



Nuclear Reference Material Program
U.S. Department of Energy



Certificate of Analysis
Certified Reference Material 042A (1-4)
Uranium Pitchblende Ore – Dunite Mixture Counting
Standard

Description: Certified Reference Material (CRM) 042A consists of four bottles, each of which contains 100 grams of a mixture of pitchblende (uraninite) diluted with dunite. The certified values for uranium concentrations (expressed as mass fraction percent) are listed in Table 1.

Table 1. Certified Property Values and Uncertainties ^(a)

	CRM 042A-1	CRM 042A-2	CRM 042A-3	CRM 042A-4
Uranium Mass Fraction (g g ⁻¹) • 100:	4.058	1.9555	1.0421	0.49055
Uncertainty:	0.018	0.0034	0.0017	0.00084

^(a) Each uncertainty is expressed as the expanded uncertainty at the 95 % level of confidence. The last figure in the reported values is provided for information purposes only and is not intended to convey a significant degree of reliability.

Intended use: CRM 042A is intended primarily to provide traceability for amounts of uranium in uranium ore materials measured by radioactive counting methods. This CRM provides a means to calibrate counting equipment by establishing the correlation between instrument response and the known quantities of uranium.

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

Minimum sample size: Uranium mass fraction certification measurements were performed at a sample size of at least 250 mg. NRMP does not guarantee uranium homogeneity for samples less than 250 mg.

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.

Measurement uncertainty: The expanded uncertainty (U) for a certified property of CRM 042A defines a confidence interval around the value of the property. It is calculated as a product of the combined standard uncertainty (u_c) and the coverage factor (k). The value of k is obtained from the Student's t-distribution and is a function of the effective degrees of freedom and the specified level of confidence. The combined standard uncertainties for the certified values consist of the variability of repeated measurements of samples and standards applies as Type A evaluated components. Other components of uncertainty were considered and determined to be insignificant.

Instructions for Handling: The material in each 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 property values are traceable to the SI unit kilogram.

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Additional information: The starting materials for CRM 042A were obtained from the same batches of material that were used in the preparation of CRM 42 issued in 1957. Each batch of material was reprocessed by blending, sieving and sampling. The NBL-Modified Davies and Gray Titrimetric method was used to determine the uranium mass fraction of the materials. For each material, two analysts, using independent titration systems, performed the mass fraction measurements. CRM 112A, Uranium Metal Assay Standard, was used to determine the uranium equivalency of the potassium dichromate titrant. The same uranium standard was used for quality control of the measurement systems.

Supplemental information on the characteristics of the sample material is given in Table 2. As reported in 1957, uranium and radium analyses of the pitchblende used in the preparation of these materials indicate that the ratio of grams of radium per gram uranium is 3.45×10^{-7} .

Table 2. Non-Certified Property Value ^(a)

	Method	CRM 042A-1	CRM 042A-2	CRM 042A-3	CRM 042A-4
Moisture mass fraction (g g^{-1}) • 100:	Loss at 110 °C	1.21	1.23	1.27	1.26
Absolute density (g cm^{-3})	Helium pycnometer	3.06	3.00	2.97	2.95

^(a) For each material, four moisture and two density measurements were made. The standard deviation for each value given in Table 2 is less than 0.01 absolute.

In 2016, the New Brunswick Laboratory facility was 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).