



**Nuclear Reference Material Program**  
*U.S. Department of Energy*



**Certificate of Analysis**  
**Certified Reference Material 131**  
**Plutonium-244 Assay and Isotopic Standard in Nitrate Form**

**Description:** Certified Reference Material (CRM) 131 is a plutonium amount and isotope-amount ratio standard. Each unit of CRM 131 consists of approximately 1 mg of <sup>244</sup>Pu as evaporated plutonium nitrate in a 125 mL Teflon bottle. Each bottle contains a unique quantity of plutonium and is assigned a serial number for identification and reference. The certified plutonium amount and isotope-amount ratio property values are provided in Table 1. Supplemental non-certified property values for the material are provided in Table 2.

**Table 1. Certified Property Values and Uncertainties** <sup>(a) (b)</sup>

<b>Bottle Number</b>		<b>Plutonium-244</b>					<b>μmols</b>
		Amount:					
		Uncertainty:					
<b>Isotope-Amount Fraction (•100)</b>							
	$n(^{238}\text{Pu})/n(\text{Pu})$	$n(^{239}\text{Pu})/n(\text{Pu})$	$n(^{240}\text{Pu})/n(\text{Pu})$	$n(^{241}\text{Pu})/n(\text{Pu})$	$n(^{242}\text{Pu})/n(\text{Pu})$	$n(^{244}\text{Pu})/n(\text{Pu})$	
Value:	0.005	0.034	0.677	0.064	1.325	97.895	
Uncertainty:	0.001	0.001	0.004	0.002	0.004	0.008	

<sup>(a)</sup> **Certified values are provided for a reference date of October 1, 1987. Certified plutonium isotope values must be decay-corrected to the date of use.**

<sup>(b)</sup> The indicated uncertainties for the above property values are 95 % confidence intervals for the mean. The uncertainty for the plutonium amount includes components due to analytical variation and weighing uncertainties of individual units.

**Intended use:** CRM 131 is a plutonium amount and isotope standard for use as a spike in the analysis of plutonium materials by isotope dilution mass spectrometry (IDMS).

**Storage:** To maintain the integrity of an unused CRM unit, it should remain in the original packaging and should be stored in a dry, temperature-controlled location.

**Period of validity:** When stored in its original unopened container, the certification of this material is valid indefinitely. The NRMP will notify customers should degradation be detected.

**Minimum Sample Size:** Certification and/or verification measurements for uranium mass fraction and isotope-amount ratios were performed on a random sampling of CRM 131 units. The homogeneity of plutonium mass fraction or isotopic composition is not certified for subsamples of the undissolved material comprising a unit.

**Instructions for Handling:** The reference material in the unit is radioactive. The bottle and its outer plastic containment should be handled under proper radiologically-controlled conditions at all times. This radioactive material should be handled only by qualified individuals. Refer to the Safety Data Sheet for further information.

### Recommended procedure for using CRM 131:

The package is designed to prepare a solution having a known concentration of plutonium on a mass basis. Once prepared, it is suggested that all the solution be immediately distributed as subportions for later use as individual spikes. Chemical separation of the plutonium from its uranium and americium daughters after spiking but prior to analysis is essential for high accuracy, since these daughters contain isotopes that 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 8 mol L<sup>-1</sup> HNO<sub>3</sub> and carefully warm the bottle to ensure total dissolution.

NOTE: Do not heat the bottle above 150 °C because bottle deformation or melting will occur. Replace and tighten cap, then allow the bottle to cool to ambient temperature. 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:

$$^{244}\text{Pu } \mu\text{moles/g} = \frac{\text{certified amount of } ^{244}\text{Pu } (\mu\text{moles})}{\text{wt. of bottle \& solution (g)} - [\text{tare of bottle (g)} - 0.0020 \text{ g}]}$$

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.

**Traceability Statement:** Certified property amount and isotope amount fraction values are traceable to the SI unit of mole.

**Additional information:** 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).

**Table 2. Non-Certified Property Value**

Estimated Radioactivity <sup>(a)</sup>	2.6 x 10 <sup>6</sup>	Bq per unit
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<sup>(a)</sup> Value is for a reference date of October 1, 1987.

In 1987, the technical and administrative transfer of Special Nuclear SRMs to NBL was completed. In 2016, the New Brunswick Laboratory facility was transitioned to a program office within the Department of Energy and is now operating within the National Nuclear Security Administration (NNSA) as the Nuclear Reference Material Program (NRMP).