Certificate of Analysis

Certified Reference Material 115 (75 g)

Uranium (Metal) Assay and Isotopic Standard, 0.2 % U-235, 75 grams

Description: Certified Reference Material (CRM) 115 is a uranium mass fraction and isotope-amount ratio standard. Each unit of CRM 115 consists of single uranium metal piece with a mass of approximately 75 grams. This CRM is not certified for absolute quantity of material which may be somewhat greater or less than the nominal mass (between 60 g and 80 g). Certified isotope composition and mass fraction values are reported in Table 1.

Table 1. Certified Property Values and Uncertainties [a] [b]

	$g\ g^{-1}$			$g\ mol^{-1}$
Uranium Mass Fraction:	0.99978	**Uranium Molar Mass:**		238.0445912
Uncertainty:	0.00010	**Uncertainty:**		0.0000055
Isotope-Amount	$n(^{234}U)/n(^{238}U)$	$n(^{235}U)/n(^{238}U)$	$n(^{236}U)/n(^{238}U)$	
Ratio:	0.000007545	0.0020337	0.000032213	
Uncertainty:	0.000000018	0.0000012	0.000000084	
Isotope-Amount Fraction	$n(^{234}U)/n(U)$	$n(^{235}U)/n(U)$	$n(^{238}U)/n(U)$	$n(^{238}U)/n(U)$
(•100):	0.0007530	0.20295	0.0032146	99.79308
Uncertainty:	0.0000018	0.00012	0.0000084	0.00012
Isotope-Mass Fraction	$m(^{234}U)/m(U)$	$m(^{235}U)/m(U)$	$m(^{236}U)/m(U)$	$m(^{238}U)/m(U)$
(•100):	0.0007403	0.20039	0.0031876	99.79568
Uncertainty:	0.0000018	0.00012	0.0000083	0.00012

[a] The uncertainty assigned to the certified assay value is the 95 % confidence limit for the mean. This limit includes components due to both random analytical variability and allowances for all known and quantified sources of systematic uncertainties. Reported numerical uncertainties for certified values are expressed as expanded uncertainties ($U = k \bullet u_c$) 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).

[b] ^{233}U isotope was not detected. The estimated limit of detection for the uranium isotope ratio associated with the methods used to assess ^{233}U content is $n(^{233}U)/n(^{238}U)$ 3.6×10^{-9}.

Intended use: CRM 115 is a uranium metal standard intended for use in calibration of and/or quality control for uranium analysis methods. The isotope-amount fraction and isotope-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 115 values.

Storage: 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.

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

(Revision of Certificate Dated November 2020)
Richard Essex, Director
January 2026

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Minimum sample size: Certification and/or verification measurements for uranium mass fraction and isotope-amount ratios were performed on a random sampling of metal pieces weighing approximately 1 gram. The homogeneity of uranium mass fraction or isotopic composition is not certified for metal pieces smaller than approximately 1 gram.

Instructions for handling: The material in the unit 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.

Prior to use, surface oxide must be removed to ensure accurate uranium mass fraction values. A suggested procedure is given below.

Suggested Procedure for Achieving Accurate Weighing and Mass Fraction Values

1. Soak the uranium metal sample in 8 mol L^{-1} nitric acid for 10-20 minutes to remove all visible surface oxides and impurities.
2. To ensure an accurate uranium metal weight, the following steps should be performed rapidly to minimize oxidation of the sample.
3. Thoroughly rinse the metal piece with distilled, deionized water.
4. Remove excess water by thoroughly rinsing the metal piece with pure acetone.
5. Allow the acetone to evaporate (30 – 60 seconds is typically sufficient).
6. Perform a weighing of sufficient accuracy for users need.

Traceability statement: The certified isotope amount ratios and isotope amount fractions are traceable to the SI unit mole. The certified isotope mass fractions and uranium mass fraction are traceable to the SI unit kilogram. The certified uranium molar mass is traceable to the SI units mole and kilogram.

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 both Type A and Type B evaluated components. For the amount content uncertainty, the standard deviation of the titrations was applied as a Type A evaluated component. The combined standard uncertainty of the SRM 136e oxidimetric standard was applied as a Type B evaluated component. For the isotope-amount ratios, standard deviations associated with isotopic ratio measurements of the samples and the $n(^{235}U)/n(^{238}U)$ ratio of CRM U030A were applied as Type A evaluated components. The combined standard uncertainties for the $n(^{235}U)/n(^{238}U)$ ratio of CRM U030A and uncertainty components to account for additional sources of uncertainty associated with background corrections and analytical biases were all applied as Type B evaluated components of uncertainty. Isotope mass fractions incorporate an additional component associated with the uncertainty of the atomic mass for the U isotopes. These were applied as Type B evaluated components. 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 NRMP.

Additional information: Uranium amount content for CRM 115 was originally determined in 1975 by the NBL High Precision Titrimetric method using SRM 136c Potassium Dichromate Oxidimetric Standard as the titrant. Although the originally certified amount content value appears to be accurate within stated uncertainties, a new amount content determination was performed to meet the requirements of international standards for expression of measurement uncertainty. In 2011 the uranium amount content for CRM 115 was re-determined by analyses using SRM 136e Potassium Dichromate Oxidimetric Standard as the titrant. The CRM 112A Uranium Metal Assay and Isotopic Standard was used as a control to verify performance of the measurement system. Traceability of the measurements is primarily established by direct determination of uranium amount content based on the titration of uranium using SRM 136e Potassium Dichromate Oxidimetric Standard provided by the National Institute of Standards and Technology.

In 2011, a detailed thermal ionization mass spectrometry measurement campaign was performed on the CRM 115 material to determine uranium isotope-amount ratios and uncertainties. Mass discrimination calibrations were performed on a sample turret basis using multiple measurements of CRM U030A Uranium Isotopic Standard. Analyses of CRM 112A Uranium Metal Assay and Isotopic Standard were performed to verify that mass spectrometric measurements were in control. Traceability of the isotope-amount ratio measurements for CRM 115 is primarily established by calibration of the mass spectrometer using measurements of CRM U030A Uranium Isotopic Standard that was originally provided by the National Bureau of Standards (now known as the National Institute of Standards and Technology) as SRM U030A Uranium Isotopic Standard.

In 1987, the technical and administrative transfer of Special Nuclear SRMs to NBL was completed. 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).