



Radiation Alert® Frisker



RADIATION®
A • L • E • R • T

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Chapter 1: Introduction

The Radiation Alert® Frisker is a radiation contamination instrument that has been designed and developed to meet the demands of today's radiation responder. By integrating the latest electronics with a proven and dependable Geiger-Mueller detector, the result is an ergonomic tool that addresses any number of radiological applications.

How The Radiation Alert® Frisker Detects Radiation

The Radiation Alert® Frisker uses a Geiger-Mueller tube to detect radiation. The Geiger tube generates a pulse of electrical current each time radiation passes through the halogen quenched tube. Each pulse is electronically detected and registers as a count. The Radiation Alert® Frisker displays the counts in the mode you choose.

The number of counts detected by the Radiation Alert® Frisker varies from moment to moment due to the random nature of radioactivity. A reading is expressed more accurately as an average over time, and the average is more accurate over a longer time period.

Precautions

To keep the Radiation Alert® Frisker in good condition, handle it with care, and observe the following precautions:

- CAUTION: Never touch the Radiation Alert® Frisker to a surface that may be contaminated. You may contaminate the instrument.
- Do not leave the Radiation Alert® Frisker in temperatures over 100° F (38° C) or in direct sunlight for extended periods of time.
- Do not get the Radiation Alert® Frisker wet. Water can damage the circuitry and the mica surface of the Geiger tube.
- Do not put the Radiation Alert® Frisker in a microwave oven. It cannot measure microwaves, and you may damage it or the oven.
- This instrument may be sensitive to and may not operate properly in radio frequency, microwave, electrostatic, and electromagnetic fields.
- If you do not expect to use the Radiation Alert® Frisker for longer than one month, remove the batteries to avoid damage from battery corrosion.
- CAUTION: When using the unit at altitudes higher than 8000 feet (2438.4 meters), it is possible that the tube window can rupture.

The Radiation Alert® Frisker

CAUTION: The mica surface of the Geiger tube is fragile and should be handled with care. Be careful not to let anything penetrate the screen.

The Radiation Alert® Frisker uses a 2-inch, thin window Geiger tube, commonly called a “pancake tube.” The screen on the back of the Radiation Alert® Frisker is called the GM Window *Figure 1(1)*. It allows alpha and low-energy beta and gamma radiation, which cannot get through the plastic case, to penetrate the mica surface of the tube. The small radiation symbol on the side of the enclosure indicates the center of the Geiger tube



Figure 1 (1).

Chapter 2: General Operation

Starting the Radiation Alert® Frisker

Before starting the Radiation Alert® Frisker, install 2 standard AA alkaline batteries in the battery compartment located in the lower rear of the handle (*Figure 1(1)*).

To start the Radiation Alert® Frisker, set the power switch to On (I) or Audio (A). The Radiation Alert® Frisker will then beep and begins a 6-second system check. SEI Frisker, the serial number of the unit, and the firmware version are displayed. After the system check, the radiation level is displayed in the selected mode. Approximately 30 seconds after you start the Radiation Alert® Frisker, a short beep indicates that enough information has been collected to ensure statistical validity.

Units of Measurement

The Radiation Alert® Frisker is designed for use of conventional units; microroentgens per hour ($\mu R/h$), milliroentgens per hour (mR/hr), counts per minute (CPM), millisieverts per hour (mSv/h), microsieverts per hour ($\mu Sv/h$), and counts per second (CPS). To switch between units of measure, push the MODE button, located to the right under the LCD display. (*Figure 1(1)*)

Maximum level

Though the Frisker is only calibrated to 50mR/hr, it will detect levels much higher than that. The maximum value to make it over range is related to the dead time and the sensitivity. Typically, the dead time is about 40 μ seconds ($1/4E-5$) and the sensitivity is around 3600 cpm/mR/hr (60cps/mR/hr). With these settings, the Frisker will over range at $(1/4E-5)/60 = 417$ mR/h.

