RADIATION ALERT®

OPERATION MANUAL FOR THE
MONITOR 4, MONITOR 4EC, MONITOR 5, AND MC1K

Before using this instrument the user must determine the suitability of the product for his or her intended use. The user assumes all risk and liability connected with such use.

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DESCRIPTION

The monitor senses ionizing radiation by means of a GM (Geiger Mueller) tube with a thin mica window. Note: There is no window on the MC1K. The tube is enclosed inside the instrument. When a ray or particle of ionizing radiation enters or passes through the tube, it is sensed electronically and displayed by a red count light. When the switch is in the AUDIO position, the instrument will also beep with each radiation event. About 5 to 25 counts at random intervals (depending on your location and altitude) can be expected every minute from naturally occurring background radiation.

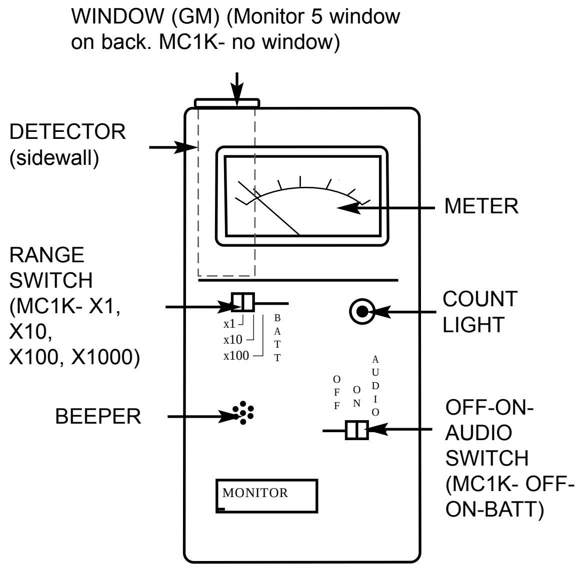


Illustration 1

OPERATION

1. Before turning on your instrument, install a 9 volt alkaline battery. If a battery is already installed, turn the instrument on and switch the range switch to the BATT position. Battery condition will be indicated on the meter.
2. Set the range switch in the X1 position. If the meter goes off scale, move the range switch to the next higher setting, X10, X100 or (X1000 MC1K only). **(Note: Refer to specifications for operating ranges.)**
3. For an audible signal, position the OFF/ON/AUDIO switch to the AUDIO position. **Note:** The flashes from the count light and the audible beeps are progressively shorter in X10, X100 or (X1000, MC1K only).

PRECAUTIONS

- Handle your instrument carefully as you would a camera.
- Avoid exposing the instrument to liquids, moisture, and corrosive gases; also avoid extreme temperatures or direct sunlight (i.e., car dashboards) for extended periods.
- Remove battery to prevent leakage if you do not plan to use the instrument for an indefinite period.
- The mica window of the GM tube can be easily damaged if struck directly. **DO NOT INSERT ANYTHING THROUGH THE SCREEN.**
- To avoid contamination, do not touch the instrument to the surface being tested.
- This instrument may be sensitive to and may not operate in radio frequency, microwave, electrostatic, and magnetic fields.
- Since the instrument has semiconductors in its circuitry, it is susceptible to EMP (electromagnetic pulse) and may be rendered inoperable by an atomic detonation. It has not been determined what distance from an atomic blast would be considered safe for semiconductor circuitry.

MAKING MEASUREMENTS

To determine whether the radiation detected is alpha, beta, or gamma hold the back of the instrument toward the source (see illustration 2 for location of Geiger tube).
Gamma; 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 sidewall of the Geiger tube, but may be detected through the window. For the Monitor 5, hold the side of the instrument towards the source.
Beta; Place a piece of aluminum about 1/8" (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 contain both beta and gamma.
Alpha; If there is no indication through the back of the case, position the window close to but not touching the source (see illustration 2). 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. Do not hold the source above the window to avoid particles falling into the instrument.

