

Portable High-Performance Mercury Analyzer for Field Use

Mercury Sniffer/PM-2

Ž Introduction

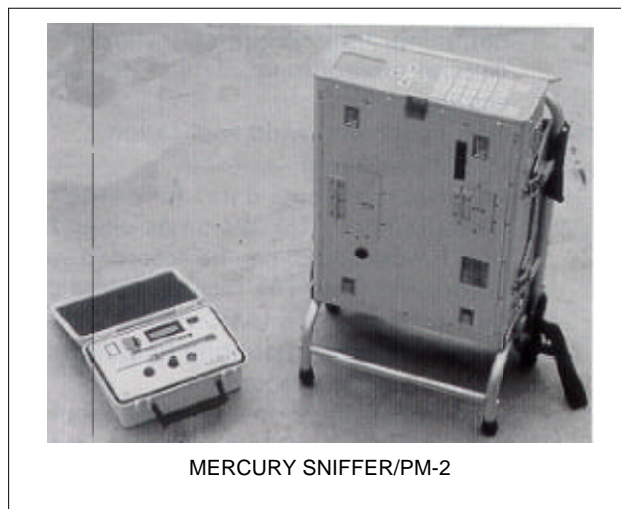
In 1995, JICA requested that Nippon Instruments Corporation (NIC) develop a mercury analyzer capable of measuring mercury gas concentrations around the Amazon River basin in Brazil. The requirements included the capability of making measurements 200 meters above the ground level. NIC developed, introduced and successfully complied to their request for this pioneering measurement system with the Mercury Sniffer/PM-2.

The development of the Mercury Sniffer/PM-2 was based on development work from NIC's PM-1A Portable Mercury Analyzer which had been available for over ten years. The operation of the PM-1A based on the gold-amalgamation cold vapor atomic absorption method.

The PM-1A was developed because many domestic customers, including the Geological Survey Institute, were not satisfied with the performance of the other mercury analyzers available. Up until the introduction of the PM-1A, commercially available systems were for on-the-spot analysis of mercury contamination at the occupational health hazard level, where limited in performance capabilities. They were based on an atomic absorption method and a system utilizing resistance variations of gold thin film.



Fig. 1. Outdoor measurement.



MERCURY SNIFFER/PM-2

These techniques were not capable of the sensitivity levels required for environmental levels and suffered many limitations in field use. At one point, a portable mercury analyzer, based on the Zeeman effect, from a Canadian supplier was thought to be the only system capable of on-site measurements of trace mercury gas. However, this system was not satisfactory for field use due to its insufficient sensitivity, low reliability in humid locations, and its light source lamp's short life span.

Thus, NIC developed the commercially available PM-1A to satisfy the needs of this mercury analysis challenge. NIC continues to expand the commercial availability of systems that measure mercury in its many forms, applications and concentration levels.

Ž Features

1. On-site measurement and recording
 - The measurement result is immediately displayed on the spot and is recorded together with information on temperature, etc. in a data logger self-contained in the system.
2. Sturdy, compact, lightweight, and drip-proof construction

- The main body can be carried on one's back with a dedicated backcarrier to move freely over fields and hills.
 - Transfer of the whole system is also easy, as all of the components including spare parts can be accommodated in a single antishock trunk.
3. High sensitivity and wide measurement range
- 0-5 ng range (Resolution 0.001 ng)
 - 0-100 ng range (Resolution 0.1 ng)
 - Sampling time: ~60 min, 00sec (Setting can be made in units of seconds) -Sampling time required: ~10min for general environment, 1 min~ for labor environment
4. High function and wide application
- Built-in data logger
 - All measurement data for 448-time measurements (for 224 times when the GPS is connected) can be recorded with associated data. The recorded data can be transferred also to PC via RS-232C.
 - Analog signals amounting to external 3 channels can be recorded.
 - The PM-2 can serve as a no-man continuous monitor by setting the auto mode (power supply: a built-in high-performance battery or commercial power supply).
 - For midair measurement by hanging the PM-2 from a balloon and for measurement in a contaminated area, a wireless remote start unit is available (optional).
 - On-site measurement of trace mercury contained in a liquid sample also can be made by reduction-aeration, gold-amalgamation method (optional).
5. Simple operation
- The PM-2 is easy to run. The operator has only to set the operating condition in an interactive manner with a liquid crystal panel mounted on the top of the unit. Sheet switches are large enough to manipulate even with a gloved hand. For condition settings, the operator can call the information in the data logger to refer to it on the panel.