When the maximum level for the current mode is reached, the Radiation Alert® Frisker beeps for 3 seconds, pauses for 3 seconds, and repeats that pattern. Also, the ALARM icon is displayed and the numerical values displayed will show 0000 instead of the specific rate. The beeping pattern will continue until the level decreases or the Radiation Alert® Frisker is turned off.

Response Time (Autoaveraging)

When the radiation level is less than 6,000 CPM, the reading in any of the dose rate modes is based on the radiation detected in the previous 30 seconds. In order to give a quicker response to changes, when the radiation level exceeds 6,000 CPM in any 30 second period, the reading is based on the previous 6 seconds.

After 30 second start-up if instrument is detecting	The reading will be based on an average of the previous
(<100 CPS) <6000 CPM or <1.75 mR/hr	30 seconds
(100 -200 CPS) 6000-12,000 CPM or 1.75-3.6 mR/hr	6 seconds

Setting the Alarm Level

To set the alarm level on the Radiation Alert® Frisker, hold down the backlight button for 3 seconds to enter into the alarm set screen. The units of measure for the alarm will be displayed as the same unit of measure you have chosen for the operation of the unit. Use the backlight button as a “+” button to increase the set alarm level. Use the mode button as a “-” button to lower the set alarm level. Once you have selected your desired alarm level, press both the backlight and mode buttons at the same time to exit the alarm set menu and resume normal operation of the Radiation Alert® Frisker.

Triggering the Alarm

When the set alarm level is reached, the unit will alarm and the display will show the word “ALARM” at the bottom.

Chapter 3: Calibration

Calibrating the Radiation Alert® Frisker

Before calibrating the Radiation Alert® Frisker, install 2 fresh standard AA alkaline batteries in the battery compartment located in the lower rear of the handle (*Figure 1(1)*).

Setting the Dead Time

To enter the menu to set the dead time of your detector, hold down the mode button while powering on the instrument. Hold down the mode button until the “Set Recip DT” screen appears.

Use the backlight button as a “+” button to increase the set dead time level. Use the mode button as a “-” button to lower the set dead time level. Once you have selected your desired dead time level, press both the backlight and mode buttons at the same time to exit the dead time set menu and resume normal operation of the Radiation Alert® Frisker.

Setting the Gamma Sensitivity

To enter the menu to set the gamma sensitivity of your detector, hold down the mode button while powering on the instrument. Hold down the mode button until the set gamma sensitivity screen appears.

Use the backlight button as a “+” button to increase the set gamma sensitivity level. Use the mode button as a “-” button to lower the set gamma sensitivity level. Once you have selected your desired gamma sensitivity level, press both the backlight and mode buttons at the same time to exit the gamma sensitivity set menu and resume normal operation of the Radiation Alert® Frisker.

Chapter 4: Using the Radiation Alert® Frisker

Checking for Surface Contamination

To check a surface, hold the detector window close to the surface (1 cm - 1 in), and read the count rate. Be careful not to touch the Frisker to any potentially contaminated surfaces to prevent contaminating the unit. Move the Frisker over the surface in a grid formation at a speed of about 1 inch every 1-2 seconds.

Chapter 5: Maintenance

The Radiation Alert® Frisker requires regular calibration and careful handling to assure good measurements. Use the following guidelines to maintain the instrument properly.

Calibration

We recommend that the Radiation Alert® Frisker be calibrated annually, or as often as your regulations require. The best way to calibrate is using a calibrated source at a calibration lab.

The Radiation Alert® Frisker is calibrated to Cs-137 by default. A certified calibration source should be used. To calibrate the Radiation Alert® Frisker for another radionuclide, use a calibrated source for that radionuclide or the appropriate conversion factor referenced to Cs-137. CAUTION: Errors can occur when using low level sources or background for calibration.

If you would like more information about source calibrations, please contact us at 1.800.293.5759 or go to seintl.com/services.

