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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

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GB/T 13701-2025

Replacing GB/T 13701-1992

Isotopic analysis of uranium by single-standard gas mass-spectrometer method

单标准气体质谱法铀同位素分析

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part

1.Structure and Drafting Rules of Standardization Documents". Drafting. This document supersedes GB/T 13701-1992 "Uranium Isotope Analysis by Single Standard Gas Mass Spectrometry" and is consistent with GB/T 13701-1992. Aside from structural adjustments and editorial changes, the main technical changes are as follows:

---The following has been deleted. "That is, 3 x 10^5 UF6 molecules enter the ion source and collect one UF5 ion at the receiving electrode" and "In the measurement section of the instrument". "No secondary electron and secondary ion signals should be observable within the sensitivity range," "Equipped with a recorder and printer," and other related information (see [link]). (Versions 3.1.1.1, 3.1.1.3, and

3.1.1.4 from the.1992 edition)

---Change "The difference in isotopic abundance ratio between the sample and the standard should be less than 10%" to "Uranium isotopic abundance standard sample, The uranium-235 isotope abundance standard sample and the sample to be tested (CX235) should meet the following requirements. CSH235 CX235 <=

1.5 or CX235 CSL235 <=1.5.(See 5.1b) [

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4.1.1 of the.1992 edition];

---The following has been deleted. "If two suitable working standards are selected as standard pairs, the standard sample pairs need to be determined according to 4.1.4.1~4.1.4.3". The abundance ratio alpha" and "the memory factor M can also be determined using other equivalent methods" (see

4.1.4 and.1992 edition). 4.1.5);

---Change "Take sufficient amounts of sample X and standard sample S, and connect the sampler to the corresponding connector of the injection system." to "Take sufficient..." For the quantity of samples and standard samples [5.1b)], connect the sampler to the injection system. (See 8.1.1,

4.2.1 of the.1992 edition);

---Change "Prepare -80°C~-60°C cryogenic fluid and attach it to the sampler." to "Immerse the sampler in the container filled with cryogenic fluid (5.4)". "In the container." (See 8.1.3,

4.2.3 of the.1992 edition);

---The section "Instrument Preparation" has been removed (see section

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1 Scope

GB/T 13701-2025 is the Chinese national standard on isotopic analysis of uranium by single-standard gas mass-spectrometer method, in the field of energy and heat transfer engineering. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 5 October 2025 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 5 October 2025. Classification: ICS 27.120, CCS F 46. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document specifies the reagents or materials, instruments, equipment, samples, and experimental procedures for determining uranium isotopes in uranium hexafluoride using single-standard gas mass spectrometry. The content includes steps, data processing, precision, quality assurance and control, and test report requirements. This document applies to the measurement of uranium isotope abundance and isotope abundance ratio in uranium hexafluoride samples.

2 Normative references

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This document has no normative references.

3 Terms and Definitions

The following terms and definitions apply to this document.

3.1 isotope abundance In a mixture of isotopes of an element, the ratio of the number of atoms of a specific isotope to the total number of atoms of that element.

3.2 isotope mass abundance In a mixture of isotopes of an element, the ratio of the mass of a specific isotope to the total mass of the element.

3.3 Abundance ratio isotoperatio In a given sample, the ratio of the number of atoms of one isotope of the same element to the number of atoms of another isotope.

3.4 isotope mass ratio In a given sample, the ratio of the mass of one isotope of the same element to the mass of another isotope.

3.5 Sensitivity The number of gas molecules required for a gas isotope mass spectrometer to produce a unit of ion.

3.6 Quality resolution reolution ratio The ratio of the average mass M of two adjacent mass spectrometer peaks to the mass difference DeltaM between the two peaks, i.e., R = DeltaM

4.Principles Select a standard sample with an abundance similar to the sample to be tested, and continuously inject the sample alternately in the sequence of sample to be tested - standard sample - sample to be tested. The abundance ratios of uranium-235 and uranium-238 in the test sample and standard sample were determined using dual-collector or multi-collector methods, respectively. The measured abundance ratios of the test sample and standard sample were then analyzed. The isotopes of the sample to be tested are calculated from the ratio alpha of the isotopic abundance ratio of the sample to the standard sample and the known isotopic abundance ratio Rs of the standard sample. The abundance ratio Rx can be used to calculate the abundance of each isotope in the sample. This measurement should be corrected for the memory effect, and the memory factor is determined by the measurement of standard sample pairs.

5 Reagents or materials

5.1 Uranium isotope abundance standard samples in uranium hexafluoride, with traceability. Details are as follows:

a) A pair of uranium isotope abundance standard samples, comprising two standard samples. one with a relatively high uranium-235 abundance (CSH235) and the other with a relatively low abundance. The standard sample (CSL235) should meet the following requirements. CSH235 CSL235 <=

3.The abundance of uranium-234 (uranium-236) isotopes is in the range of 0.0002 <= CX

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<= 0.01. Inside, the standard sample meets C SH CSL234 <=8 CSH236 CSL236 <=

8 The abundance of uranium-234 (uranium-236) isotopes is in the range of 0.01 < CX <= 0.1. Inside, the standard sample meets C SH CSL234 <=6 CSH236 CSL236 <=6 ÷. Where C represents the abundance value, X represents the sample to be tested, and SH represents the standard. The sample is a standard sample with high abundance in the medium, and SL indicates a standard sample with low abundance in the medium.

b) Uranium isotope abundance standard samples, uranium-235 isotope abundance standard samples, and the sample to be tested (CX235) should meet the following requirements. CSH235 CX235 <=

1.5 or CX235 CSL235 <=1.5.The abundance of uranium-234 (uranium-236) isotopes is in the range of 0.0002 <= CX <= 0.01, and the standard sample meets the requirements. CSH234(236) CX234(236) <=4 or CX234(236) CSL234(236) <=4 ÷, Uranium-234 (Uranium-236) isotope abundance in the range of 0.01 < CX <= 0.1, standard sample Satisfy C SH 234(236) CX234(236) <=3 or CX234(236) CSL234(236) <=3 ÷.

5.2 Anhydrous ethanol, analytical grade.

5.3 Liquid nitrogen, 99% purity.

5.4 Refrigerant (-80°C~-60°C). prepared from anhydrous ethanol (5.2) and liquid nitrogen (5.3).

6.Instruments and Equipment The instrument uses an electron impact ion source mass spectrometer and should meet the following conditions.

a) The vacuum system ensures that the mass analyzer is below 5.0x10-

6 Pa, the ion source region is below 1.0x10-

5 Pa, and the vacuum remains unchanged during sample injection.

b) Sensitivity < 3x10^5.

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