

EpeeCAM™ Operations Manual



BLADEWERX

EpeèCAM Operations Manual

Documentation version 4.3

6 March 2018

Copyright Notice

Copyright © 2004-2018, Bladewerx LLC.

All Rights Reserved.

Any technical documentation that is made available by Bladewerx LLC is the copyrighted work of Bladewerx LLC and is owned by Bladewerx LLC.

NO WARRANTY. The technical documentation is being delivered to you AS-IS and Bladewerx LLC makes no warranty as to its accuracy or use. Any use of the technical documentation or the information contained therein is at the risk of the user. Documentation may contain technical or other inaccuracies or typographical errors. Bladewerx reserves the right to make changes without prior notice. No part of this publication may be copied without the express written permission of Bladewerx, 4529 Arrowhead Ridge Dr., Rio Rancho, NM 87124.

Trademarks

Bladewerx, the Bladewerx logo, EpeèCAM, EpeèBZM and EpeèMCA are trademarks of Bladewerx LLC. Microsoft, Windows CE, Excel and the Windows logo are registered trademarks of Microsoft Corporation. Vybrid is a trademark of NXP/Freescale.

Table of Contents

GETTING STARTED	1
THE PARTS OF THE EPEÈCAM	1
CHARGING THE BATTERIES	2
ON AND OFF BUTTON	2
ALARM ACKNOWLEDGE BUTTON.....	2
VOLUME +/- BUTTONS	3
OPERATIONAL DURATION	3
TRANSFERRING FILES.....	3
EPEÈCAM CALIBRATION INTERFACE SOFTWARE INSTALLATION	4
CONFIGURATION.....	5
CONNECTING THE EPEÈCAM TO THE CALIBRATION CLIENT	5
CALIBRATION CLIENT PROPERTIES/PASSWORD SECURITY	5
PUMP SPEED.....	6
INSTRUMENT OPTIONS	6
<i>General Tab</i>	7
<i>Output Tab</i>	7
<i>Logging Tab</i>	8
<i>Flow Tab</i>	9
<i>Isotope 1 and 2 Tabs (Alpha-Reporting Option only)</i>	10
<i>Beta Tab (Beta Option req'd)</i>	11
<i>RadNet Tab (Wireless Output Option req'd)</i>	12
ALARM SETTINGS.....	13
CALIBRATION.....	15
FLOW CALIBRATION.....	15
ALPHA CALIBRATION	17
<i>Alpha Energy</i>	17
<i>Alpha Efficiency</i>	20
BETA CALIBRATION	22
<i>Beta Energy (Beta Option Req'd)</i>	22
<i>Beta Efficiency</i>	23
CALIBRATION REPORT	24
USING THE EPEÈCAM	27
STARTING DOSE MEASUREMENTS.....	27
REPORTING DOSE MEASUREMENTS	28
ENDING DOSE MEASUREMENTS	28
EPEÈCAM LOG DATA	29
RETRIEVING THE LOG FILES.....	29
VIEWING THE LOG FILES.....	31
THEORY OF OPERATION	35
ALPHA/BETA MULTI-CHANNEL ANALYZERS	35

ALPHA PEAK SHAPE FITTING	35
DIFFERENTIAL SPECTRUMS	36
DOSE ESTIMATES	37
CONCENTRATION CALCULATION METHOD	37
MINIMUM DETECTABLE CONCENTRATION AND DOSE.....	39
BETA BACKGROUND SUBTRACTION	40
RADON MODE CONSIDERATIONS	41
WIRELESS RADNET OPERATION	43
GENERAL	43
WIRELESS ACCESS POINT SETUP.....	43
RADNET CLIENT WORKSTATION SETUP	44
EPEÈCAM CONFIGURATION	44
<i>Wireless and Network Setup</i>	44
<i>EpeèCAM WiFi Setup</i>	45
ROUTINE MAINTENANCE	47
EPEÈCAM STATUS CONDITIONS	49
SPECIFICATIONS.....	51
FREQUENTLY ASKED QUESTIONS.....	53

Getting Started

The Parts of the EpeèCAM

The EpeèCAM™ consists of a rugged ABS polycarbonate enclosure containing the EpeeMicro™ and EpeeMCA™ electronics, battery and pump. A detector head mounted to the right side of the case 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 to should only be done by personnel trained in repair of the EpeèCAM .

There are four operator control buttons located on top of the EpeèCAM: Power, Alarm Acknowledge, and Vol+/Vol- 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 micro-USB port is used to calibrate, configure, and copy data directly to the PC via the micro-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 EpeèCAM 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 EpeèCAM, each package contains the A/C Adapter, a micro-USB cable and a shoulder strap or optional belt clip. A flow calibration fixture and software CD is provided with any number of EpeèCAMs on a single purchase order.

Charging the Batteries

Before the EpeèCAM 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 LED on the face of the EpeèCAM indicates the charging state. When the LED is Red, the battery is being charged. When the instrument is turned off, the charging time is approximately 4 hours for a unit with low battery and 8 hours for a unit with a completely discharged battery. The charging time is about twice this when the unit is running.

Important Notice Concerning Parameters and Data

The EpeèCAM configuration settings and parameters are saved in non-volatile flash memory thus keeping your calibration settings intact if the battery is fully discharged. The EpeèCAM 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 approximately 8 hours.

Log files may be stored in either the My Documents folder or the SD Card. Log files stored on the SD Card will be saved if the battery becomes fully discharged, while the log files in My Documents will be lost when power is turned off. If the user will be turning the instrument off after use, select the SD Card logging option.

ON and OFF Button

With the battery fully charged, you are now ready to turn the EpeèCAM on by pressing the power button on top. After pressing the button the EpeèCAM program will load and execute. When powering up, the LEDs should turn on while the operating system loads. When the EpeèCAM software is executed, the LEDs will be turned off for a few seconds while the software version and battery level is audibly announced. Full boot-up takes about 30 seconds for the pump to come on and the measurement functions to begin.

To power off the EpeèCAM, hold the power button down for about 5 seconds until the voice output announces, “shutting down,” The pump will then stop, and the lights will shut off. In the Off position, the EpeèCAM battery has a storage duration of about a month.

During monitoring periods, when the EpeèCAM is ON, the battery will last 8 to 16 hours—depending on pump speed and whether WiFi is enabled. When a monitoring period is finished, the EpeèCAM should not be turned off if the log data it is stored in the volatile My Documents folder (for more information see the Log Data Destination section). If there is no need to read the log files—or if the log data is stored on the SD Card—the unit can be powered down.

Alarm Acknowledge Button

The Alarm Acknowledge button exhibits different behavior depending on the alarming mode—Latching or Non-Latching. Under Non-Latching alarms, when the device alarms pressing this button once silences the alarm and pressing and holding it clears the alarm and starts a new spectrum and measurement cycle. With Latching alarms, pressing the button once silences the audible alarm, while pressing it a second time

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 EpeèCAM and the unit will announce “Initializing” followed by “Normal”. Since the action begins a new counting cycle, the sensitivity will be reduced for several minutes until counting statistics improve.

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 to indicate the max/min volume has been reached.

In the event of an alarm the volume level is automatically set to maximum by the software. The EpeèCAM 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. Once acknowledged, the speaker volume will return to the previous user setting.

Operational Duration

When operating off the battery, the EpeèCAM will run, depending on pump speed, for 8-16 hours before automatically powering off. The use of wireless reporting capability and the pump speed will 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 power down.

Note: In order to preserve status, spectrum, and log data, the EpeèCAM will automatically power down when the battery life reaches 15%. Before the battery fully discharges, either the log files need to be downloaded or the EpeèCAM 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 EpeèCAM. This program can be used to manually copy log files from the EpeèCAM to the computer. In order to determine where on the EpeèCAM the Log files are being saved (My Documents, SD Card, or My Documents) 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. From here you can cut and copy folders and files and move them to other local folders on your computer.



The alternate method for retrieving log files is to use a USB memory stick “thumb drive” and, with the supplied *USB to micro-USB adapter cable*, 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_1301*).

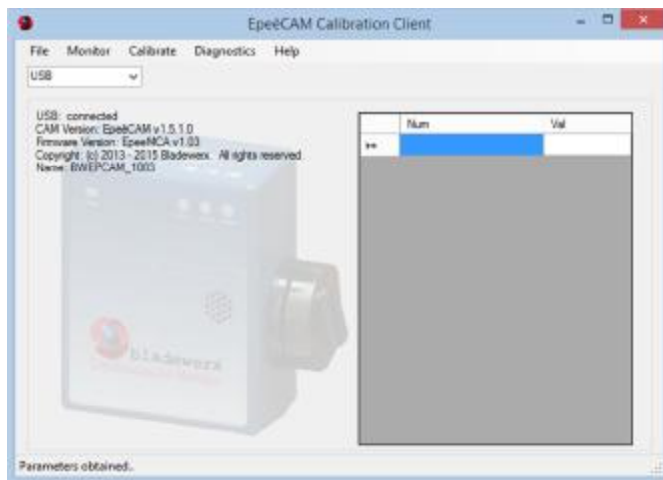
EpeèCAM Calibration Interface Software Installation

The configuration and calibration features are provided by a companion Windows 7/10-compatible program—**EpeèCAM 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 EpeèCAM to meet your specific requirements.

