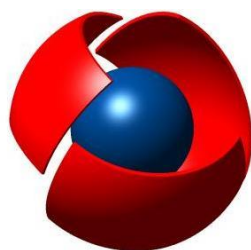


EpeeBZM™ Operations Manual



bladewerx™
Cutting-Edge Technology for Instruments and Measurement Applications

BLADEWERX

EpeeBZM Operations Manual

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Getting Started

The Parts of the EpeeBZM

The EpeeBZM™ consists of a rugged ABS polycarbonate enclosure containing the EpeeMCA™ electronics, battery and pump. A detector head mounted at the end of the umbilical contains the detector, preamp, and a filter holder.

The enclosure is dust-tight and splash-resistant. Five screws hold the front and back halves together. Opening the case should only be done by personnel trained in repair of the EpeeBZM.

There are four operator control buttons located on top of the EpeeBZM: Power, Alarm Acknowledge, and Up/Down speaker volume control buttons.

An integrated speaker is located in the front face of the instrument.

The left side panel provides several different connector ports and the rear panel exposes the external power/battery charger jack. The power jack is for the A/C Adapter and is used to power the unit for continuous operation, or to charge the internal battery. A mini-USB port is used to calibrate, configure, and copy data directly to the PC via the mini-USB cable. The standard “accessory” USB port is used for in-the-field log data retrieval with a USB memory stick. An audio jack is for use with the included headphones to monitor readings and status changes when the EpeeBZM is used in noisy environments (*the integrated speaker is disabled when headphones are plugged in*). Lastly, the recessed reset button is used for a hard reset of the instrument.

In addition to the EpeeBZM, each package contains the A/C Adapter, a mini-USB cable and a shoulder strap or optional belt clip. A flow calibration fixture and software CD is provided with any number of EpeeBZMs on a single purchase order.

Charging the Batteries

Before the EpeèBZM may be operated, the lithium-ion battery must be fully charged. The battery can be charged by plugging the A/C Adapter into a wall socket (115 VAC only) and plugging the 12 Vdc power plug into the connector on the back of the case. A Red/Green LED on the face of the EpeèBZM indicates the charging state. When the LED is Red, the battery is being charged. When the LED is Green, the battery is charged. The charging time is approximately 3 hours for a unit with low battery and 8 hours (2 charge cycles) for a unit with a completely discharged battery.

Important Notice Concerning Parameters and Data

The EpeèBZM configuration settings and parameters are saved in non-volatile flash memory thus keeping your calibration settings intact if the battery is fully discharged. The EpeèBZM will run once the power is restored to the unit. If the battery is fully discharged, all that is needed to restore the instrument to an operational condition is to recharge the battery for two complete charge cycles (i.e. 8 hours).

By default, log files are stored in volatile memory. If the battery becomes fully discharged, the log files will be lost, unless the user chooses to store them in the non-volatile SD Card folder.

ON and OFF Button

With the battery fully charged, you are now ready to turn the EpeèBZM on by pressing the power button on top. After pressing the button the EpeèBZM program will load and execute. If powering up from Off Mode, The green Normal LED should light after a few seconds. Full boot-up takes about 30 seconds for the pump to come on and the measurement functions to begin. If resuming from Sleep Mode, it only takes a couple seconds.

To put the EpeèBZM in Sleep Mode, press the power button and hold for 1 second before releasing. The instrument will announce “STANDBY,” the pump should stop, and the lights will shut off. If the power button is pressed accidentally during a monitoring period, just press the power button again to return to ON and continue measurement functions. If left in Sleep Mode, the EpeèBZM has a storage time—with a full charge—of about 2 weeks.

To fully power off the EpeèBZM, hold the power button down for 5 seconds and then release. If the shutdown is successful the EpeèBZM will report “shutting down”, the pump will stop, and the lights will shut off. In the Off position, the EpeèBZM battery has a storage time of 3 months.

During monitoring periods, when the EpeèBZM is ON, the battery will last 10 to 16 hours—depending on pump speed. When a monitoring period is finished, the EpeèBZM should be placed in Sleep Mode. Sleep Mode will keep all log data saved, whereas OFF will cause the EpeèBZM to lose all the log data if it is stored in the volatile My Documents folder (for more information see the Log Data Destination section).

To fully power down the EpeèBZM from sleep mode, you must first turn it back on, then press and hold the power button once again to perform the full shutdown.

Alarm Acknowledge Button

When the device alarms pressing this button once silences the alarm and pressing it again clears the alarm. In the case of a Dose Alarm, the alarm will immediately sound again because the activity on the filter is still present.

Holding down the **Alarm Ack** button for 10 seconds will reset the spectrum accumulated by the EpeèBZM and the unit will announce “Initializing” followed by “Normal”.

Volume +/- Buttons

The speaker and audio jack have an adjustable volume setting. To adjust the volume, use the **Vol+** and **Vol-** buttons on top of the CAM. They make a sound each time they are pushed to indicate the current volume. There are a total of 10 levels of volume. When the minimum or maximum volume levels are reached, the speaker tone will change.

In the event of an alarm the volume level is automatically set to maximum by the software. The EpeèBZM will persistently report the measurement status at the highest volume via the speaker or audio jack, until the alarm is acknowledged by pressing the **Alarm Ack** button.

Operational Duration

When operating off the battery, the EpeèBZM will run, depending on pump speed, for 10-16 hours before automatically going into Sleep Mode to preserve the log data. The use of wireless reporting capability and the flow rate can affect the run time.

When the battery charge reaches 25%, the voice output will announce LOW BATTERY. At 15%, the unit will announce BATTERY EXPIRED. SHUTTING DOWN. At which point it will enter Sleep Mode.

Note: In order to preserve status, spectrum, and log data, the EpeèBZM will automatically go to Sleep Mode when the battery life reaches 15%. Before it reaches 0%, either the log files need to be downloaded or the EpeèBZM needs to be charged in order to avoid losing the log data.

Transferring Files

When you connect the device to a PC with Windows 7/8 the Windows Mobile Device Center window will open and indicate an established connection with the EpeèBZM. This program can be used to manually copy log files from the EpeèBZM to the computer. In order to determine where on the EpeèBZM the Log files are being saved (My Documents, SD Card, or Internal Flash Drive) see **Logging** in **Section 3**.

In order to manually copy files choose “Connect without setting up your device,” then “File Management,” then “Browse the Contents of Your device,” and then open the “\” storage for the *My Documents* folder, the *SD Card* for the files saved to the SD Card, or the *Flash Disk* for



the files saved to the Flash Disk. From here you can cut and copy folders and files and move them to other destinations on your computer.

The alternate method for retrieving log files is to use a USB memory stick “thumb drive” and plug it in the side of the instrument. After a few seconds, the unit will report COPYING LOG FILES. When all files have been copied to the thumb drive, the voice output will announce COPY COMPLETE. The log files will all be stored on the thumb drive in a folder with the name of the instrument (e.g. *BWEPCAM_1010*).

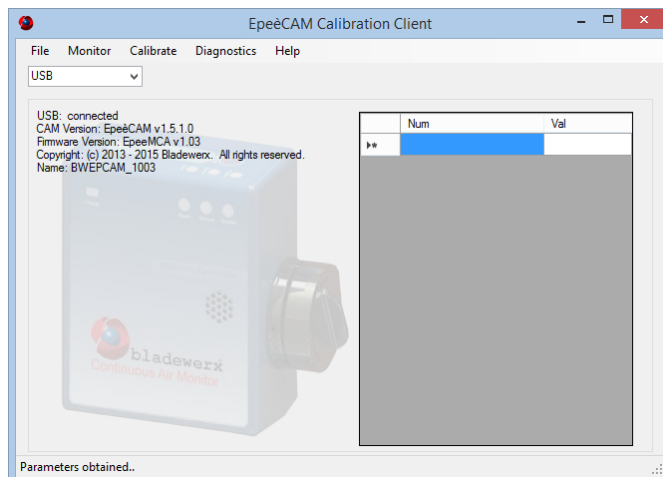
EpeèBZM Calibration Interface Software Installation

The configuration and calibration features are provided by a companion Windows 7/8-compatible program—**EpeèBZM Calibration Client**. This section explains how to install the calibration software and Section 2 explains how to fully configure and customize the operation of the EpeèBZM to meet your specific requirements.

Insert the Install CD (or Bladewerx memory stick) into the computer. Access the contents of the CD and open *EpeèCAM Calibration Client* folder. Open the program labeled Setup.exe to open the Install Wizard and follow the instructions.

Once it is installed you can run the program from a desktop icon. Note that the program does not open automatically when the EpeèBZM is connected but must be opened manually from the Programs menu, or from the desktop icon.

From this program you can change parameters and calibrate the EpeèBZM while it is connected to the PC. The software can communicate with an EpeèBZM via the USB Sync cable.



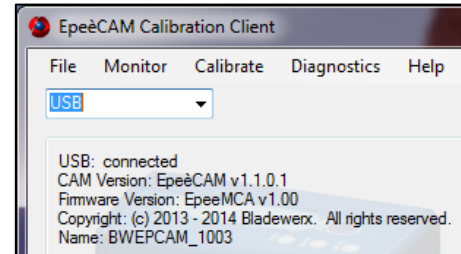
Configuration

The EpeèCAM Calibration Client provides several dialog boxes to allow configuration of the instrument operation. These dialog boxes are accessed through the menus at the top of the screen. Each dialog box and its property settings are described below.

Connecting the EpeèBZM to the Calibration Client

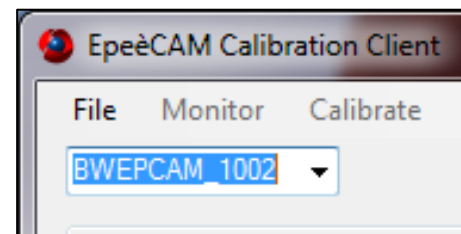
USB:

After connecting the mini USB Sync cable, in the drop down field box of the interface select or enter **USB**. In the field below this drop-down box the calibrator will display “USB: Connected.”



Wireless (requires factory configuration):

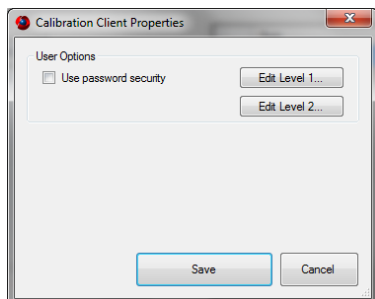
If your EpeèBZM is equipped with a Wireless Output Option it can be connected to the calibration software wirelessly. Before it can be connected wirelessly the EpeèBZM must be configured with your wireless network. For instructions on this configuration see Wireless RadNet Operation. Each EpeèBZM has a unique network identifier (i.e. network name) and network IP Address. Using Wi-Fi, the Interface can communicate with the EpeèBZM by either the name or IP address. IP addresses are typically assigned by a network router, so it is usually more practical to communicate with the EpeèBZM by its name. The name is based on the prefix BWEPCAM_ followed by the serial number. For instance, and EpeèBZM with serial number 1002 will be named BWEPCAM_1002.



On the home screen, select the drop down field box and enter or select the name of the EpeèBZM, then hit **Enter**. After a few seconds, the Interface will connect with the CAM via Wi-Fi.

Calibration Client Properties/Password Security

The EpeèBZM Calibration Client has two levels of security which can be enabled by selecting File...properties. To enable password security select Use Password Security. After enabling security in order to access the password window again it necessary to enter the password for the highest security



level. If a user is not logged in, he is at the lowest security level and only able to view settings, but not to change the configuration or calibration parameters. The second level of security is the Configuration level. This level allows changing the instrument configuration (e.g. changing isotopes-of-interest or window times, alarm settings, etc.). The highest level password is the calibration level. At this level, the user has full access and may calibrate the instrument and create different configuration profiles.

The default passwords are:

config –allows for configuration of parameters only

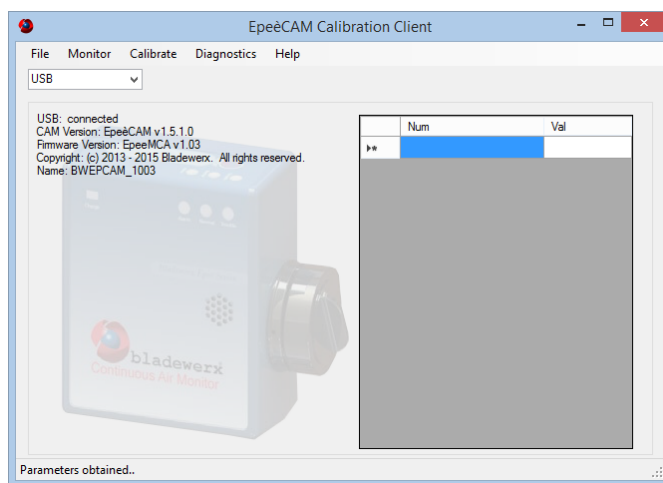
calib –allows for full access of calibration functions

You must be logged in at the calibration level in order to change the passwords. Once they are changed, the default passwords will no longer work. They can be changed from the password window by selecting Edit Level 1 or Edit Level 2 and entering the new password.

This dialog box controls the operation of the of the user interface aspects of the Calibration Client software. Select the **File – Properties...** menu item to access the dialog box.

Pump Speed

In order to change the pump speed of the EpeèBZM select **Monitor–Pump Speed...** The pump speed can be set one of four speeds: max, high, medium, or low. They correspond to approximately 1.5, 3.0, 4.5, and 6.0 LPM. To function with a higher sensitivity the EpeèBZM should be set at a higher the pump speed. For a longer battery life and lower noise level set the pump speed at a lower rate.



Instrument Options

The Instrument Options dialog box controls the functional behavior of the EpeèBZM. Access the dialog box from the menu by selecting **Monitor – Instrument Options...** Depending on factory installed options, the dialog box consists of up to seven pages of settings and information: **General, Output,**

Logging, Flow Iso 1, Iso 2, Beta, and RadNet. Each page is accessed by selecting the corresponding tab at the top of the dialog box.

Note: Depending on instrument options, not all tabs will appear.

General Tab

The *General* settings page indicates the EpeèBZM serial number that the software is linked to currently. Also, the *General* page controls the window times, which control the instrument sensitivity, and the calibration expiration settings of the EpeèBZM.

Serial Number—This field identifies the factory-defined serial number of the EpeèBZM. The serial number is not user-editable.

