BETA AIR MONITORS

SabreBPM²™
Beta Particulate Monitor

Highlights

- Beta particulate in air detection

- Real-time alpha peak-shape-fitting for determining beta background compensation for radon–significantly reducing false alarms and increasing sensitivity

- Performs both fast-responding (Acute) and high-sensitivity (Chronic) measurements

- Local Acute and Chronic dose, concentration, and flow logging as well as optional alpha spectrum logging

- Alpha monitoring of up to two isotopes of interest

- Wireless 802.11g RadNet Output Option for remote monitoring

- Compatable with Mirion WRM & GEDDS

- MDC is less than 2×10^{-9} µCi/cc for Cs-137 using a 30 minute chronic analysis time in a 10 µR/h gamma background

- Can be plumbed to house vacuum or external pump for higher flow rates and greater sensitivity

- Complete instrument including internal pump weighs 8.3 lbs.
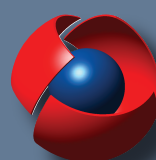
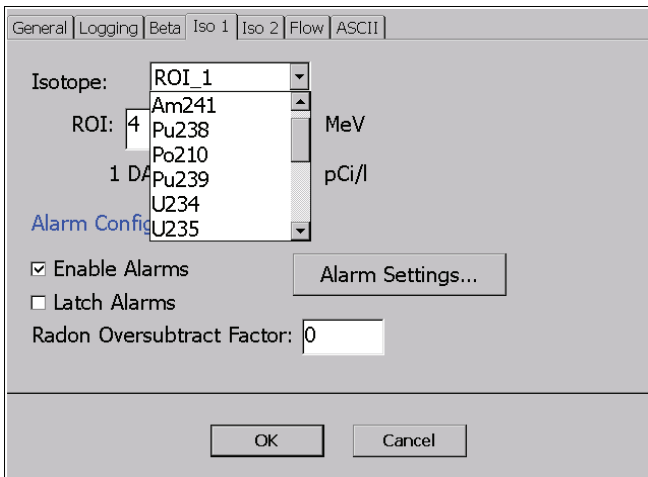- 8-Hour battery life

- American or SI units

Descriptio

The Bladewerx SabreBPM² Beta Particulate Monitor is a lightweight, battery-powered, alpha-beta air monitor that can be used as a portable workplace monitor or CAM for emergency-response assessments. Its design provides workers with an early warning of an airborne release of alpha- or beta-emitting particulates. The SabreBPM² uses the acclaimed Bladewerx peak fitting software for radon-background subtraction, meaning more accurate workplace measurement and alarm indication. A self-contained pump, built-in detector head, alarm light, Sonalert and battery operation allow the ultimate in radiological air monitoring portability. A solid-state, ion-implanted, silicon detector and reliable 1024-channel multichannel analyzer provides input for an embedded processor board to perform beta detection and alpha spectral analysis for radon background compensation. An internal gamma guard detector provides real time beta channel compensation for changing ambient gamma background levels. An integrated 7-LPM pump, lithium-ion battery and charging electronics complete the package allowing for battery operation of up to eight hours.
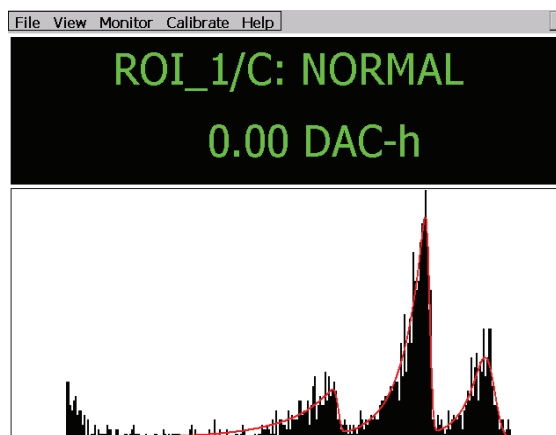
Background Subtraction

State-of-the-art alpha peak shape fitting quantifies the alpha and beta counts from radon and thoron progeny. 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 alpha spectrum. Because the individual radon peaks are independently determined, the beta background compensation is impervious to radon equilibrium changes and contributes to low probability of false alarms.

