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ALMERA Proficiency Test: Determination of Gamma Emitting Radionuclides in Simulated Air Filters

IAEA-CU-2009-04

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ALMERA Proficiency Test:
Determination of Gamma Emitting Radionuclides in Simulated Air Filters

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Sales and Promotion, Publishing Section
International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 Vienna, Austria
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For further information on this publication, please contact:

Chemistry Unit, Agency's Laboratories, Seibersdorf
International Atomic Energy Agency
2444 Seibersdorf
Austria

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FOREWORD

The ALMERA network (**A**nalytical **L**aboratories for the **M**easurement of **E**nvironmental **Ra**dioactivity) is a cooperative effort of analytical laboratories world-wide. Members of the network are nominated by their respective IAEA Member States as those laboratories which would be expected to provide reliable and timely analysis of environmental samples in the event of an accidental or intentional release of radioactivity. ALMERA currently (March 2010) consists of 120 laboratories representing 75 countries. The IAEA's Terrestrial Environment Laboratory is the central coordinator of the ALMERA network's activities.

The IAEA helps the ALMERA network of laboratories to maintain their readiness by coordination activities, including organization of meetings, by development of standardized methods for sample collection and analysis, and by conducting interlaboratory comparison exercises and proficiency tests as a tool for external quality control. The proficiency tests are designed to monitor and demonstrate the performance and analytical capabilities of the network members, and to identify gaps and problem areas where further development is needed. In this framework, the performance evaluation results of the interlaboratory comparison exercises performed in the frame of the ALMERA network are not anonymous for those laboratories nominating to participate as ALMERA members.

The results of the IAEA-CU-2009-04 proficiency test on the determination of gamma emitting radionuclides in simulated air filters, described in this report, emerged from the recommendations of the participants of the ALMERA network coordination meetings.

The IAEA wishes to thank the participant laboratories to this proficiency test and all the contributors to drafting and review. In particular, the IAEA is grateful to P. De Felice, from the Italian National Metrology Institute for Ionizing Radiation (ENEA-INMRI, Rome, Italy), who provided the technique for the preparation of the simulated air filters and to S. Tarjan, from the Radio-analytical Reference Laboratory of the Central Agricultural Office, Food and Feed Safety Directorate of Hungary, who carried out the homogeneity test on all the simulated air filters. The IAEA wishes also to express its gratitude to L. Verheyen, from SCK-CEN, Belgium, M. Letizia Cozzella (ENEA-INMRI, Rome) for the valuable suggestion in the selection of the microdispenser pipette. The IAEA officer responsible for this publication was Abdulghani Shakhashiro of the IAEA Terrestrial Environment Laboratory in Seibersdorf, Austria.

EDITORIAL NOTE

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CONTENTS

1. INTRODUCTION

The activity concentration of radionuclides in air is a critical factor in assessing the air quality and the potential impact of possible pollutants. Air is in fact one of the main pathways for human exposure to radioactivity. Radioactivity may be present in the atmosphere due to natural processes; intentional (low level) anthropogenic release; or as a consequence of nuclear or radiological incident. The resulting environmental impact should be considered carefully to ensure safety and compliance with environmental regulations.

A reliable determination of radionuclides in air is necessary for regular monitoring of air quality to comply with radiation protection and environmental regulations.

This proficiency test (PT) is one of the series of the ALMERA network proficiency tests organised on regular basis by the Terrestrial Environment Laboratory in Seibersdorf, designed to assess the technical capacity of ALMERA Members in analysing radionuclides to identify any analytical problems and to support ALMERA laboratories to maintain their preparedness to provide rapid and reliable analytical results. The range of simulated air filters used in this PT for analysis has been mainly at environmental level.

The PT set consisted of four filters. The participating laboratories were requested to analyze Mn-54, Co-57, Fe-59, Co-60, Zn-65, Cd-109, Ba-133, Cs-134, Cs-137, Eu-152 and Am-241 in filters 01, 02 and 03. The participants were informed that only some of the listed radionuclides were present in the filters and the levels of the radionuclides were such that they could be measured within a 6-hour measurement period using a conventional HPGe gamma-spectrometer of 35% relative efficiency. Filter 04, was containing only Co-60 and Ba-133 with known activities to the participants, had to be used as a control for the efficiency calibration.

The tasks of IAEA were to prepare and distribute the simulated air filters to the participating laboratories, to collect and interpret analytical results reported by the participants and to compile a comprehensive evaluation report.

The certified massic activity values of all radionuclides used in this PT were traceable to international standards of radioactivity.

276 test items (simulated air filter) were prepared and distributed to 69 participants from 46 countries on 15 September 2009. The deadline for results reporting was set to three working days from the date of package delivery confirmed by the forwarder tracking system. However, the on-line results' reporting system was available for each participant during one week from the date of package delivery. The whole proficiency test was concluded in one month by 16 October 2009.

52 laboratories reported their results to the IAEA. The analytical results of the participating laboratories were compared with the reference values assigned to the filters, and a rating system was applied.

The participants and laboratories responded to this proficiency test and contributed their efforts to the present work are highly appreciated and acknowledged.

2. MATERIALS AND METHODS

2.1. Proficiency test objectives

The measurement of air filters containing a mixture of radionuclides with an unknown (to the participants) composition was aiming at assessing the:

- network capabilities in rapid determination of gamma emitting radionuclides at two levels of activities in air filters;
- probability of reporting 'false positive' by the ALMERA members;
- effectiveness of applied summing effect corrections;
- analytical procedure repeatability;
- results commutability (comparability) amongst the network members.

2.2. Participants

69 ALMERA laboratories registered in this proficiency test, 52 of them reported their results to the IAEA. Figure 2 shows the Member States of the participating laboratories. A full listing of participants is given in Appendix II.

2.3. Preparation of the proficiency test items

The following proficiency test design was applied (Fig. 1):

- Two simulated air filters coded 01 and 03 with the same activity, each one spiked with Am-241, Co-57, Cs-134, Cs-137 and Eu-152, to verify the analytical system repeatability;
- One simulated air filter coded 02 with the same nuclides as 01 and 03 but at a lower radioactivity level;
- One simulated air filter coded 04 spiked with Co-60 and Ba-133, the activities of these two nuclides were provided to the participants to be used as a control filter;
- One blank simulated air filter to be used for preparing a calibration source.

All selected nuclides allowed the PT to check for efficiency calibration. Because no calibration source was provided, the PT participants had to rely on the available efficiency curves and apply geometry corrections if needed.

The Cs-137 was chosen as easy to measure nuclide, almost free from specific corrections. The Am-241 was added to check efficiency calibration at low photon energy. Nuclides Cs-134 and Eu-152 were chosen for their pronounced coincidence summing effect on any detector type while Co-57 was introduced to check for X-γ coincidence summing and spectral interference (Eu-152 and Co-57 121.78 keV and 122.06 keV photons).

Figure 1. Proficiency test materials set.

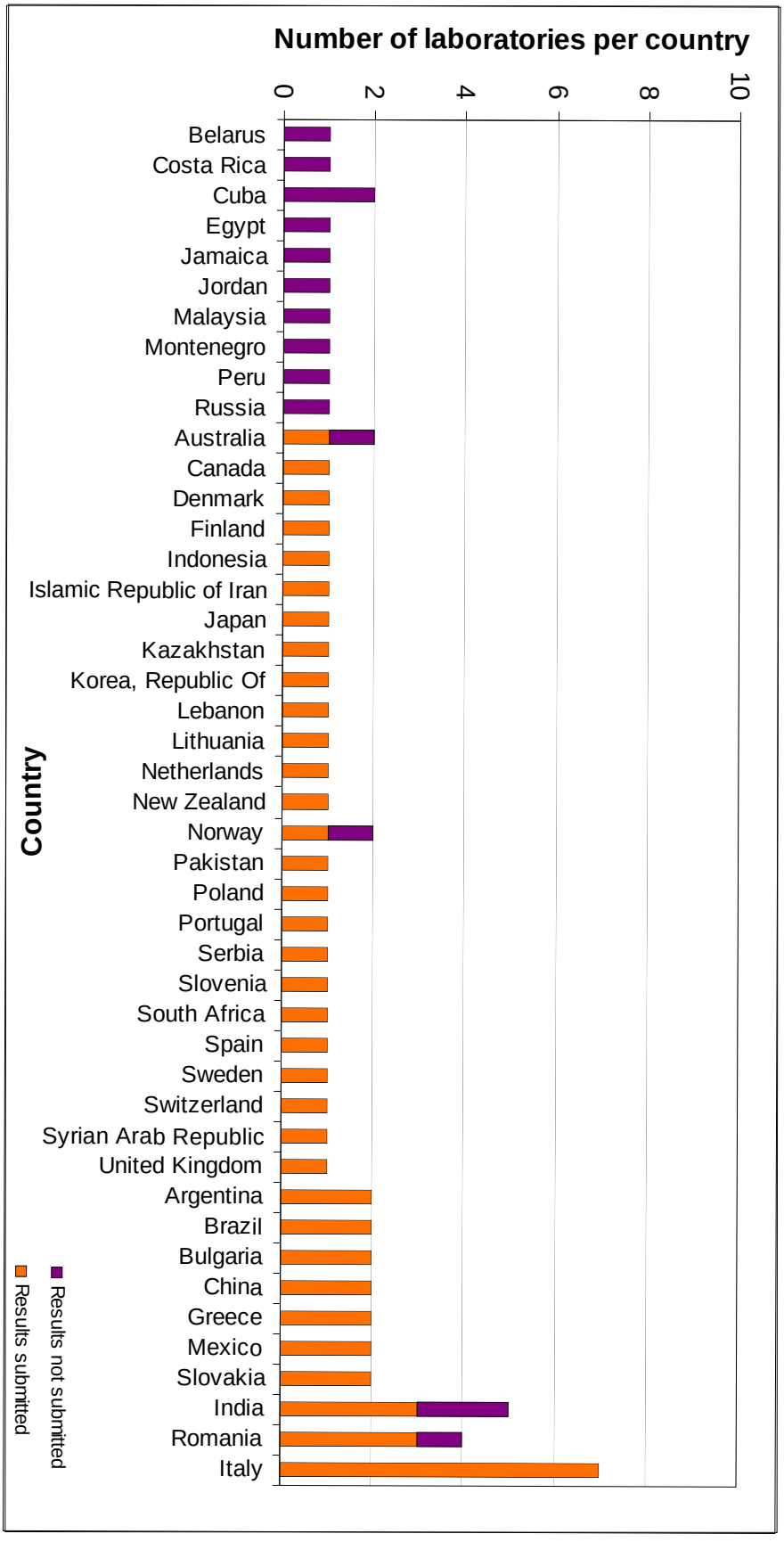


Figure 2. Participation distribution per country.

2.3.1. Preparation of the simulated air filters 01, 02, 03 and 04

Ideally, the simulated air filters sources had to reproduce the geometry of a real sample air filter and, for each batch, have all the same activity, within the stated uncertainties. Given the quite high number of sources needed, an additional requirement was that the preparation procedure had to be fast and reproducible.

The simulated air filters 01, 02, 03 and the control filter 04 were gravimetrically prepared according to a validated procedure described in [1]. The selection of the spiking pattern was also made according to [1]. The spiking mixed radionuclide solutions were prepared through a number of quantitative dilution steps, starting from individual nuclide concentrated standard solutions, traceable to the international standard of radioactivity. Table 1 shows the identification of the certified solutions of each radionuclide used in spiking the filters in this PT. As an example, the source preparation scheme followed for filter set 01 and 03 is reported in Figure 3.

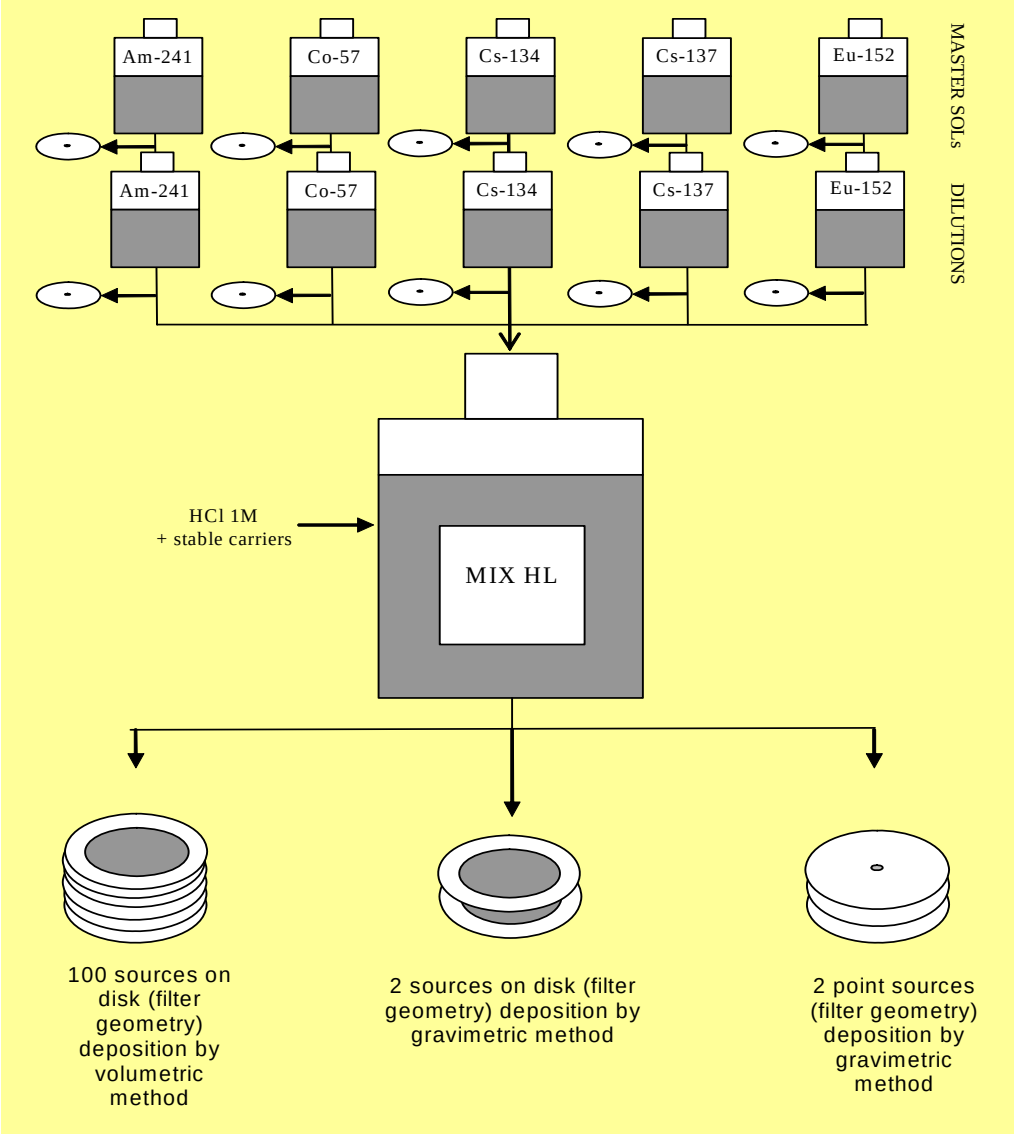


Figure 3. Simplified source preparation scheme for filter set 01 and 03 (High Level, HL). The different numbers specify the standard solutions used for the preparation of the sources.

The simulated spiked air filters were made of HDP material (diameter: 47 mm; thickness: 0.40 mm). The total amount of radionuclides was deposited on the simulated air filters in equally distributed 19 drops on hexagonal grids (pattern 'B + dispersion' in [1]). The diameter of the active deposit was 34 mm, as shown in Fig. 4. According to [1], this deposition pattern is equivalent, in terms of counting efficiency, to a uniform active circle within a maximum error of 3% that, in absence of more precise information, can be assumed as maximum error for type B uncertainty evaluations.

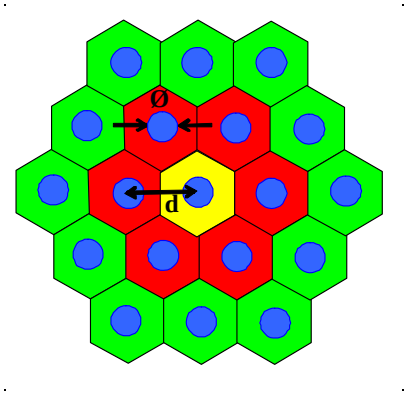


Figure 4. Geometrical scheme of the spiking patterns. Each deposited drop is represented by a small circle, d = 7.4 mm, Ø = 4.2 mm.

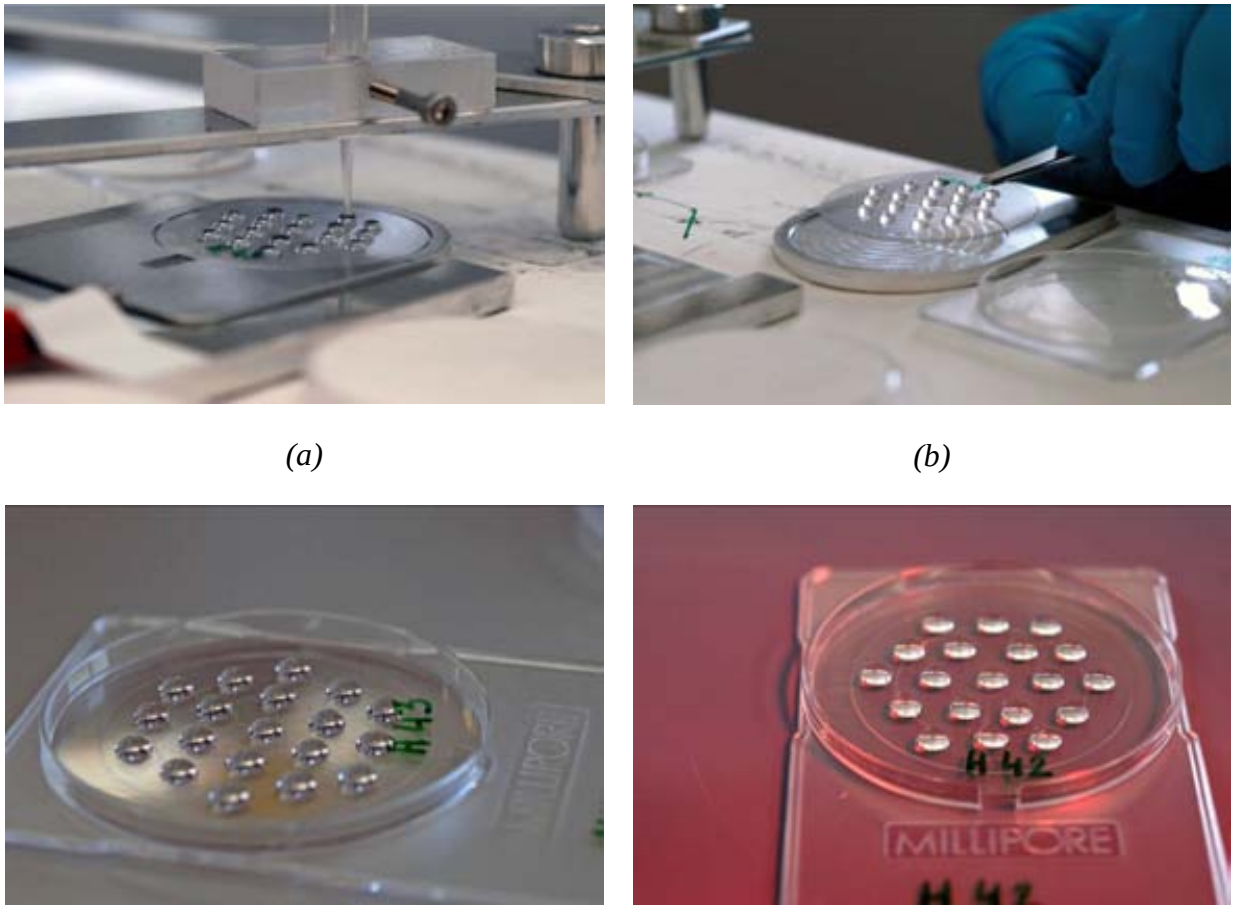
Volumetric spiking of the master radioactive solution was carried out by using an adjustable self-refilling microdispenser pipette, model ACURA manual 865. The volume of a single drop was fixed at 5 µL. The repeatability of a single drop mass was experimentally checked by repeated weighing of the delivered drops, being about 5% (expressed as relative SD).

The total mass of solution deposited on each individual simulated filter was checked by differential weighing of each filter. This allowed fine adjustment of the pipette setting during the deposition process, in order to compensate for long term variations of the dispensed volume. These were caused mainly by variation of temperature, humidity, volume of residual solution in bottle. The relative standard deviation of the solution mass on each filter was about 1%.

The spiked filters were dried under infrared lamp. The spiked area of each simulated filter was then covered with a yellow adhesive paper to avoid any contamination; the paper thickness is approximately 0.1 mm. The participants were advised not to remove this adhesive cover and to measure the filter after taking it out from the transparent plastic holder. Pictures of the deposition process are shown in Fig. 5.

2.3.2. Verification of the target activity values and homogeneity test

The exact mass of the deposited solution of the radionuclides mixture was recorded for further control. After drying and sealing the filters with the adhesive plastic, the amount of radioactivity on each filter for all radionuclides was checked by measuring all filters using gamma spectrometry; all the measurements were performed at the IAEA Laboratories in Seibersdorf.



(a) *(b)*

(c) *(d)*

Figure 5. Pictures of the spiking steps of the simulated air filters: a) Deposition by precision pipette driven by mechanical pantograph; b) and c) transfer in a filter holder; d) evaporation under infrared lamp.

TABLE 1. IDENTIFICATION OF THE CERTIFIED SOLUTIONS OF EACH RADIONUCLIDE USED IN SPIKING

Nuclide	Source manufacturer
Co-57	Czech Metrological Institute - Cz
Co-60	Cerca - Co60-ELSB50
Ba-133	Polatom - RSRBa-11
Cs-134	Cerca - Cs134ELSR50
Cs-137	Amersham - CDZ64/S4/14/70
Eu-152	Cerca - Eu152-ELMB90
Am-241	UVVVR - ER-25/178-18

The between filters homogeneity was studied and assessed by measuring all radionuclides in 6 randomly selected filters in duplicate. The standard uncertainty associated with the between filters heterogeneity was calculated using the formulas stated in ISO Guide 35 [2].

The results of single ANOVA calculation and applying the formula for estimation of the uncertainty originated from between filters heterogeneity $u*_{bb}$ are reported in Table 2.

$$u*_{bb} = \sqrt{\frac{MS_{within}}{n}} \sqrt[4]{\frac{2}{\nu_{MS_{within}}}}$$

Where:

MS_{within}	Mean square (ANOVA) of within filters.
$\nu_{MS_{within}}$	Degree of freedom of mean square of within filters.
$u*_{bb}$	Uncertainty originated from between filters heterogeneity.
n	Number of observations.

The homogeneity study results reported in Table 2 shows that the filters quality fit to be used as test items in this proficiency test.

TABLE 2. UNCERTAINTY ORIGINATED FROM BETWEEN FILTERS HETEROGENEITY

Radionuclides	$u_{\text{between-filters}}$ [% of the target value]
Co-57	0.8
Cs-134	1.2
Cs-137	0.6
Eu-152	1.4
Am-241	1.4

In estimation the uncertainty of the target value three components were taken into consideration:

- the uncertainty of the standard solution,
- the uncertainty of the of the dilution factors of original radioactive standard solutions,
- and the between filters uncertainty which was the dominant component of uncertainty.

Table 3 lists the target values and the associated combined standard uncertainty in the simulated air filters.

For all target values the reference date is 01 July 2009, the combined standard measurement result uncertainty is expressed at 1σ level.

The final target activity value in filters for each radionuclide was calculated from the certified activity values assigned to each radionuclide, taking into account the successive gravimetric dilution steps and the mass of spiking mixture.

TABLE 3. TARGET VALUES AND RESPECTIVE STANDARD COMBINED UNCERTAINTIES OF THE MEASURANDS OF INTEREST

	Radionuclides	Activity per filter [Bq]	Standard uncertainty [Bq]
Filters 02	Co-57	1.61	0.06
	Cs-134	0.50	0.02
	Cs-137	0.50	0.02
	Eu-152	1.06	0.04
	Am-241	1.58	0.06
Filter 01 and 03	Co-57	18.2	0.21
	Cs-134	18.3	0.25
	Cs-137	48.0	0.6
	Eu-152	40.3	0.6
	Am-241	51.9	0.6
Filter 04	Co-60	85.8	0.9
	Ba-133	107.5	1.9

2.3.3. Analytical procedure applied in the analysis of the air filters

Two high sensitivity gamma spectrometers were used in measurement of gamma emitting nuclides in all filters. The technical details and instrumental set-up are shown in Table 4. Figures 6, 7 and 8 show spectra obtained from filter 02 the low level activity, filters 01, 03 the high level activity and filter 04 the control filter respectively.

