

# National Bureau of Standards Certificate Standard Reference Material 4241 Barium-133

## Point-Source Activity Standard

This Standard Reference Material consists of barium-133 deposited, as the chloride, on polyester tape approximately 0.006-cm thick and covered by another layer of the same tape. The tape is mounted on an aluminum annulus 3.8-cm inside diameter and 5.4-cm outside diameter.

This Standard Reference Material is a dried deposit from an accurately weighed aliquot of a solution whose activity was measured by  $4\pi(e,x)-\gamma$  coincidence counting using the efficiency extrapolation method.

The activity of this point source of barium-133 at 1200 EST September 1, 1978, was

$$* \quad \times 10^5 \text{ s}^{-1} \pm 1.44%*$$

The uncertainty in the activity, 1.44 percent, is the linear sum of 0.52 percent, which is the limit of the random error of the coincidence measurements at the 99-percent confidence level ( $4.032 S_m$ , where  $S_m$  is the standard error of the mean computed from 6 measurements), and 0.92 percent, which is the sum of the estimated upper limits of conceivable systematic errors.

The solution from which this Standard Reference Material was prepared was examined for photon-emitting impurities with germanium-spectrometer systems and only cesium-134 was found to be present. As of the certificate date and time, the ratio of the activity of cesium-134 to that of barium-133 was  $1.8 \times 10^{-5} \pm 20$  percent. The detection limits for other impurity photons may be expressed as a percentage of the gamma-ray-emission rate of the 276-keV gamma ray emitted in the decay of barium-133. These limits are approximately 0.1 percent for gamma rays with energies greater than 20 keV and less than 379 keV, and 0.01 percent for those between 389 keV and 1900 keV, provided that the impurity photons are separated in energy by 5 keV or more from photons of equal or greater intensity emitted in the decay of barium-133.

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

Washington, D.C. 20234  
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## NOTES ON BARIUM-133 NUCLEAR DECAY DATA

The attached data are from the current Evaluated Nuclear Structure Data File, maintained by the Nuclear Data Project at the Oak Ridge National Laboratory, and published in the National Council on Radiation Protection and Measurements Report No. 58. NBS measurements for the probability per decay for the gamma rays with energies of 276-, 303-, 356- and 384-keV agree with the tabulated values to about 1 percent, but show a discrepancy of up to 5.5% for the photons of other energies. The results of an International Committee for Radionuclide Metrology inter-comparison may indicate which data are to be preferred, and this information will be made available to you.

Corrections for the summing of correlated gamma and x rays must be considered if this standard is to be counted with high efficiency.

- (1) Nucl. Instr. and Meth. 130, 189 (1975).
- (2) Nucl. Instr. and Meth. 147, 405 (1977).

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133BA EC DECAY (10.74 Y 5) I (MIN) = 0.10%

Radiation Type	Energy (keV)	Intensity (%)	$\Delta$ (g-rad/ $\mu$ Ci-h)
Auger-L	3.55	135 6 <sup>a</sup>	0.0102
ce-K- 1	17.170 16	10.5 4	0.0038
Auger-K	25.5	14.0 16	0.0076
ce-K- 2	43.636 11	3.72 15	0.0035
ce-K- 3	45.012 5	46.9 10	0.0450
ce-L- 1	47.441 16	1.43 20	0.0014
ce-MNO- 1	51.938 16	0.43 20	0.0005
ce-L- 2	73.907 11	0.59 11	0.0009
ce-L- 3	75.283 5	7.64 24	0.0122
ce-MNO- 2	78.404 11	0.194 6	0.0003
ce-M- 3	79.780 5	1.78 14	0.0030
ce-NOP- 3	80.766 5	0.32 4	0.0005
ce-K- 4	124.620 15	0.123 9	0.0003
ce-K- 6	240.412 12	0.327 12	0.0017
ce-K- 7	266.866 15	0.70 6	0.0040
ce-L- 7	297.137 15	0.103 15	0.0007
ce-K- 8	320.020 17	1.31 5	0.0089
ce-K- 9	347.866 15	0.153 5	0.0011
ce-L- 8	350.291 17	0.218 7	0.0016
X-ray L	4.29	17 5	0.0015
X-ray K $\alpha_2$	30.6251 3	34.0 8	0.0222
X-ray K $\alpha_1$	30.9728 3	62.9 12	0.0415
X-ray K $\beta$	35	22.6 6	0.0168
$\gamma$ 1	53.155 16	2.17 4	0.0025
$\gamma$ 2	79.621 11	2.66 8	0.0045
$\gamma$ 3	80.997 5	33.5 5	0.0578
$\gamma$ 4	160.605 15	0.62 4	0.0021
$\gamma$ 5	223.25 3	0.460 13	0.0022
$\gamma$ 6	276.397 12	7.09 13	0.0417
$\gamma$ 7	302.851 15	18.40 20	0.119
$\gamma$ 8	356.005 17	62.1 7	0.471
$\gamma$ 9	383.851 15	8.91 10	0.0729

a) The format used for the uncertainties in the listed values can be illustrated by the following examples.

$$1.2 \quad 56 = 1.2 \pm 5.6$$

$$1.23 \quad 56 = 1.23 \pm 0.56$$

$$1.234 \quad 56 = 1.234 \pm 0.056$$

FROM: A Handbook of Radioactivity Measurements Procedures, NCRP Report No. 58, Nov., 1978.