PET FACILITY RADIATION MONITORING SYSTEM
MODEL ~ PET-CAM-511

FEATURES:
- COMPLETE PET FACILITY AIR MONITORING SYSTEM
- REAL-TIME CONTINUOUS
- 9 DETECTION CHANNELS
- 2 AREA MONITORS
- EASY INTEGRATION INTO FACILITY INFRASTRUCTURE
- HIGH CAPACITY OIL-LESS AIR PUMP
- DETECTION OF:
  - POSITRON
  - PARTICULATE BETA/GAMMA
  - IODINE
  - NOBLE GASES
- 3 IN-PROCESS DETECTOR MONITORS: DUCTS OR CHARCOAL TRAPS
- FINAL RELEASE STACK MONITOR HAS 3 DETECTORS
- PHYSICALLY SEPARATES AND MONITORS CONTAMINANTS INTO:
  - PARTICULATES
  - AIRBORNE CHEMICALS
  - AIRBORNE AEROSOLS
  - NOBLE & INERT GASES
- RUGGED SKID OR CASTER MOUNTED

DESCRIPTION:
The PET-CAM-511 is a continuous duty, high capacity, rugged skid or caster mounted systems.

Electronics:
- Plug-in modules allowing change or addition of function as needed and allowing rapid repair by substitution of modules in the field.
- The modular system is covered by T/A’s unique exchange warranty, in addition to the full one year warranty covering all T/A products.
- Computer with 17” COLOR LCD Monitor.

Shields:
- Void free lead encased in welded steel with stainless steel liners for long, useful life and easy decontamination.
- Open for filter change or cleaning with minimum effort.
- All connections and openings sealed against air leaks.

Filters are easily changed via quick disconnect, o-ring sealed filter holder

Air Moving System is based on a high capacity oil less air pump capable of delivering 120 lpm (4cfm) free air including Real Time flow rate measurement and data analysis.

Monitor Sensitivity: More sensitive on all channels by factors of 5 to 500 than is required by USNRC and other Regulatory Agencies.
## CHANNEL & SENSOR SPECIFICATIONS

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SENSOR</th>
<th>FILTER TRAP</th>
<th>SETTING</th>
<th>DETECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IN PROCESS CHANNELS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclotron Vault</td>
<td>2” NaI</td>
<td>Duct</td>
<td>511 KeV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Strap On Style)</td>
<td>511 KeV</td>
<td></td>
</tr>
<tr>
<td>Hot Cells (2 ea)</td>
<td>2” NaI</td>
<td>Filter Bank</td>
<td>511 KeV</td>
<td></td>
</tr>
<tr>
<td><strong>FINAL RELEASE CHANNELS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particulates</td>
<td>2” dia GM</td>
<td>Particulate Filter</td>
<td>Beta/Gamma</td>
<td>Beta/Gamma</td>
</tr>
<tr>
<td>Chemicals</td>
<td>2” NaI</td>
<td>Charcoal</td>
<td>511 KeV</td>
<td></td>
</tr>
<tr>
<td>Gases</td>
<td>2” dia GM</td>
<td>Gas Chamber</td>
<td>Beta/Gamma</td>
<td>$^{13}$N, $^{11}$CO$_2$</td>
</tr>
<tr>
<td>Bypass Flow</td>
<td>Mass Flow</td>
<td>Venturi</td>
<td>LPM</td>
<td></td>
</tr>
<tr>
<td><strong>AREA MONITOR CHANNELS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclotron Vault</td>
<td>GM</td>
<td>n/a</td>
<td>Gamma</td>
<td>mR/hr (or uSv/h)</td>
</tr>
<tr>
<td>Chemistry Lab or Hot Cell</td>
<td>GM</td>
<td>n/a</td>
<td>Gamma</td>
<td>mR/hr (or uSv/h)</td>
</tr>
<tr>
<td><strong>OPTIONAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wide Gamma</td>
<td>3” NaI</td>
<td>Strap On Style</td>
<td>Wide Gamma</td>
<td>All Gamma</td>
</tr>
<tr>
<td>Wide Gamma MCA</td>
<td>3” NaI+</td>
<td>Duct or Filter</td>
<td>MCA</td>
<td>Isotope Identifier per Library</td>
</tr>
</tbody>
</table>

**THE SYSTEM CONSISTS OF 3 SUB-SYSTEMS.**

1. Main console including final release sensors. The entire system is mounted in a self-contained rugged cabinet and comes complete with all cabling, connectors, and software in place, setup, and ready to operate. The standard unit is operated from 115 V single phase, 60 Hz; 220V optional, 50 or 60 Hz.

2. Interactive control station computer with full read-outs and alarms can be placed in control room or RAD supervisors’ office, etc.

