

# SM-4 Mercury Stack Monitor

## Monitoring of Total Mercury Emissions

An  
approved  
solution  
from the  
Mercury  
Experts

- Continuous operation
- Sample dilution directly at stack – works with virtually any sample matrix
- Maintenance-free converter
- Thermocatalytic principle – no wet chemistry
- Detects elemental, ionic and bound mercury
- Automatic calibration systems (ionic and elemental mercury)



Mercury Instruments has specially designed the SM-4 Mercury Stack Monitor to meet requirements to measure very low Hg concentrations in stack gases with a matrix containing SO<sub>2</sub>, NO<sub>x</sub>, HCl and others. Applications for the SM-4 include coal-fired plants, waste incinerators, cement kilns and all other operations with process gases that contain mercury traces in a complex matrix.



## Applications

- Compliance monitoring, mercury removal control, stack testing
- Coal-fired power plants
- Waste incinerators (municipal, industrial, hazardous waste)
- Sewage sludge incinerators
- Cement kilns
- Thermal treatment plants (soil, hazardous waste and others)
- Metallurgical plants

## Operating Principle

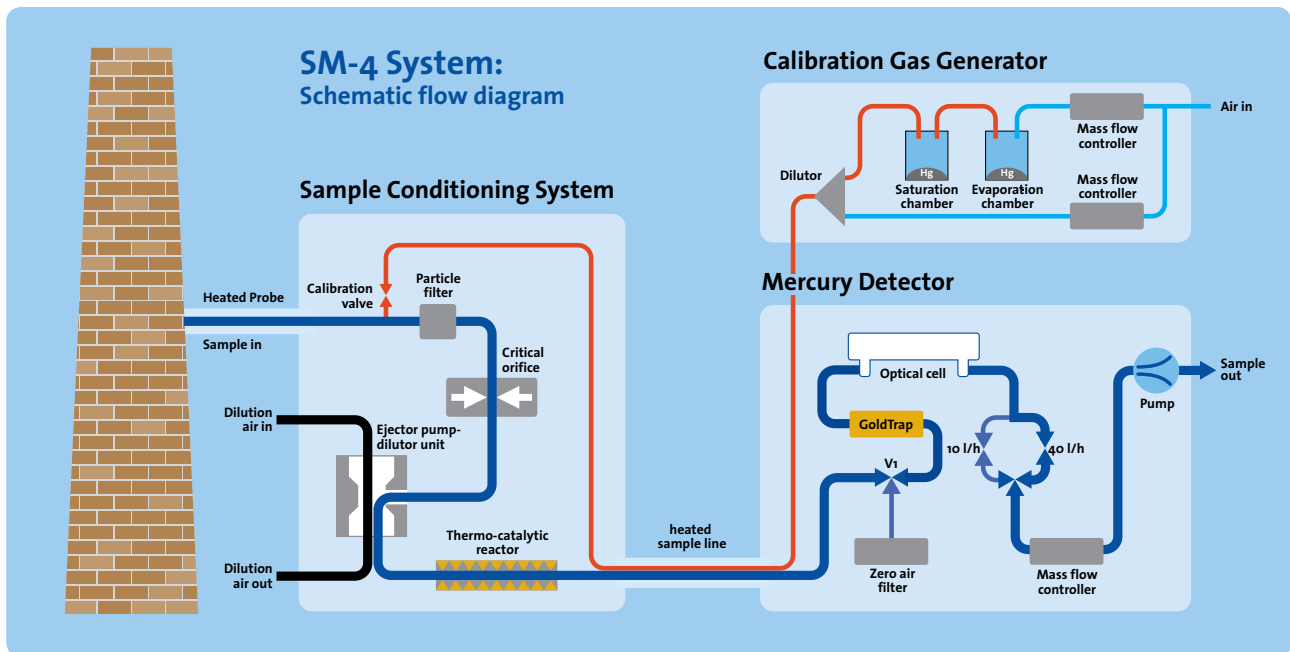
The heated sampling probe is mounted at the stack. A maintenance-free injector pump continuously draws sample gas into a dilution unit and past a heated particle filter. A critical orifice stabilizes the sample flow, thus making it independent of the pressure in the stack. A sensor continuously controls the suction vacuum. A partial flow of the diluted sample is passed through a catalyst where the different forms of mercury contained in the sample are converted to the elemental state. This treated sample is then transported through slightly heated PFA tubing to the mercury detector, which may be tens or even some hundreds of feet away from the sampling probe. The detector uses a pre-concentration technique featuring the unique Mercury Instruments GoldTrap, one of the most sensitive mercury detection devices in the market.



SM-4 analyzer cabinet

## Thermocatalytic Reactor

The mercury present in stack gases is most often elemental, but ionic and bound mercury occurs also. To measure total mercury, all these different species must be successfully detected. To this end the SM-4 uses a thermocatalytic method to convert all mercury to its elemental form. The reactor works without wet chemistry and therefore assures high reliability with low demand for maintenance.