Insert the Install CD (or Bladewerx memory stick) into the computer. Access the contents 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 Calibration Client does not open automatically when the EpeèCAM 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 EpeèCAM while it is connected to the PC. The software communicates with an EpeèCAM via the USB Sync cable.



Configuration

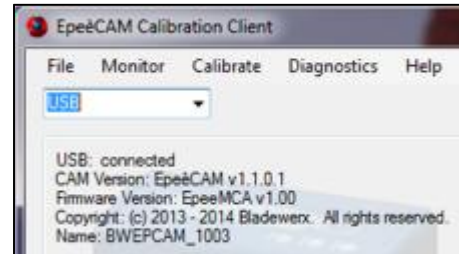
The EpeèCAM Calibration Client provides several dialog boxes to allow configuration of the instrument operation. These dialog boxes are accessed through the menus at the top of the screen. Each dialog box and its property settings are described below.

Connecting the EpeèCAM to the Calibration Client

USB:

After connecting the 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.”

If the instrument does not connect within ten seconds, then disconnect and reconnect the USB cable. Instructions at the bottom to the window will prompt you to reinsert the USB cable if communications are not established.



Calibration Client Properties/Password Security

The EpeèCAM 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

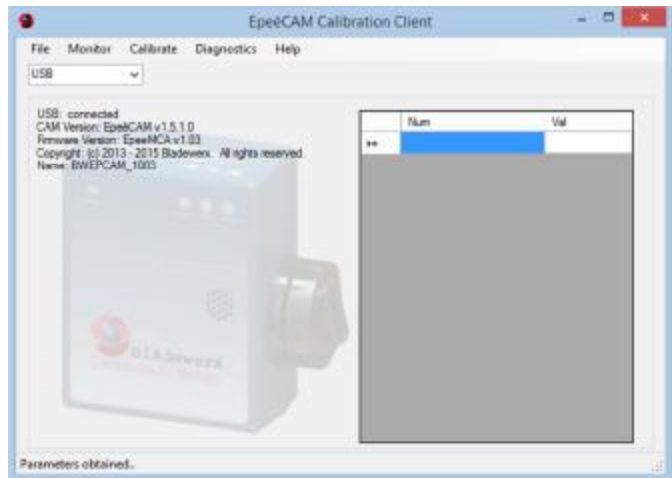
calib –allows for full access of calibration functions

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 EpeèCAM 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 EpeèCAM should be set to a higher pump speed. For a longer battery life and lower noise level set the pump speed at a lower rate.



Instrument Options

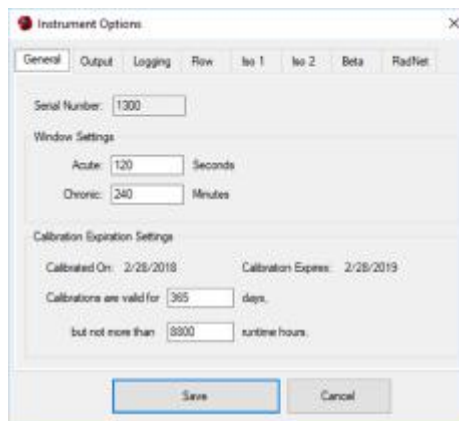
The Instrument Options dialog box controls the functional behavior of the EpeèCAM. Access the dialog box from the menu by selecting **Monitor–Instrument Options...** Depending on factory installed options, the dialog box consists of up to eight pages of settings and information: **General, Output, Logging, 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 EpeèCAM serial number that the software is linked to currently. Also, the **General** page controls the window times, which affect the instrument sensitivity, and the calibration expiration settings of the EpeèCAM.

Serial Number—This field identifies the factory-defined serial number of the EpeèCAM. 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. 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 EpeèCAM will announce “OUT OF CALIBRATION” and the Trouble light will blink. The Normal light will remain on indicating that the EpeèCAM is still functional.

Calibration expires—This non-editable item displays the date on which the EpeèCAM 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 pump runtime hours are exceeded.

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

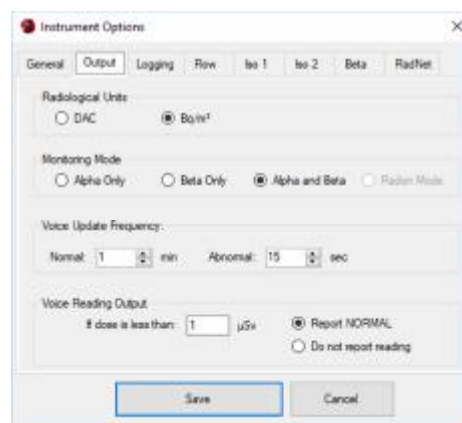
But not more than XXX runtime hours—This field sets the maximum number of hours of EpeèCAM pump runtime between calibrations. Under heavy filter-loading, the internal pump performance can start to degrade before the Calibration Days have elapsed. **Default is 8800 hours**

Output Tab

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

Radiological Units

This field identifies the reporting units of the EpeèCAM. Units can be DAC (with DAC-h), or Bq/m³ (with µSv) **Default: DAC**



Monitoring Mode

This field identifies the Monitoring Mode of the EpeèCAM. 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 1 minute*

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 EpeèCAM will begin to voice annunciate dose 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 EpeèCAM will annunciate “NORMAL” according to the Frequency set in the **Normal** field.

Do not report reading—If this setting is selected the EpeèCAM 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.**

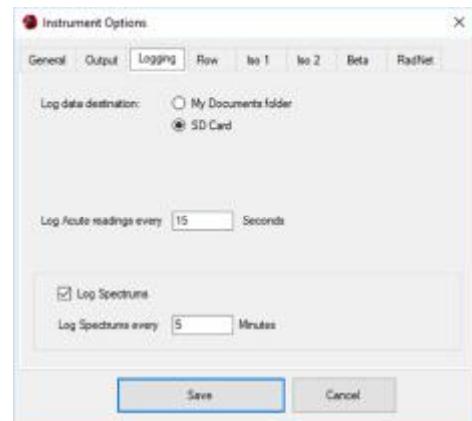
Logging Tab

The **Logging Tab** settings control the data logging behavior of the EpeèCAM. Several types of log files are created on the EpeèCAM 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 SD Card*

Ø **My Documents folder**—This setting saves log files in the My Documents folder. This is a volatile memory folder meaning all data will be lost if the EpeèCAM is turned off, shuts down, or in the event of a complete battery discharge. This setting provides the highest logging performance.

Ø **SD Card**—This setting causes log data to be saved to the non-volatile SD memory card in the EpeèCAM 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 EpeèCAM to a PC.

Log Acute readings every XX seconds—This setting controls the frequency which Acute readings are written to the Acute log file. New acute log files are started every day at midnight. *Default is 15 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*

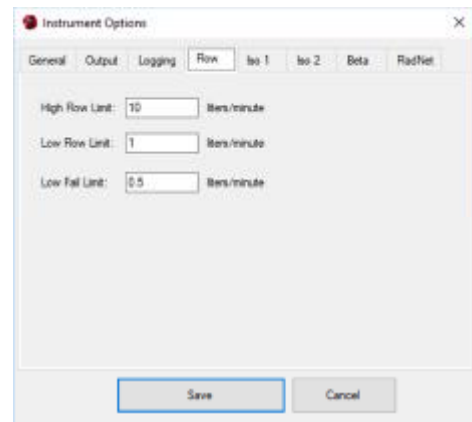
Flow Tab

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 EpeèCAM 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 EpeèCAM 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).

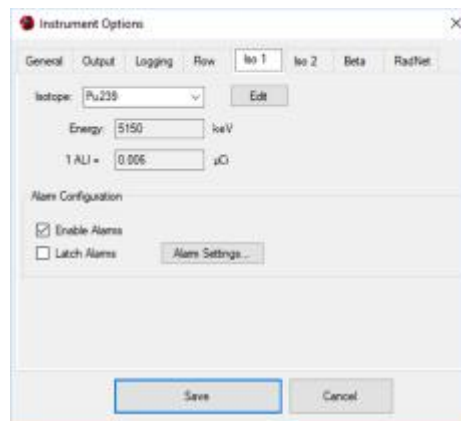


Low Fail Limit—This setting defines the limit in liters-per-minute below which the EpeèCAM will indicate a FLOW FAIL status and go out of service. A flow fail status can indicate a kinked or clogged vacuum line or that the pump is off completely.

