LEARNING OBJECTIVES:

2.18.01 Identify the factors that affect the operator's selection of a portable air sampler/filter.

2.18.02 Identify the physical and operating characteristics and the limitation(s) of high volume (> 2 cfm) portable air samplers.

2.18.03 Identify the physical and operating characteristics and the limitation(s) of low volume (≤ 2 cfm) air pumps/samplers.

2.18.04 Identify the steps for a preoperational check of a portable air sampler.

2.18.05 Describe the physical and operational characteristics and the limitation(s) of beta-gamma continuous air monitors (CAMs).

2.18.06 Describe the physical and operational characteristics and the limitation(s) of alpha continuous air monitors (CAMs).

2.18.07 Describe the routine CAM operational checks

INTRODUCTION

This lesson covers air sampling equipment in relation to types used, operational and physical characteristics, limitations, and methods of sampling. The RCT uses this information to identify and assess the hazards presented by airborne contamination and establish protective requirements for work performed in airborne contamination areas.

SELECTION FACTORS

| 2.18.01 | Identify the factors that affect the operator's selection of a portable air sampler/filter. |

The factors affecting the selection of portable air samplers/filters are:

- Type of radiation emitted by airborne contaminant in question
- Physical state of airborne contaminant (including dust loading potential)
- Type and duration of job being performed.
• Collection time and counting equipment available
• Availability of electrical power
• Physical space available for the sampler
• Required analysis

Filter Selection

The site facilities performs air monitoring for both alpha and beta emitting isotopes. Not all filters are equal in analysis for these different types of radiation. The PHMC has selected three filter types to be used in both routine workplace air monitoring and grab sampling. The CH2M Hill Company uses two filter types.

Filter Types

The types of 47 mm filters used on the site are the Versapor -3000 supported membrane, Fluoropore FS (FSLW 047 000) membrane, and the LB-5211-AO glass fiber filter. Each type has a particular reason it is used.

Versapore-3000 T (P/N 66387 only) (PHMC/CH2M Hill)

• Filters down to 3 µm (micron)
• Efficiency of 95.84 %
• 47 mm diameter
• Useful for both alpha and beta air sampling
• P/N XE20087 or 60129 should not be used due to having no smooth side
• Can be destructively or non-destructively analyzed

Fluoropore FS (FSLW 047 000) (PHMC)

• Filters down to 3 µm (micron)
• Efficiency of 99.99 %
• 47 mm diameter
• Useful for both alpha and beta air sampling
• Can only be non-destructively analyzed
LB-5211-AO Glass Fiber Filter (PHMC/CH2M Hill)

- Filters down to 0.3 µm (micron)
- Efficiency of 99.97%
- Available in 2 inch or 47 mm diameters
- Useful only for beta air sampling
- Can only be non-destructively analyzed

**Filter Application**

Filter types are designated by the facility Radiation Protection staff for each type of sample based on source term and analysis method. It is imperative that the correct filter be used for the correct application. The result could be a non-representative sample or a sample that cannot be analyzed. Environmental samples of any type only utilize the Versapor 3000 filter.

Typical Uses:

- Versapore-3000 T: All environmental samples, alpha CAMS, routine fixed head monitoring.
- Fluoropore FS: Grab samples, alpha CAMS
- LB-5211-AO: Beta CAMs

**Filter Orientation**

Proper orientation of the filter as important as the selection of the type of filter. Incorrect orientation can have not only immediate, but long lasting effects. Determining orientation of the filters can be difficult unless you use one or more of the following methods to determine the correct orientation. The use of light, feel, or divider interaction can be used to identify the correct side of the filter.

*Versapore-3000 T (P/N 66387 only)*:

With the Versapore-3000 T, the sample is to be collected on the *SMOOTH* side of the filter. This is important especially in alpha CAMs. Determining the *SMOOTH* side of the filter can be accomplished using two of the three methods below.
• **Flashlight/Light Method**

A very careful examination with direct light may give an indication of the difference in the sides of the filter by the non-collection side having a very slight shiny appearance. This is not a very reliable test method. However, shining the light across the filter will show that the rough side (non-collection) has a rough appearance as compared to the opposite side.

• **Feel Method**

With normal feeling in fingers, touch can determine the smooth side of this filter type. Placing the filter between index finger and thumb, applying moderate pressure, and attempting to move your fingers can also be a useful method. The smooth side tends to stick to the finger while the non-collection side tends to allow the thumb or index finger to move across the filter.

• **Divider Interaction**

Another method that works well with this filter type is the rubbing of the filter against the divider provided in the filter package. For the Versapore-3000 T filter, there is a difference in sound between the smooth and non-collection sides. The smooth, or collection side, makes a soft sound when rubbed against the divider. The non-collection side, or rough side, makes a much louder and more of a sand paper type sound. Also, the smooth (collection) side will offer more resistance when rubbed across the divider.

*Fluoropore FS (FSLW 047 000):*

With the Fluoropore FS, the sample is to be collected on the *SMOOTH* side of the filter. This is extremely important in alpha CAMs because the CAM will alarm if installed incorrectly. Determining the *SMOOTH* side of the filter can be accomplished using all three methods mentioned below.

• **Flashlight/Light Method**

The flashlight is of great value with the Fluoropore FS. Direct light
will show the rough (non-collection) side to have a shiny appearance. The SMOOTH or collection side changes little with the application of direct light. When the light is shone across the rough (non-collection) side of the filter, a rough, mottled appearance will be seen as compared to the smooth (collection) side.

- **Feel Method**

With normal feeling in fingers, touch can determine the smooth side or collection side of this filter type. Rubbing the filter between index and thumb, moderate pressure, can also be a useful feel method tool. The smooth side tends to stick to the finger while the non-collection side tends to allow the thumb or index finger to move across the filter.

- **Divider Interaction**

Another method that works well with this filter type is the rubbing of the filter against the divider provided in the filter package. For the Fluoropore FS filter, the smooth, or collection side, appears to stick to the divider when rubbed against the divider. The non-collection side, or rough side, offers much less resistance moving freely across the divider.

