NBL Program Office

U.S. Department of Energy

Certificate of Analysis

Certified Reference Material C112A (4g)
Uranium (Metal) Assay and Isotopic Standard, 0.7% U-235, 4 gram

Uranium Assay:	**0.99975 g U/g metal**
Uranium Assay Uncertainty:	**0.00006 g U/g metal**

	$^{234}U/^{238}U$	$^{235}U/^{238}U$
Atom Ratio:	**0.000052841**	**0.0072543**
Atom Ratio Uncertainty:	**0.000000082**	**0.0000040**

	^{234}U	^{235}U	^{238}U
Atom Percent:	**0.0052458**	**0.72017**	**99.27458**
Atom Percent Uncertainty:	**0.0000081**	**0.00039**	**0.00039**
Weight Percent:	**0.0051579**	**0.71114**	**99.28370**
Weight Percent Uncertainty:	**0.0000080**	**0.00038**	**0.00038**

Relative Atomic Weight:	**238.028918**
Relative Atomic Weight Uncertainty:	**0.000012**

Note: ^{233}U and ^{236}U were not detected. The limit of detection of uranium ratios for the technique used is 5×10^{-9}. The $^{238}U/^{235}U$ ratio and uncertainty may be calculated as 137.849 ± 0.076.

This Certified Reference Material (CRM) is a uranium metal standard intended for use in calibration of and/or quality control for uranium analysis methods. Each unit of C112A consists of a metal piece of nominal mass as listed on the container.

NOTE: The CRM should be handled under proper radiologically-controlled conditions at all times.

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 error and allowances for all known and quantified sources of systematic uncertainties. The uranium assay was determined using a constant-current coulometric reduction of uranyl ions with electrogenerated titanous ions in dilute sulfuric acid. A correction was made for iron and vanadium content of the material. The total estimated impurities in the CRM (223 µg/g) yield a calculated uranium assay value of 0.99978.

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The uncertainties for the uranium isotopic and atomic weight values are expressed as expanded uncertainties (U) as $U = k*u_c$ where u_c is the combined standard uncertainty and k is the coverage factor (k = 2). Uncertainties were determined according to the JCGM 100:2008 *Guide to the Expression of Uncertainty in Measurement*. The coverage factor of 2 was chosen to provide an approximate 95% level of confidence. The input quantities associated with the uranium isotopic composition included uncertainties from the certified value for U030A, measurement precision, and background corrections associated with the analytical techniques.

This CRM was originally issued in 1972 by the National Bureau of Standards (NBS) as Standard Reference Material (SRM) 960. The material was produced and shipped to NBL, at the request of the NBL, by the Mallincrodt Chemical Works (MCW) factory in St. Louis, Missouri. The MCW factory used the 'direct-ingot' or 'dingot' technique which produces high purity massive uranium metals with low carbon content. The dingot was shipped to NBL in 1959 and subsequently cut and processed at National Lead of Ohio prior to certification by NBS. Details of the production of the material may be found in NBL report NBL-RM-2010-CRM 112A.

The assay measurements leading to the certification of the uranium assay were performed at the National Bureau of Standards. In 1987, the technical and administrate transfer of NBS Special Nuclear SRMs into the NBL CRM Program was completed. In 1998, the standard material was repackaged and verified for uranium assay and atomic mass at NBL. In 2010, the material was again repackaged and isotopic certification and assay verification measurements were performed at the New Brunswick Laboratory.

NBL has performed uranium isotopic certification measurements on a random sampling of metal pieces of one (1) gram. NBL does not guarantee uranium isotopic homogeneity for metal pieces smaller than one gram.

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

Suggested Procedure for Achieving Accurate Weighing and Assay Values

1. Soak the uranium metal sample in 8 M nitric acid for 10-20 minutes in order to remove all visible surface oxides and impurities.
2. In order 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.

Expiration of Certificate: The NBL Program Office has produced and evaluated uranium metal reference materials stored for extended periods, exceeding 40 years. When stored in its original, unopened container, the certification of this material is valid indefinitely. The certification is nullified if the material or container is damaged, contaminated or otherwise modified. The NBL PO will periodically monitor the materials in inventory and notify customers should degradation be detected.

Stability and Storage: This material should be stored in its original packaging under normal laboratory environmental conditions. Presence of water vapor may speed surface oxidation.