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

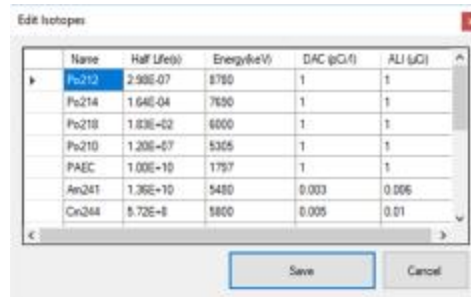
Isotope 1 and 2 Tabs (Alpha-Reporting Option only)

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, DAC and ALI Factors 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 (pCi/l)**—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.**
- **ALI (µCi)**—This setting defines the conversion constant to convert from micro-Curies to Allowable-Level-of-Intake. The default factors are set according to 10CFR835. **Note the constant uses units of µCi to avoid the need for scientific notation.**



Name	Half Life(s)	Energy(keV)	DAC (pCi/l)	ALI (µCi)
Po212	2.99E-07	8780	1	1
Po214	1.64E-04	7690	1	1
Po218	1.03E-02	6000	1	1
Po210	1.20E-07	5305	1	1
PAEC	1.00E-10	1797	1	1
An241	1.36E+10	5480	0.003	0.005
Cn244	5.72E+0	5800	0.005	0.01

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

DAC or ALI—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.**

Chronic Alarms	Acute Alarms
<input type="checkbox"/> Use Sigma Alarms	<input type="checkbox"/> Use Sigma Alarms
<input type="checkbox"/> Ignore Minimum Detectable check	<input type="checkbox"/> Ignore Minimum Detectable check
Dose (µSv): 50	Dose (µSv): 400
Concentration (Bq/h³): 80	Net Rate (ppm): 1000
Sigma Factor: 4.12	Sigma Factor: 4.58
Acceptable False Alarm Rate: 18 per Year	
Done Cancel	

Beta Tab (Beta Option req'd)

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

DAC/ALI Constant —This field defines the conversion constant to convert from Pico-Curies/liter to DAC, defined by either 10CFR835 or 10CFR20, or micro-Curies per ALI. **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.**

Instrument Options
General Output Logging Row Iso 1 Iso 2 Beta RadNet
1 ALI = 4 µCi
Alarm Configuration
<input checked="" type="checkbox"/> Enable Alarms
<input type="checkbox"/> Latch Alarms Alarm Settings...
Background Subtraction
<input checked="" type="checkbox"/> Radon subtraction
Subtraction factor: 1
Save Cancel

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 by pressing the Alarm Ack button 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.*

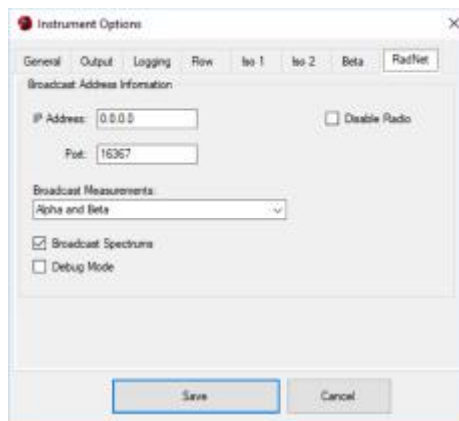
Background Subtraction

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 EpeèCAM 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 1.0.*

RadNet Tab (Wireless Output Option req'd)

This page contains the setting for RadNet broadcasts for EpeèCAM 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.*

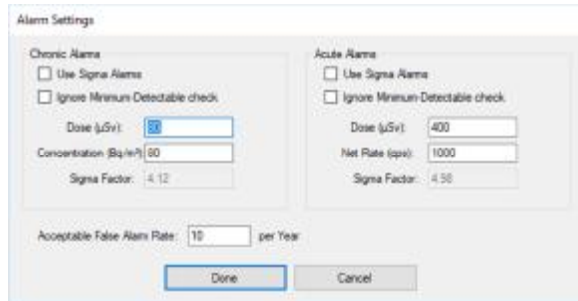
Broadcast Measurements—This list box describes the options for measurement packet broadcasts. Allowable choices limited by the instrument alpha/beta capability but are *Alpha*, *Beta*, and *Alpha and Beta*. *Default is Alpha.*

Broadcast Spectrums—This checkbox enables or disables the transmission of EpeèCAM 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).

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 Chronic 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 (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 or µSv)—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 or Bq/m³)—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 Rates* setting for the calculation of the MDA, MDC, and MDD.

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 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 or μSv)—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 for the calculation of the MDA and MDD.

Acceptable False Alarm Rate

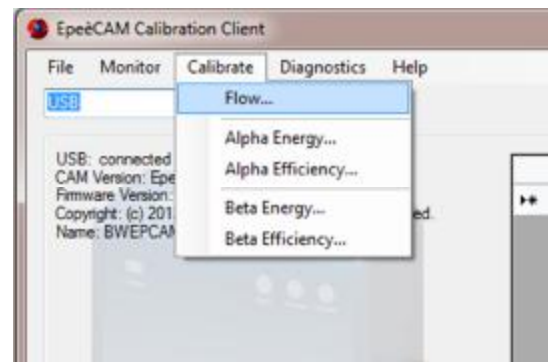
This setting defines the acceptable number of false alarms per year. The limit has an effect on the calculated minimum-detectable activity, dose and concentration, and therefore, on the dose and concentration sensitivities. When not operating in *Use Sigma Factor* mode, the setting is used to determine 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 EpeèCAM 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 EpeèCAM 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.

EpeèCAM Flow Mode

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

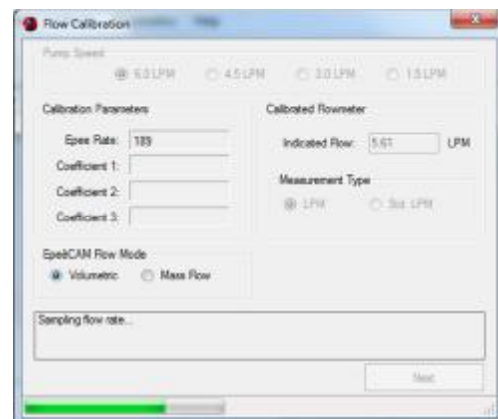
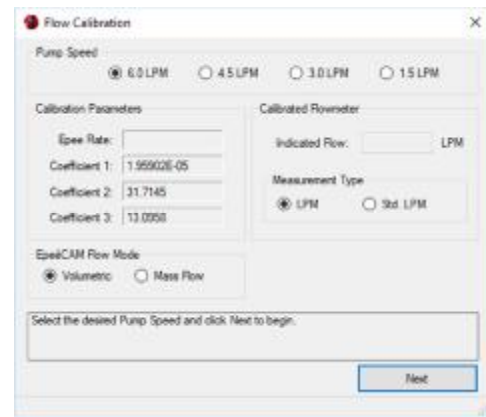
Calibration Parameters

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

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. By default, the EpeèCAM uses a linear flow model.

Instructions

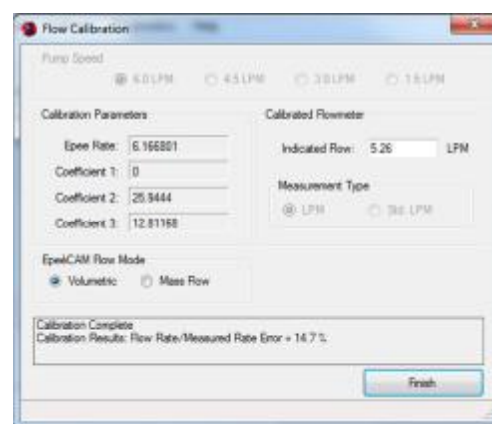
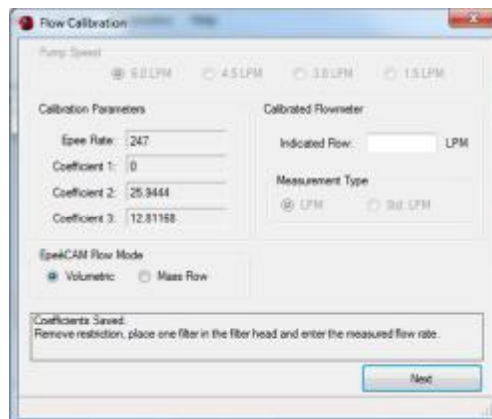
1. As seen in the [Flow Calibration Training Video](#) on [bladewerx.com](#), set up the flow calibration apparatus as follows: Radial-Entry Head without filter – EpeèCAM flow calibration aid – Tygon tubing – digital flowmeter.
2. In the **Pump Speed** field select the highest speed at which the device 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 **EpeèCAM 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 one filter 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.

