Radiation Detection Probes and Their Dial Scales

By George Dowell

Radiation detection probes:
Pay attention to the "Gamma Sensitivity" numbers in the specification sheets and charts. This figure gives a clue as to how sensitive a certain tube is compared to another tube or probe. The number indicates how many pulses you would get from a uniform flux of Cs-137, in counts per minute/per mR/H. Each probe must use a dial scale that is correctly delineated for the CPM/mR/H of that probe. Only LUDLUM MEASUREMENTS makes dial scales that are easily changed to match their respective probes. NOTE: The mR/H scale is ONLY accurate when measuring Cs-137, OR when using an energy compensated probe (44-38).

For all probes except the few specifically labeled " Energy Compensated" , the other factor is Gamma Energy Response> different tubes and probes will respond to varying energy levels according mainly to construction materials used, and volume and pressure of fill gas or crystal (size of probe). In general, Low Energy Gammas (LEG) must be of sufficient strength (meaning energy level, not number of disintegrations) to penetrate the housing material. A Z number is used to indicate density of any material, based on atomic makeup. Some probes utilize LOW Z windows to allow in extra low energy rays and particles.
Once inside the tube, lower energy Gammas are much more likely to cause an interaction, and therefore be counted. At some point as the energy level increases, the ray will simply pass out of the tube and not be counted. These facts account for the whipsaw shape of the energy response curves of all GM tubes. External filtering may be applied to compensate for this non-linear effect, resulting in a probe that is called" energy compensated". Be aware that this procedure knocks all the response down to the lowest level, and that although now nearly perfectly linear, such a probe will give lower reading than you may be used to from the more common "energy dependent" probes.

Making a rough estimate of activity may be found by applying this formula:
@1 meter 1Ci= .381 R

where 1uCi=10^-6 Ci

and using the inverse squared law:
@ 1/2 meter = X4
@1/4 meter = X 16
@ 1/8 meter= X64
@ 1/16 meter = X256
etc.

1 uCi is always equal to 3.7 X 10^4 DPS (disintegrations per second) or 2.22 X10^6 DPM no matter what type of radiation is involved.
http://www.sizes.com/units/curie.htm
http://www.radcon.arizona.edu/training/RSPC-CH.pdf

When the term 4Pi is used, it refers to disintegrations in all directions, as in a sphere. Most probes can only see from one direction and as such are 2Pi (1/2 of a sphere). GEOMETRY is the term used to indicate the area that the radiation fills in relation to the probe. Technically it is the angle subtended by the probe.
Best geometry is achieved if the probe is 10X its own diameter away from the source.
4Pi or near 4Pi can be achieved with hollow probes (as in WELL probes) where the radioactive sample is placed inside. Liquid scintillators are also 4Pi, as the sample is inside the liquid.

