The IAEA-TEL-2021-03 world wide open proficiency test on the determination of anthropogenic and natural radionuclides in water, Japanese bamboo and simulated swipe samples

Laboratory's Individual Evaluation Report
Laboratory Code: 53 (CuNo: 13949)
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IAEA-TEL-2021-03 World Wide Open Proficiency Test Exercise, Individual Evaluation Report Part I

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Abstract

This report describes the evaluation method for the proficiency test conducted within the IAEA-TEL-2021-03 world wide open proficiency test exercise. The data is evaluated by the Proficiency Test Team in the Terrestrial Environment Laboratory (TEL) of the IAEA using its standard approach for proficiency test evaluations.

1 Evaluation criteria

The data is evaluated according to the following steps:

1. The relative bias between the reported and the target value (the best estimation of the true value) is expressed by the following equation:

$$Bias_{relative} = \frac{Value_{reported} - Value_{target}}{Value_{target}} * 100\%$$

2. The relative bias is compared to the Maximum Acceptable Relative Bias (MARB) which has been determined for each analyte, considering the radioanalytical methods, the level of radioactivity and the complexity of the analysis.

If the $|Bias_{relative}| \leq MARB$, the result will be "Accepted" for accuracy.

3. Based on fit-for-purpose and good laboratory practice principles, the expanded relative combined uncertainty should cover the relative bias:

$$P = \sqrt{\left(\frac{u_{target}}{A_{target}}\right)^2 + \left(\frac{u_{reported}}{A_{reported}}\right)^2} * 100$$

$$|Bias_{relative}| \leq k * P$$

where k is the coverage factor, for the 99% confidential level, $k = 2.58$. 4. If the result is between the $\pm MARB$ values, but it is not overlapping the target value within the uncertainty, this equation is used to decide if they are significantly different or not.

5. The P value is compared to the MARB also. If both the:

$$P \leq MARB$$

and

$$|Bias_{relative}| \leq k * P$$

are fulfilled, the reported results will be "Accepted" for precision. The result will be assigned "Not accepted" for precision if either conditions are not fulfilled.

6. The final score is assigned according to the detailed evaluation described above. The possible scores are listed below:

- "Accepted" when both, accuracy and precision achieved "Accepted" status
- "Not Accepted" when the accuracy is "Not accepted"
- "Warning" when accuracy is "Accepted" but the precision is "Not accepted"

7. As additional information, a z-score parameter is shown in the evaluation tables that is calculated by using the robust standard deviation described in [2]:

$$z = \left| \frac{Value_{reported} - Value_{target}}{robustsd} \right|$$

8. If the analyte is included in the proficiency test evaluation scheme, the stated target value is used to calculate the z-score. For those analytes, which are subject of an intercomparison only, the robust mean of the values reported is used instead.

2 Tables of Target Values and Evaluation Criteria for Proficiency Test Parameters

Target Values for Gamma Spectrometry Analysis in Sample 1

TABLE 1. Target values

Sample	Analyte	Massic Activity, [Bq/kg]	Uncertainty, [Bq/kg]	MARB, [%]
1	Co-60	74.2	3.3	20.00
1	Cs-134	113.2	5.1	20.00
1	Cs-137	69.2	3.1	20.00
1	Am-241	60.9	2.7	20.00

Target Values for Gamma Spectrometry Analysis in Sample 2

TABLE 2. Target values

Sample	Analyte	Massic Activity, [Bq/kg]	Uncertainty, [Bq/kg]	MARB, [%]
2	Ba-133	147.3	6.6	20.00
2	Cs-137	147.4	6.6	20.00
2	Am-241	108.3	4.9	20.00

Target Values for Alpha/Beta Spectrometry Analysis in Sample 2

TABLE 3. Target values

Sample	Analyte	Massic Activity, [Bq/kg]	Uncertainty, [Bq/kg]	MARB, [%]
2	Sr-90	146.8	8.4	30.00

Target Values for Gamma Spectrometry Analysis in Sample 4

TABLE 4. Target values

Sample	Analyte	Massic Activity, [Bq/kg]	Uncertainty, [Bq/kg]	MARB, [%]
4	K-40	97.9	7.2	30.00
4	Cs-134	86.6	4.0	25.00
4	Cs-137	2063	93	20.00

Target Values for Gamma Spectrometry Analysis in Sample 5

TABLE 5. Target values

Sample	Analyte	Massic Activity, [Bq/kg]	Uncertainty, [Bq/kg]	MARB, [%]
5	Cs-134	19.05	0.86	30.00
5	Cs-137	26.02	1.17	25.00

Target Values for Gamma Spectrometry Analysis in Sample 7

TABLE 6. Target values

Sample	Analyte	Massic Activity, [Bq/sample]	Uncertainty, [Bq/sample]	MARB, [%]
7	Cs-137	11.2	0.6	20.00

Target Values for Alpha/Beta Spectrometry Analysis in Sample 7

TABLE 7. Target values

Sample	Analyte	Massic Activity, [Bq/kg]	Uncertainty, [Bq/kg]	MARB, [%]
7	Pu-239	8.47	0.50	40.00

3 Tables of Robust Statistics for Intercomparison Parameters

Robust Statistic Parameters for Intercomparison Parameters in Sample 1

TABLE 8. Intercomparison values

Sample	Analyte	Robust Mean, Bq/kg	Robust SD, Bq/kg	MARB, %
1	gross_alpha	105.0	26.0	50.00
1	gross_beta	159.0	45.0	55.00