5. After the sampling of the flow rate is completed repeat step 4 with two 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 calibration is required even on a Beta-only EpeeCAM since the radon-compensation on the beta channel depends on the alpha-emitting radon decay products.

Alpha Energy

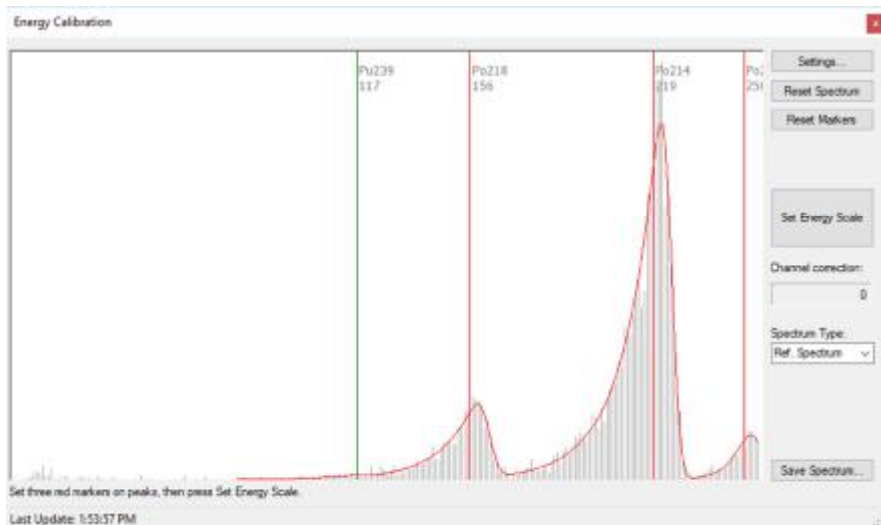
Alpha energy calibration consists of setting markers on known radionuclide peaks in the alpha spectrum so that a channel-to-energy and energy-to-channel conversion coefficients may be calculated, allowing the determination of peak locations for all alpha isotopes.

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

This dialog box controls the Alpha Energy Calibration process of the EpeeCAM 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/thoron decay product (RDP) peaks and should be adjusted to match up with the three peak locations. There are lines for the Po-218 and Po-214 radon-daughter peaks, and the Po-212 thoron-daughter peak.

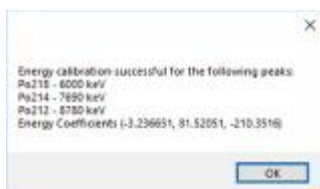
The peak locations of all other isotopes are calculated from the locations of the peak markers for Po-218, Po-214 and Po-212 decay-product peaks. The numbers at the top of each red line correspond to the channel number that the line represents.

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



When the Alpha spectrum is in view, calibrate the energy levels by dragging the three **red** peak 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.

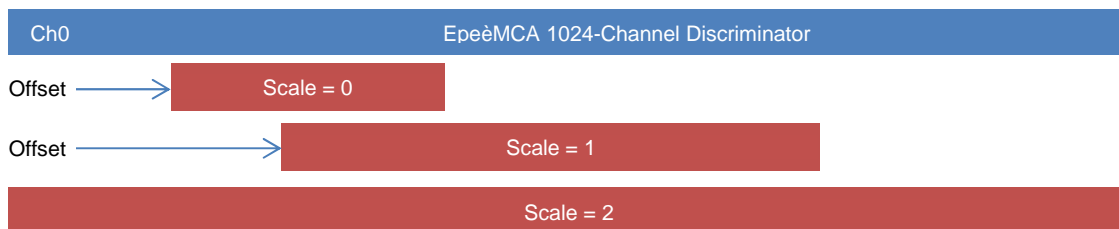
Settings


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 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 EpeèMCA 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.



Where  represents the viewable 256-channel spectrum.

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 used by the software. A value of zero results in no compression so only a 256-channel portion of the 1024-channel discriminator spectrum is used. A 2:1 compression bins 512 channels of the discriminator output into 256 spectrum channels so half of the 1024-channel discriminator spectrum is used. 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.*

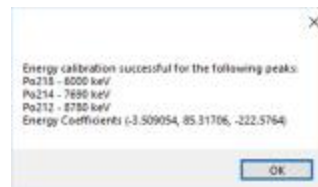
Alpha Offset—(Range 0 to 512) These values shift the scaled 256-channel spectrum by the defined number of channels to the left. Increasing the Offset shifts all peaks to the left, while decreasing the Offset shifts peaks to the right. The intent of changing the Offset is to place the Po-212 peak (8.78 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 40 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) $\text{Chan} = (\text{ADC}/\text{Scale}) - \text{Offset}$. 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 the 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 and double-peaks may appear .

Set Energy Scale

After dragging the three peak 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 isotope 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 spectrum 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 EpeèCAM Calibration Interface. Select the **Calibrate-Alpha Efficiency...** menu item to access the dialog box.

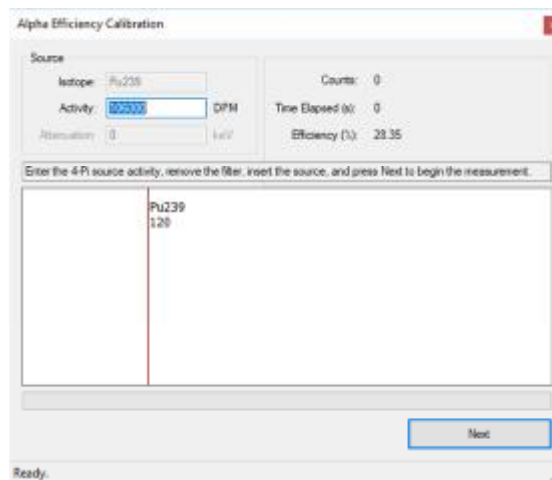
Source

Alpha sources used for calibration should be 10,000 to 130,000 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 EpeèCAM 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. *As of version 1.7 of the EpeèCAM software, this field is disabled and the program automatically accounts for the source attenuation.*

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%.*

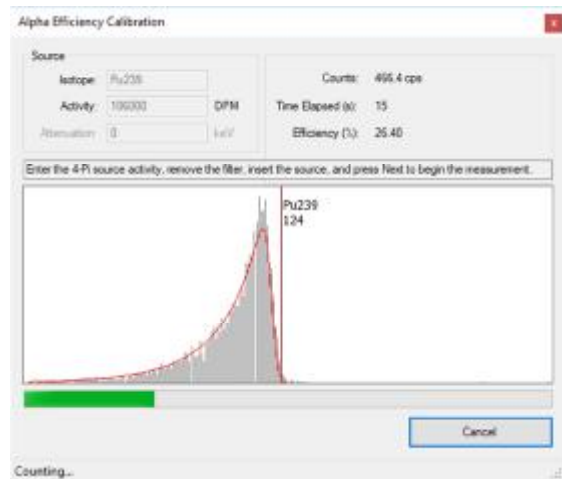


Figure 1 – Alpha Efficiency

Instructions

Insert the source in the supplied source holder. Remove the filter holder from the radial head and push the source holder in the head. Make sure it is against the internal front face of the housing and the same distance from the detector as a filter would be.

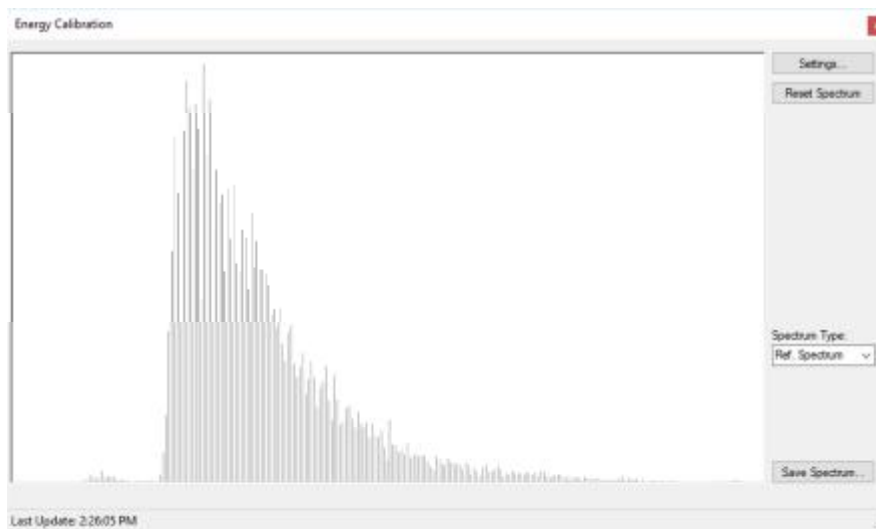
Enter the source 4-Pi emission rate of the source in the **Activity** field and press **Start**. The spectrum display will show the source peak counts and the associated red peak fit curve during the calibration and the marker location for the peak. An efficiency will be displayed on completion of the 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 EpeèCAM Calibration Interface. Select the **Calibrate–Beta Energy...** menu item to access the dialog box.



