

National Bureau of Standards

Certificate

Standard Reference Material 4309-F

Gaseous Radioactivity Standard

Radionuclide	Xenon-127
Source identification	4309F-
Source description	Gas in a flame-sealed spherical borosilicate-glass container (1)*
Gas composition	Xenon-127 and inactive xenon (2)
Activity	x 10 Bq
Reference time	1200 EST February 8, 1983
Random uncertainty	0.22 percent (3)
Systematic uncertainty	1.49 percent (4)
Total uncertainty (Random plus systematic)	1.71 percent
Photon-emitting impurities (Activity ratios at reference time)	None observed (5)
Half life	36.34 ± 0.02 days (6)
Measuring instrument	NBS pressurized "4π"γ ionization chamber B calibrated by internal gas-proportional counting

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

Washington, D.C. 20234
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FOOTNOTES

(1) Approximate ampoule specifications:

volume	34 cm ³
outside diameter	4.5 cm
wall thickness	0.10 ± 0.02 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 - 13 kPa (100 Torr) ± 20%.

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

(4) Linear sum of estimated uncertainty limits due to:

a) transfer of calibration from ionization chamber A to ionization chamber B, 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 of nine sets of ionization-chamber measurements | 0.15 percent |
| 2) photon attenuation in walls of the aluminum ampoule holders | 0.10 percent |
| 3) radium-226 reference-sources ratio | 0.05 percent |

b) calibration of pressurized "4π"γ ionization chamber A, 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 of 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 |
| 5) half the 99-percent confidence interval of the mean for 40 ionization chamber measurements | 0.19 percent |
| 6) radium-226 reference sources ratios | 0.2 percent |

(5) Limits of detection as a percentage of the gamma-ray-emission rate of the 202.84-keV gamma rays emitted in the decay of xenon-127 are

0.1 percent between 40 keV and 198 keV
0.01 percent between 208 keV and 1900 keV,

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

(6) NBS measured half life

On the Use of Xenon-127 Gaseous Radioactivity Standard

SRM 4309-F

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 34 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> <u>of ¹²⁷Xe</u> (%)	<u>Glass attenuation</u> (%)
202.84	68.3 ± 0.4	3.2
172.10	25.5 ± 0.8	3.3
374.96	17.2 ± 0.6	2.8
145.22	4.29 ± 0.14	3.5
57.60	1.33 ± 0.06	7.0

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