SPECIFICATIONS

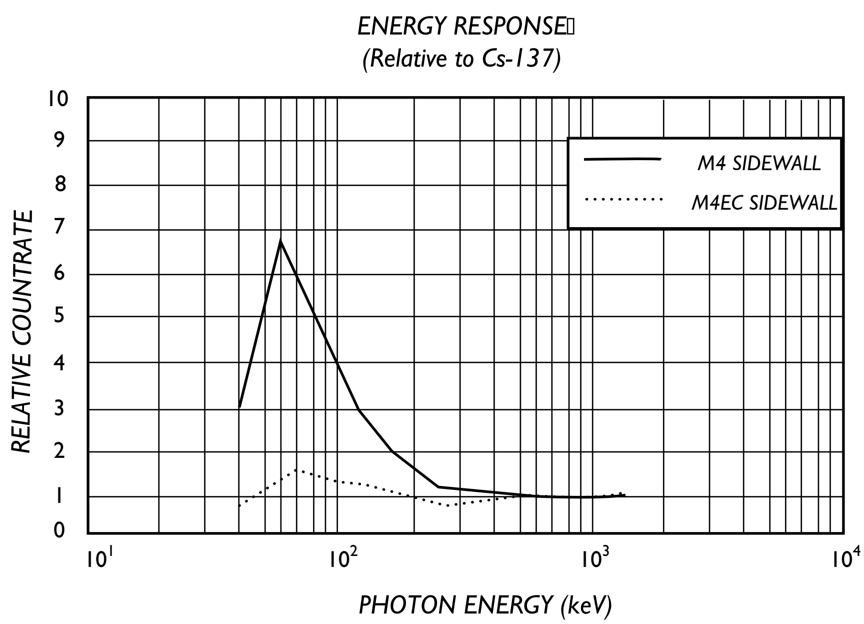
Detector for the MONITOR 4 and the MONITOR 4EC:
MONITOR 4- Halogen-quenched uncompensated GM tube Thin mica window is 1.5-2.0 mg/cm2 thick. Approx. 1,000 CPM/mR/hr for Cesium 137.
MONITOR 4EC- Halogen-quenched GM tube. Energy compensated sidewall with 2 mm tin filter. Thin mica window, 1.5-2.0 mg/cm2 thick. Approx. 1000 CPM/mR/hr for Cesium 137. Energy compensation is only effective through the sidewall of the GM (refer illustration 1).

MONITOR 4 Energy Sensitivity:

Detects alpha down to 2.5 MeV; typical detection efficiency at 3.6 MeV is greater than 80%.
Detects beta at 50 keV with typical 35% detection efficiency.
Detects beta at 150 keV with typica 75% detection efficiency.
Detects gamma and x-rays down to 10 keV typical through the window, 40 keV minimum through the case. (GRAPH 1).
Normal background is 5-20 CPM.

MONITOR 4EC Energy Sensitivity:

The energy response to gamma through the detector sidewall is flat to within +61% or -26% over the range of 40 keV to 100 keV, and within +35% or -17% over the range of 100 keV to - 1.3 MeV (referenced to Cs-137).
Detects alpha down to 2.5 MeV; typical detection efficiency at 3.6 MeV is greater than 80%.
Detects beta at 50 keV with typical 35% detection efficiency.
Detects beta at 150 keV with typical 75% detection efficiency.
Detects gamma and x-rays down to 10 keV typical through the window (non-compensated), 40 keV through the sidewall.
Normal background is approx. 5-20 CPM.



Graph 1

Operating Range- Monitor 4 and Monitor 4EC:

0-50 mR/hr and 0-50,000 CPM, or 0-500 mSv/hr and 0-50 mR/hr7/8” x 1 3/4” analog meter with dual scale.

Range Switch for the Monitor 4, Monitor 4EC:

X1, X10, X100, Battery Check. Refer to common specifications for more details

Detector for the MONITOR 5:

Halogen-quenched uncompensated GM tube with thin mica window, 1.5-2.0 mg/cm2 areal density. The effective diameter of the window is 1.13 in/28.58 mm.

MONITOR 5 Energy Sensitivity:

Referenced to Co-60, gamma sensitivity is 25 counts per second per 1 mR/hr. Recommended I-125 detection is for .5 mCi and up. Smallest detectable level of I-125 is approx. 0.02 mCi. Typical detection efficiencies compared to 2pi counter.

