Department of Commerce
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National Bureau of Standards
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National Bureau of Standards Certificate

Standard Reference Material 4307-C

Xenon-133

Gaseous Radioactivity Standard

This Standard Reference Material consists of xenon-133 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-133 in the ampoule as of 1200 EST February 10, 1978 was

* $s^{-1} \pm 2.90\%$.*

Thirty-six ampoules were filled, by cryogenic transfer, with xenon-133 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-133, 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-133, in terms of a radium-226 reference source, using xenon-133 that had been standardized in the National Bureau of Standards length-compensated internal gas-proportional counters. The activity of the xenon-133 in the selected ampoule was determined by taking into account the relative efficiencies of the chamber for xenon-133, xenon-131m, and xenon-133m.

The uncertainty in the activity, 2.90 percent, is the linear sum of 0.27 percent, which is the limit of the random error at the 99-percent confidence level (4.032 S_m, where S_m is the standard error computed from 6 intercomparison measurements), and the estimated upper limit of conceivable systematic errors, 2.63 percent, which includes the uncertainty in the calibration of the selected ampoule.

A half life of 5.245 days $\pm$ 0.11 percent for xenon-133 is recommended (L. M. Cavallo, F. J. Schima, and M. P. Unterweger, Phys. Rev. C10, 2631, 1974)

The material, from which these sources were prepared, was examined on a Ge(Li)-spectrometer system and the presence of the known production impurities of xenon-133m and xenon-131m was detected. As of the time of certification, the ratio of the activity of xenon-131m to that of xenon-133 was 0.7 percent, whereas the ratio of the activity of xenon-133m to that of xenon-133 was less than 0.07 percent and may be neglected in the subsequent use of this standard.

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 0.081-MeV gamma ray of xenon-133. These limits are approximately 0.1 percent for photon energies below 0.081 MeV and above 0.040 MeV, and 0.01 percent for photon energies above 0.081 MeV and below 1.900 MeV.

(over)

When this standard is used to construct an efficiency vs energy relationship for a spectrometer system, the attenuation in the glass walls must be considered. The attenuation, 6.8 percent, 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, this value would represent an upper limit.

When using this standard a systematic error of $\pm$ 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.

J. Paul Cali, Chief
Office of Standard Reference Material

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