The EpeèCAM 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 EpeèCAM will count amplifier noise. Consequently, it should be set just above the level where the amplifier noise is first observed. *Default Threshold is 6 for Beta.*

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 0 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) $\text{Chan} = (\text{ADC}/\text{Scale}) - \text{Offset}$

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 EpeèCAM Calibration Interface. Select the **Calibrate–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 6, 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.

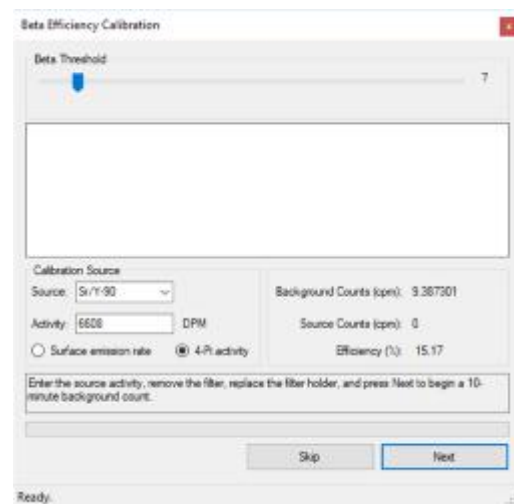
Calibration Source

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 used in the efficiency calculation. The field changes during the 10-minute background count period.



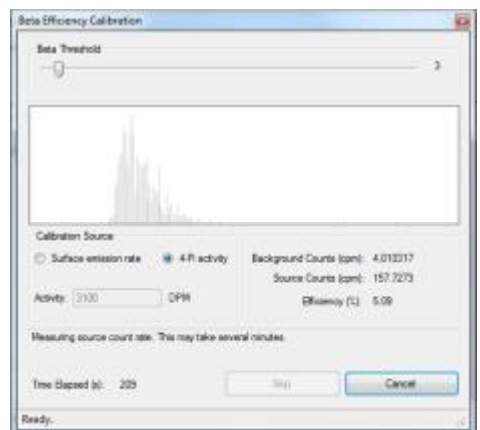
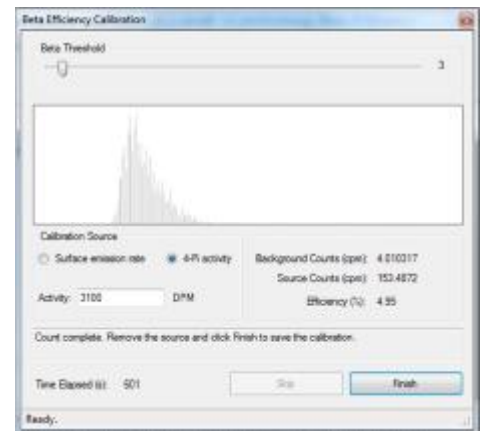
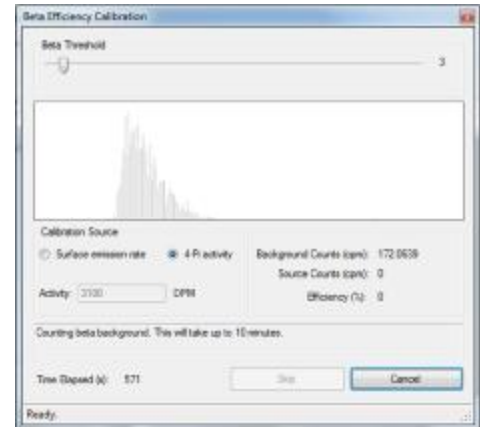
Source Counts (cpm)— This field is populated as a result of performing Beta Efficiency calibration and is not user editable. During calibration, the field reports the rate of source counts-per-minute that is then used in the efficiency calculation. The field changes during the 10-minute source count 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 replace the filterless holder in the head. Set the appropriate threshold level and select Next so that the EpeèCAM will begin the 10-minute background count. The threshold should be adjusted so that the beta background is approximately 10 cpm/ μ R/h (0.10 cpm/ μ Sv) of ambient gamma.
2. When this beta background count is finished, remove the filter holder and place the source holder in the head.
3. 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 when 100,000 counts have been measured, or a 10-minute maximum is reached.
4. 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 all 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

EpeèCAM Calibration Report

Serial Number:	1032	CalibEpeè Version:	1.4.0.18472
Network Name:	BWEPeCAM_1032	Instrument Version:	EpeèCAM v. 5.1.0
Calibration Date:	Wednesday, May 27, 2016	Firmware Ver:	EpeèMCA v. 0.0.0

ID-TSN: 113358

Flow Calibration

Coefficient 1:	1	Calibration Date:	6:1 PM
Coefficient 2:	43.18327	Validation Date:	5:04:56 PM
Coefficient 3:	11.00953	Measured Flow:	5.40 LPM
		Measurement Error:	1.18%

Alpha Calibration

MCA Gain:	10	Calibration Source:	Pu239
MCA Threshold:	0	Source Activity:	106000 DPM
MCA Offset:	50	Source Attenuation:	125 keV
MCA Scale:	scale_2tot	4-Pi Efficiency:	70.6%

Po-212 Channel:	216		
Po-214 Channel:	206	Primary 1st Channel:	119
Po-218 Channel:	148	Alternate 1st Channel:	

Beta Calibration

Hea Background:		Calibration Source:	
Crossover Channel:		Source Activity:	
Radon Sub. Factor:		1 Pi Efficiency:	
Quad Sub. Factor:			

Signed: _____ Date: _____

Bladewerx certifies that this instrument has been calibrated in accordance with ANSI N220C-2009 using naturally occurring radon decay products and a plated source cross referenced to a NIST traceable source (ratio method).

Using the EpeèCAM

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 EpeèCAM is starting from a powered-off state it will take approximately 30 seconds to boot, initialize the software, and start the pump running. When you hear the EpeèCAM 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 EpeèCAM does not require a 'warm-up period' however, the sensitivity is reduced considerably at first.

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 EpeèCAM 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.** Until all sensitivities are below the corresponding alarm setting, the green Normal LED will blink.

Reporting Dose Measurements

Reports In-The-Field

The EpeèCAM 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 EpeèCAM. All possible audible status reports and their descriptions are listed in Appendix I. The LED status descriptions are as follows:

- Trouble:** *Solid Yellow* – the EpeèCAM should not be used due to any of a number of malfunctions that are annunciated by the EpeèCAM
Blinking Yellow – the EpeèCAM 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:** *Blinking Green* – the CAM is sampling but sensitivity levels are still above at least one alarm setpoint. *It will still alarm in this state if the reading is above the sensitivity.*
Solid Green – the CAM is sampling at full sensitivity.
- Alarm:** *Red* – one of the measurements has met the alarm conditions.

Ending Dose Measurements

After a dose measurement period is complete, press and hold the Power button *for about 5 seconds*. If the speaker volume is turned up, the instrument will report SHUTTING DOWN. This will turn off the EpeèCAM and turn the pump off. This is unnecessary for continuous sampling mode operation.

EpeèCAM Log Data

The EpeèCAM 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 will erase any log files stored in the *My Documents* folder.

The log data files stored on the EpeèCAM 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*® workbook for viewing log files are included on the Bladewerx CD received with the instrument. These files have been constructed using the *Excel* Data Import feature, so that all that is required to update the charts is to select **Data-Refresh All** the data with current log files. Instructions are provided on the *Instructions* tab in the workbook.

Retrieving the Log Files

Using a USB Flash Drive

With the supplied USB to micro-USB adapter cable, plug a USB flash drive into the EpeèCAM while it's running. It will report **COPYING LOG FILES** and begin downloading all the log and spectrum files to the flash drive automatically. Depending on the size of the log files, this will take 20 seconds or more. When the EpeèCAM reports **COPY COMPLETE**, it is safe to remove the flash drive. There is now a copy of the files on both the USB flash drive and the EpeèCAM. The folder containing the log files on the USB thumb drive will be named after EpeèCAM 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 EpeèCAM to a PC for data transfer—you only need to bring a USB flash drive to the EpeèCAM.

Using a USB Sync Cable with Windows Mobile Device Center

Plug the USB Sync cable from the computer to the micro-USB connection on the EpeèCAM. 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 EpeèCAM or to manually copy them from the device to the computer. Automatic syncing requires that the EpeèCAM files must be saved in the My Documents folder. In order to determine where on the EpeèCAM the Log files are being saved (My Documents or SD Card) see **Logging in Section 3**.