**LB-5211-AO Glass Fiber Filter**

With the LB-5211-AO, the sample is to be collected on the SMOOTH side of the filter. Determining the SMOOTH side of the filter is very easy since one side has a very fibrous, rough appearance as compared to the other

**PHYSICAL, OPERATIONAL, AND LIMITING CHARACTERISTICS**

| 2.18.02 | Identify the physical and operating characteristics, features and the limitation(s) of high volume (≥ 2 cfm) portable air samplers. |

There are many models of high volume portable air samplers used at various facilities throughout the site. Even though there are many different models used, they all operate on basically the same principles. The models described in the following section are the most common models used.
STAPLEX HIGH VOLUME AIR SAMPLER (Figure 1)

Operational characteristics

- Centrifugal force is the method used to induce air movement. Centrifugal force produces kinetic energy. Resultant velocity pressure converted to suction for moving sampled air

- Self-cooling - Inappropriate for long-term continuous sampling

- Variable orifice flow meter calibrated 0-70 cfm. Calibration sticker on side is specific for appropriate collection method. Typical flow rate(s): 7-28 cfm with filters and up to 50 cfm for annular kinetic impactor head.

Physical characteristics

- 110-V fan motor with on-off switch. Requires external power source

- 4-inch filter holder assembly with intake screen. or annular kinetic impactor head. MSA charcoal adaptor available

- Portable: 10 pounds

Figure 1 – Staplex High Volume Air Sampler
Limitations

- Inappropriate for long-term continuous sampling
- May create an airborne area due to exhaust
- Potential “crawler” while in operation due to the high torque generated by the fan
- **DO NOT** use in explosive atmospheres
- Must be calibrated for the sampling head being used
- Use of the annular kinetic impactor sampling method may have a limitation on time from collection to analysis due to particle absorption in the grease used as a collection medium. Can highly affect any alpha analysis results. Self absorption of alpha in the grease can be ~ 55% immediately after sampling. Self absorption for beta is ~ 5% immediately after sampling.

Methods of sampling

- Filtration
- Absorption, if charcoal is used
- Impaction, if annular kinetic impactor head is installed

Placement for surveys

- Avoid creating airborne activity through stirring up dust with sampler exhaust air
- Tripods available
- May be hung on chain for optimum positioning
ANNULAR KINETIC IMPACTOR HEAD (Figure 2)

- Inertial Collector-Head collects large airborne particles such as plutonium while reducing (by up to 95%) the collection of coexisting particles containing radon and thoron. Collection efficiencies: Pu$^{239} \sim 93\%$, Fission products $\sim 92\%$, Radon/Thoron $\sim 5\%$.

- Principle: Air to be sampled enters annular space at rear of sample head; makes a 180-degree turn at the collection point (greased planchet or planchet with sticky pad) and out through the sampler fan. Heavy particles cannot make the turn and are impacted onto the collection surface, while lighter particles, such as Radon daughters, make the turn and are exhausted without impacting the collection surface.

![Figure 2 - Annular Kinetic Impactor Head](image)

- Size of particles collected can be varied by adjusting slit width at the turning point and air flow velocity. The facility should be characterized so that particle size selected is appropriate.

- Physical characteristics. - Head replaces Staplex 4 inch filtration head. Lightly greased or sticky pad planchet placed on head intake.

RADECO (H809-VI - Figure 3)

*Operational characteristics*

- Equipped with a rotameter air flow indicator. A rotameter consists of a "float" which is free to move up and down and a vertical tapered tube, which is larger
at top than bottom and contains the float. Air flows up the tube causing float to rise. Height to which float rises is proportional to air flow rate.

**Figure 3 - H809-VI**

- Many different types of floats are found at facilities however, rotameters are conventionally read at the point of maximum diameter, unless otherwise indicated. If in doubt about how to read a particular rotameter, check with supervision.

- Flow rate adjustable from 1 to 8 cfm

- 110-125 Volt Alternating Current, approximately 8 amps.

- Can be used with hose extension for remote sampling.

*Physical characteristics*

- Equipped with a two-stage turbine blower and one horsepower self-cooling universal type motor

- Sample head uses 2 in. or 47 mm particulate and/or silver zeolite (Iodine) filters

- Instrument panel has a three-position switch - (HIGH/OFF/VARIABLE), a control knob for FLOW ADJUST, a fuse holder, and a rotameter

- Weight: 10 lbs
Limitations

- Cannot be used in explosive atmospheres
- Inappropriate for long-term continuous sampling
- Can create airborne radioactivity if exhaust is placed too close to contaminated surface.

Methods of sampling employed

- Filtration
- Absorption, if charcoal or silver zeolite is used

RADECO (H810 – Figure 4)

Operational characteristics

- Equipped with a microprocessor controlled air flow totalizer. This allows the instrument to sample a preselected volume of air then shut itself off. Can also be operated in the total time mode, where the instrument samples for a preselected time then shuts itself off.

- Flow rate is set at calibration, but ranges 8-12 cfm. Displayed on screen during operation.

- 95-135 Volt Alternating Current

- Will sample up to 99999 ft³ or 99999 liters
Display will indicate cumulative volume, flow rate, and elapsed time during operation of the unit.

Can be used with hose extension for remote sampling.

*Physical characteristics*

- Equipped with a two-stage turbine blower and one horsepower self-cooling universal type motor
- Sample head uses 2 in. or 47 mm particulate and/or silver zeolite (iodine) filters
- Instrument panel has a start, stop, units, set, enter, clear, and numeric keys to allow the user to operate the instrument.
- Weight: 8.5 lbs

*Limitations*

- Cannot be used in explosive atmospheres
- Inappropriate for long-term continuous sampling
Methods of sampling employed

- Filtration
- Absorption, if charcoal (Tritium) or silver zeolite (Iodine) is used

HI-Q Environmental (CF-900)

Operational characteristics

- Equipped with a rotameter air flow indicator. A rotameter consists of a "float" which is free to move up and down and a vertical tapered tube, which is larger at top than bottom and contains the float. Air flows up the tube causing float to rise. Height to which float rises is proportional to air flow rate
- Many different types of floats are found at facilities however, rotameters are conventionally read at the point of maximum diameter, unless otherwise indicated. If in doubt about how to read a particular rotameter, check with supervision.
- Flow rate adjustable from 1 to 5 cfm
- 110-125 Volt Alternating Current
- Can be used with hose extension for remote sampling.

Physical characteristics

- Equipped with a two-stage turbine blower and one horsepower self-cooling universal type motor
- Sample head uses 2 in. or 47 mm particulate and/or silver zeolite (Iodine) filters
- Instrument panel has a on/off switch, a control knob for FLOW ADJUST, a fuse holder, timer (some models), and a rotameter
- Weight: 9.5 lbs

Limitations

- Cannot be used in explosive atmospheres
Inappropriate for long-term continuous sampling

Methods of sampling employed

- Filtration
- Absorption, if charcoal (Tritium) or silver zeolite (Iodine) is used.

