



New Brunswick Laboratory
U.S. Department of Energy

Certificate of Analysis

CRM U630

Uranium (U₃O₈) Isotopic Standard

	$n(^{234}\text{U})/n(^{235}\text{U})$	$n(^{236}\text{U})/n(^{235}\text{U})$	$n(^{238}\text{U})/n(^{235}\text{U})$	
Isotope-Amount Ratio:	0.0097698	0.0151895	0.55351	
Uncertainty:	0.0000062	0.0000097	0.00049	
	$n(^{234}\text{U})/n(\text{U})$	$n(^{235}\text{U})/n(\text{U})$	$n(^{236}\text{U})/n(\text{U})$	$n(^{238}\text{U})/n(\text{U})$
Isotope-Amount Fraction (•100):	0.61894	63.353	0.96230	35.066
Uncertainty:	0.00043	0.020	0.00067	0.020
	$m(^{234}\text{U})/m(\text{U})$	$m(^{235}\text{U})/m(\text{U})$	$m(^{236}\text{U})/m(\text{U})$	$m(^{238}\text{U})/m(\text{U})$
Isotope Mass Fraction (•100):	0.61354	63.069	0.96207	35.356
Uncertainty:	0.00043	0.020	0.00067	0.020
Molar Mass:	236.10175 g•mol⁻¹			
Uncertainty:	0.00061 g•mol⁻¹			

Notes:

CRM U630 is a radioactive material and should be handled and stored under proper radiologically-controlled conditions at all times.

Certified Reference Material U630 (CRM U630) is a uranium isotope-amount ratio standard intended for use in measurement calibration and/or quality control for analysis of high enriched uranium oxide. Each unit of CRM U630 consists of a 20 mL glass scintillation vial containing approximately 13 milligrams of uranium oxide (U₃O₈).

Reported numerical uncertainties for certified values are expressed as expanded uncertainties ($U = k \cdot u_c$) at the 95% level of confidence, where the expanded uncertainty (U) is the product of the combined standard uncertainty (u_c) and a coverage factor (k). The last figure in the reported values and their uncertainties is provided for information purposes and is not intended to convey a significant degree of reliability. The isotope-amount and mass fraction values and uncertainties are provided primarily for information purposes. To assure proper uncertainty propagation, it is recommended that isotope-amount ratios and associated uncertainties be used for calculations incorporating CRM U630 values.

CRM U630 units do not have an expiration date. To maintain the integrity of an unused CRM unit, it should remain in the original packaging and should be stored in a dry, temperature-controlled location.

Certification and/or verification measurements for isotope-amount ratios were performed on aliquots as small as 10 mg of U₃O₈. Accordingly, the material homogeneity for the attribute values is not certified for samples smaller than 10 mg. Note that CRM U630 has also been characterized for model purification date

but certification analyses for this attribute were performed on 100 mg oxide samples. Therefore, 10 mg CRM U630 units are only intended as uranium isotope-amount ratio standards. 1 g size CRM U630 units are certified for both isotope amount ratios and model purification age.

The amount content value for this material ($0.84661 \pm 0.00048 \text{ g U} \cdot \text{g}^{-1} \text{ oxide}$) is provided for user calculation purposes. This value was determined by NBL-Modified Davies & Gray Titrimetric analyses performed on oxide that was calcined at 900° C for 3 hours. This value is traceable to the CRM 112-A metal standard (formerly National Bureau of Standards SRM 960) which was used to normalize the SRM 136e Potassium Dichromate solutions used for titrations. The amount-content value was verified by ceric titrations performed at Los Alamos National Laboratory.

Description:

In 2001 to 2002, a detailed thermal ionization mass spectrometry measurement campaign was performed on the CRM U630 to determine uranium isotope-amount ratios and uncertainties. Mass discrimination calibrations were performed on a sample-turret basis using multiple measurements of NBL CRM U500 and CRM U750 Uranium Isotopic Standards. Traceability of the isotope-amount ratio measurements for CRM U630 is primarily established by calibration of the mass spectrometer using measurements of CRMs U500 and U750 Uranium Isotopic Standards that were originally provided by the National Bureau of Standards (now known as the National Institute of Standards and Technology) as SRM U500 and SRM U750 Uranium Isotopic Standards.

Measurement Uncertainty:

Uncertainties were determined according to the protocols outlined in JCGM 100:2008 *Guide to the Expression of Uncertainty in Measurement*. The combined standard uncertainties for certified values consist of Type A and Type B components. The Type A components for isotope-amount ratios are derived from standard deviations associated with isotopic ratios measured for the samples and the $n(^{235}\text{U})/n(^{238}\text{U})$ ratio of NBL CRM U500 and U750. Type B components are based on the combined standard uncertainties for the $n(^{235}\text{U})/n(^{238}\text{U})$ ratio of CRM U500 and U750. Isotope mass fractions incorporate an additional Type B component associated with the uncertainty of the atomic mass for the U isotopes. The coverage factor (k) for each expanded uncertainty is the Student's t-factor necessary to provide a 95% level of confidence ($k \approx 2$ for all values cited in this certificate). A more detailed explanation of measurement uncertainty can be obtained upon request from NBL.

Project Support:

Characterization analyses for U amount content measurements were funded by the Department of Homeland Security, National Technical Nuclear Forensic Center (NTNFC) under Inter-Agency Agreement HSHQDC-10-X-00135.