

**STACK GAS MONITOR
TYPE : SM809**

Technical Data



FEATURES:

- State-of-art electronics design using controllers with embedded code, I2C, micro-wire bus based devices makes the equipment compact and highly reliable.
- End window GM tube GM 125 is used as Beta detector. Efficiency achieved is better than 25% with Sr-90 Beta.
- Loose Mylar ZnS (Ag) scintillator screen coupled to 2" PMT is used as Alpha detector. Efficiency for Am-241 alpha is better than 25%.
- Collection ??for both Alpha & Beta chambers is better than 97%.
- Kr-85 gas is measured in a chamber with two long Beta sensitive detectors. Efficiency achieved is 0.5%.
- 16x2 LCD display is used for display of count-rate status and other information.
- Detachable hand-held keypad for configuration of the instrument.
- RS-485 built-in for remote monitoring and diagnostics.
- 4-20mA current loop o/p for full-scale range of each channel.
- Count-rate display additionally provided on SIX-digit SEVEN-segment display.

Stack Gas Monitor, Type: SM809 manufactured by Nucleonix Systems, designed using state-of-art electronics is primarily used for monitoring Alpha, Beta activity present in the form of suspended particulate in air and Kr-85 present in the form of gas. It is very much essential to monitor the quality of air in & around Radiochemical plants, reprocessing plants and other similar facilities. Usually stack, by pass lines are let into this system & after measurements, it is connected back to stack.

It essentially has an air suction system comprising of a suction pump, rotometers to measure air flow rate, beta suction chamber with arrangement for trapping of suspended dust particulate onto the filter paper. An end window GM tube of 1" dia facing the filter paper counts for Beta activity in CPM /CPS/Bq on continuous basis.

In addition this system has Alpha air-sampler detector assembly consists of a filter holder 60mm dia, a suction chamber with air inlet and outlet & detector housing fabricated with stainless steel. Alpha Detector consists of ZnS (Ag) deposited on loose mylar support of 50mm dia coupled to matched PMT with Pre-amplifier. Detector Efficiency achieved is of the order of 25% for Plutonium alpha particles over the entire window area

Additionally there is a krypton chamber (rectangular) with inner dimensions of (140 x 140 x 320 in mm) with 20mm lead lining all around. This chamber has two Beta-gamma detectors LND719. This chamber has two openings (a) Inlet & (b) outlet nozzles for connection to suction system. This Krypton chamber is placed after the Alpha suction chamber.

For Alpha & Beta chambers, collection efficiency better than 97% is achieved with this design for both these chambers. Suction chambers design facilitates the user to easily replace the filter paper(s) periodically as per the requirement.

Two Electronic modules built-in will indicate, the air sample activity (for Alpha & Beta) deposited on the filter paper in terms of CPM/ CPS/ Bq. Third electronic module will indicate Kr-85 activity in Bq / CPM. These electronic modules have sub-systems built-in which include HV module, SMPS, controller card, EMI/EMC filters current loop circuit, relay & relay driver circuit etc. Front panel has 16X2 LCD dot matrix display, 6-digit 7 segment display, alarms indicating cluster LED displays, audio buzzer, 9-pin D-connector to facilitate connection to external key pad etc. Rear panel has connectors for connecting to Alpha detector, Beta detector probe, test socket, 17 pin I/O connector, test sockets, 9-pin D-connectors for RS485 in/out, A.C. mains switch, fuse holder etc. This module will provide alarm annunciation both visual and aural when the activity exceeds preset level. This system provides current loop output; relay output on 17 pin I/O connector. RS485 IN/OUT ports facilitate connection to SCADA for data communication for visualization of CAM parameters.