ž Application

- On-site measurement and monitoring of general environmental atmosphere.
- Occupational environments (sites of chlorine and caustic soda plants, various fluorescent tubes plant, mines, chemical lab, hospital, thermometer maker, dental technician's room, etc.)
- Resource investigation, soil gas, volcanic gas.

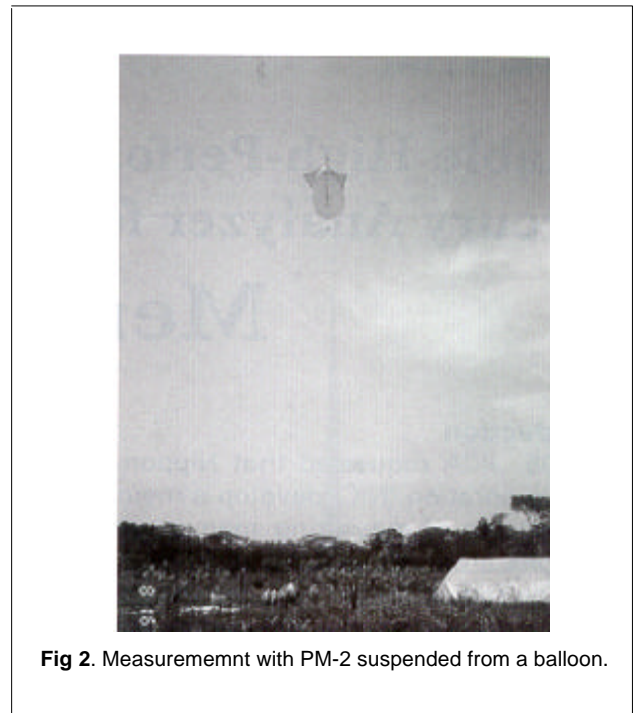


Fig 2. Measurement with PM-2 suspended from a balloon.

- Others: Where mercury is used and its use poses a problem. (semiconductor plant, spaceship assembling site)
- Analysis in ppt order of mercury in liquid (such as rain water)

ž Configuration and Specifications

(1) Block diagram, Fig. 3

(2) Specifications

Measurement method:

Gold-amalgamation cold vapor atomic absorption method

Operating environment:

0°C-40°C, Relative humidity: 95% or less

Measurement range (resolution):

Peak measurement mode: 0-5 ng (0.001 ng)
 Integrated measurement mode: 0-100ng (0.1 ng)

Sampling time:

-60 min, 00 sec (in steps of 1 minute)

Monitor:

Set to auto mode/measurement interval ~24 hrs. (in steps of 1 minute)

Sampling flow rate: ~0.5 lit/min (variable)

Sample gas suction port dia.:

Applicable tube: 4 mm O.D.

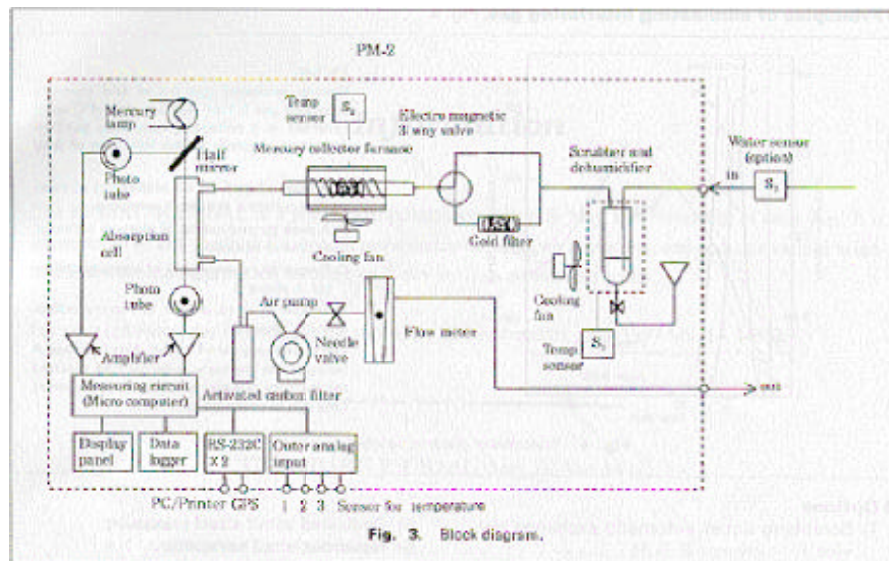


Fig 3. Block diagram.

