

SOP-RC-111

Determination of Radioactive Surface Contamination Using Swipe Surveys

Revision: 1

Approval:

 _____ 1/6/19

Laboratory Manager

Date

 _____ 12/2/19

LQAO/RSO

Date

Effective Date: 12-2-19

Renewal Date: _____ Initials: _____

Determination of Radioactive Surface Contamination Using Swipe Surveys

- i. Identification of method**
 - a. EPA 600/R-11/122, "Performance-Based Approach to the Use of Swipe Samples in a Radiological or Nuclear Incident"
 - b. Tarleton State University Radioa
- ii. Applicable matrix or matrices**
 - a. Solid samples-swipe media compatible with the counting system should be used.
- iii. Limit of detections and quantitation**
 - a. A negative swipe result doesn't conclude that there is zero removable contamination present. If removable contamination levels are present at low levels, they may not be detectable by use of swipes due to low transfer efficiency. Additionally, such low levels may not be detectable with portable survey instruments where a direct surface measurement is made, due to interference from background activity. Additionally, swipe media can influence the transfer efficiency as can the pressure applied when swiping the testing area.
 - b. Background is determined by measuring an unused swipe counted in the same manner as a sample swipe.
 - c. Level considered clean if the result is $< 2x$ background.
- iv. Scope and Application, including parameters to be analyzed**
 - a. Swipe: A radiation survey technique which is used to determine levels of removable surface contamination. A medium (typically filter paper) is rubbed over a surface (typically of area 100 cm²), followed by a quantification of the activity on the medium.
 - b. Swipes are used for confirmation of contamination free areas, or for determination of areas containing removable surface contamination. The Radiation Safety Officer (RSO) and/or Lab Manager (LM) may require swipes for safety, corrective actions or routine monitoring.
- v. Summary of methods**
 - a. To swipe test a surface area for removable radioactive contamination an appropriate filter media is used and moderate amount of pressure is applied to the swipe to transfer contamination to it from the surface area. After collecting single or multiple swipes from the same area, swipes are secured in a petri dish. Either gamma or alpha spectroscopy, gross alpha beta scintillation or a Tri-Carb Liquid Scintillation (LCS) is used determine the actual removable contamination. Additionally

Determination of Radioactive Surface Contamination Using Swipe Surveys

self-surveys are documented at a minimum of once a month or more frequent as warranted by the nature of the work, required procedure, or request of the RSO and/or LM. After the swipe has been collected and labeled it will be tested according to the appropriate testing procedure.

- b. Counting methods may be used at the direction of the RSO and/or LM include gross alpha/beta, gamma spec, etc.

vi. Definitions

- a. **Background radiation:** Every radiation detector indicates counts even without the presence of radiation sources or contamination. This results from electronic "noise" and from the detection of cosmic radiation and other natural radiation sources in the environment. This is called "background" radiation. The background counting rate for most detectors is usually between 10 and 100 counts per minute (cpm).
- b. **Fixed contamination:** refers to radioactivity remaining on a surface after repeated decontamination attempts fail to significantly reduce the contamination level.
- c. **Removable contamination:** refers to radioactivity that can be transferred from a surface to an absorbent material, such as filter paper or cotton swabs, by rubbing with moderate pressure and swiping an area of at least 100 centimeters squared.
- d. **Counts per minute (cpm):** The measure of radioactivity by which the number of nuclear disintegrations per minute (dpm) are detected and counted through detection of alpha, beta, or gamma radiation. Dpm is determined from cpm based on the detector's efficiency in measuring the radiation.
- e. **Disintegrations per minute (dpm):** The actual radioactivity of a substance representing the number of atoms decaying per minute by alpha, beta, and/or gamma radiation. Dpm is a calculated value based on the detector's cpm and efficiency in measuring the radiation.
- f. **Removal factor:** is the ratio of the activity of the radionuclides removed from the surface by one initial swipe sample to the total removable activity

vii. Interferences

- a. The amount of removable surface contamination transferred to a swipe sample will vary according to the:
 - i. Type of swipe material

