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

National Bureau of Standards
Ernest Ambler, Director

# National Bureau of Standards Certificate

## Standard Reference Material 4215F

## Mixed Radionuclide Gamma-Ray Emission-Rate Point-Source Standard

This Standard Reference Material consists of cobalt-57, cobalt-60, strontium-85, yttrium-88, cadmium-109-silver-109m, tin-113-indium-113m, cesium-137-barium-137m, cerium-139, and mercury-203, deposited as the chlorides and sulfides, on polyester tape approximately 0.006-centimeter thick and covered by another layer of the same tape.

The point source was prepared by depositing, on the tape, a weighed aliquot of a solution of a calibrated radionuclide mixture and exposing it to hydrogen sulfide gas to precipitate the mercuric sulfide.

The gamma-ray-emission rates at 1200 EST September 1, 1978 are shown in the attached table.

The activities of solutions of each of the nine radionuclides used in the preparation of the mixture were measured using the National Bureau of Standards calibrated "$4\pi$" $\gamma$ ionization chamber and a radium-226 reference source, and the corresponding gamma-ray-emission rates calculated using, where necessary, the nuclear-decay parameters shown in the table.

For each radionuclide the total uncertainty in the gamma-ray-emission rate is the linear sum of the limit to the random error of the ionization-chamber measurements at the 99-percent confidence level (2.7 $S_m$, where $S_m$ is the standard error computed from 5 sets of 20 measurements), and the estimated upper limit of conceivable systematic error. This estimate is the linear sum of uncertainties attributed to the calibration of the ionization chamber, to source preparation, and, where applicable, to the value used for gamma rays per decay.

Sources of each radionuclide in the mixture were examined for gamma-ray-emitting impurities, using germanium-spectrometer systems covering the energy region from 20 to 1900 keV. On July 25, 1978, the activity ratios for observed impurities were

$$^{56}Co/^{57}Co = 1.6 \times 10^{-5} \qquad ^{65}Zn/^{85}Sr = 5.8 \times 10^{-4}$$
$$^{75}Se/^{113}Sn = 1.6 \times 10^{-3} \qquad ^{84}Rb/^{85}Sr = 7.2 \times 10^{-4}$$
$$^{114m}In/^{113}Sn = 6.9 \times 10^{-3} \qquad ^{86}Rb/^{85}Sr = 6.8 \times 10^{-4}$$
$$^{125}Sb/^{113}Sn = 8.7 \times 10^{-4} \qquad ^{134}Cs/^{137}Cs = 2.6 \times 10^{-5}$$

No other gamma-ray-emitting impurities were observed. The detection limits for impurity gamma rays may be expressed as a percentage of the gamma-ray-emission rate of the most abundant gamma ray from each nuclide. These limits are approximately 0.1 percent for gamma rays with energies below that of the major gamma ray in each spectrum and 0.01 percent for gamma rays with energies above that of the major gamma ray.

This standard was prepared in the NBS Center for Radiation Research, Nuclear Radiation Division, Radioactivity Section, W. B. Mann, Chief.

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J. Paul Cali, Chief
*Office of Standard Reference Materials*