TABLE 4. TECHNICAL SPECIFICATIONS AND MEASUREMENT PAREMETERS OF THE GAMMA SPECTROMETERS USED IN THE HOMOGENEITY STUDY AND QUALITY CONTROL OF THE FILTERS

	Filter 01	Filter 03	Filter 02	Filter 04
Detector:	GEM-100-PLUS-S		GEM-60185-S	
Ge crystal	coaxial, p-type			coaxial, p-type
Rel.eff.	100 %	Co-60, 1332.5 keV	60 %	Co-60, 1332.5 keV
FWHM	2.1 keV	Co-60, 1332.5 keV	1.81 keV	Co-60, 1332.5 keV
Shielding	10 cm Pb, 0.3 cm Cu, 0.5 cm plexiglass		10 cm Pb, 0.3 cm Cu	
Analyser	Dspec Jr	8 k channel	DSP 9660 8k	channel
Counting time, live time (sec)	2000	2000	10000	4000

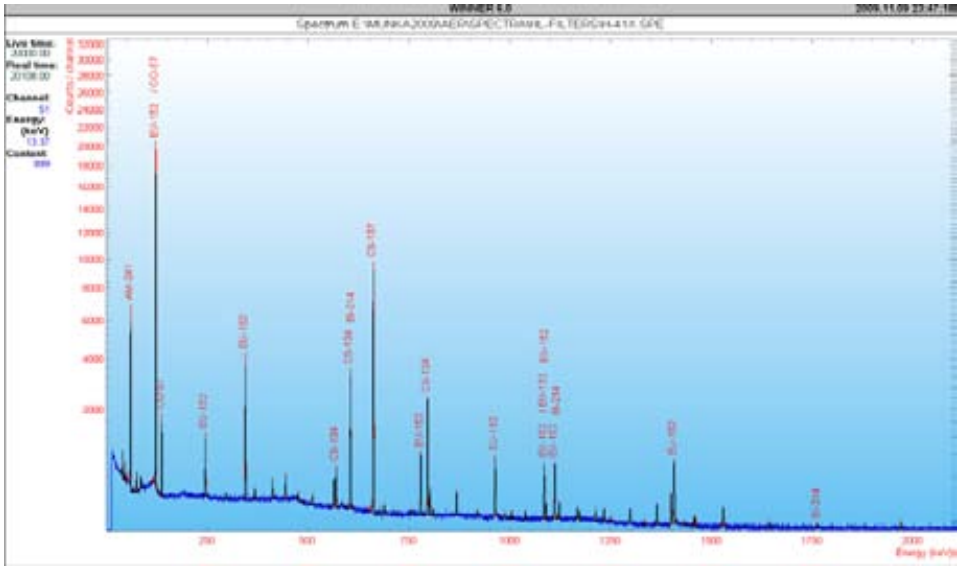


Figure 6. Gamma spectrum of the high level activity air filter 02.

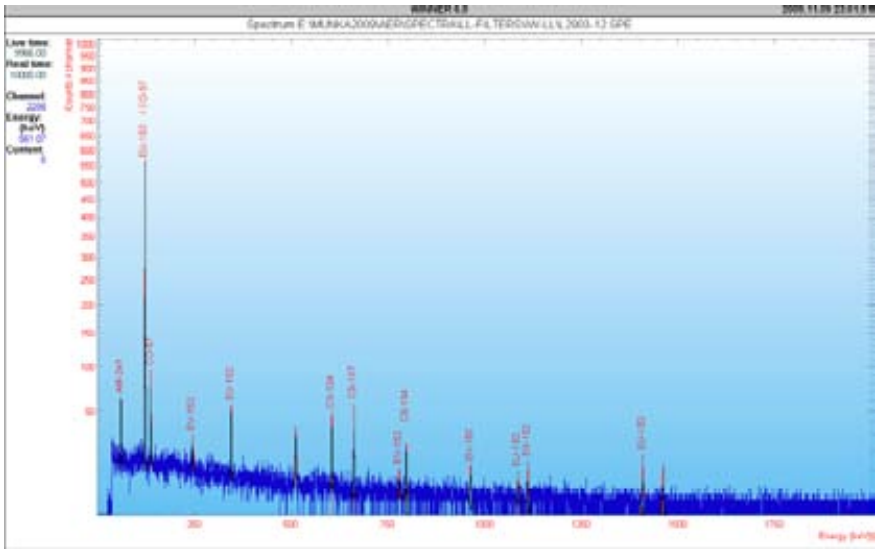


Figure 7. Gamma spectrum of the low level activity air filters 01 and 03.

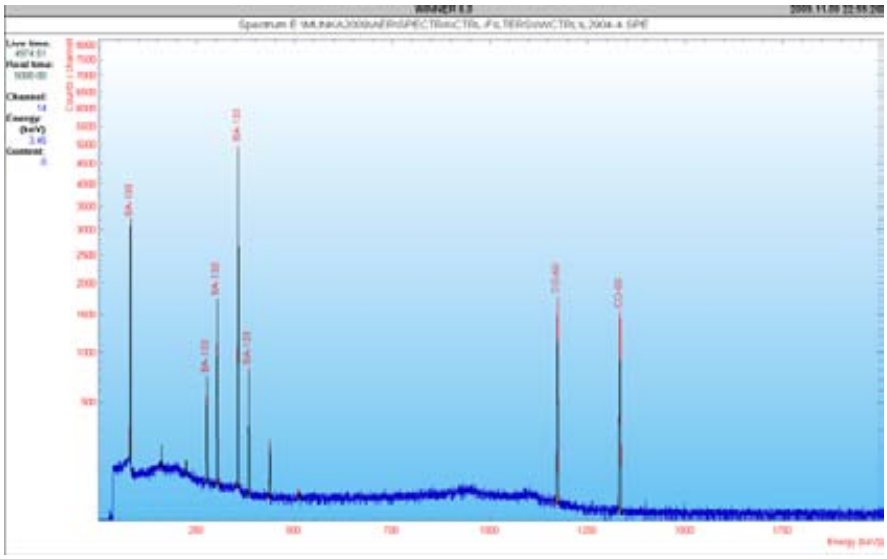


Figure 8. Gamma spectrum of the control air filters 04.

3. PERFORMANCE CRITERIA

The proficiency testing scoring system applied by the Terrestrial Environment Laboratory in Seibersdorf, takes into consideration the bias and the uncertainty of the reported result and it includes in the evaluation both the total combined uncertainty associated with the target value of testing item and the total uncertainty reported by the participating laboratories.

However, in this specific PT the relative bias was used as a performance indicator to calculate the final score of analytical performance. This approach was applied due to the fact that simulated plastic air filters for which the estimated measurement results uncertainty in the participants' laboratories could not be valid as for the real filters normally analyzed. This approach is more correct as a wrongly reported uncertainty could affect the participants' final evaluation score.

Both scores (with and without uncertainty consideration) were calculated and listed in the evaluation tables (Appendix I) to give an idea about the effect of claimed measurement result uncertainty on the final evaluation score.

3.1. Relative bias

The first stage in producing a score for a result $\text{Value}_{\text{reported}}$ (a single measurement of analyte concentration in a test material) is obtaining the estimate of the bias. To evaluate the bias of the reported results, the relative bias between the reported value and the target value is calculated and expressed as a percentage:

$$Bias_{relative} = \frac{\text{Value}_{\text{reported}} - \text{Value}_{\text{target}}}{\text{Value}_{\text{target}}} \times 100 \qquad (1)$$

3.2. Evaluation procedure taking into account the reported uncertainty

The proficiency test results were evaluated against the acceptance criteria for trueness and precision and assigned the status 'acceptable', 'acceptable with warning' or 'Not acceptable' accordingly [3, 4].

3.2.1. Trueness

The participant result is assigned 'acceptable' status for trueness if:

$$A1 \leq A2$$

where:

$$A1 = \left|\text{Value}_{\text{target}} - \text{Value}_{\text{reported}}\right|$$

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

3.2.2. Assessment of reported uncertainty

To evaluate the reported measurement result uncertainty an estimator P is calculated for each reported uncertainty, 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 result uncertainty claimed by the participant. The Limit of acceptable Precision (LAP) for each analyte respectively is defined for the respective proficiency test in advance, 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 the claimed uncertainty when $P \leq LAP$. The LAP values used in the evaluation of all radionuclides in this PT is 20% for all radionuclides.

In the evaluation, both scores for trueness and precision are combined. A result must obtain an 'acceptable' score in both criteria to be assigned the final score 'acceptable'. Obviously, if a score of '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', a further check is applied. The reported result relative bias (R. Bias) is compared with the maximum acceptable bias (MAB). If R. Bias ≤ MAB, the final score will be 'acceptable with warning'. 'warning' will reflect mainly two situations. The first situation will be a result with small measurement uncertainty; however its bias is still within MAB. The second situation will appear when result close to the assigned property value is reported, but the associated uncertainty is large. If R. Bias > MAB, the result will be 'not acceptable'. The results of the performance evaluation according to this approach are listed in Appendix I in the column entitled 'Score'.

3.3. Analytical performance final score

For evaluation of the analytical performance final score of the reported results of gamma emitting nuclides in the spiked air filters the relative bias was calculated according to 3.1 and used as a basis for evaluation:

The participant result was assigned 'acceptable' score if:

$$Bias_{Relative} \leq 20\%$$

The participant result was assigned 'acceptable with warning' score if:

$$20\% < Bias_{Relative} \leq 30\%$$

The participant result was assigned 'not acceptable' score if:

$$Bias_{Relative} > 30\%$$

The results of the performance evaluation according to this approach are listed in Appendix I in the column entitled 'Final score'.

4. RESULTS AND DISCUSSION

4.1. General

In this PT, 877 measurement results were reported to the IAEA from 53 laboratories in 36 IAEA Member States. The participants' data along with the statistical performance evaluation were compiled and presented. Performance evaluation tables sorted by analyte are reported in Appendix I.

Three weeks after the deadline for results reporting each participant obtained an individual evaluation report in order to have a rapid feed back on own performance.

The number of reported results and obtained evaluation as acceptable/acceptable with warning/not acceptable of each laboratory is presented graphically in Fig. 7. This way of presentation allows the participating laboratories to benchmark their performance level with peers.

To have an overview of the participants' performance for each specific radionuclide, each radionuclide was studied individually; Table 5 shows the distribution of results scored as acceptable/acceptable with warning/not acceptable for each evaluated radionuclide and for each filter.

TABLE 5. SUMMARY EVALUATION OF ALL NUCLIDES SORTED BY FILTER NUMBER

	Radionuclide	No. of reported results	Percentage of 'acceptable' results (%)	Percentage of 'warning' results (%)	Percentage of 'not acceptable' results (%)
Filter 01	Co-57	52	71	8	21
	Cs-134	53	87	11	2
	Cs-137	52	77	17	6
	Eu-152	52	85	10	6
	Am-241	50	80	8	12
Filter 02	Co-57	52	67	15	17
	Cs-134	53	85	11	4
	Cs-137	52	67	19	14
	Eu-152	50	82	4	14
	Am-241	49	78	8	14
Filter 03	Co-57	52	71	8	21
	Cs-134	53	87	11	2
	Cs-137	52	81	12	8
	Eu-152	52	81	14	6
	Am-241	50	78	8	14
Filter 04	Co-60	52	92	4	4
	Ba-133	51	88	4	8

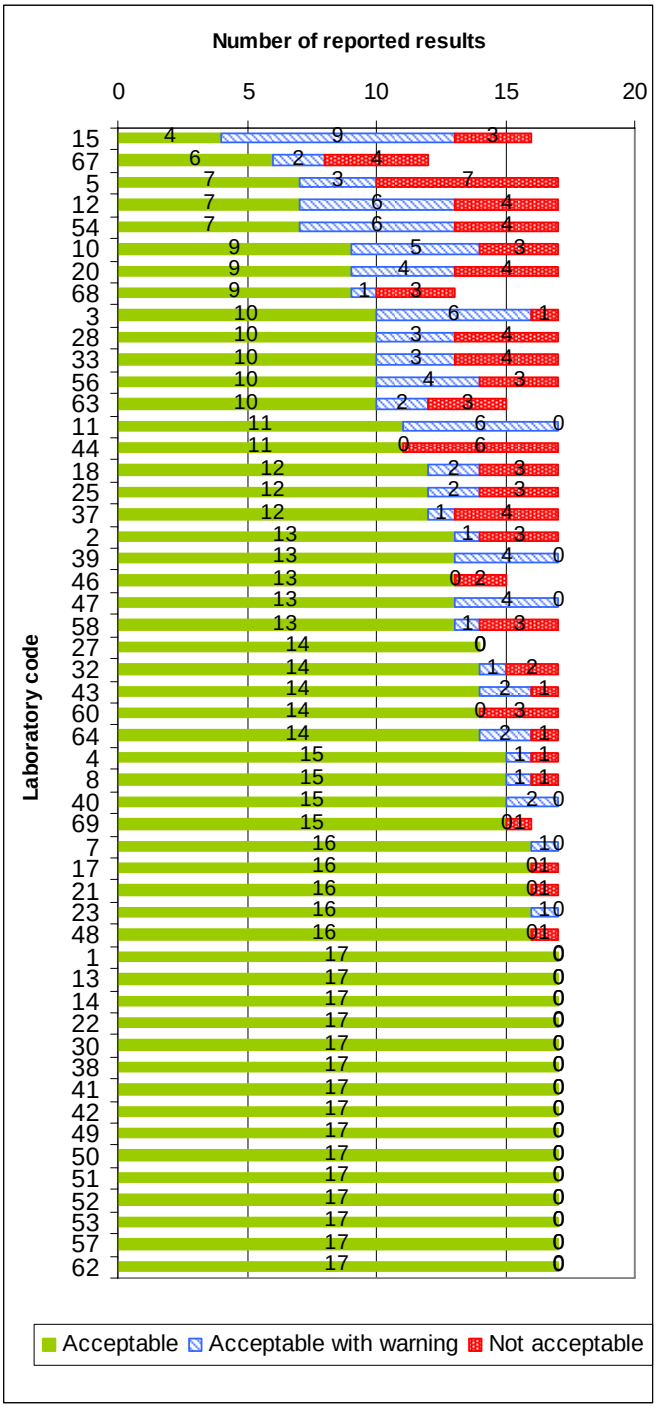


Figure 9. Performance evaluation results sorted by the number of acceptable results obtained.

To have an overall view of the analytical performance of the laboratories population in this PT the S-shape charts of evaluated analytes were presented in Appendix I.

The overall evaluation showed that only 11% of all reported results failed to meet the PT criteria. The main reasons of not acceptable performance are discussed later.

To compare the performance level of each laboratory a normalized mean of analytical performance score and the percentage of 'not acceptable' scores were calculated in the following way:

Normalized mean of analytical performance score (%) = ((A+W)/ NRR)*100

Percentage of ‘not acceptable scores’ (%) = (N/NRR)*100

Where:

A: number of obtained ‘acceptable’ scores

W: number of obtained ‘acceptable with warning’ scores.

N: number of obtained ‘not acceptable’ scores.

NRR: total number of reported results.

The results of the calculation are shown in Table 6.

TABLE 6. SUMMARY INDIVIDUAL EVALUATION SORTED BY LABORATORY CODE

Laboratory code	Number of reported results	Number. of ‘acceptable’ results	Number of ‘warning’ results	Number of ‘not acceptable’ results	Normalized mean of performance (%)	Percentage of ‘not acceptable’ (%)
1	17	17	0	0	100	0
2	17	13	1	3	82	18
3	17	10	6	1	94	6
4	17	15	1	1	94	6
5	17	7	3	7	59	41
7	17	16	1	0	100	0
8	17	15	1	1	94	6
10	17	9	5	3	82	18
11	17	11	6	0	100	0
12	17	7	6	4	76	24
13	17	17	0	0	100	0
14	17	17	0	0	100	0
15	16	4	9	3	81	19
17	17	16	0	1	94	6
18	17	12	2	3	82	18
20	17	9	4	4	76	24
21	17	16	0	1	94	6
22	17	17	0	0	100	0
23	17	16	1	0	100	0
25	17	12	2	3	82	18
27	14	14	0	0	100	0
28	17	10	3	4	76	24
30	17	17	0	0	100	0
32	17	14	1	2	88	12
33	17	10	3	4	76	24
37	17	12	1	4	76	24
38	17	17	0	0	100	0
39	17	13	4	0	100	0

Laboratory code	Number of reported results	Number. of 'acceptable' results	Number of 'warning' results	Number of 'not acceptable' results	Normalized mean of performance (%)	Percentage of 'not acceptable' (%)
40	17	15	2	0	100	0
41	17	17	0	0	100	0
42	17	17	0	0	100	0
43	17	14	2	1	94	6
44	17	11	0	6	65	35
46	15	13	0	2	87	13
47	17	13	4	0	100	0
48	17	16	0	1	94	6
49	17	17	0	0	100	0
50	17	17	0	0	100	0
51	17	17	0	0	100	0
52	17	17	0	0	100	0
53	17	17	0	0	100	0
54	17	7	6	4	76	24
56	17	10	4	3	82	18
57	17	17	0	0	100	0
58	17	13	1	3	82	18
60	17	14	0	3	82	18
62	17	17	0	0	100	0
63	15	10	2	3	80	20
64	17	14	2	1	94	6
67	12	6	2	4	67	33
68	13	9	1	3	77	23
69	16	15	0	1	94	6

4.2. Lessons learned and recommendations to the laboratories

The performance evaluation results demonstrated the competence of ALMERA network laboratories in determination of gamma emitting radionuclides in air filters, 79% of all reported results fulfilled the proficiency test criteria. Figure 10 shows the summary evaluation of the reported results.

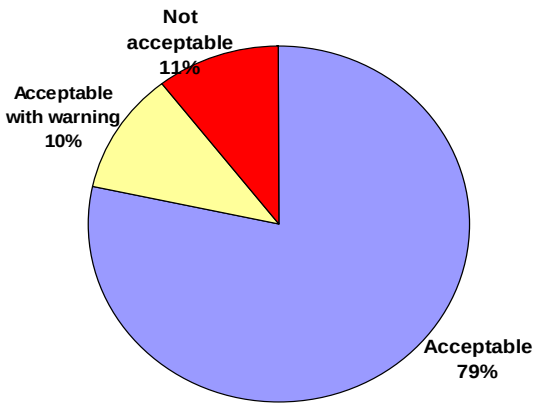
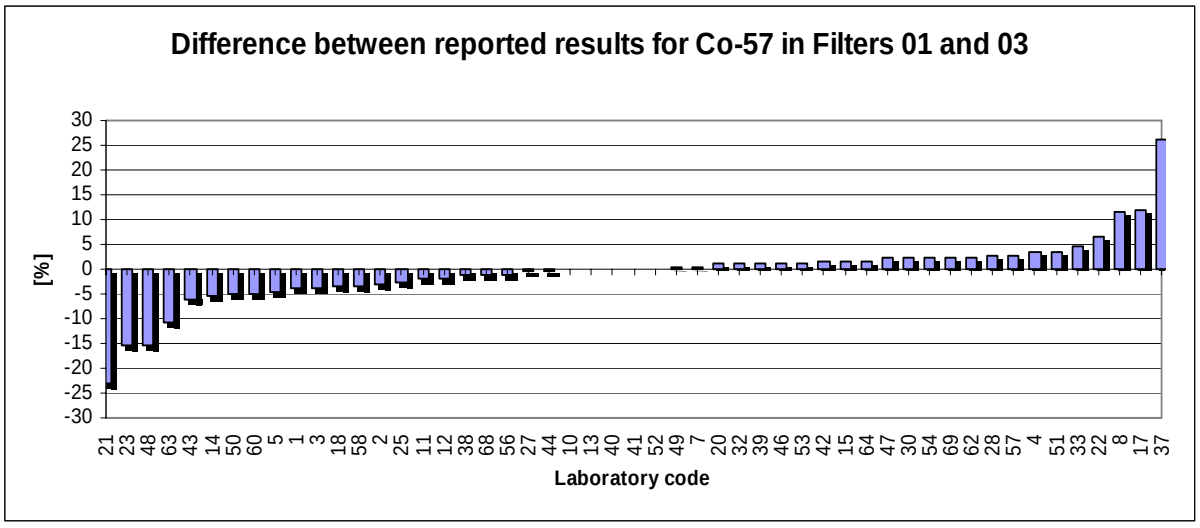


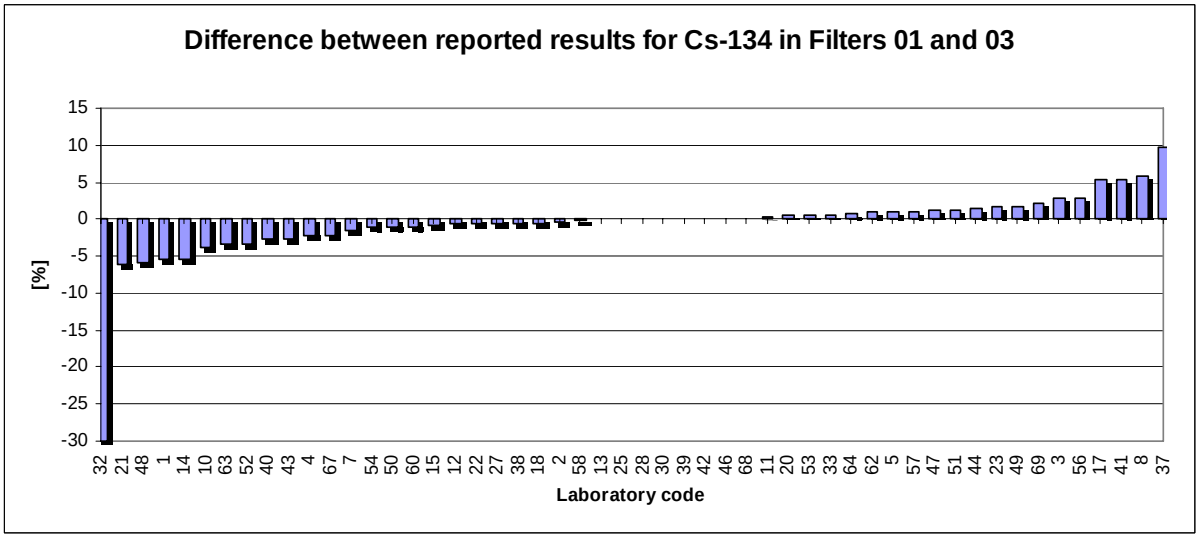
Figure 10. Summary evaluation of the reported results.

