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Alarm Point Setting Guide
Model 375P-1000
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To meet the radiation detection requirements of the state of Pennsylvania concerning NORM at landfills and transfer stations, which is to alarm at the radiation detector when the detector "sees" 10 uR/hr above background, this paper helps calculate the alarmpoint to meet this standard with a Ludlum Model 375P-1000. Note that local preferences (ie. confidence level or safety factor) and regulations will supersede these instructions.

Onsite Alarmpoint Calculation:

Since the radiation background varies by geographic region, the alarmpoint setting must be reset onsite. Use the following procedure to calculate the setting:

1. Ensure the proper dipswitch settings are set

Ludlum Measurements, Inc. normally recommends that the fourth setting of the dipswitch, the 1/2SEC-2SEC switch be to the right, or on the 2SEC position. This setting, where the alarm is checked every 2 seconds, is the preferred setting to maximize sensitivity and to reduce false alarms. The 1/2SEC setting should only be used if vehicle speed is not controlled or is over 15 mph (miles per hour). If using the 1/2SEC setting is used, then all alarm calculations below should use values based on ½ second measurements, not 2 seconds.

2. Measure the background reading at the system.

Background radiation will vary from site to site, so the system should be turned on, allowed to warm up for about a minute, and then the reading should be recorded.

Example: The Model 375P measures a background of 4 kcps. This is a sum reading from both detectors (assume that each detector measures half of this or 2 kcps), but note that the sigma alarm calculation (based on 2 seconds) is thus 4000 counts per detector.

3. Know the conversion of background measurement to uR/hr.

The sensitivity of the detector for the Model 375P-1000 has been averaged over many detectors and is approximately 400 cps per uR/hr.

Example: Using the example above each detector measures 2 kcps at background, and thus measures 5 uR/hr at each detector. Note that since the Model 375P-1000 detector has lead shielding on the back of the detector, it will normally read <u>less</u> background than a handheld detector like a Ludlum Model 19.

4. Convert the 10 uR/hr alarmpoint to counts

Assuming the sensitivity of the detector for the Model 375P-1000 is 400 cps per uR/hr, than each detector should receive 4000 cps from a 10 uR/hr increase.

Example: Using the example above where each detector measures 2 kcps at background, we will then want the detector to alarm when the radiation level changes from 2 kcps to 6 kcps (4 kcps increase equaling a 10 uR/hr increase). More accurately, since the alarm is calculated over 2 seconds, the detector should alarm when the 2 second background of 4000 counts rises to 12,000 counts.

5. Calculate the sigma setting for 10 microR above background

"Sigma" is approximated by the square root of the background, and the alarmpoint is set at the number of these "sigmas" to activate the alarm.

Example: Sigma is, in this case, the square root of 4000, which equals 63 (rounding off). The number of sigma in 10 uR/hr above background is calculated by dividing 8000 counts (10 uR/hr) by 63 (the square root of 4000). The value is 8000/63, or 127 sigma.

6. Set the Sigma Alarm to the number calculated in the preceding step.

Ensure that the top dipswitch CALMODE is set to the right, and press the SIGMA ALARM button and the up and down arrow buttons to change the alarmpoint. When done, put the CALMODE switch back to the left.

Example: The amount calculated above was 127 sigma, so adjust the SIGMA ALARM level to 127.

7. (Optionally) Adjust the sigma to allow for truck speeds higher than 6 mph.

The sensitivity of the detector is lowered as speed increases. The sigma value must be lowered to compensate. The sigma setting is proportional to the square root of the ratio of the change of speed. The calculation above is appropriate for 6 mph. To account for speeds up to 10 mph, the change is a ratio increase of 1.6. The square root of this value is 1.26. The sigma value should be lowered by factor of 1.26.

Example: Sigma was calculated to be 127, so it is reduced to a new value calculated as 127/1.26 or 100 sigma if vehicle speeds are frequently 6-10 mph.

8. Verification using supplied 10 microcurie check source.

Ludlum Measurements supplies an exempt 10 microcurie checksource that may be used to verify and check for proper operation. This verification can be done as a one-time process, or as a regular check to ensure system operation. The checksource is only accurate to within 20% so some allowances must be made for uncertainty. The 10 microR/hr limit as specified by the state of Pennsylvania is equal to a distance of approximately 22.5 inches between the source and the internal face of the detector. One could pass the checksource within 17.5 inches, equal to 12 microR/hr, of the front of the detector's housing (while blocking the optional infrared beam if present) to confirm that the system alarms.

To confirm that the alarm isn't too sensitive, one could also pass the checksource 29 inches in front of the detector housing, equal to 5 microR/hr above background, and verify that the system does not alarm.