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Standard Reference Material 4309-B

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 34.5 cm^3, an outside diameter of 4.2 cm, and wall thickness of approximately 0.12 cm. The pressure of the gas in the ampoule is approximately 2.67×10^4 pascals (200 torrs).

The activity of the xenon-127 in the ampoule as of 1200 EST February 6, 1978 was

* $\times 10^5$ s^{-1} ± 2.23%*.

Thirty-six ampoules were filled, by cryogenic transfer, with xenon-127 and inactive xenon and flame sealed. The ampoules were intercompared with a selected ampoule of the same material in an automated pressure-ionization-chamber system. The selected ampoule had been filled by total transfer of a sample of xenon-127, the activity of which had been measured, relative to a radium-226 reference source, in the National Bureau of Standards "4π"γ pressure-ionization chamber that had been previously calibrated for xenon-127, in terms of a radium-226 reference source, using xenon-127 that had been standardized in the National Bureau of Standards length-compensated internal gas-proportional counters.

The uncertainty in the activity, 2.23 percent, is the linear sum of 0.23 percent, which is the limit of the random error at the 99-percent confidence level (4.604 S_m where S_m is the standard error computed from 5 intercomparison measurements), and the estimated upper limit of conceivable systematic errors, 2.0 percent, which includes the uncertainty in the calibration of the selected ampoule.

A half life of 36.41 ± 0.02 days (M. J. Martin, App. A. NCRP Report 58, 1978) was used to correct the data which were taken over a period of twenty days.

The gamma-ray spectra of a number of sources were examined, at the time of preparation, with a Ge(Li) spectrometer in the energy region of 0.080 MeV to 1.900 MeV, and no photon-emitting impurities were detected. The lower detection limits for the detection of photons emitted from radionuclidic impurities can be expressed as a percentage of the emission rate of the 0.375-MeV gamma ray for energies above 0.375 MeV and as a percentage of the emission rate of the 0.203-MeV gamma ray for energies below 0.375 MeV. These limits are approximately 0.2 percent for photon energies below 0.203 MeV and above 0.080 MeV, 0.1 percent for photon energies between 0.203 and 0.375 MeV, and 0.01 percent for photon energies above 0.375 MeV and below 1.900 MeV. Approximately 9.0 months after target separation, the activities of ^{129m}Xe and ^{131m}Xe impurities, formed during the production of the ^{127}Xe, were estimated to be less than 0.00002 and 0.001 percent, respectively, of the total ^{127}Xe activity. These estimates were based on measurements of previous material that had been produced under similar conditions and that had aged about eight weeks after target separation.

(over)

When this standard and the accompanying table of gamma-ray probabilities per decay are used to construct an efficiency vs. energy relationship for a spectrometer system, the attenuation in the glass walls must be considered. The attenuation correction given in the table was 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 poorer resolution, or a NaI(Tl) spectrometer system, the tabulated values would represent upper limits.

When using this standard a systematic error of ± 0.25 mm in the position of the center of activity within the sphere should be included due to the possible non-sphericity of the ampoule.

This Standard Reference Material was prepared in the Center for Radiation Research, Radioactivity Section, W. B. Mann, Chief.

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The following table taken from M. J. Martin, App. A, NCRP Report 58, 1978, with the addition of the measured glass-wall-attenuation values, is provided for the convenience of the user of the standard.

ENERGY (keV)	*γ-probability per disintegration of ^{127}Xe (%)*	*glass attenuation (%)*
202.84	68.3 ± 0.5	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 ± .06	10.5