



Standard Test Method for Determination of Uranium in Urine by Inductively Coupled Plasma Mass Spectrometer Following Nitric Acid Dilution¹

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1. Scope

1.1 This test method covers the determination of uranium in urine by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) after dilution in nitric acid. The method is presented in two parts. Part A describes a method for determination of total uranium in urine that does not distinguish between uranium isotopes. Part B describes a method that determines the ratio of ^{235}U to ^{238}U (the enrichment) in samples that Part A has shown to contain levels of uranium that the user of the data considers to be significant. The measurement in Part B may be combined with the measurement in Part A to calculate a ^{235}U concentration. The enrichment measurement may in turn be used to estimate levels of minor uranium isotopes, in particular ^{234}U , that are important for calculating the internal radiation dose received by an individual exposed to uranium. The estimation of minor isotope concentrations and the calculation of internal dose does not form part of this standard.

1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards*:²

C859 Terminology Relating to Nuclear Materials

D1193 Specification for Reagent Water

3. Terminology

3.1 *Definitions*—For definitions of other standard terms in this test method, refer to Terminology C859.

¹ This test method is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.05 on Methods of Test.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *internal reference standard*—a solution containing non-analyte elements that is analyzed by the ICP-MS alongside all samples. The signal is used to correct for small matrix effects and instrumental drift during the run to give a more precise measurement. The element or elements are selected such that they are not present in the unknown samples at significant concentrations, are within the general mass range of the measured analytes and have similar chemical behaviors in the instrument.

3.2.2 *method blank*—a solution which in so far as is practical duplicates the preparation process of the sample to be analyzed and passes through the same measurement process but does not initially contain significant quantities of any of the analytes to be measured.

3.2.2.1 *Discussion*—The method blank does not initially contain significant quantities of analyte, hence the value of any analyte measured may be assumed to be due to interference, matrix effects or contamination introduced as a consequence of sample processing. If the contribution of such factors is evaluated to be representative to the measurement of the unknown samples in the batch then subtracting the measured value for the method blank from the value measured on the genuine sample will eliminate these interferences, typically providing a better estimate for the true value of the quantity of analyte in the sample.

3.2.3 *spike*—a known quantity of analyte added to a sample which is used to evaluate losses during the sample preparation process or biases during measurement.

4. Summary of Test Method

4.1 For the determination of total uranium in urine: samples of urine are initially diluted by a factor of 20 with 0.32 M nitric acid (this is a 2 % by volume dilution of typical, concentrated nitric acid). The diluted sample is then analyzed for total uranium using an ICP-MS. Prior to analysis of samples the instrument is calibrated using 0, 50, 100, and 200 ng/L Uranium Standards prepared in 0.32 M nitric acid, that has been prepared using ultra high purity (UHP) concentrated acid. The Certified Reference Materials used for Standard preparation typically contain natural uranium. A method blank is run after the calibration and all subsequent results are blank