LOW VOLUME AIR PUMPS/SAMPLERS

Types of Low Volume Pumps/Samplers:

- Hi-Q Environmental
- Eberline

These units normally used to sample for extended periods of time at low flow rates.

Operational characteristics of typical low volume air pumps

- Flow rate maintained relatively constant by regulator.
- Requires 110 V power supply.

Physical characteristics of typical low volume air samplers/pumps

- Sample heads used designed to accept either 2 inch or 47 mm diameter media for particulates, iodine, or tritium; depending on sampling head.
- Common components are the carbon vane vacuum pump, the constant flow air regulator, and a flow meter. May also have a timer to track elapsed time of sample.
- Grounded three wire power cord is provided.
Limitations of typical low volume air samplers/pumps

- Pumps subject to seizing as the carbon vanes wear and heating during use. May require several attempts to restart pump.
- Flow meter needs to be placed as close as practical to the sampling head to minimize errors in measurement.

EBERLINE RAS-1 (Figure 5)

Typical features

- Operational characteristics - Rotameter type flow meter with a flow rate range 0.5 to 3.5 cfm and power requirement of ~5 amps. Utilizes a bypass type regulator that is adjusted by varying the amount of air that bypasses the filter train where.

- Physical characteristics - 'Screw in' type particulate filter holder, a 'Clamshell' type iodine filter holder, a ON/OFF power switch, and weight is 35 lb

Sampling Considerations

- Filter paper must cover intake screen.
- Charcoal/silver zeolite cartridge holder must have good seal.
- Check flow rate after turning on and before turning off.
Reading a rotameter

- Rotameter consists of a "float" which is free to move up and down, and a vertical tapered tube, which is larger at top than bottom and contains the float.

- It operates using air pressure. Air flows up the tube, causing the float to rise. Height to which float rises is proportional to air flow rate.

- Rotameters are conventionally read at the point of maximum diameter, unless otherwise indicated.

Typical features – Hi-Q Environmental Low Volume Sampling Systems

- Operational characteristics - Rotameter type flow meter with a flow rate range 1 to 5 cfm and power requirement 5 amps. Utilizes a diaphragm regulator that is adjusted by varying the amount spring pressure on the diaphragm.

- Physical characteristics – quick disconnect type particulate filter holder, a ON/OFF power switch, timer, variable height adjustment, and weighs 45 lb. All contained on a cart for easy movement.

Sampling Considerations

- Filter paper must cover intake screen.

- Check flow rate after turning on and before turning off.
Reading a rotameter

- Rotameter consists of a "float" which is free to move up and down, and a vertical tapered tube, which is larger at top than bottom and contains the float.

- It operates using air pressure. Air flows up the tube, causing the float to rise. Height to which float rises is proportional to air flow rate.

- Rotameters are conventionally read at the point of maximum diameter, unless otherwise indicated.

PRE-OPERATIONAL CHECKOUT OF PORTABLE AIR SAMPLERS

2.18.04 List the steps for a pre-operational checkout of a portable air sampler.

1. Verify the air sampler has a current Calibration Sticker and ensure using the correct filter for the application as per facility directives.

2. Physical Damage
   - Power cord in good condition
   - All o-rings in place and not cracked
2.18 - AIR SAMPLING EQUIPMENT

3. Working Condition

- No missing, physically broken controls or cracked flowmeter.
- Verify operating properly by checking for sound (no unusual noises), sight (no smoke, no excessive sparking from motor brushes), smell (no burning), and feel (no unusual vibration, not overly hot to touch).
- Appropriate air flow
- Controls on sampler are operable
- Ensure filters and/or cartridges are selected based on type(s) of radiation expected and analysis method.
- Ensure filters and/or cartridges are loaded in proper orientation to air-flow prior to sampling.

BETA-GAMMA CONSTANT AIR MONITORS (CAMs)

GENERAL

The continuous air monitor (CAM) is used to monitor the air in a room or system continuously and provide indication and warning of a high airborne condition. Several different models of CAMs are used on the Hanford site and a few of the more common models are described below.

Eberline AMS-3 SERIES (Figure 8)

The Eberline AMS-3 family of Continuous Air Monitors (CAMs) are instruments designed to detect and measure airborne particulate concentrations of beta-emitting radionuclides in the presence of ambient gamma fields and Radon/Thoron daughter product’s alpha emissions. The CAM utilizes both physical shielding and electronic subtraction to compensate the beta counting data for external gamma fields. A 2 inches of lead shields the instrument's aerosol filter and adjacent pancake GM detector from background gamma fields. A second pancake GM, also located within the
shielded containment, electronically compensates for residual gamma fields penetrating the lead shielding material.

**PHYSICAL DESCRIPTION**

Three functionally similar models of the Eberline AMS-3 Beta CAM are present on site: AMS-3, AMS-3A, and AMS-3A-1. These are similar in size and weigh either 117 or 160 lbs, depending on shielding arrangement. Due to the large weight, never try to move one of these units on your own and use proper lifting techniques. Many injuries have been received over the years due to improper movement of these CAMS.

![Figure 8 - Eberline AMS-3 SERIES](image)

**Detector**

Uses 2 Geiger-Muller (GM) “Thin Window” pancake tubes contained within a 2” thick lead detector chamber. Uses a mica window - does not react with fill gas

Responds to Alpha. Beta, Gamma, and X-ray radiation with minimum energies of:

- Alpha > 3 MeV
- Beta > 40 KeV
- Gamma/X-ray > 6 KeV

**AMS-3A Continuous Air Monitor**

Each detector has an active surface area of 15.5 cm² (2.4 in²)
One detector monitors activity on a 47 mm or 2” collection filter and the other monitors gamma background inside the lead detector chamber which is used for gamma background subtraction.

### Alarm Components

The AMS-3 family of continuous air monitors contain alarm indication as follows:

1) Rotating Red Beacon
2) Red alarm light
3) Bell

### Chart Recorder/Meter

The CAM contains a combination meter/strip chart recorder with a range of 10 – 100K cpm.

Meter/strip chart uses a logarithmic scale. Be aware that the Rustrac models of strip chart recorders read differently than Simpson models. Rustrac reads for example “1000”, the next line is 2000, then 4000 and so on. The Simpson reads 1000, 2000, 3000 and so on. Each vertical division on a Simpson strip chart represents ~ 30 minutes, where each vertical division on a Rustrac represents ~ 15 minutes.

The CAM indication is calibrated to the strip chart and not the meter. Therefore, alarm setpoints and indications should be taken off the strip chart not the meter. If the unit has no strip chart, then all indications and setpoints should be based on the meter reading.

