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

Bureau of Standards
t Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 4251

Barium-133

Radioactivity Standard

This Standard Reference Material consists of barium-133 in grams of carrier solution in a flame-sealed borosilicate-glass ampoule. The solution contains 118 micrograms of barium chloride per gram of approximately 1 molar hydrochloric acid and has a density of 1.014 ± 0.002 grams per milliliter at 25.2°C.

The radioactivity concentration of the barium-133 as of 1200 EST September 1, 1978, was

$$*5.470 \times 10^{5}\ s^{-1}g^{-1} \pm 1.39\%*.$$

This Standard Reference Material was prepared from a master solution whose activity as measured by $4\pi(e,x)$-γ coincidence counting using the efficiency extrapolation method.

The uncertainty in the activity, 1.39 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 0.87 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 of 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.

ıshington, D.C. 20234
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J. Paul Cali, Chief
Office of Standard Reference Materials

SRM 4251-

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

Radiation Type	Energy (keV)	Intensity (%)	Δ(g-rad/μCi-h)
Auger-L	3.55	135 6[a]	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 Kβ	35	22.6 6	0.0168
γ 1	53.155 16	2.17 4	0.0025
γ 2	79.621 11	2.66 8	0.0045
γ 3	80.997 5	33.5 5	0.0578
γ 4	160.605 15	0.62 4	0.0021
γ 5	223.25 3	0.460 13	0.0022
γ 6	276.397 12	7.09 13	0.0417
γ 7	302.851 15	18.40 20	0.119
γ 8	356.005 17	62.1 7	0.471
γ 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 56 = 1.2 ± 5.6

1.23 56 = 1.23 ± 0.56

1.234 56 = 1.234 ± 0.056

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