Robust Statistic Parameters for Intercomparison Parameters in Sample 2

TABLE 9. Intercomparison values

Sample	Analyte	Robust Mean, Bq/kg	Robust SD, Bq/kg	MARB, %
2	gross_alpha	97.0	28.0	55.00
2	gross_beta	457	112	50.00
2	H-3	1653.6	98.2	30.00
2	Eu-152	3.01	0.37	30.00

Robust Statistic Parameters for Intercomparison Parameters in Sample 5

TABLE 10. Intercomparison values

Sample	Analyte	Robust Mean, Bq/kg	Robust SD, Bq/kg	MARB, %
5	gross_alpha	16.4	5.4	60.00
5	gross_beta	33.0	9.0	50.00
5	Pu-239	5.93	2.27	25.00
5	Am-241	4.85	0.57	30.00
5	Cm-244	7.02	2.00	25.00

Robust Statistic Parameters for Intercomparison Parameters in Sample 7

TABLE 11. Intercomparison values

Sample	Analyte	Robust Mean, Bq/sample	Robust SD, Bq/sample	MARB, %
7	gross_alpha	7.64	1.34	40.00
7	gross_beta	10.18	2.69	40.00

4 References

References

[1] International Organization for Standardization (ISO). (2010). Conformity assessment - General requirements for proficiency testing, ISO/IEC 17043:2010. Geneva: Switzerland.

[2] International Organization for Standardization (ISO). (2015). Statistical methods for use in proficiency testing by interlaboratory comparison, ISO 13528:2015. Geneva: Switzerland.

Individual Evaluation Report
for
Laboratory Nr. 53

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Evaluation Tables for Labcode 53. (Values and uncertainties expressed in Bq/kg)

Evaluation Result Table for Sample 1

Sample Code	Analyte	Target Value	Target Unc.	MARB	Rep. Value	Rep. Unc	Rel. Bias	Robust SD	Z-Score	Accuracy	P	Precision	Final Score
1	Am-241	60.9	2.7	20 %	59.7	2.1	-1.97 %	3.98	0.30	A	5.66	A	A
1	Co-60	74.2	3.3	20 %	77.1	3.5	3.91 %	3.31	0.88	A	6.36	A	A
1	Cs-134	113.2	5.1	20 %	113.9	5.1	0.62 %	6.12	0.11	A	6.35	A	A
1	Cs-137	69.2	3.1	20 %	68.3	4.2	-1.30 %	3.23	0.28	A	7.61	A	A

Evaluation Result Table for Sample 2

Sample Code	Analyte	Target Value	Target Unc.	MARB	Rep. Value	Rep. Unc	Rel. Bias	Robust SD	Z-Score	Accuracy	P	Precision	Final Score
2	Am-241	108.3	4.9	20 %	98.6	4.0	-8.96 %	8.05	1.20	A	6.08	A	A
2	Ba-133	147.3	6.6	20 %	132.6	5.4	-9.98 %	7.17	2.05	A	6.05	A	A
2	Cs-137	147.4	6.6	20 %	145.7	7.7	-1.15 %	5.9	0.29	A	6.93	A	A

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Values and uncertainties for Sample 4 (Japanese bamboo) in Bq/kg , for Sample 5 (water) in Bq/kg, for Sample 7 (Simulated Swipes) in Bq/sample

Evaluation Result Table for Sample 4

Sample Code	Analyte	Target Value	Target Unc.	MARB	Rep. Value	Rep. Unc	Rel. Bias	Robust SD	Z-Score	Accuracy	P	Precision	Final Score
4	Cs-134	86.6	4	25 %	89.0	5.0	2.77 %	10	0.24	A	7.27	A	A
4	Cs-137	2063	93	20 %	2030	100	-1.60 %	180.39	0.18	A	6.68	A	A

Evaluation Result Table for Sample 5

Sample Code	Analyte	Target Value	Target Unc.	MARB	Rep. Value	Rep. Unc	Rel. Bias	Robust SD	Z-Score	Accuracy	P	Precision	Final Score
5	Cs-134	19.05	0.86	30 %	19.9	1.2	4.46 %	1.18	0.72	A	7.53	A	A
5	Cs-137	26.02	1.17	25 %	25.6	1.5	-1.61 %	1.29	0.33	A	7.39	A	A

Evaluation Result Table for Sample 7

Sample Code	Analyte	Target Value	Target Unc.	MARB	Rep. Value	Rep. Unc	Rel. Bias	Robust SD	Z-Score	Accuracy	P	Precision	Final Score
7	Cs-137	11.2	0.6	20 %	11.7	1.4	4.46 %	0.79	0.63	A	13.11	A	A

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Intercomparison Parameter Evaluation: (Values for Sample 1,2,4,5 in Bq/kg, sample 7 in Bq/sample)

Sample Code	Analyte	Robust Mean	Robust SD	Rep. Value	Rep. Unc	Z-Score	Z-Score Evaluation
2	Eu-152	3.01	0.37			n.a.	n.a.
5	Am-241	4.85	0.57	4.45	0.25	0.70	A
7	gross_alpha	7.64	1.34	6.5	1.6	0.85	A
7	gross_beta	10.18	2.69	10.4	1.9	0.08	A

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The analytes listed in the table below have been identified but are not present in the samples (false positive):

Sample Code	Analyte	Reported Value