### Pump

Typically uses standard CAM pump similar to the low volume samplers mentioned in the previous sections. These units can be installed with a building vacuum system instead of single, stand alone pump.

### Flowmeter

- Used to indicate flowrate of unit
- Generally, use units of “lpm”
- Calibrated as part of the annual calibration
Failure Indicator

This CAM is equipped with a failure indicator that is activated when count rate out of the detector circuit is less than 1 cpm. When this indicator is activated, the “green” counting light is extinguished. The failure indicator will clear and “green” counting light will illuminate when counts are > 1 cpmp out of the detector circuit.

RADIATION AND ENERGY RESPONSE

Beta detection efficiencies for common site contaminants (Tc$^{99}$, Cs$^{137}$, Cl$^{36}$ and Sr$^{90}$Y$^{90}$) range from 20% to 25%. Although the Beta CAMs are only slightly sensitive (<1%) to gamma rays, the instrument is operated in its “background subtraction” mode to compensate for internally (internal to the shield) and/or externally generated gamma fields not shielded by the lead detector chamber. These instruments also respond to beta emitting radon daughters collected on the filter; however the radon/thoron daughter product’s alpha emissions are discriminated against by the distance from the filter to the detector face as well as the detector window density-thickness.

INTERNAL SOURCES

These instruments have no internal radioactive sources.

OPERATING CHARACTERISTICS

Placing an AMS Beta CAM in service requires local access to 120 VAC power and vacuum source utilities.

Prior to using an AMS-3 family CAM (upon receipt from calibration), perform a receipt test to verify CAM operation and to establish instrument response to check sources. In use, AMS-3 CAMs undergo a combination of daily, weekly and monthly performance tests. The radiological control organization has generated specific instructions for conducting these performance tests and for establishing appropriate CAM operating.

SETTING ALARM SET POINTS

The AMS-3 family of CAMs; possesses 3 alarm related controls all located below the CAM's count rate meter.

- A “PUSH-TO-SET” button that displays the alarm set point on the CAM's count rate meter display.
• A “SET” control that adjusts the alarm to any point in the instrument's counting rate range. In some facilities, the SET button is recessed to prevent inadvertent adjustment. In these cases, a simple tool is required to adjust the alarm set point.

• An “ACKNOWLEDGE” switch that resets the audible alarm while leaving the visual relay alarm actuated. The visual alarm will remain actuated until the count rate drops below the alarm set point.

The following sequence is used to set the alarm set point:

• Depress the “PUSH-TO-SET” switch to indicate current alarm set point.

• While holding in the “PUSH-TO-SET” switch, adjust the alarm setting to the desired value with the “SET” control. Turning this control will change the alarm set point regardless of the position of the “PUSH-TO-SET” button.

• Release the “PUSH-TO-SET” switch.

LIMITATIONS

The design temperature range of the Eberline AMS-3 family of Beta CAMs is -7°C to 49°C (20°F to 120°F). These instruments are operated at the same pressure at which they are calibrated. As such, these CAMs may be used at atmospheric pressure but should not be used with an operating vacuum or pressure vessel. As for RFI interference, portable and mobile communication transceivers may create instrument response if brought into close proximity to an operational Beta CAM

EBERLINE AMS-4 SERIES (Figure 9)

The Eberline AMS-4 family of CAMs is used to continuously monitor beta emitting isotopes in the air. It is microprocessor controlled and is currently the replacement for the AMS-3 family of CAMs as they require replacement.

PHYSICAL DESCRIPTION

Detector Module

The AMS-4 is equipped with a Radial Inlet Sampling Head or in-line head, which has
enclosed in it, two beta detectors. The sampling head has a swing out door, which holds the filter paper.

There are two identical detectors, which are sealed gas-proportional type. The gas used is Argon-CO₂ in the radial entry head or Neon-CO₂ for the in-line head. The detector located in the swing door is used for counting beta particulate on the filter paper, and the other detector counts background gamma radiation for subtraction purposes.

Can be used with detector to processor cable lengths of up to 1000 feet.

Central Processor

The main processing unit is the brain of the system, which monitors all inputs and controls all outputs. Three serial ports support communications with the sampling head, printer, and host computer. The main processing unit provides operator/user interfaces with a keyboard, display, and status lights.

Pump

The unit is designed to work with either a standard, oil-less, carbon vane vacuum pump or an integral vacuum pump that can be purchased as an option for the AMS-4. The pumps are powered by standard 115 VAC, 60 Hz power. The AMS-4 unit contains a installed outlet for powering the pump. A switch located on the rear of the unit controls this outlet.

Physical Dimensions/Weights

16.4” W X 12.8” H X 7.3” D, Weighs 13.3 pounds

Sample Heads

The In-line is used for stack or duct monitoring. The detector window made of mica with an effective detector diameter of 1.75” and a window density-thickness of 2-3 mg/cm².
Instrument specifications and limitations

There are limitations and certain parameters that the AMS-4 beta CAM must operate in. Most of the following was determined by PNNL during acceptance testing.

**Temperature Range**

40°C (104°F) to 0°C (32°F) temperature range. These units were designed for indoor use.

**Temperature Shock**

Beta CAMs are typically operated indoors and not exposed to temperature shocks. However, it is good practice to allow an instrument’s temperature to equalize with the ambient temperature (~ 1 hour) before placing it in service.
Humidity & Pressure
AMS-4 CAMs were tested to and met the humidity (40% -95%) standard but were only partially compliant with regard to the pressure [500-800 torr (66-107 kPa)] requirements. These CAMs may be used at atmospheric pressure but should not be used within an operating vacuum or pressure vessel.

Electromagnetic Interference
None observed during testing

Radio Frequency Interference
The effects of RFI induced interference upon β-CAM performance was tested against the ANSI N42.17B standard by PNNL. The results were found to be acceptable at 60 Hz but failed over radio-frequency ranges: 0.3 -35 MHZ and 140 MHZ.

Consequently, portable and mobile communication transceivers may create instrument response problems if brought into close proximity to an operational β-CAM. Cell phones and radios use should be minimized in close proximity of these units.

Response interference would also be expected from any electrical spark source, such as welding, in the immediate vicinity of the AMS-4 family of β-CAMs.