Window Settings

Acute Window—This setting defines the count time used to determine the Acute Dose and Acute Net Count Rate. It should be set to provide the fastest response to large sudden releases of a pre-determined level. Shorter times result in higher minimum-detectable levels but do not necessarily result in faster response times. A review of the Acute MDA and MDD from the log files may be required to achieve a desired alarm level and response time. *Default is 120 Seconds.*

Chronic Window—This setting defines the count time used to determine the Chronic Dose and Chronic Concentration. It should be set to provide the fastest response to low-level releases. Longer times provide the best sensitivity for small chronic releases. *Default is 240 Minutes.*

Calibration Expiration Settings

When the Calibration expires the EpeèBZM will annunciate “OUT OF CALIBRATION” and the Trouble light will blink. The Normal light will remain on indicating that the EpeèBZM is still functional.

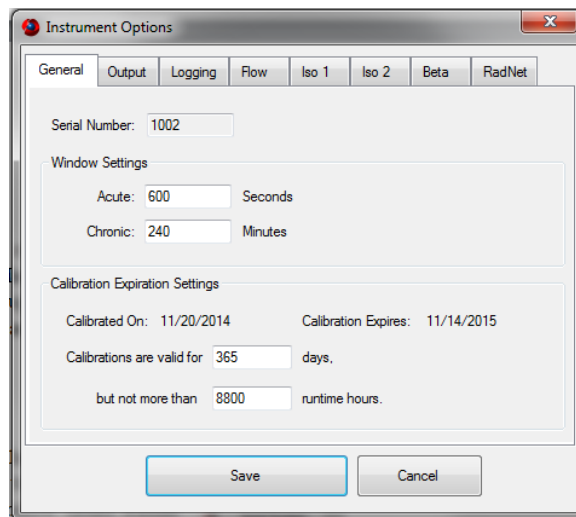
Calibration expires—This non-editable item displays the date on which the EpeèBZM calibration will expire. It is based on the user-defined days the calibration is valid for. The expiration could occur sooner if the user-defined maximum runtime hours are exceeded.

Calibrations are valid for XXX days—This field sets the maximum number of days between calibrations. *Default is 365 days.*

But not more than XXX runtime hours—This field sets the maximum number of hours of EpeèBZM pump runtime between calibrations. Under heavy filter-loading, the internal pump performance can start to degrade before the Calibration Days have elapsed. *Default is 8800 hours.*

Output Tab

The *Output Tab* settings control the voice output behavior of the EpeèBZM. During operation, the EpeèBZM annunciates data readings at varying frequencies.

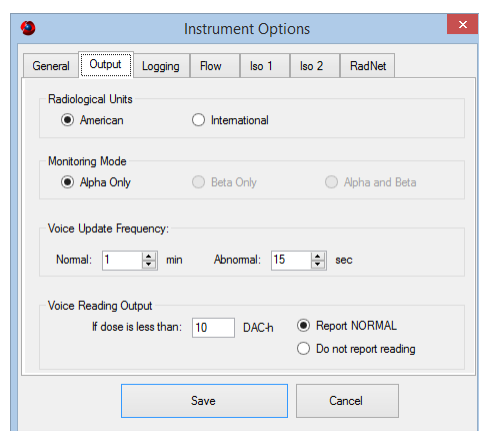


Radiological Units

This field identifies the reporting units of the EpeèBZM. Units can be American (i.e. DAC and DAC-h), or SI (i.e. mSv and Bq/m³) *Default: American.*

Monitoring Mode

This field identifies the Monitoring Mode of the EpeèBZM. The option may or may not be enabled depending on factory options. An instrument ordered with the Alpha and Beta capability will have all three settings available. Alpha-only instruments will have only the first option available. An instrument may be configured for Alpha Only, even though it has alpha/beta capability.



Voice Update Frequency

Normal—This field controls the frequency of status voice annunciations during normal operation. *Default is 60 seconds.*

Abnormal —This field controls the frequency of status voice annunciations during any abnormal condition, e.g. low pump flow, high alarms, and calibration expiration. It should be more frequent than the Normal setting. *Default is 15 seconds.*

If dose is less than —This field allows the user to set the dose level at which the EpeèBZM will begin to voice annunciate DAC-h readings. If the reading is less than this level, the following two fields dictate the output behavior. *Default is 1 DAC-h.*

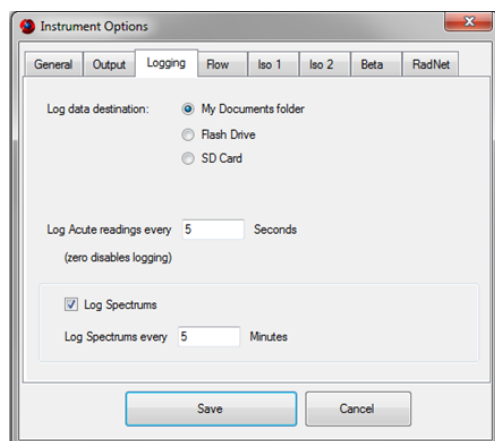
Report NORMAL —If this setting is selected and the dose is below the specified level in the **If dose is less than** field, the EpeèBZM will annunciate “NORMAL” according to the Frequency set in the **Normal** field.

Do not report reading—If this setting is selected the EpeèBZM will only report measurements if they exceed the value set in the ‘If dose is less than’ field. **There will be no audible indication if the reading is below ‘If dose is less than’ value.**

Logging Tab

The *Logging Tab* settings control the data logging behavior of the EpeèBZM. Several types of log files are created on the EpeèBZM during operation. See *Retrieving the Log Files* and *Viewing the Log Files* for more information on viewing the log files and **Transferring Files** for more information automatically and manually copying files.

Log data destination—This selection defines the location where log data will be saved. Only one data destination may be selected at a time. *Default is My Documents Folder*



- My Documents folder—This setting saves log files in the My Documents folder. This is a volatile folder meaning all data will be lost if the EpeèBZM is turned off, or in the event of a complete battery discharge. This setting provides the highest logging performance.
- Internal Flash Drive— If selected, an internal USB flash drive will save log files in non-volatile memory and will be saved in the event of a complete battery discharge or loss of battery power. Data saved to the Flash Drive is accessible via the USB sync cable and can be manually copied from the EpeèBZM to a PC. This setting provides the poorest logging performance.
- SD Card—This setting causes log data to be saved to the non-volatile SD memory card in the EpeèBZM and will be retained in the event of a complete battery discharge or loss of battery power. Data saved to the SD Card is accessible via the USB sync cable and can be manually copied from the EpeèBZM to a PC.

Log Acute readings every XX seconds—This setting controls the frequency which Acute readings are written to the `<IoI>_Acute_YYYYMMDD.txt` file. New acute log files are started every day at midnight. *Default is 5 Seconds.*

Log Spectrums—This setting controls whether Chronic spectrum snapshots logged. If the setting is checked, the Log Spectrums frequency field will be enabled. *Default is Spectrum Logging is ON.*

Log Spectrums every XX minutes—This setting defines the frequency in minutes that spectrums are added to the spectrum log file. A new spectrum log file is started every Sunday morning at 12:00 midnight. Each weekly spectrum log file created is named `Spectrum_YYYYMMDD.txt` where the date refers to the Sunday at the beginning of the week logged. *Default is 5 Minutes.*

Flow Tab

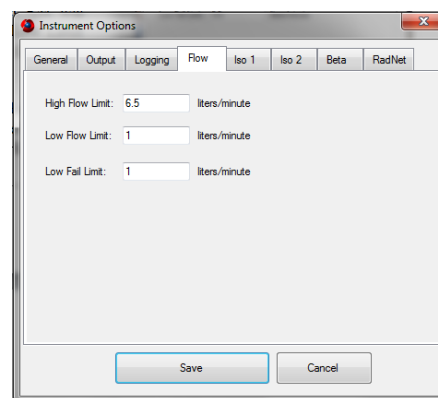
The *Flow Tab* settings define the alarm and failure limits on the sample flow measurement of the pump.

Flow Properties

Low Limit—This setting defines the limit in liters-per-minute below which the EpeèBZM will indicate a LOW FLOW status. The Low Limit should be set to indicate when a loaded filter needs to be changed out.

High Limit—This setting defines the limit in liters-per-minute above which the EpeèBZM will indicate a HIGH FLOW status. A High Limit should be set to indicate a missing filter, leaking or disconnected vacuum line. This can be achieved by measuring the flow rate of the pump with a clean filter and then setting the high limit slightly above this rate (e.g. by 0.3 LPM).

Low Fail Limit—This setting defines the limit in liters-per-minute below which the EpeèBZM will indicate a FLOW FAIL status and go out of service. A flow fail status can indicate a kinked or clogged vacuum line or that the pump is off completely.

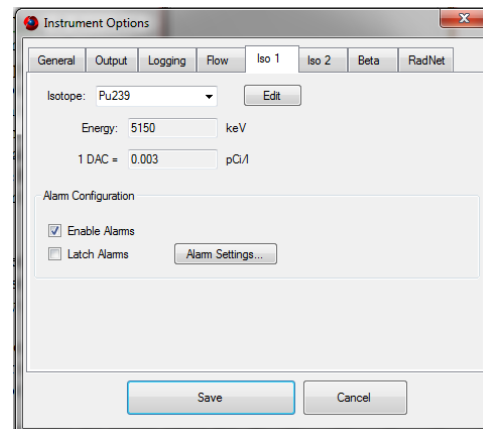


In the event of a flow failure, the instrument will shut the pump off after 15 seconds. It will to turn the pump on again after another 15 seconds to determine if the problem has been fixed. This sequence is repeated three time after which the pump is turned off and left off.

Isotope 1 and 2 Tabs (Alpha-Reporting Option req'd)

These pages define the parameters related to the measurement of an alpha-emitting isotope-of-interest. The second isotope-of-interest page (Iso 2) has the same settings as the first. By default, the isotope of interest is Pu-239, however, this isotope may be changed to support the measurement of other alpha-emitting isotopes. *Note: the radon daughters of Po-218, Po-214 and Po-212 are always monitored and used in the radon background subtraction algorithm.*

Isotope—This pull-down list provides for the selection of available isotopes-of-interest. This selection affects only the isotope-of-interest and not the measurement of radon daughters, which are always monitored (except Po-210). The isotope details are user editable in the **Edit Isotopes** dialog box by selecting the **Edit...** button. Here the Name, Half Life, Energy level, and DAC Factor for an isotope or source can be changed or added. *Default is Pu-239.*



- **Name**—This is the name used to refer to the isotope. An isotope can be added to the list by entering the name at the bottom of the list in an empty row.
- **Half Life(s)**—This value describes the rate of decay of the isotope. Is usually only used for short lived isotopes like radon progeny. This setting should not be changed for the isotopes.
- **Energy(keV)**— This setting identifies the energy where the peak of the selected isotope-of-interest is expected by the peak-fit algorithm.
- **DAC Factor**—This setting defines the conversion constant to convert from Pico-Curies/liter to DAC, usually defined by 10CFR835 or 10CFR20. The default factors are set according to 10CFR835. *Note: the constant uses units of pCi/l to avoid the need for scientific notation.*

Name	Half Life(s)	Energy(keV)	DAC Factor
Po218	1.83E+02	6000	1
Po210	1.20E+07	5305	1
Beta	1.00E+10	0	100
Gamma	1.00E+10	0	1
PAEC	1.00E+10	1797	1
Am241	1.36E+10	5480	0.003
Cm244	5.72E+8	5800	0.005
Th230	2.43E+12	4680	0.003
Pu238	2.77E+9	5490	0.003
Pu239	7.61E+11	5150	0.003
U234	1E+15	4760	0.02
U235	1E+15	4380	0.02
U238	1E+15	4180	0.02
MixedU	1E+15	4300	0.02
Source	1E+15	4800	0.003
*			

Energy—This value is retrieved from the isotope data and cannot be edited directly.

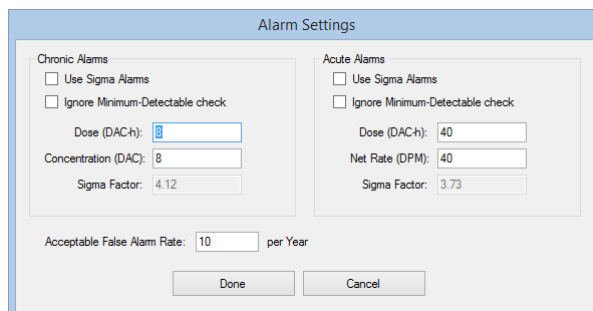
DAC—This value is retrieved from the isotope data and cannot be edited directly.

Alarm Configuration

Enable Alarms—This checkbox controls the checking for and annunciation of alarms for this Isotope-of-Interest. **If the box is unchecked, alarming on this isotope will be disabled.** *Default is Enable Alarms checked.*

Latch Alarms—This checkbox configures whether alarms are latching or non-latching. Checking the box makes the alarms for the selected isotope latching. It can only be checked if the enable alarms box is checked. Latching alarms must be acknowledged by the user before the alarm status will be cleared. Non-latching alarms will clear automatically once the reading drops below the alarm set point. *Default is Latch Alarms unchecked.*

Alarm Settings—This button calls up the **Alarms Settings** dialog box to configure the alarm set points for the isotope-of-interest. For more detailed information, refer to the **Alarm Settings** dialog box summary in the next section. *There are no default settings for the configuration.*



Beta Tab (Beta Option req'd)

This page defines the parameters related to the measurement of beta-emitting particulates.

DAC Constant—This field defines the conversion constant to convert from Pico-Curies/liter to DAC, defined by either 10CFR835 or 10CFR20. *Default is 100 pCi/l.*

Alarm Configuration

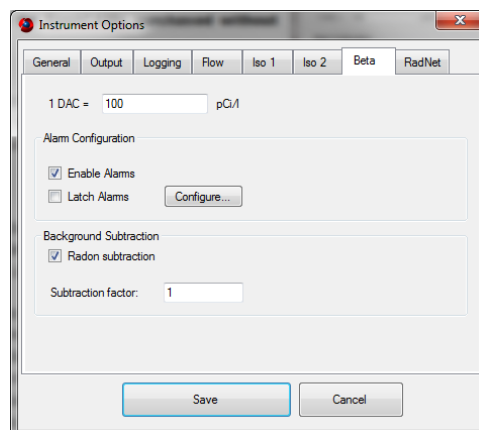
Enable Alarms—This checkbox controls the checking for and annunciation of alarms for beta levels. **If the box is unchecked, beta alarming will be disabled.** *Default is Enable Alarms checked.*

Latch Alarms—This checkbox configures whether alarms are latching or non-latching. Checking the box makes the alarms for the isotope selected latching. It can only be checked if the enable alarms box is checked. Latching alarms must be acknowledged by the user before the alarm status will be cleared. Non-latching alarms will clear automatically once the reading drops below the alarm set point. *Default is Latch Alarms unchecked.*

Alarm Settings—This button calls up the **Alarm Settings** dialog box to configure the alarm set points for the beta levels. For more detailed information, refer to the **Alarm Settings** dialog box summary in the next section. *There are no default settings for the configuration.*

Background Subtraction

Radon Subtraction—This checkbox configures whether the instrument compensates the beta channel for Radon background or not. *Default is checked.*



Subtraction Factor—This field allows the user to scale the Radon Subtraction for over- or under-compensation. The values range from 1.2 (over-compensation) to 0.5 (under-compensation). Setting the Subtraction Factor at 1 allows the EpeèBZM to compensate for all background Radon. Setting it at 0.9 compensates for 90% of background Radon, which is a typical conservative subtraction factor. To overcompensate for background Radon, set the subtraction factor higher than 1. *Default is 0.9.*

RadNet Tab (Wireless Output Option req'd)

This page contains the setting for RadNet broadcasts for EpeèBZM units with the wireless or Ethernet RadNet Option installed. From this window the user can set the IP Address so that only one workstation can view the logging data instead of every computer which has access to the network. For more information on RadNet, see Section 7 on **Wireless RadNet Operation** or your network administrator.

