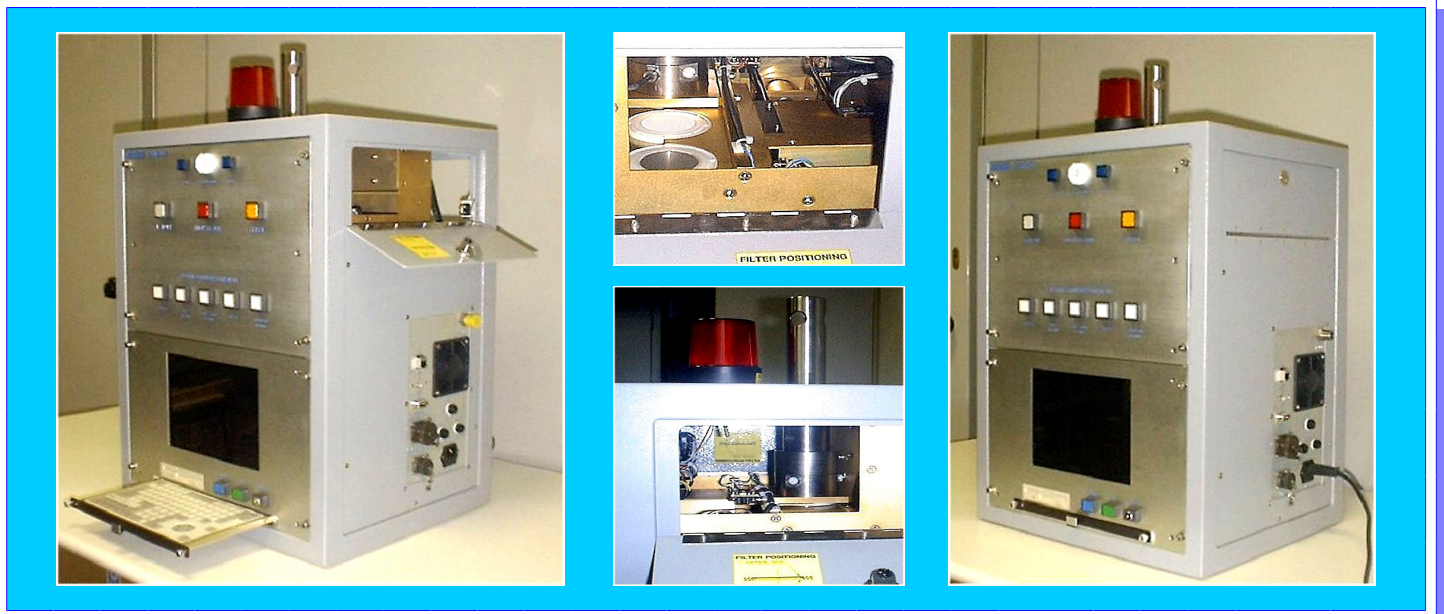


CAM-01 & CAM-03 CONTINUOUS AEROSOL MONITORS



The CAM-01 (one filter unit) and CAM-03 (three filters unit) permits the continuous monitoring of radioactive aerosols (particulates) collected on a circular filter from air, using a spectrometry technique. They perform the on-line alpha (and beta if requested) measurement from the filter using a 5-ROIs (Regions of interest) analysis to evaluate the presence of long lived alpha (Pu-239 or other user defined nuclides) and beta emitters. The result is the associated concentrations in air (in Bq/m³, or pCi/l, or DAC). Detection is carried out using a solid state detector connected to a charge preamplifier and a multi-channel analyzer board including an input amplifier/shaper. The counts are acquired by the local processor and divided into 5 ROIs. One of them is dedicated to beta emissions (and gamma background) and the other four to alpha emissions. The counts from these ROIs are then processed by a complex algorithm to identify the contributing components of alpha and beta emitters, and determine whether they are artificial or long lived and naturally (radon and thoron daughters) occurring. Up to three algorithms can be optionally running simultaneously. The CAM-01 and CAM-03 have been designed as modular instruments to allow easy maintenance for a wide range of applications. The local processor performs parameter set-up, data acquisition and processing, data readout and output functions. They are designed for wall mounting or as a free standing cabinet composed of a sampling/measuring module and a controller module, which can optionally be installed separately. The air inlet is mounted at the top of the cabinet for easy access. For process monitoring applications (i.e. duct/stack) the air inlet may be provided with accessories to enable connection to field installed pipes.