Energy & Types of Radiation

The AMS-4 beta CAM responds to alpha, beta, and gamma radiations.
- Beta emitters with energies above 100 keV (e.g., $^{14}$C with $\beta_{\text{max}}=0.156$ MeV) Beta response is energy dependent, increasing with energy. On the low end, $^{99}$Tc measures $\sim 9\%$ efficient. On the high-end, $^{90}$Sr/Y ($E_{\text{max}} = 2.28$ MeV) measures $\sim 18\%$ efficient.
- Alpha emitters with energy above about 3 MeV (e.g., uranium, $^{230}$Th).
- A guard detector compensates for ambient gamma response and electronic discriminators segregate alpha from beta radiation based on energy. Although the detector is sensitive to alpha, beta, and gamma, the instrument is monitoring beta radiation for the user.
Interfering Radiation

- **Gamma**: The electronic shielding circuit, under normal conditions, compensates for this response.
- **Neutron**: The AMS-4 CAMs do not respond to neutron radiation.
- **Alpha**: Electronic discriminators establish an alpha window at higher energy and separate from the beta window. For monitoring purposes, the AMS-4 reads the beta window exclusively.

**OPERATING CHARACTERISTICS**

The time dependent activity collected on the sample filter, after compensating for the presence of radon progeny and gamma-fields, is used with integrated mass flow rate data to derive running averages of the airborne concentration of beta-emitting isotopes. This concentration or other data is compared against alarm values.

The AMS-4 main processing unit provides a 2-line x 20-character dot matrix vacuum fluorescent display, which displays nine different pages of information that can be viewed while the unit is in the normal operational mode. Pressing the up or down arrow keys scrolls through the different display pages. The display pages may also be displayed by selecting the button for the page to be viewed. A Menu button provides access to the test mode menu, and the red “Alarm Ack.” button acknowledges alarms to silence the high frequency tone on both the main unit and the remote in-line head. The high alarm visual indicators remain active until the alarm condition clears.

A green “Ready” light and an amber “Malfunction” light helps provide quick status indication, if the unit is operating correctly. The green [Ready] light indicates alarm checking is enabled.

The amber [Malfunction] light indicates sample flow is either too high or too low, beta count rate too high or too low.

A bar graph on the main unit displays the percentage of the Slow Alarm Concentration setpoint. For example if the setpoint is 2.0E-12 uCi/cm³ and the display reads 50%, the Slow Alarm Concentration value is 1.0E-12 uCi/cm³.

The RED Strobe and an audible high
The CAM utilizes a sealed gas proportional detector and a dual-channel analyzer to electronically distinguish between alpha and beta events, thereby allowing compensation for naturally occurring activities.

Eberline’s AMS-4 detector is sensitive to both α and β/γ radiation. However, the AMS-4 only utilizes its alpha-sensitivity to compensate for the presence of naturally occurring radon progeny. Typical beta-detection efficiencies for common Site contaminants range from 9% for 99Tc to 18% for 90Sr (90Y).

Although the AMS-4 CAMs are only slightly sensitive to gamma-radiation, a second detector is used to compensate instrument response for ambient gamma-fields.
ACTIVITY ALARMS

The AMS-4 CAMs are configured with 5 user-modifiable activity alarm set points. When the alarm is posted the local and remote horns will sound until the appropriate alarm acknowledge button is pressed. The alarm acknowledge key on the base unit will silence the local and remote horn; the alarm acknowledge switch on the sampling head will silence only the remote horn. Additionally, when an alarm occurs a change of status is logged into the history file, the alarm relay will actuate (if equipped), and both the local strobe and the alarm light on the sampling head will turn on. The strobe, remote alarm light, and alarm relay will continue to be active until the alarm condition ceases.

The name and purpose of each of these alarms are summarized below:

**Slow Alarm**

A slow alarm will be posted if the current interval of slow alarm concentration history exceeds the concentration of the previous history interval by the value specified by the slow alarm setpoint. This condition is checked every minute. The Slow Alarm is disabled if the alarm setpoint is 0.

**Fast Alarm**

An alarm will be posted if the current interval of fast alarm concentration history exceeds the concentration of the previous history interval by the value specified by the fast alarm setpoint. This condition is checked every 5 seconds. The Fast Alarm is disabled if the alarm setpoint is 0.

**Net Alarm**

Beta Net Count Rate Alarm Setpoint determines the beta net count rate at which an alarm will occur. An alarm will be posted if the current beta net count rate exceeds the net alarm setpoint. This condition is checked every 5 seconds. The Net Alarm is disabled if the alarm setpoint is 0.

**Stack Alarm**

An alarm will be posted if the current release rate is equal to or greater than the alarm setpoint. This condition is checked every minute. The Stack Alarm is disabled if the alarm setpoint is 0.
DAC-Hour Alarm

An alarm will be posted if the current total DAC hour reading is equal to or greater than the alarm setpoint. The DAC hour total is updated then compared to the DAC hour Alarm Setpoint every minute. The DAC Hour Alarm is disabled if the alarm setpoint is 0.

FAILURE ALARMS

The following are various types of internal checks, which are performed to determine a system failure condition. If one or more of the following Fail Parameters is out of limits, the AMS-4 will suspend history logging, store the change of status condition(s) in the history buffer, illuminate the front panel Malfunction light, and actuate the Fail relay (if equipped).

History logging will continue after all Fail Parameters are within limits. At this time the Malfunction light will turn off, the Fail relay will de-activate, and normal operation will resume.

Min Flow Rate

This is the flow rate value at which a flow rate failure is determined. A measured flow rate that is less than this value, defaulted at 0.3 ft³/min, will cause a Malfunction condition.

Max Flow Rate

This is the flow rate value at which a maximum flow rate failure is determined. Valid settings range between 0.3 to 4 ft³/min or the equivalent in other flow units. The default setting is 4 ft³/min.

Min Beta Count Rate

The minimum beta count rate parameter determines the count rate value at which a failure is determined after each five second counting interval. A beta channel count rate less than this value will cause a Malfunction condition. The minimum setting for minimum beta count rate is 0 CPM. Setting the value to 0 will disable checking of this error. The default value is 0.
Max Beta Count Rate

The maximum beta count rate parameter determines the count rate value at which a failure is determined. A beta channel count rate greater than this value will cause a malfunction condition. The default value is 600,000 CPM.

BETA CAM APPLICATIONS

Beta CAMs are continuous air monitors designed to selectively detect airborne concentrations of beta emitters in the presence of ambient gamma fields. These instruments provide both visual and audible alarms if airborne particulate concentrations of beta emitters exceed a predetermined, user selectable value (DAC-hr equivalent alarm set point).

CAM usage is required (10 CFR 835, 835.403[2]) in normally occupied areas where an individual is likely to be exposed to a concentration of airborne radioactivity exceeding one DAC or where there is a need to alert potentially exposed individuals to unexpected increases in airborne radioactivity levels. See HNF-13536, 5.2.1(FH), Workplace Air Monitoring, for further guidance on when to employ CAMs in the workplace.