3. In-Process & Area Monitor Detectors- report to the main control (1) and to control station (2).
PET FACILITY RADIATION MONITORING SYSTEM
MODEL ~ PET-CAM-511

SPECIFICATIONS FOR PET-CAM-511

CHANNELS: Nine (9)

ACTIVITY DETECTED: Positron Annihilation, Beta-Gamma Particulate, Airborne Chemicals, Noble Gas.

<table>
<thead>
<tr>
<th>ACTIVITY DETECTED</th>
<th>POSITRON</th>
<th>BETA-GAMMA PARTICULATE</th>
<th>AIRBORNE CHEMICALS</th>
<th>NOBLE OR INERT GASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE COLLECTOR</td>
<td>Existing Ducts</td>
<td>2” dia Filter</td>
<td>2.5” dia x 1” thick</td>
<td>One Liter Chamber</td>
</tr>
<tr>
<td>FILTER TYPE</td>
<td>Existing Ducts</td>
<td>Glass Fiber Filter</td>
<td>TEDA Activated Charcoal Cartridge</td>
<td>Stainless Steel Lined</td>
</tr>
<tr>
<td>SAMPLE COLLECTION EFFICIENCY</td>
<td>Per Best Geometry</td>
<td>Up to 99% Efficiency at 0.3 micron particle size</td>
<td>60 KeV to 3 MeV (25 KeV to 7 MeV optional)</td>
<td>60 KeV to 3 MeV (7 MeV optional)</td>
</tr>
</tbody>
</table>

Detector: 5 each
- Positron: 511 KeV: 2 inch diameter NaI(Tl) (Spectroscopic Grade)
- 1 each Particulate Beta-Gamma: 2 inch diameter GM or optional Proportional Detector
- 1 each Iodine: 2 inch diameter NaI(Tl) Model PGS-3LI (Spectroscopic Grade)
- 2 each Noble Gas Standard Range: 2 inch diameter GM or Optional Proportional Detectors

Shielding: 3 inch Lead; 4pi. Plus 1 inch lead placed between adjacent detectors

Detector Sensitivity: Monitor is more sensitive on all channels by factors of 5 to 500 than is required by USNRC and other Regulatory Agencies.

Calibration: On screen instructions for user-assisted automatic calibration.

Decontamination: Shields are straight-through bore with Stainless Steel liner for easy decontamination.
- Other wetted parts are stainless steel or quick and easy replacement

Corrosion: Each detector is protected against moisture by design, construction and 0.0005” window.

<table>
<thead>
<tr>
<th>Type of Detector</th>
<th>1 Minute</th>
<th>1 Hour</th>
<th>10 Hours</th>
<th>1 Day</th>
<th>1 Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate Beta-Gamma</td>
<td>6 x 10^{-10} uCi/ml/min</td>
<td>1x10^{-11} uCi/ml</td>
<td>1x10^{-12} uCi/ml</td>
<td>6 x 10^{-13} uCi/ml</td>
<td>1 x 10^{-13} Bq/ml</td>
</tr>
<tr>
<td>Cs-137, Co-58, etc</td>
<td>3.7 x 10^{-7} Bq/ml</td>
<td>3.7 x 10^{-6} Bq/ml</td>
<td>2.4 x 10^{-8} Bq/ml</td>
<td>4 x 10^{-9} Bq/ml</td>
<td></td>
</tr>
<tr>
<td>Airborne Chemicals</td>
<td>6 x 10^{-9} uCi/ml/min</td>
<td>1 x 10^{-11} uCi/ml</td>
<td>1x10^{-12} uCi/ml</td>
<td>6x10^{-13} uCi/ml</td>
<td>1 x 10^{-13} Bq/ml</td>
</tr>
<tr>
<td>511KeV, etc.</td>
<td>3.7 x 10^{-7} Bq/ml</td>
<td>3.7 x 10^{-6} Bq/ml</td>
<td>2.4 x 10^{-8} Bq/ml</td>
<td>4 x 10^{-9} Bq/ml</td>
<td></td>
</tr>
<tr>
<td>Gas-Standard Range</td>
<td>6 x 10^{-7} uCi/ml</td>
<td>1x10^{-11} uCi/ml</td>
<td>2.7 x 10^{-6} uCi/ml</td>
<td>1 x 10^{-8} Bq/ml</td>
<td>2.7 x 10^{-9} Bq/ml</td>
</tr>
<tr>
<td>Xe-133, etc.</td>
<td>1x10^{-7} uCi/ml</td>
<td>3.7 x 10^{-9} Bq/ml</td>
<td>3.7 x 10^{-9} Bq/ml</td>
<td>1 x 10^{-8} Bq/ml</td>
<td>1 x 10^{-9} Bq/ml</td>
</tr>
</tbody>
</table>

TECHNICAL ASSOCIATES
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PET FACILITY RADIATION MONITORING SYSTEM
MODEL ~ PET-CAM-511

Display Mode: Model PET-CAM-511 features a Intel Processor Computer with a Color LCD Monitor. Reads out directly in concentration Bq/m³ or other units.

