S. Department of Commerce
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National Bureau of Standards

Certificate

Standard Reference Material 4267

**Radioactivity Standard
for
Low-Energy-Photon-Efficiency and
Reactor-Neutron-Dosimetry Calibrations**

Radionuclide	Niobium-93m
Source identification	4267-
Source description	Point source (1)*
Activity	Bq (2)
Reference time	1200 EST August 23, 1985
Overall uncertainty	2.4 percent (3)
Photon-emitting impurities (Activity ratios at reference time)	$^{94}Nb/^{93m}Nb$: 2.77×10^{-3} ±5% (4)
Half life	16.13 ± 0.15 years (5)
Measuring instrument	20.32 x 20.32-cm NaI(Tl) crystals previously calibrated by 4πβ liquid-scintillation counting (6)

This Standard Reference Material was prepared in the Center for Radiation Research, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader, in cooperation with the European Community, Central Bureau for Nuclear Measurements, Geel, Belgium laboratory, Radionuclides Group, Walter Bambynek, Group Leader.

Gaithersburg, MD 20899
October 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

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NOTES

(1) The source consists of a dried deposit of niobium as the fluoride on a 0.7-cm cation-exchange paper disk. The amount of stable niobium may be calculated from the specific activity of 0.16 ng Nb per Bq of ^{93m}Nb. The cation exchange paper is covered on both sides by a protective layer of 0.006-cm polyester tape. The tape is supported by an aluminum annulus 5.4 cm in outer diameter and 3.8 cm in inner diameter.

(2) Although the source is certified for activity, it is intended for use in calibrating low-energy photon detectors. Measurements of N_{Kx}, the x-ray emission rate, and P_{Kx}, the probability of K x-ray emission are in progress and purchasers of this standard will receive a supplemental information sheet.

The K_α x-rays at 16.521 and 16.615 keV, and the K_β group at an average of 18.6 keV, are sensitive to scattering. Losses in the ion-resin-paper disk and in the protective polyester cover, depend on counting geometry, detector resolution, and peak analysis methods. Corrections, which can be of the order of 1.5 percent for reasonable spectrometry systems, should be measured by the user. Attenuation in the accompanying blank assembly, when placed between the source and the detector but near the source, is approximately twice that in the source. The additional uncertainty in the corrected source emission rate should be less than 0.5 percent if the blank assembly transmission is greater than 0.95. When the assembly is placed behind the source, any offsetting contribution from backscattered radiation can also be estimated. The center portion of the absorber packet can be cut from the ring for these tests.

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

a) 7 liquid-scintillation measurements	0.05 percent
b) 9 NaI(Tl) measurements of standard sources from CBNM solution No. 8403	0.10 percent
c) 28 NaI(Tl) measurements of SRM 4267	0.10 percent
d) extrapolation of liquid-scintillation counting rate	0.75 percent
e) dead time for liquid-sicntillation counting	0.09 percent
f) source preparation	0.10 percent
g) dead time for NaI(Tl) counting	0.20 percent

(4) Gamma-ray measurements at the Central Bureau for Nuclear Measurements (CBNM) on high activity samples from this lot showed traces of ^{60}Co, ^{154}Eu, ^{155}Eu, and ^{241}Am. The activity ratios to ^{93m}Nb were less than 50 parts per million for each of those nuclides.

Notes cont.

(5) Vaninbroukx, R. Int. J. Appl. Radia. Isot. 34, 1121 (1983).

(6) Activity measurements were made at the CBNM using an EKCO liquid-scintillation counter which employs a single RCA 8850 phototube. The activity concentration was verified to within 0.6 percent by measurements at NBS using a Beckman LS7800, which employs two Hamamatsu R 331-05 phototubes operated in coincidence.

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