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1.0 INTRODUCTION

⇒ The Eberline ESP/pancake probe consists of a microcomputer-based portable radiation survey instrument (Eberline Smart Portable, ESP) and a "pancake" Geiger Mueller (GM) tube (Hand Probe, HP260/HP360) with a thin mica window. The thin mica window, which is protected by a sturdy wire screen, permits the useful detection of beta radiation of energies as low as 40 KeV. ^{10 CFR 835.401(c)(2)}

This procedure has been revised to incorporate applicable parts of "Occupational Radiation Protection," 10 CFR 835.

2.0 PURPOSE

This procedure provides guidance in the proper operation of the Eberline ESP/pancake Beta/Gamma survey meter.

3.0 SCOPE

This procedure applies to ESH-1 personnel who operate the Eberline ESP/pancake probe. The instrument may be used to perform a direct frisk of personnel, equipment or areas, or may be used to monitor swipes/smears.

4.0 DOCUMENT SPECIFIC DEFINITIONS

See "Master Glossary," ESH-1-01-05, for standardized definitions.

Count rate mode: In the context of this procedure, count rate mode refers to using the ESP/HP260/HP360 in a rapid response manner. The display indicates counts per minute in this mode and is the typical mode of operation.

Scaler mode: In the context of this procedure, scaler mode refers to using the ESP/HP260/HP360 in a timed count manner while holding the probe still. The count time is set by the user for ten minutes (as an example) and the counts are collected for that ten minutes. Dividing the counts by the time gives the cpm. The scaler mode is useful in determining lower levels of activity.

5.0 RESPONSIBILITIES

Radiological Control Technicians (RCTs) and other appropriately trained and qualified individuals

- Operate the Eberline ESP/HP260/HP360 in accordance with the requirements of this procedure.
- Report any abnormalities encountered during instrument performance testing and/or operation to RCT supervision.
- Ensure that instruments are returned to the ESH-4 Radiation Instrument Pool (RIP) for routine calibration, preventive maintenance and/or corrective maintenance.

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RCT supervision

Ensure that RCTs follow this procedure.

6.0 PRECAUTIONS AND LIMITATIONS

- 6.1 The HP260/HP360 window is protected by a wire screen. Reasonable care should be taken to avoid poking the window with sharp objects.
- 6.2 A faulty detector cable may cause false readings when the cable is moved.
- 6.3 The HP260/HP360 probe will respond to alpha particles of energies above 3 MeV.
- 6.4 High voltages exist in the instrument whenever it is on. Always turn the instrument off before opening the case or removing or replacing detectors or cables.
- 6.5 The potential for contamination of the HP260/HP360 probe holder exists. The probe holder should be surveyed during the instrument release survey.

7.0 PROCEDURAL STEPS

7.1 Prerequisites

- ⇒ 7.1.1 Verify that the instrument is in calibration by inspecting the calibration sticker on the instrument. ^{10 CFR 835.401(c)(1)}

NOTE: If the instrument is due for calibration, remove it from service and go to section 7.7, Instrument Maintenance.

- 7.1.2 Inspect the instrument and detector for evidence of mechanical or electrical defects (such as broken detector mylar, loose electrical connections, or dents in the instrument case).

NOTE: If the instrument has visible defects that would prevent it from operating acceptably, remove it from service and go to section 7.7 Instrument Maintenance.

- 7.1.3 Turn the instrument on by pressing the "ON/OFF" switch.

- 7.1.4 If the first character of the display is blinking, or if the display does not come on, the batteries need to be replaced. If the display indicates anything other than "CNT/MIN" (counts per minute), remove the instrument from service and go to section 7.7, Instrument Maintenance.

- 7.1.5** Press "RESET"; the bar graph and the numerical indication of the count rate should be displayed. Perform the following steps:
- 1) Observe the count rate which should typically be between 150 and 250 cpm. (The display would show *1.50 + 02* to *2.50 + 02 cnt/min.*)
 - 2) Move the probe around as you would in surveying. If the count rate changes greatly, it may be an indication of a faulty detector cable.
 - 3) If the count rate is significantly lower or higher than in step 1 or if the count rate changes drastically to the extent that it would prevent you from conducting the survey, go to section 7.7, Instrument Maintenance.
- 7.1.6** Press "SPKR," and listen for an audible indication (clicking sounds) that the instrument is detecting "events."
- ⇒ **7.1.7** Refer to "Operational Checks of Beta/Gamma Survey Instruments," ESH-1-07-85, for the required instrument operational checks. ^{10 CFR 835.401(c)(4)}
- 7.1.8** Press "ON/OFF" to turn the instrument off.
- 7.2** **Determining the Area Background with the Eberline ESP/HP260/HP360**
- 7.2.1** Press "ON/OFF" to turn the instrument on.
- 7.2.2** Press "MODE." The display shows "SCALER MODE?"
"+ = USE/ - = NO"
- 7.2.3** Press "+." The display shows "UNITS = cnt"
"+ = USE/ - = NO"
- 7.2.4** Press "+." The display shows "UNITS = cnt"
"ALM AT x.xx + xx"
(where x is a number)
- 7.2.5** Press "+." The display shows "UNITS = cnt"
"CNT FOR x:xx:xx"
- 7.2.6** If you want to change the count time for the scaler mode, then hold down "RESET" while pressing "+" to increase the count time (which is in minutes) or while pressing "-" to decrease the count time.
- NOTE: The rate of change of the count time increases the longer the "+" or "-" switches are held down.*
- 7.2.7** Press "+." The display shows "CNT FOR 0:01:00" (or the count time just set)
"RESET TO START."