SOURCE	ENERGY	EFFICIENCY
Sr-90 (.035 mCi)	5.46 keV & 1.2 MeV b max	18%
Bi-210 (.0255 mCi)	1.16 MeV	20%
C-14 (.130 mCi)	156 keV b max	.07%

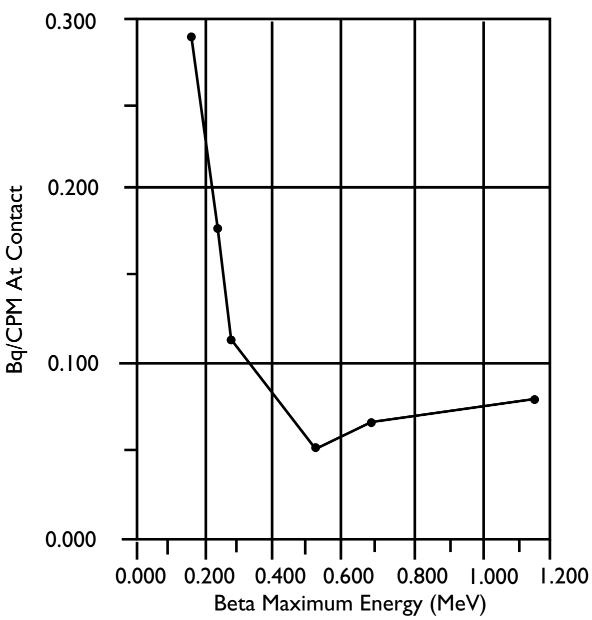
MONITOR 5

Beta Activity Determination

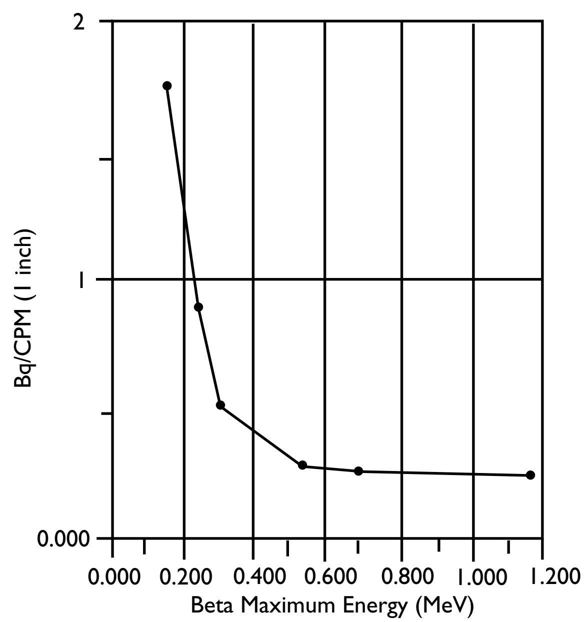
The following graphs enable the user to determine the activity of a known beta emitter from a measurement with the Monitor 5.

Radio Nuclide	Energy (MeV) Max.	Avg.	HALF LIFE	Bq/CPM Contact	1 inch
C-14	.156	.049	5730 y	.295	1.8
Pm-147	.225	.062	2.6234 y	.178	.89
Sr-90/Y-90	.546	.196	29.5 y	.054	.30
Cl-36	.710	.251	3.01x105 y	.066	.29
Bi-210	1.162	.389	22.3 y	.078	.28
Po-210	5.305		138.376 d	.129	11.0

To determine the activity of a known beta emitter, make a measurement with the Monitor 5 at a distance of one inch from the source or just above contact with the source. Look up the maximum energy level of the source on the appropriate graph to determine the Bq/CPM number for that source. Multiply the Monitor 5 reading times the Bq/CPM. The result will be the activity of the source in Becquerels. Note: The diameter of the test source should be equal to or smaller than the detector diameter.



Graph 2



Graph 3

Operating Range-MONITOR 5:

0-500, 0-5000, 0-50,000 CPM. Each range is independently calibrated.

