Applied Radiological Control, Inc.

HEALTH AND SAFETY PROCEDURE

TITLE Air Sample Analysis

NUMBER 2.5

REVISION NUMBER 1

Prepared by:	Approved:

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ARC

APPLIED RADIOLOGICAL CONTROL, INC.

HEALTH & SAFETY PROCEDURE 2.5

AIR SAMPLE ANALYSIS

1.0 SCOPE AND APPLICABILITY

This procedure establishes the method for measuring the gross alpha and beta activity of air particulate samples, and evaluating the results. The same basic method is used for both occupational samples (such as high-volume job-related samples and personal air samples), and for fence-line ambient air samples.

2.0 RESPONSIBILITIES

2.1 The Health & Safety Supervisor is responsible for implementation of this procedure.

2.2 HP Technicians are responsible for performance of air sample analyses in accordance with this procedure.

3.0 SUMMARY OF METHOD

Gross alpha and beta radioactivity of air filters is measured using a dual phosphor detector, calibrated with NIST-traceable sources. No sample preparation is required. The results are evaluated in terms of Appendix B to 10 CFR 20.1001 - 2401.

3.1 General Practices

This procedure does not process the samples in any way. Questions of reproducibility therefore do not arise. Quality control of the counting instrument provides surveillance over the reproducibility of its performance.

Nuclear counting times are selected so as to ensure that the minimum detectable concentration for each measurement (based on 5% probabilities for false detection and false non-detection) do not exceed one-half of the concentration limit applicable to the sample type.

4.0 APPARATUS

Ludlum Model 2929 dual scaler with Model 43-10-1 dual phosphor probe

Planchets, 2" diameter

5.0 PROCEDURE

5.1 Preparation

5.1.1 Obtain a clean copy of the appropriate record form: an Occupational Air Sample Analysis Record for personal air samples and job-related samples; or a Fence-Line Air Sample Analysis Record for fence-line samples.

5.1.2 Record the descriptive information at the top of the record form, down to the Sample Method description.

5.2 Counting

5.2.1 Select one of the Ludlum 2929 instruments that is currently in service.

5.2.1.1 Check the calibration sticker to verify that it is in calibration, if not tag "out of service" and return to the manufacturer for calibration.

5.2.1.2 When an instrument in calibration is obtained, record its instrument ID and calibration due date.

5.2.2 From data on the form determine whether the instrument has received its daily operational check.

5.2.2.1 If the daily operational check has not been performed, it must be performed prior to use of the instrument.

5.2.2.2 When the instrument has passed its daily operational check, record its alpha and beta background counts and counting times, and alpha and beta counting efficiencies.

5.2.3 Using the data in Appendix B to 10 CFR 20.1001 - 20.2401, select and record the applicable concentration limits for the sample.

1 5.2.4 Select a sample counting time and sample volume such that the requirements of Attachment 1 are satisfied (see note 1). Do not count samples for a period longer than 1000 minutes without instructions from site Health & Safety Supervision.

5.2.5 Count the sample in accordance with procedure 4.6, recording the gross counts and actual counting time.

5.3 Calculations

5.3.1 Following the directions given on the record form, calculate and record the net count rate and air concentration, for the alpha channel and the beta channel.

5.3.2 Following the directions given on the record form, calculate and record the applicable limit fraction for the alpha channel and the beta channel.

5.3.3 Following the directions given on the record form, calculate and record the total applicable limit fraction.

5.4 Evaluation of Results

5.4.1 For occupational air samples:

5.4.1.1 If the total MPC fraction does not exceed 0.1, no special action is required. Sign the record form and submit it for routine review and retention.

5.4.1.2 If the total MPC fraction does exceed 0.1, this indicates the potential for significant inhalation intakes, depending on the type of respiratory protection that was in use during the job and the length of the job.

A. Without delay, notify site Health & Safety Supervision of this occurrence to ensure that the potential for intakes and the need for special bioassay are evaluated.

B. Sign the record form and submit it for review and retention.

5.4.2 For fence-line air samples:

5.4.2.1 If the total effluent concentration fraction does not exceed 1.0, no special action is required. Sign the record form and submit it for routine review and retention.

5.4.2.2 If the total effluent concentration fraction does exceed 1.0, this indicates that the site will violate 10 CFR 20.1301 if the condition persists for the calendar year.