Operation: When PET-CAM-511 continuous air monitor is in normal operation, the Color LCD Monitor displays:

High Voltage Supply: Separately variable from 0 to 2000 VDC at 200 uA on scintillation or proportional channels.

LCD Color Monitor: 17 inch Monitor shows Real Time Concentration & Accumulated Dose for all Channels

ACCURACY: + 10% except for resolution loss and statistical variation.

ALARMS: Alarms are pre-settable to any trigger level.
- Low level Alarm: Automatic Reset
- High Level Alarm: High level alarm remains activated until RESET button is pushed.
- Alarm Indicator Lights: Each of the 8 channels has on-screen, RED High alarm indicator & also activates audio alarm and relay.
  Each of the 8 channels also has on-screen low count/self-test indicator which can also activate a maintenance required relay.
- Audio: 1000 Hz, greater than 80db.

AIR MOVING SYSTEM: For Effluent Channels
- Air Pump: Extremely rugged continuous duty.
- Pumping System: Pump noise is reduced by heavy duty internal muffler.
- Oil less Pump Motor: 1/3 Horsepower, 50/60hz, capacitor start, induction run.
- Real-time Flow rate: On screen Flow Rate Display 0 to 4 or 0-120 lpm.
- Inlet and Outlet: 20 foot 1” hose inlet: 6 meter 2.5 cm I.D.
  20 foot 1” hose outlet. May be extended.
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Flow Rate: Factory setting is at 4 cfm. Mass flow meter feeds Real Time data to PET-CAM-511 software.

Outputs: Alarm Condition Outputs:
1. Logic Level Signal, 2. Contact Closure or opening, 3. Ethernet LAN Connection

INSTALLATION: Cabinet of heavy gauge steel.
Skid or caster mounted With 4 five inch ball bearing casters. Two of these are full 360 degree swiveling.

Special Safety: Loss of system vacuum air flow alarm and relay switch closure.
Loss of signal alarm.
All System Circuits are Fused.

OPTIONS: Three Channel push-button check sources (License Exempt Quantities) to Detect & Test any of the lead shielded channels.
Flow rate can be increased to 30 cfm with minor changes in the plumbing.

Features: Thermal Protection on Motor. Positive displacement Pump

WEIGHT & DIMENSIONS:
Dimensions: 29” wide by 31” long by 41” high exclusive of casters.
Weight: 1,600 lbs. (Lighter weight models are available with 1” Shielding.
Shipping Weight: 1,750 lbs.

ELECTRONIC SYSTEM:
1. CPU with data acquisition
2. High Resolution, 17” LCD Color Monitor Display
3. Mouse
4. OPTIONAL: Graphic Printer for hard copy – graphical printout shows trend data.
5. 4-20mA interface is provided for up to 3 channels.
6. Keyboard
7. Audio
8. Manuals
10. Specialized Air Monitor software custom tuned and designed for the CAM-33 Air Monitor.
11. Ethernet-LAN port allows for duplicate PC display in supervisor’s office.
TECHNICAL ASSOCIATES STANDARD MODULAR SERIES – ALL SOLID STATE:

- 1 ea. Digital Acquisition Board
- 4 ea. 5202 with amplifiers including fully adjustable single channel analyzer for scintillation detectors.
- 4 ea. HV individual +/- 1% stable high voltage for each detector group. Once the high voltage levels are set by the technician, they do not change.
- 1 ea. HP DeskJet Color Inkjet Printer -OPTIONAL
- 2 ea. MAL-B3 Alarm Module
- 1 ea. BAM-SWX Pump Power Control Module
- 1 ea. Mass Flow Meter with on-screen display

IMPORTANT FEATURES TO NOTE WITH TA’S PET-CAM-511 Air Monitors

- 4-20mA output signals – 3 channels
- Big 17” Color LCD Monitor
- LABTECH Virtual Instrument Software
- Real-Time Mass Flow meter
- Final release detectors with 3” Lead (Pb) shields light weight with compact Beta/Gamma Detectors
- Positive Position check sources with “throw length” and trouble free operation.

PLEASE SEE SOFTWARE “SCREEN SHOTS” FOR CAM-33 ON TA’S WEB PAGE “ALPHABETICAL LIST OF PRODUCTS”

Recommended Reading

Gaseous Radioactive Effluent Restrictions, Measurements, And Minimization At A PET/Cyclotron Facility.
P.S. Plascjak, K.K.Kim, S.W. Googins and W.C. Meyer Jr.
Cyclotron Facility, National Institutes of Health, Bethesda, MD 20892, USA