Optional tri-scale:

0-12.5, 0-125, 0-1,250 CPS
0-.5, 0-5, 0-50 mR/hr
0-5, 0-50, 0-500 mSv/hr. 7/8” x 1 3/4” analog meter.

Range Switch for the Monitor 5

X1, X10, X100, Battery Check. **Refer to common specifications for more details**

Detector for the MC1K:

Energy compensated halogen-quenched GM tube no window.

MC1K Energy Sensitivity:

Detects gamma and x-rays down to 40 keV. Response is flat from 40 keV up. Normal background, avg. 4 CPM (counts per minute)

Range Switch for the MC1K:

X1, X10, X100, X1000

Operating Range- MC1K:

X1 position (in .05 increments) 0 to 1 mR/hr or 0 to .01 mSv/hr (milli-Sievert per hour)
X10 position (in .5 increments) 0 to 10 mR/hr or 0 to .1 mSv/hr
X100 position (5) 0 to 100 mR/hr or 0 to 1 mSv/hr
X1000 position (50) 0 to 1000 mR/hr (1R) or 0 to 10 mSv/hr
7/8" x 1 3/4" analog meter.

COMMON SPECIFICATIONS FOR THE MONITOR 4, MONITOR 4EC, MONITOR 5, AND MC1K

Accuracy:

± 15% of full scale (referenced to Cs-137)

Audio:

Built-in piezoelectric transducer gives audible beep when switch is in the AUDIO position. Can be switched off for silent operation. Note: The MC1K audio cannot be switched off.

Anti-Saturation:

Meter will hold at full scale in fields as high as 100 times the maximum reading

Operating Voltage :

7-11 Volts DC. High and low voltage is fully regulated

Power Requirements:

One 9 Volt alkaline battery. Battery life is up to 2,000 hours at normal background radiation levels.

Temperature Range:

-20°C to 55°C (-4° F to 131° F)

Weight:

Monitor 4: 178 grams (6.3 oz.) without battery
Monitor 4EC: 198 grams (7 oz.) without battery
Monitor 5: 240.5 grams (8.5 oz.) without battery
MC1K: 188 grams (6.4 oz.) without battery

Size:

145 x 72 x 38 mm (5.7 x 2.8 x 1.5 in.)

Includes:

1 year limited warranty, carrying case, and CE mark.

Options for the Monitor 4, Monitor 4EC, and MC1K:

Stainless steel belt clip (attached to instrument)

CALIBRATION

Factory calibration is by pulse generator and is typically ±15% of full scale relative to Cesium 137. For calibration to N.I.S.T. standards, contact the manufacturer, distributor, or a certified lab.
Calibration Procedure for the Monitor 4, Monitor 4EC, and MC1K: Position the instrument upright with the back of the instrument facing the source. (refer to Illustration 2 and 3) Adjust the height of the instrument so the center of the tube (lengthwise) will be centered with the beam. Measure the appropriate distance from the source to the center of the tube's diameter and length.
To adjust the calibration, simply remove the two switch knobs on the front of the case. On the back of the case, remove the two top screws and the two screws from inside the battery compartment. Ease off the front of the case and adjust the trimpot located above the OFF/ON/AUDIO switch.

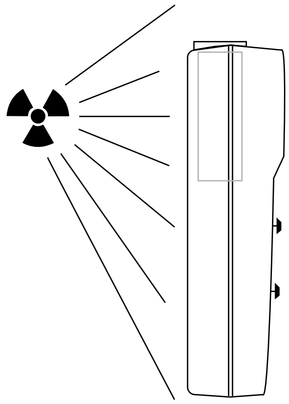


Illustration 2

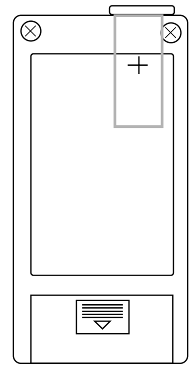


Illustration 3
MONITOR 4, 4EC, MC1K

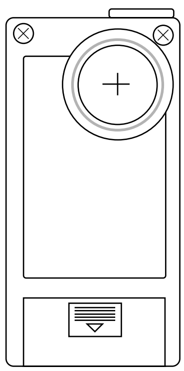


Illustration 4
MONITOR 5

Calibration procedure for the Monitor 5:

Position the instrument upright with the back of the instrument facing the source. Adjust the height of the instrument so the center of the tube (refer to illustration 2 and 4) will be centered with the beam. Measure the appropriate distance from the source to the center of the tube's diameter.

