HARVARD
Campus Services
ENVIRONMENTAL HEALTH & SAFETY

Radiation Survey Meter and Probe Choice

Which Radiation Detector/Probe should I be using?

Each portable radiation survey instruments has different detection capabilities. There are 3 common categories : Geiger-Mueller, scintillation, and ionization chambers. Typically, labs do not use an ionization chamber. Choose the hand-held survey meter or instrument as appropriate for the radionuclide from the table below.

Which Instrument(s) should I use?

Radionuclide	Emission	Energy (MeV)	Detector	Probe
^{3}H	beta	0.0186	LSC	N/A
^{14}C	beta	0.156	Survey Meter	Pancake GM Probe
			LSC	N/A
^{32}P	beta	1.709	Survey Meter	Pancake GM Probe
^{33}P	beta	0.249	Survey Meter	Pancake GM Probe
			LSC	N/A
^{35}S	beta	0.167	Survey Meter	Pancake GM Probe
^{45}Ca	beta	0.257	Survey Meter	Pancake GM Probe
^{51}Cr	gamma	0.320	Survey Meter	Pancake GM Probe
^{60}Co	gamma	1.17, 1.33	Survey Meter	Pancake GM Probe
^{125}I	gamma	0.035	Survey Meter	Nal
^{131}I	gamma, beta	0.364	Survey Meter	Pancake GM Probe, Nal

- In general, for betas, choose a pancake probe (preferable) or at least a Thin Window GM detector.

Geiger-Mueller Detector

The Geiger-Mueller (GM) probe is the most common radiation detection instrument on campus. In this meter, radiation detection causes both visual and audio responses. The meter detects radiation events and does not differentiate types of energies or radiation. The GM is only used to detect radiation and does not measure radiation dose. The most common GM is a Pancake Probe, as shown below with a survey meter.

General Purpose Survey Meter with GM Probe

The GM probe has a thin 'window' at one end that is very fragile. This probe is used for detecting beta emitters (e.g., ^{32}P, ^{35}S, and ^{14}C). However, low energy beta emitters such as ^{3}H are not detectable since they do not have enough energy to penetrate the window. Instead use a liquid scintillation counter. ^{14}C and ^{35}S emit betas energetic enough to pass through the thin window. Examples of GM probe efficiencies (approx.) under ideal conditions:

Radionuclide	Pancake GM Efficiency at 1 cm
^{3}H	Not Detectable
^{14}C	1% - 5%
^{35}S	3% - 8%
^{32}P	25% - 30%
^{125}I	< 0.01%

Low energy betas may not be detectable if the probe window is covered with paraffin film, plastic wrap, or other protective material. The efficiency for higher energy betas will be substantially reduced with any covering.

Because radioactive decay is random, the meter reading, at low count rates, often fluctuates widely. For this reason, the audio speaker is sometimes a better indicator of small amounts of radioactivity. At higher count rates, the speaker response is often faster than the meter reading. It is better, therefore, to have the speaker on and the response set to fast, "f", on the f/s switch, when using a survey meter to look for contamination. Once contamination is found, switch to slow ("s") to measure the count rate.

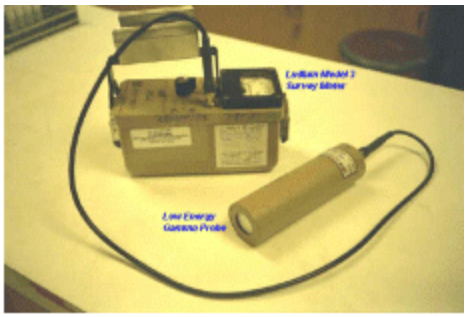
Scintillation Detector/Probe

Scintillation detectors absorb radiation and emit light that is converted into a radiation measurement. There are two types of scintillation detectors a solid hand-held instrument and a liquid counting system.

Liquid Scintillation Counter

The Liquid Scintillation Counter (LSC), is used to detect low energy emitters (^{3}H, ^{14}C, ^{35}S, and ^{125}I) and can be use to count contamination removed by wipe samples.

A scintillation probe is used on survey meters like the Ludlum 3 for low energy photons (gamma-rays (125I) and x-rays less than 40 keV). The efficiency of a low energy scintillation probe (shown right) for the detection of 125I is about 30-35%.



Survey Meter with Scintillation Probe

Ionization Chamber

Ionization Chamber

Ionization chambers (shown left) are suitable for measuring radiation exposure rate or cumulative radiation exposure. This instrument is not recommended for use in labs to detect contamination.