General Maintenance Tips

1. Do not get the instrument wet.
2. Be sure to store the meter in a location without direct sunlight, as sunlight can damage the end window of the detector over time.
3. Be sure to store the unit inside the carrying case when not in use.
4. If you are planning to store the unit for a long time, remove the batteries to avoid damage from battery corrosion.
5. Do not place the unit inside a microwave oven as it can damage the unit and/or the microwave. This instrument is for detecting ionizing radiation such as alpha, beta, gamma, and x-rays. It will not detect non-ionizing radiation such as microwave and radio emissions.
6. Do not place any objects that may puncture the mica end window of the detector near the detector.

Chapter 6: Troubleshooting

The Radiation Alert® Frisker is a highly reliable instrument. If it does not seem to be working properly, look through the following chart to see if you can identify the problem.

Problem	Possible Cause	Action
Display works, but no counts are registered	defective Geiger tube	Look through the window to check the mica surface of the tube; if it is wrinkled or a break is visible, replace it
Reading is high, but another instrument has a normal reading in the same location	possible contamination	Scan the Frisker with another instrument.
Instrument has false high reading	moisture	The circuit board may be wet. Dry the instrument in a warm dry place; if it still has a problem, it requires service
Instrument has false high reading	photosensitivity	Remove from direct sunlight and ultraviolet sources. If the high count drops, the mica window coating may have washed off the Geiger tube due to getting wet. The tube will need to be replaced
	continuous discharge	Replace the Geiger tube
	electromagnetic field	Move the instrument away from possible sources of electromagnetic or radio frequency radiation.
Display is blank	no battery, dead battery, poor battery connection, defective LCD	install a new AA Batteries If count light and audio work, the LCD may need to be replaced.

Chapter 7: Taking Measurements

The Radiation Alert® Frisker will not detect neutron, microwave, RF (radio frequency), laser, infrared, or ultraviolet radiation. All of our instruments are most accurate for Cesium-137 and isotopes of similar energies. Some isotopes detected relatively well by most Geiger counters are Cobalt-60, Technicium-99M, Phosphorous-32, Strontium-90, and many forms of Radium, Plutonium, Uranium, and Thorium.

Some forms of radiation are very difficult or impossible for a Geiger tube to detect. Tritium, for example, is a by-product of a nuclear reactor and is used in research. The beta emissions from Tritium are so weak that there are very few instruments that are capable of detecting it. More sophisticated equipment is needed for the measurement of environmental samples, such as radioactivity in milk, produce, soil, etc., unless you are looking for gross contamination.

The radiation from some isotopes can cause a Geiger tube to overexcite and indicate a higher level of radiation than is actually present. Americium 241 is an example of this phenomenon. Americium 241 is used in some smoke detectors and many different types of industrial density and flow meters.

Unless you know exactly what you are measuring and understand the limitations of detection instruments, it is possible to draw misleading conclusions from your readings. We design our instruments to detect the broadest range of ionizing radiation possible and still be affordable. The full spectrum of ionizing radiation cannot be measured by one single instrument. Everyone agrees that radioactive materials can be dangerous. We encourage you to seek out other sources of information.

How to Detect Background Radiation

To see what the background radiation is in your area, simply turn the instrument on and, after the 30 second start up beep, the general background radiation will be displayed.

How To Survey a Surface

When surveying a surface, such as a counter top, you will need to hold the Radiation Alert® Frisker about 1-2 centimeters from the surface while moving the unit horizontally across the survey area at a rate of 50 cm per second.

How to Perform a General Survey

A general survey may be used to find a potential source. For example, if you are looking for a potential source in a pile of scrap, the Radiation Alert® Frisker will typically detect about 2 feet into a pile. To find the source, slowly move the Radiation Alert® Frisker in the direction of the higher readings or clicks until the potential source is found.

Geiger counters can detect the four main types of ionizing radiation: alpha, beta, gamma, and x-rays. Some detect only gamma and x-rays. Our instruments are calibrated to Cesium 137, but also serve as excellent indicators for many other sources of ionizing radiation. Gamma and x-rays are measured in milliroentgens per hour (mR/hr), microsievarts ($\mu\text{Sv/hr}$), or millisievarts (mSv/hr). Alpha and beta are measured in counts per minute (CPM) or counts per second (CPS).