MODEL 44-9 Pancake G-M Detector

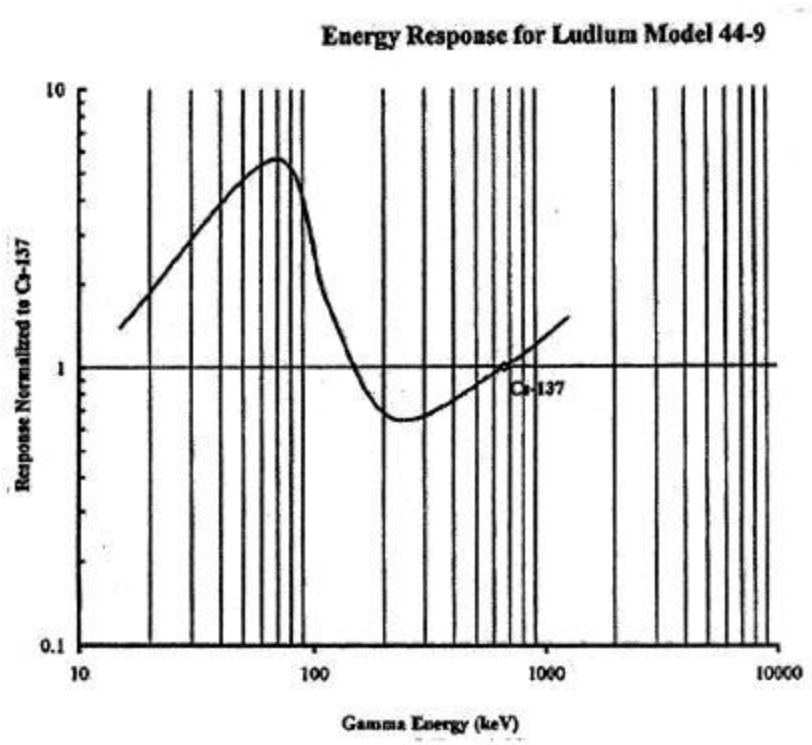
PART NUMBER: 47-1539

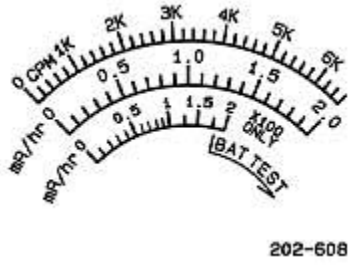
The Model 44-9 is a pancake G-M that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

CE

INDICATED USE: Alpha beta gamma survey; Frisking
DETECTOR: Pancake type halogen quenched G-M
WINDOW: 1.7 ± 0.3 mg/cm² mica
WINDOW AREA:
Active - 15 cm²
Open - 12 cm²
EFFICIENCY (4pi geometry): Typically 5%-^{14}C; 22%-$^{90}Sr/^{90}Y$; 19%-^{99}Tc; 32%-^{32}P; 15%-^{239}Pu
SENSITIVITY: Typically 3300 cpm/mR/hr (^{137}Cs *gamma*)

MODEL 44-9 Alpha, Beta, Gamma Detector





0-6.6k cpm; 0-2 mR/hr
For Model 44-9; 44-9-18;
44-40; 44-88; 44-89; 44-94

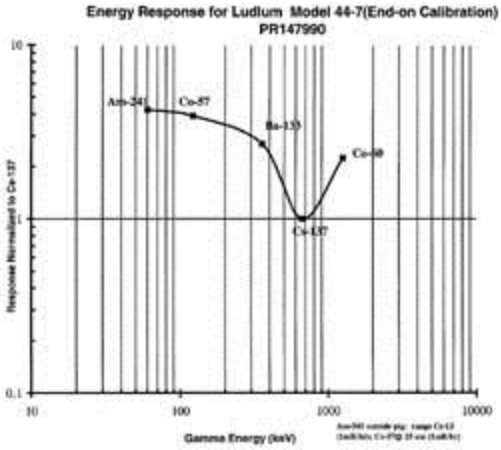
MODEL 44-7 End Window G-M Detector

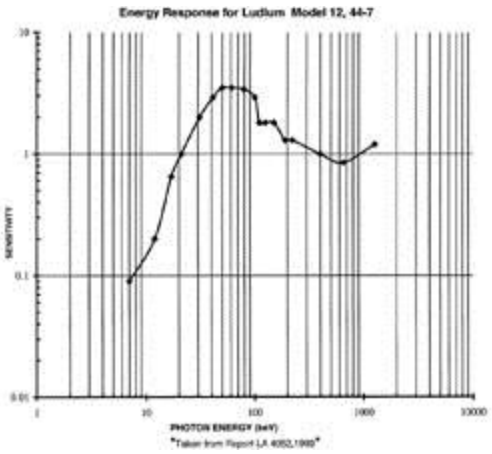
PART NUMBER:47-1536

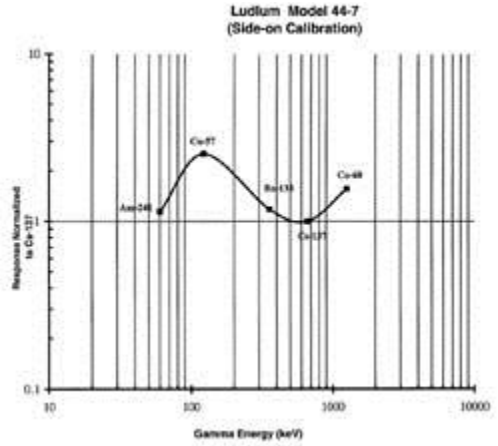
The Model 44-7 is an end window G-M that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