ALPHA CONTINUOUS AIR MONITORS (CAMs)

2.18.06 Describe the physical and operational characteristics and the limitation(s) of alpha continuous air monitors (CAMs).

Eberline Alpha-4/5/5A Family

The Eberline Alpha Air Monitor Models 4, 5, 5A, and 5AS are semi-portable devices designed to monitor alpha radioactivity in the air. These alpha CAMs are only capable of monitoring alpha emitting airborne particulates.

PHYSICAL DESCRIPTION

Alpha CAMs use a 25 mm diameter, solid state diffused junction (semi-conductor) detector to monitor activity collected on a 47 mm diameter filter paper. The maximum sensitivity under laboratory conditions is approximately 4 DAC-hrs for Pu-239. Typical operating alarm levels range from 24-40 DAC-hours under field conditions.
2.18 - AIR SAMPLING EQUIPMENT

Figure 11 - Eberline Alpha Air Monitor model 5

Alpha CAMs measure approximately 27 cm high x 38 cm wide x 32 cm deep (11” x 15” x 13”) and weigh approximately 6.6 kg (15 lb). Alpha CAMs require 120/220 VAC 50/60 Hz, 0.5 amp power.

DISPLAYS AND ALARM INDICATORS

CAMs provide a visual indication of the measured count rate resulting from activity collected on the filter paper. This indication may be a meter or a chart recorder. Strip chart recorders provide a visual indication of the CAM's count rate as well as a historical record that may be used in evaluating CAM alarms, including estimating DAC-hr exposure. The CAM indication is calibrated to the strip chart and not the meter. Therefore, alarm setpoints and indications should be taken off the strip chart not the meter. If the unit has no strip chart, then all indications and setpoints should be based on the meter reading.

The range of the meter/strip chart recorder is 1 – 10K cpm. Meter uses logarithmic scale with units of cpm. Each vertical division on a Simpson strip chart represents ~ 30 minutes.

CAMs provide alarm signals to indicate elevated levels of alpha-emitting airborne radioactivity. Workplace CAMs typically have a visual beacon and an audible alarm bell. Radiation alarms are typically non-latching (i.e., the alarm indication will clear when the count rate decreases below the alarm set point).
Failure Indicator

This CAM is equipped with a failure indicator that is activated when count rate out of the detector circuit is less than 1 cpm. When this indicator is activated, the “green” counting light is extinguished. The failure indicator will clear and “green” counting light will illuminate when counts are > 1 cpm out of the detector circuit. Loss of signal (i.e., counts) may indicate a failed detector.

FLOW METER INDICATOR

- Used to indicate flowrate of unit
- Generally, use units of “lpm”
- Calibrated as part of the annual calibration

RADIATION AND ENERGY RESPONSE

Alpha CAMs respond to alpha radiation (exclusively) because of the type of detector used and the pulse height discriminator. The instruments will not respond to neutron or beta radiation.

Alpha CAMs also respond to naturally occurring alpha-emitting airborne particulate such as radon and thoron progeny. Pulse height discrimination is used to differentiate between naturally occurring alpha-emitting activity and nuclides of interest (Pu-239, Am-241, or uranium).

Beta and gamma radiation is discriminated against by the very thin active area of the detector.
Fluoropore Orientation Comparison
(Raw Data)

Counts

Channel

Incorrect
Correct

0 50 100 150 200 250 300

14000
12000
10000
8000
6000
4000
2000
0

PU

ALPHA Series Spectral View

The use of the “GROSS/PHA/PHA-SUB” switch in conjunction with the “Threshold” and “Window” Controls is used to establish the single channel analyzer counting window (red lines above). The “Threshold” control sets the low end of the single channel analyzer while the “Window” setting is an amount above the threshold control that sets the top end of the analysis range.

INTERNAL SOURCES

These instruments have no internal radioactive sources. Some models may have had a commercial product (Coleman Lantern Mantel) applied to the detector to prevent failure alarms.

OPERATING CHARACTERISTICS

Placing an alpha CAM in service requires local access to 120 VAC power and vacuum-source utilities.
CAM CONTROLS

Alpha 4, 5, 5A and 5AS CAMs have the following external controls and indicators which are used during operation:

Push-to-Set When pressed, the alarm set point is displayed on the meter or strip chart recorder.

Set The “SET” button is used in conjunction with the “PUSH-TO-SET” button to adjust the alarm set point.

Acknowledge Pressing the “ACKNOWLEDGE” button silences the audible alarm.

Power The power lamp will illuminate when the CAM is on.

Counting The counting lamp will illuminate when the CAM is in the normal operating condition. During failure alarms, the counting lamp will turn off.

GROSS: See all alphas

PHA: Puts “window” & “threshold” controls in circuit building the single channel analyzer

PHA-SUB: Uses single channel analyzer and also subtracts a set number of counts (25% of counts outside the window during calibrations) from window.

CAM ALARMS

An airborne alarm is initiated when the count rate in the window of interest exceeds the alarm set point. This alarm turns on the CAM's beacon and alarm bell. In addition, relay contacts on the rear of the CAM may initiate remote alarms. When the alarm condition clears, either by pressing the “ACKNOWLEDGE” button or when the count rate drops below the alarm set point (unless the CAM is modified for latching alarms), the alarm signals will reset. During an alarm condition, the “ACKNOWLEDGE” button on the front of the CAM will silence the audible alarm. However, the alarm beacon will remain “on” until the count rate drops below the alarm set point.
CAMs located downstream of HEPA filters may not collect enough naturally occurring activity on the filter to continuously provide detector signal. Hence, these CAMs may initiate failure alarms more often than acceptable. In these situations, low-activity sources may be attached to the CAM detector to provide a continuous low signal to prevent failure alarms. The source is a very small piece of a thorium lantern mantle. Count rates from these keep-alive sources are typically 2 to 5 counts per minute.

**SETTING ALARM SET POINTS**

Alarm Set Points are determined according to HNF-13536, 5.2.4 (FH), “Continuous Air Monitor Operation” The alarm set point is displayed on the recorder readout when the “PUSH-TO-SET” button on the front of the CAM is pressed.

- PRESS AND HOLD the PUSH-TO-SET button.
- ADJUST the SET knob until the recorder displays the desired alarm set point.
- RELEASE the PUSH-TO-SET button.