Broadcast Address Information

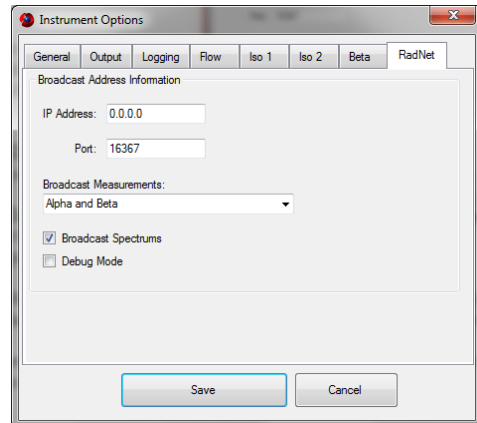
IP Address—This field is user editable and specifies RadNet packets are only broadcast a specific network address. To broadcast to an entire C-Class IP Subnet, leave at default. *Default is 0.0.0.0*

Port—This field specifies the UDP Port number which RadNet packets are broadcast on. It must match the port number that the RadNet client application expects to receive broadcast on. *Default is 16367.*

Broadcast Measurements—This list box describes the options for measurement packet broadcasts. Allowable choices limited by the instrument alpha/beta capability but are *Alpha*, *Beta*, and *Alpha and Beta*. *Default is Alpha.*

Broadcast Spectrums—This checkbox enables or disables the transmission of EpeèBZM alpha spectrums to RadNet clients. Check the box to enable alpha spectrum broadcasts. *Default is checked.*

Debug mode—Checking this setting will insert wireless debug information into the status log. It can be of use to IT personnel when attempting to troubleshoot communications issues.



Alarm Settings

There are separate alarms for each alpha isotope-of-interest and the beta channel, settable from the **Alarms...** button on the Beta, Iso 1 and Iso 2 tabs of the **Instrument Options** dialog box. The Alarms dialog allows separate configuration of acute and chronic alarm set points for net count rate, dose and concentration alarms.

The Chronic Alarm limits are checked every minute against the Chronic dose and concentrations. Acute Alarm limits are checked every second against the Acute net count rate and dose.

See the section above on the General tab to set the time windows (pg. 7).

The screenshot shows the 'Alarm Settings' dialog box. It is divided into two panels: 'Chronic Alarms' on the left and 'Acute Alarms' on the right. Both panels have a 'Use Sigma Alarms' checkbox (unchecked) and an 'Ignore Minimum-Detectable check' checkbox (unchecked). Under 'Chronic Alarms', the 'Dose (DAC-h)' field is set to 8, 'Concentration (DAC)' is set to 8, and 'Sigma Factor' is 4.12. Under 'Acute Alarms', the 'Dose (DAC-h)' field is set to 40, 'Net Rate (DPM)' is set to 40, and 'Sigma Factor' is 3.73. At the bottom, the 'Acceptable False Alarm Rate' is set to 10 per Year. There are 'Done' and 'Cancel' buttons at the bottom right.

Chronic Alarms

Use Sigma Alarms—This checkbox disregards Dose and Concentration alarm limits in favor of a specified Sigma Factor multiplier above the standard deviation of the reading. The Sigma Factor mode does not alarm at a specific dose or concentration, but rather when the dose or concentration exceeds the Sigma Factor times the standard deviation from the mean dose or concentration. *Default is unchecked (i.e. using fixed chronic alarm limits).*

Ignore Minimum-Detectable check—This flag when checked overrides the check that a reading is above *both* the alarm limit *and* the chronic minimum-detectable value (MDA, MDC or MDD). When checked, the instrument will alarm if the reading is above the alarm setpoint, regardless the minimum-detectable value. Note: Overriding the minimum-detectable check may cause false alarms unless a warm-up period is implemented. *Default is unchecked.*

Dose (DAC-h)—This setting defines the alarm set point for a chronic dose alarm. Dose alarm levels are usually determined by site specific regulations. *Default is 20 DAC-h.*

Concentration (DAC)—This setting defines the alarm set point for a chronic concentration alarm. Concentration alarm levels are usually determined by site specific regulations. *Default is 20 DAC.*

Sigma Factor—In conjunction with the Use Sigma Alarms checkbox, this setting defines the sigma multiplier to use for Chronic Alarms. When *Use Sigma Alarms* is not checked, this value reflects the *Sigma Factor* calculated by the software to meet the *Acceptable False Alarm Rate* setting.

Acute Alarms

Use Sigma Alarms—This checkbox disregards Dose and Net Count Rate limits in favor of a specified Sigma Factor. *Default is unchecked (i.e. using fixed acute alarm limits).*

Ignore Minimum-Detectable check—This flag when checked overrides the check that a reading is above *both* the alarm limit *and* the acute minimum-detectable value (MDA, MDC or MDD). When checked, the instrument will alarm if the reading is above the alarm setpoint, regardless the minimum-detectable value. Note: Overriding the minimum-detectable check may cause false alarms unless a warm-up period is implemented. *Default is unchecked.*

Dose (DAC-h)—This setting defines the alarm set point for an acute dose alarm. Dose alarm levels are usually determined by site specific regulations. *Default is 200 DAC-h.*

Net count rate (cps)—This setting defines the alarm set point for the acute Net CPS. *Default is 1000 cps.*

Sigma Factor—In conjunction with the *Use Sigma Alarms* checkbox, this setting defines the alarm set point for Acute Alarms. When *Use Sigma Alarms* is not checked, this value reflects the *Sigma Factor* calculated by the software to meet the *Acceptable False Alarm Rate* setting.

Acceptable False Alarm Rate

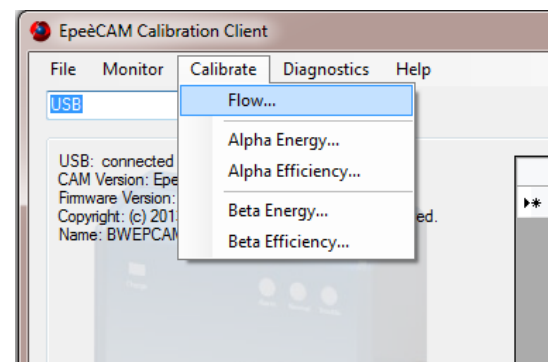
This setting defines the acceptable number of false alarms per year. The limit has an effect on the calculated minimum-detectable dose and concentration, and therefore, on the dose and concentration sensitivities. When not operating in *Use Sigma Factor* mode, the setting is used to determine the Sigma Factor, which is multiplied by the standard deviation of the calculated dose and concentration to yield the minimum-detectable level. This setting cannot be changed when the sigma factors for both Chronic and Acute alarms are set manually using the *Use Sigma Alarms* checkbox.

When not using sigma-based alarms, this setting sets the Minimum-Detectable Dose/Concentration (MDD/MDC) levels, based on an acceptable level of false alarms. The MDD/MDC will be affected by the number of alarm determinations per 8800 hours, indicated by both the Acute alarm determinations per hour (i.e. 3600/Acute Window), and the Chronic alarm determinations per hour (i.e. 60/Chronic Window). Allowing more false alarms will provide better alarm sensitivity at the expense of more frequent false alarms. *Default is 10 false alarms per year.*

Calibration

Flow Calibration

Flow calibration of the EpeèBZM is performed by measuring the pump current at three different flow rates measured by a calibrated flow meter placed in-line with the sample head. The software then calculates conversion coefficients for use in converting the internally-measured pump current to a flow rate in liters-per-minute. The final step in the flow calibration compares the calibrated flow meter rate, at a nominal flow rate close to the operating point, to the calculated rate of the EpeèBZM at that flow rate and reports the error.



The calibration is performed at one of the four possible flow rate settings—preferably the one used during normal operation. The user can choose whether to calibrate to mass flow or volumetric (i.e. ambient) flow rate reporting.

From the menu, select **Calibrate—Flow...** to start a flow calibration.

Pump Speed

Choose a pump speed of 6.0, 4.5, 3.0 or 1.5 LPM at which to calibrate the Flow. The best instrument sensitivity can be achieved at 6.0 LPM, while longer battery life and a quieter monitor can be achieved at 1.5 LPM.

Calibrated Flowmeter

Indicated Flow—Use this field to enter the flow rate in LPM that appears on the calibrated flowmeter during each calibration step.

Measurement Type—Selecting *LPM* indicates that flow will be measured using volumetric methods, whereas selecting *Std. LPM* indicates that flow will be corrected to mass flow. Choosing one or the other depends on site regulations, but note that the type (or configuration) of the flow meter used for calibration must match the selection made.

EpeèBZM Flow Mode

This setting allows the user to determine how the EpeèBZM reports and uses flow; in volumetric units or mass units. If this setting is changed the EpeèBZM must be re-calibrated.

Calibration Parameters

Epee Rate—This field is populated as a result of performing flow calibration and is not user editable. During flow calibration, the field reports the A/D reading used in the flow rate calculation. When calibration is complete, the field reports the calculated flow rate of the EpeèBZM.

Coefficients 1 to 3—These fields are populated as a result of performing flow calibration and are not user editable. During flow calibration, these coefficients are calculated, saved, and then validated as part of the Flow Calibration error calculation. They represent the coefficients of the 2nd-order polynomial used to convert pump current to flow rate in LPM.

Instructions

1. As seen in the [Flow Calibration Training Video](#) on [bladewerx.com](#), set up the flow calibration apparatus as follows: Radial-Entry Head without filter – EpeèBZM flow calibration aid – Tygon tubing – digital flowmeter.
2. In the **Pump Speed** field select the highest speed at which the device will be running (this will calibrate for all pump speeds less than the speed selected), and in the **Measurement Type** select the appropriate type for the flow regulator being used. Under the **EpeèBZM Flow Mode** select the units and select **Next**.
3. With the filter removed but with the filter cap in place and the flow calibration aid attached, allow the pump to operate unrestricted flow. Press the flow calibration fitting tight against the head and enter the flow rate measured by the flow regulator in the **Indicated Flow** field reading from the flowmeter, and select **Next**. The program will then begin to sample the flow rate and display the Epee flow sensor reading. The unrestricted flow rate may not be the same as the **Pump Speed** that you chose; this is acceptable since as pumps age the flow rate will decrease.
4. After the sampling of the flow rate is completed install two filters in the head and reattach the calibration aid. Once again, press the flow calibration fitting tight against the head and enter the flow rate measured by the flow regulator in the **Indicated Flow** field.

The screenshot shows the 'Flow Calibration' window. At the top, 'Pump Speed' has four radio buttons: 6.0 LPM (selected), 4.5 LPM, 3.0 LPM, and 1.5 LPM. Below this, 'Calibration Parameters' includes 'Epee Rate' (empty), 'Coefficient 1' (empty), 'Coefficient 2' (empty), and 'Coefficient 3' (empty). To the right, 'Calibrated Flowmeter' shows 'Indicated Flow' (empty) and 'Measurement Type' with 'LPM' (selected) and 'Std. LPM'. At the bottom, 'EpeèCAM Flow Mode' has 'Volumetric' (selected) and 'Mass Flow' (unselected). A text box says 'Select the desired Pump Speed and click Next to begin.' with a 'Next' button.

The screenshot shows the 'Flow Calibration' window after sampling. 'Pump Speed' remains at 6.0 LPM. 'Epee Rate' is now populated with the value '189'. 'Indicated Flow' is populated with '5.61' LPM. 'Measurement Type' is still 'LPM'. 'EpeèCAM Flow Mode' is still 'Volumetric'. A new text box labeled 'Sampling flow rate...' is present at the bottom. A progress bar at the very bottom is partially filled with green. The 'Next' button is still visible.

5. After the sampling of the flow rate is completed repeat step 4 with three filters in the head. At the conclusion of this step, the polynomial coefficients are calculated and displayed. These coefficients are used to determine the validation step flow error.
6. After the sampling of the flow rate is completed open the radial head and insert a single filter, then replace the filter cap and the flow calibration aid. As in step 3, enter the measured flow rate reading (with filter) from the flowmeter, and select **Next**.
7. The Flow Calibration is now complete. The *Flow Rate* over the *Measured Rate* error is given as a percent. Depending on the accuracy of the calibration flowmeter used, typical errors are less than 3%. If the result is above 10%, the Flow Calibration should be run again, taking special care to be accurate and follow all steps. If it is below 10%, select **Finish**, and then **Yes** to update the **Calibration Date**.

Note: The calibration date displayed under instrument options will not change until the device is disconnected

Alpha Calibration

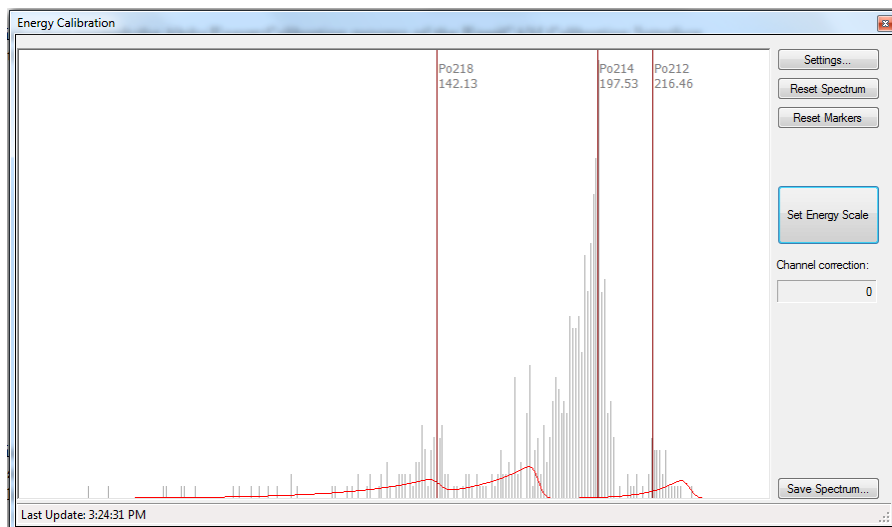
Alpha Energy

Alpha energy calibration consists of setting markers on known radionuclide peaks in the alpha spectrum so that a channel-to-energy and energy-to-channel conversion coefficients may be calculated, allowing the determination of peak locations for all alpha isotopes.