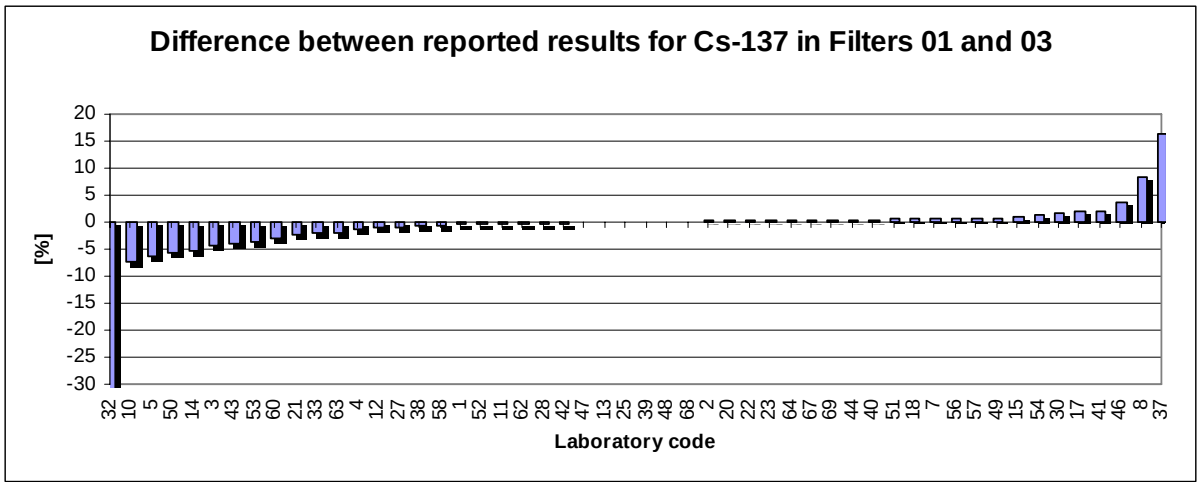
Assessment of the analytical procedure repeatability

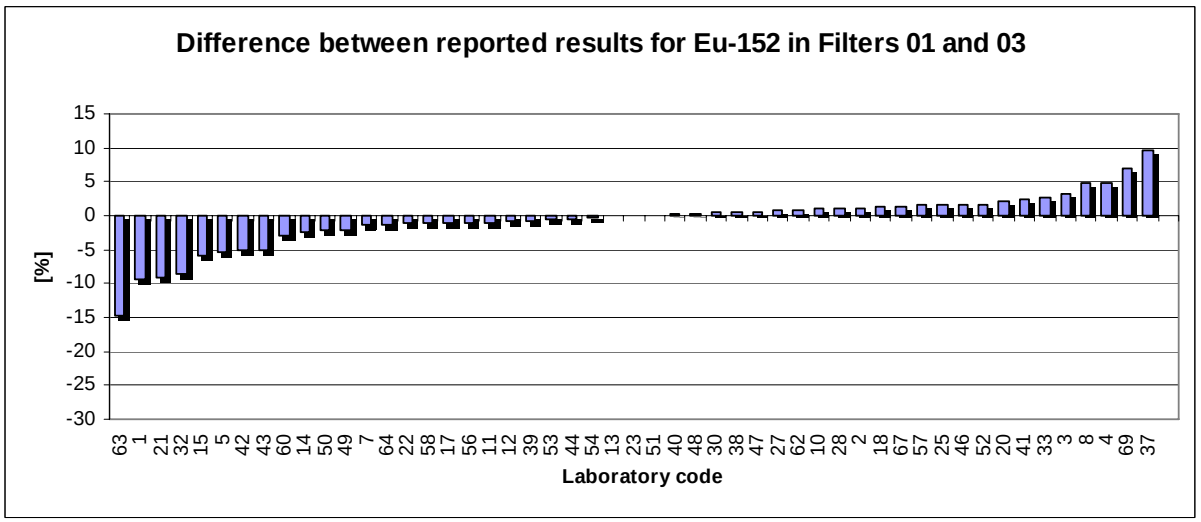
The analytical results repeatability was checked in this proficiency test by analyzing the duplicate filters 01 and 03. Certain laboratories need to improve their results repeatability. Figures 11 to 15 show the difference in reported results for the same target value for each radionuclide in filters 01 and 03. It can be seen from the figures that the difference between the two identical target values was within ±5% for most of the participants. The highest variability was found in Am-241 results of the laboratories with codes 18, 20, 21, 47, 48, 54, 58 and 62 which could be correlated to the difficulty of measuring a radionuclide in the low energy part of the spectra.

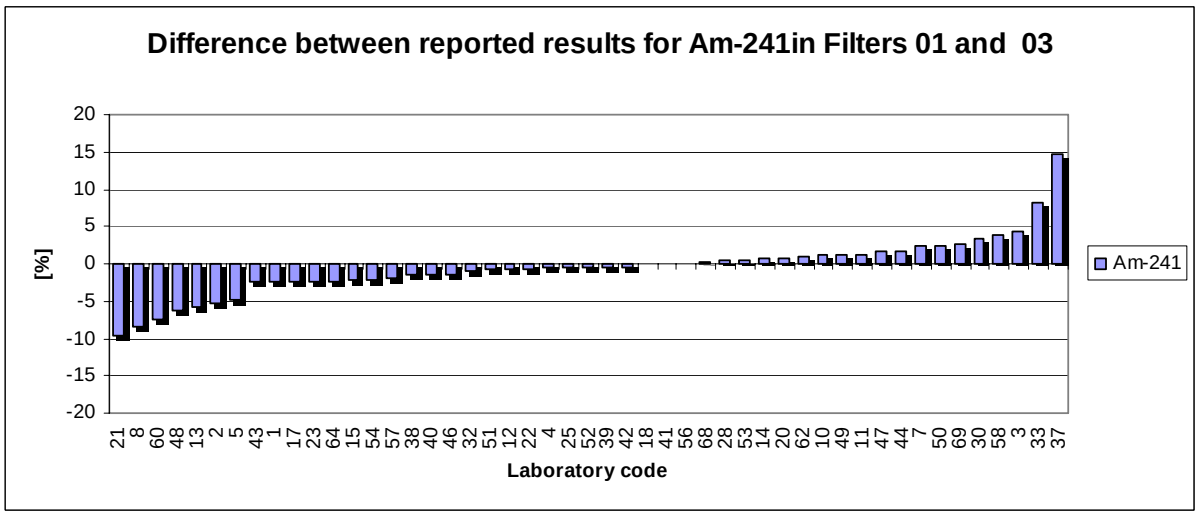
In many cases the claimed measurement result uncertainty was significantly smaller than the observed difference (variation) which indicates an underestimated uncertainty or a need for improving the repeatability of the analytical procedure.











Figures 11, 12, 13, 14 and 15. Observed deviations between the results of the duplicate filters 01 and 03.

Co-57 lessons learned

Several laboratories with codes 12, 18, 20, 25, 28, 37, 44, 45, 54 and 68 reported results for Co-57 with positive bias which is a common problem in such combination of radionuclides. The root cause of this overestimation could be attributed to the overlapping peaks of Eu-152 at 121.78 keV and the Co-57 at 122.01 keV. Certain participants informed the PT organizer that they overlooked these two peaks as the difference in the energy between them is very small, therefore the manual spectral deconvolution was not performed which resulted in overestimation of Co-57. In other cases the correction for the overlap was not accurate and resulted in introduction of a large uncertainty.

Cs-134 lessons learned

The quality of the reported results of the Cs-134 was quite good and did not suffer from the true coincidence cascade summing effect and it can be noticed that the ALMERA laboratories performance in analyzing Cs-134 was substantially improved comparing to previous PTs.

The evaluation score of Cs-134 was the highest amongst other nuclides in this PT, see Table 8.

Cs-137 lessons learned

From the S-shape graphs of the Cs-137 in Appendix I, it can be noticed that the participants' results were slightly higher than the target value but still within the claimed measurement results uncertainty. It is worth to note that the reported results of Cs-137 were as expected of excellent quality regarding the accuracy, repeatability and claimed uncertainty.

Eu-152 lessons learned

Six laboratories reported underestimated results for Eu-152, this could be due to the true coincidence summing effect. In addition, the overlapping peak of Co-57 could cause an over estimation of the results. Proper spectra deconvolution should be applied. The use of improper efficiency calibration could also lead to a bias from the target value.

Am-241 lessons learned

Laboratories with codes 2, 5, 15, 20, 25, 45, 54, 56, and 60 reported overestimated results (positive bias) for Am-241. The positive bias could be originated from a calibration problem. 5-10 % could be attributed to the difference of the efficiency between the single point and the matrix pattern used in the PT. The bias could also be caused due to the difference between the simulated air filter (plastic) and the material of the filter used for calibration especially at the lower energy part of the spectra. It is worth to mention al of the not acceptable results were due to a negative bias.

False positive reported results

Three laboratories reported false positive for Cd-109 and one laboratory for Zn-65 as listed in Table 7. The rest of participants were able to identify the nuclides which were present on the filter. It is known that Cd-109 is in a heavily populated region of the spectra and needs attention to properly identify the measurand.

TABLE 7. REPORTED FALSE POSITIVE RESULTS

Lab code	Cd-109		Zn-65	
	Activity [Bq]	Uncertainty [Bq]	Activity [Bq]	Uncertainty [Bq]
10	2.9	0.78	-	-
20	16.9	2.6	-	-
60	2.23	0.39	-	-
67	-	-	10.1	0.7

Overall participants' performance for each radionuclide

To have an overview of the participants' performance for each specific radionuclide, each radionuclide was studied individually in each filter; Table 8 shows the distribution of results scores for each evaluated radionuclide and for each sample. It can be noticed that he performance level in filter 02 is worse than in filters 01 and 03 due to its lower activity level. Co-57 was the most difficult nuclide for the participants where around 20% of reported results failed the PT criteria.

Compliance to the reporting deadline

The participants were informed that the deadline for results reporting is three working days from the date of samples delivery confirmed by the forwarder. Most of the participants were able to comply with the deadline. However, due to different logistic problems certain shipments suffered from delays which resulted in reporting delays. In some cases where the forwarder did not provide the exact date of samples delivery it was not possible to know the exact number of elapsed days between samples delivery and results reporting.

Based on the available data and information reported in the PT data base it was found that the average number of elapsed days between samples delivery and results reporting is four days.

For future PTs it would be recommended to improve the samples' shipment tracking system and to encourage all forwarders especially in Asia and Latin America to report accurately the delivery date, or to involve the regional coordinators in sample delivery to speed up the process and to improve shipment trackability.

It should be noted that sixteen participants with codes 6, 9, 16, 19, 24, 26, 29, 31, 34, 35, 36, 55, 59, 61, 65, 66 did not report back their results to the PT organizer despite the fact that filters preparation and PT package shipment consumed a lot of time, efforts and rescores. The number of non reporting participants should be reduced to the minimum in forthcoming PTs.

5. CONCLUSIONS

The IAEA-CU-2009-04 proficiency test was successfully completed with high level of reporting-back the analytical results, whereas 77% of the registered laboratories reported their results to the IAEA. Most participants were able to quantify certain number of radionuclides of interest in air filters.

The technical competence of ALMERA network in reporting valid analytical results for gamma emitting radionuclides was demonstrated where only 11% of all reported results did not pass the PT acceptance criteria, which is a quite acceptable from statistical point of view.

TABLE 8. DISTRIBUTION OF EVALUATION SCORES FOR EACH EVALUATED RADIONUCLIDE IN EACH FILTER

	Radionuclide	Number of reported results	Percentage of 'acceptable' results (%)	Percentage of 'acceptable with warning' results (%)	Percentage of 'not acceptable' results (%)
Filter 01	Co-57	51	71	8	21
	Cs-134	52	87	11	2
	Cs-137	51	77	17	6
	Eu-152	51	85	10	5
	Am-241	49	80	8	12
Filter 02	Co-57	51	67	16	17
	Cs-134	52	85	11	4
	Cs-137	51	68	19	13
	Eu-152	49	82	4	14
	Am-241	48	78	8	14
Filter 03	Co-57	51	71	8	21
	Cs-134	52	87	11	2
	Cs-137	51	81	11	8
	Eu-152	51	80	14	6
	Am-241	49	78	8	14

The proficiency test results showed that the ALMERA laboratories performance in analyzing Cs-134 was substantially improved comparing to previous PTs, while Co-57 results were overestimated due to peaks overlapping with Eu-152.

This PT provides the possibility to improve the comparability and reliability of analytical results produced by ALMERA laboratories for the determination of gamma emitting radionuclides in air filters.

This PT shows the need for further improvement of the applied corrections for true summing effects. The calibration procedure needs also to be improved to reduce the bias in reported results. Most of the participants' analytical systems showed a good level of repeatability; however Am-241 results demonstrated the highest variations between the duplicate filters.

It is obvious that the laboratories who obtained a good performance scoring should not stop continuous improvement and optimization of the analytical performance, a closer look on the results' bias could indicate the need for further corrective actions despite the good scoring.

The scientific courage and transparency was the main characteristic of all analysts who took part in this proficiency test knowing in advance that the evaluation results will not be anonymous. This is a demonstration of a keen interest in improving the analytical performance and high level of professionalism of all analysts regardless the performance scoring. Therefore, the proficiency test organizer considers that all participants successfully participated in this test.

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APPENDIX I: PERFORMANCE EVALUATION TABLES SORTED BY ANALYTE

All results listed in this Appendix are expressed in Bq units at a reference date set to 01 July 2009.

The abbreviations used in the Table header are explained below:

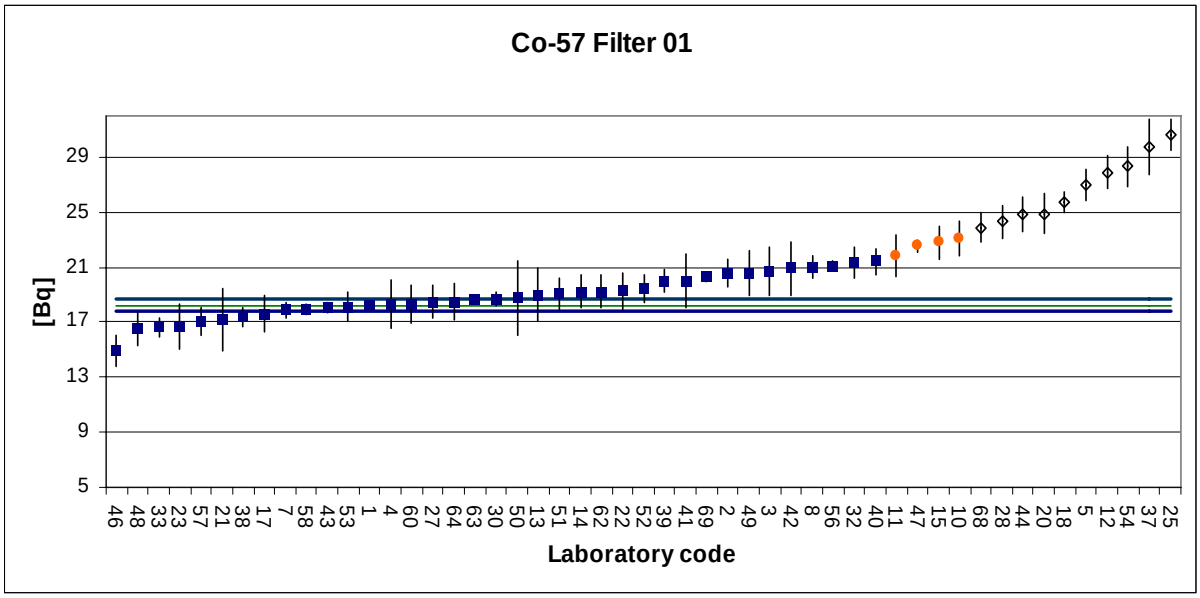
Rep. Value:	Reported measurement result value for the analyte of interest in Bq.
Rep. Unc.	Reported standard measurement result uncertainty in Bq.
Unc. [%]	Reported standard measurement result uncertainty in percentage.
Rel. Bias	Relative bias calculated according to formula (1) in paragraph 3.1.
A1 and A2	Evaluation estimators for trueness please see 3.2 in the report body.
True	Evaluation score for Trueness please see 3.2 in the report body.
P	Calculated estimator to assess the reported uncertainty please see 3.2.
Prec.	Evaluation score for uncertainty, please see 3.2 in the report body.
Score	Evaluation score taking into consideration the reported measurement result uncertainty and the uncertainty of the target value.
Final score	Evaluation score based on the value of the relative bias only.
A	Acceptable: The reported measurement result fulfils the PT criteria.
W	Acceptable with warning.
N	Not acceptable: The reported measurement result did not fulfil the PT criteria.

The evaluation results are presented in ascending order of the laboratory code.

Performance evaluation of Co-57 measurement results

Simulated air filter 01

Target Value 18.2 ± 0.2 [Bq]



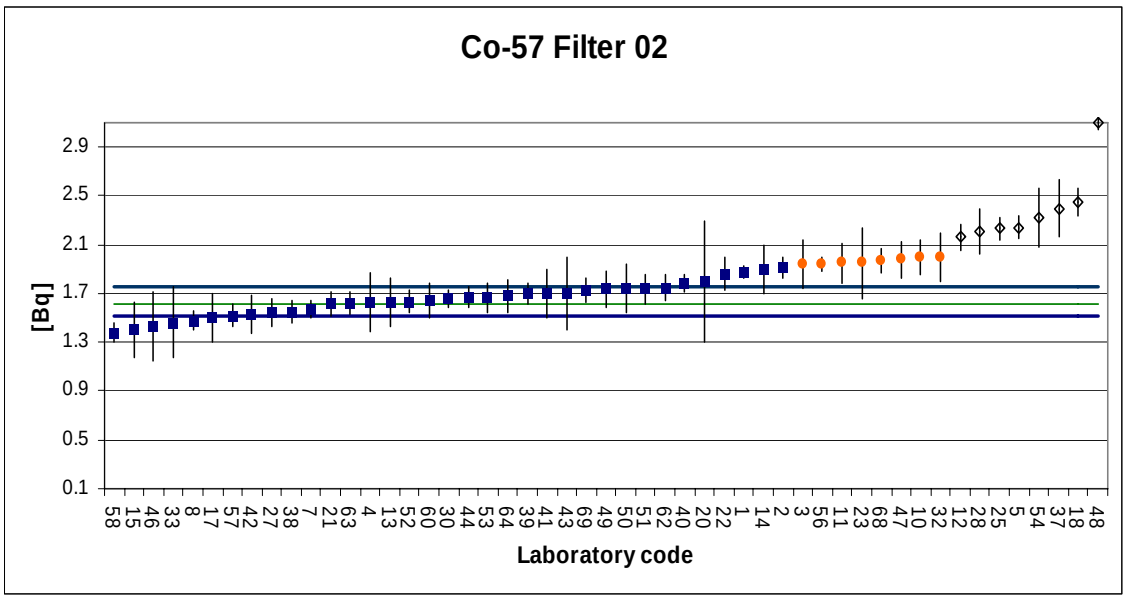
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	18.2	0.16	0.88	0.00	0.0	0.7	A	1.5	A	A	**A**
2	20.54	1.01	4.92	12.86	2.3	2.7	A	5.1	A	A	**A**
3	20.7	1.7	8.21	13.74	2.5	4.4	A	8.3	A	A	**A**
4	18.3	1.8	9.84	0.55	0.1	4.7	A	9.9	A	A	**A**
5	26.95	1.1	4.08	48.08	8.8	2.9	N	4.3	A	N	**N**
7	17.9	0.6	3.35	-1.65	0.3	1.6	A	3.6	A	A	**A**
8	20.997	0.785	3.74	15.37	2.8	2.1	N	3.9	A	W	**A**
10	23.1	1.26	5.45	26.92	4.9	3.3	N	5.6	A	N	**W**
11	21.87	1.52	6.95	20.16	3.7	4.0	A	7.1	A	A	**W**
12	27.9	1.16	4.16	53.30	9.7	3.0	N	4.3	A	N	**N**
13	19	1.9	10.00	4.40	0.8	4.9	A	10.1	A	A	**A**
14	19.2	1.2	6.25	5.49	1.0	3.1	A	6.4	A	A	**A**
15	22.8	1.21	5.31	25.27	4.6	3.2	N	5.4	A	N	**W**
17	17.6	1.3	7.39	-3.30	0.6	3.4	A	7.5	A	A	**A**
18	25.705	0.716	2.79	41.24	7.5	1.9	N	3.0	A	N	**N**
20	24.9	1.4	5.62	36.81	6.7	3.7	N	5.8	A	N	**N**
21	17.22	2.27	13.18	-5.38	1.0	5.9	A	13.2	A	A	**A**
22	19.27	1.36	7.06	5.88	1.1	3.6	A	7.2	A	A	**A**
23	16.7	1.6	9.58	-8.24	1.5	4.2	A	9.7	A	A	**A**

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	30.6	1.1	3.59	68.13	12.4	2.9	N	3.8	A	N	**N**
27	18.5	1.2	6.49	1.65	0.3	3.1	A	6.6	A	A	**A**
28	24.3	1.2	4.94	33.52	6.1	3.1	N	5.1	A	N	**N**
30	18.7	0.5	2.67	2.75	0.5	1.4	A	2.9	A	A	**A**
32	21.3	1.1	5.16	17.03	3.1	2.9	N	5.3	A	W	**A**
33	16.63	0.66	3.97	-8.63	1.6	1.8	A	4.1	A	A	**A**
37	29.77	1.99	6.68	63.57	11.6	5.2	N	6.8	A	N	**N**
38	17.4	0.7	4.02	-4.40	0.8	1.9	A	4.2	A	A	**A**
39	20	0.8	4.00	9.89	1.8	2.1	A	4.2	A	A	**A**
40	21.4	0.9	4.21	17.58	3.2	2.4	N	4.4	A	W	**A**
41	20	2	10.00	9.89	1.8	5.2	A	10.1	A	A	**A**
42	20.9	1.9	9.09	14.84	2.7	4.9	A	9.2	A	A	**A**
43	18.1	0.4	2.21	-0.55	0.1	1.2	A	2.5	A	A	**A**
44	24.79	1.25	5.04	36.21	6.6	3.3	N	5.2	A	N	**N**
46	14.9	1.1	7.38	-18.13	3.3	2.9	N	7.5	A	W	**A**
47	22.58	0.44	1.95	24.07	4.4	1.3	N	2.3	A	N	**W**
48	16.5	1.2	7.27	-9.34	1.7	3.1	A	7.4	A	A	**A**
49	20.55	1.66	8.08	12.91	2.4	4.3	A	8.2	A	A	**A**
50	18.8	2.7	14.36	3.30	0.6	7.0	A	14.4	A	A	**A**
51	19.06	1.11	5.82	4.73	0.9	2.9	A	5.9	A	A	**A**
52	19.45	0.96	4.94	6.87	1.3	2.5	A	5.1	A	A	**A**
53	18.1	1.1	6.08	-0.55	0.1	2.9	A	6.2	A	A	**A**
54	28.3	1.5	5.30	55.49	10.1	3.9	N	5.4	A	N	**N**
56	21.1	0.3	1.42	15.93	2.9	1.0	N	1.9	A	W	**A**
57	17.1	1	5.85	-6.04	1.1	2.6	A	6.0	A	A	**A**
58	17.96	0.38	2.12	-1.32	0.2	1.1	A	2.4	A	A	**A**
60	18.3	1.4	7.65	0.55	0.1	3.7	A	7.7	A	A	**A**
62	19.23	1.2	6.24	5.66	1.0	3.1	A	6.4	A	A	**A**
63	18.66	0.26	1.39	2.53	0.5	0.9	A	1.8	A	A	**A**
64	18.5	1.3	7.03	1.65	0.3	3.4	A	7.1	A	A	**A**
68	23.9	1.1	4.60	31.32	5.7	2.9	N	4.8	A	N	**N**
69	20.3	0.3	1.48	11.54	2.1	1.0	N	1.9	A	W	**A**

Performance evaluation of Co-57 measurement results

Simulated air filter 02

Target Value: 1.61 ± 0.06 [Bq]



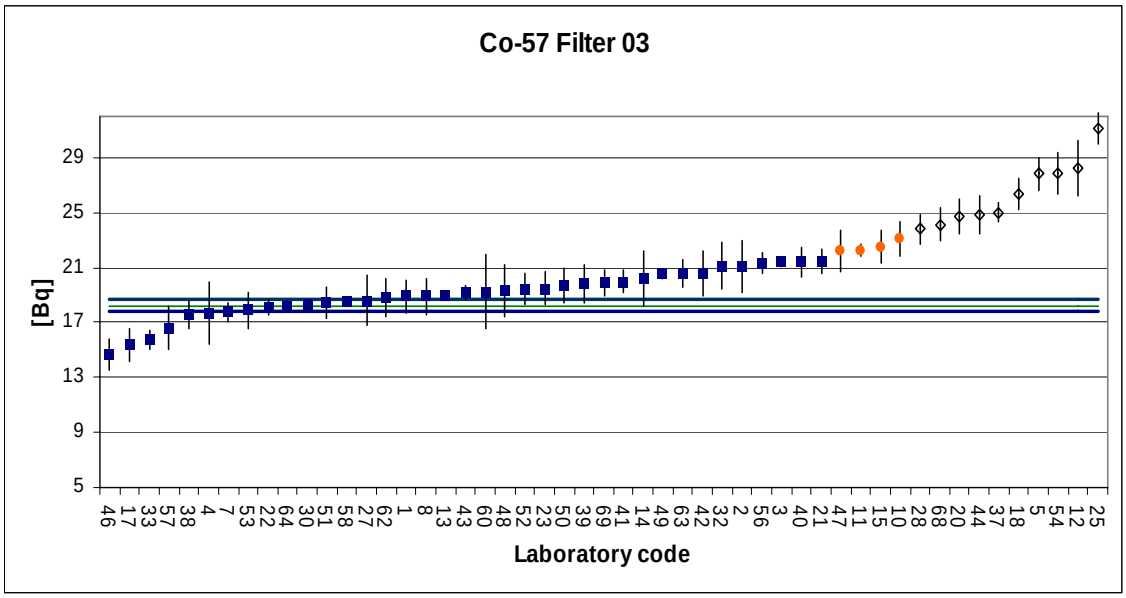
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	1.87	0.05	2.67	16.13	0.3	0.2	N	4.6	A	W	A
2	1.91	0.08	4.19	18.62	0.3	0.3	N	5.6	A	W	A
3	1.94	0.2	10.31	20.48	0.3	0.5	A	11.0	A	A	W
4	1.63	0.24	14.72	1.23	0.0	0.6	A	15.2	A	A	A
5	2.24	0.09	4.02	39.11	0.6	0.3	N	5.5	A	N	N
7	1.57	0.07	4.46	-2.50	0.0	0.2	A	5.8	A	A	A
8	1.477	0.082	5.55	-8.28	0.1	0.3	A	6.7	A	A	A
10	2	0.14	7.00	24.20	0.4	0.4	A	7.9	A	A	W
11	1.95	0.16	8.21	21.10	0.3	0.4	A	9.0	A	A	W
12	2.16	0.11	5.09	34.14	0.5	0.3	N	6.3	A	N	N
13	1.63	0.2	12.27	1.23	0.0	0.5	A	12.8	A	A	A
14	1.9	0.2	10.53	17.99	0.3	0.5	A	11.2	A	A	A
15	1.4	0.23	16.43	-13.06	0.2	0.6	A	16.8	A	A	A
17	1.5	0.2	13.33	-6.85	0.1	0.5	A	13.8	A	A	A
18	2.453	0.113	4.61	52.34	0.8	0.3	N	5.9	A	N	N
20	1.8	0.5	27.78	11.78	0.2	1.3	A	28.0	N	W	A
21	1.609	0.099	6.15	-0.08	0.0	0.3	A	7.2	A	A	A
22	1.86	0.13	6.99	15.51	0.2	0.4	A	7.9	A	A	A
23	1.95	0.29	14.87	21.10	0.3	0.8	A	15.3	A	A	W

