U.S. Department of Commerce
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National Bureau of Standards
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National Bureau of Standards Certificate

Standard Reference Material 4309-C

Xenon-127

Gaseous Radioactivity Standard

This Standard Reference Material consists of xenon-127 and inactive xenon in a flame-sealed, almost spherical, borosilicate-glass ampoule having a volume of approximately 32.5 cm^3, an approximate outside diameter of 4.2 cm, and wall thickness of approximately 0.12 cm. The pressure of the gas in the ampoule is approximately 5.33×10^3 pascals (40 torrs).

The activity of the xenon-127 in the ampoule as of 1200 EST June 20, 1979, was

* $s^{-1} \pm 1.67\%$*.

Forty-five ampoules were filled, by cryogenic transfer, with xenon-127 and inactive xenon, and flame-sealed. These ampoules were intercompared with a spherical calibrated reference ampoule with the same gas filling in an automated pressure-ionization-chamber system. This reference ampoule had been filled by total cryogenic transfer of the xenon from a standard ampoule. The activity of the gas in the standard ampoule had been measured, relative to a radium-226 reference source, in the National Bureau of Standards "4π"γ pressure ionization chamber. This chamber had previously been calibrated, in terms of a radium-226 reference source, with xenon-127 contained in standard borosilicate-glass ampoules, the activity of the contents having been determined using the NBS length-compensated internal gas counters.

The xenon-127, from which this Standard Reference Material was prepared, was examined on a Ge(Li)-spectrometer system and the presence of the known production impurities of xenon-129m and xenon-131m was detected. As of the time of certification, the ratio of the activity of xenon-129m to that of xenon-127 was 0.0024 ± 0.0003, and the ratio of the activity of xenon-131m to that of xenon-127 was 0.00012 ± 0.00012. Corrections were made for the contribution of these impurities to the ionization-chamber response.

The detection limits for other impurity photons are approximately 0.2 percent for gamma rays with energies greater than 37 keV and less than 201 keV, 0.1 percent for those between 205 keV and 373 keV, and 0.01 percent for those between 377 keV and 1900 keV, provided that they are separated in energy by 2 keV or more from photons emitted in the decay of xenon-127.

The uncertainty in the activity of the xenon-127, 1.67 percent, is the linear sum of 0.17 percent, which is the limit of the random error at the 99-percent confidence level (2.861 S_m, where S_m is the standard error computed from 20 intercomparison measurements), and the estimated upper limit of conceivable systematic errors, 1.50 percent, which includes the uncertainty in the calibration of the intercomparison reference ampoule. There is also an uncertainty of ± 0.25 mm in the location of the center of the spherical ampoule, due to possible nonsphericity.

(over)

This Standard Reference Material was prepared in the Center for Radiation Research, Nuclear Radiation Division, Radioactivity laboratory, W. B. Mann, Principal Scientist.

Washington, D. C.
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George A. Uriano, Chief
Office of Standard Reference Materials

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Notes on the Use of Xenon-127 Gaseous Radioactivity Standard

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A half life of 36.41 ± 0.02 days for xenon-127 is suggested (NCRP Report No. 58, p. 376, 1978).

When this Standard Reference Material and the following* table of gamma-ray probabilities per decay are used to measure the efficiency as a function of energy of a photon spectrometer system, the attenuation in the glass walls must be considered. The attenuation corrections given in the table were determined with a Ge(Li)-spectrometer system with a resolution of 0.86-keV full width at half maximum at 122 keV. For a germanium-spectrometer system of appreciably poorer resolution, or a NaI(Tl)-spectrometer system, the tabulated attenuations would be maximum values.

Energy (keV)	gamma-ray probability per decay of ^{127}Xe (%)	glass attenuation (%)
202.84	68.3 ± 0.4	3.3
172.10	25.5 ± 0.8	3.3
374.96	17.2 ± 0.6	3.4
145.22	4.29 ± 0.14	3.6
57.60	1.33 ± 0.06	10.5

*Gamma-ray energies and probabilities per decay taken from NCRP Report No. 58, p. 376, 1978.