Select the **Calibrate –Alpha Energy...** menu item to access the dialog box.

This dialog box controls the Alpha Energy Calibration process of the EpeeBZM Calibration Client and presents the current Alpha spectrum from channel 0 to 255. The vertical scale is in counts and adjusts automatically to display the highest peak. Three vertical red lines are present along the alpha spectrum. These lines indicate the position of the radon decay product (RDP) peaks and should be adjusted to match up with the three peak locations. There are lines for the Po-218, Po-214 and Po-212 radon-daughter peaks.

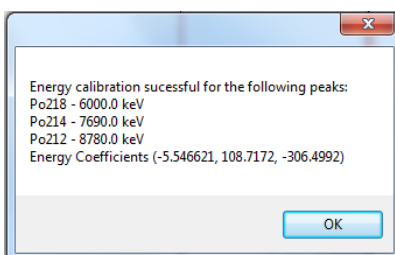
The peak locations of all other isotopes are calculated from the locations of the peak markers for Po-218, Po-214 and Po-212 radon-decay-product peaks. The numbers at the top of each red line correspond to the channel number that the line represents.



Note: In order to accumulate enough counts for accurate calibration it is recommended that the EpeMCA is run overnight.

When the Alpha spectrum is in view, calibrate the energy levels by dragging the three **red** Radon-daughter markers to the highest point of their accumulated peaks, then select the **Set Energy Scale** button. A dialog box appears that indicates that

energy calibration was successful and reports the energies of each peak and the coefficients. Click **OK** and **Exit** the Energy Calibration dialog box. After exiting a window will open asking to update the calibration date. If the calibration was satisfactory select “Yes”.

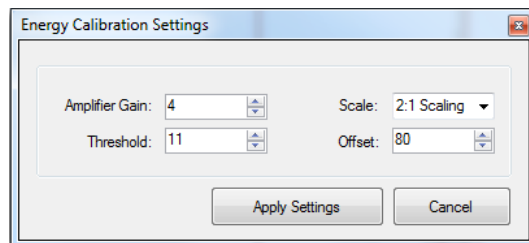


The **green** markers reflect the calculated positions of the Iso_1 and Iso_2 peaks. If Iso_2 is not defined, then only one green marker line will be displayed.

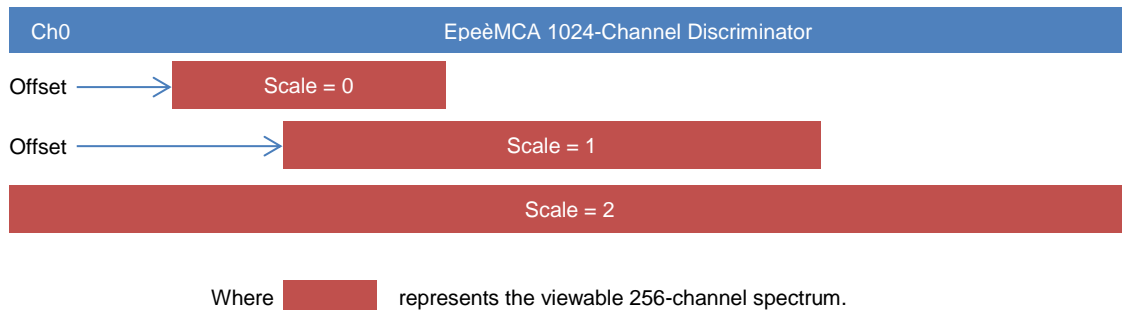
Settings

Energy Calibration Settings—This dialog box allows changes to how alpha spectrums are positioned in the 256-channel window. These settings affect the location, width, spacing and offset of isotope peaks on the spectrum.

The gain, threshold, and scale should not have to be adjusted from factory settings, but the offset may have to be changed based on the elevation at the instrument’s location. The instrument is initially calibrated at 5100 feet. It is important to adjust the settings for the altitude since Alpha calibration is altitude dependent. The values for these settings are stored permanently on the EpeMCA board, and changing any of them will save the new values over the old values.



NOTE: Any changes applied to the settings will clear the calibration spectrum history.



Amplifier Gain—(Range 1 to 100%) This value controls the amplitude of pulses coming from the detector. Increasing the gain shifts peaks to the right and spreads individual peaks further apart. As the Gain is increased, the peak(s) can be shifted completely off the right end of the spectrum display. Shifting to the next Scale will bring the peaks back into view on the spectrum. *Default Gain should not normally be changed from factory setting.*

Scale—(No Scaling, 2:1, and 4:1) These values control the binning or compression of the 1024-channel discriminator output into the 256-channel spectrum value. A value of zero results in no compression. A 2:1 compression bins 512 channels of the discriminator output into 256 spectrum channels. A 4:1 compression bins all 1024 channels of the discriminator output into 256 spectrum channels. *Default Scale is 2:1 for Alpha and should not normally be changed.*

Alpha Thresholds—(Range 0 to 85) These values control the amplitude threshold that pulses must exceed to be measured. It should be set just above the level where the amplifier noise is first observed. *Default Threshold is 1 for Alpha.*

NOTE: As Amplifier Gain is increased, the noise amplitude will increase proportionally, requiring a compensating increase in Threshold level.

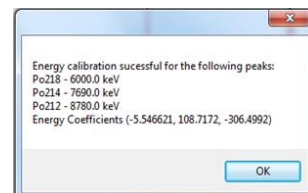
Alpha Offset—(Range 0 to 512) These values shift the scaled 256-channel spectrum by the defined number of channels to the left. Increasing the Offset shifts all peaks to the left, while decreasing the Offset shifts peaks to the right. The intent of changing the Offset is to place the Po-212 peak (8.78 MeV) near the right edge of the spectrum, yet fully visible, the Po-214 peak near channel 210, and the Po-218 peak near channel 150. *Default Offset is 56 for Alpha.*

NOTE: The Offset is related to the Scale setting by controlling the 256-channel window on the scaled discriminator output according to the following equation: (where ADC is the 1024-channel discriminator output) **Chan = (ADC/Scale) – Offset**. As a consequence for a greater scale compression a smaller offset value is needed to view the same part of the spectrum, e.g. the highest compression for 4:1 needs no offset value since the whole spectrum of 256 compressed channels is visible.

Reset Spectrum—This menu item clears all the counts in the Alpha spectrum. This should be done after any changes to the Alpha settings in the **Energy Calibration Settings** dialog box have been made. If the spectrum is not **Reset**, it will not erase counts already present in the spectrum.

Set Energy Scale

After dragging the three Radon-daughter markers to the highest point of their accumulated peaks, select the **Set Energy Scale** Button. A dialog box appears that indicates that energy calibration was successful and reports the energies of each peak and the coefficients.



There is a red curve displayed over the spectrum histogram. This curve is the peak-fit curve used to determine individual peak counts. The red curve is updated once a minute (once every 5 seconds for the Acute Spectrum) and should closely match the histogram counts. If the curve appears to be offset to the left or right of the actual peaks, the peak markers should be adjusted and the Calibrate function run again.

Channel correction

This value displays the channel offset used to compensate for temperature and barometric pressure changes from the temperature and pressure saved during calibration.

Spectrum Detail

A drop-down box defines the time detail of the displayed spectrum. There are four spectrum details available for display: Acute, Chronic, Reference, and Cumulative. The Acute and Chronic Spectrums reflect the differential spectrums over the respective Acute and Chronic Window intervals. The Acute Spectrum is updated every 5 seconds. All other Spectrum displays are updated every minute. The Reference Spectrum is a fixed 4-hour differential spectrum. The Cumulative Spectrum is the spectrum of total counts since the last filter change or instrument reset. A peak fit is performed on all spectrums except the cumulative spectrum.

Save Spectrum

This is a *Save As* function to store the Energy Calibration spectrum for later viewing. It is saved in *.csv format and may be opened with Excel. Only the channel and counts for each channel are saved—not the peak fit line or the markers.

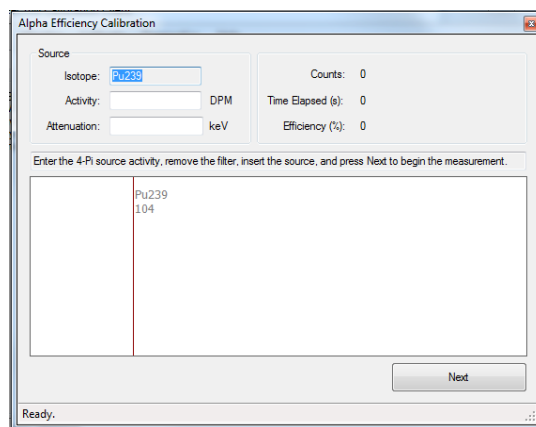
Alpha Efficiency

This dialog box controls the Alpha Efficiency Calibration process of the EpeèBZM Calibration Interface. Select the **Calibrate – Advanced – Alpha Efficiency...** menu item to access the dialog box.

Source

Alpha sources used for calibration should be 10,000 to 100,000 DPM, 37mm (1.25 in.) diameter, and have a 25mm (1 in.) plated active area centered on the disk.

NOTE: If the source active area is larger than 1 inch, all but the center 1 inch will be masked by the detector head, producing a low efficiency.



Isotope—This field indicates the Isotope for which the efficiency is being calculated. It displays whatever Isotope is selected under **Instrument Options....Iso 1** and cannot be changed from this window. See Section 2 on Instrument Options under Isotope 1 and 2 for instructions on how to change this setting.

Activity (DPM)—Use this field to enter the activity of your Alpha source (i.e. 4-pi source activity given in disintegrations per minute (dpm)).

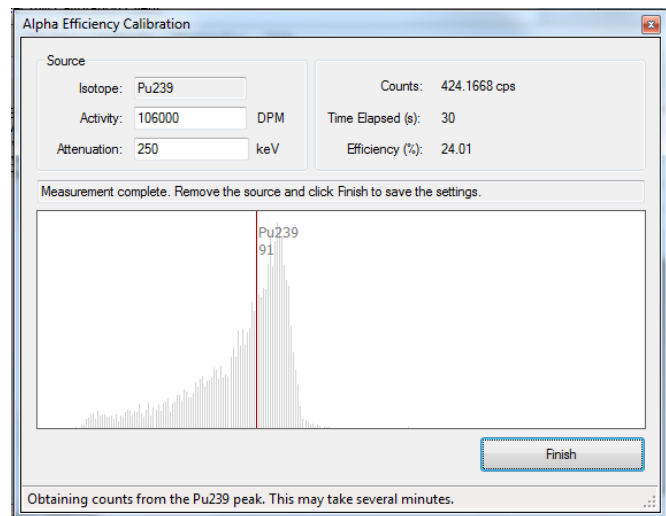
Attenuation (keV)—Plated alpha sources produce peaks that are offset (attenuated) downward in energy due to the manufacturing annealing and coating process. This means that a source peak will be lower than the location where the EpeèBZM expects a peak to appear in the spectrum from airborne material deposited on a filter. The Attenuation parameter allows for an adjustment of the peak location so that the peak fit algorithm can more quickly fit the source counts. *Typical attenuation values are 150 keV for Nickel sources, and 80 keV for Stainless Steel sources.*

Results

Counts (cps)— This field is populated as a result of performing Alpha Efficiency calibration and is not user editable. During calibration, the field reports the source counts per second rate that is then used in the efficiency calculation. The field changes during the source count period.

Time Elapsed (sec)—This field is populated by a timer that counts up from the start of calibration. It is used in the Alpha efficiency calculation. Count times will range from 1 – 10 minutes depending on source activity.

Efficiency (%)—This field is populated as a result of performing Alpha Efficiency calibration and is not user editable. During calibration, the field reports the current efficiency calculation. The field changes during the source count period, but reports the actual efficiency at the end of calibration. *Alpha efficiencies should range between 25 – 33%.*



Instructions

Remove the filter holder from the radial head and remove the filter. Place the source where the filter would normally go and screw on the retainer ring and push the holder back in the head. Make sure it is against the internal front face of the housing.

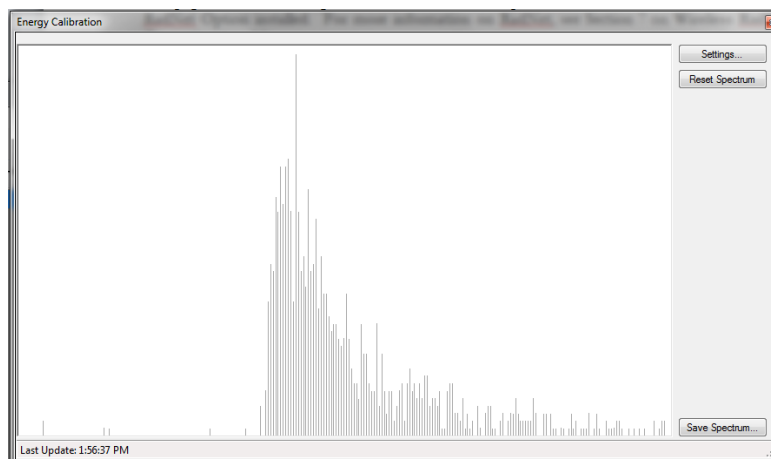
Enter the source 4-Pi emission rate of the source in the *Activity* field and the source attenuation value in the *Attenuation* field, and press **Start**. The spectrum display will show the source peak during the calibration and the marker location for the peak. An efficiency will be displayed on completion of the count (a 1-minute minimum count is performed, or until 10,000 counts have been measured, or until a maximum of 10 minutes has elapsed).

Select **Finish** completing the calibration and saving the new efficiency.

Beta Calibration

Beta Energy (Beta Option Req'd)

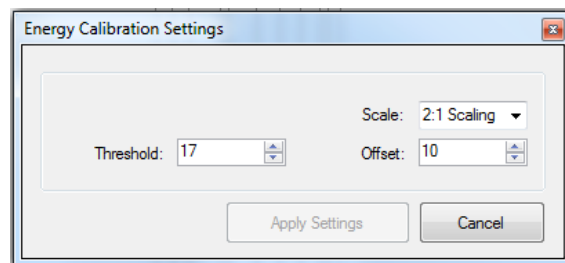
This dialog box controls the Beta Energy Calibration process of the EpeèBZM Calibration Interface. Select the **Calibrate –Beta Energy...** menu item to access the dialog box.