**ALPHA CAM LIMITATIONS**

The operational temperature range of Eberline's family of alpha CAMs is -7°C (19°F) to 54°C (129°F). Ambient pressure does not greatly vary (~3%) across the Hanford site and therefore is not considered to effect CAM performance. The Alpha 4, 5, 5A, and 5AS CAMs are not responsive to gamma emissions or neutron or beta radiation. The Alpha CAMs are sensitive to visible light. Light leaks will generate spurious counts within the spectrum.

CAM usage is required (10CFR835, 835.403[2]) in normally occupied areas where an individual is likely to be exposed to a concentration of airborne radioactivity exceeding one DAC or where there is a need to alert potentially exposed individuals to unexpected increases in airborne radioactivity levels.

**CANBERRA ALPHA SENTRY (Figure 12 and 13)**

The Canberra Alpha Sentry continuous air monitor (CAM) is a semi-portable device designed to monitor alpha radioactivity in the air. The Fluoropore membrane filter, manufactured by Millipore, is recommended. Glass fiber filters are discouraged because of self-absorption characteristics that can cause false alarms.
PHYSICAL DESCRIPTION

The Alpha sentry CAM consists of two components, a sampling head and controller. Two different sampling heads are used at Hanford, the AS1700 and AS1700R. Both use a 1700 mm² Canberra passivated implanted planar silicon (PIPS) (semi-conductor) detector with a diameter of 4.7 cm (1.8 in.). The AS1700R is an ANSI N42.17B complaint version of the AS1700. From the outside, the two models are indistinguishable. Up to eight sampling heads can be controlled from a single controlling unit (e.g., model ASM1000). An in-line adapter is available for the sampling head to allow direct connection to a pipe or duct.

Sampling Head

The Alpha Sentry sampling head measures approximately 31 cm (12 in.) high and 18 cm (7 in.) in diameter. The head weighs approximately 3.6 kg (8 lb). The head requires 24 VAC, 50/60 Hz, and <15 W power, supplied by the ASM. The ASM measures roughly 32 cm (13 in.) high by 22 cm (8.7 in) wide by 9 cm (3.5 in.) deep. The ASM requires 115 +10 VAC, or 230 +20 VAC depending on specific model, 50/60 Hz, and <15 W supplied power. The air inlet on the sampling head is covered with a diffusion screen that removes more than 95% of the unattached radon and radon progeny. This screen is most effective in laboratory environments with treated air (e.g., down stream of a HEPA filter). The unattached fraction in typical Hanford environments is small compared to the attached radon and radon progeny.
OPERATIONAL DESCRIPTION

The Alpha Sentry uses a 256 channel multi-channel analyzer (MCA) and performs radon rejection protocols based on peak fitting/stripping methods. More detailed technical information can be obtained by contacting the Radiological Calibration Laboratory.

Both the ASM and sampling head provide alarm signals to indicate elevated levels of alpha-emitting airborne radioactivity. The alarm signals include audible and visual alarms, and actuating remote alarm relays. The instrument also provides a series of fault alarms, including high background, low or high airflow, detector bias power supply failure, door open, no data acquisition, excessive energy calibration shift, and communication failure between ASM and sampling head. Instrument alarms may be latching or non-latching, depending upon facility configuration. To clear latching alarms, press the Stop Alarm Button on the ASM. By default, if the alarm condition remains, pressing the Stop Alarm Button silences the audible alarm, leaving the visual alarm active. This feature can be disabled using Canberra’s Alpha Sentry CAM software.
Personnel interact with the CAM using the ASM. The ASM’s detailed display screen provides specific information regarding measured radioactivity for an attached head. The measured DAC-hr, activity concentration, sample flow rate, and measured counts per minute are listed. The ASM also lists active alarms. The ASM can display the energy spectrum and maintains history logs for review.

Alpha sentry CAMs are equipped with mass flow meters to measure flow rate. The unit typically reads out in cubic feet per minute (cfm); however, other flow units are available. Filter papers are placed in a filter puck assembly that is set in the filter drawer of the sampling head.

**CAM Controls**

The ASM includes many controlling features. Those features commonly used by CAM operators (e.g., health physics technicians) are discussed below. Controls are accessed by pressing a soft key (membrane) switch on the ASM.

*Stop Alarm* This red Button acknowledges posted alarms and clears latching alarms after the alarm condition has been eliminated.

*Filter Change (F1)* Press this button before changing the filter paper assembly. Two options follow, Date/Time and Filter Change. Date/Time is used to update the head’s internal date and time before changing the filter paper. Pressing Filter Change “primes” the head for changing the filter assembly.

*Perf Check (F2)* Press this button before source checking the CAM. Pressing Perf Check “primes” the head for removing the filter paper and placing the check source puck into the head.

*Data Review (F3)* Press this button to access three review options, Hist Trends (F1), Alarm Log (F2), and View Spectrum (F3). Hist Trends displays an electronic strip chart and View Spectrum displays the energy spectrum for the selected head.

*System Setup (F4)* Press this button to access a series of control features including:

- Source Info: Used to enter specific activity information for the check source
- Parameter Setup: Used to adjust alarm set point, units, and miscellaneous CAM settings.
Network Display Press this button to display the heads currently attached to an ASM. From the network display, the user selects the head they wish to access for further information.

Detailed Display Press this button to access detailed information for the selected head, including air flow rate, cpm, concentration, DAC-hr exposure, active alarms, and date of the last efficiency and airflow calibration.

Alarms (Activity & Fault)

There are four different classes of alarms (acute, chronic, instrument fault, and high background).

The Acute Alarm calculation is performed every user preset “Acute Alarm Counting Interval” (default value is 30 seconds) in the sampling head based on the counts collected during the previous Acute Alarm Counting Interval. An Acute Alarm occurs if the number of counts in the region of interest (e.g., 239Pu) exceeds the acute alarm setpoint AND the ratio of the average counts per channel in the region of interest to the average counts per channel from the region of interest to the 6.05 MeV radon progeny peak exceeds 2. By default, the acute alarm setpoint is set at the factory to 80 cpm. This value can be changed by connecting to a remote computer and using the Alpha Sentry Software program. If communication is lost between the ASM and head, the Acute Alarm remains active.

The Chronic Alarm calculation is performed by the ASM and relayed to the head. The chronic alarm has two modes, DAC and DAC-hr. A Chronic Alarm occurs when the selected setpoint has been exceeded and the region of interest has collected at least 25 counts in the current counting interval. For DAC-hr alarms, the time since the last filter change is used to determine the exposure. If communication is lost between the ASM and head, the Chronic Alarm is disabled.

The ASM also performs diagnostics, continuously verifying functionality, including communications between the ASM and attached head(s). Errors discovered during these diagnostics trigger the Fault Alarm. Alarms trigger a combination of audible and visual alarms.