This configuration, based on a modular architecture, permits future expansion of internal as well as external measurements and features. The local processor, performing data acquisition, processing, presentation and control, can allow data collection from other sensors and data transfer and communication to and from a central computer. Communications in a network configuration may be tailored to any desired architecture, including, but not limited to Ethernet, RS-485, RF/Wireless, RADNET, etc.

The system operates automatically, being fully controlled by the local processor and is specifically designed to meet the needs of continuous monitoring of radioactive alpha (and beta) particulate contaminants of the air in applications such as plant workplace monitoring as well as environmental surveillance networks. Air sampling is accurately measured and optionally controlled to ensure constant air flow through the filter (a standard circular one 47 mm diameter, or optionally customized for the CAM-01) or to meet isokinetic conditions when sampling is from ducts or stacks. The filters changing mechanism is manual in the CAM-01 and completely automatic in the CAM-03; both allowing easy manual replacement. In the CAM-03 all the filter movements are carried out through mechanisms driven by low voltage AC motors. All movements are controlled by means of sensors. The filters storage unit is a horizontal guide along which a three filter support is placed. The local processor controls the movement of this support in order to place the filters in the sampling/measuring position or in the reset positions. An air-tight holder, controlled by the local processor, holds the filter in the sampling position, while allowing the alpha (and beta) measurement. At the end of the measurement, the holder is opened, the sampled filter is replaced with a new one and the holder is closed again. Up to three filters can be used. One alternate could be to have two filters and one check source (mounted as a filter), which allows automatic replacement of the filter in case of contamination or other condition, and the possibility of automatic and/or remotely actuated check source function.

On-line measurements with programmable and/or self-adjusting period and refresh are continuously performed during sampling. Alpha (and beta) concentration in Bq/m³, pCi/l or DAC, as well as Alpha (and beta) collected activity (Bq or pCi) or exposure (DACH), are calculated during each periods (at each refresh) and at the end of each measurement period.

The suggested filters are made of cellulose homogeneous polymer with a collecting efficiency well over 90% at flow-rates up to about 12 m³/h (7 ft³/min). This filter was selected as the best choice for alpha aerosol monitoring. The filters are free of gamma emitters and have intrinsic radioactive emissions lower than the detection limits. Other types of filters can also be used.

The use of a spectrometry technique combined with the 'real time' processing of the differential equations related to the natural decay chains, allows compensation of the radon and thoron contribution to the radioactive aerosols and measurement of the radon and thoron concentrations in Bq/m³ or pCi/l. This isotope separation enables the system to determine the collected activity and the concentration in air of the long lived alpha (and beta) isotopes to be calculated. This is calculated using the slope of the increase of the so-called 'artificial' alpha and beta net count rates during sampling.

When the optional beta measurement is provided, the gamma background is measured by means of an energy compensated detector. When only the alpha monitoring function is provided, the gamma background measurement is optional.

The software performs the following functions; flow-rate measurement (referenced to standard conditions), and regulation, processing the filter count rate, gamma background measurement and processing, 5-ROIs processing and readout, evaluation of the activities on the filter and the concentrations in air, system parameters set-up, control of the signals when alert and alarm thresholds are exceeded, control of the signals due to failures, automatic filter replacing (CAM-03 only), automatic test functions, instrument emulation, processing analog and digital outputs, and providing data communication.

The main available data are: Air flow rate [m³/h or l/min or cfm], Sampled air volume [m³ or l or cf – also at standard condition], 'Long lived' Beta activity on filter (or exposure) - optional [Bq or pCi (or DACH)], 'Long lived' Alpha activity on filter (or exposure) [Bq or pCi (or DACH)], 'Long lived' Beta concentration in air – optional [Bq/m³ or pCi/l or DAC with error - σ selectable], 'Long lived' Alpha concentration in air [Bq/m³ or pCi/l or DAC with error - σ selectable], Radon and Thoron concentrations in air [Bq/m³ or pCi/l with confidence level - σ selectable], Gamma background – optional when Beta monitoring is not provided [uSv/h or uR/h].