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	2.23	0.09	4.04	38.49	0.6	0.3	N	5.5	A	N	N
27	1.54	0.11	7.14	-4.36	0.1	0.3	A	8.1	A	A	A
28	2.21	0.18	8.14	37.25	0.6	0.5	N	9.0	A	N	N
30	1.66	0.07	4.22	3.09	0.0	0.2	A	5.6	A	A	A
32	2	0.2	10.00	24.20	0.4	0.5	A	10.7	A	A	W
33	1.46	0.29	19.86	-9.33	0.2	0.8	A	20.2	N	W	A
37	2.395	0.235	9.81	48.73	0.8	0.6	N	10.5	A	N	N
38	1.55	0.09	5.81	-3.74	0.1	0.3	A	6.9	A	A	A
39	1.7	0.08	4.71	5.57	0.1	0.3	A	6.0	A	A	A
40	1.79	0.07	3.91	11.16	0.2	0.2	A	5.4	A	A	A
41	1.7	0.2	11.76	5.57	0.1	0.5	A	12.3	A	A	A
42	1.53	0.15	9.80	-4.98	0.1	0.4	A	10.5	A	A	A
43	1.7	0.3	17.65	5.57	0.1	0.8	A	18.0	A	A	A
44	1.67	0.09	5.39	3.71	0.1	0.3	A	6.6	A	A	A
46	1.43	0.28	19.58	-11.19	0.2	0.7	A	19.9	A	A	A
47	1.98	0.15	7.58	22.96	0.4	0.4	A	8.4	A	A	W
48	3.65	0.06	1.64	126.67	2.0	0.2	N	4.1	A	N	N
49	1.74	0.15	8.62	8.06	0.1	0.4	A	9.4	A	A	A
50	1.74	0.2	11.49	8.06	0.1	0.5	A	12.1	A	A	A
51	1.74	0.121	6.95	8.06	0.1	0.3	A	7.9	A	A	A
52	1.63	0.091	5.58	1.23	0.0	0.3	A	6.7	A	A	A
53	1.67	0.12	7.19	3.71	0.1	0.3	A	8.1	A	A	A
54	2.32	0.24	10.34	44.08	0.7	0.6	N	11.0	A	N	N
56	1.94	0.052	2.68	20.48	0.3	0.2	N	4.6	A	N	W
57	1.52	0.09	5.92	-5.60	0.1	0.3	A	7.0	A	A	A
58	1.38	0.08	5.80	-14.30	0.2	0.3	A	6.9	A	A	A
60	1.64	0.14	8.54	1.85	0.0	0.4	A	9.3	A	A	A
62	1.745	0.105	6.02	8.37	0.1	0.3	A	7.1	A	A	A
63	1.62	0.09	5.56	0.61	0.0	0.3	A	6.7	A	A	A
64	1.68	0.13	7.74	4.33	0.1	0.4	A	8.6	A	A	A
68	1.97	0.1	5.08	22.34	0.4	0.3	N	6.3	A	N	W
69	1.73	0.1	5.78	7.44	0.1	0.3	A	6.9	A	A	A

Performance evaluation of Co-57 measurement results

Simulated air filter 03

Target Value 18.2 ± 0.2 [Bq]



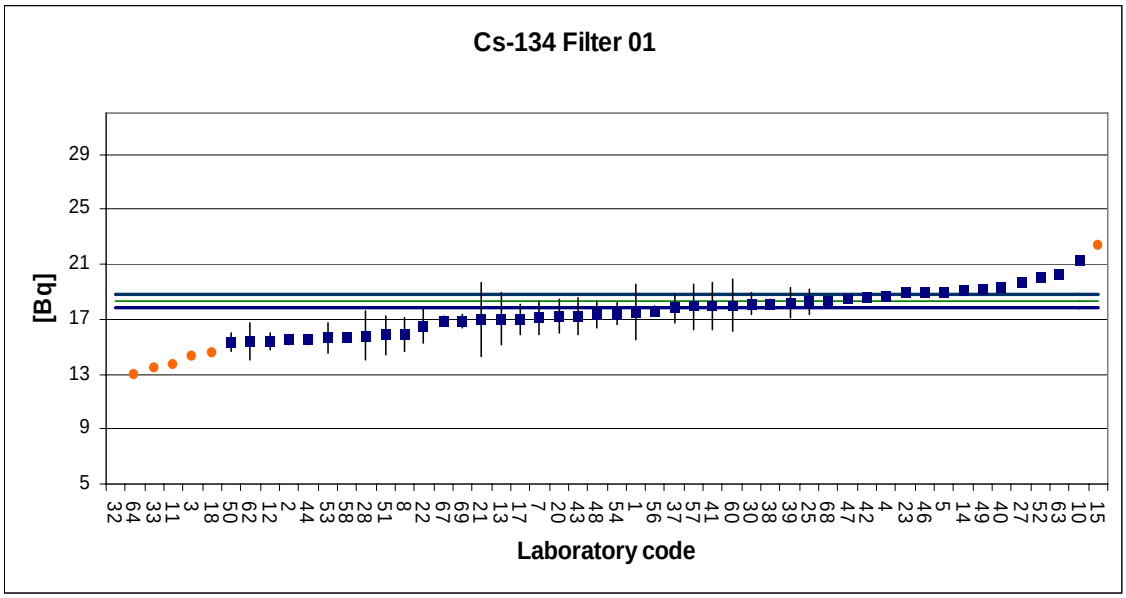
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	18.9	0.74	3.92	3.85	0.7	2.0	A	4.1	A	A	A
2	21.12	1	4.73	16.04	2.9	2.6	N	4.9	A	W	A
3	21.4	1.6	7.48	17.58	3.2	4.2	A	7.6	A	A	A
4	17.7	1.7	9.60	-2.75	0.5	4.4	A	9.7	A	A	A
5	27.8	1.1	3.96	52.75	9.6	2.9	N	4.1	A	N	N
7	17.8	0.3	1.69	-2.20	0.4	1.0	A	2.1	A	A	A
8	18.918	0.701	3.71	3.95	0.7	1.9	A	3.9	A	A	A
10	23.1	1.15	4.98	26.92	4.9	3.0	N	5.1	A	N	W
11	22.21	1.55	6.98	22.03	4.0	4.0	A	7.1	A	A	W
12	28.22	1.17	4.15	55.05	10.0	3.1	N	4.3	A	N	N
13	19	2	10.53	4.40	0.8	5.2	A	10.6	A	A	A
14	20.2	1.2	5.94	10.99	2.0	3.1	A	6.1	A	A	A
15	22.5	1.21	5.38	23.63	4.3	3.2	N	5.5	A	N	W
17	15.4	1.1	7.14	-15.38	2.8	2.9	A	7.2	A	A	A
18	26.345	0.729	2.77	44.75	8.1	2.0	N	3.0	A	N	N
20	24.7	2.9	11.74	35.71	6.5	7.5	A	11.8	A	A	N
21	21.42	1.84	8.59	17.69	3.2	4.8	A	8.7	A	A	A
22	18.11	1.44	7.95	-0.49	0.1	3.8	A	8.0	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
23	19.5	1.8	9.23	7.14	1.3	4.7	A	9.3	A	A	A
25	31.1	1.1	3.54	70.88	12.9	2.9	N	3.7	A	N	N
27	18.6	1.2	6.45	2.20	0.4	3.1	A	6.6	A	A	A
28	23.8	1.1	4.62	30.77	5.6	2.9	N	4.8	A	N	N
30	18.3	0.4	2.19	0.55	0.1	1.2	A	2.5	A	A	A
32	21.1	1.1	5.21	15.93	2.9	2.9	N	5.4	A	W	A
33	15.76	0.5	3.17	-13.41	2.4	1.4	N	3.4	A	W	A
37	25	1.73	6.92	37.36	6.8	4.5	N	7.0	A	N	N
38	17.6	0.7	3.98	-3.30	0.6	1.9	A	4.2	A	A	A
39	19.8	0.7	3.54	8.79	1.6	1.9	A	3.7	A	A	A
40	21.4	0.9	4.21	17.58	3.2	2.4	N	4.4	A	W	A
41	20	2	10.00	9.89	1.8	5.2	A	10.1	A	A	A
42	20.6	1.9	9.22	13.19	2.4	4.9	A	9.3	A	A	A
43	19.2	0.4	2.08	5.49	1.0	1.2	A	2.4	A	A	A
44	24.84	1.26	5.07	36.48	6.6	3.3	N	5.2	A	N	N
46	14.7	1.1	7.48	-19.23	3.5	2.9	N	7.6	A	W	A
47	22.19	0.49	2.21	21.92	4.0	1.4	N	2.5	A	N	W
48	19.3	1.1	5.70	6.04	1.1	2.9	A	5.8	A	A	A
49	20.51	1.66	8.09	12.69	2.3	4.3	A	8.2	A	A	A
50	19.7	2.8	14.21	8.24	1.5	7.2	A	14.3	A	A	A
51	18.43	1.07	5.81	1.26	0.2	2.8	A	5.9	A	A	A
52	19.44	0.96	4.94	6.81	1.2	2.5	A	5.1	A	A	A
53	17.9	1.1	6.15	-1.65	0.3	2.9	A	6.3	A	A	A
54	27.9	1.5	5.38	53.30	9.7	3.9	N	5.5	A	N	N
56	21.3	0.31	1.46	17.03	3.1	1.0	N	1.9	A	W	A
57	16.6	1	6.02	-8.79	1.6	2.6	A	6.1	A	A	A
58	18.56	0.33	1.78	1.98	0.4	1.0	A	2.2	A	A	A
60	19.2	1.5	7.81	5.49	1.0	3.9	A	7.9	A	A	A
62	18.79	1.22	6.49	3.24	0.6	3.2	A	6.6	A	A	A
63	20.59	0.27	1.31	13.13	2.4	0.9	N	1.8	A	W	A
64	18.2	1.3	7.14	0.00	0.0	3.4	A	7.2	A	A	A
68	24.1	1.1	4.56	32.42	5.9	2.9	N	4.7	A	N	N
69	19.9	0.3	1.51	9.34	1.7	1.0	N	1.9	A	W	A

Performance evaluation of Cs-134 measurement results

Simulated air filter 01

Target Value 18.3 ± 0.25 [Bq]



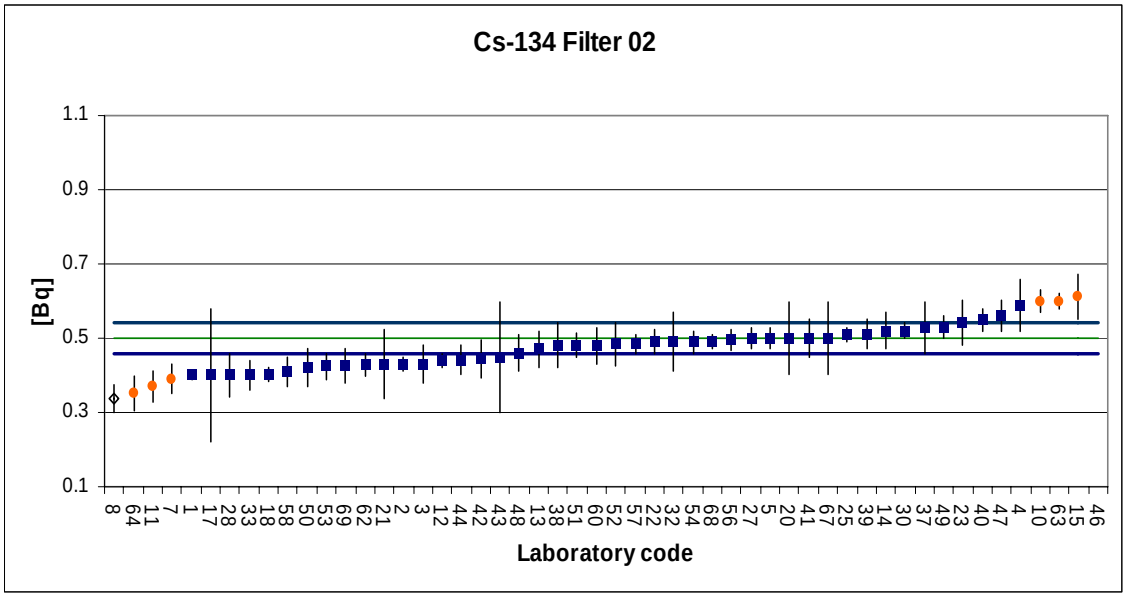
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	17.5	0.43	2.46	-4.51	0.8	1.3	A	2.8	A	A	A
2	15.52	0.56	3.61	-15.31	2.8	1.6	N	3.9	A	W	A
3	14.3	1.2	8.39	-21.97	4.0	3.2	N	8.5	A	N	W
4	18.7	0.6	3.21	2.04	0.4	1.7	A	3.5	A	A	A
5	18.96	0.68	3.59	3.46	0.6	1.9	A	3.8	A	A	A
7	17.1	0.3	1.75	-6.69	1.2	1.0	N	2.2	A	W	A
8	15.894	0.363	2.28	-13.27	2.4	1.1	N	2.7	A	W	A
10	21.3	0.5	2.35	16.22	3.0	1.4	N	2.7	A	W	A
11	13.72	0.89	6.49	-25.14	4.6	2.4	N	6.6	A	N	W
12	15.43	0.45	2.92	-15.81	2.9	1.3	N	3.2	A	W	A
13	17	1.7	10.00	-7.24	1.3	4.4	A	10.1	A	A	A
14	19	1.2	6.32	3.67	0.7	3.2	A	6.5	A	A	A
15	22.37	1.17	5.23	22.06	4.0	3.1	N	5.4	A	N	W
17	17	1.5	8.82	-7.24	1.3	3.9	A	8.9	A	A	A
18	14.533	0.346	2.38	-20.70	3.8	1.1	N	2.7	A	N	W
20	17.2	1	5.81	-6.15	1.1	2.7	A	6.0	A	A	A
21	16.97	0.51	3.01	-7.40	1.4	1.5	A	3.3	A	A	A
22	16.54	0.87	5.26	-9.75	1.8	2.3	A	5.4	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
23	18.9	0.6	3.17	3.13	0.6	1.7	A	3.5	A	A	A
25	18.3	0.6	3.28	-0.15	0.0	1.7	A	3.6	A	A	A
27	19.6	0.95	4.85	6.95	1.3	2.5	A	5.0	A	A	A
28	15.8	0.6	3.80	-13.79	2.5	1.7	N	4.0	A	W	A
30	18.1	0.4	2.21	-1.24	0.2	1.2	A	2.6	A	A	A
32	1.9	0.09	4.74	-89.63	16.4	0.7	N	4.9	A	N	N
33	13.37	0.2	1.50	-27.05	5.0	0.8	N	2.0	A	N	W
37	17.78	1.15	6.47	-2.98	0.5	3.0	A	6.6	A	A	A
38	18.1	0.7	3.87	-1.24	0.2	1.9	A	4.1	A	A	A
39	18.2	0.6	3.30	-0.69	0.1	1.7	A	3.6	A	A	A
40	19.3	0.4	2.07	5.31	1.0	1.2	A	2.5	A	A	A
41	18	2	11.11	-1.78	0.3	5.2	A	11.2	A	A	A
42	18.6	1.6	8.60	1.49	0.3	4.2	A	8.7	A	A	A
43	17.2	0.4	2.33	-6.15	1.1	1.2	A	2.7	A	A	A
44	15.52	0.78	5.03	-15.31	2.8	2.1	N	5.2	A	W	A
46	18.9	0.5	2.65	3.13	0.6	1.4	A	3.0	A	A	A
47	18.41	0.42	2.28	0.45	0.1	1.3	A	2.7	A	A	A
48	17.3	0.6	3.47	-5.60	1.0	1.7	A	3.7	A	A	A
49	19.13	0.5	2.61	4.38	0.8	1.4	A	2.9	A	A	A
50	15.3	1.8	11.76	-16.52	3.0	4.7	A	11.8	A	A	A
51	15.86	0.818	5.16	-13.46	2.5	2.2	N	5.3	A	W	A
52	20	2.2	11.00	9.13	1.7	5.7	A	11.1	A	A	A
53	15.6	0.9	5.77	-14.88	2.7	2.4	N	5.9	A	W	A
54	17.4	0.5	2.87	-5.06	0.9	1.4	A	3.2	A	A	A
56	17.6	0.15	0.85	-3.97	0.7	0.8	A	1.6	A	A	A
57	17.9	0.9	5.03	-2.33	0.4	2.4	A	5.2	A	A	A
58	15.69	0.44	2.80	-14.39	2.6	1.3	N	3.1	A	W	A
60	18	1.6	8.89	-1.78	0.3	4.2	A	9.0	A	A	A
62	15.38	0.95	6.18	-16.08	2.9	2.5	N	6.3	A	W	A
63	20.24	0.24	1.19	10.44	1.9	0.9	N	1.8	A	W	A
64	12.9	0.72	5.58	-29.61	5.4	2.0	N	5.7	A	N	W
67	16.9	0.9	5.33	-7.78	1.4	2.4	A	5.5	A	A	A
68	18.3	0.2	1.09	-0.15	0.0	0.8	A	1.7	A	A	A

Performance evaluation of Cs-134 measurement results

Simulated air filter 02

Target Value 0.50 ± 0.02 [Bq]



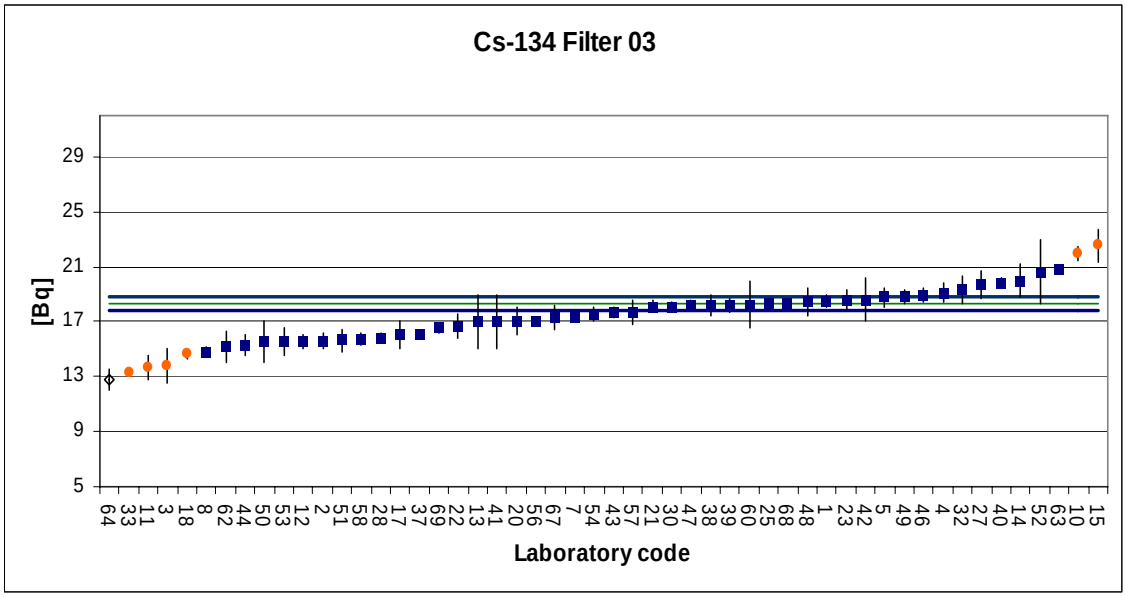
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	0.4	0.01	2.50	-19.90	0.1	0.1	N	4.7	A	W	A
2	0.43	0.02	4.65	-13.89	0.1	0.1	A	6.1	A	A	A
3	0.43	0.05	11.63	-13.89	0.1	0.1	A	12.3	A	A	A
4	0.59	0.07	11.86	18.15	0.1	0.2	A	12.5	A	A	A
5	0.5	0.03	6.00	0.13	0.0	0.1	A	7.2	A	A	A
7	0.39	0.04	10.26	-21.90	0.1	0.1	A	11.0	A	A	W
8	0.338	0.038	11.24	-32.31	0.2	0.1	N	11.9	A	N	N
10	0.6	0.03	5.00	20.15	0.1	0.1	N	6.4	A	N	W
11	0.37	0.04	10.81	-25.91	0.1	0.1	N	11.5	A	N	W
12	0.44	0.02	4.55	-11.89	0.1	0.1	A	6.1	A	A	A
13	0.47	0.05	10.64	-5.88	0.0	0.1	A	11.4	A	A	A
14	0.52	0.05	9.62	4.13	0.0	0.1	A	10.4	A	A	A
15	0.61	0.06	9.84	22.15	0.1	0.2	A	10.6	A	A	W
17	0.4	0.18	45.00	-19.90	0.1	0.5	A	45.2	N	W	A
18	0.404	0.019	4.70	-19.10	0.1	0.1	N	6.2	A	W	A
20	0.5	0.1	20.00	0.13	0.0	0.3	A	20.4	N	W	A
21	0.4298	0.092	21.41	-13.93	0.1	0.2	A	21.8	N	W	A
22	0.49	0.032	6.53	-1.88	0.0	0.1	A	7.7	A	A	A
23	0.54	0.06	11.11	8.14	0.0	0.2	A	11.8	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	0.51	0.02	3.92	2.13	0.0	0.1	A	5.6	A	A	A
27	0.499	0.029	5.81	-0.07	0.0	0.1	A	7.1	A	A	A
28	0.4	0.06	15.00	-19.90	0.1	0.2	A	15.5	A	A	A
30	0.52	0.02	3.85	4.13	0.0	0.1	A	5.6	A	A	A
32	0.49	0.08	16.33	-1.88	0.0	0.2	A	16.8	A	A	A
33	0.4	0.04	10.00	-19.90	0.1	0.1	A	10.8	A	A	A
37	0.527	0.071	13.47	5.53	0.0	0.2	A	14.1	A	A	A
38	0.48	0.06	12.50	-3.88	0.0	0.2	A	13.1	A	A	A
39	0.51	0.04	7.84	2.13	0.0	0.1	A	8.8	A	A	A
40	0.55	0.03	5.45	10.14	0.1	0.1	A	6.8	A	A	A
41	0.5	0.05	10.00	0.13	0.0	0.1	A	10.8	A	A	A
42	0.443	0.051	11.51	-11.29	0.1	0.1	A	12.2	A	A	A
43	0.45	0.15	33.33	-9.89	0.0	0.4	A	33.6	N	W	A
44	0.44	0.04	9.09	-11.89	0.1	0.1	A	9.9	A	A	A
46	0.72	0.15	20.83	44.18	0.2	0.4	A	21.2	N	N	N
47	0.56	0.04	7.14	12.14	0.1	0.1	A	8.2	A	A	A
48	0.46	0.05	10.87	-7.88	0.0	0.1	A	11.6	A	A	A
49	0.53	0.03	5.66	6.13	0.0	0.1	A	6.9	A	A	A
50	0.42	0.05	11.90	-15.89	0.1	0.1	A	12.6	A	A	A
51	0.48	0.0326	6.79	-3.88	0.0	0.1	A	7.9	A	A	A
52	0.484	0.06	12.40	-3.08	0.0	0.2	A	13.0	A	A	A
53	0.424	0.034	8.02	-15.09	0.1	0.1	A	9.0	A	A	A
54	0.49	0.03	6.12	-1.88	0.0	0.1	A	7.3	A	A	A
56	0.495	0.026	5.25	-0.87	0.0	0.1	A	6.6	A	A	A
57	0.484	0.024	4.96	-3.08	0.0	0.1	A	6.4	A	A	A
58	0.41	0.04	9.76	-17.90	0.1	0.1	A	10.5	A	A	A
60	0.48	0.05	10.42	-3.88	0.0	0.1	A	11.2	A	A	A
62	0.428	0.03	7.01	-14.29	0.1	0.1	A	8.1	A	A	A
63	0.6	0.02	3.33	20.15	0.1	0.1	N	5.2	A	N	W
64	0.352	0.046	13.07	-29.51	0.1	0.1	N	13.7	A	N	W
67	0.5	0.1	20.00	0.13	0.0	0.3	A	20.4	N	W	A
68	0.49	0.02	4.08	-1.88	0.0	0.1	A	5.7	A	A	A
69	0.425	0.045	10.59	-14.89	0.1	0.1	A	11.3	A	A	A

