



Standard Practice for Alternate Actinide Calibration for Inductively Coupled Plasma-Mass Spectrometry¹

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1. Scope

1.1 This practice provides guidance for an alternate linear calibration for the determination of selected actinide isotopes in appropriately prepared aqueous solutions by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). This alternate calibration is mass bias adjusted using thorium-232 (^{232}Th) and uranium-238 (^{238}U) standards. One of the benefits of this standard practice is the ability to calibrate for the analysis of highly radioactive actinides using calibration standards at much lower specific activities. Environmental laboratories may find this standard practice useful if facilities are not available to handle the highly radioactive standards of the individual actinides of interest.

1.2 The instrument response for a series of determinations of known concentration of ^{232}Th and ^{238}U defines the mass versus response relationship. For each standard concentration, the slope of the line defined by ^{232}Th and ^{238}U is used to derive linear calibration curves for each mass of interest using interference equations. The mass bias corrected calibration curves, although generated from interference equations, are specific to the instrument operating parameters and tuning in effect at the time of data acquisition. Because interference equations are part of the normal ICP-MS manufacturer's software package, this calibration methodology is widely applicable.

1.3 For this standard practice, the actinide atomic mass range that has been studied is from amu 232–244. Guidance for an extended range of amu 228–248 is given in this practice.

1.4 Using this practice, analyte concentrations are reported at each amu and not by element total (that is, ^{239}Pu versus plutonium).

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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

C1168 Practice for Preparation and Dissolution of Plutonium Materials for Analysis

C1347 Practice for Preparation and Dissolution of Uranium Materials for Analysis

C1411 Practice for The Ion Exchange Separation of Uranium and Plutonium Prior to Isotopic Analysis

C1414 Practice for The Separation of Americium from Plutonium by Ion Exchange

C1463 Practices for Dissolving Glass Containing Radioactive and Mixed Waste for Chemical and Radiochemical Analysis

D1193 Specification for Reagent Water

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms relating to nuclear materials, refer to Terminology **C859**.

3.1.2 *AMU*—atomic mass unit.

4. Summary of Practice

4.1 Calibration for the actinides by ICP-MS can be performed in a variety of ways with varying degrees of data quality. An alternative calibration method has been developed to compensate for instrument mass bias using a generated mass response curve defined by the ^{232}Th and ^{238}U data points. The mass response curve defined by ^{232}Th and ^{238}U approximates the mass response curve from amu 232–244 as verified experimentally and graphically depicted in Fig. 1. The mass response curve shown reflects the operating parameters and

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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.