SPECIFICATIONS

The Stack Monitoring System (Alpha, Beta and Kr 85) is capable of monitoring airborne releases of alpha & beta emitting radio nuclides and Kr 85 activity in the gaseous effluents being released through Stack. The instrument comprises of three sets of air sampler cum detector assembly and an electronic unit. The detectors is ZnS (Ag) Scintillation detector, Halogen quenched end window GM detector and thin wall GM detector. The electronic unit comprises of three channels of low voltage supplies, High voltage supply, Pre-amplifier & Amplifier, Count rate meter and Alarm generation module. The electronic unit and the detector assemblies are mounted on a single floor mounted trolley.

The gas effluents being released through the stack is to be sampled from exhaust duct and returned to the duct after passing through the air samplers. Sampling pipes with holes are fitted inside the duct through the cross section. Two nos. of 0.25 inch SS Pipes are welded to the duct at these sampling points. The pipes are laid upto the location of the stack monitoring systems. Each pipe is provided with two taps along with isolating valves and they are connected to the air sampler of running and standby instruments.

AIR-SAMPLER CUM DETECTOR ASSEMBLY (ALPHA):

The air sampler cum detector assembly for alpha consist of a filter holder 60mm dia., a suction chamber with two nozzles (air inlet and outlet) with one touch coupler serrated and detector housing. . Typical drawing will be provided to the successful bidder.

Air sampler is fabricated with stainless steel SS 304L. Minimum 4 numbers of threads shall be

provided for free and smooth fixing and removal of each part of the sampler assembly. Air sampler is designed and fabricated to achieve the particle collection efficiency better than 99% for air particles down to 0.3 micron size on glass filter paper. It is designed considering the iso-kinetic properties of particles for uniform dust collection over entire filter paper area. The air sampler shall be tested for zero leakage at 2 Kg/sq.cm.

The Detector assembly for Alpha monitoring shall have the following specifications:

Detector and size : ZnS(Ag) phosphor, 50mm dia coupled to a matched photo-multiplier with pre-amplifier.

Window Thickness : 1.5 mg/cm² light-sensitive pin-hole free aluminized mylar with protection against puncture.

Detector Efficiency : Not less than 25% for plutonium alpha particles over the entire window area.

AIR-SAMPLER CUM DETECTOR ASSEMBLY (BETA):

The air sampler cum detector assembly for beta consists of a filter holder 60mm dia., a suction chamber with two nozzles (air inlet and outlet) with one touch coupler and detector housing.

Air sampler is fabricated with stainless steel SS 304L. Air sampler is designed and fabricated to achieve the particle collection efficiency better than 99% for air particles down to 0.3 micron size on glass filter paper. The air sampler is tested for zero leakage at 2 Kg/sq.cm.

The assembly is to be shielded by 50mm of lead in a manner that provides easy access for loading and unloading of the filter paper and removal of detector. The lead assembly is designed with proper care to avoid any injury to the technicians while opening and closing the assembly.

The Detector assembly for Beta monitoring has the following specifications:

Halogen-quenched end-window G.M. Counter

Type : LND - 72314 or equivalent

Window : 1.5 - 2.0 mg/cm², mica

Wall thickness : 1.5 mm

Effective length : 36.25 mm.

Effective dia : 28.12 mm

Material : 446 SS

Max. Tube dia. : 33.0 mm.

Max. Overall length : 52.50 mm

Operating voltage range : 450-750 V.

Operating voltage : 500 V

Max. Plateau slope : 5% per 100V

Max. Background : 15 cpm with 5 cm of lead shielding.

Beta efficiency response: Upto 4 Mev

Gamma energy : 0.3 MeV to 1.5 MeV

AIR-SAMPLER CUM DETECTOR ASSEMBLY (KRYPTON) :

The air sampler cum detector assembly consists of a detector chamber with two nozzles (air inlet and outlet) with one touch coupler serrated. Krypton (Kr 85) is detected by passing the air with gaseous effluents through the large volume detector chamber containing 2 numbers of long thin SS walled GM detector.

The detector chamber is fabricated with stainless steel SS 304L. The detector is mounted in the chamber. The chamber is provided with proper gaskets for arresting leaks.