Performance evaluation of Cs-134 measurement results

Simulated air filter 03

Target Value 18.3 ± 0.25 [Bq]



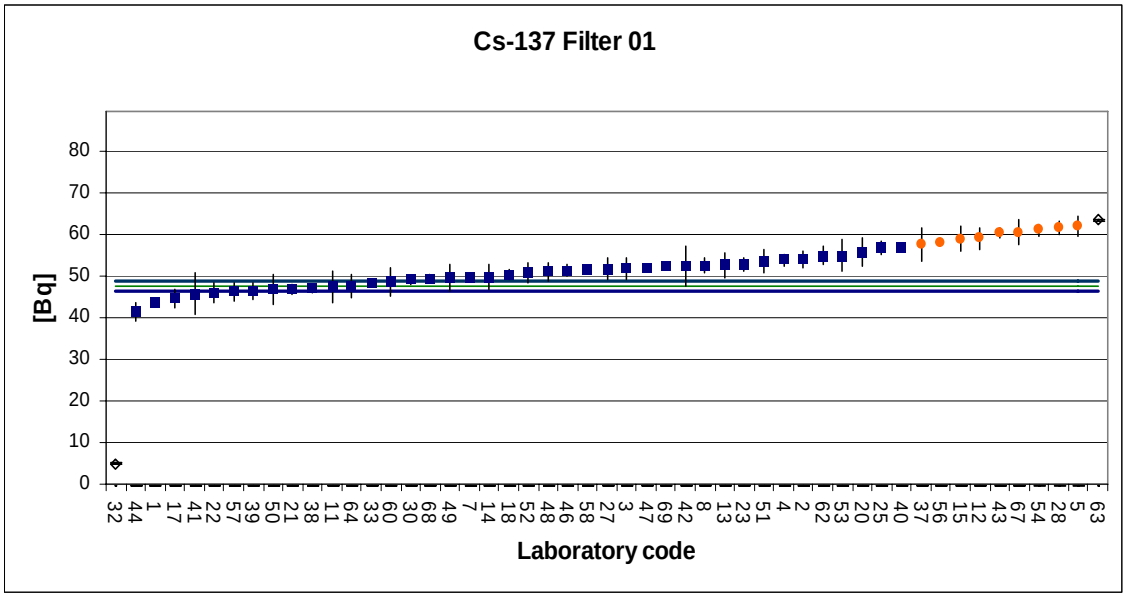
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	18.5	0.41	2.22	0.95	0.2	1.2	A	2.6	A	A	A
2	15.6	0.54	3.46	-14.88	2.7	1.5	N	3.7	A	W	A
3	13.8	1.3	9.42	-24.70	4.5	3.4	N	9.5	A	N	W
4	19.1	0.7	3.66	4.22	0.8	1.9	A	3.9	A	A	A
5	18.76	0.68	3.62	2.36	0.4	1.9	A	3.9	A	A	A
7	17.36	0.2	1.15	-5.27	1.0	0.8	N	1.8	A	W	A
8	14.814	0.346	2.34	-19.17	3.5	1.1	N	2.7	A	W	A
10	22	0.51	2.32	20.04	3.7	1.5	N	2.7	A	N	W
11	13.68	0.89	6.51	-25.35	4.6	2.4	N	6.6	A	N	W
12	15.55	0.45	2.89	-15.15	2.8	1.3	N	3.2	A	W	A
13	17	2	11.76	-7.24	1.3	5.2	A	11.8	A	A	A
14	20	1.2	6.00	9.13	1.7	3.2	A	6.2	A	A	A
15	22.52	1.18	5.24	22.88	4.2	3.1	N	5.4	A	N	W
17	16	1	6.25	-12.70	2.3	2.7	A	6.4	A	A	A
18	14.628	0.348	2.38	-20.18	3.7	1.1	N	2.7	A	N	W
20	17.1	1	5.85	-6.69	1.2	2.7	A	6.0	A	A	A
21	18.09	0.44	2.43	-1.29	0.2	1.3	A	2.8	A	A	A
22	16.66	0.9	5.40	-9.09	1.7	2.4	A	5.6	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
23	18.6	0.7	3.76	1.49	0.3	1.9	A	4.0	A	A	A
25	18.3	0.2	1.09	-0.15	0.0	0.8	A	1.7	A	A	A
27	19.7	0.96	4.87	7.49	1.4	2.6	A	5.1	A	A	A
28	15.8	0.4	2.53	-13.79	2.5	1.2	N	2.9	A	W	A
30	18.1	0.4	2.21	-1.24	0.2	1.2	A	2.6	A	A	A
32	19.3	1	5.18	5.31	1.0	2.7	A	5.4	A	A	A
33	13.26	0.21	1.58	-27.65	5.1	0.8	N	2.1	A	N	W
37	16	0.09	0.56	-12.70	2.3	0.7	N	1.5	A	W	A
38	18.2	0.8	4.40	-0.69	0.1	2.2	A	4.6	A	A	A
39	18.2	0.5	2.75	-0.69	0.1	1.4	A	3.1	A	A	A
40	19.8	0.4	2.02	8.04	1.5	1.2	N	2.4	A	W	A
41	17	2	11.76	-7.24	1.3	5.2	A	11.8	A	A	A
42	18.6	1.6	8.60	1.49	0.3	4.2	A	8.7	A	A	A
43	17.7	0.4	2.26	-3.42	0.6	1.2	A	2.6	A	A	A
44	15.26	0.77	5.05	-16.73	3.1	2.1	N	5.2	A	W	A
46	18.9	0.5	2.65	3.13	0.6	1.4	A	3.0	A	A	A
47	18.18	0.42	2.31	-0.80	0.1	1.3	A	2.7	A	A	A
48	18.4	1	5.43	0.40	0.1	2.7	A	5.6	A	A	A
49	18.82	0.49	2.60	2.69	0.5	1.4	A	2.9	A	A	A
50	15.5	1.5	9.68	-15.42	2.8	3.9	A	9.8	A	A	A
51	15.62	0.806	5.16	-14.77	2.7	2.2	N	5.3	A	W	A
52	20.6	2.3	11.17	12.40	2.3	6.0	A	11.2	A	A	A
53	15.5	1	6.45	-15.42	2.8	2.7	N	6.6	A	W	A
54	17.6	0.5	2.84	-3.97	0.7	1.4	A	3.2	A	A	A
56	17.1	0.15	0.88	-6.69	1.2	0.8	N	1.6	A	W	A
57	17.7	0.9	5.08	-3.42	0.6	2.4	A	5.3	A	A	A
58	15.73	0.41	2.61	-14.17	2.6	1.2	N	2.9	A	W	A
60	18.2	1.7	9.34	-0.69	0.1	4.4	A	9.4	A	A	A
62	15.21	1.12	7.36	-17.01	3.1	3.0	N	7.5	A	W	A
63	20.87	0.16	0.77	13.88	2.5	0.8	N	1.6	A	W	A
64	12.77	0.76	5.95	-30.32	5.6	2.1	N	6.1	A	N	N
67	17.3	0.9	5.20	-5.60	1.0	2.4	A	5.4	A	A	A
68	18.3	0.2	1.09	-0.15	0.0	0.8	A	1.7	A	A	A
69	16.5	0.3	1.82	-9.97	1.8	1.0	N	2.3	A	W	A

Performance evaluation of Cs-137 measurement results

Simulated air filter 01

Target Value 48.0 ± 0.6 [Bq]



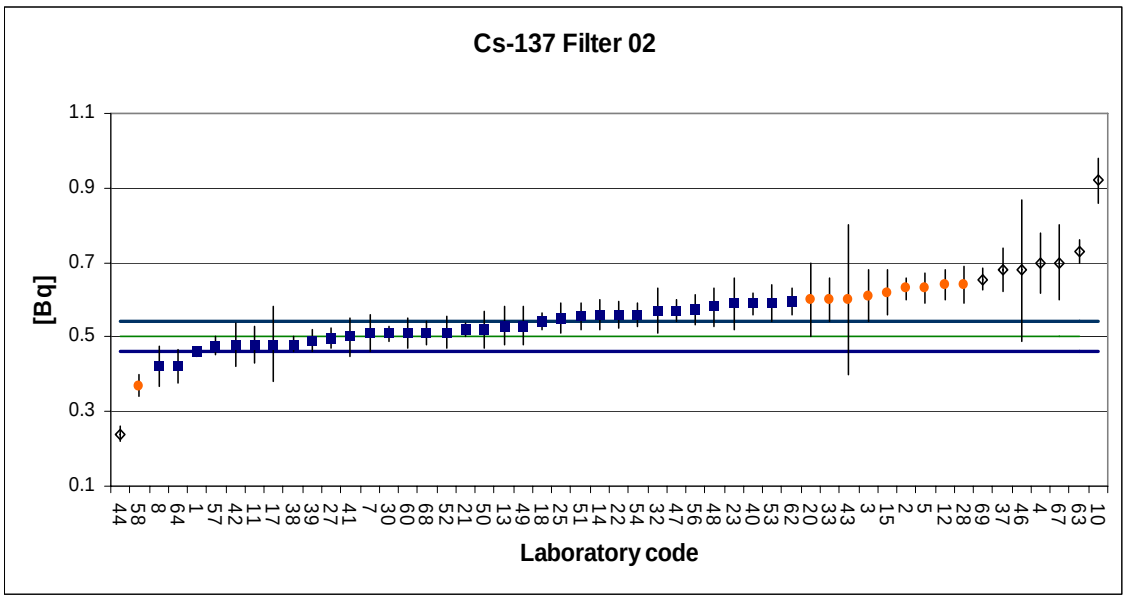
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	43.9	0.81	1.85	-8.56	4.1	2.6	N	2.2	A	W	A
2	54.3	2.12	3.90	13.10	6.3	5.7	N	4.1	A	W	A
3	52.2	2.6	4.98	8.73	4.2	6.9	A	5.1	A	A	A
4	54.2	1.5	2.77	12.89	6.2	4.2	N	3.0	A	W	A
5	62.32	2.38	3.82	29.81	14.3	6.3	N	4.0	A	N	W
7	50	0.8	1.60	4.15	2.0	2.6	A	2.0	A	A	A
8	52.947	1.85	3.49	10.28	4.9	5.0	A	3.7	A	A	A
10	86.8	2.49	2.87	80.80	38.8	6.6	N	3.1	A	N	N
11	47.79	3.92	8.20	-0.46	0.2	10.2	A	8.3	A	A	A
12	59.39	2.59	4.36	23.70	11.4	6.9	N	4.5	A	N	W
13	53	3	5.66	10.39	5.0	7.9	A	5.8	A	A	A
14	50	3	6.00	4.15	2.0	7.9	A	6.1	A	A	A
15	59.29	3.09	5.21	23.50	11.3	8.1	N	5.4	A	N	W
17	45.1	2.2	4.88	-6.06	2.9	5.9	A	5.0	A	A	A
18	50.726	1.07	2.11	5.66	2.7	3.2	A	2.5	A	A	A
20	56	3.4	6.07	16.64	8.0	8.9	A	6.2	A	A	A
21	47.16	1.02	2.16	-1.77	0.8	3.1	A	2.5	A	A	A
22	46.36	2.43	5.24	-3.44	1.6	6.5	A	5.4	A	A	A
23	53.1	1.5	2.82	10.60	5.1	4.2	N	3.1	A	W	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	57.2	1.7	2.97	19.14	9.2	4.7	N	3.2	A	W	A
27	52.1	2.5	4.80	8.52	4.1	6.6	A	5.0	A	A	A
28	61.8	1.6	2.59	28.72	13.8	4.4	N	2.9	A	N	W
30	49.5	1	2.02	3.10	1.5	3.0	A	2.4	A	A	A
32	5.25	0.25	4.76	-89.06	42.8	1.7	N	4.9	A	N	N
33	48.71	0.37	0.76	1.46	0.7	1.8	A	1.5	A	A	A
37	58	4.04	6.97	20.81	10.0	10.5	A	7.1	A	A	W
38	47.4	1	2.11	-1.27	0.6	3.0	A	2.5	A	A	A
39	46.7	1.9	4.07	-2.73	1.3	5.1	A	4.3	A	A	A
40	57.2	1	1.75	19.14	9.2	3.0	N	2.1	A	W	A
41	46	5	10.87	-4.19	2.0	13.0	A	10.9	A	A	A
42	52.7	4.8	9.11	9.77	4.7	12.5	A	9.2	A	A	A
43	60.9	1.2	1.97	26.85	12.9	3.5	N	2.3	A	N	W
44	41.76	2.1	5.03	-13.02	6.2	5.6	N	5.2	A	W	A
46	51.7	1.3	2.51	7.69	3.7	3.7	A	2.8	A	A	A
47	52.47	0.73	1.39	9.29	4.5	2.4	N	1.9	A	W	A
48	51.4	2.3	4.47	7.06	3.4	6.1	A	4.6	A	A	A
49	49.96	3.01	6.02	4.06	2.0	7.9	A	6.2	A	A	A
50	47	3.6	7.66	-2.10	1.0	9.4	A	7.8	A	A	A
51	54.12	2.78	5.14	12.73	6.1	7.3	A	5.3	A	A	A
52	51.2	2.5	4.88	6.64	3.2	6.6	A	5.0	A	A	A
53	55.3	3.7	6.69	15.18	7.3	9.7	A	6.8	A	A	A
54	61.4	1.5	2.44	27.89	13.4	4.2	N	2.7	A	N	W
56	58.5	0.53	0.91	21.85	10.5	2.1	N	1.5	A	N	W
57	46.6	2.3	4.94	-2.94	1.4	6.1	A	5.1	A	A	A
58	52.06	0.79	1.52	8.44	4.1	2.6	N	2.0	A	W	A
60	49	3.5	7.14	2.06	1.0	9.2	A	7.3	A	A	A
62	55.22	2.2	3.98	15.02	7.2	5.9	N	4.2	A	W	A
63	63.87	0.29	0.45	33.03	15.9	1.7	N	1.3	A	N	N
64	48	2.9	6.04	-0.02	0.0	7.6	A	6.2	A	A	A
67	60.9	3.1	5.09	26.85	12.9	8.1	N	5.2	A	N	W
68	49.6	1	2.02	3.31	1.6	3.0	A	2.4	A	A	A
69	52.6	0.3	0.57	9.56	4.6	1.7	N	1.4	A	W	A

Performance evaluation of Cs-137 measurement results

Simulated air filter 02

Target Value 0.50 ± 0.02 [Bq]



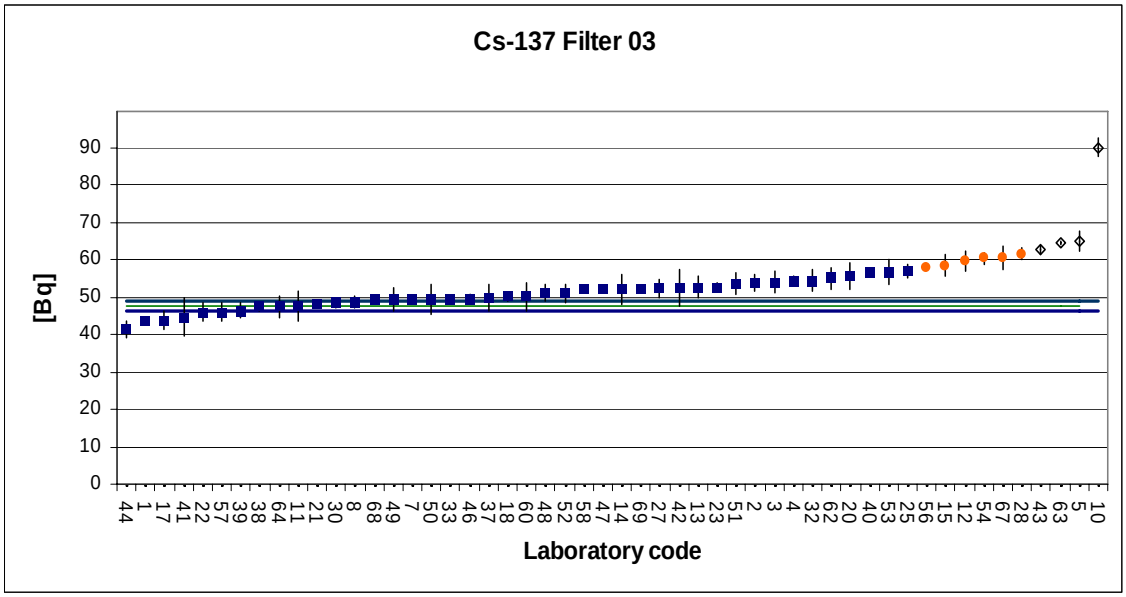
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	0.46	0.01	2.17	-7.88	0.0	0.1	A	4.6	A	A	A
2	0.63	0.03	4.76	26.16	0.1	0.1	N	6.2	A	N	W
3	0.61	0.07	11.48	22.15	0.1	0.2	A	12.2	A	A	W
4	0.7	0.08	11.43	40.18	0.2	0.2	A	12.1	A	A	N
5	0.63	0.04	6.35	26.16	0.1	0.1	N	7.5	A	N	W
7	0.51	0.05	9.80	2.13	0.0	0.1	A	10.6	A	A	A
8	0.421	0.053	12.59	-15.69	0.1	0.1	A	13.2	A	A	A
10	0.92	0.06	6.52	84.23	0.4	0.2	N	7.7	A	N	N
11	0.48	0.05	10.42	-3.88	0.0	0.1	A	11.2	A	A	A
12	0.64	0.04	6.25	28.16	0.1	0.1	N	7.4	A	N	W
13	0.53	0.05	9.43	6.13	0.0	0.1	A	10.2	A	A	A
14	0.56	0.04	7.14	12.14	0.1	0.1	A	8.2	A	A	A
15	0.62	0.06	9.68	24.16	0.1	0.2	A	10.5	A	A	W
17	0.48	0.1	20.83	-3.88	0.0	0.3	A	21.2	N	W	A
18	0.543	0.022	4.05	8.74	0.0	0.1	A	5.7	A	A	A
20	0.6	0.1	16.67	20.15	0.1	0.3	A	17.1	A	A	W
21	0.5184	0.018	3.47	3.81	0.0	0.1	A	5.3	A	A	A
22	0.56	0.035	6.25	12.14	0.1	0.1	A	7.4	A	A	A
23	0.59	0.07	11.86	18.15	0.1	0.2	A	12.5	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	0.55	0.04	7.27	10.14	0.1	0.1	A	8.3	A	A	A
27	0.499	0.027	5.41	-0.07	0.0	0.1	A	6.7	A	A	A
28	0.64	0.05	7.81	28.16	0.1	0.1	N	8.8	A	N	W
30	0.51	0.02	3.92	2.13	0.0	0.1	A	5.6	A	A	A
32	0.57	0.06	10.53	14.14	0.1	0.2	A	11.3	A	A	A
33	0.6	0.06	10.00	20.15	0.1	0.2	A	10.8	A	A	W
37	0.68	0.057	8.38	36.17	0.2	0.2	N	9.3	A	N	N
38	0.48	0.02	4.17	-3.88	0.0	0.1	A	5.8	A	A	A
39	0.49	0.03	6.12	-1.88	0.0	0.1	A	7.3	A	A	A
40	0.59	0.03	5.08	18.15	0.1	0.1	A	6.5	A	A	A
41	0.5	0.05	10.00	0.13	0.0	0.1	A	10.8	A	A	A
42	0.478	0.058	12.13	-4.28	0.0	0.2	A	12.8	A	A	A
43	0.6	0.2	33.33	20.15	0.1	0.5	A	33.6	N	N	W
44	0.24	0.02	8.33	-51.94	0.3	0.1	N	9.2	A	N	N
46	0.68	0.19	27.94	36.17	0.2	0.5	A	28.2	N	N	N
47	0.57	0.03	5.26	14.14	0.1	0.1	A	6.6	A	A	A
48	0.58	0.05	8.62	16.15	0.1	0.1	A	9.5	A	A	A
49	0.53	0.05	9.43	6.13	0.0	0.1	A	10.2	A	A	A
50	0.52	0.05	9.62	4.13	0.0	0.1	A	10.4	A	A	A
51	0.556	0.0357	6.42	11.34	0.1	0.1	A	7.6	A	A	A
52	0.512	0.042	8.20	2.53	0.0	0.1	A	9.1	A	A	A
53	0.59	0.05	8.47	18.15	0.1	0.1	A	9.4	A	A	A
54	0.56	0.03	5.36	12.14	0.1	0.1	A	6.7	A	A	A
56	0.574	0.041	7.14	14.95	0.1	0.1	A	8.2	A	A	A
57	0.476	0.024	5.04	-4.68	0.0	0.1	A	6.4	A	A	A
58	0.37	0.03	8.11	-25.91	0.1	0.1	N	9.0	A	N	W
60	0.51	0.04	7.84	2.13	0.0	0.1	A	8.8	A	A	A
62	0.595	0.036	6.05	19.15	0.1	0.1	A	7.3	A	A	A
63	0.73	0.03	4.11	46.18	0.2	0.1	N	5.7	A	N	N
64	0.422	0.046	10.90	-15.49	0.1	0.1	A	11.6	A	A	A
67	0.7	0.1	14.29	40.18	0.2	0.3	A	14.8	A	A	N
68	0.51	0.03	5.88	2.13	0.0	0.1	A	7.1	A	A	A
69	0.655	0.029	4.43	31.17	0.2	0.1	N	6.0	A	N	N

Performance evaluation of Cs-137 measurement results

Simulated air filter 03

Target Value 48.0 ± 0.6 [Bq]