CE

INDICATED USE: Alpha beta gamma survey; Sample counting
DETECTOR: End window halogen quenched G-M
WINDOW: 1.7 ± 0.3 mg/cm² mica
WINDOW AREA:
Active - 6 cm²
Open - 5 cm²
EFFICIENCY (4pi geometry): Typically 2%-^{14}C; 10%-$^{90}Sr/^{90}Y$; 7%-^{239}Pu
SENSITIVITY: Typically 2100 cpm/mR/hr (^{137}Cs *gamma*)







202-330

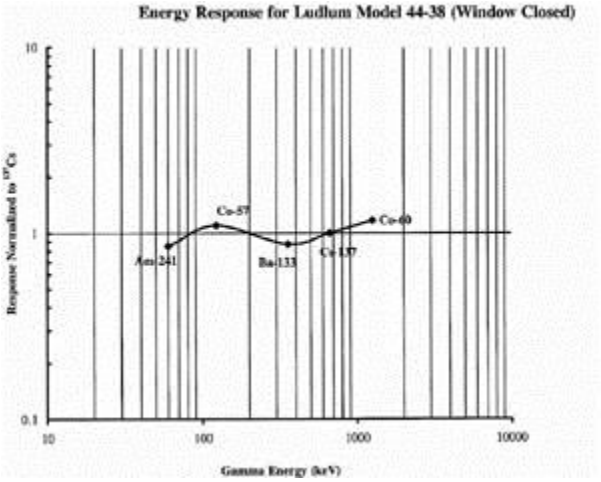
202-330
0-4k cpm; 0-2 mR/hr
For Model 44-7

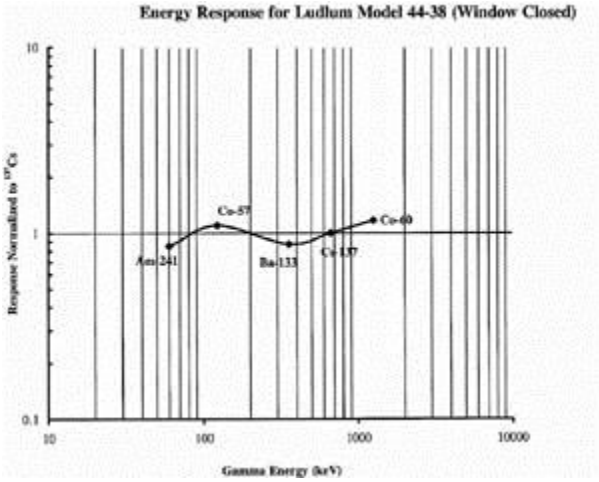
MODEL 44-38 Energy Compensated G-M

PART NUMBER: 47-1588

The Model 44-38 is an energy compensated sidewall G-M detector with a rotary beta shield for general purpose survey.

INDICATED USE: Beta gamma survey
DETECTOR: 30 mg/cm² stainless steel wall halogen quenched G-M
SENSITIVITY: Typically 1200 cpm/mR/hr (^{137}Cs *gamma*)





