.

- (6) NBS-measured half life based on the formula $T_{1/2} = N \ln(2)/A$, where N is the number of atoms, computed using an atomic mass for technetium-99 of 98.906254 ± 0.000002 grams and the gravimetrically determined mass of technetium-99, and A is the activity determined by liquid-scintillation counting. The value recommended by the Oak Ridge Nuclear Data Project is $(2.13 \pm 0.05) \times 10^5$ years. (E)

[‡] References on last page

The following individuals and organizations contributed to the characterization of this Standard Reference Material.

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- C. Gibson, J.A.B. and Marshall, M., Int. J. Appl. Radiat. Isotopes, **23**, 321 (1972).
- D. Gibson, J.A.B., Computed counting efficiencies as a function of merit figure for 14 beta-particle-emitting radionuclides (July, 1980). Unpublished data.
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