The IAEA-CU-2009-03 world wide open proficiency test on the determination of natural and artificial radionuclides in moss-soil and spiked water

Laboratory's Individual Evaluation Report
Laboratory Code: 124 (CuNo: 13949)
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Individual Evaluation Report

for

Laboratory No. 124

Your personal customer number: 13949

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Evaluation Criterias

Based on more than 40 years experience with open world-wide laboratory intercomparison studies, it was decided in the Chemistry Unit of the IAEA Seibersdorf laboratories to use a modified u-score evaluation, where the trueness and precision of participants' results are evaluated separately.

For trueness evaluation the participants' results are assigned 'Acceptable' if:

$$A1 \le A2$$

where

$$A1 = |Value_{\mathrm{IAEA}} - Value_{Lab}|$$

$$A2 = 2.58 \times \sqrt{u^2_{\mathrm{target}} + u^2_{\mathrm{reported}}}$$

For evaluation of precision estimator P is calculated for each participant, according to the following formula:

$$P = \sqrt{\left(\frac{u_{\mathrm{target}}}{\mathrm{Value}_{\mathrm{target}}}\right)^2 + \left(\frac{u_{\mathrm{reported}}}{\mathrm{Value}_{\mathrm{reported}}}\right)^2} \times 100\%$$

P directly depends on the measurement uncertainty claimed by the participant. The acceptance limit for precision (LAP) for each analyte respectively is defined in Tables 1 - 3 including any adjustment due to the concentration or activity level of the analytes concerned and the complexity of the analytical problem. Participants' results are scored as 'Acceptable' for precision when (P < LAP) or (P = LAP).

In the final evaluation, both scores for trueness and precision are combined. A result must obtain 'Acceptable' score in both criteria to be assigned final score 'Acceptable'. Obviously, if a score 'Not Acceptable' was obtained for both, trueness and precision, the final score will also be 'Not Acceptable'. In cases where either precision or trueness is 'Not Acceptable', further check is applied. The value of the relative bias (RB) is compared with the maximum acceptable bias (MAB), which is defined by the IAEA in advance, similarly as LAP. If (RB < MAB) or (RB = MAB), the final score will be 'Warning'. If RB > MAB, the result will be 'Not Acceptable'. 'Warning will reflect mainly two situations. The first situation will be a biased result with small measurement uncertainty, however still within MAB. The second situation will appear when result close to the assigned property value will be reported, but the associated uncertainty is large.

References:

1.) Guide to the Expression of Uncertainty in Measurement, International Organization for Standardization, Geneva, 1995.
2.) Quantifying Uncertainty in Nuclear Analytical Measurements, TECDOC-1401, International Atomic Energy Agency, Vienna, 2004.
3.) C. J. Brookes, I. G. Betteley, and S. M. Loxton, Fundamentals of Mathematics and Statistics, Wiley, UK, 1979.
4.) ISO 5725 (E), 'Accuracy (trueness and precision) of Measurement Methods and Results', International Organization for Standardization, Geneva, 1994.

Acceptance Limits

Please find below in the tables the acceptance limits for LAP (%) and MAB (%) in relation to the matrix and the analyte that have been used for the evaluation.

Parameter Table 1 for Sample 1, Moss-Soil, Radiochemical Analysis

Analyte	LAP(%)	MAB(%)
Am-241	25	20
Pb-210	20	20
Po-210	20	20
Pu-(239+240)	20	20
Pu-238	35	20
Ra-226	20	20
Sr-90	20	20
U-234	30	20
U-238	30	20

Parameter Table 2 for Sample 2, Moss-Soil, Gamma emitting Radionuclides

Analyte	LAP(%)	MAB(%)
Ac-228	20	20
Am-241	25	20
Bi-214	20	20
Cs-137	20	20
K-40	20	20
Pb-210	20	20
Pb-212	20	20
Pb-214	20	20
Ra-226	20	20
Th-234	25	20
Tl-208	20	20

Parameter Table 3 for Sample 3, Spiked Water

Analyte	LAP(%)	MAB(%)
Co-57	10	10
Co-60	10	10
Cs-134	10	10
Cs-137	10	10
Eu-152	10	10

Parameter Table 4 for Sample 4, Spiked Water

Analyte	LAP(%)	MAB(%)
Co-57	10	10
Co-60	10	10
Cs-134	10	10
Cs-137	10	10
Eu-152	10	10

Parameter Table 5 for Sample 5, Spiked Water

Analyte	LAP(%)	MAB(%)
Co-57	10	10
Co-60	10	10
Cs-134	10	10
Cs-137	10	10
Eu-152	10	10

The IAEA-CU-2009-03 World-wide open proficiency test

Laboratory No. 124, Results submitted on 2010-05-02

2010-06-16

Evaluation on Sample 1, Moss-Soil, Radiochemical Analysis

Reference Date: 15th of November 2009

Analyte	IAEA Value [Bq/kg d.m.]	IAEA Unc [Bq/kg d.m.]	Lab Value [Bq/kg d.m.]	Lab Unc [Bq/kg d.m.]	Lab Unc %	Rel. Bias %	z-Score	u-Test	Ratio Lab/IAEA	A1	A2	Trueness	P(%)	Precision	**Final Score**
Am-241	2.2	0.2													
Pb-210	424	20													
Po-210	423	10													
Pu-(239+240)	5.3	0.16													
Pu-238	0.15	0.015													
Ra-226	25.1	2.0													
Sr-90	5.0	0.3													
U-234	21.8	0.8													
U-238	22.2	0.8													

