

Highlights

- Measure and alarm on alpha and beta particulates in air with real time radon compensation
- Radon Mode Option determines PAEC as well as radon and thoron progeny equilibrium
- Umbilical that allows the sample point to be located in the breathing zone of the worker
- 8-Hour battery life
- Ultra compact - at 5" x 5" x 3" and weighing a mere 2 lbs
- Uses alpha peak-shape-fitting for individual measurements of alpha nuclides—increasing sensitivity while significantly reducing false alarms
- Performs both fast-responding (Acute) and high-sensitivity (Chronic) measurements
- Voice annunciation of status changes and dose provide hands-free operation
- Acute and Chronic dose, concentration, and flow logging as well as spectrum logging
- Typical ²³⁹Pu sensitivity of 1.0 DAC-h (Chronic) and 25 DAC-h (Acute) with less than one false alarm per 2080 hours of operation
- Wireless or Ethernet Output Options for remote monitoring

Description

The Bladewerx EpeeBZM™ is an ultra-compact, breathing zone monitor capable of real-time detection of alpha and beta emitting particulates. Its flexible design provides a high performance platform for detecting trace amounts of radioactive particulates in the presence of ambient radon or alternatively for making high accuracy radon measurements. The EpeeBZM can be configured to measure and alarm on the presence of special nuclear materials (SNM) or to perform radon progeny measurements and report on potential alpha energy concentration (PAEC) in working levels. It has a 3ft umbilical that allows the sampling point to be located remotely on the worker near the lapel using a clip (e.g. at the breathing zone).



The EpeeBZM is available with a belt clip and is small enough to be worn inside worker's anti-C Level A suits. The close proximity of the sampling head to the wearer means much more accurate worker dose assessments and alarm indications than is possible for larger CAMs running at much higher sampling rates. Having a size less than 5" x 5" x 3" and weighing a mere 2 lbs., it can be comfortably worn by a user during the work day. The built-in rechargeable lithium-ion battery provides for 8-hours of continuous operation away from any electrical power source. When plugged into the supplied 12V AC adapter, it can be run continuously.

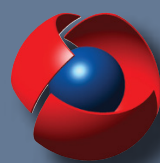
EpeeBZM is designed and built to survive the rigors of industrial use. The case is manufactured from a high impact thermopolymer material and is splash and dust resistant with protected connectors. When conditions are especially dusty, the pump flow rate can be adjusted to reduce filter loading and extend filter and battery life. The pump is a high reliability model proven over years of use in personal air samplers.

Features

The EpeeBZM is a fully standalone battery-powered CAM with visual alarms as well as voice output for alarms and data reporting. Measurements are made using a solid-state alpha/beta detector viewing a filter in the flow path of the built-in 6 LPM pump. The internal Windows-CE processor board analyzes the data from the alpha multi-channel analyzer and gross beta channel and performs alarm determinations and data reporting. Complete log and spectral data can be retrieved from the unit by connecting a USB memory stick or by syncing to a laptop, tablet or PC. Calibration and setup are via PC connected to the micro-USB "client" port. All necessary software is provided with the unit.

User Interface

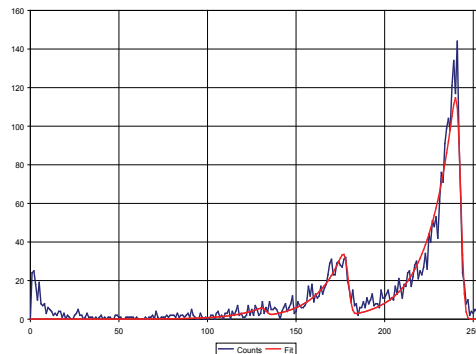
Operation of the EpeeBZM is simple and intuitive, requiring no specialized knowledge. Pressing the ON button turns the unit on and monitoring begins immediately. Nothing else is required of the user. Other controls available include volume controls for the speaker and the alarm acknowledge button. The status of the instrument is displayed through the illumination of the alarm, normal or trouble LEDs located on the top and front panels. Voice output of dose and status changes through the EpeeBZM speaker or ear buds allows for hands-free monitoring,



permitting the instrument to be worn on the inside of protective garments. With the 802.3 Ethernet RadNet Output or the Wireless 802.11g RadNet Output Option installed, multiple EpeeBZMs report their status and readings to a local area network where a local laptop or PC workstation running Bladewerx RadNet Client software or other RadNet compliant client software provides remote supervisory monitoring, in real-time, of up to ten instruments.

Alpha Peak-Shape-Fitting

Key to the powerful data analysis capabilities of the EpeeBZM is the state-of-the-art alpha peak shape fitting, which is used to separate the spectrum into the contributions from its constituent nuclides and quantify the spectrum counts from radon progeny and the user-defined isotope-of-interest. Alpha peak shape fitting is a technique that uses the profiles of multiple alpha isotope peaks to create a composite curve which best fits the actual spectrum. Because the individual nuclide peaks are independently determined, the separation of nuclides is impervious to radon equilibrium changes and allows the beta channel reading to be compensated for the background radon interference. These capabilities contribute to a very low probability of false alarms. Precise fitting of the ^{218}Po tail results in excellent sensitivity—superior, in many cases, to instruments sampling at 40LPM.