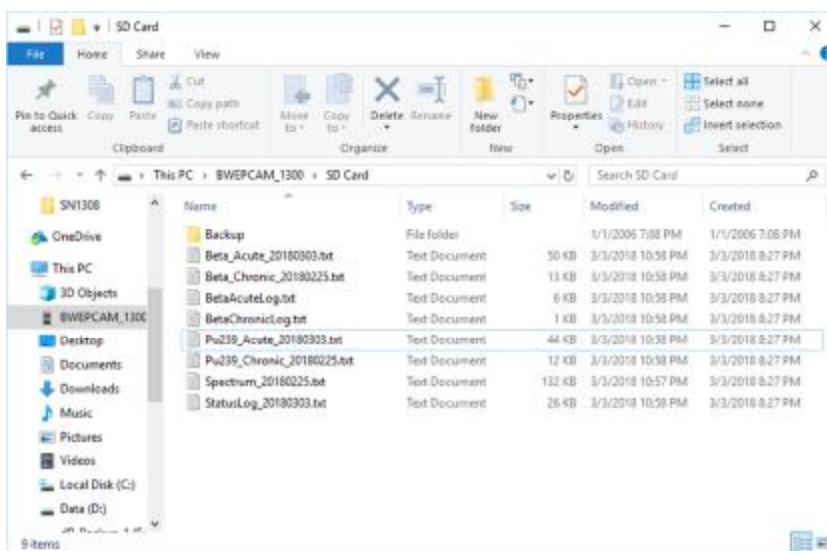
Automatic syncing is not recommended as the instrument name can be inadvertently changed by the Windows Mobile Device Center software.

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 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 EpeèCAM 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 EpeèCAM 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 EpeèCAM 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 EpeèCAM 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 EpeèCAM 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.*

BetaAcuteLog.txt—This factory-enabled text file contains information useful in troubleshooting radon background subtraction problems. It contains Acute measurement information.

BetaChronicLog.txt—This factory-enabled text file contains information useful in troubleshooting radon background subtraction problems. It contains Chronic measurement information.

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 EpeèCAM 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

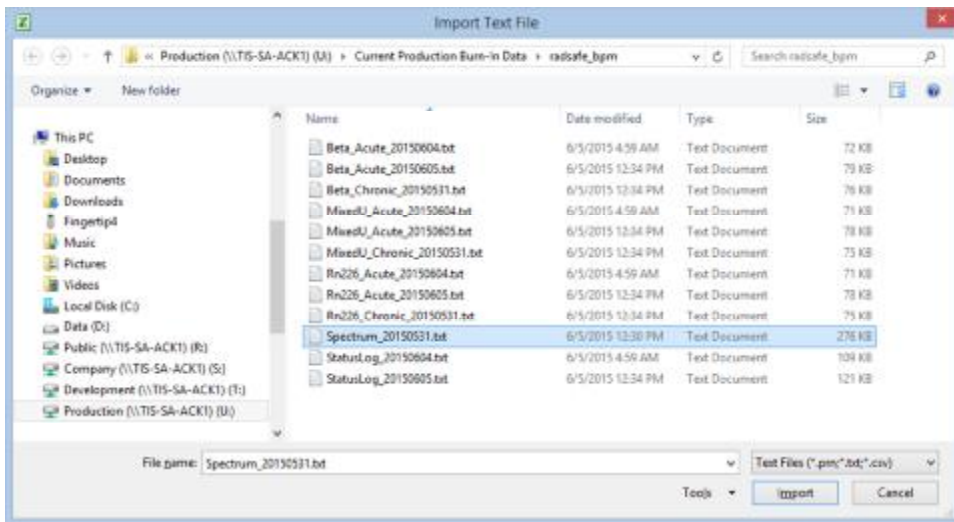
Initially, all files are saved as *.txt files, but they are in comma-delimited format and can be easily imported into *Microsoft Excel*®.

Bladewerx-Supplied Excel Charts

On the CD included with the order are two Excel files in the Burn-In Data folder: *Data Charting Template DAC 7.xlsm* and *Data Charting Template SI 4.xlsm*. The appropriate workbook (DAC for Imperial units, and SI for International units) will replay the growth of the alpha spectrum from the logged spectrum snapshots the chronic and acute dose/concentration for the beta and/or alpha logs.

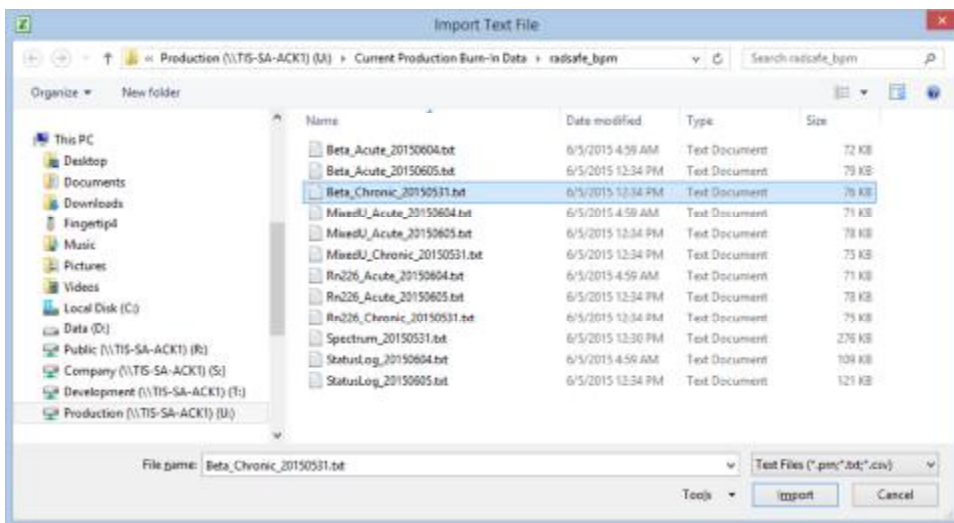
To view log data from an Epee, all that is required is to Refresh the data import and point them to the new saved log files from the instrument.

Open the workbook 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 copied from the Epee and click Open. The imported data replaces the old data on the page.

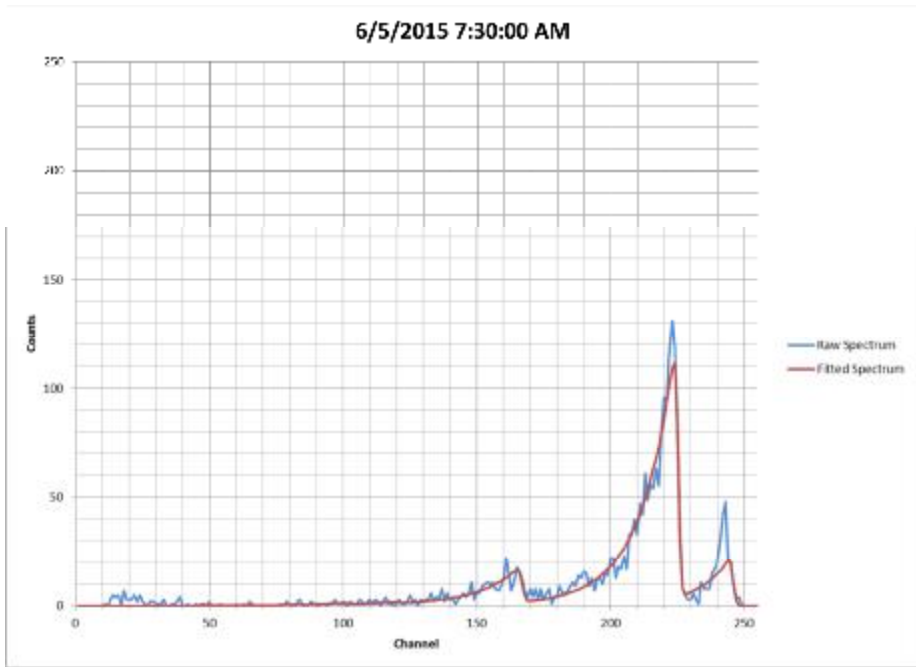


Refresh the other pages in the order they appear on the tabs: Beta Chronic Data, Beta Acute Data, Alpha Chronic Data, and Alpha Acute Data.