The EpeèBZM does only gross beta counting and does not use spectral information. The spectrum is shown only to provide visual indications of the noise threshold for use in setting the Threshold.

Settings

Energy Calibration Settings—This dialog box allows changes to how the Energy Calibration Beta spectrums are viewed. These configuration settings affect the location, scaling, and offset of the beta count on the spectrum.



NOTE: Any changes applied to the settings will clear the spectrum history.

Beta Scale—(No Scaling, 2:1 and 4:1) Like the alpha MCA settings, these values control the binning or compression of the 1024-channel discriminator output into the 256-channel spectrum value. A value of zero results in no compression. A 2:1 compression bins 512 channels of the discriminator output into 256 spectrum channels. A 4:1 compression bins all 1024 channels of the discriminator output into 256 spectrum channels. *Default Scale is “No Scaling” and should not normally be changed.*

Beta Threshold—(Range 0 to 85) These values control the amplitude threshold that pulses must exceed to be measured. A lower setting results in greater efficiency. If the setting is too low the EpeèBZM will count amplifier noise. Consequently, it should be set just above the level where the amplifier noise is first observed. *Default Threshold is 4 for Beta.*

NOTE: As Gain is increased, the noise amplitude will increase proportionally, requiring a compensating increase in Threshold level.

Beta Offset—(Range 0 to 512) These values shift the 256-channel spectrum by the defined number of channels to the left. Increasing the Offset shifts all peaks to the left, while decreasing the Offset shifts peaks to the right. The intent of changing the Offset is to place the Beta count near the left edge of the spectrum, yet fully visible. *Default Offset is 20 for Beta.*

NOTE: The Offset is related to the Scale setting by controlling the 256-channel window on the scaled discriminator output according to the following equation: (where ADC is the 1024-channel pulse-height-analyzer converter output) **Chan = (ADC/Scale) - Offset**

Reset

This menu item clears the all the counts in the Beta spectrum. This should be done after any changes to the Beta settings in the **Energy Calibration Settings** dialog box have been made. If the spectrum is not **Reset**, it will incorrectly display the spectrum counts.

Save Spectrum

This is a Save As function to store the Energy Calibration spectrum for later viewing. It is saved in *.csv format to be opened with Excel. Only the counts for each channel are saved, not the peak fit line or the markers.

Beta Efficiency

This dialog box controls the Beta Efficiency Calibration process of the EpeèBZM Calibration Interface. Select the **Calibrate – Advanced – Beta Efficiency...** menu item to access the dialog box.

Beta Threshold

This field controls the amplitude threshold that pulses must exceed to be measured. It should be set just above the level where the amplifier noise is first observed. For higher pump speeds it is sometimes necessary to set the threshold higher. *Default is 4, Range is 0-88.*

Spectrum Window

This is the space where counts appear according to their energies, from both background and the beta source. The vertical scale adjusts automatically to display the highest peak.

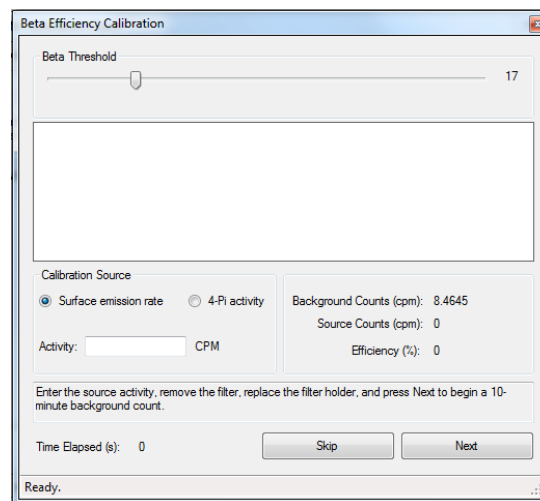
Calibration Source

Surface emission rate/4-Pi activity—Use this field to determine how the source activity is calibrated.

Activity (DPM or CPM)—Use this field to enter the activity of your Beta source given in disintegrations per minute (DPM) for 4-Pi sources, or counts per minute (CPM) for surface emission rate sources.

Results

Background Counts (cps)—This field is populated as a result of performing Beta Efficiency calibration and is not user editable. During calibration, the field reports the rate of background counts



per second that is then used in the efficiency calculation. The field changes during the 10 minute background count period.

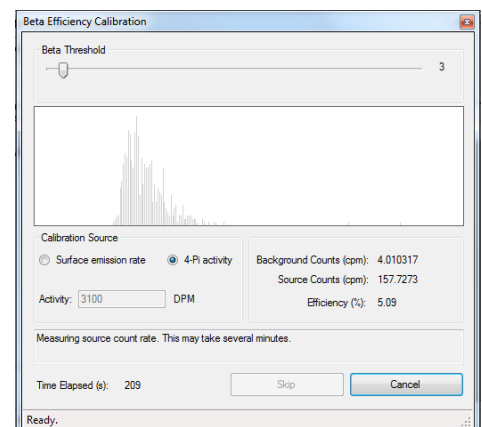
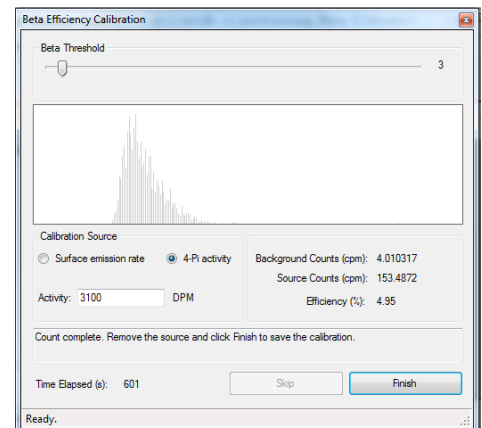
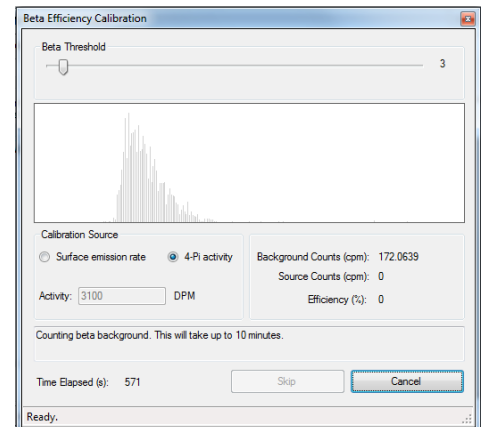
Source Counts (cps)— This field is populated as a result of performing Beta Efficiency calibration and is not user editable. During calibration, the field reports the rate of source counts per second that is then used in the efficiency calculation. The field changes during the 10 minute source count period.

Efficiency (%)—This field is populated as a result of performing Beta Efficiency calibration and is not user editable. During calibration, the field reports the current efficiency calculation. The field changes during the 10 minute source count period, but reports the actual efficiency at the end of calibration.

Time Elapsed—This field displays the time elapsed during the calibration.

Instructions


1. Remove the filter cap and filter from the radial head and set the appropriate threshold level. Select Next so that the EpeèBZM will begin to take background counts. This will take about ten minutes. The threshold should be adjusted so that the beta background is approximately 10 cpm/ μ R/h (for ambient gamma).
2. If the EpeèBZM has been calibrated before and the background counts are consistent with the environment in which the device is being calibrated, select **Skip** to skip the background measurement and proceed directly to the source efficiency measurement.
3. When this beta background count is finished place the source where the filter would normally go.
4. Enter the source 4-Pi emission rate (dpm) or Surface emission rate (cpm) in the Activity field, and select Next. The spectrum display will show the source peak during the calibration and the marker location for the peak. An efficiency will be displayed on completion of the count (a 1-minute minimum count is performed, or until 10,000 counts have been measured).
5. Select **Finish** and **OK** in order to complete the calibration and save the new efficiency.



Calibration Report

The results of the calibration may be viewed, printed and/or saved to disk following the steps above via the File – Calibration Report... menu selection. Calibration steps that were not completed will have incomplete report entries. Menu buttons across the top of the report screen will provide the options to print or save the report.

An example report is shown below:

 **bladewerx**

EpeeCAM Calibration Report

Serial Number: 1032

CalibEpee Version: 1.4.0.18472

Network Name: BWEPCAM_1032

Instrument Version: EpeeCAM v1.5.1.0

Calibration Date: Wednesday, May 27, 2015

Firmware Ver.: EpeeMCA v1.03

DET SN: 118358

Flow Calibration

Coefficient 1: 0

Calibration Rate: 6 LPM

Coefficient 2: 43.18327

Validation Flow: 5.544564 LPM

Coefficient 3: 11.08853

Measured Flow: 5.48 LPM

Measurement Error: 1.16%

Alpha Calibration

MCA Gain: 10

Calibration Source: Pu239

MCA Threshold: 0

Source Activity: 106000 DPM

MCA Offset: 60

Source Attenuation: 425 keV

MCA Scale: scale_2to1

4-Pi Efficiency: 26.6 %

Po-212 Channel: 246

Primary Iol Channel: 119

Po-214 Channel: 205

Alternate Iol Channel:

Po-218 Channel: 146

Beta Calibration

Beta Background:

Calibration Source:

Crossover Channel:

Source Activity:

Radon Sub. Factor:

4-Pi Efficiency:

Guard Sub. Factor:

Signed: _____

Date: _____

Bladewerx certifies that this instrument has been calibrated in accordance with ANSI N323C-2009 using naturally-occurring radon decay products and a plated source cross-referenced to a NIST traceable source (ratio method).

Using the EpeèBZM

Starting Dose Measurements

Check the Filter

Begin by checking if a new filter is correctly installed. On the radial head, twist the Filter Holder until the small cutouts in the lip clear the locking screws, then pull it out. The filter is retained on the holder by a screw-on cap. If the filter needs to be replaced, do so at this time, then press the holder back in the head and lock it in under the screws.

Turn It On

Push the Power button and the green Normal light will come on immediately. If the EpeèBZM is starting from a powered-off state—not Sleep Mode—it will take approximately 30 seconds to boot, initialize the software, and start the pump running. When you hear the EpeèBZM report STARTING DOSE MEASUREMENT, it has entered normal operation and begun monitoring for beta activity and for the alpha isotope(s)-of-interest. The instrument will begin measuring dose and concentration immediately and can alarm on a measurable activity. The EpeèBZM does not require a ‘warm-up period’ however, the sensitivity is reduced considerably. In order to alarm, the measurement must be above the minimum-detectable value and the

NOTE: The minimum-detectable levels of concentration and dose will be elevated until the Acute and Chronic Window times have elapsed. Until the full window times have elapsed, the EpeèBZM is using incomplete spectrum accumulations to calculate the dose and concentration and has elevated statistical fluctuations of the results. This means that for the first 120 seconds, the Acute MDD will be elevated, and, for the first four hours, the Chronic MDD will be elevated. **To alarm during these periods, the dose or concentration must exceed both the minimum-detectable and the alarm set point.**

Reporting Dose Measurements

Reports In-The-Field

The EpeèBZM regularly reports all current measurements, alarms or problems audibly over the speaker or headphones. Three levels of status are also indicated— Trouble, Normal and Alarm—by the LEDs on the top and face of the EpeèBZM. All possible audible status reports and their descriptions are listed in Appendix I. The LED status descriptions are as follows:

- Trouble:** *Solid Yellow* – the EpeèBZM should not be used due to any of a number of malfunctions that are annunciated by the EpeèBZM
Blinking Yellow – the EpeèBZM can be used but is either out of calibration, low on battery, or the flow rate is out of limits (but not flow failed).
- Normal:** *Green* – the CAM is sampling correctly.
- Alarm:** *Red* – one of the measurements has met the alarm conditions.

Ending Dose Measurements

After a dose measurement period is complete, press the Power button *for about 1 second* and release. If the speaker volume is turned up, the instrument will report STANDBY. This will put the EpeèBZM in Sleep mode and turn the pump off. This is unnecessary for continuous sampling mode operation.

EpeèBZM Log Data

The EpeèBZM logs readings and spectrums to comma-delimited-text files during operation, creating a record of the sampling session. Starting a new sampling session will append data to the log files already present on the instrument, or create new log files if there are none. The instrument will archive up to two weeks of log data. Old log files are deleted after two weeks, preventing possible out-of-memory conditions.

NOTE: Shutting the instrument down (as opposed to Sleep Mode) will erase any log files stored in the *My Documents* folder.

The log data files stored on the EpeèBZM may be retrieved and analyzed on a PC via the USB Sync cable or a USB flash drive. The data can be imported into a spreadsheet or database and archived for future use.

NOTE: Sample *Microsoft Excel*® spreadsheets for viewing log files are included on the Bladewerx CD received with the instrument. These files have been constructed using the Data Import Excel feature, so that all that is required to update the charts is to **Refresh** the data with current log files.

Retrieving the Log Files

Using a USB Flash Drive

Plug a USB flash drive into the EpeèBZM while it's running. It will report COPYING LOG FILES and begin downloading all the log and spectrum files automatically. Depending on the size of the log files, this will take 20 seconds or more. When the EpeèBZM reports COPY COMPLETE, it is finished copying and it is safe to remove the flash drive. There is now a copy of the files on both the USB flash drive and the EpeèBZM. The folder containing the log files on the USB thumb drive will be named after EpeèBZM serial number (BWEPCAM_XXXX).

An advantage to using a USB flash drive to transfer the log files is that it can be done in the field. There is no need to regularly bring the EpeèBZM to a PC for data transfer—you only need to bring a USB flash drive.

Using a USB Sync Cable With Windows Mobile Device Center

Plug the USB Sync cable from the computer to the mini-USB connection on the EpeèBZM. If the unit is turned on, the computer should automatically open a WMDC sync dialog box.

This program can be used to automatically sync the data files collected by the EpeèBZM or to manually copy them from the device to the computer. Automatic syncing requires that the EpeèBZM files must be saved in the My Documents folder. In order to determine where on the EpeèBZM the Log files are being saved (My Documents, SD Card, or Internal Flash Drive) see **Logging in Section 3**.

