U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 4307-D

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 32.5 cm^3, an approximate 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 April 12, 1979, was

* $s^{-1} \pm 2.86\%$*.

Forty-five ampoules were filled, by cryogenic transfer, with xenon-133 and inactive xenon, and flame-sealed. These ampoules were intercompared with a spherical calibrated reference ampoule with the same gas filling in an automated pressure-ionization-chamber system. This reference ampoule had been filled by total cryogenic transfer of the xenon from a standard ampoule. The activity of the gas in the standard ampoule had been measured, relative to a radium-226 reference source, in the National Bureau of Standards "4π"γ pressure ionization chamber. This chamber had previously been calibrated, in terms of a radium-226 reference source, with isotopically separated xenon-133 contained in standard borosilicate-glass ampoules, the activity of the contents having been determined using the NBS length-compensated internal gas counters.

The xenon-133, from which this Standard Reference Material was 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 0.012 ± 0.001, and the ratio of the activity of xenon-133m to that of xenon-133 was 0.00058 ± 0.00006. Corrections were made for the contribution of these impurities to the ionization-chamber response.

The detection limits for other impurity photons may be expressed as a percentage of the gamma-ray-emission rate of the 81-keV gamma ray of xenon-133. These limits are approximately 0.1 percent for gamma rays with energies greater than 37 keV and less than 79 keV, and 0.01 percent for those between 83 keV and 1900 keV, and provided that they are separated in energy by 2 keV or more from photons emitted in the decay of xenon-133.

The uncertainty in the activity of the xenon-133, 2.86 percent, is the linear sum of 0.86 percent, which is the limit of the random error at the 99-percent confidence level (2.861 S_m, where S_m is the standard error computed from 20 intercomparison measurements), and the estimated upper limit of conceivable systematic errors, 2.00 percent, which includes the uncertainty in the calibration of the intercomparison reference ampoule. There is also an uncertainty of ± 0.25 mm in the location of the center of the spherical ampoule, due to possible nonsphericity.

(over)

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).

This Standard Reference Material was prepared in the Center for Radiation Research, Nuclear Radiation Division, Radioactivity laboratory, W. B. Mann, Principal Scientist.

Washington, D. C.
June, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

4307-D-

Notes on the Use of Xenon-133 Gaseous Radioactivity Standard

SRM 4307-D

When this Standard Reference Material is used to measure the efficiency as a function of energy of a photon-spectrometer system, the attenuation in the glass walls must be considered. The attenuation, 6.8 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, this attenuation would be a maximum value.