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bladewerx™

General | Logging | Beta | Iso 1 | Iso 2 | Flow | ASCII

Isotope: ROI_1
ROI: 4
Am241
Pu238
Po210
Pu239
U234
U235
MeV
1 DA
pCi/l
Alarm Config
☑ Enable Alarms
☐ Latch Alarms
Radon Oversubtract Factor: 0
Alarm Settings...
OK   Cancel

File   View   Monitor   Calibrate   Help

PAEC/C: NORMAL

1.4 mWL

13:54:00 [PAEC] Chronic: 5.28 mWL MDC: 30.42 Exposure: 0.00 mWL-h MD
13:55:00 [PAEC] Chronic: 4.03 mWL MDC: 22.39 Exposure: 0.00 mWL-h MD
13:56:00 [PAEC] Chronic: 3.46 mWL MDC: 19.18 Exposure: 0.00 mWL-h MD
13:57:00 [PAEC] Chronic: 2.61 mWL MDC: 15.48 Exposure: 0.00 mWL-h MD
13:58:00 [PAEC] Chronic: 2.39 mWL MDC: 14.06 Exposure: 0.00 mWL-h MD
13:59:00 [PAEC] Chronic: 2.24 mWL MDC: 12.63 Exposure: 0.00 mWL-h MD
14:00:01 [PAEC] Chronic: 2.20 mWL MDC: 11.10 Exposure: 0.00 mWL-h MD
14:01:00 [PAEC] Chronic: 1.70 mWL MDC: 9.66 Exposure: 0.00 mWL-h MD
14:02:00 [PAEC] Chronic: 1.66 mWL MDC: 8.95 Exposure: 0.00 mWL-h MD
14:03:00 [PAEC] Chronic: 1.57 mWL MDC: 8.06 Exposure: 0.00 mWL-h MD
14:04:00 [PAEC] Chronic: 1.50 mWL MDC: 7.54 Exposure: 0.00 mWL-h MD
14:05:00 [PAEC] Chronic: 1.47 mWL MDC: 7.02 Exposure: 0.00 mWL-h MD
14:06:00 [PAEC] Chronic: 1.35 mWL MDC: 6.51 Exposure: 0.00 mWL-h MD

General | Logging | Beta | Iso 1 | Iso 2 | Flow | ASCII

Serial No: 329
                        Acute: Chronic:
Window Settings   120 Seconds   240 Minutes
Calibration Expiration Settings
Calibration expires: 5/25/2022
Calibrations are valid for   365   days,   ☐ End of Month
        but not more than 8800   runtime hours.
OK   Cancel

Alpha Monitoring

The SabreBPM² can monitor up to two alpha isotopes of interest simultaneously with beta monitoring. The Bladewerx peak-shape-fitting algorithm differentiates the trans uranic counts from radon background, giving accurate reading of alpha particulate concentration and dose. Both isotopes-of-interest(IOI) can be changed through a simple dropdown menu in the instrument options, allowing the unit to be used in a great variety of situations.

If the exact mix of isotopes being monitored is unknown, or the dose of a specified energy range is needed, up to two regions of interest may be configured by setting one or both of the Isotopes of Interest to a Region-of-Interest (ROI). This will calculate the dose and concentration from a user-set energy range while using the peak shape fitting of radon progeny to exclude radon progeny counts from the region of interest. Energy regions can be set from 0.0 to 5.8 MeV while still allowing accurate peak shape fitting on the radon progeny portion of the spectrum for background subtraction purposes.

