NBL Program Office

U.S. Department of Energy

Certificate of Analysis

Certified Reference Material C131

Plutonium-244 Spike Assay and Isotopic Solution Standard in Nitrate Form

Plutonium-244 Content: ± µmoles
Serial Number: Teflon Bottle #

Plutonium-238	0.005 ± 0.001 At.%
Plutonium-239	0.034 ± 0.001 At.%
Plutonium-240	0.677 ± 0.004 At.%
Plutonium-241	0.064 ± 0.002 At.%
Plutonium-242	1.325 ± 0.004 At.%
Plutonium-244	97.895 ± 0.008 At.%

All values are as of October 1, 1987.

This Certified Reference Material (CRM) is an assay and isotopic standard for use as a spike in the analysis of plutonium materials by isotope dilution mass spectrometry (IDMS). Each unit of C131 consists of approximately 1 mg of ^{244}Pu as evaporated plutonium nitrate in a 30-mL Teflon bottle. Each bottle contains a unique quantity of plutonium and is assigned a serial number for identification and reference.

NOTE: *The bottle and its outer plastic containment should be handled under proper radiologically controlled conditions at all times.*

The indicated uncertainty for the certified values are 95% confidence intervals for the mean based upon measurement imprecisions. The uncertainty for the plutonium assay values include allowances for weighing errors of individual units.

This CRM was originally issued in 1981 by the National Bureau of Standards (NBS) as Standard Reference Material (SRM) 996.The measurements made at NBS leading to the certification were performed by J.D. Fassett, H.M. Kingston, and L.A. Machlan, under the direction of E.L. Garner. In 1987, the technical and administrative transfer of NBS Special Nuclear SRMs into the NBL CRM Program was coordinated by the NBS Office of Standard Reference Materials and N. M. Trahey, NBL.

The certified isotopic abundance values were determined at NBS using solid-sample thermal ionization mass spectrometry. These analyses were corrected for mass discrimination effects relative to the plutonium isotopic CRMs 137 and 138 (formerly NBS SRMs 947 and 948).

C131 had a radioactivity of about 70 μCi per unit on October 1, 1987, which is dominated by ^{241}Pu.

The half-life values (in years) used for the decay calculations are as follows: ^{238}Pu - 87.74; ^{239}Pu - 24,119; ^{240}Pu - 6,562; ^{241}Pu - 14.35; ^{242}Pu - 376,300; and ^{244}Pu - 8 x 10^7.

RECOMMENDED PROCEDURE FOR USING C131

The package is designed to prepare a solution having a known concentration of plutonium on a weight basis. Once prepared, it is suggested that all the solution be immediately distributed as subportions for later use as individual spikes. Chemical separation of plutonium from its uranium and americium daughters prior to use is essential for high accuracy, since these daughters contain isotopes which are isobaric with plutonium isotopes.

Wipe the Teflon bottle with a chamois or damp cloth to dissipate any static charge which may cause expulsion of the material upon opening. Weigh the bottle then unscrew the cap, add a desired quantity of 8M HNO3 and carefully warm the bottle to insure total dissolution. DO NOT HEAT THE BOTTLE ABOVE 150°C BECAUSE BOTTLE DEFORMATION WILL OCCUR! Replace and tighten cap, then allow the bottle to cool to ambient temperature. Loosen the cap to equalize air pressure, retighten, wipe the bottle with a chamois or damp cloth, and weigh.

Shake vigorously to homogenize the contents and distribute all the solution as weighed portions into suitable containers for use as spikes. Calculate the plutonium concentration by:

$$^{244}\text{Pu, μmoles/g} = \frac{\text{(Certified content of } ^{244}\text{Pu, μmoles)}}{\text{(wt. of bottle and solution, [g])-(tare of bottle, (g)-0.0020)}}$$

in which 0.0020 grams is the nominal weight of evaporated plutonium nitrate residue.

If a more dilute solution is desired, dissolve the residue as above, transfer the solution quantitatively to a larger tared container, weigh, mix vigorously, and distribute all the solution as weighed portions.