Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 4307G

Gaseous Radioactivity Standard

Radionuclide	Xenon-133
Source identification	SRM 4307G-
Source description	Gas in flame-sealed spherical borosilicate-glass container (1)*
Gas composition	Xenon-133 and inactive xenon (2)
Activity	Bq (s^{-1}) (3)
Reference time	12 noon EST March 24, 1982
Random uncertainty	0.16 percent (4)
Systematic uncertainty	1.71 percent (5)
Total uncertainty (Random plus Systematic)	1.87 percent
Photon-emitting impurities (Activity ratios at reference time)	$^{131m}Xe/^{133}Xe$: 0.0181 ± 10% $^{133m}Xe/^{133}Xe$: 1.3×10^{-4} ± 10% (6)
Half life	5.245 ± 0.006 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, Dale D. Hoppes, Group Leader.

Washington, D.C. 20234
April 12, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

*Footnotes on back

FOOTNOTES

(1) Approximate ampoule specifications:

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 - 23 kPa (180 Torr) ± 20%.

(3) For decay scheme parameters and attenuation in the glass walls for the 81-keV gamma ray following the decay of xenon-133, see attached sheets.

(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

1) half the 99-percent confidence interval of the mean for 6 sets of ionization chamber measurements	0.38 percent
2) gas transfer losses	0.1 percent
3) photon attenuation in walls of the aluminum ampoule holders	0.1 percent
4) impurities	0.1 percent

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

1) half the 99-percent confidence interval of the mean for 3 series of gas counting measurements	0.66 percent
2) extrapolation of the gas counting data	0.22 percent
3) half the 99-percent confidence interval of the mean for 3 series of ionization chamber measurement	0.01 percent
4) radium-226 reference ratios	0.14 percent

(6) Limits of detection, as a percentage of the gamma-ray-emission rate of the 81-keV gamma ray from the decay of xenon-133, are

0.1 percent for energies between 37 keV and 76 keV

0.01 percent for energies between 86 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-133.

(7) L.M. Cavallo, F.J. Schima, and M.P. Unterweger, Phys. Rev. C10, 2631, 1974.

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

Notes on the Use of Xenon-133 Gaseous Radioactivity Source

SRM 4307-G

When this source is 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-cm^3 ampoule must be considered. The attenuation, 11.3 percent, for the 0.081-MeV gamma ray was determined using 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 attenuation would be less than 11.3 percent.

DECAY SCHEME: NCRP REPORT NO. 58, p. 387, 1978

133XE B- DECAY (5.245 D 6) I(MIN) = 0.10%

Radiation Type	Energy (keV)	Intensity (%)	Δ (g-rad/ μCi-h)
Auger-L	3.55	49.0 20	0.0037
Auger-K	25.5	5.5 7	0.0030
ce-K- 1	43.636 11	0.30 6	0.0003
ce-K- 2	45.0124 4	52.0 3	0.0498
ce-L- 2	75.2827 4	8.49 20	0.0136
ce-MNO- 2	79.7799 4	2.3 3	0.0039
β- 1 max	266 3		
avg	75.0 10	0.66 10	0.0011
β- 2 max	346 3		
avg	100.5 10	99.34 10	0.213
total β- avg	100.3 10	100.01 15	0.214
X-ray L	4.29	6.1 17	0.0006
X-ray $K\alpha_2$	30.6251 3	13.3 3	0.0087
X-ray $K\alpha_1$	30.9728 3	24.6 5	0.0163
X-ray Kβ	35	8.84 20	0.0066
γ 1	79.621 11	0.22 6	0.0004
γ 2	81	37.1 4	0.0640

4 weak γ's omitted (ΣIγ = 0.07%)