A "Beta-Only" option is available for work areas that do not require monitoring of transuranic alpha particulates but still need accurate radon subtraction
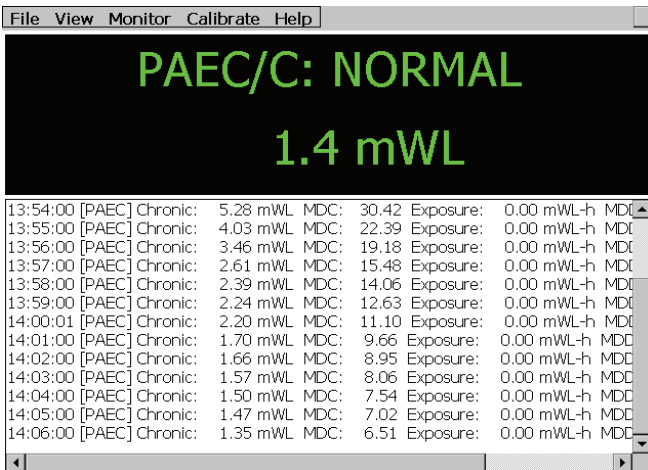
Working Level Monitoring

The SabreBPM² may be set in 'Radon Mode' by setting the primary isotope-of-interest to PAEC (Potential-Alpha-Energy-Concentration). In this mode, the instrument will monitor the PAEC of airborne radon progeny and/or thoron progeny. The display units can be configured for either American units of milli-Working Levels (mWL) and mWL-h, or SI units of $\mu J/m^3$ and μJ-h/m³. Because the individual progeny concentrations are known, the effective (dis)equilibrium ratio of radon progeny can be determined and displayed. This feature can provide useful insights into the 'age' of the air sampled. A secondary Isotope of interest may still be monitored while in Radon Mode.

Guard Detector

An internal guard detector provides real time beta compensation for changing gamma background levels. An adjustable gamma subtraction factor allows for correction of slight differences in beta and guard count rate in a fixed gamma field to produce proper energy response. If real time compensation of gamma background is not needed, units without internal guard detectors are available. Units without guard detectors use a fixed subtraction factor to correct beta counts for an unchanging gamma background.

User Interface and Controls

An integrated 5.5-inch LCD resistive touch screen with VGA resolution displays detailed information on the instrument status and readings while in operation. The dose and instrument status are prominently displayed in an upper window while the lower window either displays the historical readings and battery status or the current alpha spectrum. The menu bar at the top contains familiar Windows dropdown menus for access to configuration and calibration functions. These functions can be password locked to prevent unauthorized persons from changing detector settings.

The face of the unit has 3 buttons: "Units", "Alarm Ack" (Alarm Acknowledge), and "Channel". The Units button cycles the units displayed in the upper window between DAC-h, pCi, CPS, and DAC or their SI equivalents, the Channel button cycles the upper display between beta, the isotope channels and flow rate, and the Alarm Acknowledge alarm button silences the audible and clears latched alarms. The Alarm
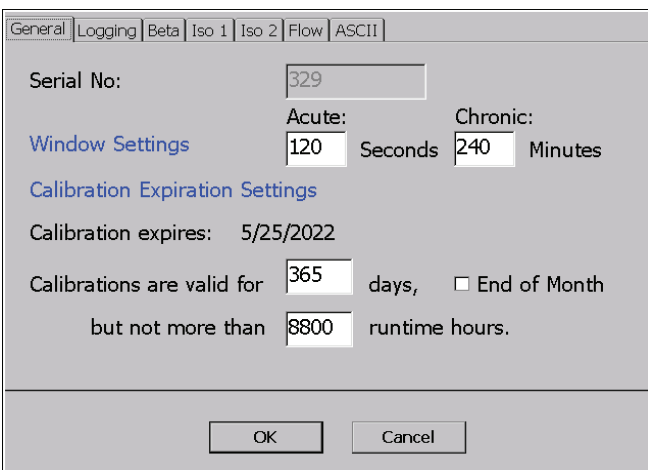
Acknowledge button can be disabled via menu options to prevent unauthorized clearing of latched alarms.