The window of the GM tube is very thin mica. This mica window is protected by a screen. Some levels of alpha, low energy beta, gamma, and x-rays that cannot penetrate the plastic case or the side of the tube can be sensed through the window.

Try not to touch the instrument to any suspected radioactive substance.

Although some beta and most gamma radiation can go through protective gear, try to avoid skin contamination and ingestion. When you leave a radioactive area, remove any protective outerwear and dispose of it properly. If you think you have been contaminated, as an additional precaution, shower and consult a physician.

How to Determine Alpha, Beta, or Gamma source.

To determine whether the radiation detected is alpha, beta, or gamma, hold the instrument toward the source.

Alpha: If there is no indication through the back of the case (the side of the tube), position the window close to but not touching the source. If there is an indication, it is alpha, beta, or low energy gamma. If a sheet of paper placed between the window and the source stops the indication, it is most likely alpha. To avoid particles falling into the instrument, do not hold the source above the window.

Beta: Place a piece of aluminum about 1/8 inch (3 mm) thick between the instrument and the source. If the indication stops, decreases, or changes, it is most likely beta radiation. Most common isotopes emit both beta and gamma radiation. This is why the indication would decrease or change but not stop.

The non-occupational dose limits set by the government is 100 mR above background annually.

It is up to the individual to decide what a safe radiation level is. It will be different depending on the individual and their knowledge of radiation and its effects. Radiation levels will vary according to location and circumstances. As an example; if your background level is 25 CPM (counts per minute) where you live, when you fly in an airplane at 30,000 feet your rate meter may measure 200 CPM (.2 mR) for 2 to 5 hours. That is 8 times your normal background radiation on the ground, but it is only for a limited amount of time.

When measuring radiation in an emergency response situation, it is good to have something to compare your readings to. Taking a background radiation level reading in your area before a radiation event will help you determine if you have an elevated level of radiation and whether or not to stay in that location. Background radiation is naturally occurring radiation that is always present. It includes high energy gamma rays from the sun and outer space and alpha, beta, gamma radiation emitted from elements in the earth. Using a rate meter, you can determine your normal background radiation levels.

Gamma and X-Rays: If there is an indication of radioactivity, it is most likely gamma or high energy beta. Low energy gamma and x-rays (10-40 keV) cannot penetrate the side of the GM tube, but may be detected through the window.

If you perform the alpha/beta test above and there is no change or only a very slight change in the indication, the source is emitting primarily gamma radiation.

Chapter 8: Unit Conversions

Radiation Measurement Units

Several different units are used to measure radiation, exposure and dosage.

Roentgen is the amount of X-radiation or gamma radiation that produces one electrostatic unit of charge in one cc of dry air at 0° C and 760 mm of mercury atmospheric pressure. One thousand milliroentgen (1,000 mR)= 1R. The Radiation Alert® Frisker displays in milliroentgens per hour (mR/hr).

Rad is the unit of exposure to ionizing radiation equal to an energy of 100 ergs per gram of irradiated material. This is approximately equal to 1.07 roentgen.

Rem is the dosage received from exposure to a rad. It is the number of rads multiplied by the quality factor of the particular source of radiation. The rem and millirem are the most commonly-used measurement units of radiation dose in the U.S. 1 rem= 1 rad.

Sievert is the standard international measurement of dose. One sievert is equivalent to one hundred rems. A microsievert (μSv) is one millionth of a sievert. A unit of dose equivalent. 1 Sv= 100 roentgens, 10 μSv/hr = 1 milliroentgen/hr.

Curie is the amount of radioactive material that decays at the rate of 37 billion disintegrations per second, approximately the decay rate of one gram of radium. Microcuries (millionths of a curie) and picocuries (trillionths of a curie) are also often used as units of measurement.

