New Brunswick Laboratory
U.S. Department of Energy

Certificate of Analysis

CRM 124

Uranium (U_3O_8) 24 Element Impurity Standard

(Each unit consists of a set of 7 levels)

This Certified Reference Material (CRM) is an impurity standard intended for use in determining the impurity content of uranium materials. Each unit of CRM 124(1-7) consists of six (6) bottles containing uranium oxide-U_3O_8 (natural isotopic composition) as matrix material, approximately 25 grams per bottle, to which twenty-four (24) selected elements have been added in varying concentrations. A seventh bottle, completing the unit, consists of matrix material alone.

The U_3O_8 matrix material was sieved and blended before the impurity elements were added in solution form. As each of the seven levels was prepared, it was subjected to a wet-dry mixing procedure, then dried, ignited, milled, reblended and bottled. A complete discussion of the preparation is found in NBL-310 [1]. NOTE: NBL does not guarantee CRM 124(1-7) will be absolutely dry when received; therefore, it is recommended that the material be dried at 110°C for one (1) hour before use. NBL further recommends a minimum sample size of 1 g of the CRM material to ensure homogeneity. A factor of 0.848 g / g shall be used in calculating the conversion of impurity mass content per mass U_3O_8 to impurity mass content per mass uranium. The uncertainty in the factor of 0.848 g / g is assumed to be negligible compared to the uncertainties of the certified impurity values.

The certified values for the impurity elements are based on the "as prepared" values [2], with the impurity contents prepared using gravimetric mixing [1]. The expanded uncertainties (coverage factor k equivalent to 95 % level of confidence) are based upon a re-evaluation of reported analytical data, which confirmed the impurity content [2]. An assessment of the degree of homogeneity is included in the uncertainty budget. The expanded uncertainties for the certified values are regarded as being conservative. No indication of significant changes in the impurity concentrations as a function of time (shelf-life) was observed. The reference material is traceable to the SI units.

July 03, 2008
Argonne, Illinois

Jon Neuhoff, Director
New Brunswick Laboratory

(Editorial revision of Certificate dated January 15, 1991

Certificate of Analysis

Micrograms of Impurity Element per one gram of Uranium

Element	124-1	124-2	124-3	124-4	124-5	124-6	124-7 #
Aluminum (Al)	205 ± 37	105 ± 14	55.0 ± 7.7	25.0 ± 3.4	15.0 ± 1.9	10.0 ± 1.4	5.0
Beryllium (Be)	25.0 ± 7.3	12.5 ± 1.7	5.00 ± 0.75	2.50 ± 0.22	1.30 ± 0.08	0.50 ± 0.08	< 0.1
Bismuth (Bi)	50 ± 14	25.0 ± 7.1	10.0 ± 2.1	5.00 ± 0.82	2.50 ± 0.33	1.00 ± 0.18	< 0.2
Boron (B)	5.1 ± 1.0	2.60 ± 0.56	1.10 ± 0.28	0.60 ± 0.14	0.35 #	0.2 #	0.1
Cadmium (Cd)	5.20 ± 0.88	2.70 ± 0.35	1.20 ± 0.22	0.70 ± 0.15	0.45 ± 0.13	0.3 #	0.2
Calcium (Ca)	200 ± 36	100 ± 22	51.0 ± 9.3	21.0 ± 6.9	11.0 ± 3.8	5.8 #	0.8
Chromium (Cr)	102 ± 14	52.0 ± 6.5	22.0 ± 4.2	12.0 ± 2.3	7.0 ± 2.1	4.3 #	2.3
Cobalt (Co)	25.0 ± 6.1	12.5 ± 2.5	5.00 ± 0.87	2.60 ± 0.42	1.40 ± 0.77	0.60 ± 0.09	0.1
Copper (Cu)	50.0 ± 9.4	25.0 ± 5.2	10.4 ± 2.1	5.4 ± 1.1	2.9 #	1.40 ± 0.44	0.4
Iron (Fe)	210 ± 24	110 ± 13	60.0 ± 9.9	30 #	20 #	15 #	10
Lead (Pb)	51 ± 15	26.0 ± 7.3	10.8 ± 3.1	5.8 ± 1.6	3.3 ± 1.0	1.80 ± 0.45	0.8
Magnesium (Mg)	101 ± 13	51 ± 10	21.0 ± 4.5	11.0 ± 3.2	6.0 ± 1.6	3.00 ± 0.55	1.0
Manganese (Mn)	51.0 ± 7.6	26.0 ± 2.4	11.0 ± 1.3	5.70 ± 0.83	3.20 ± 0.78	1.70 ± 0.49	0.7
Molybdenum (Mo)	100.0 ± 5.5	50.0 ± 4.2	20.0 ± 3.9	10.00 ± 0.48	5.0 ± 1.4	2.00 ± 0.66	< 0.1
Nickel (Ni)	202 ± 17	102.0 ± 7.2	52.0 ± 6.0	22.0 ± 3.1	12.0 ± 1.8	7.0 ± 1.0	2.0
Silicon (Si)	202 ± 58	102 ± 20	52 ± 11	22.0 ± 3.9	12.0 ± 2.5	7.3 ± 6.5	2.3
Silver (Ag)	5.0 ± 3.6	2.5 ± 1.9	1.00 ± 0.79	0.5 #	0.25 #	0.1 #	< 0.1
Sodium (Na)	400 ± 127	200 ± 43	100 ± 33	40 ± 13	20 #	10 #	< 0.5
Tin (Sn)	51.0 ± 6.9	26.0 ± 5.4	10.6 ± 1.6	5.6 ± 1.1	3.10 ± 0.58	1.60 ± 0.44	0.6
Titanium (Ti)	50 ± 14	25.0 ± 5.6	10.3 ± 3.8	5.3 ± 1.6	2.8 ± 1.3	1.30 ± 0.28	0.3
Tungsten (W)	200 ± 22	100 ± 12	50.0 ± 6.3	20.0 ± 9.8	10 #	5.0 ± 1.0	< 0.1
Vanadium (V)	50.0 ± 7.2	25.0 ± 2.8	10.0 ± 1.1	5.00 ± 0.71	2.50 ± 0.35	1.00 ± 0.13	< 0.2
Zinc (Zn)	202 ± 57	102 ± 13	52 ± 11	22.0 ± 4.2	12.0 ± 3.1	6.6 #	1.6
Zirconium (Zr)	200 ± 61	100 ± 32	50 ± 18	20.0 ± 6.0	10 #	5.0 ± 1.7	< 5

Values are not certified

1 P. M. Santoliquido, "Preparation and Provisional Certification of NBL Spectrographic Impurity Standards CRM Nos. 123(1-7) and 124(1-7)", USDOE Report NBL-310, September 1983.

2 S. Bürger, K. J. Mathew, P. Mason, U. Narayanan, "Reference materials characterized for impurities in uranium matrices – an overview and re-evaluation of the NBL CRM 124 series", Journal of Radioanalytical and Nuclear Chemistry, accepted

July 08, 2008
Argonne, Illinois

www.nbl.doe.gov

Jon Neuhoff, Director
New Brunswick Laboratory

(Editorial revision of Certificate dated September 1, 1983