Evaluation on Sample 2, Moss-Soil, Gamma emitting Radionuclides

Reference Date: 15th of November 2009

Analyte	IAEA Value [Bq/kg d.m.]	IAEA Unc [Bq/kg d.m.]	Lab Value [Bq/kg d.m.]	Lab Unc [Bq/kg d.m.]	Lab Unc %	Rel. Bias %	z-Score	u-Test	Ratio Lab/IAEA	A1	A2	Trueness	P(%)	Precision	**Final Score**
Ac-228	37.0	2.0	35.56	1.46	4.11	-3.89	-0.39	-0.58	0.96	1.44	6.39	A	6.79	A	A
Am-241	2.2	0.2													
Bi-214	24.8	2.0	18.70	0.97	5.19	-24.60	-2.46	-2.74	0.75	6.10	5.73	N	9.59	A	N
Cs-137	425	10	413.7	15.8	3.82	-2.66	-0.27	-0.60	0.97	11.30	48.24	A	4.49	A	A
K-40	550	20	599.3	24.6	4.10	8.96	0.90	1.55	1.09	49.30	81.80	A	5.48	A	A
Pb-210	424	20	408.8	54.5	13.33	-3.58	-0.36	-0.26	0.96	15.20	149.78	A	14.14	A	A
Pb-212	37.0	1.5	34.96	1.59	4.55	-5.51	-0.55	-0.93	0.94	2.04	5.64	A	6.09	A	A
Pb-214	26.0	2.0	20.07	0.95	4.73	-22.81	-2.28	-2.68	0.77	5.93	5.71	N	9.03	A	N
Ra-226	25.1	2.0	20.41	2.05	10.04	-18.69	-1.87	-1.64	0.81	4.69	7.39	A	12.82	A	A
Th-234	25.5	3.0	29.68	4.11	13.85	16.39	1.64	0.82	1.16	4.18	13.13	A	18.17	A	A
Tl-208	13.0	0.5	11.94	0.49	4.10	-8.15	-0.82	-1.51	0.92	1.06	1.81	A	5.62	A	A

Evaluation on Sample 3, Spiked Water

Reference Date: 15th of November 2009

Analyte	IAEA Value [Bq/kg]	IAEA Unc [Bq/kg]	Lab Value [Bq/kg]	Lab Unc [Bq/kg]	Lab Unc %	Rel. Bias %	z-Score	u-Test	Ratio Lab/IAEA	A1	A2	Trueness	P(%)	Precision	**Final Score**
Co-57	7.5	0.15	6.399	0.479	7.49	-14.68	-1.47	-2.19	0.85	1.10	1.29	A	7.75	A	A
Co-60	6.0	0.12	6.406	0.288	4.50	6.77	0.68	1.30	1.07	0.41	0.80	A	4.92	A	A
Cs-134	13.9	0.28	12.25	0.42	3.43	-11.87	-1.19	-3.27	0.88	1.65	1.30	N	3.98	A	N
Cs-137	9.5	0.19	9.754	0.465	4.77	2.67	0.27	0.51	1.03	0.25	1.30	A	5.17	A	A
Eu-152	11.3	0.23	11.08	0.54	4.87	-1.95	-0.19	-0.37	0.98	0.22	1.51	A	5.28	A	A

Evaluation on Sample 4, Spiked Water

Reference Date: 15th of November 2009

Analyte	IAEA Value [Bq/kg]	IAEA Unc [Bq/kg]	Lab Value [Bq/kg]	Lab Unc [Bq/kg]	Lab Unc %	Rel. Bias %	z-Score	u-Test	Ratio Lab/IAEA	A1	A2	Trueness	P(%)	Precision	**Final Score**
Co-57	2.5	0.05	2.249	0.240	10.67	-10.04	-1.00	-1.02	0.90	0.25	0.63	A	10.86	N	N
Co-60	2.1	0.04	1.904	0.128	6.72	-9.33	-0.93	-1.46	0.91	0.20	0.35	A	6.99	A	A
Cs-134	4.6	0.1	4.125	0.179	4.34	-10.33	-1.03	-2.32	0.90	0.48	0.53	A	4.85	A	A
Cs-137	3.2	0.06	3.179	0.197	6.20	-0.66	-0.07	-0.10	0.99	0.02	0.53	A	6.47	A	A
Eu-152	3.7	0.08	3.175	0.268	8.44	-14.19	-1.42	-1.88	0.86	0.53	0.72	A	8.71	A	A

Evaluation on Sample 5, Spiked Water

Reference Date: 15th of November 2009

Analyte	IAEA Value [Bq/kg]	IAEA Unc [Bq/kg]	Lab Value [Bq/kg]	Lab Unc [Bq/kg]	Lab Unc %	Rel. Bias %	z-Score	u-Test	Ratio Lab/IAEA	A1	A2	Trueness	P(%)	Precision	**Final Score**
Co-57	7.5	0.15	6.386	0.376	5.89	-14.85	-1.49	-2.75	0.85	1.11	1.04	N	6.22	A	N
Co-60	6.0	0.12	5.970	0.213	3.57	-0.50	-0.05	-0.12	1.00	0.03	0.63	A	4.09	A	A
Cs-134	13.9	0.28	11.95	0.34	2.85	-14.03	-1.40	-4.43	0.86	1.95	1.14	N	3.49	A	N
Cs-137	9.5	0.19	9.757	0.363	3.72	2.71	0.27	0.63	1.03	0.26	1.06	A	4.22	A	A
Eu-152	11.3	0.23	10.14	0.41	4.04	-10.27	-1.03	-2.47	0.90	1.16	1.21	A	4.53	A	A