202-241

202-241
0-2 mR/hr; 0-2.4k cpm
For Model 44-6; 44-38

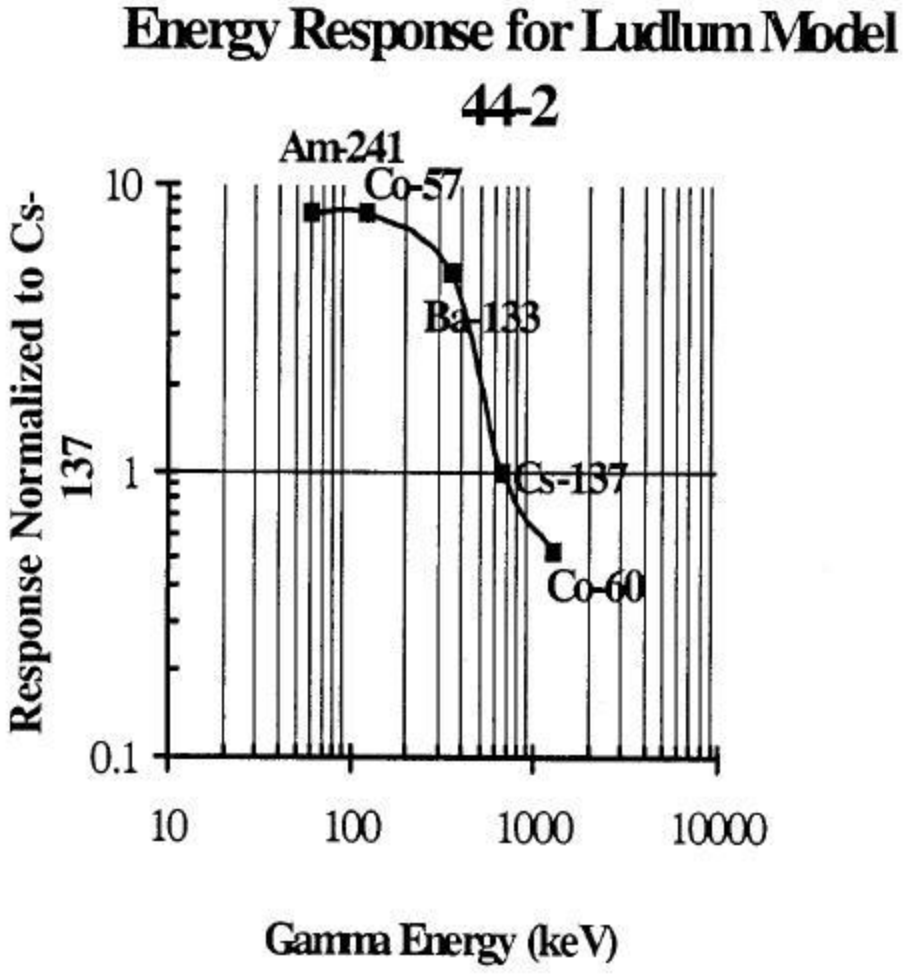
MODEL 44-2 Gamma Scintillator

PART NUMBER:47-1532

The Model 44-2 is a 1" X 1" NaI(Tl) Gamma Scintillator that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

CE

INDICATED USE: High energy gamma detection
SCINTILLATOR: 1" (2.5 cm) diameter X 1" (2.5 cm) thick sodium iodide (NaI)Tl scintillator
SENSITIVITY: Typically 175 cpm/microR/hr (^{137}Cs)



202-654

202-654
0-50 µR/hr; 0 - 8.5k cpm
For Model 44-2

MODEL 44-10 Gamma Scintillator

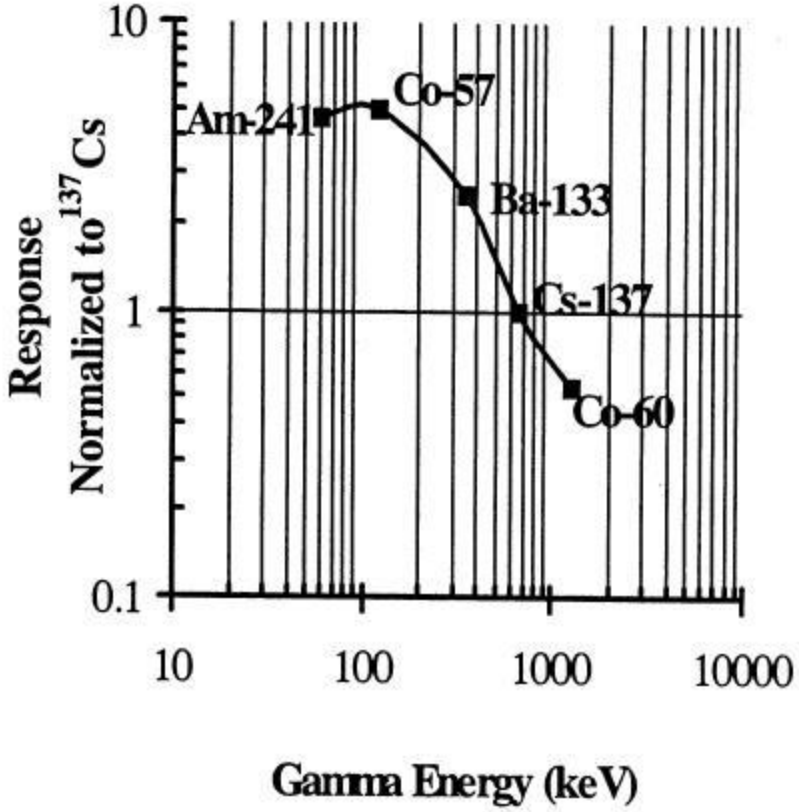
PART NUMBER:47-1540

The Model 44-10 is a 2" X 2" NaI(Tl) Gamma Scintillator that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