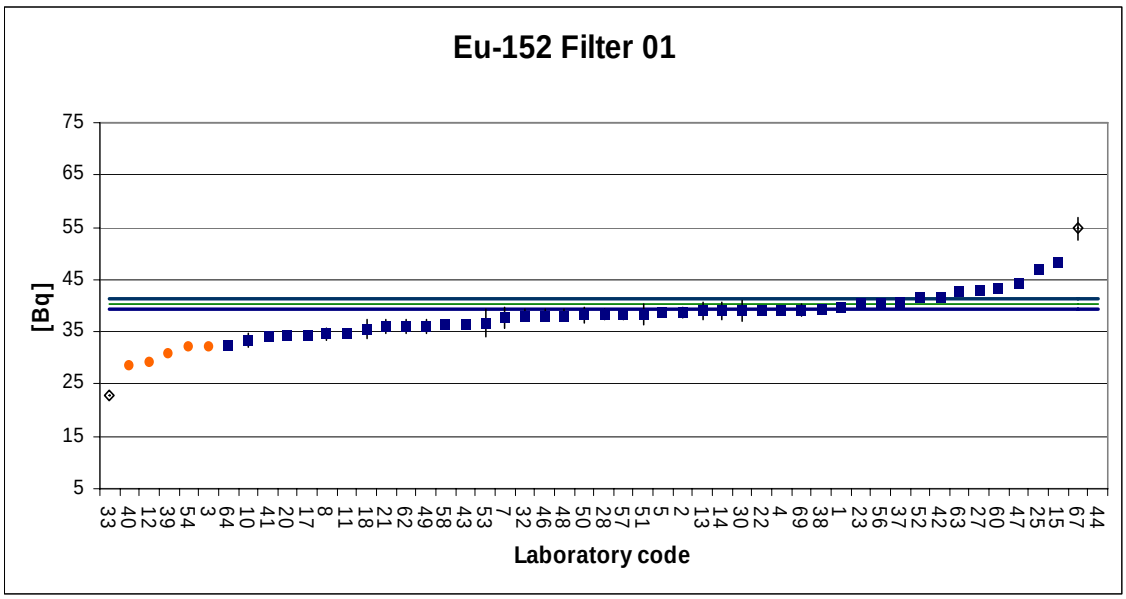
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	44.1	0.71	1.61	-8.14	3.9	2.4	N	2.0	A	W	A
2	54.2	2.08	3.84	12.89	6.2	5.6	N	4.0	A	W	A
3	54.3	2.9	5.34	13.10	6.3	7.6	A	5.5	A	A	A
4	54.8	1.3	2.37	14.14	6.8	3.7	N	2.7	A	W	A
5	65.3	2.5	3.83	36.01	17.3	6.6	N	4.0	A	N	N
7	49.7	0.6	1.21	3.52	1.7	2.2	A	1.7	A	A	A
8	49.014	1.716	3.50	2.09	1.0	4.7	A	3.7	A	A	A
10	90.3	2.45	2.71	88.09	42.3	6.5	N	3.0	A	N	N
11	47.92	3.93	8.20	-0.19	0.1	10.3	A	8.3	A	A	A
12	59.93	2.62	4.37	24.83	11.9	6.9	N	4.5	A	N	W
13	53	3	5.66	10.39	5.0	7.9	A	5.8	A	A	A
14	52.5	4	7.62	9.35	4.5	10.4	A	7.7	A	A	A
15	58.79	3.06	5.20	22.45	10.8	8.0	N	5.4	A	N	W
17	44.1	2.3	5.22	-8.14	3.9	6.1	A	5.4	A	A	A
18	50.46	1.064	2.11	5.10	2.5	3.2	A	2.5	A	A	A
20	55.9	3.4	6.08	16.43	7.9	8.9	A	6.2	A	A	A
21	48.26	0.92	1.91	0.52	0.3	2.8	A	2.3	A	A	A
22	46.26	2.46	5.32	-3.64	1.7	6.5	A	5.5	A	A	A
23	53	1.2	2.26	10.39	5.0	3.5	N	2.6	A	W	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	57.2	1.7	2.97	19.14	9.2	4.7	N	3.2	A	W	A
27	52.6	2.6	4.94	9.56	4.6	6.9	A	5.1	A	A	A
28	61.9	1.5	2.42	28.93	13.9	4.2	N	2.7	A	N	W
30	48.7	1	2.05	1.44	0.7	3.0	A	2.4	A	A	A
32	54.8	2.7	4.93	14.14	6.8	7.1	A	5.1	A	A	A
33	49.75	0.38	0.76	3.62	1.7	1.8	A	1.5	A	A	A
37	50.22	3.56	7.09	4.60	2.2	9.3	A	7.2	A	A	A
38	47.8	1.1	2.30	-0.44	0.2	3.2	A	2.6	A	A	A
39	46.7	1.9	4.07	-2.73	1.3	5.1	A	4.3	A	A	A
40	57	1	1.75	18.73	9.0	3.0	N	2.2	A	W	A
41	45	5	11.11	-6.27	3.0	13.0	A	11.2	A	A	A
42	52.8	4.8	9.09	9.98	4.8	12.5	A	9.2	A	A	A
43	62.9	1.2	1.91	31.01	14.9	3.5	N	2.3	A	N	N
44	41.61	2.1	5.05	-13.33	6.4	5.6	N	5.2	A	W	A
46	49.9	1.3	2.61	3.94	1.9	3.7	A	2.9	A	A	A
47	52.49	0.73	1.39	9.33	4.5	2.4	N	1.9	A	W	A
48	51.4	2.3	4.47	7.06	3.4	6.1	A	4.6	A	A	A
49	49.62	2.99	6.03	3.35	1.6	7.9	A	6.2	A	A	A
50	49.7	3.8	7.65	3.52	1.7	9.9	A	7.7	A	A	A
51	53.87	2.77	5.14	12.21	5.9	7.3	A	5.3	A	A	A
52	51.4	2.5	4.86	7.06	3.4	6.6	A	5.0	A	A	A
53	57	3.5	6.14	18.73	9.0	9.2	A	6.3	A	A	A
54	60.7	1.5	2.47	26.43	12.7	4.2	N	2.8	A	N	W
56	58.2	0.53	0.91	21.22	10.2	2.1	N	1.5	A	N	W
57	46.3	2.3	4.97	-3.56	1.7	6.1	A	5.1	A	A	A
58	52.31	0.77	1.47	8.96	4.3	2.5	N	1.9	A	W	A
60	50.5	3.7	7.33	5.19	2.5	9.7	A	7.4	A	A	A
62	55.33	2.82	5.10	15.25	7.3	7.4	A	5.2	A	A	A
63	64.87	0.46	0.71	35.12	16.9	2.0	N	1.4	A	N	N
64	47.9	2.9	6.05	-0.23	0.1	7.6	A	6.2	A	A	A
67	60.8	3.1	5.10	26.64	12.8	8.1	N	5.2	A	N	W
68	49.6	1	2.02	3.31	1.6	3.0	A	2.4	A	A	A
69	52.5	0.3	0.57	9.35	4.5	1.7	N	1.4	A	W	A

Performance evaluation of Eu-152 measurement results

Simulated air filter 01

Target Value 40.3 ± 0.6 [Bq]



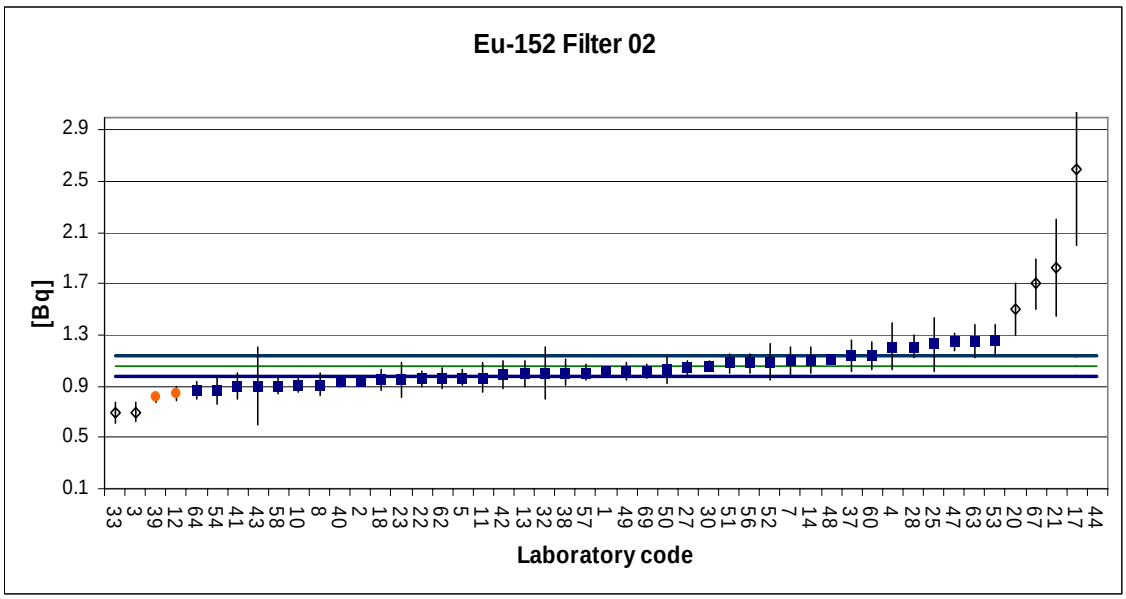
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	39.8	0.94	2.36	-1.16	0.5	2.8	A	2.7	A	A	A
2	38.68	1.32	3.41	-3.95	1.6	3.7	A	3.7	A	A	A
3	32.1	2.2	6.85	-20.29	8.2	5.9	N	7.0	A	N	W
4	39.1	1.9	4.86	-2.90	1.2	5.1	A	5.1	A	A	A
5	38.6	1.36	3.52	-4.14	1.7	3.8	A	3.8	A	A	A
7	37.7	1.3	3.45	-6.38	2.6	3.7	A	3.7	A	A	A
8	34.614	0.561	1.62	-14.04	5.7	2.0	N	2.1	A	W	A
10	33.5	0.99	2.96	-16.81	6.8	2.9	N	3.3	A	W	A
11	34.79	2.05	5.89	-13.61	5.5	5.5	A	6.1	A	A	A
12	28.95	0.54	1.87	-28.11	11.3	2.0	N	2.3	A	N	W
13	39	4	10.26	-3.15	1.3	10.4	A	10.4	A	A	A
14	39	2.2	5.64	-3.15	1.3	5.9	A	5.8	A	A	A
15	48.28	2.8	5.80	19.89	8.0	7.4	N	6.0	A	W	A
17	34.5	1.7	4.93	-14.33	5.8	4.6	N	5.1	A	W	A
18	35.486	1.045	2.94	-11.88	4.8	3.1	N	3.3	A	W	A
20	34.3	1.8	5.25	-14.82	6.0	4.9	N	5.4	A	W	A
21	36.04	1.26	3.50	-10.50	4.2	3.6	N	3.8	A	W	A
22	39.01	2.08	5.33	-3.13	1.3	5.6	A	5.5	A	A	A
23	40.2	2	4.98	-0.17	0.1	5.4	A	5.2	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	46.9	3.4	7.25	16.47	6.6	8.9	A	7.4	A	A	A
27	43.1	2.1	4.87	7.03	2.8	5.6	A	5.1	A	A	A
28	38.3	1.7	4.44	-4.89	2.0	4.6	A	4.7	A	A	A
30	39	0.8	2.05	-3.15	1.3	2.5	A	2.5	A	A	A
32	38.1	3.8	9.97	-5.39	2.2	9.9	A	10.1	A	A	A
33	22.99	0.32	1.39	-42.91	17.3	1.7	N	2.0	A	N	N
37	40.81	2.86	7.01	1.34	0.5	7.5	A	7.1	A	A	A
38	39.2	1.6	4.08	-2.65	1.1	4.4	A	4.3	A	A	A
39	30.6	1	3.27	-24.01	9.7	3.0	N	3.6	A	N	W
40	28.5	0.9	3.16	-29.23	11.8	2.7	N	3.5	A	N	W
41	34	4	11.76	-15.57	6.3	10.4	A	11.8	A	A	A
42	41.6	3.6	8.65	3.31	1.3	9.4	A	8.8	A	A	A
43	36.5	0.7	1.92	-9.36	3.8	2.3	N	2.4	A	W	A
44	103.15	5.18	5.02	156.15	62.9	13.4	N	5.2	A	N	N
46	38.1	1.1	2.89	-5.39	2.2	3.2	A	3.2	A	A	A
47	44.31	0.69	1.56	10.04	4.0	2.3	N	2.1	A	W	A
48	38.1	2.2	5.77	-5.39	2.2	5.9	A	5.9	A	A	A
49	36.15	0.75	2.07	-10.23	4.1	2.4	N	2.5	A	W	A
50	38.2	3.4	8.90	-5.14	2.1	8.9	A	9.0	A	A	A
51	38.31	2.2	5.74	-4.86	2.0	5.9	A	5.9	A	A	A
52	41.5	4.6	11.08	3.06	1.2	12.0	A	11.2	A	A	A
53	36.6	2.3	6.28	-9.11	3.7	6.1	A	6.4	A	A	A
54	32	1	3.13	-20.53	8.3	3.0	N	3.4	A	N	W
56	40.2	0.33	0.82	-0.17	0.1	1.7	A	1.6	A	A	A
57	38.3	2.3	6.01	-4.89	2.0	6.1	A	6.2	A	A	A
58	36.22	0.49	1.35	-10.05	4.0	1.9	N	1.9	A	W	A
60	43.2	4	9.26	7.28	2.9	10.4	A	9.4	A	A	A
62	36.04	2.1	5.83	-10.50	4.2	5.6	A	6.0	A	A	A
63	42.6	1.28	3.00	5.79	2.3	3.6	A	3.3	A	A	A
64	32.5	1.7	5.23	-19.29	7.8	4.6	N	5.4	A	W	A
67	54.7	2.8	5.12	35.84	14.4	7.4	N	5.3	A	N	N
69	39.1	0.4	1.02	-2.90	1.2	1.8	A	1.7	A	A	A

Performance evaluation of Eu-152 measurement results

Simulated air filter 02

Target Value 1.06 ± 0.04 [Bq]



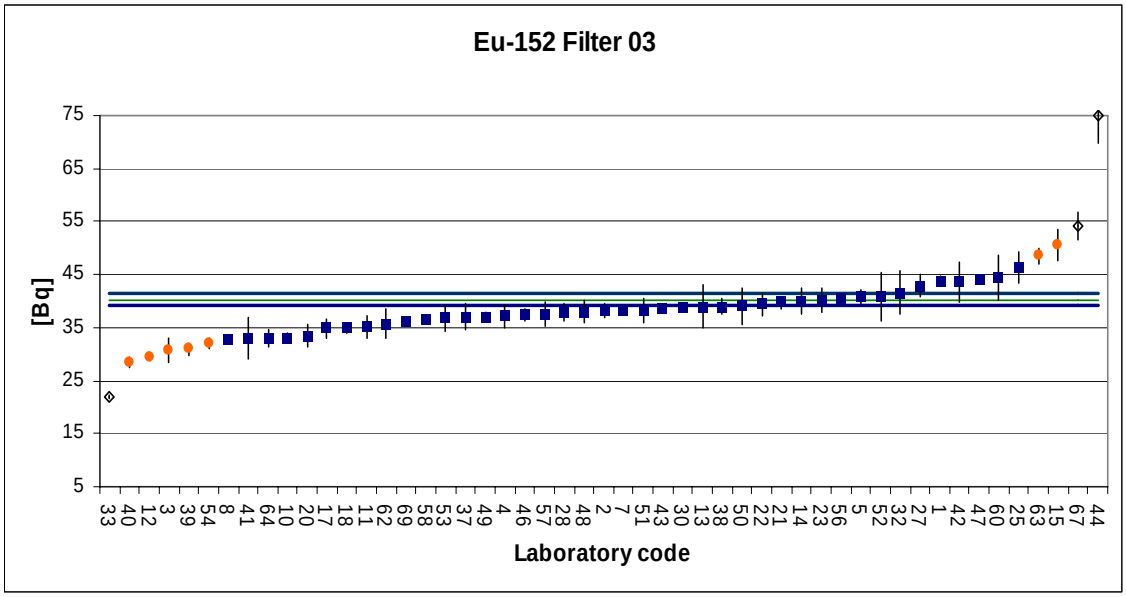
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	1.02	0.03	2.94	-3.77	0.04	0.13	A	4.8	A	A	A
2	0.94	0.03	3.19	-11.32	0.12	0.13	A	4.9	A	A	A
3	0.7	0.07	10.00	-33.96	0.36	0.21	N	10.7	A	N	N
4	1.21	0.18	14.88	14.15	0.15	0.48	A	15.3	A	A	A
5	0.97	0.06	6.19	-8.49	0.09	0.19	A	7.2	A	A	A
7	1.1	0.11	10.00	3.77	0.04	0.30	A	10.7	A	A	A
8	0.915	0.092	10.05	-13.68	0.15	0.26	A	10.7	A	A	A
10	0.91	0.05	5.49	-14.15	0.15	0.17	A	6.7	A	A	A
11	0.97	0.11	11.34	-8.49	0.09	0.30	A	12.0	A	A	A
12	0.84	0.05	5.95	-20.75	0.22	0.17	N	7.0	A	N	W
13	1	0.1	10.00	-5.66	0.06	0.28	A	10.7	A	A	A
14	1.1	0.1	9.09	3.77	0.04	0.28	A	9.8	A	A	A
17	2.6	0.6	23.08	145.28	1.54	1.55	A	23.4	N	N	N
18	0.949	0.082	8.64	-10.47	0.11	0.24	A	9.4	A	A	A
20	1.5	0.2	13.33	41.51	0.44	0.53	A	13.9	A	A	N
21	1.826	0.372	20.37	72.26	0.77	0.97	A	20.7	N	N	N
22	0.96	0.063	6.56	-9.43	0.10	0.19	A	7.6	A	A	A
23	0.95	0.14	14.74	-10.38	0.11	0.38	A	15.2	A	A	A
25	1.23	0.21	17.07	16.04	0.17	0.55	A	17.5	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
27	1.04	0.058	5.58	-1.89	0.02	0.18	A	6.7	A	A	A
28	1.21	0.09	7.44	14.15	0.15	0.25	A	8.3	A	A	A
30	1.06	0.04	3.77	0.00	0.00	0.15	A	5.3	A	A	A
32	1	0.2	20.00	-5.66	0.06	0.53	A	20.4	N	W	A
33	0.69	0.08	11.59	-34.91	0.37	0.23	N	12.2	A	N	N
37	1.14	0.12	10.53	7.55	0.08	0.33	A	11.2	A	A	A
38	1.01	0.1	9.90	-4.72	0.05	0.28	A	10.6	A	A	A
39	0.81	0.04	4.94	-23.58	0.25	0.15	N	6.2	A	N	W
40	0.93	0.03	3.23	-12.26	0.13	0.13	N	5.0	A	W	A
41	0.9	0.1	11.11	-15.09	0.16	0.28	A	11.7	A	A	A
42	0.99	0.11	11.11	-6.60	0.07	0.30	A	11.7	A	A	A
43	0.9	0.3	33.33	-15.09	0.16	0.78	A	33.5	N	W	A
44	6.94	0.36	5.19	554.72	5.88	0.93	N	6.4	A	N	N
47	1.25	0.07	5.60	17.92	0.19	0.21	A	6.8	A	A	A
48	1.11	0.03	2.70	4.72	0.05	0.13	A	4.6	A	A	A
49	1.02	0.07	6.86	-3.77	0.04	0.21	A	7.8	A	A	A
50	1.03	0.11	10.68	-2.83	0.03	0.30	A	11.3	A	A	A
51	1.08	0.0754	6.98	1.89	0.02	0.22	A	7.9	A	A	A
52	1.09	0.14	12.84	2.83	0.03	0.38	A	13.4	A	A	A
53	1.26	0.12	9.52	18.87	0.20	0.33	A	10.2	A	A	A
54	0.87	0.11	12.64	-17.92	0.19	0.30	A	13.2	A	A	A
56	1.08	0.071	6.57	1.89	0.02	0.21	A	7.6	A	A	A
57	1.01	0.06	5.94	-4.72	0.05	0.19	A	7.0	A	A	A
58	0.9	0.06	6.67	-15.09	0.16	0.19	A	7.7	A	A	A
60	1.14	0.11	9.65	7.55	0.08	0.30	A	10.4	A	A	A
62	0.963	0.077	8.00	-9.15	0.10	0.22	A	8.8	A	A	A
63	1.25	0.13	10.40	17.92	0.19	0.35	A	11.1	A	A	A
64	0.865	0.066	7.63	-18.40	0.20	0.20	A	8.5	A	A	A
67	1.7	0.2	11.76	60.38	0.64	0.53	N	12.4	A	N	N
69	1.02	0.05	4.90	-3.77	0.04	0.17	A	6.2	A	A	A

Performance evaluation of Eu-152 measurement results

Simulated air filter 03

Target Value 40.3 ± 0.6 [Bq]



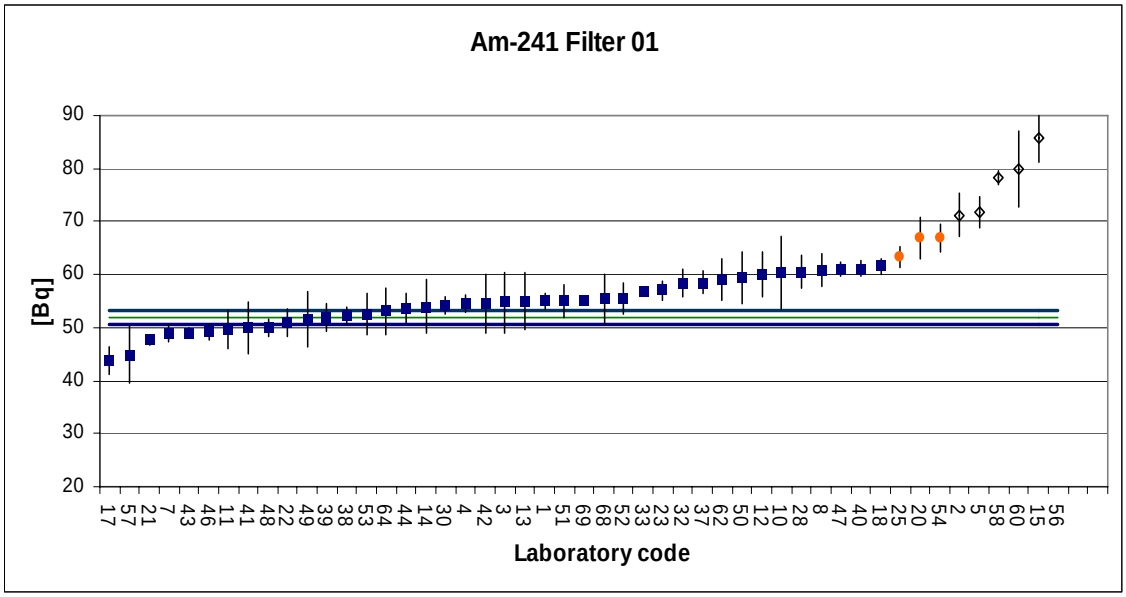
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	43.6	0.99	2.27	8.27	3.3	2.9	N	2.7	A	W	A
2	38.2	1.26	3.30	-5.14	2.1	3.6	A	3.6	A	A	A
3	30.8	2.2	7.14	-23.51	9.5	5.9	N	7.3	A	N	W
4	37.2	2.1	5.65	-7.62	3.1	5.6	A	5.8	A	A	A
5	40.8	1.4	3.43	1.32	0.5	3.9	A	3.7	A	A	A
7	38.2	0.5	1.31	-5.14	2.1	1.9	N	1.9	A	W	A
8	32.715	0.536	1.64	-18.76	7.6	2.0	N	2.1	A	W	A
10	33.1	0.82	2.48	-17.80	7.2	2.6	N	2.8	A	W	A
11	35.18	2.08	5.91	-12.64	5.1	5.6	A	6.1	A	A	A
12	29.32	0.55	1.88	-27.19	10.9	2.0	N	2.3	A	N	W
13	39	4	10.26	-3.15	1.3	10.4	A	10.4	A	A	A
14	40	2.3	5.75	-0.67	0.3	6.1	A	5.9	A	A	A
15	50.63	2.92	5.77	25.73	10.4	7.7	N	5.9	A	N	W
17	34.9	1.8	5.16	-13.33	5.4	4.9	N	5.3	A	W	A
18	34.988	1.034	2.96	-13.11	5.3	3.0	N	3.3	A	W	A
20	33.4	2.1	6.29	-17.06	6.9	5.6	N	6.4	A	W	A
21	39.69	1.17	2.95	-1.44	0.6	3.3	A	3.3	A	A	A
22	39.45	2.1	5.32	-2.03	0.8	5.6	A	5.5	A	A	A
23	40.2	2.3	5.72	-0.17	0.1	6.1	A	5.9	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	46.3	3	6.48	14.98	6.0	7.9	A	6.6	A	A	A
27	42.8	2.1	4.91	6.29	2.5	5.6	A	5.1	A	A	A
28	37.9	1.6	4.22	-5.88	2.4	4.4	A	4.4	A	A	A
30	38.8	0.8	2.06	-3.65	1.5	2.5	A	2.5	A	A	A
32	41.6	4.2	10.10	3.31	1.3	10.9	A	10.2	A	A	A
33	21.86	0.33	1.51	-45.71	18.4	1.7	N	2.1	A	N	N
37	36.93	2.42	6.55	-8.29	3.3	6.4	A	6.7	A	A	A
38	39	1.6	4.10	-3.15	1.3	4.4	A	4.3	A	A	A
39	30.9	1	3.24	-23.27	9.4	3.0	N	3.5	A	N	W
40	28.4	0.9	3.17	-29.47	11.9	2.7	N	3.5	A	N	W
41	33	4	12.12	-18.05	7.3	10.4	A	12.2	A	A	A
42	43.7	3.7	8.47	8.52	3.4	9.7	A	8.6	A	A	A
43	38.5	0.7	1.82	-4.39	1.8	2.3	A	2.3	A	A	A
44	103.35	5.19	5.02	156.65	63.1	13.5	N	5.2	A	N	N
46	37.5	1.1	2.93	-6.88	2.8	3.2	A	3.2	A	A	A
47	44.05	0.71	1.61	9.39	3.8	2.3	N	2.1	A	W	A
48	38	2.2	5.79	-5.63	2.3	5.9	A	6.0	A	A	A
49	37.04	0.76	2.05	-8.02	3.2	2.4	N	2.5	A	W	A
50	39.1	3.4	8.70	-2.90	1.2	8.9	A	8.8	A	A	A
51	38.29	2.2	5.75	-4.91	2.0	5.9	A	5.9	A	A	A
52	40.8	4.5	11.03	1.32	0.5	11.7	A	11.1	A	A	A
53	36.8	2.4	6.52	-8.61	3.5	6.4	A	6.7	A	A	A
54	32.1	1	3.12	-20.29	8.2	3.0	N	3.4	A	N	W
56	40.6	0.33	0.81	0.82	0.3	1.7	A	1.6	A	A	A
57	37.7	2.3	6.10	-6.38	2.6	6.1	A	6.3	A	A	A
58	36.65	0.43	1.17	-8.99	3.6	1.8	N	1.8	A	W	A
60	44.4	4.1	9.23	10.26	4.1	10.7	A	9.3	A	A	A
62	35.7	2.68	7.51	-11.35	4.6	7.1	A	7.6	A	A	A
63	48.51	1.37	2.82	20.47	8.2	3.8	N	3.1	A	N	W
64	33	1.7	5.15	-18.05	7.3	4.6	N	5.3	A	W	A
67	54.2	2.7	4.98	34.60	13.9	7.1	N	5.2	A	N	N
69	36.3	0.4	1.10	-9.86	4.0	1.8	N	1.8	A	W	A

