

MMS

Mercury Monitoring System for Natural Gas



- Automatic and Continuous Operation
- Fast and Reliable Results
- Detects Elemental and Bound Mercury
- Automatic Calibration
- Sample Point Multiplexer
- Sample Dilution for High Concentrations
- No Carrier Gases Required
- Certified for Hazardous Zones



MMS Mercury Monitoring System for Natural Gas

Natural gas often contains mercury at concentrations that vary from below 1 to above 10000 $\mu\text{g}/\text{m}^3$. Mercury is both toxic and potentially damaging: it can corrode or embrittle common gas plant components. Gas plants reduce mercury in natural gas with mercury removal units (MRUs). MRUs use fixed bed absorbers, often with sulfur-impregnated carbon or other chemisorbents as the active material. The Mercury Monitoring System is an ideal tool to determine the efficiency of each MRU in real time, and necessary to successfully monitor and control mercury concentrations during natural gas production and processing.



Continuous Measurement of Mercury in Natural Gas

Mercury Instruments has engineered a system for automatic and continuous monitoring of mercury levels in natural gas and other flammable gases. We install the mercury analyzer (and accessories such as a calibrator) in a pressurized enclosure that is approved for use even in hazardous zones (ATEX, EExP). A heated system takes the sample and guides it to the analyzer via stainless steel tubing that has been surface-treated for ultra-low adsorptivity. A built-in gas sensor will shut the system down and stop the sample gas flow if any leakage is detected.

Highly Selective and Sensitive Detector

The UT-3000 Mercury Ultratracer is used to detect and precisely measure mercury levels in natural gas. A proprietary gold collector selectively absorbs mercury from a constant sample volume. The collector is then heated for a very short period. The mercury is thus released into an optical cell and quantitatively detected using atomic absorption measurement (AAS). In contrast to atomic fluorescence systems, the UT-3000 does not require special carrier gases. Air is used as a carrier gas, thus keeping the gold surface clean and enhancing the collector lifetime compared to other systems. With the UT-3000, interference from hydrocarbons or other gaseous components is insignificant (see Benzene interference diagram).



Mercury Monitoring System for natural gas, single point version with automatic calibration unit



A Mercury Removal Unit (MRU) on an offshore platform. The MRU reduces the mercury in a natural gas stream via a bed of sulfurized activated carbon. The mercury concentration at the outlet is monitored to be less than 10 ng/m^3 ; this level is regarded as harmless to plant components downstream.



Sample Conditioning Systems (SCS) for natural gas. The SCS is installed close to the sampling point and reduces pressure from process conditions to 1-2 bar. The method of construction assures that the mercury concentration in the sample stream remains unaltered when flowing through the SCS.

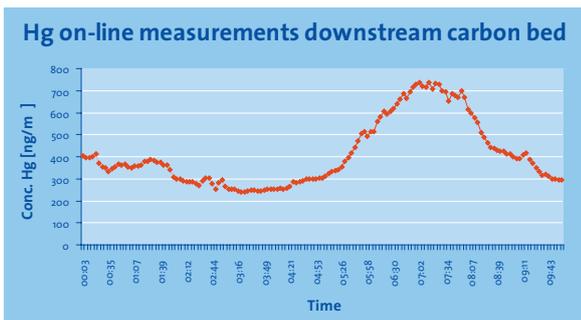
Sampling System for Natural Gas

The integrity of the sampling system is as important as the analyzer itself. To sample natural gas from a pipeline, the sampling system must reduce pressure and guide the sample from the sampling point to the analyzer, leaving the mercury concentration unchanged. Plus it should show a minimum lag time and be suited to hard use in hazardous zones. The MMS sample conditioning system by Mercury Instruments fulfills these requirements. The surface of the pressure-reduction system is electrically heated to obviate condensation and mercury loss caused by the Joule-Thomson cooling effect. A specially coated coalescing filter effectively removes aqueous mist as well as hydrocarbon condensate. Tubing and filter surfaces are specially coated for ultra-low adsorption and constantly conditioned with sample gas. Our system design allows a maximum input pressure of 3480 psig (240 bar) and the output pressure is adjustable from 1 to 28 psig (0.07 to 2 bar).

Sampling Point Multiplexer

For process control it is often useful to monitor mercury levels at different process points - the inlet and outlet of each mercury removal system, for example. Our microprocessor-controlled multiplexer unit feeds samples from up to 16 sampling points to the analyzer for sequential measurement. Using the fast loop principle all sample lines, including those currently not being measured, are continuously purged with sample and thereby constantly preconditioned. A short response time is the result.