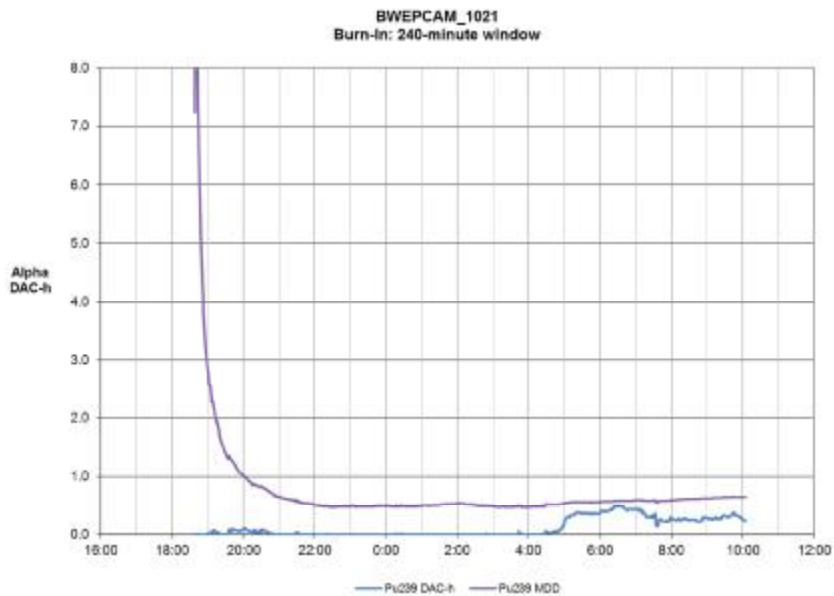
To refresh, navigate to the corresponding file and click Open, then the next file, then the next file and so forth until all data tabs have been refreshed. Each tab will be refreshed with the corresponding data from the text files. The different files can also be refreshed individually in which case the order is irrelevant.

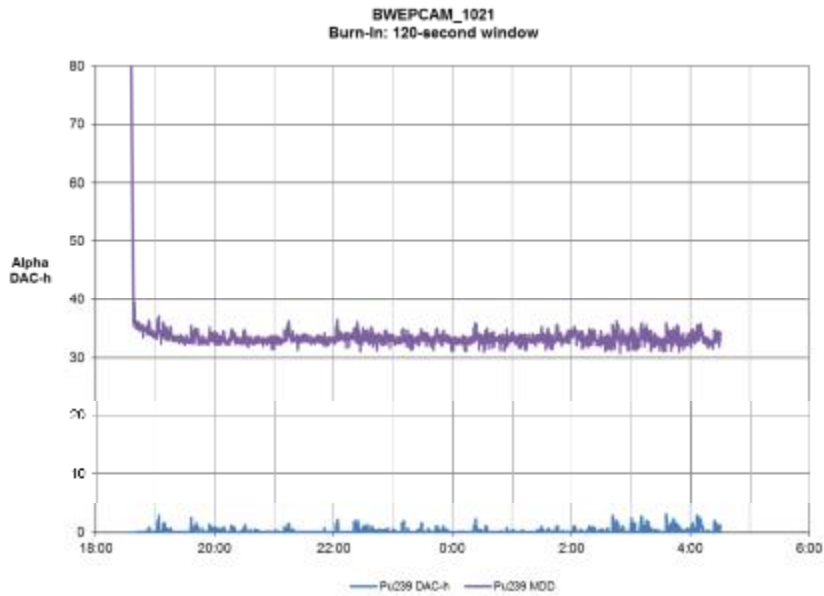


Finally, go back to the *Spectrum Chart* tab and click the **Animate** button and watch the spectrum growth on the chart.



Next, go to each of the *Chart* tabs and view the data from the monitoring session.





Creating New Excel Charts

For viewing custom types of EpeèCAM files, open a blank Excel spreadsheet and select Data—Get External Data—Import Text File. Select the saved EpeèCAM 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 EpeeCAM 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 like Pu-239 or Mixed-U.

Alpha Peak Shape Fitting

The Bladewerx EpeeBZM uses a technique called *alpha peak shape fitting* to analyze a spectrum and resolve 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.



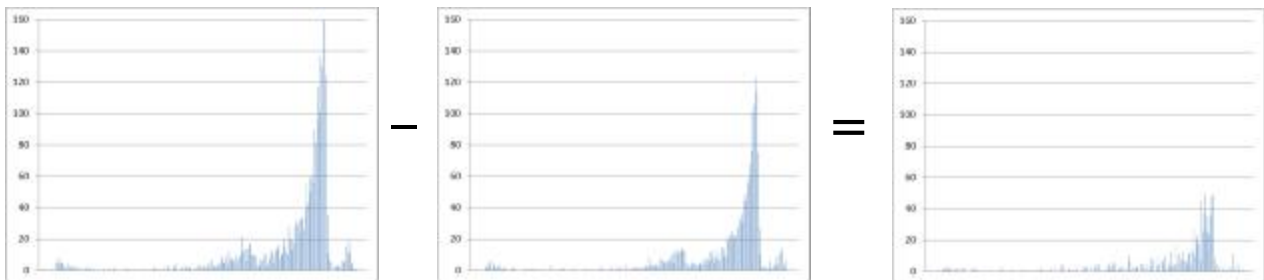
Note: The 16-bit counters limit a single channel to a maximum of 65,535 counts. When a single channel counter overflows, the EpeeBZM will automatically perform a spectrum reset and start a new spectrum.

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 equation to display the red curves which overlay the raw alpha spectrum in the displays and Excel charts. The peak fit function also yields coefficients for each isotope that correspond to the spectrum counts under that isotope peak, the peak channel number, a 'full-width-half-max' coefficient, and a tailing amplitude coefficient.

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 spectrums—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 EpeèCAM 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. Because the EpeèCAM is typically used to continuously monitor the air in a facility, the concept of worker dose is dependent upon the portion of time the worker spends in the facility in comparison to the time the EpeèCAM filter has been accumulating activity. For instance, if an EpeèCAM has been sampling air at 6 LPM for 40 hours, and the Pu-239 dose is reading 12.5 DAC-h, the worker dose is not 12.5 DAC-h, but is dependent on how much of the 40 hours the worker spent inside the room being monitored. The determination of worker dose must be accomplished administratively by noting the dose readings when the worker enters and leaves the area and calculating the increase in dose.

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 seconds^t

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 change in 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* 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, $I = \frac{\ln(2)}{T_{1/2}}$ 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.

The concentration equation used for the *Chronic* calculation uses one half the Chronic Window to allow a faster response on startup when the actual window time is increasing:

$$Concentration = \frac{\frac{Net_1 - Net_0}{0.5 \times T_{WA}} + Net_0 \lambda}{0.5 \times Vol_{sample} \times K_{DAC} \times Cal \times Yield \times Eff}$$

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 an 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.

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 EpeèCAM, 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.

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:

$$\sigma_{bkg} = \sqrt{\text{MAX}[p, \text{Variance}_0 - \text{Net}_0]}$$

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

The limit of detection used is derived as follows:

$$L_D = K \times \sigma_{bkg} + 1.65 \times \sqrt{\text{Net}_0}$$

The limit of quantitative determination is also:

$$L_Q = K \times \sqrt{\text{MAX}[p, \text{Net}_0]}$$

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

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

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 for Acute

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

Where,

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

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

Calculation of the Minimum Detectable Concentration for Chronic

$$MDC = \sqrt{\left[\frac{\sqrt{L_D + Var_0}}{0.5 \times T_{WA}} + \lambda \times \sqrt{Variance_0} \right]^2 + \left[\frac{Error_{VOL}}{0.5 \times Volume} \right]^2} \times \left| \frac{Concentration}{K_{DAC}} \right|$$

Where,

$Variance_0$ = Peak area variance for previous $\frac{1}{2} T_{WA}$

$Variance_1$ = Peak area variance for most recent $\frac{1}{2} T_{WA}$

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 EpeèCAM to determine individual radon progeny activities for Po-212, Po-214 and Po-218/Bi-212. Tail counts from these interferences 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
- Bi-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.

Net Beta Calculation

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

$$Beta_{Net} = Beta_{Gross} - Bkg_{Fixed} - F \times Bkg_{Radon}$$

Where, *F* is the radon subtraction factor

Radon Mode Considerations

The EpeèCAM 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

EpeèCAM units ordered with the wireless RadNet Output option come equipped with 802.11b/g-compatible wireless capability 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 EpeèCAM 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 EpeèCAM units may be linked to a single RadNet Client workstation (PC, Tablet, etc.).

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 192.168.0.50 in the address bar (if a different address has been factory-set, the IP Address will appear on Wireless Configuration Summary document on your CD and in the box the WAP came in). When connected, the log-on screen will display. Enter “Admin” as the User and leave the password blank.

Name	Admin
Password	<none>
IP Address	192.168.0.50 where multiple access points are used, number sequentially (e.g. 51, 52, 53, etc.)