The SabreBPM² uses a Sonalert visual/audio alarm stack. The default unit includes a red alarm light and audible alarm. The audible alarm has an intensity of 94 decibels at 1 meter to ensure any worker in the area will quickly become aware of alarm conditions. Other indicator options are available, including a yellow alert light to indicate when concentration reaches 50% of alarm levels, a white maintenance light to indicate the unit requires maintenance, and a blue fail light to indicate failure conditions. Not all options can be installed on the same unit.

Data Logging

The SabreBPM² creates log files of both the Acute (from 1- to 30-second detail) and Chronic (1-minute detail) readings, along with spectrum log files at a user-defined interval. These log files are saved for later retrieval and review in the internal memory or an SD memory card. The log files use the comma-separated-variable (*.csv) clear text format, recognized by most spreadsheet and database software.

Readings are aggregated over user-set Acute and Chronic Window times to calculate the concentration of isotopes by examining the change in count rate between the last 2 window times. Acute Window times can be set from 5 seconds to 10 minutes, and Chronic Window times can be set from 5 minutes to 10 hours. The Acute Window offers fast detection of high dose releases while the Chronic Window provides accurate measurement of long-term conditions by averaging data from longer measurement periods.
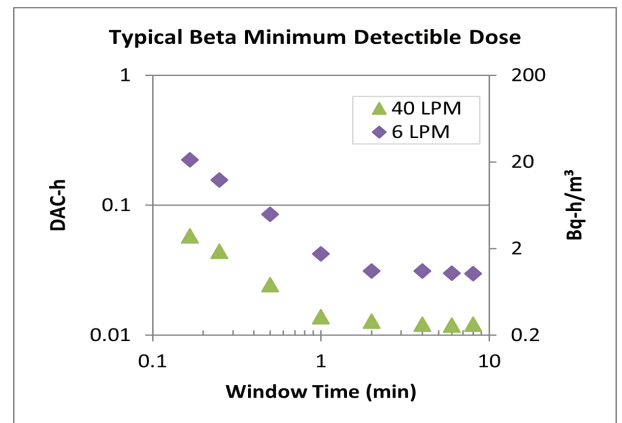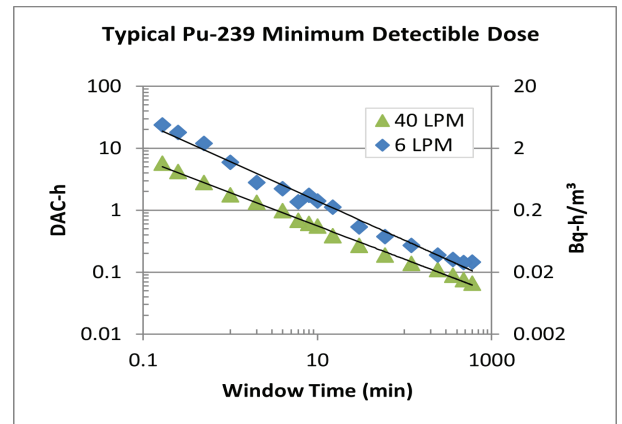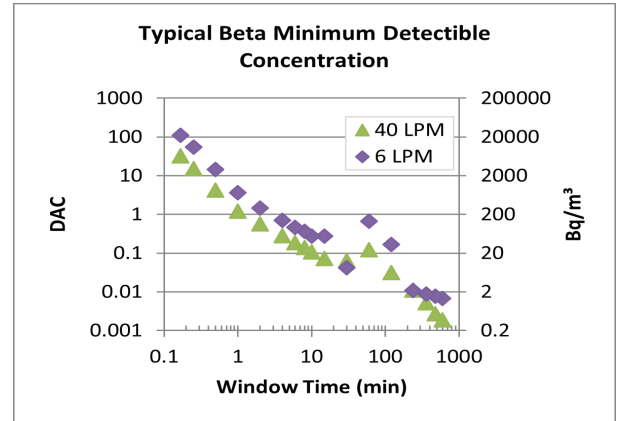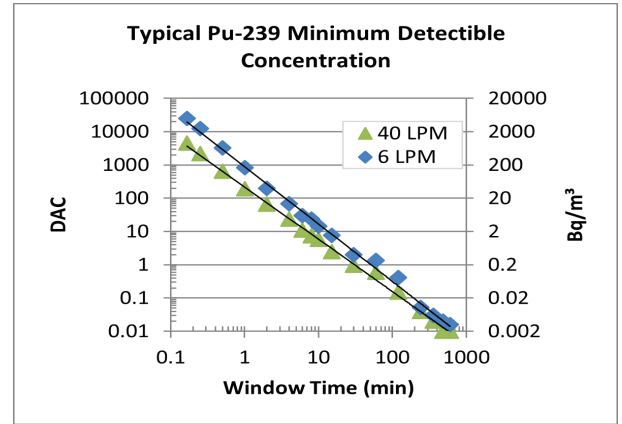
Sensitivity and Response Time