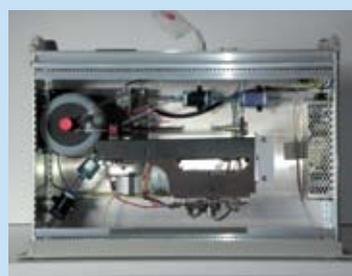
MMS Mercury Monitoring System with two detectors, sample point multiplexer, multiplexer-valve unit and automatic calibrator



Continuous mercury measurement in a natural gas process stream after a mercury removal unit (MRU).

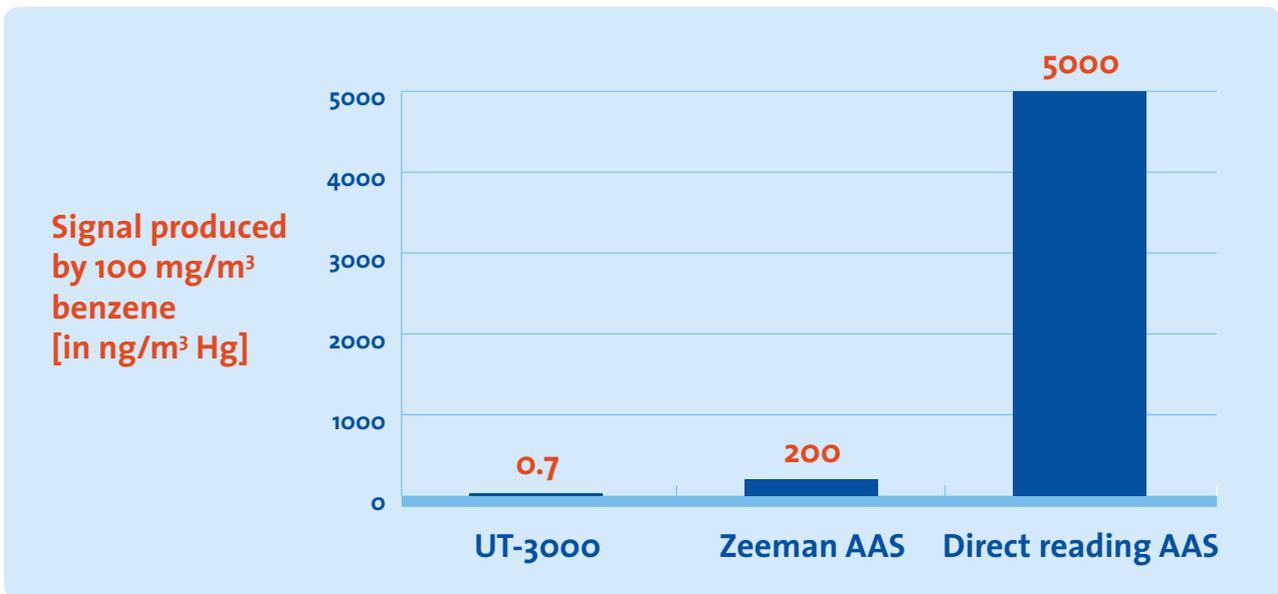


On-line field measurement of mercury in a natural gas plant. This mobile setup employs a SCS and a UT-3000 Mercury Ultratracer. The result: quick measurement of the mercury load of the gas at different points and its distribution in the process.



Automatic calibration unit. The system is based on mercury concentration in a saturation chamber. This concentration is automatically calculated using the mercury vapor pressure equation according to NIST.

Benzene interference of different detectors



Calibration and Quality Assurance

For quality assurance a regular calibration check is recommended. Calibration can be performed manually using the Manual Calibration Set or automatically with the Automatic Calibration Unit. Both devices use the principle of static calibration with mercury-saturated air. These devices are maintenance-free and unlike permeation devices do not require re-weighing.

Calibration gas is generated in a mercury chamber surrounded by a thermoelectrically cooled aluminum jacket. The chamber contains highly pure elemental mercury, and the temperature of the mercury is precisely measured by a sensor. The UT-3000 analyzer uses this temperature signal to calculate the true mercury concentration via the mercury vapor pressure equation recommended by the NIST*. A small volume of air is extracted from the mercury chamber with a syringe and injected into the analyzer's calibration port.

The Automatic Calibration Unit is permanently installed in the analyzer cabinet, and it extracts the mercury vapor and injects it into the UT-3000 calibration port by means of a digital syringe. Up to 12 calibration points can be programmed, and automatic calibration can be set to repeat at a fixed time interval or at a fixed daily hour.

* National Institute of Standards and Technology

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Manual calibration of the mercury analyzer. A known volume of calibration gas is drawn from the calibration device using a gas-tight microsyringe and injected into the analyzer's calibration port.



