



**The IAEA-TEL-2011-03 world wide open proficiency test on the determination
of natural and artificial radionuclides in water and soil**

Laboratory's Individual Evaluation Report

Laboratory Code: 22 (CuNo: 13949)

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Individual Evaluation Report
for
Laboratory No. 22

Your personal customer number: 13949

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The IAEA-TEL-2011-03 World-wide open proficiency test

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:

$$A1 \leq A2$$

where

$$A1 = |Value_{IAEA} - Value_{Lab}|$$
$$A2 = 2.58 \times \sqrt{u_{target}^2 + u_{reported}^2}$$

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

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

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.

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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, Spiked Water

Analyte	LAP(%)	MAB(%)
Am-241	20	20
Ba-133	20	20
Co-60	15	15
Cs-134	20	20
Cs-137	20	20
Eu-152	15	15
H-3	20	20

Parameter Table 2 for Sample 2, Spiked Water

Analyte	LAP(%)	MAB(%)
Am-241	20	20
Ba-133	20	20
Co-60	15	15
Cs-134	20	20
Cs-137	20	20
Eu-152	15	15
H-3	20	20

Parameter Table 3 for Sample 3, Spiked Water

Analyte	LAP(%)	MAB(%)
Am-241	20	20
Ba-133	20	20
Co-60	15	15
Cs-134	20	20
Cs-137	20	20
Eu-152	15	15
H-3	20	20

Parameter Table 4 for Sample 4, Soil

Analyte	LAP(%)	MAB(%)
K-40	20	20
Sr-90	20	20

Analyte	LAP(%)	MAB(%)
Cs-137	20	20
Tl-208	20	20
Pb-210	20	20
Pb-212	20	20
Pb-214	20	20
Bi-214	20	20
Ra-226	20	20
Ac-228	20	20
U-234	20	20
U-235	20	20
U-238	20	20
Am-241	20	20
Pu-238	20	20
Pu-239+240	20	20
Po-210	20	20

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Laboratory No. 22, Results submitted on 2012-05-23

2012-05-23

Evaluation on Sample 1, Spiked Water

Reference Date: 15th of November 2011

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
Am-241	4.7	0.1	4.635	0.341	7.36	-1.38	-0.07	-0.18	0.99	0.07	0.92	A	7.66	A	A
Ba-133	5.0	0.1	4.625	0.143	3.09	-7.50	-0.38	-2.15	0.93	0.38	0.45	A	3.68	A	A
Co-60	15.3	0.2	14.95	0.62	4.15	-2.29	-0.11	-0.54	0.98	0.35	1.68	A	4.35	A	A
Cs-134	7.7	0.1	6.258	0.497	7.94	-18.73	-0.94	-2.84	0.81	1.44	1.31	N	8.05	A	W
Cs-137	6.2	0.1	5.975	0.206	3.45	-3.63	-0.18	-0.98	0.96	0.23	0.59	A	3.81	A	A
Eu-152	15.4	0.2	14.80	0.61	4.12	-3.90	-0.19	-0.93	0.96	0.60	1.66	A	4.32	A	A
H-3	50.2	0.9													

Evaluation on Sample 2, Spiked Water

Reference Date: 15th of November 2011

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
Am-241	2.4	0.1	2.340	0.122	5.21	-2.50	-0.13	-0.38	0.98	0.06	0.41	A	6.67	A	A
Ba-133	2.5	0.1	2.268	0.083	3.66	-9.28	-0.46	-1.79	0.91	0.23	0.34	A	5.42	A	A
Co-60	7.6	0.1	7.312	0.311	4.25	-3.79	-0.19	-0.88	0.96	0.29	0.84	A	4.45	A	A
Cs-134	3.8	0.1	3.162	0.258	8.16	-16.79	-0.84	-2.31	0.83	0.64	0.71	A	8.57	A	A
Cs-137	3.1	0.1	3.014	0.161	5.34	-2.77	-0.14	-0.45	0.97	0.09	0.49	A	6.24	A	A
Eu-152	7.7	0.1	7.261	0.486	6.69	-5.70	-0.29	-0.88	0.94	0.44	1.28	A	6.82	A	A
H-3	25.0	0.5													

Evaluation on Sample 3, Spiked Water

Reference Date: 15th of November 2011

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
Am-241	3.3	0.1	3.261	0.137	4.20	-1.18	-0.06	-0.23	0.99	0.04	0.44	A	5.18	A	A
Ba-133	3.5	0.1	3.273	0.106	3.24	-6.49	-0.32	-1.56	0.94	0.23	0.38	A	4.32	A	A
Co-60	10.7	0.2	10.48	0.44	4.20	-2.06	-0.10	-0.46	0.98	0.22	1.25	A	4.60	A	A
Cs-134	5.4	0.1	4.424	0.373	8.43	-18.07	-0.90	-2.53	0.82	0.98	1.00	A	8.63	A	A
Cs-137	4.4	0.1	4.235	0.173	4.09	-3.75	-0.19	-0.83	0.96	0.17	0.52	A	4.67	A	A
Eu-152	10.8	0.2	10.52	0.41	3.90	-2.59	-0.13	-0.61	0.97	0.28	1.18	A	4.31	A	A
H-3	35.1	0.6													

Evaluation on Sample 4, Soil

Reference Date: 15th of November 2011

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
K-40	485	11	529.2	23.9	4.52	9.11	0.46	1.68	1.09	44.20	67.88	A	5.05	A	A
Sr-90	2.4	0.5													
Cs-137	14.4	0.6	13.02	0.41	3.15	-9.58	-0.48	-1.90	0.90	1.38	1.87	A	5.22	A	A
Tl-208	13.0	0.7	12.43	1.02	8.21	-4.38	-0.22	-0.46	0.96	0.57	3.19	A	9.81	A	A
Pb-210	42.6	2.2	41.24	3.00	7.27	-3.19	-0.16	-0.37	0.97	1.36	9.60	A	8.92	A	A
Pb-212	36.5	1.6	35.57	2.26	6.35	-2.55	-0.13	-0.34	0.97	0.93	7.14	A	7.72	A	A
Pb-214	50.0	3.8	34.78	2.24	6.44	-30.44	-1.52	-3.45	0.70	15.22	11.38	N	9.96	A	N
Bi-214	50.0	2.8	40.27	3.08	7.65	-19.46	-0.97	-2.34	0.81	9.73	10.74	A	9.48	A	A
Ra-226	50.2	2.0	36.80	2.00	5.43	-26.69	-1.33	-4.74	0.73	13.40	7.30	N	6.74	A	N
Ac-228	41.0	2.0	34.54	2.20	6.37	-15.76	-0.79	-2.17	0.84	6.46	7.67	A	8.02	A	A
U-234	26.4	2.0													
U-235	1.24	0.02													
U-238	27.0	1.4													
Am-241	0.21	0.08													
Pu-238	0.05	0.014													
Pu-239+240	0.26	0.055													
Po-210	42.6	2.2													

NOTE: If the score information displays {n.e} for {not evaluated} the analyte has not been scored due to the low activity concentration. Evaluation will be provided in the final report.