Subnet mask	255.255.255.0
Network name SSID	Bladewerx
WEP Authentication Type	Open Key
WEP encryption	128 bits
WEP Passphrase	"Willcox45" or "332af3df083633478b32da1bc8"

In the event that the WAP no longer responds to the 192.168.0.50 address, reset it back to D-Link factory defaults. After two minutes, the unit may be reconfigured. Open the web browser and enter 192.168.0.50, the default IP address. At the login screen enter *admin* for the User Name and *leave the password blank*. The unit may then be set up according to the settings table above.

RadNet Client Workstation Setup

In order to communicate with the RadNet Client on your PC, the PC, EpeèCAM and wireless access point must be configured with compatible IP Addresses in the same Class-C range (e.g. 192.168.0.xxx). Choose addresses that do not conflict with any printers, PCs, routers, or other devices on your network.

If the client workstation is operating wirelessly in addition, be sure to set up the SSID to match the SSID of the WAP and use 128-bit WEP Encryption with the passphrase "Willcox45" (or the hex key 332af3df083633478b32da1bc8). Select "Infrastructure mode" or "Access Points Only."

Note: Be sure that UDP Port 16367 is not blocked by the network firewall.

EpeèCAM Configuration

EpeèCAM 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 EpeèCAM. 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 EpeèCAM is shipped configured as follows:

Device Name	BWEPCAM_xxxx where xxxx represents the EpeèCAM serial number (BWEPCAM_1004)
Description	Bladewerx EpeèCAM
IP Address	WAP assigns IP address (DHCP)
Subnet mask	255.255.255.0
Network name SSID	Bladewerx
Connects to	Work
WEP encryption	Enabled (128-bit) <i>Open</i>
Network Authentication	Disabled
Key provided automatically	Disabled
Network Key	332a f3df 0836 3347 8b32 da1b c8 (no spaces!)

Bluetooth	Disabled
ActiveSync USB connection	Enabled

EpeèCAM WiFi Setup

Use the WiFi Utility to set up the wireless network on the EpeèCAM. To open the WiFi Utility open the Remote Display Control (installed automatically with the EpeèCAM Calibration Client) and select the lower **File** button and then select **Exit** to turn off the EpeèCAM. The EpeèCAM Desktop will display. Open the WiFi Utility from the taskbar shown below by clicking the icon and follow the subsequent steps:

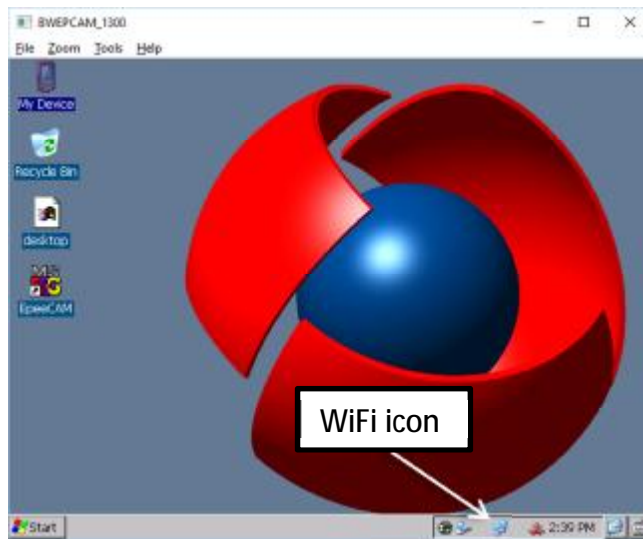


Figure 2 - First open the utility by clicking on WiFi Icon in the lower right-hand taskbar window.

The WiFi Utility has two tabs which display the current *IP Information*, and the *Wireless Information*.

If a Bladewerx Wireless Access Point (WAP) was provided with the system, the configuration may already be set up by simply plugging in power to the WAP. A wireless connection will appear on the Wireless Information tab as in Figure 4.

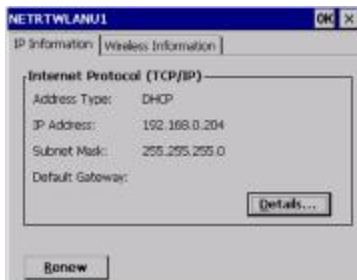


Figure 4

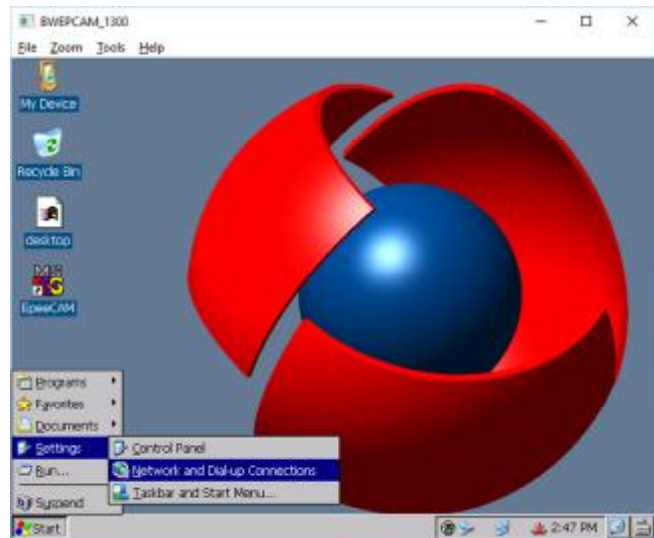
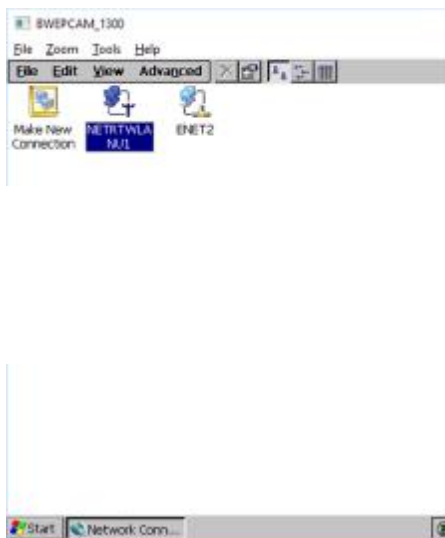


Figure 3 — Select the BWxxxxxxxx entry and click the Advanced button to set the parameters.



Define a new Network Name SSID if desired and specify new encryption and authentication settings to match the WAP settings.

If it is necessary to specify a fixed IP Address for the EpeèCAM, it can be set though the Dial-up and Network Connections dialog. Select the Start—Network and Dial-up Connections, the click the NETRTWLANU1 icon.



After configuring the EpeèCAM to the wireless network the logging data can be view by opening the RadNet Client program on the PC with a connection to the WiFi network through the WAP. Once again, to be able to view the RadNet data, the PC must have a network IP address in the same Class-C subnet as the EpeèCAM (e.g. Epee IP: 192.168.0.204 and the PC IP: 192.168.0.109).

Note: The EpeèCAM only broadcasts data once per minute so it may be up to 60 seconds before the data shows up on the client.

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 damping 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 scratch the detector surface and irreparably cause light leaks and noise counts.

EpeèCAM Status Conditions

Voice Output	Description
Initializing	EpeèCAM program starting up (momentary condition)
Starting Dose Measurement	Monitoring of Alpha and Beta activity has begun (also reported after a spectrum Reset)
Below Minimum-Detectable (no audio—LED only)	An MDC or MDD are above the user-defined alarm setpoint (clears after statistics improve). Green LED will blink.
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 leak or no filter.
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%, unit automatically shuts off
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. EpeèCAM is due for calibration.
Missing Configuration File	Configuration file is corrupted or missing.
Clock not set	Occurs before EpeèCAM 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

- § 30 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 optional Beta.
- § Acute (fast response) and Chronic (high sensitivity) dose determinations
- § Processor: *Windows CE 6.0*-based, NXP Vybrid processor

Physical

- § Battery powered: 8.4 V Lithium-Ion, 4.1Ah (10 - 16 hr. run-time)
- § EpeèCAM 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 caused MCA Failures?

MCA communications failures are usually caused by excessive count rates. This can be caused by lowering the beta threshold into the noise or raising the beta gain, or by very high activity sources. The maximum combined alpha and beta count rate is approximately 200,000 CPM.

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 shut the instrument down by pressing and holding the power button. Press it again to turn the unit back ON and restart measurement functions with a new spectrum.

After restarting the instrument, 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 EpeèCAM is using incomplete spectrum accumulations to calculate the dose and concentration and has elevated statistical fluctuations of the results.

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 EpeèCAM 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, the use of headphones or earbuds disables the integrated speaker.

What does it mean when the Normal light is blinking?

The Normal light blinks until sufficient count time has elapsed that one or more of the minimum-detectable levels (i.e. Acute MDD, Chronic MDC and MDD) are below a user-set alarms level. The instrument can still alarm during this time but only if the dose or concentration level is above the minimum detectable level.

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

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

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