CE

INDICATED USE: High energy gamma detection
SCINTILLATOR: 2" (5.1 cm) diameter X 2" (5.1 cm) thick sodium iodide (NaI)Tl scintillator
SENSITIVITY: Typically 900 cpm/microR/hr (^{137}Cs)

Energy Response for Ludlum Model 44-10



202-717

202-717
0-5 µR/hr
For Model 44-10

MODEL 44-3 Low Energy Gamma Scintillator

PART NUMBER:47-1533

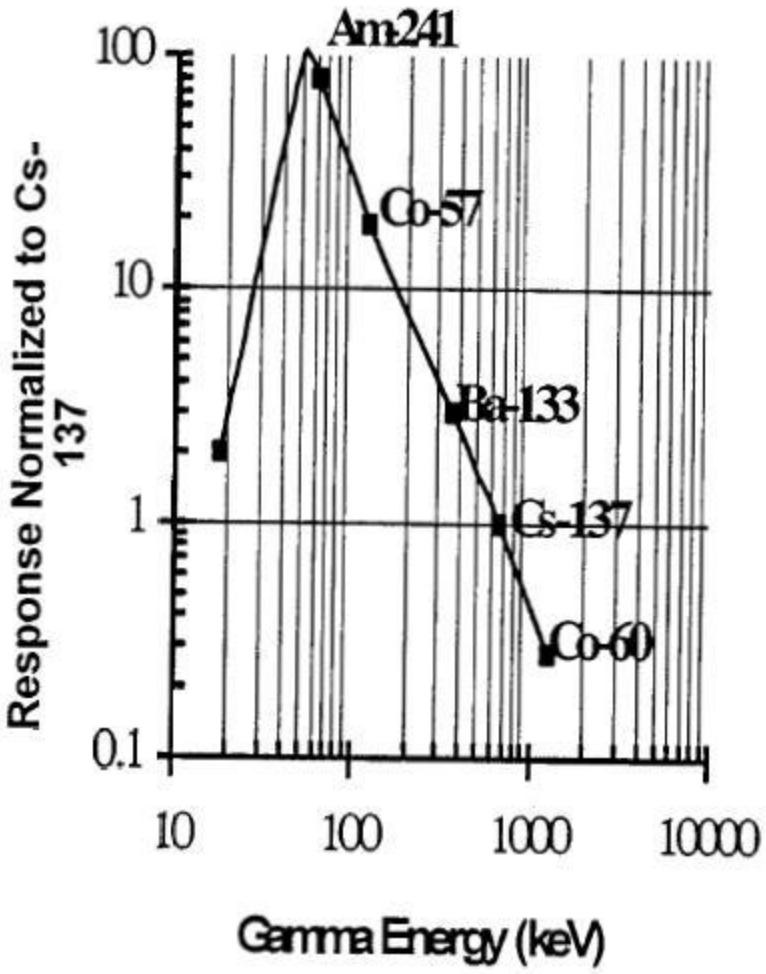
The Model 44-3 is a 1" X 1mm NaI(Tl) Gamma Scintillator for low energy gamma that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

CE

INDICATED USE: ^{125}I and x-ray survey
SCINTILLATOR: 1" (2.5 cm) diameter X 1mm thick sodium iodide (NaI)Tl scintillator
ENTRY WINDOW: 18.4 mg/cm²
WINDOW AREA: 5 cm² active and open
RECOMMENDED ENERGY RANGE: Approximately 10 - 60 keV
BACKGROUND: Typically 40 cpm/microR/hr

SENSITIVITY: Typically 675 cpm/microR/hr (^{125}I)

Energy Response for Ludlum Model 44-3



202-212

202-212
0-5 μR/hr; 0-3500 cpm
For Model 44-3(I-125)

LOW ENERGY GAMMA (LEG) Probes have a thin crystal, making them more like"non-high energy detectors".

Since low energy Gammas and X-Rays are absorbed in the first 1/100th of an inch in NaI(Tl), there is no need to make the crystal any thicker than that.

Without a thick crystal, high energy rays are not well absorbed, therefore add little to the desired signal.

In addition most LEG probes incorporate some sort of thin entrance window, making it easier for the LEG to penetrate into the crystal.

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