
	UR-ENERGY USA, INC. LOST CREEK ISR, LLC STANDARD OPERATING PROCEDURE	
ALPHA/BETA SAMPLE COUNTING SYSTEMS		
Edition: 16Jul2013	SOP Number: SOP_LC_HP-011	Author: CJP
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1.0 PURPOSE



The purpose of this Standard Operating Procedure (SOP) is to describe the use of Alpha/Beta (α/β) sample counting systems for radiologic assessments at the Lost Creek ISR (LC-ISR) Project site. The instruments are used to detect alpha (α) and beta (β) radiation on swipes or filters used for a variety of health physics (HP) survey tasks such as surface contamination surveys, respirator swipe surveys for dryer operators, in-field sample analysis, clean up sample analysis. The instruments will likely be kept in the HP Lab. Examples of instruments that may be used for α/β counting include the Ludlum Model 3030P and the Protean ASC-950-DP Automatic Sample Counter. This SOP will be used in conjunction with the owner's manuals to ensure quality results are obtained.



2.0 RESPONSIBILITIES

The Radiation Safety Officer (RSO) and EHS Staff are responsible for:

- Ensuring up-to-date calibration, and routine instrument function checks
- Ensuring proper training of instrument users

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Instrument Users are responsible for:

- Proper use of instrument according to the SOP and User's Manual in a manner that does not damage the instrument and produces reliable, consistent results
- Maintaining instrument in a working condition
- Notifying the RSO or Health Physics Technician (HPT) if the instrument is not functioning properly

3.0 PREREQUISITES AND TRAINING

The instrument shall be maintained in a properly functioning condition through routine calibration, cleanliness, and function checks.

Swipe or filter samples will have been produced from a variety of health physics survey techniques and will be placed in the sample counters for analysis.

Instrument users are required to read this SOP, be familiar with the User's Manual, and receive hands on training with the RSO or HPT.

4.0 DEFINITIONS

Crosstalk: The overlap of counting pulse height or pulse shape between the alpha signal and the beta signal when the two signals are counted simultaneously.



Count: When alpha or beta particle disintegration is detected by the instrument the result is called a count. The sum of the counts is interpreted as a pulse which is the statistical interpretation of the sum of the counts based on the detected energy of the particle and the number of detections.

Function check: A routine check to ensure the instrument is functioning properly and that measurement has not deviated from calibration.

Planchet: Circular disc with a rim for holding filter/swipe samples for analysis.

Plate: A planchet holder on an automatic counting system that allows the instrument to know which sample is in the detector chamber. There are five types:

- End Plate: Tells the machine to stop

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- Skip Plate: Just used as a spacer between the End Plate and the last sample plate.
- Routine Plate: Tells the instrument how to count and report results for a batch.
- QC Plates: A set of three plates, that instrument uses to know which control chart to update.

Routine: Is the set up measurement characteristics of the sample, such as time, sample flagging limits, and which radiation types are being measured.

Window: This is a cover over the detectors active counting volume. In an α/β instrument it is made of Mylar, a very thin and shiny material.

5.0 HAZARD ASSESSMENT AND PPE

There are no inherent hazards using an α/β counting device.



Instrument users may wear disposable gloves (e.g. nitrile) when placing media in the counters.

6.0 PROCEDURE

An α/β counter will be used to count either swipe or filter samples produced from a variety of HP surveys. Associated SOPs that may result in filter or swipe samples counted by the instrument may include:

- SOP_LC_HP-005: *Indoor Radon Monitoring and Mitigation*
- SOP_LC_HP-008: *Indoor Airborne Radiological Sampling*
- SOP_LC_HP-010: *Surface Contamination Surveys*
- SOP_LC_HP-014: *Screening and Decontamination of Materials*
- SOP_LC_HP-017: *Breathing Zone Air Monitoring*

After the sample swipe or filter is used in a survey, it is placed in the counting device to measure or count the quantity of alpha and/or beta particles emitted from the media. Samples are typically stored in envelopes. Care should be used to prevent damage to sample media when transferring to and from envelopes. Tweezers may be used to transfer media between envelopes and counting trays or planchets.

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6.1 Analyzing Sample

Select applicable instrument for analysis following sample collection.