TECHNICAL SPECIFICATIONS

Detected radiation:	alpha > 2.7 MeV, beta (option C0103-1) > 80 keV	
Detector:	rugged silicon 600 mm ² (0.93 sq in)– typical efficiencies for α and β : \approx 20%	
Analysis unit:	5-SCA or (option C0103-2) up to 2048 ch. MCA.	
Measuring range:	natural emitters (Rn & Tn) up to 10 ⁴ Bq/m ³ (2.7 \cdot 10 ² pCi/l) alpha artificial emitters up to 10 ⁶ Bq/m ³ (2.7 \cdot 10 ⁴ pCi/l) beta artificial emitters up to 10 ⁶ Bq/m ³ (2.7 \cdot 10 ⁴ pCi/l) other ranges on request	
On line Sensitivity: (95% conf. level)	alpha artificial MDL	Bq/m ³ - pCi/l 0.1 – 2.7 \cdot 10 ⁻³ (1h) 0.01 – 2.7 \cdot 10 ⁻⁴ (4h)
	beta artificial MDL	Bq/m ³ - pCi/l 0.5 – 1.3 \cdot 10 ⁻² (1h) 0.05 – 1.3 \cdot 10 ⁻³ (4h)
	conditions for the above MDLs:	Rn \leq 10 Bq/m ³ (0.27 pCi/l) – Tn \leq 0.5 Bq/m ³ (0.01 pCi/l) Gamma background \leq 0.2 uSv/h (20 uR/h) Flow rate \geq 5 m ³ /h (3 cfm)
Measuring units:	programmable	
Calibration:	programmable, resident on HD	
Accuracy:	\pm 15% typ	
Stability:	\leq 10% over 500 h	
Gamma bkgd detector:	optional item (option C0103-3)	
Filter autonomy:	1 (CAM-01), up to 3 (CAM-03).	
Microprocessor:	x86 - 266 MHz with 32 MB RAM, 20 GB HD, 1.44 MB FD.	
Keyboard/display:	alphanumeric/functional – 10" b/w LCD (color as option C0103-5)	
Interfaces:	Serial RS232 or RS422 or RS485 – LAN RJ-45 100/10 BASE-T Fast Ethernet	
Analog outputs:	two 0 or 4 – 20 mA outputs with programmable zero, f.s., trend (linear or logarithmic), and quantity (concentration, exposure, sampled volume, flow-rate, etc.). (option R01-5)	
Alarms:	visual (amber, red, white), audible, displayed and (option R01-6) up to 4 free relay contacts	
Flow-rate range:	normal operation 2 – 8 m ³ /h (1 – 4 cfm). Others possible	
Flow-rate control:	measurement \pm 2% typ - regulation \pm 4% typ (option C0103-4)	
Filters:	circular Φ 47 mm (or 2") cellulose homogeneous polymer efficiency 99.9% at flow-rates up to 12 m ³ /h (7 cfm)	
Pump:	external option (option C0103-7) oil free, 14 m ³ /h (8 cfm) - free air	
Oper. temp.:	suggested 0 to +40 °C (32 to 104 °F); possible -10 to + 50 °C (14 to 122 °F)	
Oper. RH:	0 to 95% non-condensing	
Protection:	IP45 (higher on request)	
EMC:	current CE directives	
Power supply:	110 or 220 Vac / 50 or 60 Hz 200 W (excluding pump)	
Dimensions:	618 x 457 x 380 mm (24 x 18 x 15 ") - (CAM-03 - wall mounting version excluding pump) special compact versions (CAM-01) available (also with separated modules)	
Weight:	25 kg (55 lb) excluding pump (CAM-03) approximate	
IEC Reference std.:	60579, 60761-1/2, 61172, 61578, 61306	