



National Bureau of Standards

Certificate

Standard Reference Material 4309E

Gaseous Radioactivity Standard

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| Radionuclide | Xenon-127 |
| Source identification | SRM 4309E- |
| Source description | Gas in flame-sealed spherical borosilicate-glass container (1)* |
| Gas composition | Xenon-127 and inactive xenon (2) |
| Activity | Bq (s ⁻¹) (3) |
| Reference time | 12 noon EST September 1, 1981 |
| Random uncertainty | 0.11 percent (4) |
| Systematic uncertainty | 1.92 percent (5) |
| Total uncertainty (Random plus Systematic) | 2.03 percent |
| Photon-emitting impurities (Activity ratios at reference time) | None detected (6) |
| Half life | 36.41 ± 0.02 days (7) |
| Measuring instrument | NBS pressurized "4π"γ ionization chamber C calibrated by internal gas-proportional counting |

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

Washington, D.C. 20234
September, 1981

George A. Uriano, Chief
Office of Standard Reference Materials

FOOTNOTES

(1) Approximate ampoule specifications:

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|------------------|----------------------|
| volume | 30.0 cm ³ |
| outside diameter | 4.24 cm |
| wall thickness | 0.19 cm |

There is also an uncertainty of ± 0.25 mm in the location of the center of the spherical ampoule, due to possible nonsphericity.

(2) Pressure - 26 kPa (200 Torr) \pm 20%.

(3) For gamma-ray probabilities and attenuation in the glass walls for the gamma rays from the decay of xenon-127, see attached sheet.

(4) Half the 99-percent confidence interval of the mean (2.756 times the standard error computed from 30 ionization-chamber measurements).

(5) Consists of the linear sum of estimated uncertainty limits due to

a) transfer of calibration from ionization chamber A to ionization chamber C, which is the linear sum of the estimated uncertainty limits due to

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|--|--------------|
| 1) half the 99-percent confidence interval of the mean for 6 sets of ionization chamber measurements | 0.23 percent |
| 2) gas transfer losses | 0.1 percent |
| 3) photon attenuation in walls of the aluminum ampoule holders | 0.1 percent |

b) calibration of the pressurized "4 π " γ ionization chamber A, which is the linear sum of the estimated uncertainties due to

| | |
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| 1) half the 99-percent confidence interval of the mean for 51 gas counting measurements | 0.40 percent |
| 2) gram-mole measurements | 0.1 percent |
| 3) extrapolation of the gas counting data | 0.2 percent |
| 4) dilution of sources for gas counting | 0.4 percent |
| 3) half the 99-percent confidence interval of the mean for 40 ionization chamber measurements | 0.19 percent |
| 4) radium-226 reference ratios | 0.2 percent |

(6) Limits of detection, as a percentage of the gamma-ray-emission rate of the 202.84-keV gamma ray from the decay of xenon-127, are

0.1 percent for energies between 40 keV and 198 keV

0.01 percent for energies between 208 keV and 1900 keV,

provided the impurity photons are separated in energy by 5 keV or more from photons emitted in the decay of xenon-127.

(7) NCRP Report No. 58, p. 376, 1978. NBS measured half life is 36.34 ± 0.02 days.

For further information, contact Michael Unterweger or Frank Schima, (301) 921-2396.

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On the Use of Xenon-127 Gaseous Radioactivity Standard

SRM 4309-E

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 of the 30.0 cm³ ampoule 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 and a source to detector distance of 25 cm. For a germanium-spectrometer system of appreciably poorer resolution, or a NaI(Tl)-spectrometer system, the tabulated attenuations would be maximum values.

| <u>Energy</u> (KeV) | <u>gamma-ray probability per decay</u> of ¹²⁷ Xe (%) | <u>glass attenuation</u> (%) |
|------------------------|---|---------------------------------|
| 202.84 | 68.3 ± 0.4 | 8.0 |
| 172.10 | 25.5 ± 0.8 | 8.2 |
| 374.96 | 17.2 ± 0.6 | 6.2 |
| 145.22 | 4.29 ± 0.14 | 8.7 |
| 57.60 | 1.33 ± 0.06 | 14.0 |

*Gamma-ray energies and probabilities per decay taken from NCRP Report No. 58, p. 376, 1978. Uncertainties correspond to about a 68% probability.