Single Sample Counter (e.g. Ludlum 3030P)

1. Turn on instrument
2. Perform a QC checks on instrument if not already completed
 - a. Remove all insert from the sample tray.
 - b. Place a beta source in the center of sample tray, and then alpha source on top of the beta source.
 - c. Close tray and push "QC Check" button. The instrument will indicate if it is not within acceptable limits.
3. Carefully remove media from envelope or other storage device
4. Place sample in planchet, ensuring samples do not stick up above the planchet. Swipe samples are placed with the active side up (i.e. the side that made contact with the sampled surface).
5. Open sample tray
6. Place planchet in sample tray
7. Ensure count time is set to an appropriate count time, as detailed in the specific SOP related to the type of sample being measured.
8. Start the count
9. If the sample is contaminated, dispose of sample in 11e2 byproduct waste
10. Turn off instrument when finished

Automated Sample Counter (e.g. Protean ASC-950-DP)

For a small number of samples to be counted, it might be easier to manually insert the sample. A QC check is only needed if it has not been performed already that day.



1. Turn on instrument
2. Perform QC checks on instrument if not already completed once that day
 - a. Select QC check
 - b. Use the deepest planchette holder.
 - c. Place a beta source in the center of sample planchette, and then alpha source on top of the beta source. Place the planchette and planchette holder into the sample tray.

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- d. Select "0" button, to choose to only count the sample once.
 - e. When finished compare the results to the acceptable range (posted on the instrument). Press "Exit" to remove samples.
3. Place sample in planchet, ensuring samples do not stick up above the planchet
 - a. Samples that stick up could damage the instrument's thin Mylar window.
 - b. Swipe/Filter samples are inserted with the side that collected the sample facing up.
4. Place planchet in sample plate.
5. Press "Diagnostics" button on the top menu.
6. Press "Manual Count".
7. Select the desired counting mode: Alpha, Beta, or Alpha and Beta.
8. Select the desired sample count time , as detailed in the specific SOP related to the type of sample being measured.
9. Press "Load" and the sample arm will extend.
10. Insert sample plate with sample into open sample arm.
11. Press "Start" and the sample arm will retract to measure the sample.
12. The screen will say "Ready" when the sample is finished.
13. Push "Exit" when complete.
14. Turn off instrument when finished

When measuring multiple samples in a sample batch:

1. Turn on instrument
2. Include the 3 QC check sample trays: blank, alpha source, and beta source
3. Place samples in planchets, ensuring samples do not stick up above the planchet
 - a. Samples that stick up could damage the instrument's thin Mylar window.
 - b. Swipe/Filter samples are inserted with the active side that collected the sample facing up.
4. Load samples in the appropriate stacks
5. Place sample stack in sample tray
6. Analyze sample batch

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6.2 Quality Assurance/Quality Control

6.2.1 Data Objectives

Data collected from the α/β system includes sample activity in gross α or gross β counts per minute for swipes or filters. The confidence in data is maintained by control charts. Confidence in the instrument is maintained by QC checks, efficiency determination, crosstalk adjustment, and calibration of the instrument as described below. The expected data is likely to be at background levels. Data will be charted for control thresholds. Any data with values greater than background at 95% confidence may be an indication of contamination issues that shall be investigated in accordance with the ALARA program.

The detection limit of the instrument is dependent upon the sample being analyzed. Count times should be sufficient to allow for the detection limit to be met. Detection limits for various samples are discussed in the SOP applicable to the sample collection method.



6.2.2 Measurement Quality Control

Function checks are described above in Section 6.1 and include QC checks for the instrument. The acceptable range for check source values are +/- 10% of the statistical average of 20 background-corrected measurements. Check source thresholds are described in SOP_LC_HP-004: *Instrument Calibration*.

Weekly, the two systems will be cross checked by running the same sample on both. Initially a deviation within 10 percent will be considered acceptable.