Becquerel (Bq) is defined as the activity of a quantity of radioactive material in which one nucleus decays per second. 1 dps (one disintegration per second).

Converting CPM to mR/hr

$$\text{mR/hr} = \frac{\text{cpm}}{\text{sensitivity}}$$

Sensitivity is expressed in cpm per mR/hr (Counts Per Minute for every milliroentgen the GM tube can detect) referenced to Cs-137. Mathematically the cpm units cancel each other out leaving mR/hr, as shown below.

$$\frac{\text{cpm}}{\frac{\text{cpm}}{\text{mR/hr}}} = \frac{\text{cpm}}{1} \times \frac{\text{mR/hr}}{\text{cpm}} = \text{mR/hr}$$

For example, if you have collected 200 CPM with the Radiation Alert Radiation Alert® Frisker, which has a typical gamma sensitivity of 3600 cpm per mR/hr, you would divide the 200 cpm by the 3600 cpm per mR/hr sensitivity. The cpm cancels out and you are left with 200/3600 mR/hr = 0.056 mR/hr

$$\frac{200 \text{ cpm}}{3600 \frac{\text{cpm}}{\text{mR/hr}}} = 0.056 \text{ mR/hr}$$

Chapter 9: Glossary of Common Terms

Background Radiation

Naturally occurring radiation is always present. It includes high energy gamma rays and particles from the sun and outer space and alpha, beta, and gamma radiation emitted from elements in the earth.

CPM (counts per minute)

The unit of measurement usually used to measure alpha and beta radiation.

Ion

An atomic particle, atom, or molecule that has acquired an electrical charge, either positive or negative, by gaining or losing electrons.

Ionization

The process by which neutral atoms or molecules are divided into pairs of oppositely charged particles known as ions.

Ionizing Radiation

Radiation capable of producing ionization by breaking up atoms or molecules into charged particles called ions.

Radiation

The emission and propagation of energy through space or through matter in the form of particles or waves.

Radionuclide

The naturally occurring or artificially produced radioactive form of an element.

Decay

When an atom emits an alpha or beta particle or a gamma ray, it becomes a different type of atom. Radioactive substances may go through several stages of decay before they change into a stable, or non-ionizing, form. For example; U-238 has 14 different stages of decay before it stabilizes. An element may have several forms, or isotopes. A radioactive isotope of an element may be called a radioisotope. However, the more correct term is radionuclide.

Half-life

Each radionuclide has a characteristic half-life, which is the time required for half of a quantity of the material to decay.

Appendix A: Technical Specifications

Calibratable Operating Range

$\mu\text{R/hr}$ - 1 to 50,000 CPM - 0.0 to 175,000

nSv/hr - 1 to 500,000 CPS - 0.0 to 2500

Accuracy (Cs^{137})

$\mu\text{R/hr}$ $\pm 10\%$ typical (NIST), $\pm 15\%$ max - 0 to 50,000

nSv/hr $\pm 10\%$ typical (NIST), $\pm 15\%$ max - 1 - 500,000

CPM $\pm 10\%$ typical (NIST), $\pm 15\%$ max - 0 to 175,000

(Referenced to Cs^{137})

Energy Sensitivity

Detects Alpha down to 2 MeV. Detects Beta down to 0.16 MeV; typical detection efficiency at 1 MeV is approximately 25%.

Detects Gamma down to 10 KeV through the detector window. 3340 CPM/mR/hr (Cs^{137}). Smallest detectable level for I^{125} is .02 μCi at contact.

Anti-Saturation

Readout will OVERRANGE in radiation fields as high as 100 times the maximum reading.

Alert

Pulsating beeper sounds the alert. Adjustable alert levels are used for $\mu\text{R/hr}$, CPM, $\mu\text{Sv/hr}$, and CPS.

Display

Backlit liquid crystal display with mode indicators.

Count Light

Red LED flashes with each count.