Performance evaluation of Am-241 measurement results

Simulated air filter 01

Target Value 51.9 ± 0.6 [Bq]



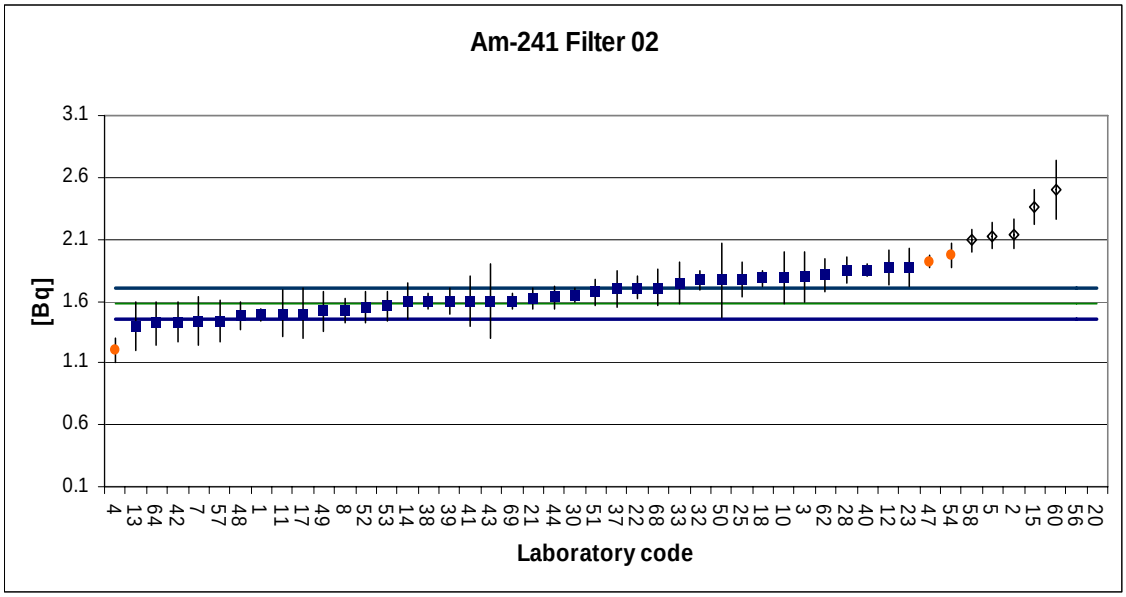
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	55.02	1.54	2.80	6.01	3.1	4.3	A	3.0	A	A	A
2	71.21	4.07	5.72	37.21	19.3	10.6	N	5.8	A	N	N
3	54.7	5.6	10.24	5.39	2.8	14.5	A	10.3	A	A	A
4	54.6	1.7	3.11	5.20	2.7	4.7	A	3.3	A	A	A
5	71.7	2.99	4.17	38.15	19.8	7.9	N	4.3	A	N	N
7	48.9	1.7	3.48	-5.78	3.0	4.7	A	3.7	A	A	A
8	60.777	3.164	5.21	17.10	8.9	8.3	N	5.3	A	W	A
10	60.3	6.8	11.28	16.18	8.4	17.6	A	11.3	A	A	A
11	49.67	3.5	7.05	-4.30	2.2	9.2	A	7.1	A	A	A
12	60.09	4.32	7.19	15.78	8.2	11.3	A	7.3	A	A	A
13	55	5.5	10.00	5.97	3.1	14.3	A	10.1	A	A	A
14	54	5	9.26	4.05	2.1	13.0	A	9.3	A	A	A
15	85.68	4.46	5.21	65.09	33.8	11.6	N	5.3	A	N	N
17	43.8	2.7	6.16	-15.61	8.1	7.1	N	6.3	A	W	A
18	61.512	1.328	2.16	18.52	9.6	3.8	N	2.5	A	W	A
20	66.9	4	5.98	28.90	15.0	10.4	N	6.1	A	N	W
21	47.72	1.06	2.22	-8.05	4.2	3.2	N	2.5	A	W	A
22	50.93	2.66	5.22	-1.87	1.0	7.0	A	5.4	A	A	A
23	57	1.8	3.16	9.83	5.1	4.9	N	3.4	A	W	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	63.2	2	3.16	21.77	11.3	5.4	N	3.4	A	N	W
28	60.4	3.1	5.13	16.38	8.5	8.2	N	5.3	A	W	A
30	54.3	1.6	2.95	4.62	2.4	4.4	A	3.2	A	A	A
32	58.5	2.6	4.44	12.72	6.6	6.9	A	4.6	A	A	A
33	56.64	0.58	1.02	9.13	4.7	2.2	N	1.6	A	W	A
37	58.5	2.14	3.66	12.72	6.6	5.7	N	3.8	A	W	A
38	52.3	1.7	3.25	0.77	0.4	4.7	A	3.5	A	A	A
39	52	2.6	5.00	0.19	0.1	6.9	A	5.1	A	A	A
40	61.1	1.5	2.45	17.73	9.2	4.2	N	2.7	A	W	A
41	50	5	10.00	-3.66	1.9	13.0	A	10.1	A	A	A
42	54.6	5.5	10.07	5.20	2.7	14.3	A	10.1	A	A	A
43	48.9	1	2.04	-5.78	3.0	3.0	A	2.4	A	A	A
44	53.66	2.81	5.24	3.39	1.8	7.4	A	5.4	A	A	A
46	49.2	1.5	3.05	-5.20	2.7	4.2	A	3.3	A	A	A
47	61	1.2	1.97	17.53	9.1	3.5	N	2.3	A	W	A
48	50	1.7	3.40	-3.66	1.9	4.7	A	3.6	A	A	A
49	51.69	5.24	10.14	-0.40	0.2	13.6	A	10.2	A	A	A
50	59.3	4.9	8.26	14.26	7.4	12.7	A	8.3	A	A	A
51	55.06	3.13	5.68	6.09	3.2	8.2	A	5.8	A	A	A
52	55.6	2.9	5.22	7.13	3.7	7.7	A	5.4	A	A	A
53	52.5	3.9	7.43	1.16	0.6	10.2	A	7.5	A	A	A
54	66.9	2.5	3.74	28.90	15.0	6.6	N	3.9	A	N	W
56	161	12	7.45	210.21	109.1	31.0	N	7.5	A	N	N
57	44.8	5.4	12.05	-13.68	7.1	14.0	A	12.1	A	A	A
58	78.18	1.32	1.69	50.64	26.3	3.8	N	2.1	A	N	N
60	80	7.2	9.00	54.14	28.1	18.6	N	9.1	A	N	N
62	59.07	4	6.77	13.82	7.2	10.4	A	6.9	A	A	A
64	53.1	4.4	8.29	2.31	1.2	11.5	A	8.4	A	A	A
68	55.4	4.7	8.48	6.74	3.5	12.2	A	8.6	A	A	A
69	55.2	0.5	0.91	6.36	3.3	2.1	N	1.5	A	W	A

Performance evaluation of Am-241 measurement results

Simulated air filter 02

Target Value 1.58 ± 0.06 [Bq]



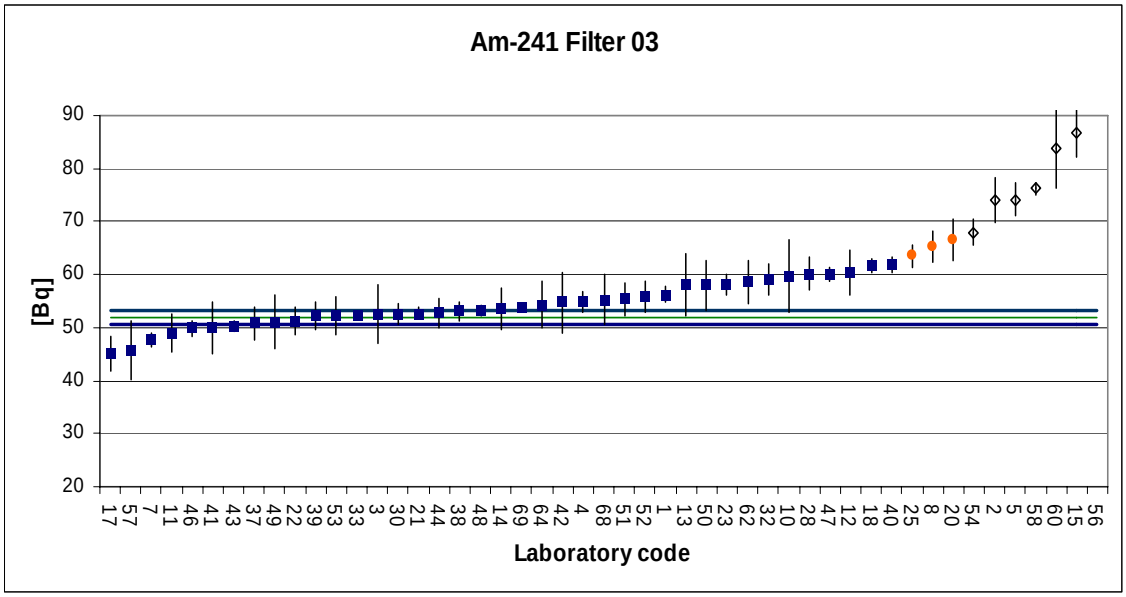
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	1.49	0.05	3.36	-5.62	3.1	0.09	0.20	A	5.1	A	A
2	2.14	0.12	5.61	35.55	19.3	0.56	0.35	N	6.8	A	N
3	1.8	0.2	11.11	14.01	2.8	0.22	0.54	A	11.7	A	A
4	1.2	0.1	8.33	-23.99	2.7	0.38	0.30	N	9.2	A	N
5	2.13	0.1	4.69	34.92	19.8	0.55	0.30	N	6.0	A	N
7	1.44	0.2	13.89	-8.79	3.0	0.14	0.54	A	14.4	A	A
8	1.525	0.098	6.43	-3.40	8.9	0.05	0.30	A	7.5	A	A
10	1.79	0.21	11.73	13.38	8.4	0.21	0.56	A	12.3	A	A
11	1.5	0.19	12.67	-4.99	2.2	0.08	0.51	A	13.2	A	A
12	1.87	0.14	7.49	18.45	8.2	0.29	0.39	A	8.4	A	A
13	1.4	0.2	14.29	-11.32	3.1	0.18	0.54	A	14.8	A	A
14	1.6	0.15	9.38	1.35	2.1	0.02	0.42	A	10.1	A	A
15	2.36	0.14	5.93	49.49	33.8	0.78	0.39	N	7.0	A	N
17	1.5	0.2	13.33	-4.99	8.1	0.08	0.54	A	13.9	A	A
18	1.785	0.062	3.47	13.06	9.6	0.21	0.22	A	5.1	A	A
20	18.4	1.6	8.70	1065.4	15.0	16.82	4.13	N	9.5	A	N
21	1.621	0.086	5.31	2.68	4.2	0.04	0.27	A	6.5	A	A
22	1.71	0.09	5.26	8.31	1.0	0.13	0.28	A	6.5	A	A
23	1.87	0.15	8.02	18.45	5.1	0.29	0.42	A	8.9	A	A
25	1.78	0.14	7.87	12.75	11.3	0.20	0.39	A	8.7	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
28	1.85	0.11	5.95	17.18	8.5	0.27	0.32	A	7.1	A	A
30	1.65	0.06	3.64	4.51	2.4	0.07	0.22	A	5.3	A	A
32	1.77	0.08	4.52	12.11	6.6	0.19	0.26	A	5.9	A	A
33	1.75	0.17	9.71	10.85	4.7	0.17	0.47	A	10.4	A	A
37	1.7	0.145	8.53	7.68	6.6	0.12	0.40	A	9.3	A	A
38	1.6	0.06	3.75	1.35	0.4	0.02	0.22	A	5.3	A	A
39	1.6	0.1	6.25	1.35	0.1	0.02	0.30	A	7.3	A	A
40	1.85	0.05	2.70	17.18	9.2	0.27	0.20	N	4.7	A	W
41	1.6	0.2	12.50	1.35	1.9	0.02	0.54	A	13.1	A	A
42	1.43	0.16	11.19	-9.42	2.7	0.15	0.44	A	11.8	A	A
43	1.6	0.3	18.75	1.35	3.0	0.02	0.79	A	19.1	A	A
44	1.63	0.09	5.52	3.25	1.8	0.05	0.28	A	6.7	A	A
47	1.92	0.05	2.60	21.62	2.7	0.34	0.20	N	4.6	A	N
48	1.48	0.11	7.43	-6.25	9.1	0.10	0.32	A	8.3	A	A
49	1.52	0.16	10.53	-3.72	1.9	0.06	0.44	A	11.2	A	A
50	1.77	0.3	16.95	12.11	0.2	0.19	0.79	A	17.4	A	A
51	1.67	0.109	6.53	5.78	7.4	0.09	0.32	A	7.6	A	A
52	1.55	0.12	7.74	-1.82	3.2	0.03	0.35	A	8.6	A	A
53	1.56	0.12	7.69	-1.19	3.7	0.02	0.35	A	8.6	A	A
54	1.97	0.1	5.08	24.78	0.6	0.39	0.30	N	6.3	A	N
56	4.75	0.373	7.85	200.87	15.0	3.17	0.97	N	8.7	A	N
57	1.44	0.17	11.81	-8.79	109.1	0.14	0.47	A	12.4	A	A
58	2.09	0.09	4.31	32.38	7.1	0.51	0.28	N	5.7	A	N
60	2.5	0.24	9.60	58.35	26.3	0.92	0.64	N	10.3	A	N
62	1.81	0.127	7.02	14.65	28.1	0.23	0.36	A	8.0	A	A
64	1.42	0.18	12.68	-10.05	7.2	0.16	0.49	A	13.2	A	A
68	1.71	0.15	8.77	8.31	1.2	0.13	0.42	A	9.6	A	A
69	1.6	0.06	3.75	1.35	3.5	0.02	0.22	A	5.3	A	A

Performance evaluation of Am-241 measurement results

Simulated air filter 03

Target Value 51.9 ± 0.6 [Bq]



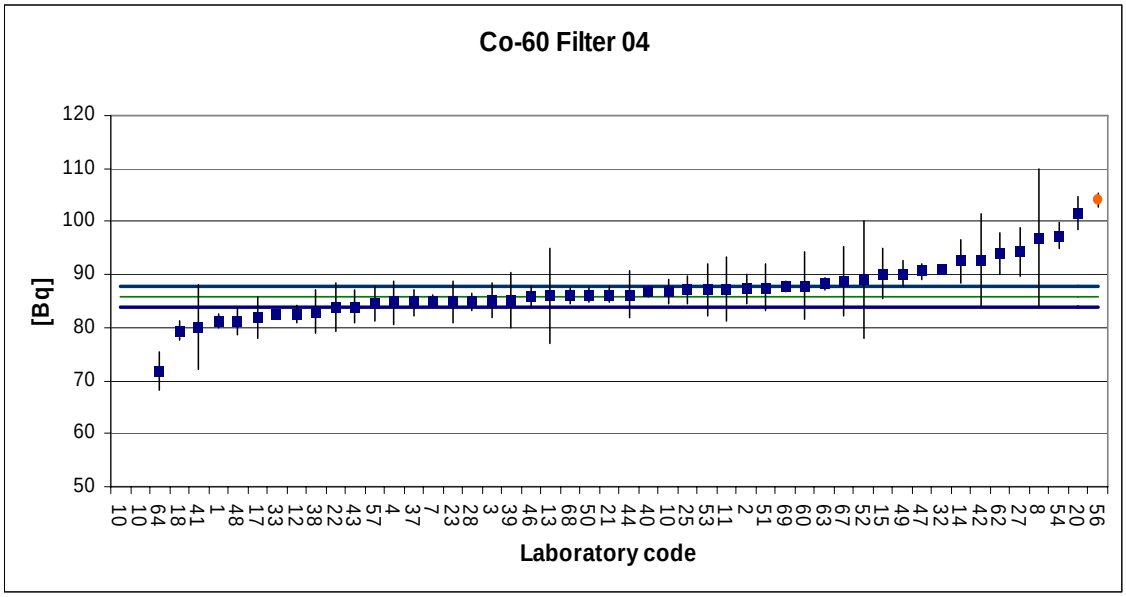
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	56.3	1.56	2.77	8.48	4.4	4.3	N	3.0	A	W	A
2	74	4.16	5.62	42.58	22.1	10.9	N	5.7	A	N	N
3	52.5	5.5	10.48	1.16	0.6	14.3	A	10.5	A	A	A
4	54.9	1.9	3.46	5.78	3.0	5.2	A	3.7	A	A	A
5	74.2	3.1	4.18	42.97	22.3	8.2	N	4.3	A	N	N
7	47.7	1.4	2.94	-8.09	4.2	4.0	N	3.2	A	W	A
8	65.151	2.924	4.49	25.53	13.3	7.7	N	4.6	A	N	W
10	59.7	6.74	11.29	15.03	7.8	17.5	A	11.4	A	A	A
11	49.01	3.48	7.10	-5.57	2.9	9.1	A	7.2	A	A	A
12	60.42	4.34	7.18	16.42	8.5	11.3	A	7.3	A	A	A
13	58	5.8	10.00	11.75	6.1	15.0	A	10.1	A	A	A
14	53.6	4	7.46	3.28	1.7	10.4	A	7.6	A	A	A
15	86.83	4.52	5.21	67.30	34.9	11.8	N	5.3	A	N	N
17	45	3.2	7.11	-13.29	6.9	8.4	A	7.2	A	A	A
18	61.543	1.329	2.16	18.58	9.6	3.8	N	2.5	A	W	A
20	66.5	4	6.02	28.13	14.6	10.4	N	6.1	A	N	W
21	52.71	0.998	1.89	1.56	0.8	3.0	A	2.2	A	A	A
22	51.26	2.7	5.27	-1.23	0.6	7.1	A	5.4	A	A	A
23	58.2	2	3.44	12.14	6.3	5.4	N	3.6	A	W	A
25	63.5	2.1	3.31	22.35	11.6	5.6	N	3.5	A	N	W

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
28	60.1	3.1	5.16	15.80	8.2	8.2	N	5.3	A	W	A
30	52.5	1.9	3.62	1.16	0.6	5.2	A	3.8	A	A	A
32	59	3	5.08	13.68	7.1	7.9	A	5.2	A	A	A
33	52.39	0.58	1.11	0.94	0.5	2.2	A	1.6	A	A	A
37	50.84	3.01	5.92	-2.04	1.1	7.9	A	6.0	A	A	A
38	53.1	1.8	3.39	2.31	1.2	4.9	A	3.6	A	A	A
39	52.2	2.6	4.98	0.58	0.3	6.9	A	5.1	A	A	A
40	61.9	1.5	2.42	19.27	10.0	4.2	N	2.7	A	W	A
41	50	5	10.00	-3.66	1.9	13.0	A	10.1	A	A	A
42	54.8	5.7	10.40	5.59	2.9	14.8	A	10.5	A	A	A
43	50.2	1	1.99	-3.28	1.7	3.0	A	2.3	A	A	A
44	52.74	2.77	5.25	1.62	0.8	7.3	A	5.4	A	A	A
46	49.9	1.5	3.01	-3.85	2.0	4.2	A	3.2	A	A	A
47	60.1	1.2	2.00	15.80	8.2	3.5	N	2.3	A	W	A
48	53.2	1	1.88	2.50	1.3	3.0	A	2.2	A	A	A
49	51.08	5.18	10.14	-1.58	0.8	13.5	A	10.2	A	A	A
50	58	4.8	8.28	11.75	6.1	12.5	A	8.4	A	A	A
51	55.41	3.15	5.68	6.76	3.5	8.3	A	5.8	A	A	A
52	55.9	2.9	5.19	7.71	4.0	7.7	A	5.3	A	A	A
53	52.2	3.7	7.09	0.58	0.3	9.7	A	7.2	A	A	A
54	68	2.5	3.68	31.02	16.1	6.6	N	3.9	A	N	N
56	161	12.1	7.52	210.21	109.1	31.3	N	7.6	A	N	N
57	45.8	5.5	12.01	-11.75	6.1	14.3	A	12.1	A	A	A
58	76.19	1.24	1.63	46.80	24.3	3.6	N	2.0	A	N	N
60	83.9	7.7	9.18	61.66	32.0	19.9	N	9.3	A	N	N
62	58.61	4.1	7.00	12.93	6.7	10.7	A	7.1	A	A	A
64	54.3	4.5	8.29	4.62	2.4	11.7	A	8.4	A	A	A
68	55.3	4.7	8.50	6.55	3.4	12.2	A	8.6	A	A	A
69	53.8	0.5	0.93	3.66	1.9	2.1	A	1.5	A	A	A

Performance evaluation of Co-60 measurement results

Simulated Control air filter 04

Target Value 85.8 ± 0.9 [Bq]