A. Notify site Health & Safety Supervision of this occurrence to ensure that future sample results from the same fence-line location will receive appropriate attention.

B. Sign the record form and submit it for review and retention.

6.0 RADON DAUGHTER ACTIVITY CALCULATION

6.1 High initial Alpha activity on an air sample may be indicative of Radon activity.

6.2 For a field determination of Radon-220 or Radon 222 Daughter Product Activity Refer to H&SP 2.6.

7.0 NOTES

1. Routine counting times that meet or exceed the requirements of Attachment 1 under specified worst normal conditions may be determined and used.

8.0 REFERENCES

1. DOE ORDER 5480.11.
2. 10 CFR 20

Attachment 1. Minimum Detectable Activity Calculation
for Determining Sample Counting Times

The gross sample counting time t_G should be chosen such that the following inequality is satisfied for both the alpha and beta channels:

$$\frac{\frac{2.71}{t_G} + 3.29\sqrt{R_B\left(\frac{1}{t_G}+\frac{1}{t_B}\right)}}{\epsilon \; V \; f \; 2.22\times10^6} \leq RMDA$$

where:

t_G = sample gross counting time, in minutes;

R_B = background count rate in the alpha or beta channel as applicable, in cpm;

t_B = background counting time over which R_B was determined, in minutes;

ϵ = alpha or beta channel counting efficiency as applicable, as a fraction such as cpm per dpm;

V = total volume represented by the sample, in ml;

f = fraction of the sample being counted; and

$RMDA$ = minimum detectable activity required for alpha- or beta-emitters, as applicable, in µCi/ml.

Note:

1 1. If the sample volume is indicated in ft^3, convert to ml using the following:

$ml = ft^3 \times 2.83E4$

OCCUPATIONAL AIR SAMPLE ANALYSIS RECORD

Sample No.: _____ Person/Location/Job: _____

Date Time On:_____
Date Time Off:_____

Flow Rate:_____ Sample Method (Personal/Hi-vol/Other): _____

Volume [A]: _____ mL

Instrument ID: _____ Calibration Due: ____/____/____

Instrument ID: _____ Calibration Due: ____/____/____

		Alpha Channel	Beta Channel
Gross counts	[E]:		
Gross counting time, minutes	[F]:		
Background counts	[G]:		
Background counting time, minutes	[H]:		
Net count rate, cpm	[J = E/F - G/H]:		
Instrument efficiency, cpm/dpm	[K]:		
Conversion factor	[L = A x K x 2.22E+06]:		
Air concentration, µCi/mL	[M = J / L]:		
MPC, µCi/mL	[N]:		
MPC fraction	[P = M/N]:		
Total MPC fraction	[P(alpha) + P(beta)]:		Lowest Limit ≤ 0.1

Notes:

[N]: Default for alpha is 3 E-12 µCi/mL. Default for beta is 5 E-10 µCi/mL.

Analyst _____ Date ____/____/____

Reviewed by _____ Date ____/____/____

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FENCE-LINE AIR SAMPLE ANALYSIS RECORD

Sample No.: _____ Location: _____

Date/Time On: _____

Date/Time Off: _____

Flow Rate: _____

Volume [A]: _____ mL

Sample Method
(Hi-vol/Low-vol/Other): _____

Instrument ID: _____ Calibration Due: ____/____/____

Instrument ID: _____ Calibration Due: ____/____/____

		Alpha Channel	Beta Channel
Gross counts	[E]:		
Gross counting time, minutes	[F]:		
Background counts	[G]:		
Background counting time, minutes	[H]:		
Net count rate, cpm	[J = E/F - G/H]:		
Instrument efficiency, cpm/dpm	[K]:		
Conversion factor	[L = A x K x 2.22E+06]:		
Air concentration, µCi/mL	[M = J / L]:		
Effluent Concentration guide, µCi/mL	[N]:		
Effluent concentration fraction	[P = M/N]:		
Total fraction	[P(alpha) + P(beta)]:		Limit: ≤ 1.0

Notes:
[N]: Default for alpha is 2 E-14 µCi/mL. Default for beta is 2 E-12 µCi/mL.

Analyst _____ Date ____/____/____

Reviewed by _____ Date ____/____/____

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