The assembly is to be shielded by 20mm of lead in a manner that provides easy access for removal of detector. The opening portion of the lead assembly is provided with heavy duty hinges, soft pads and locking arrangement. The lead assembly is designed with proper care to avoid any injury to the technicians while opening and closing the assembly.

The Detector assembly for Krypton monitoring has the following specifications:-

Halogen-quenched thin walled GM detector (suitable for beta detection)
Type : LND 719 or equivalent
No of detectors: 2
Operating voltage range : 750-950 V.
Operating voltage : 900 V
Max. plateau slope : 5% per 100V
Sensitivity : 90 cps/mR/hr.

Suction / vacuum system: This Suction / Vacuum system provides required suction for drawing air through the filter paper in the air sampler assembly. The system comprises of a Dry type, noise-free, continuous duty, pump-motor set.

Vacuum pump-motor set :

Free air displacement : 150 liters/min (Min.)
Ultimate vacuum : 550 mm Abs (22" Hg)
Pressure : 1.4 Kgs/cm² (20 lbs)
Duty : Continuous.
Electric Motor : ½ HP, 1440 RPM with gear box, 220/230V AC, capacitor start, single phase TEFC B-56 frame, Class "B" insulation, continuous rating Crompton or equivalent.
Vaness : Made of self lubricant special H17 grade graphite.
Bearings : Sealed ball bearings.
Mountings : Pump and motor mounting is on a common base plate.
Drive : "V" belt and pulley driven (belt covered by belt guard)
Air inlet/outlet : ¼" serrated nozzles.

Vibration : suitable anti-vibration pad.

Silencer : The pump should be provided with a silencer to give a noise free operation.

Pump failure alarm : Pump failure alarm indication is provided on the instrument and the same is wired on the remote console.

Make : The pump is of M/s Tawde make or equivalent.

Flow measurement and regulation:

- a) The instrument has two sets of Air rotameter 50- 200 lpm. with one touch coupler serrated brass nozzles for connection to 12 mm ID PVC / Copper tubing.
- b) Rotameters should be mounted on a tamper-proof manner in the air sampling line.
- c) One rotameter is connected to the air sampler for Alpha and the other to the air sampler for beta.
- d) The outlet of air sampler for alpha activity is connected to the air sampler for Krypton and then back to the stack
- e) Provision is given to discharge the hot air from the vacuum pump

Electronic unit: The electronic Unit comprises of three channels of Low voltage power supplies, EHT supply, pre-amplifier, amplifier, count-rate meter based on Intel Microprocessor/microcontroller and audio visual alarm system is provided for the two detectors.

Low Voltage power supply:

Independent low voltage power supplies generate the DC power supplies required for the operation of each channel of electronic module. They will have a adequate line voltage and load regulation. The modules are fitted with Mains line filters to avoid line interferences.

EHT Supply: Three independent EHT channels are provided for the

working of the Beta, Krypton & Alpha channel detectors. The output voltage of each channel is continuously variable from +300V to +1500V independently. Output should be adjustable by screwdriver and EHT is shown on the display by the use of the keypad

Pre-amplifier and Amplifier:

Three independent Pre-amplifier & amplifier channels compatible with the two GM detectors & ZnS Scintillation detector are provided. It provides the necessary amplification and shaping for the pulse signals from the detectors. The output of the amplifier will be given to the Count Rate meter for further data processing and display.

Count-rate meter: Three independent Count Rate meters are provided for processing the data from the three detectors and display the same. Each count-rate meter has the following specification

Unit : CPM / CPS / Bq

Ranges : For Alpha and Beta channels
0 - 50000 CPM OR 0-2000 CPS
OR 0 - 50000 Bq, with provision for unit selection and range adjustment.

For Krypton Channel
0-500000 CPM OR 0-20000 CPS
OR 0-250000 Bq with provision for unit selection and range adjustment.