The Fast Tone is an intermittent loud tone with a period of one-half second. The Slow Tone is an intermittent soft tone with a period of two seconds. Loud tones are 90 dB, soft tones 85 dB.
Radiation and Energy Response

Alpha CAMs respond to alpha radiation (exclusively). Alpha particles with energies from approximately 3 MeV to 10 Mev are measured. The Alpha Sentry CAM has an average efficiency of 29% for electroplated 241Am sources (47mm diameter). The instruments do not respond to neutron or beta radiation.

Alpha CAMs respond to naturally occurring alpha-emitting airborne particulate such as radon progeny. The Alpha Sentry CAM uses a radon rejection screen to prevent up to 95%, or more, of the unattached radon progeny from reaching the filter paper and being measured by the detector. For radon progeny collected on the filter, the CAM uses an alpha peak tail stripping algorithm to remove interfering radon progeny data from the region of interest, differentiating between naturally occurring alpha-emitting activity and radionuclides of interest (e.g., 239Pu, 241Am).

Alpha Sentry detectors are sensitive to visible light. Light leaks will generate spurious counts within the spectrum. These counts typically register across the entire spectrum. Instruments are particularly susceptible to strobe lights.

Integral Sources

These instruments have no internal radioactive sources.

Specifications and Limitations

Temperature

The operational temperature of CAM head is 0°C (32°F) to 55°C (131°F). The ASM shares the temperature range of the head. However, the LCD display may not function above 35°C (95°F).

Temperature Shock

Alpha CAMs are typically operated indoors and not exposed to temperature shocks. However, it is good practice to allow an instrument’s temperature to equalize with the ambient temperature before placing it in service.

Humidity and Pressure

The CAM head and ASM are appropriate for the ambient humidity (0 to 95%) and pressure encountered on the Hanford Site. The instrument should
not be used in condensing environments.

Electromagnetic Field Interference

The AS1700 is influenced by Electromagnetic fields. Field strengths of 20 V/m between 30 and 35 MHz will interfere with the CAM head. The AS1700R withstands fields exceeding 100 V/m within this frequency range.

The AS1700 is influenced by microwave fields. Field strengths of 50 V/m (915 MHz) and 100 V/m (2450 MHz) will interfere with the CAM head. The AS1700R withstands fields exceeding 200 V/m at both frequencies.

RFI/EMI Interference

The AS1700 is influenced by radio frequency fields. Field strengths of 5 V/m (140 MHz) will interfere with the CAM head. The AS1700R withstands fields exceeding 100 V/m at this frequency. The AS1700 is sensitive to electrostatic shock. 5000 V shocks caused the measured background to increase by more than 15x. The AS1700R was insensitive to the same electrostatic stimulus.

Energies and Types of Radiation

Alpha Sentry CAMs are sensitive to alpha radiation. The PIPS detector exhibits uniform energy response to alpha particles in the MeV range. The average efficiency for electroplated 241Am sources (47mm diameter) is 29%. The calibration determines the energy range of interest. For example, an alpha CAM calibrated for 239Pu (Analysis Window = 2.7 MeV, Upper Energy Limit = 5.7 MeV), monitors alpha radiation between 3 and 5.7 MeV as the region of interest.

Applications

The Alpha Sentry CAM is designed to selectively measure airborne concentrations of man-made alpha-emitters in the presence of natural occurring radon and their progeny. These instruments provide both visual and audible alarms, as equipped, if airborne concentrations of the isotope being monitored exceed a predetermined, user selectable value (e.g., DAC-h alarm set point). This instrument is most often applied as a workplace monitor although it may be applied to stack, duct or plenum exhaust monitoring. The manufacturer claims, under “non-laboratory conditions” (~ 1 pCi/l radon background, most attached) and a constant 1 DAC Pu concentration, a sensitivity of ~ 3.5 DAC-hr (1700 mm2 detector) or ~4 DAC-hr (450 mm2 detector).
CAM OPERATIONAL CHECKS

2.18.07 Describe the routine CAM operational checks

Response limits are established for each CAM when it is received from the calibration laboratory. A radioactive source (minimum activity of 3000 dpm) is placed in the CAM and the count rate is allowed to stabilize. The stable response and source ID are recorded and response limits are established at +/-20% of that stable response. The process may be repeated with additional sources to establish response limits for a number of sources. The initial response obtained needs to be evaluated to determine if it is reasonable. This is done by comparing the calibration efficiency with the efficiency determined using the facility source. The efficiencies should compare to within 5% of each other. Below are summary instructions for the Eberline AMS-3 and ALPHA-4/5/5A series of monitors. The other monitors in this module have instructions that are very similar.

DAILY CHECKS

Daily checks are performed and documented once each day, as a minimum. The daily check includes the following:

- Positive air flow within established tolerance, normally 48.1-65.1 lpm (1.7-2.3 cfm) for workplace air monitoring applications. Environmental monitoring applications may dictate other ranges. Some facilities using built-in vacuum systems as a vacuum source have difficulty obtaining this range and may operate in the 1 cfm range.
- CAM power is ON
- Verifying a non-zero response to background. On CAMS that are operating below indication ranges, non-zero response to background can be evaluated on the AMS-3 AND ALPHA-3/4/5/5A families of CAM by observing the failure indicator. If the failure indicator is not illuminated, then the detector is registering counts.
- Verifying chart recorder/meter operation and adequate paper supply. Since the CAM is operated to the chart paper on the CAM (if equipped), it is important to ensure the chart paper/drive is operating properly.
- Verifying that vacuum lines are secure
- Removing any debris/obstructions present on CAM. Ensures no obstructions present that could block air flow.
• Verifying that the “Counting” lights is ON
• Verifying that the “Failure” light is OFF
• Verifying that the sample plunger is fully seated. Ensures representative sample by ensuring good seal to the detector chamber.
• Verifying the CAM Calibration is current
• Verifying the CAM control settings (Alarm Set Point is appropriately set and the Background Subtraction switch is on.)

WEEKLY SOURCE CHECK

This check is performed once each week to verify that the CAM’s measured response is within response limits established for the source, upon receipt from calibration.

MONTHLY ALARM FUNCTION TEST

Once each month, every CAM in service is tested for proper alarm operation. CAM alarms are initiated by placing a radioactive source into the filter holder.

SUMMARY

This lesson covered air sampling equipment in relation to types used, operational and physical characteristics, limitations, and methods of sampling. The RCT uses this information to identify and assess the hazards presented by airborne contamination and establish protective requirements for work performed in airborne contamination areas.

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