Measurement frequency example:

60 times/within 12 hours, 20 times/within 24 hours per charged battery, 25°C

Gas scrubbing, dehumidification:

pH-6.86 standard buffer solution, electronic cooling

Temperature sensor:

-20°C-50°C (in steps of 0.1°C)

Data logger

- 1) Number of data for recording: 448 measurements/max. (224 measurements/max. when GPS is used.)
- 2) Recording contents: Date, measuring condition, measured values, etc.
- 3) Data recording from external equipment: 3 channels (analog signals)
- 4) Recorded data display: LCD display on the PM-2 panel
- 5) Recorded data transfer: Transfer to notebook PC (optional 6) via RS-232-C

Self-diagnosis function

- 1) Warning display: Battery rundown, system internal temp. at below 0°C
- 2) Error display: Lamp burn-out, broken heater, contaminated cell, faulty thermal sensor, faulty cooler function

Self protection device

1) Drip-proof construction

2) Prevention of overdischarge of battery/automatic power off

When using optional items:

- 1) For use as a monitor in a highly humid environment (option 1)
- 2) Remote start (option 2)

Effective distance/when visible: ~2 km, when invisible: ~200 m

- 3) Prevention of water suction when collecting soil gas through a hole made in the earth surface. (option 3)
- 4) Measurement of mercury in liquid sample (option 4)

Measurement by the reduction aeration, gold amalgamation method

- 5) Measurement result printout (option 5)
- Sample No., peak profile, mercury quantity and concentration

Power supply (two power supplies)

- 1) Nickel-Metal-Hydrid battery-dedicated charger/needs 3 hours for full charge
- 2) Dedicated adaptor-85 V~240 V AC, input voltage automatic switchover

Dimensions & weight

300 mm(W) x 100 mm(D) x 430 mm(H), 7.9 kg (main body and battery)

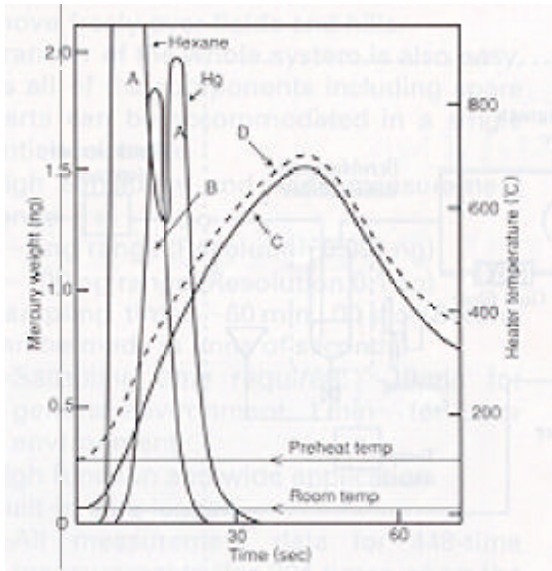


Fig. 4. Principles of eliminating interfering gas

Sample:

Hexane saturated gas 0.5ml and mercury saturated gas 0.1 ml (1.89ng) at 24.4°C were collected in a collecting tube with purified dry air as a carrier at the flow rate of 0.51/min.

A A peak caused by no preheating of mercury collector at time of sampling.

B A peak by preheating of mercury collector at time of sampling.

C Temperature variations of mercury collector in above A

D Temperature variations of mercury collector in above B.

The peak B appeared earlier than the peak A because the mercury collector had reached the mercury release temperature in a shorter time due to preheating.

355 mm(W) x 190 mm(D) x 560 mm(H), 9.5 kg (main body, battery, backcarrier)

Dimensions & weight of carrying case (when accommodating the PM-2 main body, accessories, spare parts, etc.)

725 mm(W) x 595 mm(D) x 400 mm(H), 34.5 kg (not including caster 100 mm width)

ž Options

1) Scrubbing liquid automatic exchange device

2) Wireless remote-start unit

3) Sensor for water suction

4) Liquid sample measurement kit

5) Dedicated small-sized printer

6) Notebook-sized computer

7) Printer for the above

8) GPS

9) Balloon and winch