Time Constant : Between 60 to 1 sec automatically varying inversely with count-rate through out the range.

Display : Auto ranging direct reading, 6 digit 7 segment LED display & 16x2 LCD display. 6x7 LED display is interfaced using multiplexed display driver and is used for display of count-rate and hardware status indication & 16x2 LCD for visualization of preset alarm and other parameters.

Display updating : First reading on Power ON within 12 secs.

Normal (Slow) : 60 sec to 12 sec automatically varying inversely with the radiation level.

Abrupt detection : Update the current reading within 1 sec and return to normal mode.

Overload : Senses overload above 200% of fullscale indicates on display "OL"

Over-range : Senses if the radiation field being measured has exceeded the measurement range of the instrument and upto 200% of the instrument and displays "OFI"

Recorder output : 4 to 20 mA, with 600 ohm load.

Recorder output stability

- a) Non-linearity : Max = 0.025% of Span
- b) Offset current (I_o=4mA) : Max = 0.0005% of Span / C
- c) Span Error (I_o=20mA) : Max = 0.005% of Span / C

Accuracy : +/- 5% Full scale.
Calibration Accuracy : +/- 5% through out the range.

Testing Facilities : Provision to inject a suitable pulse generator signal for routine testing of Count rate meter are provided on the rear panel.

Additionally a test pulse mode through software for checking count-rate meter is provided

Instrument "ON" Indication : Large Area Green LED Lamp. This will indicate the Normal condition also.

Audio visual alarm system:

Alarm range : 1 to full scale reading
Alarm setting : The alarm level setting is carried out through RS-485 serial port with handheld configurator / PC with password protection.

Alarm Indication :

- a) Red (LED) flashing large area window display.

b) Loud audio tone (dual frequency tones)

Alarm annunciation scheme :
As tabulated below;

Parameter Status	Visual indication (Red LED)	Audio
Normal	OFF	OFF
Abnormal	Flashing	ON
On ACK	Steady Red	OFF
Back to normal	Steady Red	OFF
Reset on abnormal	Steady Red	OFF
Reset on normal	OFF	OFF

Instrument Controls :

- a) Acknowledgement switch for muting audio.
- b) Reset switch for resetting the Alarm indication and alarm relay.
- c) Power ON/OFF switch with Power ON indication.
- d) EHT ON/OFF control is provided on the front panel of the instrument.

Instrument Fault indication:

- a) EHT failure: Visual alarm with flashing red LED indication & "Eht" message on display
- b) Detector failure: Visual alarm with flashing red LED & "d-FL" message on display.
- c) Microprocessor / microcontroller failure: Visual alarm with flashing green lamp.
- d) Fault indications are cleared automatically if normal status is resumed.

Housing: All the modules of the Electronic unit are housed in rack mounted type cabinet. The modules are plug in type and all the controls and display on the front panel. The enclosure complies with IP-21.

Remote /External Console:

The instrument is provided with three remote console connectors for the three channels.

- a) 4 - 20 mA linear proportional to full scale display output. Current output is able to drive load of 600 ohms. Output circuitry is able to drive 200 mtrs.of twisted pair of wires.

b) Two sets of potential free contacts of Alarm relay (Change over). Contact rating 3 Amp at 250 VAC. The relay is energized on normal condition and de-energised under alarm condition.

c) Remote alarm acknowledgement and reset signals for the field instruments.

d) Indication of instrument fault condition (detector, EHT & microprocessor failure), over range & overload conditions by up-scale 4-20 mA. (22.5 mA)

e) Pump failure alarm contact.

f) All these signals are terminated on a 17 pin socket (Allied Connectors). The corresponding mating plug with 5 mtr cable is supplied with the monitor.

g) RS-485 serial port. This is in parallel with D-type connectors.