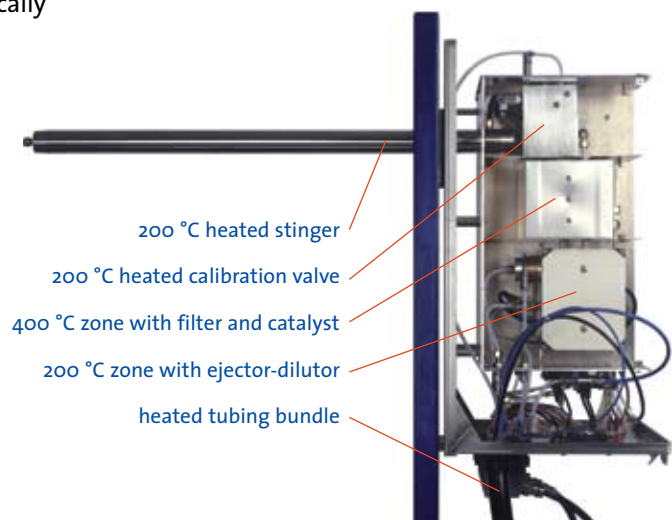


## Detector

The SM-4 uses a highly sensitive detector based on the atomic absorption principle, and featuring an amalgamation unit (GoldTrap) connected upstream. The ultrapure gold surface captures the mercury which is then abruptly released when the gold trap is rapidly heated to approximately 700° C. Purified air is used as a carrier, which produces a self-cleaning effect, avoids passivation, and results in prolonged life for the gold trap.

## Sampling Probe

The sampling probe has a key role: to extract a representative sample of gas and supply it to the sample conditioning system. All parts that come into contact with the sample are made of PFA (perfluoralkoxy) or silica coated, guaranteeing a minimum memory effect. All parts are heated so no mercury is retained in the probe. An automatically backflushed filter keeps particles away from the analytical pathway of the sample. An automatic valve allows calibration gas to be introduced upstream of the sample filter. Both the dilution unit and the catalyst are integral to the sampling probe, thus ensuring minimum length for their connecting lines.



## Interference Prevention

SO<sub>2</sub>, NO<sub>x</sub>, HCl, and VOCs all interfere with standard mercury measurement techniques. The most up-to-date mercury CEMs try to minimize this negative effect with an amalgamation step or sample dilution. Amalgamation alone, however, reaches its limit when the gold surface is affected by matrix constituents, whereas sample dilution alone may not reduce interference to tolerable levels. The SM-4 uses both sample dilution and gold trap amalgamation to completely eliminate interference.

## Features and Benefits of the SM-4

- Dry thermocatalytic method: no need for reagents, water refills or solid reagent cartridge replacements
- Sample dilution eliminates interference from matrix gases such as SO<sub>2</sub>, NO<sub>x</sub>, and HCl and produces a large measuring range
- No liquid waste or condensate is generated
- Extreme high sensitivity: low measuring range is 0.05 µg/m<sup>3</sup>
- Automatic backflush of particulate filter
- Fast response: t(90) time typically 180-360 sec
- Sample line length up to 300 feet
- Ready for temporary or fixed installation of an ionic calibration gas source (HOVACAL®, HOVAQUICK®)
- Option to install an elemental mercury calibration gas generator, NIST traceable, inside the analyzer cabinet
- Very low maintenance

## Automatic Calibration

The SM-4 is packaged with daily calibration sources as per EPA and other national and international quality control requirements. It is available with built-in span calibration sources for elemental or ionic mercury and can also perform a baseline check automatically. The latest development is a calibration gas generator that produces ionic mercury reference gas and can be integrated into the SM-4 system for automatic operation. Quality assurance during operation as required by the European Regulation EN 14181 (QUAL3) can be performed automatically.

## System components

- Sample conditioning system with detachable sampling probe
- Heated bundle containing sample line, air supply line, calibration gas feed line
- Probe controller module
- Analyzer cabinet with detector and calibrator (option)