Radon Mode

The EpeeBZM may be configured to operate in a 'Radon Mode' where the instrument will monitor the potential-alpha-energy-concentration (PAEC) of airborne radon and thoron progeny. Because the alpha peak-fitting algorithm separates out the individual activities of ^{218}Po , ^{214}Po and ^{212}Po , the ^{214}Pb and ^{212}Bi beta contributions to PAEC can be determined. This allows for an exact solution for PAEC since all the individual activities of the alpha and beta decay products are known. The display units can be configured for either units of milli-Working Levels (mWL) and WL-h, or SI units of $\mu\text{J}/\text{m}^3$ and $\mu\text{J}\cdot\text{h}/\text{m}^3$. Because the individual progeny concentrations are known, the effective (dis)equilibrium ratio of radon progeny can be determined. This feature can provide useful insights into the 'age' of the air sampled. Further, the beta channel is used to determine the RaB (^{214}Pb) contribution to the PAEC, making this an extremely accurate radon monitor with a sensitivity of under 1 mWL.

Sensitivity and Response Time

The sensitivity of the EpeeBZM for measuring and alarming on specific isotopes of interest in the presence of a radon background is dependent on several factors including the radon background, dust loading, sample flow rate, count time settings, and, of course, the energy of the isotope of interest. The count data are analyzed simultaneously with two different user-settable count times, the shorter one referred to as "Acute" and the longer referred to as "Chronic". In a radon background of ~ 2 pCi/L, a minimum detectable dose (MDD) of less than 2 DAC-h is achievable with Chronic count time of 4-hours. A simultaneously running Acute count time of 2 minutes achieves an MDD of less than 40 DAC-h.

Data Logging

The EpeeBZM creates log files of both the Acute (from 5- to 30-second detail) and Chronic (1-minute detail) readings, along with spectrum log files at a user-defined interval of 1 to 30 minutes. These log files are stored for later retrieval and review. The log files use the comma-separated-variable (*.csv) format, recognized by most spreadsheet and database software.

Specifications

Sampling Head and Flow

- Detector: Solid-state ion-implanted silicon (450 mm² active area, 300 μm depletion)
- Pump: diaphragm-type, 6.0 LPM (typical), flow rate is adjustable
- Filter: 30 mm SpecIon™ 1.5 μm PTFE membrane (25 mm collection area)

Data Analysis

- Multi-Channel Analyzer: 256 channel spectrum
- Peak-fitting algorithm for ^{214}Po , ^{218}Po , ^{212}Po and one or two additional radionuclide (e.g. ^{239}Pu)
- Acute (120 sec window) and Chronic (240 min window) sensitivities, plus net count rate alarm
- Processor: 500 MHz NXP Vybrid VF6
- Max Count Rate: 300,000 cpm
- Calibration: Electro-plated stainless steel source required for efficiency calibration. 30mm diameter with 25mm active area. ^{241}Am or ^{239}Pu recommended.
- Alpha Energy Range: 1.0 - 10 MeV
- Beta Energy Range: 150 KeV - 2 MeV

Physical

- Battery powered: 7.4 V Li-Ion, 4.1Ah (8 Hr run-time, 4-hour charge time)
- Weight: 2.1 lbs (1 kg)
- Dimensions: 4.75" w x 5.5" h x 3" d (12 x 14 x 7.6 cm)
- Temperature: 0 to 122 °F (-20 to 50°C)

Base Model

BIN-EBZM-ACAM	EpeeBZM, Alpha with 2 Isotopes of Interest and Radon background subtraction
BIN-EBZM-CAM	EpeeBZM, Alpha & Beta with 2 Isotopes of Interest and Radon background subtraction

Options

BIN-CAM-OPT1	RadNet Output via WiFi
BIN-CAM-OPT12	RadNet Output via Ethernet
BIN-CAM-OPT13	ASCII Output via Ethernet

Accessories

BSP-FILT-15B030	SpecIon filters, 30mm diameter 1.5 μm pore size, box of 100 ea.
BAC-RNCL-1	RadNet Client software
BPT-WAPG-1	802.11b/g Wireless Access Point
BSP-CAL-HOLD1	Calibration Source Holder
BPT-FLOWCAL-3	Flow Calibration Kit (flowmeter)

Spare Parts

BPT-LION-4100	4100 mA-h Li-Ion battery
BSP-PUMP-5L	6 LPM pump
BPT-DETC-SD450-3	Detector, 450 mm ²
BPT-EARB-M1	Ear bud headphones
BPT-ACADP-1222	AC adapter/charger