To adjust the calibration, simply remove the two knobs on the front of the case. From the back of the case, remove the two top screws and the two screws from inside the battery compartment. Ease off the front of the case. Adjust the X1 trimpot (VR1A) located above the OFF/ON/AUDIO switch to the right. The X10 and X100 trimpots are located above the OFF/ON/AUDIO switch to the left. The X10 trimpot (VR3) is above the X100 trimpot (VR2).

For detailed calibration instructions, a service manual can be purchased.

CALIBRATION DATABASE SERVICE

For U.S. and CANADA only

We offer a continuing calibration service. Your instrument can be entered into our Calibration Database. At specified intervals, you will be sent a notice reminding you of the upcoming calibration date.

Included in this manual is a Calibration Database Application. Please send it to the address below and we will enter you in the database free of charge.

TECHNICAL SERVICE

Should this instrument ever need servicing or calibration, please contact the address below or your local distributor.

DO NOT SEND CONTAMINATED INSTRUMENTS FOR REPAIR OR CALIBRATION UNDER ANY CIRCUMSTANCES.

S.E. INTERNATIONAL, INC.
P. O. Box 39
436 Farm Road
Summertown, TN 38483-0039 USA
Tel: (931) 964-3561 Fax: (931) 964-3564

ADDITIONAL INFORMATION FOR THE NEWCOMER TO RADIATION PROTECTION

Since our instruments are sometimes purchased by individuals with no background in radiation protection, we thought it would be helpful to include this information.

MEASURING RADIATION

The Monitor 4, Monitor 4EC, and Monitor 5 detect the four main types of ionizing radiation: alpha, beta, gamma, and x-rays. The MC1K detects gamma and x-rays. They are calibrated to Cesium 137, but also serve as an excellent indicator for many other sources of ionizing radiation. Gamma and x-rays are measured in milli-Roentgens per hour (mR/hr) micro-Sieverts (mSv/hr) or milli-Sieverts (mSv/hr). Alpha and beta are measured in counts per minute (CPM) or counts per second (CPS) .

The position of the GM tube detector is shown in illustrations 3 and 4. The window of the tube is very thin mica. This mica window is protected by a screen (the MC1K does not have a window). 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. See Specifications for the GM tube sensitivities.

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 properly. If you think you have been contaminated, as an additional precaution, shower and consult a physician.

BRIEF OVERVIEW OF RADIATION DETECTION

None of the instruments listed in this manual detect neutron, microwave, RF (radio frequency), laser, infra-red, or ultra-violet radiation.

All of the instruments are most accurate for Cesium 137 and isotopes of similar energies. Some isotopes detected relatively well 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 is a by-product of a nuclear reactor and is used in research. The beta emissions from Tritium are so weak that there is very little instrumentation that is capable of detecting it. Other examples of when more sophisticated equipment is needed are for the measurement of contamination in environmental samples, such as radioactivity in milk, produce, soil, etc..

The radiation from some isotopes can cause a Geiger tube to overexcite and cause an indication of a higher level of radiation than is actually there. 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 designed our instruments to be able to detect the broadest range of ionizing radiation possible and remain in the price range of the average person. 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.

POSSIBLE HOUSEHOLD SOURCES OF RADIATION

SMOKE DETECTORS: Some smoke detectors contain a sealed radioactive isotope as part of the smoke sensing mechanism.

CAMPING LANTERN MANTLES: In recent years this has changed but, some lantern mantles are made with radioactive Thorium. Be especially careful not to inhale or ingest the fine ash that is left when they are burned out.

CLOCKS, WATCHES, AND TIMERS: Many old timepieces have dials painted with radium to make them glow in the dark. Tritium is now commonly used to obtain the same effect. Tritium is also radioactive but emits low energy radiation which cannot penetrate the lens of the timepiece.

