



# National Institute of Standards & Technology Certificate

## Standard Reference Material 4415L-R Gaseous Radioactivity Standard

Radionuclide	Xenon-133
Source identification	4415L-R
Source description	Gas in a flame-sealed borosilicate-glass ampoule [1]*
Gas composition	Xenon-133 and inactive xenon [2]
Activity	$\times 10^9$ Bq
Reference time	1300 EST April 13, 1994
Relative expanded uncertainty	0.68 percent [3]
Photon-emitting impurities (Activity ratios at reference time)	$^{85}\text{Kr}/^{133}\text{Xe}$ : $(1.3 \pm 0.3) \times 10^{-6}$ [4] $^{131\text{m}}\text{Xe}/^{133}\text{Xe}$ : $(6.6 \pm 0.6) \times 10^{-3}$ $^{133\text{m}}\text{Xe}/^{133}\text{Xe}$ : $(5.3 \pm 0.5) \times 10^{-4}$
Half life	$5.243 \pm 0.001$ days [5]
Measuring instrument	NIST pressurized "4 $\pi$ " $\gamma$ ionization chamber "A" calibrated by internal gas-proportional counting

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M. Robin Hutchinson, Group Leader.

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\*Notes on back

## NOTES

- [1] Approximate ampoule specifications:

volume	5 cm <sup>3</sup>
length	4.5 cm
diameter	1.5 cm
wall thickness	0.12 ± 0.02 cm

- [2] Pressure: 25 kPa (187 Torr) ± 20%.

- [3] The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1297* (1993)].

The relative **combined standard uncertainty**,  $u_c = 0.34$  percent, is the quadratic combination of the standard deviations (or standard deviations of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a) photon-emitting impurities in this sample	0.01 percent
b) 20 ionization-chamber measurements on this sample	0.02 percent
c) three series of gas-counting measurements	0.23 percent
d) original ionization-chamber calibration measurements	0.01 percent
e) efficiency extrapolation	0.11 percent
f) attenuation losses in the original calibration	0.18 percent
g) radium 1000 to radium 20 reference sources ratio	0.08 percent
h) radium-226 reference source half life	0.01 percent
i) radium reference source positioning	0.10 percent

The **relative expanded uncertainty**,  $U = 0.68$  percent, is obtained by multiplying  $u_c$  by a coverage factor of  $k = 2$  and is assumed to provide an uncertainty interval of approximately 95 percent confidence.

- [4] Limits of detection as a percentage of the gamma-ray-emission rate of the 81-keV gamma rays emitted in the decay of xenon-133 are:

0.5 percent between 85 keV and 156 keV
0.05 percent between 168 keV and 379 keV
0.01 percent between 387 keV and 3200 keV

provided that impurity photons are separated in energy by four keV or more from photons emitted in the decay of xenon-133.

- [5] NCRP Report No. 58, 2nd edition, February 1985, p. 442.