Sample point multiplexer unit. Up to 16 sample streams can be connected to the multiplexer inlet. For minimum response times, the sample lines are continuously purged to keep them conditioned. Specially coated bypass filters retain entrained liquids (coalescing filters can also be used).

TECHNICAL SPECIFICATIONS OF THE MMS FOR NATURAL GAS

Detector

Detection principle:	Atomic Absorption Spectrometry (AAS)
Analytical wavelength:	253.7 nm
Matrix effect elimination:	Goldtrap technique
Measuring range:	0.001 µg/m ³ ... 50 µg/m ³ (with sample dilution system up to 2000 µg/m ³)
Signal output:	4-20 mA; RS232; Modbus RTU RS485, Ethernet

Multiplexer

Number of sample points:	2-16
Measuring duration for one measurement:	approx. 3 minutes
Purge of sample lines:	continuously

Sample Conditioning System (SCS)

Max. inlet pressure:	240 bar (3480 psi)
Pressure regulator:	heated to compensate for Joule-Thomson cooling (EEx certified)
Sample wetted surfaces:	coated for low mercury adsorption

Automatic Calibrator

Operating principle:	Mercury vapor saturation, injection of a constant volume
Calculation of mercury vapor pressure:	according to NIST recommended equation

Certification and Applied Standards

Hazardous zone certification:	ATEX 2G IIC T4 EExp (or equivalent)
Calibration :	ISO/DIS 6978-3 ; ASTM D 5954 ; VDI 2267 Part 8 ; NIST recommendations
Sampling and mercury determination :	ISO 6978-1; ASTM 5954

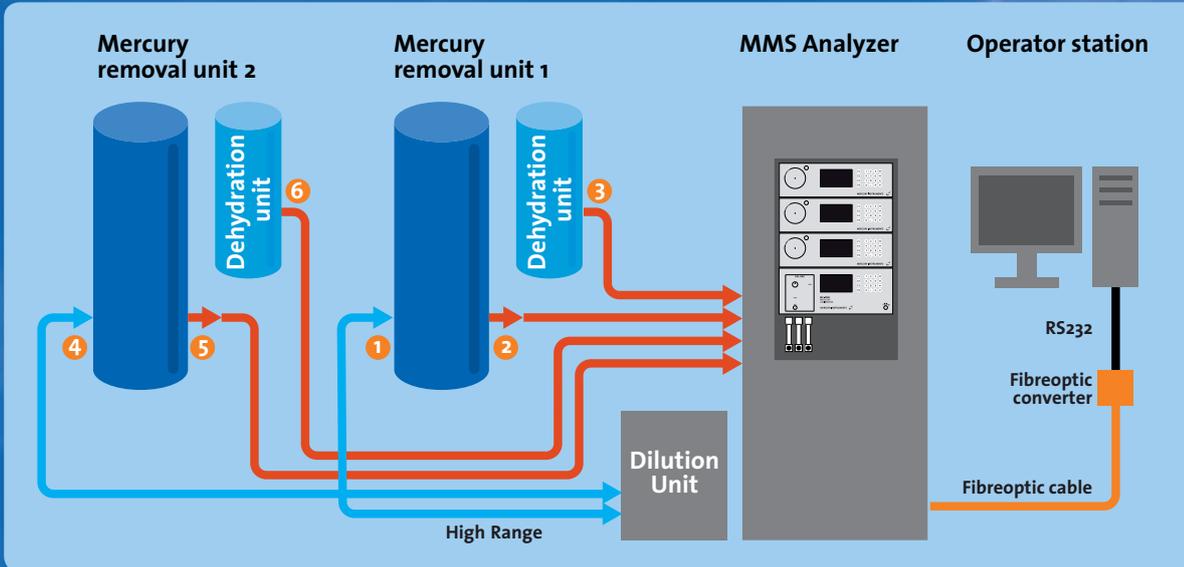
Customized Solutions

Each mercury on-line system will differ in sample characteristics as well as installation conditions and operating environment, and thus will require a customized solution. Mercury Instruments has the experience to design systems that fully meet the requirements of your particular mercury monitoring task.





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Example: the MMS Mercury Monitoring System installed in a gas separation plant, where mercury must be removed from the gas to avoid corrosion of aluminum heat exchangers and to produce mercury-free product streams. The MMS is the perfect tool to monitor the efficiency of the mercury removal units and to verify a low mercury concentration in the processed gas.

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

Quantitative trace analysis of mercury has been a challenging task for the analyst until now. We from Mercury Instruments have made it our job to develop instruments for mercury analysis of the highest technical level. The range of applications for our mercury analyzers is unique world-wide.



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