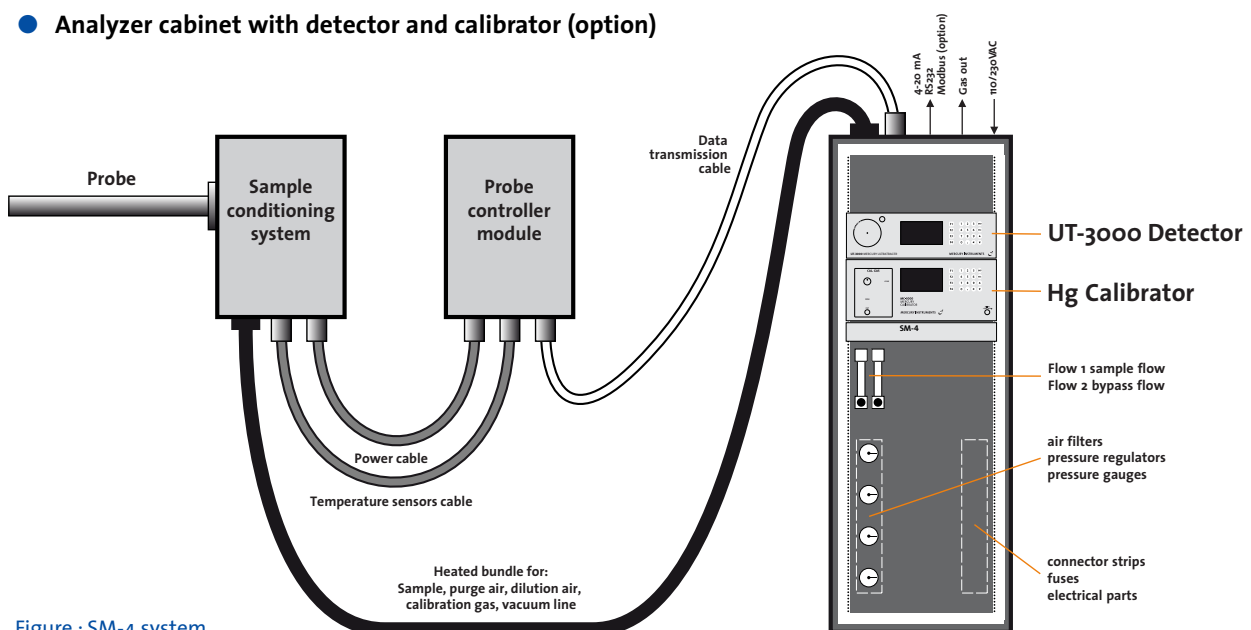


Figure : SM-4 system components

# TECHNICAL SPECIFICATIONS

## SM-4 MERCURY STACK MONITOR

<b>Principle of Measurement:</b>	Mercury dilution probe with thermocatalytic converter at stack, fast loop to analyzer unit, atomic absorption detector with Gold Trap
<b>Detector:</b>	Cold vapor atom absorption spectrometry (CVAAS) with amalgamation, wavelength 253.7 nm
<b>Measured component:</b>	Hg <sup>T</sup> (total mercury)
<b>Measuring range:</b>	0.05 µg/m <sup>3</sup> to 500 µg/m <sup>3</sup> Hg (optionally up to 1000 µg/m <sup>3</sup> )
<b>Detection limit:</b>	0.0001 µg/m <sup>3</sup> (detector); <0.01 µg/m <sup>3</sup> (system)
<b>Response time:</b>	180 – 360 sec
<b>Max. Sample gas temperature:</b>	250°C (482°F)
<b>Ambient temperature range allowed:</b>	-5°C to 40°C (23°F to 104°F)
<b>Sample line length:</b>	Up to 30 m (100 feet); up to 100 m (300 feet) optionally
<b>Signal output:</b>	4-20 mA (max. 500 Ohms); RS232; modbus RTU/RS485 (option) ; ethernet (option)
<b>Status output:</b>	3 x pairs of relay contacts (dry contacts)
<b>Remote access:</b>	Modem and SM-4 communication software (option)
<b>Electrical power consumption:</b>	230 V AC/50-60 Hz (115 V AC/ 50-60 Hz); analyzer cabinet : 450 W, probe/converter unit : 1000 VA, sample line 30 W per meter (10 W per foot)
<b>Dimensions:</b>	Analyzer cabinet: 161 x 60 x 60 cm (63.6" x 23.6" x 23.6") HxWxD Probe: 36 x 36 x 66 cm (14.2" x 14.2" x 26") HxWxD Probe controller: 48 x 44 x 27 cm (19" x 17" x 11") HxWxD
<b>Weight:</b>	Analyzer (including automatic calibrator): 130 kg (285 lbs) Probe controller: 14 kg (30 lbs) Converter unit: 28 kg (62 lbs)
<b>Air consumption:</b>	5 bar (72 PSI); 16 l/min approx.
<b>Calibration/span check:</b>	Automatically, with calibration gas from a cylinder or with an integrated calibration gas generator (option). A heated fitting is installed at the probe for span check and converter efficiency check with ionic mercury
<b>Certifications:</b>	Conforms to US EPA 40CFR60 PS-12A Mercury CEMS





## MERCURY INSTRUMENTS ANALYTICAL TECHNOLOGIES

### What are the advantages of Atomic Absorption with Amalgamation ?

- No carrier gas needed, unlike typical atomic fluorescence (AF) systems
- Higher sensitivity than AF systems without gold trap
- Comparable sensitivity to AF systems with gold preconcentration (MDL <math>0.05 \text{ ug/m}^3</math>)
- Atomic absorption (AA) not prone to quenching effect (molecules which cause quenching of atomic fluorescence radiation do not interfere with atomic absorption)
- No compensation or correction provisions required, unlike direct AA
- Allows components such as  $\text{SO}_2$ ,  $\text{O}_2$ ,  $\text{NO}_x$ , and organics to be present at levels 1000 to 100000 times higher than mercury
- No zero drift due to amalgamation technique
- Linear range over five orders of magnitude

### The Challenge: Mercury Analysis. The Response: Mercury Instruments.

Quantitative trace analysis of mercury has challenged the world until now. At Mercury Instruments, we have made it our job to develop the instruments to analyze mercury at the highest technical level. We uniquely offer mercury analyzers to fit the widest range of applications worldwide.



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