- 7.2.8** Press "RESET." The display shows
"0:00:59 LEFT" (or the remaining count time)
"1.49 + 02 cnt" (display shows the actual total count).

*NOTE: At the end of the count time the display shows
"CNT FOR 0:1:00" (or the actual total count time)
"1.50 + 02 cnt" (display shows the actual total count).
Divide the total count by the count time (in minutes) to obtain the background
count rate in cpm.*

- 7.2.9** If the area background count rate is greater than 500 cpm, the equipment or item to be surveyed should be moved to an area of lower background or the source of interfering radiation should be removed.

NOTE: If the equipment or item cannot be moved or if the background count rate cannot be lowered, consult with ESH-1 supervision.

- 7.2.10** Press "RESET" to start another background count or "ON/OFF" to turn off the instrument.

7.3 Determining Minimum Detectable Count Rate (MDCR) and Minimum Detectable ⇒ Activity (MDA)

- 7.3.1** Perform an area background count in accordance with section 7.2.
- 7.3.2** Record the background count rate in cpm on the survey form.
- 7.3.3** Calculate the minimum detectable count rate (MDCR) by using the following formula.

$$MDCR = R_b + 3.29\sqrt{R_b}$$

(MDCR equals background count rate plus 3.29 times the square root of the background count rate.)

NOTE: This calculation is for the 95% confidence level.

- 7.3.4** Calculate the minimum detectable activity (MDA) in DPM by multiplying the MDCR by the calibration correction factor (typically 2 for this instrument). ^{10 CFR 835.404(a)}

7.4 Operating the ESP/HP260/HP360 in the Count Rate Mode

- 7.4.1** The Eberline ESP/HP260/HP360 may be used to perform a direct frisk of personnel, equipment or areas, or may be used to monitor swipes/smears.
- 7.4.2** Press "ON/OFF" to turn the ESP on.

NOTE: The "RESET" switch provides a rapid means of resetting the meter to zero after a reading has been taken and recorded.

7.4.3 Press "MODE." The display shows "SCALER MODE?"
"+ = USE/ - = NO"

7.4.4 Press "-." The display shows
"ALM AT x.xx +xx" (display shows the actual set point)
"1.51 + 02 cnt/min" (display shows the actual count rate).

7.4.5 If you want to change the alarm set point for the count rate mode, then hold down "RESET" while pressing "+" to increase the alarm set point or while pressing "-" to decrease the alarm set point.

NOTE: The rate of change of the alarm set point increases the longer the "+" or "-" switches are held down.

NOTE: The alarm set point is determined by the release criteria. Refer to "Releasing Materials and Equipment," LP107-04, for release criteria.

7.4.6 Press "MODE." The display shows the bar graph and the numerical indication of the count rate.

7.4.7 Press "SPKR" to turn the speaker on.

7.4.8 Listen to the speaker and observe the meter for an indication of the average background count rate.

⇒ 7.4.9 If performing a direct frisk, hold the detector within ½ inch of the surface to be surveyed and move the detector across the surface to be surveyed at less than or equal to 2 inches per second. If a positive response above background is noted (an increase in clicking rate or the numerical or bar graph display), stop the frisk and monitor the affected area for about 30 seconds or until meter response has stabilized. ^{10 CFR 835.404(a)}

NOTE: The HP260/HP360 will respond to alpha particles of energies above 3 MeV with an efficiency much lower than its efficiency for typical beta particles. If interference by alpha particles is suspected, a piece of paper held between the detector and the source of radiation will stop any alpha particles while having minimal effect on most beta particles.

NOTE: Pressing the "+" key temporarily places the meter into a slower response mode, which also allows a more precise count.

NOTE: Do not allow the probe to come into direct contact with the surface being surveyed to prevent contamination and damage to the probe.