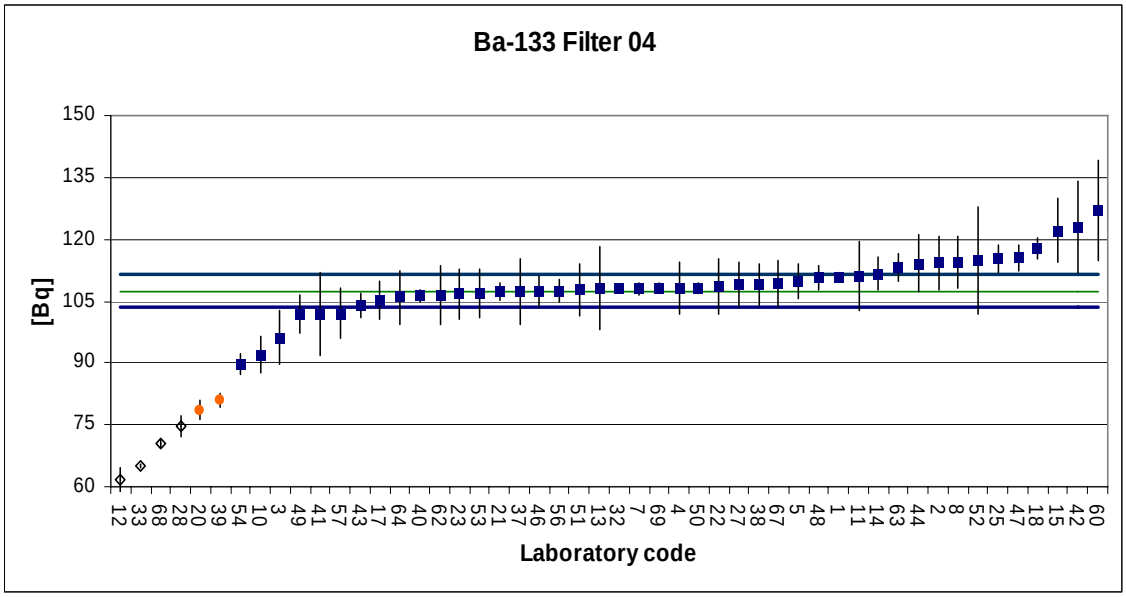
Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	81.29	1.18	1.45	-5.26	4.5	3.9	N	1.8	A	W	A
2	87.4	2.8	3.20	1.86	1.6	7.6	A	3.4	A	A	A
3	85.1	3.2	3.76	-0.82	0.7	8.6	A	3.9	A	A	A
4	84.7	4	4.72	-1.28	1.1	10.6	A	4.9	A	A	A
5	107.2	3.6	3.36	24.94	21.4	9.6	N	3.5	A	N	W
7	84.9	1.2	1.41	-1.05	0.9	3.9	A	1.8	A	A	A
8	96.93	12.972	13.38	12.97	11.1	33.6	A	13.4	A	A	A
10	0.6	0.11	18.33	-99.30	85.2	2.5	N	18.4	A	N	N
10	0.5	0.09	18.00	-99.42	85.3	2.5	N	18.0	A	N	N
10	86.9	2.31	2.66	1.28	1.1	6.4	A	2.9	A	A	A
11	87.2	6	6.88	1.63	1.4	15.7	A	7.0	A	A	A
12	82.7	1.61	1.95	-3.61	3.1	4.8	A	2.2	A	A	A
13	86	9	10.47	0.23	0.2	23.3	A	10.5	A	A	A
14	92.5	4	4.32	7.81	6.7	10.6	A	4.5	A	A	A
15	90.14	4.68	5.19	5.06	4.3	12.3	A	5.3	A	A	A
17	81.8	3.9	4.77	-4.66	4.0	10.4	A	4.9	A	A	A
18	79.431	1.715	2.16	-7.42	6.4	5.1	N	2.4	A	W	A
20	101.5	3.1	3.05	18.30	15.7	8.4	N	3.2	A	W	A
21	86.24	1.5	1.74	0.51	0.4	4.6	A	2.1	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
22	83.84	4.44	5.30	-2.28	2.0	11.7	A	5.4	A	A	A
23	84.9	4	4.71	-1.05	0.9	10.6	A	4.8	A	A	A
25	87	2.6	2.99	1.40	1.2	7.1	A	3.2	A	A	A
27	94.4	4.6	4.87	10.02	8.6	12.1	A	5.0	A	A	A
28	84.9	1.7	2.00	-1.05	0.9	5.0	A	2.3	A	A	A
32	91.1	0	0.00	6.18	5.3	2.5	N	1.1	A	W	A
33	82.6	0.46	0.56	-3.73	3.2	2.7	N	1.2	A	W	A
37	84.72	2.42	2.86	-1.26	1.1	6.7	A	3.1	A	A	A
38	83	4	4.82	-3.26	2.8	10.6	A	4.9	A	A	A
39	85.1	5.2	6.11	-0.82	0.7	13.6	A	6.2	A	A	A
40	86.8	1.1	1.27	1.17	1.0	3.7	A	1.7	A	A	A
41	80	8	10.00	-6.76	5.8	20.8	A	10.1	A	A	A
42	92.6	8.9	9.61	7.93	6.8	23.1	A	9.7	A	A	A
43	84	3	3.57	-2.10	1.8	8.1	A	3.7	A	A	A
44	86.28	4.36	5.05	0.56	0.5	11.5	A	5.2	A	A	A
46	85.8	2	2.33	0.00	0.0	5.7	A	2.6	A	A	A
47	90.6	1.5	1.66	5.59	4.8	4.6	N	2.0	A	W	A
48	81.3	2.5	3.08	-5.24	4.5	6.9	A	3.3	A	A	A
49	90.19	2.57	2.85	5.12	4.4	7.1	A	3.1	A	A	A
50	86.2	1.2	1.39	0.47	0.4	3.9	A	1.8	A	A	A
51	87.58	4.47	5.10	2.07	1.8	11.8	A	5.2	A	A	A
52	89	11	12.36	3.73	3.2	28.5	A	12.4	A	A	A
53	87.1	4.8	5.51	1.52	1.3	12.6	A	5.6	A	A	A
54	97.3	2.5	2.57	13.40	11.5	6.9	N	2.8	A	W	A
56	104	1.29	1.24	21.21	18.2	4.1	N	1.7	A	N	W
57	84.5	3.4	4.02	-1.52	1.3	9.1	A	4.2	A	A	A
60	87.9	6.3	7.17	2.45	2.1	16.4	A	7.3	A	A	A
62	93.95	3.95	4.20	9.50	8.2	10.5	A	4.3	A	A	A
63	88.33	1.13	1.28	2.95	2.5	3.8	A	1.7	A	A	A
64	71.9	3.6	5.01	-16.20	13.9	9.6	N	5.1	A	W	A
67	88.6	6.5	7.34	3.26	13.9	9.6	N	5.1	A	W	A
68	86	1.5	1.74	0.23	2.8	16.9	A	7.4	A	A	A
69	87.7	0.9	1.03	2.21	0.2	4.6	A	2.1	A	A	A

Performance evaluation of Ba-133 measurement results

Simulated Control air filter 04

Target Value 107.5 ± 1.9 [Bq]



Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
1	110.74	1.07	0.97	3.01	3.2	5.7	A	2.0	A	A	A
2	114.3	6.4	5.60	6.33	6.8	17.2	A	5.9	A	A	A
3	96.2	6.4	6.65	-10.51	11.3	17.2	A	6.9	A	A	A
4	108.3	6.3	5.82	0.74	0.8	17.0	A	6.1	A	A	A
5	109.7	4.1	3.74	2.05	2.2	11.7	A	4.1	A	A	A
7	108.1	1.5	1.39	0.56	0.6	6.3	A	2.3	A	A	A
8	114.4	6.419	5.61	6.42	6.9	17.3	A	5.9	A	A	A
10	92	4.5	4.89	-14.42	15.5	12.6	N	5.2	A	W	A
11	111.2	8.3	7.46	3.44	3.7	22.0	A	7.7	A	A	A
12	61.83	2.9	4.69	-42.48	45.7	9.0	N	5.0	A	N	N
13	108	10	9.26	0.47	0.5	26.3	A	9.4	A	A	A
14	111.6	4	3.58	3.81	4.1	11.5	A	4.0	A	A	A
15	122.08	7.73	6.33	13.56	14.6	20.6	A	6.6	A	A	A
17	105.2	4.6	4.37	-2.14	2.3	12.9	A	4.7	A	A	A
18	117.70	2.486	2.11	9.50	10.2	8.1	N	2.8	A	W	A
20	78.6	2.4	3.05	-26.88	28.9	7.9	N	3.5	A	N	W
21	107.3	1.93	1.80	-0.19	0.2	7.0	A	2.5	A	A	A
22	108.57	6.53	6.01	1.00	1.1	17.6	A	6.3	A	A	A
23	106.7	6.2	5.81	-0.74	0.8	16.8	A	6.1	A	A	A

Lab code	Rep. Value	Rep. Unc.	Unc. [%]	Rel. Bias	A1	A2	True	P	Prec	Score	Final Score
25	115.4	3.4	2.95	7.35	7.9	10.1	A	3.5	A	A	A
27	109	5.3	4.86	1.40	1.5	14.6	A	5.2	A	A	A
28	74.6	2.6	3.49	-30.60	32.9	8.4	N	3.9	A	N	N
32	108	0	0.00	0.47	0.5	5.0	A	1.8	A	A	A
33	65	0.32	0.49	-39.53	42.5	5.0	N	1.9	A	N	N
37	107.38	8	7.45	-0.11	0.1	21.2	A	7.7	A	A	A
38	109	5	4.59	1.40	1.5	13.8	A	4.9	A	A	A
39	80.8	1.7	2.10	-24.84	26.7	6.6	N	2.8	A	N	W
40	106.3	1.5	1.41	-1.12	1.2	6.3	A	2.3	A	A	A
41	102	10	9.80	-5.12	5.5	26.3	A	10.0	A	A	A
42	123	11	8.94	14.42	15.5	28.8	A	9.1	A	A	A
43	104	3	2.88	-3.26	3.5	9.2	A	3.4	A	A	A
44	114.2	7	6.13	6.23	6.7	18.7	A	6.4	A	A	A
46	107.4	3.8	3.54	-0.09	0.1	11.0	A	4.0	A	A	A
47	115.6	3.1	2.68	7.53	8.1	9.4	A	3.2	A	A	A
48	110.5	2.9	2.62	2.79	3.0	9.0	A	3.2	A	A	A
49	101.75	4.66	4.58	-5.35	5.8	13.0	A	4.9	A	A	A
50	108.3	1.3	1.20	0.74	0.8	6.0	A	2.2	A	A	A
51	107.7	6.18	5.74	0.19	0.2	16.7	A	6.0	A	A	A
52	115	13	11.30	6.98	7.5	33.9	A	11.4	A	A	A
53	106.9	5.8	5.43	-0.56	0.6	15.8	A	5.7	A	A	A
54	89.8	2.5	2.78	-16.47	17.7	8.1	N	3.3	A	W	A
56	107.48	2.58	2.40	-0.02	0.0	8.3	A	3.0	A	A	A
57	102	6	5.88	-5.12	5.5	16.3	A	6.2	A	A	A
60	127	12	9.45	18.14	19.5	31.4	A	9.6	A	A	A
62	106.48	7.03	6.60	-0.95	1.0	18.8	A	6.8	A	A	A
63	113.18	3.19	2.82	5.28	5.7	9.6	A	3.3	A	A	A
64	105.9	6.5	6.14	-1.49	1.6	17.5	A	6.4	A	A	A
67	109.3	5.6	5.12	1.67	1.8	15.3	A	5.4	A	A	A
68	70.5	1	1.42	-34.42	37.0	5.6	N	2.3	A	N	N
69	108.2	1.2	1.11	0.65	0.7	5.9	A	2.1	A	A	A

APPENDIX II: LIST OF PARTICIPATING LABORATORIES[1]

Laboratory code: 01

Environmental Monitoring Group/Health Physics Division Pakistan Institute Of Nuclear Science & Technology (Pinstech) P.O. Nilore Islamabad, 45650

Pakistan

Laboratory code: 02

Radiation Protection Environmental Protection & Civil Protection Laboratory Institute For Nuclear Research, Pitesti Campului Street, 1 P. O. Box 78 R-115400, Mioveni

Romania

Laboratory code: 03

National Radiation Protection Department. Iranian Nuclear Regulatory Authority North Karegar Street P.O.Box:14155-4494, 14374. 14374, Tehran Islamic

Iran, Islamic Republic Of

Laboratory code: 04

Radioisotope Metrology Laboratory Atomic Energy National Commission Centro Atomico Ezeiza Presbitero Juan Gonzalez Y Aragon 15 B-1802 Aya, Buenos Aires

Argentina

Laboratory code: 05

Comissao Nacional De Energia Nuclear (Cnen) Instituto De Radioprotecao E Dosimetria (Ird) Servico De Analises Ambientais (Seana) Av. Salvador Allende, S/N,Recreio Dos Bandeirantes Cep 22.780-160 - Rio De Janeiro - Rj

Brazil

[1] Only those laboratories who reported their results were listed in the list of participating laboratories.

Laboratory code: 06

Results Not Submitted

Dept. Of Life And Environmental Physics Horia Hulubei National Institute Of R&D For Physics And Nuclear Engineering (Ifin-Hh) 407 Atomistilor Street, P.O. Box Mg 6 R-077125, Ilfov County

Romania

Laboratory code: 07

Module 6 National Physical Laboratory Quality Of Life Division G6-A5, Hampton Road Teddington, Tw11 0lw Middlesex

United Kingdom

Laboratory code: 08

Unit Of Laboratory And Special Measurements Nuclear Power Plant Bohunice Sk-919 31, Jaslovske Bohunice

Slovakia

Laboratory code: 09

Results Not Submitted

Norwegian Radiation Protection Authority Grini Naeringspark 13 P.O. Box 55 N-1361, Osteras

Norway

Laboratory code: 10

Laboratory Of Radiometry Central Mining Institute Plac Gwarkow 1 P.O.Box 3672 Pl-40-166, Katowice

Poland

Laboratory code: 11

Horia Hulubei National Institute Of R&D For Physics And Nuclear Engineering (Ifin-Hh) Radioactive Waste Management Department (Dmdr) Spectroscopy Analysis Laboratory (Las) 407 Atomistilor Str. P.O. Box Mg 6 R-077125, Magurele Ilfov County

Romania

Laboratory code: 12

Institute Of Environment And Sustainable Development In Agriculture, Caas No.12 Zhongguancun South Street Beijing 100081

China

Laboratory code: 13

Department Of Electrical And Computer Engineering Aristotle University Campus Aristotelian University Of Thessaloniki Egnatia Street Gr-54124, Thessaloniki

Greece

Laboratory code: 14

Department Of Environmental Radioactivity Greek Atomic Energy Commission P.O. Box 60092 Gr-153 10, Aghia Paraskevi - Attikis

Greece

Laboratory code: 15

Centre For Technology Of Radiation Safety And Metrology Ptkmr-Batan J1. National Nuclear Energy Agency Lebak Bulus Raya No. 49 Pasar Jumat Jakarta, 12440

Indonesia

Laboratory code: 16

Results Not Submitted

Health Physics Division Bhabha Atomic Research Centre 3, 326-S Modular Laboratories Trombay, Mumbai, 400 085

India

Laboratory code: 17

Swedish Radiation Safety Authority Solna Strandvgen 96 171 16, Stockholm

Sweden

Laboratory code: 18

Environmental Survey Laboratory Hpd, Barc Taps Colony Bhabha Atomic Research Centre Poghivali, Via Boisar Thane, 401 504 Maharashtra

India

Laboratory code: 19

Results Not Submitted

Environmental Assessment Div. Bhabha Atomic Research Centre Maharastra 400 Trombay, Bombay, 400 085

India

Laboratory code: 20

Instituto Nacional De Investigaciones Nucleares (Inin) Carretera Mexico-Toluca S/N, La Marquesa Ocoyoacac, C.P. 52045

Mexico

Laboratory code: 21

Dpt. Ingenieria Nuclear Y Mecanica De Fluidos Escuela Tecnica Superior De Ingenieria Alda. Urquijo, S/N 48013, Bilbao

Spain

Laboratory code: 22

Laboratorio Ambientale Centrale Elettronucleare Di Trino So.G.I.N Laboratories Strade Statale 31 Bis 13039, Trino Vercelli

Italy

Laboratory code: 23

National Commission Of Atomic Energy Centro Atomico Ezeiza Presbitero Juan Gonzalez Y Aragon 15 B-1802 Aya, Buenos Aires

Argentina

Laboratory code: 24

Results Not Submitted

International Centre For Environmental & Nuclear Sciences University Of The West Indies Mona Campus Kingston, 7

Jamaica

Laboratory code: 25

Serbian Institute Of Occupational Health Dr Dragomir Karajovic Deligradska 29 Yu-11000, Belgrade

Serbia

Laboratory code: 26

Results Not Submitted

National Center For Nuclear Safety & Radiation Control Egyptian Atomic Energy Authority Nasr City 3, Ahmed El-Zomor Street P. O. Box 7551 Cairo, 11762 Arab

Egypt

Laboratory code: 27

Japan Chemical Analysis Center 295-3, Sanno-Cho, Inage-Ku Chiba-Shi Chiba, 263-0002

Japan

Laboratory code: 28

Radioanalysis South African Nuclear Energy Corporation (Necsa) Building 1600 Church Street P.O. Box 582 West Pretoria,

South Africa

Laboratory code: 29

Results Not Submitted

Laboratorio De Vigilancia Radiologica Ambiental Centro De Proteccion E Higiene De Las Radiaciones Calle 20 Entre 4113 Y 47. Playa P.O. Box 6195 - C.P. 10600 La Havana, 11300

Cuba

Laboratory code: 30

Lab For High Resolution Gamma Ray Spectrometry Institute Jozef Stefan Jamova 39 1000, Ljubljana

Slovenia

Laboratory code: 31

Results Not Submitted

Laboratory Of Radioecology Instituto Peruano De Energia Nuclear Avenida Canada 1470 - San Borja Apartado 1687 Lima, 41

Peru

Laboratory code: 32

Nuclear Research & Consultancy Group Westerduinweg 3 Nl-1755 Zg, Petten

Netherlands

Laboratory code: 33

Departamento De Vigilancia Radiologica Ambiental Comision Nacional De Seguridad Nuclear Y Salvaguardias (Cnsns) Dr. Barragan 779, Piso 1 Col. Narvarte C.P. 03020 Mex-03020, Mexico, D.F.

Mexico

Laboratory code: 34

Results Not Submitted

Centro De Investigation En Ciencias Atomicas, Nucleares Y Moleculares Universidad De Costa Rica San Pedro De Montes De Oca 11501-2060, San Jose

Costa Rica

Laboratory code: 35

Results Not Submitted

Jordan Atomic Energy Commission Shafa Badran P.O. Box 70 Amman, 11934 Hashemite

Jordan

Laboratory code: 36

Results Not Submitted

Research Department Of Radiative Metrology (Rdrm) Belarussian State Institute Of Metrology Starovilenski Trakt 93 220053, Minsk

Belarus

Laboratory code: 37

Pocos De Caldas Laboratory / Lapoc Brazilian Nuclear Energy Commission /Cnen Radiochemistry Division Rodovia Pocos De Caldas-Andradas Km 13, Cep 37701-970, Pocos De Caldas, Mg

Brazil

Laboratory code: 38

Departmento De Proteccao Radiologica E Seguranca Nuclear Instituto Tecnologico E Nuclear E.N. 10, Apartado 21 P-2686-953, Sacavem

Portugal

Laboratory code: 39

Istituto Di Radioprotezione Laboratorio Saluggia Enea Research Centre Strada Per Crescentino, 41 Casella Postale 25 I-13040, Saluggia (Vercelli)

Italy

Laboratory code: 40

Radioactivity Measurement Laboratory, Executive Environment Agency, Ministry Of Environment And Water 136 Tzar Boris Iii, Blvd. P.O. Box 251 Bg-1618, Sofia

Bulgaria

Laboratory code: 42

National Radiation Laboratory 108 Victoria St. P.O. Box 25099 Christchurch

New Zealand

Laboratory code: 43

Institute Of Radiation Safety And Ecology Of The Nationa Nuclear Center Of The Republic Of Kazakhstan 2, Krasnoarmeyskaya St. 071100, Kurchatov

Kazakhstan

Laboratory code: 44

Canadian Nuclear Safety Commission Building No. 7 200 Tunneys Pasture Driveway Ottawa, K1a 0l2 Ontario

Canada

Laboratory code: 46

Quality Assurance Office Atomic Energy Commission Of Syria Kafersosah , 17th Nisan Street P.O. Box 6091 Damascus

Syrian Arab Republic

Laboratory code: 47

Environmental Monitoring Section Health And Safety Department Institute For Energy Technology Instituttveien 18 P.O. Box 40 N-2027, Kjeller

Norway

Laboratory code: 48

Radioactive Analysis Laboratory Lebanese Atomic Energy Commission Airport Road - Riad El Solh 1107 P.O. Box 11-8281 2260, Beirut

Lebanon

Laboratory code: 49

Ispra - Instituto Superiore Per La Protezione E La Ricerca Ambientale Via Di Castel Romano, 100 I-00128, Rome

Italy

Laboratory code: 50

Enea Istituto Di Radioprotezione Laboratorio Casaccia Via Anguillarese 301 I-00123, Santa Maria Di Galeria Roma

Italy

Laboratory code: 51

Centrale Elettronucleare Di Caorso So.G.I.N Laboratories Via Enrico Fermi, Frazione Zerbio 29012, Caorso Piacenza

Italy

Laboratory code: 52

Arpa Lombardia Dipartimento Di Milano U.O. Agenti Fisici Via Filippo Juvara 22 I-20129, Milano

Italy

Laboratory code: 53

China Institute For Radiation Protection Xuefu Street 102 P.O. Box 120 Taiyuan, 030 006 Shanxi Province

China

Laboratory code: 54

Enea Istituto Di Radioprotezione Laboratorio Trisaia Strada Statale Ionica 106, Km 419,5 I-75026, Rotondella Matera

Italy

Laboratory code: 55

Results Not Submitted

Radioanalytical Services Australian Radiation Protection And Nuclear Safety Agency (Arpansa) Lower Plenty Road 619 Yallambie, Victoria 3085

Australia

Laboratory code: 56

Environmental Laboratory Nuclear Power Plant Cernavoda Strada Medgidiei, 1 C.P. 42 905200, Cernavoda Jud. Constanta

Romania

Laboratory code: 57

Research & Environmental Surveillance Radiation And Nuclear Safety Authority (Stuk) Laippatie 4 Fin-00880, Helsinki

Finland

Laboratory code: 58

Environmental Assessment Division Low Level Counting Laboratory Bb-51 Barc Hospital Bhabha Atomic Research Centre Maharastra Trombay, Mumbai, 400 094

India

Laboratory code: 59

Results Not Submitted

Laboratory Of Measurement Of Ionizing Radiations
Russian Institute Of Agricultural Radiology And
Agroecology Kievskoe Street, 109 Km 249020,
Obninsk Kaluzhskaya Oblast

Russian Federation

Laboratory code: 60

Section Surveillance De La Radioactivite
Departement Federal De L Interieur Dfi Office
Federal De La Sante Publique Ofsp Unite De
Direction Protection Des Consommateurs
Schwarzenburgstrasse 165 Ch-3097, Liebefeld

Switzerland

Laboratory code: 61

Radiation Protection And Monitoring Department
Center For Ecotoxicological Researches Of
Montenegro Put Radomira Ivanovica 2 P.O. Box 371
Yu-81000, Podgorica Montenegro

Montenegro

Laboratory code: 62

Lab. Measurement Of Radio-Activity Kozloduy
Nuclear Power Plant Kozloduy, 3321

Bulgaria

Laboratory code: 63

Environmental Survey Laboratory Government Of
India Bhabha Atomic Research Centre Atomic
Energy Township Sadras Colony West Kalpakkam,
603 102 Kancheepuram District

India

Laboratory code: 64

Lrko & Tds Group Nuclear Power Plant Bohunice
Sk-917 31, Jaslovske Bohunice

Slovakia

Laboratory code: 65

Results Not Submitted

Laboratorio De Vigilancia Ambiental Centro De Estudios Ambientales De Cienfuegos Apartado Postal 5 Carretera A Castillo De Jagua, Km 1 1/2 Codigo Postal 59350 Ciudad Nuclear, Cienfuegos

Cuba

Laboratory code: 66

Results Not Submitted

Radiochemistry And Environment Group Malaysian Institute For Nuclear Technology Research (Mint) Selangor Darul Ehsan Bangi, 43000, Kajang, Selangor D.E.

Malaysia

Laboratory code: 67

Institute For Environmental Research Australian Nuclear Science And Technology Organization Building 34, New Illawarra Rd Lucas Heights Menai, 2234 New South Wales

Australia

Laboratory code: 68

Radiation Protection Centre Kalvariju 153 Lt-08221, Vilnius

Lithuania

Laboratory code: 69

Head Of Living & Environmental Radioactivity Assessment Department Radiation Assessment Division, Radiation Safety Headquarter Korea Institute Of Nuclear Safety 19, Guseong-Dong, Yuseong-Gu, Taejeon, 305-338,

Korea, Republic Of

CONTRIBUTORS TO DRAFTING AND REVIEW

Benesch, Thomas	International Atomic Energy Agency
De Felice, Pierino	National Metrology Institute for Ionizing Radiation (ENEA-INMRI), Italy
Gondin da Fonseca Azeredo, A.M.	International Atomic Energy Agency
Kim, Chang Kyu	International Atomic Energy Agency
Kis-Benedek, Gyula	International Atomic Energy Agency
Martin, Paul	International Atomic Energy Agency
Sansone, Umberto	International Atomic Energy Agency
Schorn, Renate	International Atomic Energy Agency
Shakhashiro, Abdulghani	International Atomic Energy Agency
Tarjan, Sandor	Central Agricultural Office, Food and Feed Safety Directorate, Hungary
Törvenyi, A.	International Atomic Energy Agency
Trinkl, Alexander	International Atomic Energy Agency

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