The SabreBPM²'s sensitivity varies primarily as a function of the window time. The longer Chronic Window has improved sensitivities over a shorter Acute Window time. Sensitivity is calculated and recorded in the chronic and acute logs at same frequency as the respective data logs. Sensitivity is reported in Minimum Detectable Concentration (MDC) in DAC and Minimum Detectable Dose (MDD) in DAC-h. SI units are also available.

A higher flow rate with the external pump option improves the sensitivity. For Pu-239, using an external 40 LPM pump shows significantly better sensitivity at low window times, also allowing greater response times on acute releases.

The typical MDC and MDD graphs shown will vary from onsite measurements based on radon background, filter loading, and the exact isotope of interest. The charts to the right were generated with a new filter in a 10 μR/h gamma background.

Optional Remote Monitoring

The beta and alpha channels can be remotely monitored when paired with the RadNet or ASCII output options. The SabreBPM² can be configured to output its status, readings, and spectrum over an Ethernet or Wi-Fi connection using RadNet protocol, allowing a laptop or PC running Bladewerx RadNet Client or other RadNet compliant client software to monitor detector status over a network connection. ASCII protocol output is also available using an Ethernet, Wi-Fi, or RS-232 connection. This capability allows for real-time remote supervisory monitoring of up to 50 work areas. Wireless output options allow

Typical Pu-239 Minimum Detectible Concentration

Typical Beta Minimum Detectible Concentration

Typical Pu-239 Minimum Detectible Dose

Typical Beta Minimum Detectible Dose

multiple SabreBPM²s report to a wireless access point up to 300 feet away. The ASCII protocol is supported by the Mirion WRM moderns and by sew technologies GEDDS, as well as others.

Optional Remote Host Protocol

The Bladewerx CAM Remote Host Protocol (CRHP) is a command-based ASCII protocol that allows a remote user to edit parameters remotely over a TCP/IP or serial RS-232 link, either through a direct connection, WiFi, or a dial-up modem, in addition to accessing the SabreBPM²'s log data and spectrums. The remote user can change instrument settings such as Isotopes of Interest, acute and chronic window times, frequency of spectrum logs, and alarm settings without requiring physical access to the unit. The unit will also dial-out to push alarms to the remote user to ensure alarm status is communicated quickly. This option employs password security login to prevent unauthorized modification of detector settings.

Optional External Pump

The SabreBPM can be ordered with a 3/8" hose barb to allow connection of an external pump of up to 90 LPM to increase the volume of sampled air. An external pump is not included with this option, but a 60 LPM external diaphragm pump is available from Bladewerx. Mounting provisions are not included with the Bladewerx external pump. The external pump option and the internal 7 LPM pump are mutually exclusive configurations.