Determination of Radioactive Surface Contamination Using Swipe Surveys

- ii. Method used,
 - iii. Physical and chemical nature of the contaminated material,
 - iv. Surface roughness of the material swiped, and
 - v. Physical and chemical nature of the radionuclide contaminant(s).
- b. In order to determine the extent of surface contamination of materials and the effectiveness of the decontamination processes reliably, the swipe removal factor for the contaminant must be determined for the various materials swiped
- c. Surface contamination can be influenced by many factors, including the presence of dirt and dust, migration into pores and cracks, pH, humidity, chemical interactions of the contamination with the surface, and weathering. The depth of contamination will vary with the radionuclide, its chemical form, type of surface, and the time since deposition. Penetration of contamination into the surface does not necessarily imply that it is not removable.
- viii. Safety**
- a. The individual who performs contamination surveys is always mindful of the presence of the radiation and radioactive material which may be present. While surveying for contamination, the individual will minimize the time spent in an area that is determined to be a radiation area. PPE must be worn.
 - b. Refer to QAM-S-101, "Laboratory Safety"
- ix. Equipment and supplies**
- a. Dry absorbent material (swipes) used to wipe the testing area, such as Whatman 41 filter paper or equivalent
 - b. Containers, bags or scintillation vial to hold the swipe
- x. Reagents and Standards**
- a. Refer to SOP-RC-103 "Determination of Tritium by Liquid Scintillation".
- xi. Sample collection, preservation, shipment and storage**
- a. Take a filter (swipe) then wipe an area approximately 100 cm² in an S shaped wipe in approximately 30 cm in length (assuming that the filter is 3 cm wide).
 - b. If stored, swipe samples are individually placed in paper envelopes, bags or scintillation vials. The containers are labeled with at least the sample ID, sampler name or initials,

SOP-RC-111

Determination of Radioactive Surface Contamination Using Swipe Surveys

and date/time of sample. Samples are received and logged into ESDMS as any other environmental sample received by the lab in accordance with QAM-Q-110, "Sample Receipt and Login".

- c. Swipes are placed directly into petri dishes or scintillation vials with cocktail rather than bags.

xii. **Quality control**

- a. All requirements for the counting method must follow the appropriate SOP and QAM-Q-101 "Laboratory Quality Control" unless the RSO and/or LM request data for information only.

xiii. **Calibration and Standardization**

- a. Refer to QAM-RI-101, QAM-RI-102 and QAM-RI-103 for calibration and operation of the appropriate instrument.

xiv. **Procedure**

a. **Swipe Surveys**

- i. Detection and evaluation of surface contamination can be carried out using one or more dry or wet smear [swipe] samples. When taking smear [swipe] samples from large areas, the following points are taken into consideration to determine the distribution of contamination (EPA Method ISO 7503):
- ii. If possible, the area to be smeared [swiped] measures about 100 cm².
 - Where regulations permit the averaging of the surface contamination over larger areas, such areas may be used for sampling and are included in the calculation of the results.
 - The smear [swipe] material is chosen to suit the surface to be checked (for example, filter paper for smooth surfaces, cotton textile for rough surfaces)
- iii. If a wetting agent is used for moistening the smear [swipe] material, this wetting agent should not exude from the material; **WARNING:** since the contamination may be absorbed into the structure of the smear [swipe] material or may be covered by residual moisture, the use of a wetting agent may lead to a significant underestimation of the contamination in the case of alpha-emitters.
- iv. The smear [swipe] is pressed moderately against the surface to be checked, using fingertips or, preferably, by

Determination of Radioactive Surface Contamination Using Swipe Surveys

means of a holder which is designed to ensure uniform and constant pressure

- v. The entire area of 100 cm² is smeared [swiped], when smearing outline an "S" shaped area.
- vi. If possible, circular filter papers are used as the swipe material (Whatman 41 paper)
- vii. The contaminated area of the swipe sample is smaller than or equal to the sensitive area of the probe, if an alternate instrument to the LSC is used.
- viii. After sampling, the swipe material is carefully dried in such a way that loss of activity is prevented.