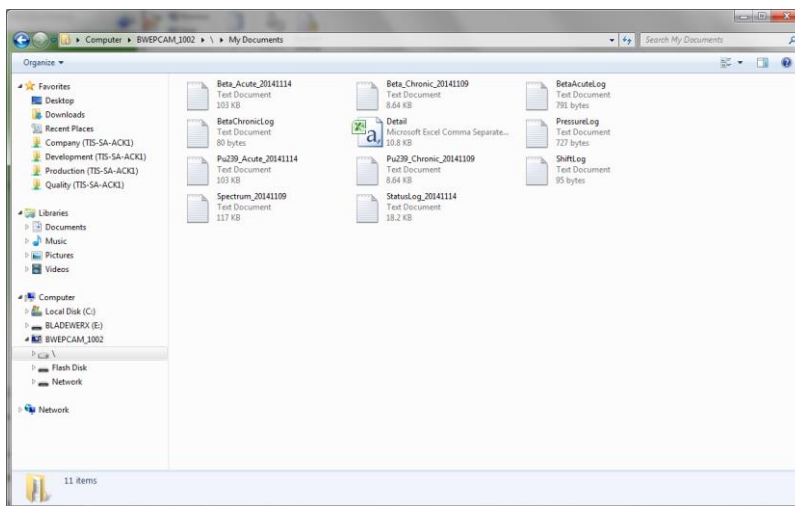
Automatic syncing is not recommended as the instrument name can be inadvertently changed by the Mobile Device Center software.

In order to manually copy files choose “Connect without setting up your device,” then “File Management,” then “Browse the Contents of Your device,” and then open the “\” storage for the My Documents folder, the SD Card for the files saved to the SD Card, or the Flash Disk for the files saved to the Flash Disk. From here you can cut and copy folders and files and move them to other destinations on your computer.



Log File Structure

Each file begins with a header line describing the individual fields, followed by a date stamp for the day the data started logging. The following list describes the files and their contents:



Beta_Acute_YYYYMMDD.txt—This text file contains the log of acute readings archived during the EpeèBZM dose measurement period. *New acute log files are started every day at midnight.*

Beta_Chronic_YYYYMMDD.txt—This text file contains the log of acute readings archived during the EpeèBZM dose measurement period. *New chronic log files are started every Sunday morning at 12:00 midnight.*

<IoI_Name>_Acute_YYYYMMDD.txt—This text file contains the log of acute readings archived during the EpeèBZM dose measurement period. Note: the file name may be different if Pu-239 is not defined as the isotope-of-interest. *New acute log files are started every day at midnight.*

<IoI_Name>_Chronic_YYYYMMDD.txt—This text file contains the log of chronic readings archived during the EpeèBZM dose measurement period. The file name may be different if Pu-239 is not defined as the isotope-of-interest. *New chronic log files are started every Saturday night at 12:00 midnight.*

Spectrum_YYYYMMDD.txt—These text files contain chronic spectrum snapshots at fixed (user-defined) intervals during the dose measurement period. Each line in the file contains a set of peak-fit coefficients, a 255-channel spectrum of raw counts, and a 255-channel spectrum of the cumulative peak fit. *A new spectrum log files is started every Saturday night at 12:00 midnight.*

StatusLog_YYYYMMDD.txt—This text file contains a copy of the readings and status changes logged to the EpeèBZM during dose measurement. It includes a listing of any alarms and the time at which they occurred, along with chronic and peak acute readings. *A new status log files is started every day at midnight.*

You may select any or all of the log files and copy them to a more permanent storage location on the PC. The files can be opened, imported into a spreadsheet, or printed.

Disconnecting Hardware

Once the EpeèBZM log data has been retrieved and saved elsewhere, you may disconnect the USB Flash Drive or Sync Cable. Disconnecting the USB cable will not affect the operation of the unit. There is no need to ‘eject hardware’.

Viewing the Log Files

Importing the data into Microsoft Excel

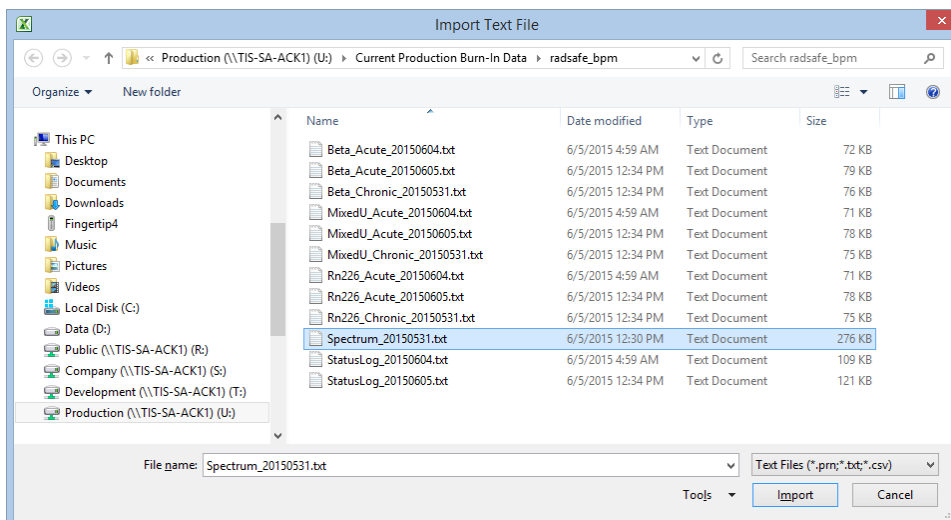
Initially, all files are saved as *.txt files, but they are in comma-delimited format and can be easily imported into *Microsoft Excel®*.

Bladewerx-Supplied Excel Charts

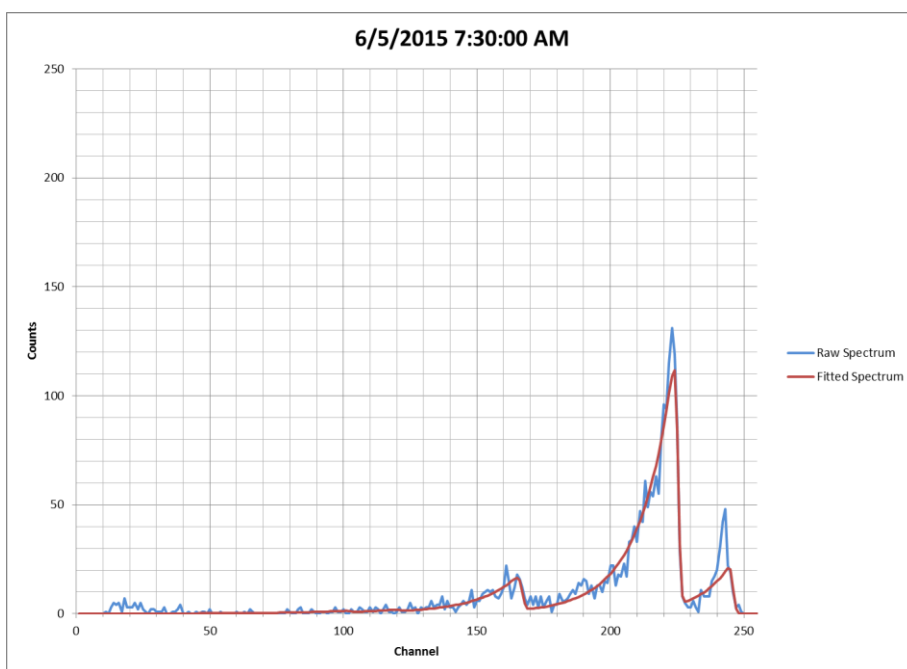
On the CD included with the order are two Excel files in the Burn-In Data folder: *Spectrum_Animate.xlsm*, and *Epee Burn-In.xls*. The *Spectrum_Animate* will replay the growth of the alpha spectrum from the logged data, while the *Epee Burn-In Data* charts the chronic and acute dose for the beta and/or alpha isotopes.

To view log data from an Epee, all that is required is to Refresh the data import and point them to the new saved log files from the instrument.

Spectrum_Animate—Open the spreadsheet and on the **Spectrum Data** tab along the bottom of the page and select cell A1. Next, from the **Data** menu, click **Refresh All**. When the File Open dialog appears, navigate to the spectrum log file from the Epee and click Open. The imported data replaces the old data on the page.

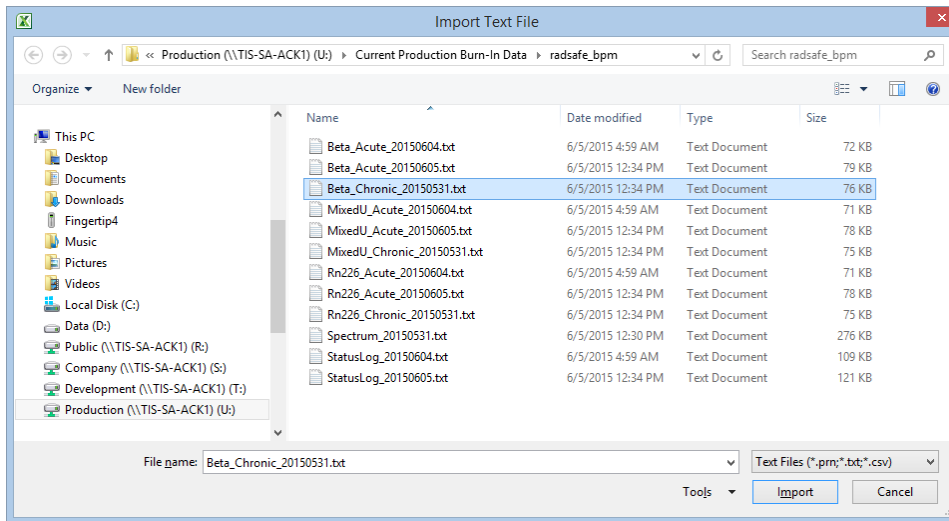


Finally, go back to the *Spectrum Chart* tab and click the **Animate** button and watch the spectrum growth on the chart.

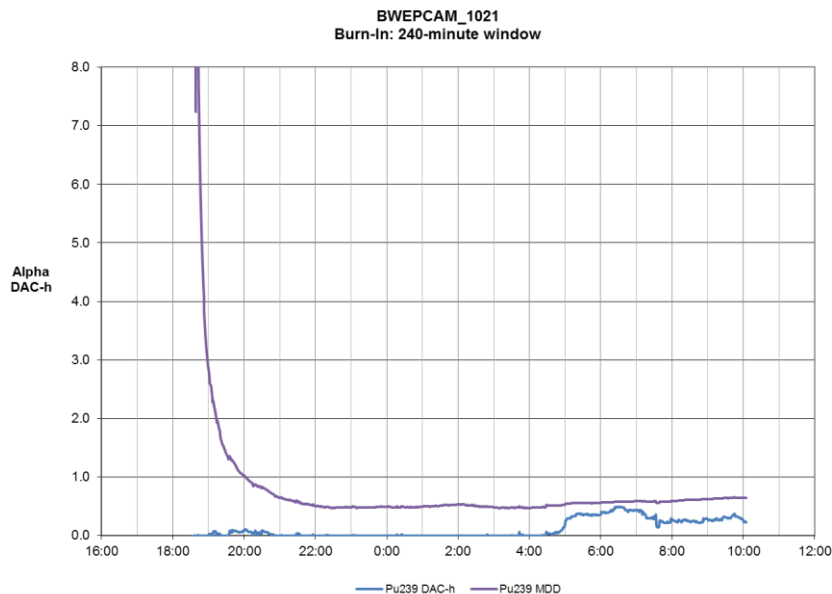


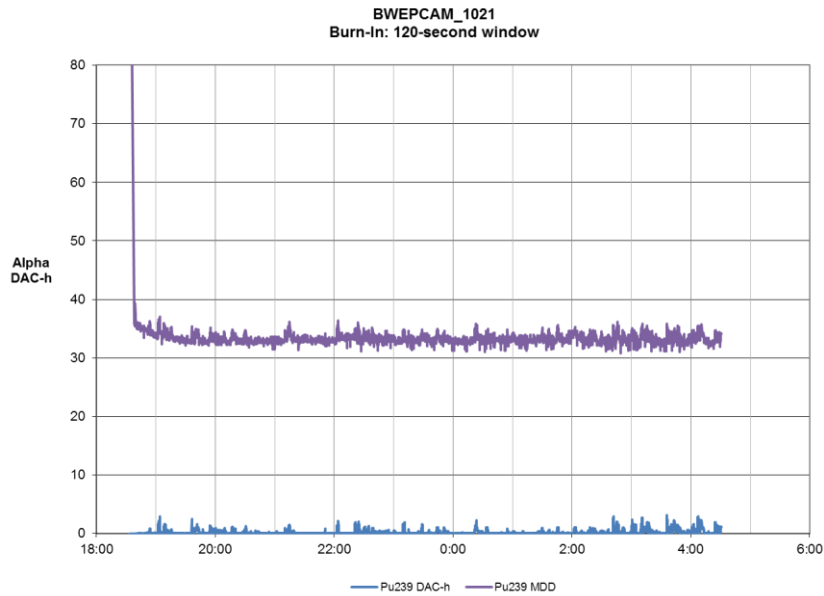
Epee Burn-In Data—Open the spreadsheet and click on the first **Chronic Data** tab along the bottom of the page and select cell A1 (there are two or more tabs—a Chronic and Acute for each isotope). Next, from the **Data** menu, click **Refresh All**. The files requested are in the order of the tabs across the bottom of the workbook (e.g. Beta Chronic Data, Beta Acute Data, ...). When the File Open dialog appears, navigate to the file from the Epee corresponding to the tab you are on (e.g. Beta_Chronic_150602.txt) and click Open. The imported data replaces the old data on the current page.

Next, navigate to the corresponding Acute file and click Open, then the next Chronic file, then the next Acute file and so forth until all data tabs have been refreshed. The different files can also be refreshed individually in which case the order is irrelevant.



Finally, go back to the *Chart* tabs and view the data from the monitoring session.





Creating New Excel Charts

For viewing different sessions of EpeèBZM files open a blank Excel spreadsheet and select Data—Get External Data—Import Text File. Select the saved EpeèBZM log file from the local desktop folder and import it into cell A1. The data can now be graphed and analyzed. Save the spreadsheet to preserve the link to the imported data.

Theory of Operation

Alpha/Beta Multi-Channel Analyzers

The Bladewerx EpeeBZM incorporates two multi-channel analyzers (MCAs) in its processing of detector counts—and alpha MCA and a beta MCA. Beta pulses require greater amplification to be accurately measured for pulse height and so are sampled by a different MCA circuit. The alpha MCA keeps its own 256-channel spectrum, while the beta MCA may keep a 256-channel spectrum or simply the beta gross counts, depending on the configuration. Regardless, the beta spectrum is used for reference only to provide visual feedback during threshold calibration. Only the beta gross counts are used for any beta calculations.

