



# Standard Test Method for Isotopic Analysis of Uranium Hexafluoride by Single-Standard Gas Source Multiple Collector Mass Spectrometer Method<sup>1</sup>

This standard is issued under the fixed designation C 1428; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method is applicable to the isotopic analysis of uranium hexafluoride ( $\text{UF}_6$ ) with  $^{235}\text{U}$  concentrations less than or equal to 5 % and  $^{234}\text{U}$ ,  $^{236}\text{U}$  concentrations of 0.001 to 0.1 %.

1.2 This test method may be applicable to the analysis of the entire range of  $^{235}\text{U}$  isotopic compositions providing that adequate standards are available.

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 health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

**C 787** Specification for Uranium Hexafluoride for Enrichment

**C 996** Specification for Uranium Hexafluoride Enriched to Less than 5 %  $^{235}\text{U}$

2.2 *Other Document:*

**USEC-651** Uranium Hexafluoride: A Manual of Good Handling Practices<sup>3</sup>

## 3. Summary of Test Method

3.1 The unknown sample and a standard whose isotopic composition is close to that of the sample are introduced in sequence into the mass spectrometer, and  $^{234}\text{U}$ ,  $^{235}\text{U}$ ,  $^{236}\text{U}$ , and  $^{238}\text{U}$  ions are focused through corresponding collector slits

to the four separate collectors. Measurements are made that are proportional to the ratios of  $^{234}\text{U}$ ,  $^{235}\text{U}$ , or  $^{236}\text{U}$  to  $^{238}\text{U}$ . With the known composition of the standard, these ratios of molar ratios permit calculation of the  $^{234}\text{U}$ ,  $^{235}\text{U}$ , and  $^{236}\text{U}$  contents. Memory corrections are applied based on the periodic measurement of two standards.

## 4. Significance and Use

4.1 Uranium hexafluoride is a basic material used to produce nuclear reactor fuel. To be suitable for this purpose, the material must meet criteria for isotopic composition. This test method is designed to determine whether the material meets the requirements described in Specifications **C 787** and **C 996**.

## 5. Apparatus

5.1 A gas source multiple collector mass spectrometer with the following attributes:

5.1.1 The resolving power of the mass spectrometer is not less than 500. The resolving power ( $R$ ) is calculated from the registered mass spectrum of both the  $^{235}\text{UF}_5^+$  and  $^{238}\text{UF}_5^+$  isotopes as follows:

$$R = \frac{a \cdot M}{b \cdot \Delta M} \quad (1)$$

where

$a$  = distance between centers of the  $^{235}\text{UF}_5^+$  and  $^{238}\text{UF}_5^+$  peaks,

$b$  = peak width of the  $^{238}\text{UF}_5^+$  isotope (10 % valley),

$M$  = 333 – mass(u)  $^{238}\text{UF}_5^+$ , and

$\Delta M$  = 3 = 333 – 330, 330 – mass(u)  $^{235}\text{UF}_5^+$

5.1.2 The abundance sensitivity of the mass spectrometer is specified as less than  $1 \times 10^{-5}$  as contribution of mass 333 ( $^{238}\text{UF}_5^+$ ) to mass 331 ( $^{236}\text{UF}_5^+$ ).

5.1.3 The four collectors have collector slits adjusted for ions of masses 329, 330, 331, and 333. Ion currents are amplified by four amplifiers, having noise level less than 0.5 mV.

5.1.4 The ion beams are kept within the slits by an automatic beam positioner circuit.

<sup>1</sup> 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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<sup>2</sup> 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.

<sup>3</sup> Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.