



**Nuclear Reference Material Program**  
*U.S. Department of Energy*



**Certificate of Analysis**  
**Certified Reference Material U010 (5 mg)**  
**Uranium (U<sub>3</sub>O<sub>8</sub>) Isotopic Standard, 1.0 % U-235, 5 mg U**

**Description:** Each unit of Certified Reference Material (CRM) U010 consists of approximately 5 milligrams of uranium, in the form of highly purified U<sub>3</sub>O<sub>8</sub>, contained in a glass bottle. Certified isotope-amount and isotope-mass fractions values are reported in Table 1.

**Table 1. Certified Property Value and Uncertainty <sup>(a)</sup>**

	$n(^{234}\text{U})/n(\text{U})$	$n(^{235}\text{U})/n(\text{U})$	$n(^{236}\text{U})/n(\text{U})$	$n(^{238}\text{U})/n(\text{U})$
Isotope-Amount Fraction ( $\cdot 100$ ):	0.00541	1.0037	0.00681	98.984
Uncertainty:	0.00005	0.0010	0.00007	0.001
	$m(^{234}\text{U})/m(\text{U})$	$m(^{235}\text{U})/m(\text{U})$	$m(^{236}\text{U})/m(\text{U})$	$m(^{238}\text{U})/m(\text{U})$
Isotope-Mass Fraction ( $\cdot 100$ ):	0.00532	0.9911	0.00675	98.997
Uncertainty:	0.00005	0.0010	0.00007	0.001

<sup>(a)</sup> The indicated uncertainties for the isotope composition of the CRM are 95 % confidence intervals for a single determination. This term can be defined as an approximate two-sigma limit, where sigma is the standard deviation of the measurements data obtained from the material. The uncertainties include allowances for inhomogeneity of the material as well as measurement uncertainty.

**Intended use:** CRM U010 is intended primarily for use as an isotopic standard in mass spectrometric analysis of uranium.

**Storage:** This material should be stored in its original packaging under normal laboratory environmental conditions.

**Period of validity:** When stored in its original, unopened container, the certification of this material is valid indefinitely. The Nuclear Reference Material Program (NRMP) will notify customers should any degradation be detected.

**Minimum sample size:** The NRMP has validated that samples of 1 mg of oxide or larger are isotopically homogenous. Accordingly, NRMP does not guarantee uranium isotopic homogeneity for oxide samples smaller than 1 mg.

**Instructions for handling:** The material in the unit bottle is radioactive. This radioactive material should be handled only by qualified individuals. To minimize personnel exposure, appropriate facilities and personal protective equipment should be used. Refer to the Safety Data Sheet for further information.

**Traceability statement:** Certified isotope-amount fractions are traceable to the SI base unit of the mole. Certified isotope-mass fractions are traceable to the SI base units of the mole and the kilogram.

**Additional information:** For the original certification, the  $^{235}\text{U}/^{238}\text{U}$  measurements were made on a single stage thermal ionization mass spectrometer equipped with a Faraday cup detection system. The isotope ratios were corrected for mass discrimination effects by intercomparison with synthetic calibration mixtures of similar  $^{235}\text{U}$  levels, prepared from high-purity  $^{235}\text{U}$  and  $^{238}\text{U}$  separated isotopes. The  $^{235}\text{U}/^{238}\text{U}$  value for this standard, 0.010140, is known to at least 0.1 %. The  $^{234}\text{U}$  and  $^{236}\text{U}$  abundances were determined by isotope dilution mass spectrometry using high-purity  $^{233}\text{U}$  as the spike. These measurements were performed on a thermal ionization mass spectrometer equipped with an ion-multiplier detection system.

This CRM was originally issued in 1970 by the National Bureau of Standards (NBS), now known as the National Institute of Standards and Technology (NIST), as Standard Reference Material (SRM) U-010. The measurements made at NBS leading to the certification were performed by E. L. Garner, L. A. Machlan, L.J. Moore and W.R. Shields. In 1987, the technical and administrative transfer of NBS Special Nuclear SRMs to the New Brunswick Laboratory (NBL) CRM Program was coordinated by the NBS Office of Standard Reference Materials and N. M. Trahey, at NBL. In 2016 NBL transitioned to a program office within the Department of Energy and is now operating within the National Nuclear Security Administration (NNSA) as the Nuclear Reference Material Program (NRMP).

NOTE: NBS Special Publication 260-27 presents further details of the measurements made at NBS, which provided the basis for the certification, and is available from the NIST Office of Reference Materials.