Computer Interface: Each channel of the instrument will have a RS-485 Serial Communication port for interfacing with a IBM PC-compatible computer. The PC and the monitor operate in a host-slave configuration in a multi-drop network through this interface. The PC as the host will give commands and send queries. The monitor will carry out the various functions as per the required information in response to the queries.

The firmware of the monitor is able to send the instrument data like Instrument ID, Instrument type, Input range, Display range, alarm settings, alarm status, current reading, diagnostic status of EHT/ GM tube etc. to the Host PC on demand. The firmware is able to receive commands from Host PC and carry out the setting of different parameters like Instrument ID, Instrument type, Input range, Display range, alarm settings, Ack, Reset, EHT setting etc. The configuration settings are password protected and the password is user defined. Detailed list of the command and response for the Host-slave communication will be provided by the user.

The detailed specifications for the interface are as follows:-

Type : RS-485 Multidrop Serial Communication Port, Half Duplex Bi-directional communication.

Character Format : ASCII

Protocol : Modbus/RTU

Bit Rate : User configurable to 9600 or 19200 bits per sec.

Address : User configurable from 0 to 255.

Connector : 9-pin D-type connectors (2 connectors connected in parallel for daisy chaining a number of instruments). The mating connectors with cover is supplied.

Hand held Configurator:

- a) The monitor is supplied with a hand held configurator with RS-485 serial port interface. The configurator is a full function LCD display terminal comprising a keyboard/navigating keys and a large alphanumeric LCD display.
- b) The configurator is capable of fully configuring and monitoring of all functions of the Continuous air monitor.
- c) The configurator shall not be instrument specific and will be able to work in conjunction with all Continuous air monitors meeting the above specifications.
- d) Dimension should be such that it can be easily held in single hand. It is provided with a carrying case and shoulder belt.
- e) It is operated on a rechargeable battery of long life and the battery charger is part of the supply.
- f) The configuration settings are password protected and the password is user defined.

Self Diagnostics : The monitor will have built-in self diagnostics. On being powered it will perform tests to ensure that all components and sub systems are functioning properly. It will check for the Power supply, High Voltage Supply, Detector, Counting and measuring circuits, Alarm Systems and Display Systems. All the alarms generated during diagnostics is Auto Reset type.

The firmware will not halt monitoring / data acquisition function any time. The firmware is designed for high reliability and availability.

Test points are provided for checking the EHT voltage and for connecting external input pulse signals.

Input Power : 230VAC +/-10%, 50Hz, single phase supply. Protection is provided with spike suppressor and line filter. Power ON/OFF indication is provided with an indicator LED.

Environment : The instrument is designed to be able to withstand temperature up to 50 deg C and relative humidity upto 90% in radiation areas.

Environmental compliance : As per IS 9000 / ANSI N 42.17

The instrument enclosure and detector assembly will comply with IP-21. Electronic units will withstand cumulative radiation dose of 10000 Rad. (30 years of operation).

EMI / EMC compliance : As per IEC 61000 / ANSI N42.17

Mechanical Dimensions (overall): Size :

*Height : 1500mm

*Width : 650mm

*Depth : 480mm

Instrument trolley:

- a) All the hardware like Vacuum pump, Air sampler - detector assembly, lead shielding, rotameters, Electronic unit etc may be fitted in an Instrument trolley made of M.S.
- b) The trolley is provided with castor wheels with locks / breaks.
- c) The trolley is powder coated with Siemens Grey colour.
- d) It is fabricated to provide protection as per IP-21.
- e) Front and Rear sides will have doors with magnetic lock.
- f) The doors are provided with holes to facilitate air suction from surroundings.
- g) The vacuum pump is fitted at the bottom with guards & shock absorbers.
- h) Pump discharge (hot air) will go out of cabinet.
- i) Two Mains supply boards with required sockets, indicators and switches / MCBs are provided inside the trolley.
- j) One power board will be used for Vacuum pump and the other shall be used for electronic unit.
- k) Internal PVC tubing is done between Suction head, Rotameter, pump etc.