Optional In-Line Head

The In-Line Head option allows for remote sampling of an airstream up to 15 ft from the unit itself by plumbing the detector head to an in-house system or remote sampling apparatus. The In-Line Head has a 1" NPT male pipe fitting for plumbing into stacks or ventilation systems. The In-Line Head option requires an external pump.

Iodine-131 Monitoring

The SabreBPM² can effectively monitor for I-131 when using carbon-impregnated filters as the collection medium. In most cases, a second SabreBPM² in the upstream air-sampling path monitors for any particulate isotopes and removes particulates that would interfere with I-131 detection. External pumps and in-line heads are required for a dual-CAM configuration. The Iodine CAM may be set up with a carbon-impregnated filter only, or with a Speclon™ filter on top of the carbon-impregnated filter to ensure accurate I-131 monitoring in high radon areas. If the dual-CAM configuration is not used, the Speclon required on top of the carbon-impregnated filter is heavily recommended to limit other particulates from interfering with I-131 monitoring.

Specifications

Sampling Head and Flow
- Detector: Solid-state ion-implanted silicon (450 mm² active area, 300 µm depletion)
- Pump: diaphragm-type, 7.0 LPM max flow rate
- Filter: 37 mm Speclon™ 1.5 µm PTFE membrane or compatible 37mm PTFE ¬filter (25 mm collection area)

Data Analysis
- Single beta channel with upper/lower discriminator setting
- Alpha MCA: 1024-channel ADC binned to 256 channel alpha spectrum
- Radon plus fixed background subtraction
- Acute Window and Chronic Window sensitivities
- Processor: Windows CE-based
- Max Count Rate: 600,000 cpm (beta + alpha)
- Source Response Check diagnostic
- Calibration: Electro-plated stainless-steel sources required for efficiency calibration, 32mm diameter with 25mm active area
- Alpha Energy Range: 1.0 - 9.0 MeV
- Beta Efficiency: 7-18% energy-dependent

Physical
- Battery powered: 8.4 V Li-Ion, 6.6Ah
- 8-hour run-time, 4-hour charge time
- Weight 8.3 lbs (3.8 kg)
- Dimensions: 10" x 12" x 5" (W x H x D)
- Temperature: 0 to 122 °F (-20 to 50°C)

Base Model

BIN-SABR-BPM2	SabreBPM², Alpha/Beta CAM with Radon and gamma background subtraction

Options

BIN-BPM2-OPT1	RadNet Output via WiFi
BIN-BPM2-OPT4	External Pump Configuration
BIN-BPM2-OPT5DEL	Beta Measurement Only
BIN-BPM2-OPT11	In-Line Head (remote sampler)
BIN-BPM2-OPT12	ASCII Output via RS-232
BIN-BPM2-OPT13	ASCII Output via Wi-Fi
BIN-BPM2-OPT21	RadNet Output via Ethernet
BIN-BPM2-OPT22	ASCII Output via Ethernet

Accessories

BSP-FILT-15B037	1.5 µm pore Speclon ¬filters
BAC-RNCL-1 user	RadNet Client software, single
BAC-RNCL-5	RadNet Client software, five users
BPT-WAPG-1	802.11b/g wireless access point
BPT-FLOWCAL-2	Flow Calibration Kit
BSP-CAL-HOLD	Calibration Source Holder 32mm

Spare Parts

BPT-LION-6600	6600 mA-h Li-Ion battery
BSP-PUMP-7L	7.0 LPM pump
BSP-SMCA-A1	SabreMCA board
BSP-ANNUN-A1	Annunciator board
BSP-BETA-A1	Beta counting board
BSP-PAMP-B1	Preamp board
BPT-TDX-A1	Configured processor board
BPT-DETC-SD450-3	Detector, 450 mm²
BPT-ACADP-1222	AC adapter/charger (U.S.)