b. Counting Swipes

- i. Swipes are loaded into an appropriately sized LSC vial. LSC cocktail (counting fluid) is then be added to the vial and then the vials will be placed into LSC racks and counted. The counting protocol is programmed to detect the radionuclides being used by the appropriate SOP/QAM. A background sample (a clean swipe in cocktail) is prepared and run along with your swipes. ***Contamination may considered to be any swipe sample that is found to have a count rate greater than two times the count rate of the background sample.***
- ii. Use the equation detailed in section xv. Data analysis and calculations to obtain the total removable surface contamination.
- iii. Approved counting methods, such as gross alpha/beta, gamma spectroscopy and liquid scintillation are used as authorized by the RSO and dependent on the material used for the procedure or survey.

a. Decontaminating a surface

- iv. Wear disposable gloves.
- v. If dry, then wet the area with water, which will prevent re-suspension.
- vi. Wipe up or wash down the area until the contamination is no longer visible, or until the contamination is likely removed. Paper towels are recommended, but anything can be used, such as a mop, and will finally be disposed of as waste.

Determination of Radioactive Surface Contamination Using Swipe Surveys

- vii. An adhesive material such as masking tape can be used to remove contamination that is not easily removable.
- viii. Anything used to clean up the contamination such as gloves or paper towels must be disposed of as dictated by QAM-W-101 "Disposal of Laboratory Waste"
- ix. Verification swipe tests will be performed to ensure contamination was cleaned up to appropriate limits.
- x. Dispose of any cleaning media according to QAM-W-101 "Disposal of Laboratory Waste".

xv. Data analysis and calculations

- a. Use the following equation to determine the dpm (Frame and Abelquist);

$$A_s = (R_{S+B} - R_B) / (\epsilon_i \epsilon_s F S)$$

- A_s = total removable surface contamination
- R_{S+B} = the gross count rate on a smear counter
- R_B = the background count rate
- ϵ_i = the instrument's efficiency i.s., the fraction of the particles leaving the surface that produce a count.
- ϵ_s = the source or surface efficiency i.s., the fraction of the decays within the sample that results in a particle (quantum) of radiation leaving the surface of the source.
- F = the removal fraction
- S = the surface area covered by the smear (100 cm²)

xvi. Method performance

- a. Method performance, data assessment and acceptance, corrective action: refer to QAM-Q-101, "Laboratory Quality Control".

xvii. Pollution prevention

- a. Waste management and pollution prevention: refer to QAM-W-101, "Disposal of Laboratory Waste".

xviii. Data assessment and acceptance criteria for quality control measures

- a. Method performance, data assessment and acceptance, corrective action: refer to QAM-Q-101, "Laboratory Quality Control".

xix. Corrective actions for out-of-control data

- a. All aspects of this procedure comply with QAM-Q-101, "Quality Control" and QAM-Q-105 "Corrective Action".

Determination of Radioactive Surface Contamination Using Swipe Surveys

- xx. Contingencies for handling out-of-control or unacceptable data**
 - a. All aspects of this procedure comply with QAM-Q-101, "Quality Control" and QAM-Q-105 "Corrective Action".
- xxi. Waste management**
 - a. Refer to QAM-W-101 "Disposal of Laboratory Waste"
- xxii. References**
 - a. Performance-Based Approach to the Use of Swipe Samples in a Radiological or Nuclear Incident, EPA 600/R-11/122, October 2011.
 - b. STANDARD OPERATING PROCEDURE FOR RADIATION CONTAMINATION SURVEYS, Radiation Safety Office at the University of Vermont.
 - c. Frame, Paul W., and Eric W. Abelquist. "Use of Smears for Assessing Removable Contamination." Health Physics 76 (1999).
 - d. QAM-R-100, "TIAER Laboratory Radiochemistry Program".
- xxiii. Table, diagrams, flowcharts and validation data**
 - a. none