Audio Indicator

Internally mounted beeper

(can be switched off for silent operation)

Power Requirements

Two (2) AA alkaline batteries. Battery life is approx. 500 hours at normal background radiation levels w/o backlight (based on 1000m/Ah batteries).

Temperature Range

-10° to $+50^{\circ}\text{C}$ (14° to 122°F)

Weight

217 g (7.7 oz.)

Size

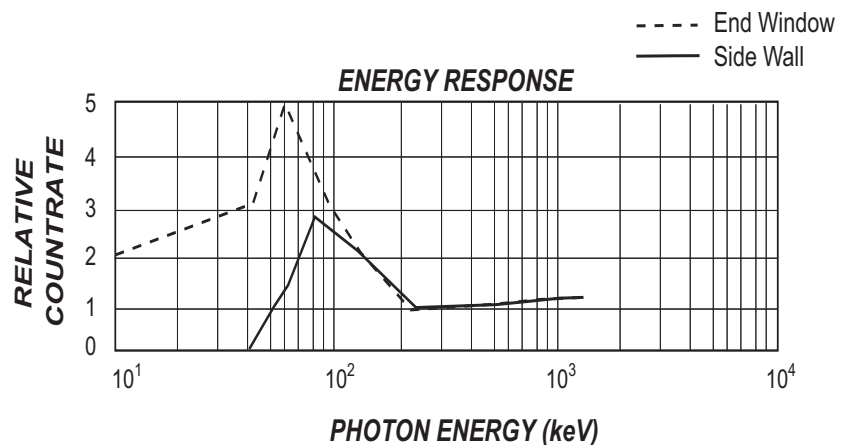
276 x 44 x 64 mm (10.875 x 1.75 x 2.5 in.)

Includes

Carrying Case

Limited Warranty

1 year limited warranty



Appendix B: Limited Warranty

WARRANTOR: S.E. International, Inc., P.O. Box 39, 436 Farm Road, Summertown, TN 38483-0039, USA, (931) 964-3561

ELEMENTS OF WARRANTY: S.E. International, Inc., warrants for 90 days the included detector and for one year all materials and craftsmanship in this product to be free from all defects with only the limitations set out below.

WARRANTY DURATION: The warranty shall terminate and be of no further effect one year (90 days on the detector) after the original date of purchase of the product or at the time the product is: a) damaged or not maintained as is reasonable or necessary, b) modified, c) repaired by someone other than the warrantor for a defect or malfunction covered by this Warranty, d) contaminated with radioactive materials, or e) used in a manner or purpose for which the instrument was not intended or contrary to S.E. International, Inc.'s written instructions. This warranty does not apply to any product subjected to corrosive elements, misuse, abuse, or neglect.

STATEMENT OF REMEDY: In the event that the product does not conform to the warranty at any time while this warranty is effective, the Warrantor will repair the defect and return the instrument to you prepaid, without charge for parts or labor.

NOTE: While the product will be remedied under this warranty without charge, this warranty does not cover or provide for the reimbursement or payment of incidental or consequential damages arising from the use of or the inability to use this product. The liability of the company arising out of the supplying of this instrument, or its use, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the instrument, and after the said one year (90 days on the tube) period all such liability shall terminate. Any implied warranty is limited to the duration of the written warranty.

PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY: In the event that the product does not conform to this warranty, please write or call to the address above. S.E. International, Inc. will not accept contaminated instruments for calibration or repair under warranty or otherwise.

NOTE: Before using this instrument, the user must determine the suitability of the product for his or her intended use.

Calibration Database Application

Please fill out this form and send it back to us if you would like to be notified of the NIST calibration renewal for your instrument to:

S.E. International, Inc.

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www.seintl.com | radiationinfo@seintl.com

NAME

MODEL NAME

COMPANY

SERIAL NUMBER

ADDRESS

DATE PLACED IN SERVICE

CITY

EMAIL

STATE, ZIP, & COUNTRY

PHONE NUMBER

Or fill out the form online at
<http://seintl.com/calibrations/>

