



Standard Test Method for Isotopic Analysis of Uranium Hexafluoride by Double— Standard Multi—Collector Gas Mass Spectrometer¹

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1. Scope

1.1 This is a quantitative test method applicable to determining the mass percent of uranium isotopes in uranium hexafluoride (UF₆) samples. This method as described is for concentrations of ²³⁵U between 0.1 and 10 mass percent, and ²³⁴U and ²³⁶U between 0.0001 and 0.1 mass percent.

1.2 This test method is for laboratory analysis by a gas mass spectrometer with a multi-collector.

1.3 This standard complements C 761, sections 35 through 40, the double-standard method for gas mass spectrometers using a single collector, by providing a method for spectrometers using a multi-collector.

1.4 *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:

C 761 Test Methods for Chemical, Mass Spectrometric, Spectrochemical, Nuclear, and Radiochemical Analysis of Uranium Hexafluoride²

C 787 Specification for Uranium Hexafluoride for Enrichment²

C 996 Specification for Uranium Hexafluoride to Less Than 5 % ²³⁵U²

C 1215 Guide for Preparing and Interpreting Precision and Bias Statements in Test Method Standards Used in the Nuclear Industry²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *A standard, n*—the low-value standard of a standard pair that brackets the sample.

3.1.2 *B standard, n*—the high-value standard of a standard

pair that brackets the sample.

3.1.3 *determination, n*—a single isotopic value, calculated from a sequence of ratios; the most basic isotopic value calculated.

3.1.4 *Lagrange's interpolation formula, n*—a mathematical equation designed to estimate values between two or more known values.

3.1.5 *run, n*—a completed, six-entry symmetrical sequence consisting of A standard, sample, B standard, B standard, sample, and A standard from which a determination can be calculated for one or more isotopes.

3.1.6 *standard spread, n*—the difference between the high and low standards; sometimes called standard range.

3.1.7 *test result, n*—a reported value; the mean of two or more determinations.

4. Summary of Test Method

4.1 Uranium hexafluoride gas is introduced into an ionization source. The resulting ions are accelerated down the flight tube into the magnetic field. The magnetic field separates the ions into ion beams in accordance with the *m/e* ratio. Four collectors are stationed so the ²³⁴UF₅⁺, ²³⁵UF₅⁺, ²³⁶UF₅⁺, and ²³⁸UF₅⁺ ion beams strike individual collectors.

4.2 Two standards are chosen whose values bracket the desired isotope of the sample. The sample and two standards are introduced in a six-entry, symmetrical sequence. Then, measurements are taken which give the mole ratio of the desired isotope to ²³⁸U.

4.3 Through Lagrange's interpolation formula, these measurements are used to calculate the mass percent of the desired isotope. If standards are available that bracket all isotopes, then the ²³⁴U, ²³⁵U, and ²³⁶U mass percents are calculated from the same six-entry run.

4.4 The results of two six-entry, symmetrical-sequence runs are averaged to find test results for each isotope. The ²³⁸U mass percent is obtained by subtraction.

5. Significance and Use

5.1 Uranium hexafluoride used to produce nuclear-reactor fuel must meet certain criteria for its isotopic composition. This test method may be used to help determine if sample

¹ This test method is under the jurisdiction of ASTM Committee C-26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.05 on Methods of Test.

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² *Annual Book of ASTM Standards*, Vol 12.01.