- 7.4.10 If screening swipes/smears or filters prior to analysis, hold the detector within ½ inch of the sample media and wait for a meter response. Monitor for about 10 seconds; if no increase in count rate is noted, move to the next sample. If an increase in count rate is noted, monitor for about 30 seconds or until meter response has stabilized.
- 7.4.11 Compare the meter readings with the MDCR determined in section 7.3.
- 7.4.12 If the meter reading is less than the MDCR determined in section 7.3, record it as < MDA on the survey record, or NDA (no detectable activity).
- 7.4.13 If the meter reading is greater than the MDCR, then subtract the background from the meter reading. This is the net CPM (counts per minute) to be used in the calculation for DPM/100 cm² or DPM per probe area.
- ⇒ 7.4.14 The conduct of surveys, the conversion of survey data to dpm and the recording of survey results shall be performed in accordance with "Contamination Monitoring Standard," ESH-1-02-01, and "Surveying for Alpha and/or Beta/Gamma Contamination," ESH-1-02-02. ^{10 CFR 835.404(a)}
- 7.4.15 When instrument use is complete, press the "ON/OFF" switch to turn the instrument off.
- 7.5 Surveying with the ESP/HP260/HP360 in the Scaler Mode**
- 7.5.1 Press "ON/OFF" to turn the instrument on.
- 7.5.2 Press "MODE." The display shows "SCALER MODE?"
"+ = USE/ - = NO"
- 7.5.3 Press "+." The display shows "UNITS = cnt"
"+ = USE/ - = NO"
- 7.5.4 Press "+." The display shows "UNITS = cnt"
"ALM AT x.xx + xx"
- 7.5.5 If you want to change the alarm set point for the scaler mode, then hold down "RESET" while pressing "+" to increase the alarm set point, or while pressing "-" to decrease the alarm set point.
- NOTE: The rate of change of the alarm set point increases the longer the "+" or "-" switches are held down.*
- NOTE: The alarm set point is determined by the release criteria. Refer to "Releasing Materials and Equipment," LP107-04, for release criteria.*
- 7.5.6 Press "+." The display shows "UNITS = cnt"
"CNT FOR x:xx:xx"

- 7.5.7 If you want to change the count time for the scaler mode, then hold down "RESET" while pressing "+" to increase the count time (which is in minutes) or while pressing "-" to decrease the count time.
- 7.5.8 Press "+." The display shows
"CNT FOR 0:01:00" (or the count time just set)
"RESET TO START"
- 7.5.9 Hold the probe directly over and within ½ inch of the surface to be surveyed while in the scaler mode.
- 7.5.10 Press "RESET." The display shows
"0:00:59 LEFT" (or the remaining count time)
"1.49 + 02 cnt" (display shows the actual total count).

NOTE: At the end of the count time the display shows

"CNT FOR 0:1:00" (or the actual total count time)

"1.50 + 02 cnt" (display shows the actual total count).

Divide the total count by the count time (in minutes) to obtain the background count rate in cpm.

- 7.5.11 Press "RESET" to start another background count or "ON/OFF" to turn off the instrument.

7.6 Battery Replacement

CAUTION: Do not open the instrument case in an area controlled for contamination.

- 7.6.1 If the batteries need to be replaced, perform the following steps.

NOTE: Routine battery replacement is normally performed by ESH-4. In those situations where an instrument has dead batteries and no other appropriate instrument is available, the RCT in the field may replace the batteries in accordance with this procedure.

- 7.6.2 Ensure the meter is "OFF."
- 7.6.3 Turn the instrument upside down and remove the large screw in the center of the bottom cover with a screw driver.
- 7.6.4 Remove the bottom cover.
- 7.6.5 Replace the six 'C' cell batteries with fresh batteries. The inside of the instrument case is marked with the correct battery polarity.
- 7.6.6 Replace the bottom cover and screw the large screw back in and go to section 7.1 Prerequisites

7.7 Instrument Maintenance

CAUTION: Instrument maintenance to be performed by the RCT is limited to the actions stated in this section. Do not adjust calibration or controls not specifically stated in this procedure.

- ⇒ **7.7.1** If the instrument is due for calibration or if the meter (not the detector or cable) has visible damage that would prevent it from operating acceptably, survey and tag it for return to RIP. ^{10 CFR 835.401(c)(1)}

NOTE: The HP260/HP360 probe holder should be surveyed as part of the instrument release survey because the potential exists for contamination of the probe handle and the probe holder.

- 7.7.2** If the detector cable is defective, perform the following steps.

- 1) Ensure the meter is "OFF."
- 2) Detach the cable from both the detector and meter ends.

CAUTION: The two connector ends on the cable are not identical. The connector end with the protruding longer white insulator connects to the ESP. Do not force the connectors to go together.

- 3) Replace the defective cable with a good cable of the same type and length and go to section 7.1, Prerequisites.

- 7.7.3** If the cable needs to be returned to RIP, survey and tag it for return.

8.0 REQUIRED RECORDS

None

9.0 REFERENCES

LANL Radiological Control Manual, LM107-01
"Releasing Materials and Equipment," LP107-04
"Contamination Monitoring Standard," ESH-1-02-01
"Surveying for Alpha and/or Beta/Gamma Contamination," ESH-1-02-02
"Operational Checks of Beta/Gamma Survey Instruments," ESH-1-07-85
Eberline Model ESP (Eberline Smart Portable) Technical Manual
"Eberline ESP-1 Survey Meter with the Model HP-260 GM Pancake Probe," ESH4-RIC-TBD-003, RO

10.0 ATTACHMENTS

NONE