JEWELRY: Some gold used to encapsulate radium and radon for medical purposes was improperly reprocessed and entered the market as radioactive rings and other types of gold jewelry. Some imported cloisonne being glazed with uranium oxide exceeds U.S. limits.

Some gems are irradiated by an electron beam or in an accelerator to enhance their color. Irradiated gems typically are held until there is no residual activity remaining.

ROCK COLLECTIONS: Many natural formations contain radioactive materials. Hobbyists who collect such things should vent the rooms in which these items are stored and be careful to avoid inhaling the fine dust particles from these samples.

POTTERY: Some types of pottery is glazed with uranium oxide. To the best of our knowledge, this process has been discontinued, although some of these pieces are still in circulation.

GLOSSARY

ALPHA: Positively charged particles emitted from the nucleus of an atom. Alpha particles are relatively large, and very heavy. Due to this strong (+) charge and large mass, an alpha particle cannot penetrate far into any material. A sheet of paper or an inch of air can usually stop most alpha particles.

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

BETA PARTICLES: Negatively charged particles emitted from an atom. Beta particles have a mass and charge equal to that of an electron. They are very light particles (about 2,000 times less mass than a proton) and have a charge of -1. Because of their light mass and single charge, beta particles can penetrate more deeply than alpha particles. A few millimeters of aluminum will stop most beta particles.

Bq (Becquerels): A quantity of radioactivity in which one atom is transformed per second. 1 dps (one disintegration per second).

CPM (counts per minute): The unit of measurement usually used to measure alpha and beta radiation.

GAMMA RAYS: Short wavelength electromagnetic radiation higher in frequency and energy than visible and ultraviolet light. Gamma rays are emitted from the nucleus of an atom. These high energy photons are much more penetrating than alpha and beta particles.
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 of 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.
ROENTGEN (rent-gen): A basic unit of measurement of the ionization produced in air by gamma or x-rays. One Roentgen (R) is exposure to gamma or x-rays that will produce one electrostatic unit of charge in one cubic centimeter of dry air. One thousand milliroentgen (1,000 mR)= 1R.
RADIOISOTOPE: A natural occurring or artificially produced radioactive form of an element.
SIEVERT: A unit of dose equivalent. 1 Sv= 100 roentgens, 10 mSv/hr = 1 milliroentgen/hr. (mSv micro-Sievert, micro is one millionth, milli is one thousandth.)
X-RAYS: Electromagnetic radiation (photons) of higher frequency and energy than visible and ultraviolet light, usually produced by bombarding a metallic target with high speed electrons in a vacuum. X-rays are photons emitted by interactions involving orbital electrons rather than atomic nuclei. X-rays and gamma rays have the same basic characteristics. The only difference between them is their source of origin.

LIMITED WARRANTY

ELEMENTS OF WARRANTY: This warranty covers all materials and craftsmanship in this product to be free from defect for a period of one year with only the limitations or exclusion set out below.
WARRANTY DURATION: This warranty shall terminate and be of no further effect one year 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 the defect or malfunction covered by this Warranty, d) used in a manner or purpose for which the instrument was not intended or contrary to the written instructions or e) is contaminated with radioactive material. This warranty does not apply to any product subject to corrosive elements, misuse, abuse, or neglect.
STATEMENT OF REMEDY: In the event the product does not conform to this warranty at any time while this warranty is effective, the Warrantor will repair the defected and return 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 reimbursement or payment of incidental or consequential damages arising from the use of 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 period, all such liability shall terminate. Any implied warranty is limited to the duration of this written warranty.
PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY: In the event that the product does not conform to this warranty, please contact your local distributor.
NOTE: Before using this instrument, the user must determine the suitability of the product for his or her intended use. The user assumes all risk and liability connected with such use.

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CALIBRATION DATABASE APPLICATION

______________________________ name

______________________________ company

______________________________ address
City, state, zip code +4

______________________________ phone number

______________________________ model name

______________________________ serial no.
(Inside battery compartment or rear label

______________________________ calibrations per year
(circle) 1 2 3 4

Mail to Attn: Steve Skinner, S.E. International, Inc., P.O. Box 39, Summertown, TN 38483-0039 or fax to (931) 964-3564