

## Rapid Radiochemical Method Plutonium-238 (<sup>238</sup>Pu) and <sup>239</sup>Pu in Water Samples



EPA's **rapid radiochemical methods** expedite analytical turnaround time for selected radionuclides while providing quantitative results that meet measurement quality objectives. Methods are applicable to samples where contamination is from either known or unknown origins. This fact sheet is intended for radioanalytical laboratory personnel, decision makers within the incident command structure, additional reoccupancy decision makers (e.g., state and local public health), and other field environmental response personnel.

**Method Summary:** This method uses two chromatographic extraction resins to isolate and purify plutonium (Pu) by removing interfering radionuclides as well as other components of the matrix in order to prepare the Pu fraction for counting by alpha spectrometry. The method uses vacuum-assisted flow to improve the speed of the separations. Prior to using the extraction resins, a water sample is filtered as necessary to remove any insoluble portions, equilibrated with <sup>242</sup>Pu tracer, and concentrated by either evaporation or calcium phosphate [Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>] coprecipitation. The sample test source is prepared by microprecipitation with neodym(III)-fluoride. Standard laboratory protocol for the use of an alpha spectrometer should be used when the sample is ready for counting.

<p><b>Time to Process: 7.5 hr</b></p> <p>Includes radiochemical processing and counting</p> <p><u>Compare to traditional method (ASTM D3084-05):</u> 14–27 hr</p>	<p><b>Method Application</b></p> <p>The method is specific for soluble <sup>238</sup>Pu and <sup>239/240</sup>Pu in drinking water and other aqueous samples. Application of this method should be validated by the laboratory using the protocols provided in <a href="#">Method Validation Guide for Qualifying Methods Used by Radiological Laboratories Participating in Incident Response Activities</a>, or the protocols published by a recognized standards organization for method validation.</p>		
<p><b>Measurement Quality Objectives</b></p> <p>Required method uncertainty: 1.9 pCi/L          Analytical action level (AAL): 15 pCi/L          Required relative uncertainty: 13% above AAL          Minimum detectable concentration: 1.5 pCi/L          Sample quantity: ~ 200mL          Count time: At least 1 hr</p>	<p><b>Equipment and Supplies</b></p> <p><b>Alpha spectrometer</b> calibrated for range of ~ 3.5–10 MeV   <b>Analytical balance:</b> 10<sup>-4</sup> g readability or better   <b>Cartridge reservoirs:</b> 10 or 20 mL syringe style with locking device, or equivalent   <b>Centrifuge and 250 mL flasks</b>   <b>Filter apparatus</b> with 25 mm diameter polysulfone filtration chimney, stem support, and stainless steel support or a single-use (disposable) filter funnel/filter combination   <b>Filters:</b> 0.45 μm membrane; 25 mm polypropylene with 0.1 μm pore size or equivalent   <b>Laboratory supplies:</b> 250 mL and 500 mL plastic/glass ware; 10 mL plastic culture tubes with caps; 100 μL pipettes and plastic tips; pH paper; stainless steel planchets or other sample mounts able to hold the 25 mm filter; tweezers   <b>Vacuum system:</b> box; pump or laboratory system; white inner tips; yellow outer tips   <b>Vortex mixer</b></p>		
<p><b>Sample Preservation</b></p> <p>Samples should be collected in 1 L plastic containers          Analysis within 3 days of sampling: No preservation required          Holding time &gt;3 days: Adjust pH to &lt;2 with concentrated nitric acid</p>	<p><b>Contacts</b></p> <table> <tr> <td><b>Program:</b> Kathy Hall 513-379-5260 hall.kathy@epa.gov</td> <td><b>Technical:</b> John Griggs 334-270-3450 griggs.john@epa.gov</td> </tr> </table>	<b>Program:</b> Kathy Hall 513-379-5260 hall.kathy@epa.gov	<b>Technical:</b> John Griggs 334-270-3450 griggs.john@epa.gov
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<p><b>Waste Generated per Sample</b></p> <ul style="list-style-type: none"> <li>~ 90 mL acidic waste</li> <li>~ 1 mL hydrofluoric acid</li> <li>~ 8 mL ethanol</li> <li>~ 100–1000 mL pH neutral decanted solution if Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub> coprecipitation performed</li> <li>2 resin cartridges</li> <li>Isotopes of americium, uranium, neptunium, and thorium if present in the original sample</li> </ul>			
<p><b>Method Access:</b>  <a href="https://www.epa.gov/sites/production/files/2015-06/documents/pu-238-239_in_water_rev_0_1_epa_402-r-10-001b.pdf">https://www.epa.gov/sites/production/files/2015-06/documents/pu-238-239_in_water_rev_0_1_epa_402-r-10-001b.pdf</a></p>			