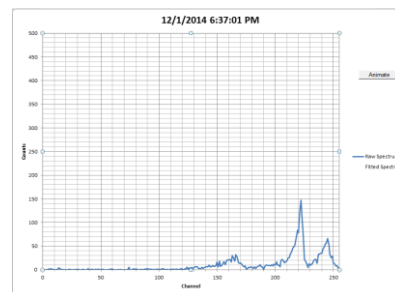
Note: Instruments are factory-configured for alpha operation, beta operation or alpha-beta operation depending on the options ordered. Alpha-beta capable instruments can have either measurement mode disabled by the user to operate in either alpha-only or beta-only mode.

All configurations use the alpha spectrum to determine the radon background, however, unless the Alpha-Reporting Option is specified when the instrument is ordered, it will not have the capability of alarming on and logging alpha isotopes-of-interest.

Alpha Peak Shape Fitting

The Bladewerx EpeeBZM uses a technique called alpha peak shape fitting to analyze a spectrum and separate out counts due to the different alpha isotopes of which the radon decay products contribute the majority typically.

As described above, the alpha spectrum is comprised of 256 16-bit counters, one for each of the 256 discrete MCA channels of alpha energy bins.



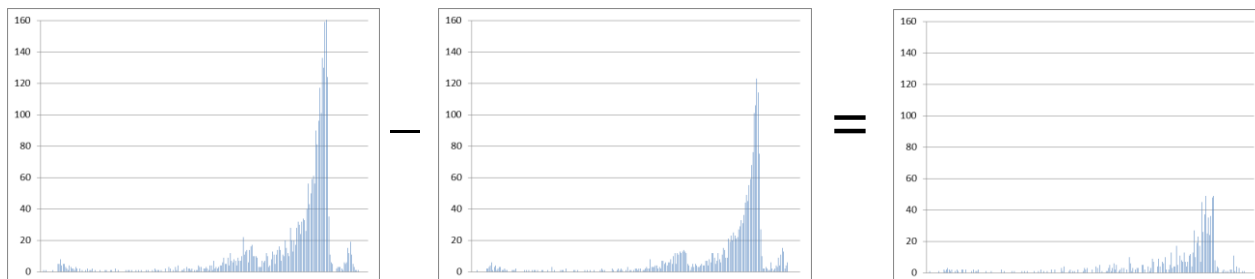
Note: The 16-bit counters limit a single channel to a maximum of 65,535 counts. When a single channel counter overflows, the EpeeBZM will automatically perform a spectrum reset and start a new spectrum.

A mathematical model (Bortels, et. al.) which describes the left-handed Gaussian shape of a typical alpha spectral peak is used by the peak shape fitting algorithm to resolve the counts from each isotope by using a non-linear least-squares minimization algorithm known as a Levenberg-Marquardt algorithm. The result of this algorithm produces the red curves which overlay the raw alpha spectrum in the displays and Excel charts. The peak fit function also produces coefficients for each isotope that correspond to the spectrum counts under that isotope peak.

This algorithm is applied, not to the cumulative alpha MCA spectrum, but to a differential spectrum of a specific time interval.

Differential Spectrums

After every instrument reset, a cumulative spectrum begins to grow in the MCA. The software keeps histories of snapshots of these spectra—600 acute entries of 1-second detail (covering 10 minutes), and 600 chronic entries of 1-minute detail (covering 10 hours). By subtracting any history entry from the current cumulative spectrum, a ‘differential’ spectrum is produced which represents only the spectrum counts accumulated in a specific interval. For instance, a spectrum from 120 seconds previous is subtracted from the current cumulative spectrum—the result being the acute spectrum counts in the last two minutes. Likewise, a spectrum from 240 minutes previous is subtracted from the current cumulative spectrum—the result being the chronic spectrum counts in the last four hours.



In contrast to the cumulative spectrum which is not peak fit, peak fits are performed on three differential spectrums:

- a 4-hour ‘reference’ differential spectrum used to determine the shape of peaks and their channel locations
- a Chronic differential spectrum, used to determine chronic dose and concentrations
- an Acute differential spectrum, used to determine acute net count rate and dose

The time differential used to determine the acute and chronic differential spectrums are defined by the *Acute Window* and *Chronic Window* settings respectively. The Cumulative spectrum, along with all three differential spectrums may be viewed from the Alpha Energy dialog on the Epee Calibration Client.

If the EpeèBZM has been monitoring for a shorter time than the Acute or Chronic Window times, the resulting differential spectrum will be simply the cumulative spectrum.

Dose Estimates

The Epee program calculates dose in direct proportion to the activity collected on the filter paper. A worker wearing the EpeèBZM throughout an entry into a work area will accumulate a dose roughly equivalent to the DAC-h reading of the instrument on exit from the area.

The net counts used in the calculation are taken directly from the output of the peak fit.

$$Activity = \frac{Net_1}{T_{WA} \times Cal \times Eff \times Yield}$$

$$Dose = \frac{Activity}{K_{DAC} \times Flow_{Sample} \times 60}$$

Where,

T_{WA} = Actual chronic/acute window time in seconds¹

Net_1 = Net counts from T - T_{WA} to T

Cal = Calibration constant

Eff = Detector efficiency (4-Pi)

$Yield$ = Isotope Alpha yield

K_{DAC} = DAC conversion factor (equals one if DAC/DAC-h not used)

Note: The Epee dose is an estimate only and should not be used for worker intake reporting purposes.

Concentration Calculation Method

In order to calculate a concentration, the counts for each peak, taken from the peak fit, are saved (along with the flow rate and volume) in a history array, so that the increase in counts over time can be used to determine the net count rate.

The peak counts—based on the history values over one and two window times—are used to determine the net count rates. For instance, if the window time is 60 seconds, then the net count rates for one minute previous and two minutes previous are calculated. For long-lived isotopes, the difference in net count rates over the two intervals is proportional to the concentration. Once the *change* in net count rate between the two windows is known, the calibration constant and flow volume are used to derive the concentration in the specified measurement units.

An additional term is included in the concentration calculation to account for the expected count rate losses due to activity that has decayed off during the last interval. For longer half-lived isotopes the term $Net_0 \lambda$ approaches zero. However, this term is very important for the proper treatment of the short-lived radon decay products.

It should be noted that in situations where the counts under a peak are changing very slowly or not at all, slight variations may occur in the determination of the net count rate, which can result in small negative concentrations. These effects are minimized by the use of the two different evaluation intervals, with a longer interval providing greater precision in low-level measurements.

Concentration Equation

The concentration equation used for the *Acute* and *Chronic* calculation is:

$$Concentration = \frac{\frac{Net_1 - Net_0}{T_{WA}} + Net_0\lambda}{Vol_{sample} \times K_{DAC} \times Cal \times Yield \times Eff}$$

Where,

T_{WA} = Actual slow/fast window time in seconds¹

Net_0 = Net counts from $T - 2T_{WA}$ to $T - T_{WA}$

Net_1 = Net counts from $T - T_{WA}$ to T

Cal = Calibration constant

Eff = Detector efficiency (4-Pi)

$Yield$ = Isotope Alpha yield

Vol_{sample} = Sampled volume over the window time T_{WA}

K_{DAC} = DAC conversion factor (equals one if DAC not used)

λ = decay constant, $\lambda = \frac{\ln(2)}{T_{1/2}}$ where, $T_{1/2}$ = isotope half-life

The flow measurement is used to accurately determine the volume of air collected on the filter paper during the count time.

Minimum Detectable Concentration and Dose

Uncertainties in Peak Counts

In most ROI-based Alpha-CAM's, the minimum detectable concentration is based on the statistical uncertainty of the background counts that fall within the region, in combination with the uncertainty of any counts in excess of the background. In the EpeèBZM, the minimum detectable concentration (MDC) is not directly related to the spectrum counts, but to the uncertainty in the peak fit.

An examination of the peak area variances confirms that when the counts due to an interfering isotope greatly outnumber the counts due to the isotope of interest, the variance of the isotope of interest increases. Likewise, when there are very few interfering counts from other isotopes, the variance begins to approach a value equal to the peak area counts.

When spectrum counts are zero, there is still a minimum variance of the peak areas. This minimum variance affects the minimum detectable levels of dose, concentration and activity.

¹ The actual window time may be shorter than the user-defined window time. When a new spectrum is begun, following a spectrum reset or a filter change, a window time equal to the elapsed time, is used so that a approximate concentration value can be calculated. This actual window time will increase until it is equal to the user-defined time. This occurs when the user-defined window time has elapsed since the filter change or spectrum reset. After this point, the user-defined time is used.

Uncertainties in Flow Rate

The measurement of the flow rate and volume has a statistical variance that contributes to the MDC and MDD. This statistical variance is calculated by the program and applied in the MDC and MDD calculations.

Calculation of the Variance of Peak Counts

The variances returned from the curve fit routine represent the uncertainties on the peak counts for each isotope during the last peak-fitting. The variance returned from the peak fit is a combination of the background variance and the variance of the Isotope-of-Interest counts. The background sigma is calculated as follows:

$$\sigma_{bkg} = \sqrt{MAX[p, Variance_0 - Net_0]}$$

Where, p is a minimum to account for low count Poisson statistics.

The limit of detection used is derived as follows:

$$L_D = K \times \sigma_{bkg} + 1.65 \times \sqrt{Net_0}$$

The limit of quantitative determination is also:

$$L_Q = K \times \sqrt{MAX[p, Net_0]}$$

Where, K is the Sigma Factor—a multiplier based on the False Alarm setting and the number of alarm determinations per year. If configured to Use Sigma Alarms, this value represents the user-defined Sigma Factor.

Calculation of the Minimum Detectable Activity

$$MDA = \frac{L_D}{T_{WA} \times Cal \times Eff}$$

The MDA is calculated differently when operating in Use Sigma Factor mode:

$$MDA = \frac{L_Q}{T_{WA} \times Cal \times Eff}$$

Calculation of the Minimum Detectable Concentration

$$MDC = \sqrt{\left[\frac{\sqrt{L_D + Var_0}}{T_{WA}} + \lambda \times \sqrt{Variance_0} \right]^2 + \left[\frac{Error_{VOL}}{Volume} \right]^2} \times \left| \frac{Concentration}{K_{DAC}} \right|$$

Where,

$Variance_0$ = Peak area variance for previous T_{WA}

$Variance_1$ = Peak area variance for most recent T_{WA}

Calculation of Minimum Detectable Dose

$$MDD = \frac{MDA}{K_{DAC} \times Flow_{Sample} \times 60 \times Cal}$$

Beta Background Subtraction

Radon Background Subtraction

Alpha spectroscopy allows the EpeèBZM to determine individual radon progeny activities for Po-212, Po-214 and Po-218/Bi-212. Tail counts from these interferents are automatically separated from the Isotope-of-Interest counts during peak fitting so no additional calculations are necessary for alpha background subtraction. This radon decay product count information is very important for background compensation on the beta channel (for beta-enabled instruments).

There are several betas resulting from Radon and Thoron decay that can be subtracted from the beta counts. When Radon subtraction is selected in the *Beta* configuration tab, the following beta-emitters are subtracted from the beta channel:

- Bi-214
- Pb-214
- Pb-212
- Tl-208

Fixed Gamma Background Subtraction

During calibration, a beta channel background rate is measured and the rate, due to gamma background, is saved. This background rate is subtracted from the gross beta rate during beta monitoring.

Alpha/Beta Crossover Subtraction

The alpha peak shape fitting algorithm produces a peak fit curve which allows the EpeèBZM to determine alpha tailing into the beta channel. During Alpha Efficiency Calibration, the crossover channel is determined where the tailing counts under the curve below the crossover channel equal the net beta counts (Gross beta minus fixed background).

During beta monitoring, the crossover counts are calculated from the fitted alpha curve and subtracted from the beta channel.

Net Beta Calculation

The three beta background subtraction components described above are applied as follows:

$$Beta_{Net} = Beta_{Gross} - Bkg_{Fixed} - Bkg_{Crossover} - Bkg_{Radon}$$

Radon Mode Considerations

The EpeèBZM may be configured to operate as a radon progeny monitor, measuring and alarming on PAEC (potential alpha energy concentration) levels of milli-Working Levels (mWL), and dose estimates in mWL-h. Alternatively, if configured for SI units, the instrument will report radon concentration in $\mu\text{J}/\text{m}^3$ and dose estimates in $\mu\text{J}\cdot\text{h}/\text{m}^3$.

The PAEC reading is treated as the primary alpha isotope-of-interest and the chronic PAEC dose is reported as the default reading by the instrument (i.e. PAEC/C), with the acute PAEC reading displayed and logged as PAEC/A.

The PAEC is based on the individual radon decay product concentrations as measured off the filter.

On alpha-only instruments, the beta-decay product Pb-214 is estimated from the concentrations of Po-218 and Po-214 before its contribution to the PAEC can be added. The Thoron contributions from Po-212 and Bi-212 are also included in the PAEC result and, when Bi-212 is present, the 6.0 MeV peak counts are corrected for known contributions from Bi-212 before the ultimate energy yield of 13.69 MeV of Po-218 are summed.

On alpha-beta instruments, the actual Pb-214 beta contributions to PAEC are determined and included.

Wireless RadNet Operation

General

EpeèBZM units ordered with the wireless RadNet Output option come equipped with a 802.11b/g-compatible wireless smart card and are configured to allow broadcasting of RadNet Alpha and Beta measurements and Alpha spectrum packets. These packets may be received and displayed by RadNet Client software available from several sources, including Bladewerx. If the RadNet Client is purchased from Bladewerx a CD will accompany your order containing the installation files. A wireless access point (WAP) is required to receive the transmissions from the EpeèBZM and relay those transmissions either via an Ethernet cable to the RadNet Client workstation, or via a second wireless link to the client workstation. The concentration readings and spectrums from up to ten EpeèBZM units may be linked to a single RadNet Client workstation (PC, Tablet, etc.).

Configuration

EpeèBZM units purchased with the RadNet Output Option come preconfigured for operation with the wireless access point; however, site security requirements may call for changes to the setup. The tables below are included to provide a brief guide to the wireless configuration of the EpeèBZM. Exact details of the setup are not provided here but sufficient information is included that will enable a network administrator or user experienced in network setup to perform the configuration.