Instrument background will be determined each day the instrument is used, and the results are added to the control chart. The instrument efficiency value will be determined based on the results of the source counted during a function check. The efficiency for α and β separately shall be calculated daily using the following equations:

$$E_{\alpha} = \frac{CPM_{\alpha \text{ source}} - CPM_{\alpha \text{ background}}}{DPM_{\alpha \text{ source}}} \times 100\%$$

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$$E_{\beta} = \frac{CPM_{\beta \text{ source}} - CPM_{\beta \text{ background}}}{DPM_{\beta \text{ source}}} \times 100\%$$

Where:

***CPM_{α source}** : The α count rate with a Th-230 source (or alternate) in the instrument*

***CPM_{β source}** : The β count rate with a Tc-99 source (or alternate) in the instrument*

***CPM_{α background}** : The α count rate with no source in the instrument*

***CPM_{β background}** : The β count rate with no source in the instrument*

***DPM_{α source}** : The true decay rate of the α source*

***DPM_{β source}** : The true decay rate of the β source*

For α/β counters, the crosstalk factor needs to be determined. Use the following equations for determining the crosstalk using the 10 minute count time data from steps a, b, and c:

$$\text{Alpha Crosstalk} = \frac{\alpha \text{Source} \beta \text{Counts} - \text{Counts} \beta \text{Background}}{\alpha \text{Source} \alpha \text{Counts}} \times 100\%$$

Where:

***αSourceαCounts**: The total α counts when the α source is in the instrument*



***αSourceβCounts**: The total α counts when the β source is in the instrument*

***CountsαBackground**: The total α counts for a background measurement*

$$\text{Beta Crosstalk} = \frac{\beta \text{Source} \alpha \text{Counts} - \text{Counts} \alpha \text{Background}}{\beta \text{Source} \beta \text{Counts}} \times 100\%$$

Where:

***βSourceαCounts**: The total β counts when the α source is in the instrument*

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β Source β Counts: *The total β counts when the β source is in the instrument*

Counts β Background: *The total β counts for β background measurement*



1. Under the General Settings tab of the LMI Model 3030P Control Software enter the appropriate information (The Automated Sample Counter, - Protean ASC-950-DP, performs the above calculations automatically):
 - a. Under count mode select DPM.
 - b. Enter the efficiencies calculated in step 6d.
 - c. Activate Background Subtract, and enter the background information determined in step 6a.
 - d. Activate Crosstalk Correction, and enter the information calculated in step 6e.
 - e. Update the Calibration Due date.
2. Download the data from the instrument and clear the data, including previous QC check data.
3. Shut down the software, and remove the USB cable from the instrument.
4. Perform a QC check.
 - a. Remove all inserts from the sample tray.
 - b. Place a beta source in the center of sample tray, and then alpha source on top of the beta source.
 - c. Close tray and push "QC Check" button. The instrument will indicate if it is not within acceptable limits.

6.2.3 Calibration

Either the instrument will be sent to Ludlum for calibration annually or instrument calibration will be performed by the RSO or HPT using procedures described in the User's Manual for the make and model of counter. Instrument calibration is also discussed in SOP_LC_HP-004: *Instrument Calibration*.

6.2.4 Data Validation and Verification

The operator shall only operate the instrument during a valid calibration period. The RSO/HPT shall review the data results to look for any unusual data inconsistent with expectations. How the data validation and verification will be performed will depend

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mostly on the type of sampling. See the specific SOP for the type of sampling being performed (E.g. Airborne Radionuclide, Surface Contamination, etc.).

6.2.5 Audits/Corrective Actions/ALARA

The RSO/HPT may review the results of calibration and background control to determine if the instrument is performing within expectations. Control charts will be an indicator of problems that should be investigated such as upward trends in sample data values which may be an indicator of increasing contamination levels. An ALARA investigation should be performed and the results provided in the Monthly RPP/ALARA Report. Corrective actions shall be recommended and implemented as feasible.

7.0 DOCUMENTS AND RECORDS

Document and records that will be retained associated with alpha/beta counter operation include:

- Analytical data. If equipped with a datalogger, data from the instrument shall be downloaded at least monthly.
- Calibration records kept on file either in the electronic database or a paper copy will be kept on file in the EHS offices.

8.0 REFERENCES

Ludlum Measurements, Inc., *Ludlum Mod 3030P Alpha Beta Sample Counter*, Feb 2013, [LINK](#)

Protean Instrument Corporation, *ASC-950 Manual*, Revision 1.3, [LINK](#)

SOP_LC_HP-004: *Instrument Calibration*

SOP_LC_HP-005: *Plant Radon Monitoring and Mitigation*

SOP_LC_HP-008: *Indoor Airborne Radiological Sampling*

SOP_LC_HP-010: *Surface Contamination Surveys*

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