Wireless and Network Setup

The EpeèBZM is shipped configured as follows:

Device Name	BWEPCAM_xxxx where xxxx represents the EpeèBZM serial number (BWEPCAM_1004)
Description	Bladewerx EpeèBZM
IP Address	Server assigns IP address
Subnet mask	255.255.255.0
Network name SSID	Bladewerx

Connects to	Work
WEP encryption	Enabled (128-bit) <i>(Shared key—not Open)</i>
Network Authentication	Disabled
Key provided automatically	Disabled
Network Key	332a f3df 0836 3347 8b32 da1b c8 <i>(no spaces!)</i>
Bluetooth	Disabled
ActiveSync USB connection	Enabled

Summit Client Utility

Use the Summit Client Utility to set up the wireless network on the EpeèBZM. To open the Summit Client Utility open the Remote Display Control (installed automatically with the EpeèBZM Calibration Client) and select the lower **File** button and then select **Exit** to turn off the EpeèBZM. The EpeèBZM Desktop will display. Open the Summit Client Utility from the desktop and follow the subsequent steps:

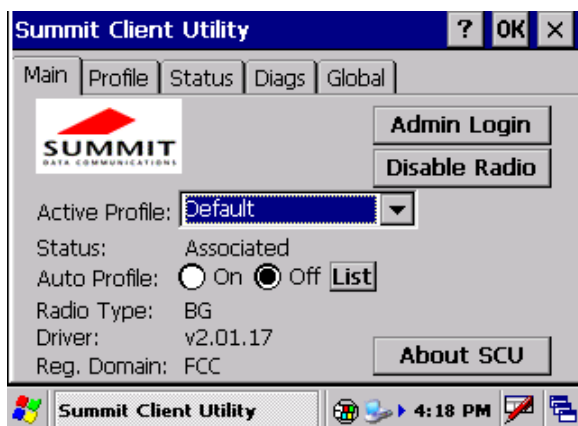
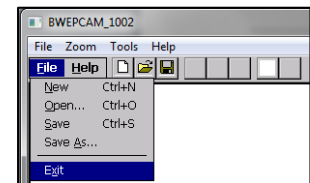


Figure 1: Main screen of Summit Client Utility

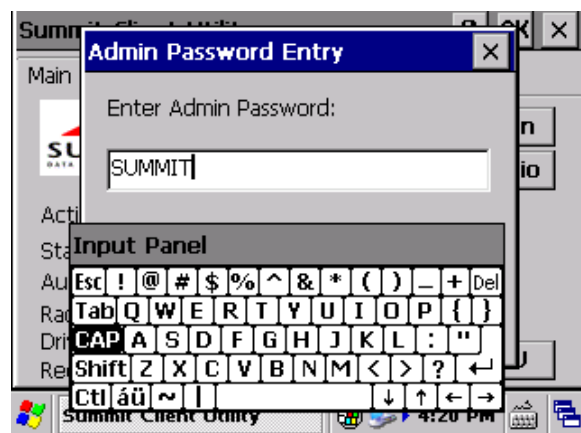


Figure 2: First login by clicking on “Admin Login” which is located under the “Main” tab. Enter the Admin Password: SUMMIT

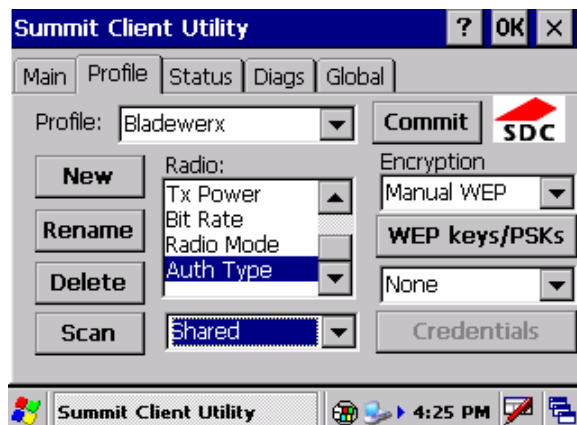


Figure 3: Navigate to the “Profile” tab, and click on “Scan”. In the window that appears, highlight “Bladewerx” by clicking on it and hit “Configure”.



Figure 4: A dialog box will ask if you want to “Create a new profile”. Click “Yes,” and then enter the WEP Key: 332af3df083633478b32da1bc8

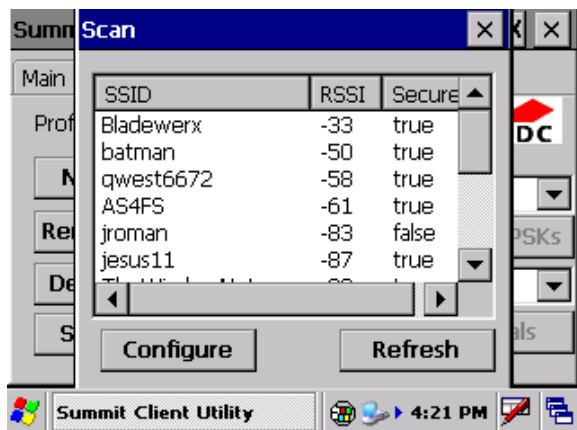


Figure 5: Still in the "Profile" tab, change the "Auth Type" to "Shared," and then hit "Commit".

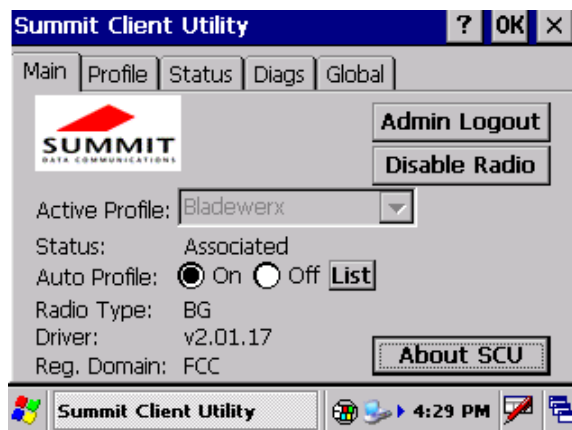


Figure 6: Now go back to the "Main" tab. Click on the "List" button and click on the white box next to "Bladewerx" so that a black check mark appears. Click "OK". On the "Main" screen, turn the "Auto Profile" on. Then click "OK" in the top right-hand corner. The program will close.

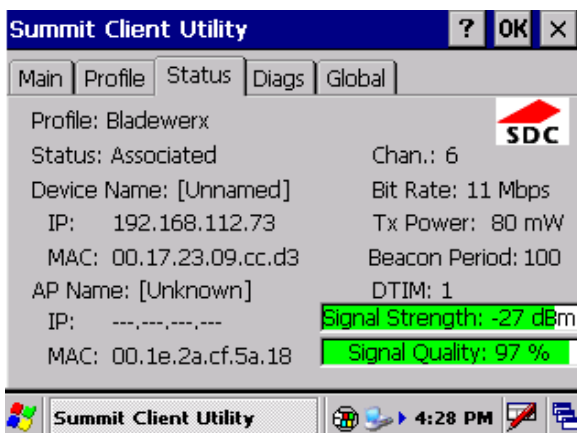


Figure 7: Figures 6, 7, and 8 are screen captures of what each tab should look like when this procedure has been completed.

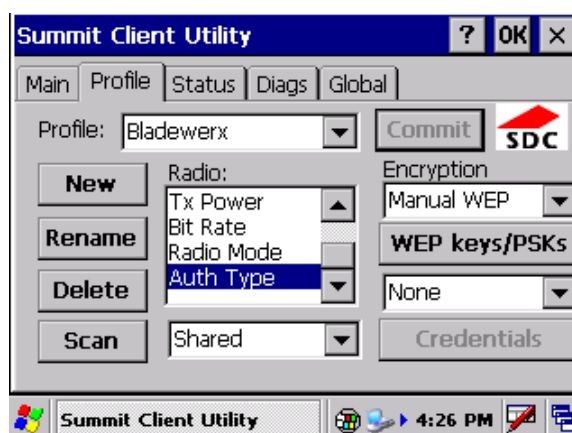


Figure 8

After configuring the EpeèBZM to the wireless network the logging data can be view by opening the RadNet Client program.

Wireless Access Point Setup

To set up your WAP, refer to your network administrator and the Wireless Access manual. A brief summary of set up follows:

The wireless access point (WAP) is an industrial-grade access point capable of extended range operation and can be operated in a Repeater mode. Configuration of the WAP is completed through a web browser such as *Internet Explorer*. Connect the WAP to the PC used for its configuration using an Ethernet cable or a cable into a network hub. Open the web browser and enter the IP address 192.168.0.115 in the address bar (if a different address has been factory-set, the IP Address will appear on a label underneath

the WAP). When connected, the log-on screen will display. Enter “Admin” as the User and “master” as the password.

Name	Admin
Password	master
IP Address	192.168.0.115 where multiple access points are used, number sequentially (e.g. 116, 117, 118, etc.)
Subnet mask	255.255.255.0
Network name SSID	Bladewerx
WEP Authentication Type	Shared Key
WEP encryption	128 bits
WEP Passphrase	Willcox45

In the event that the WAP no longer responds to the 192.168.0.115 address, reset it back to Netgear factory defaults by holding down the *Reset* button on the rear of the chassis for ten seconds then releasing. After the *Test* light goes out, the unit may be reconfigured. Open the web browser and enter 192.168.0.228, the default IP address. At the login screen enter *admin* for the User Name and *password* for the Password. The unit may then be set up according to the settings table above.

RadNet Client Workstation Setup

In order to communicate with the EpeèBZM and wireless access point, the client workstation must be configured with a compatible IP Address in the 192.168.0.xxx Class-C range. Choose an address that does not conflict with the addresses of the EpeèBZMs or the wireless access point(s) (e.g. 192.168.0.12). Addresses below 115 are usually safe.

If the client workstation is operating wirelessly, be sure to set up the SSID of “Bladewerx” and use 128 bit WEP Encryption with the passphrase “Willcox45” (or the hex key 332a f3df 0836 3347 8b32 da1b c8). Select “Infrastructure mode” or “Access Points Only.”

Routine Maintenance

- Inspect the exterior of the device, tubing, and detector head for any damage.
- Check wire cable for cuts and frays.
- Check tubing for cuts or kinks.
- Ensure that all O-rings and seals are in good condition.
- Ensure that the screws which retain the filter holder are positioned and secured with **Loctite®** so that a slight drop in flow rate is noted when the holder is locked under the screws. This insures a low-leakage flow system.
- Remove the filter holder and filter and inspect the detector face for any contamination (particles, fingerprints, etc.). If the contamination is observed, follow the subsequent instructions for cleaning the detector face:
 - To clean the detector first blow dry air or nitrogen gas to remove particles that might scratch the surface.
 - Gently dab a cotton ball with Acetone or a MOS quality isopropyl alcohol on the surface to remove any contaminating oils; do not use methyl alcohol. Avoid excess dampening of the detector face.
 - Repeat treatment to remove any remaining contamination.
 - Finally, blow again with dry air to remove any residual moisture.

Do not wipe the detector with any other cleaning pad or brush. This can easily irreparably scratch the surface.

EpeèBZM Status Conditions

Voice Output	Description
Initializing	EpeèBZM program starting up (momentary condition)
Starting Dose Measurement	Monitoring of Alpha and Beta activity has begun (also reported after a spectrum Reset)
Normal	Operating normally
High Alarm	Dose or Concentration set point has been exceeded
Alarm Acknowledged	Alarm has been silenced
Alarm Cleared	Alarm has been cleared
Low Flow	Flow rate is below Low Limit, possibly due to loaded filter.
High Flow	Flow Rate is above High Limit, possibly due to a hose leak
Flow Failure	Flow Rate is below Low Fail Limit, possibly due to a blocked or kinked hose.
Detector Failure	No counts have been received from detector in ten minutes
Low Battery	Battery is below 25%
Battery Expired, Shutting Down	Battery is at 15%, automatically enters Standby mode
MCA Failure	No communications with EpeèMCA processor
Poor Curve Fit	Could not fit the spectrum with the defined isotopes. Possible unknown isotope or electronic noise.
Out of Calibration	Calibration has expired. EpeèBZM is due for calibration.
Standby	Pauses dose measurement, but retains registry settings and saves battery. Occurs when power button is pressed or battery is below 15%
Missing Configuration File	Configuration file is corrupted or missing.
Clock not set	Occurs before EpeèBZM is synced with a workstation clock
Copying Log Files	USB drive inserted into CAM: saving all log data to USB Drive
Copy Complete	USB drive inserted into CAM: Safe to remove USB Drive
Installing software update	Software is installing. Will report Initializing when OK to remove

Specifications

Sampling Head and Flow

- 37 mm Filter holder
- Detector: Solid-state silicon (450 mm² active area)
- Pump: diaphragm-type, 6.0 LPM with no load

Data Analysis

- MCA: 1024-channel analyzer binned to 256 channel spectrum
- Alpha Peak-shape-fitting algorithm
- Po-218, Po-214, Po-212, plus one or two isotopes-of-interest and Beta.
- Acute (fast response) and Chronic (high sensitivity) dose determinations
- Processor: *Windows CE*-based, 533 MHz *Intel* X-Scale processor

Physical

- Battery powered: 8.4 V Lithium-Ion, 4.1Ah (10 - 16 hr. run-time)
- EpeèBZM Weight: 2 lbs. (0.9 kg)
- Umbilical length (EpeèBZM): 37 in. (94 cm.)
- Dimensions: (W x H x D) 5 x 6 x 3 in.
- Temperature: 0 to 122 °F (-17 to 50 °C)
- Humidity: 5 to 100% (non-condensing)

Frequently Asked Questions

What should I do when I take my lunch break?

In most cases, it is best to leave the monitor running. However, it is possible to put the unit into Standby mode and suspend the dose measurement by pressing the power button. Press it again to turn the unit back ON and resume measurement functions.

If more than an hour goes by before starting the dose measurement again, the minimum-detectable levels of concentration and dose will be elevated until the Acute and Chronic Window times have elapsed. Until the full window times have elapsed, the EpeèBZM is using incomplete spectrum accumulations to calculate the dose and concentration and has elevated statistical fluctuations of the results.

What happens when I accidentally turn the EpeèBZM off?

When the power button is pressed, the EpeèBZM will go into Standby mode and suspend measurement functions. To preserve measurement integrity, immediately resume the dose measurement by pressing the power button again.

Why does the speaker/headphone volume change when an alarm occurs?

To insure that alarm annunciations are heard when the speaker is turned down, the EpeèBZM turns the speaker volume to maximum on an alarm. When the alarm is acknowledged, the volume is restored to its pre-alarm level.

Can everyone hear an alarm, even if I'm wearing my headphones?

No, use of headphones disabled the integrated speaker.

If the Trouble light is on or blinking, can I still use the EpeèBZM?

If the Trouble light is **blinking**, you may continue to use the instrument, but the status annunciated needs to be addressed.

If the light is **continuously on**, do not use the EpeèBZM. Bring it to your site technician for diagnostics, calibration or repair.