Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

CERTIFICATE

on Product Conformity (QAL1)

Certificate No.: 0000036948_01

Approved AMS:	SM-4 for Hg	
Manufacturer:	Mercury Instruments GmbH Liebigstraße 5 85757 Karlsfeld Germany	IMT Innovative Meßtechnik GmbH Am Forst 11 92648 Vohenstrauß Germany
Test Institute:	TÜV Rheinland Energie und Umwelt GmbH	

This is to certify that the AMS has been tested and found to comply with:

EN 15267-1: 2009, EN 15267-2: 2009, EN 15267-3: 2007 and EN 14181: 2004

Certification is awarded in respect of the conditions stated in this certificate (see also the following pages).

The present certificate replaces Certificate No. 0000036948 of 20 August 2012

www.tuv.com TÜVRheinland® ID: 0000036948

- EN 15267-3 tested
- QAL1 certified
- TUV approved
- Annual inspection

Publication in the German Federal Gazette (BAnz.) of 05 March 2013

This certificate will expire on: 19 July 2017

German Federal Environment Agency
Dessau, 22 March 2013

i. A. Dr. Marcel Langner

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 21 March 2013

ppa. Dr. Peter Wilbring

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Accreditation according to EN ISO/IEC 17025 and certified according to ISO 9001:2008.	

Test report:	936/21213740/B of 13 October 2012
Initial certification:	20 July 2012
Expiry date:	19 July 2017
Publication:	BAnz AT 05 March 2013 B10, chapter I, No. 2.1

Approved application
The tested AMS is suitable for use at combustion plants according to EC Directive 2001/80/EC and at waste incineration plants according to EC Directive 2000/76/EC and other plants requiring official approval. The measured ranges have been selected considering the wide application range of the AMS.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a six-month field test at an industrial plant for hazardous waste incineration, a one-month field test at a lignite-fired power plant (fluidized-bed firing) using secondary fuel and a one-month field test at a rotary kiln for lime production (fuels: lignite dust/natural gas and secondary fuel).

The AMS is approved for an ambient temperature range of +5 °C to +40 °C.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the installation at which it will be installed.

Basis of the certification
This certification is based on:

- test report 936/21213740/B of 13 October 2012 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- the ongoing surveillance of the product and the manufacturing process
- publication in the German Federal Gazette: BAnz AT 05 March 2013 B10, chapter I, No. 2.1

AMS designation:
SM-4 for Hg

Manufacturer:
Mercury Instruments GmbH, Karlsfeld,
IMT Innovative Messtechnik GmbH, Moosbach

Field of application:
Measurement at plants requiring official approval such as plants within the scope of 2000/76/EC (waste incineration directive) and 2001/80/EC (large combustion plants directive)

Measuring ranges during performance test:

Component	Certification range	Supplementary range	Unit
Hg	0 – 45	0 – 100	µg/m³

Software version:
6.37 D

Restriction:
The requirement of the DIN EN 15267-3 for the response time was not met during the suitability test.

Notes:
1. Wet gases shall be used for span point tests (QAL3). To this effect, the AMS is equipped with a test gas generator. An external test gas generator (type HOVACAL) may be used alternatively.
2. The maintenance interval is three months.
3. Every third day, the AMS performs an automatic span point correction.
4. The length of the test gas line during the testing procedure was between 15 and 19,5 m.
5. A complementary test (approval of an additional plant of application) to Federal Environmental Agency notice of 6 July 2012 (Federal Gazette (BAnz.) AT 20 July 2012 B11, Chapter I Number 2.1).

Test report:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21213740/B of 13 October 2012

Certified product
This certificate applies to automated measurement systems conforming to the following description:

The SM-4 measuring system is an extractive instrument that measures total mercury, i. e. mercury, ionic mercury and mercury in its compounds.

An ejector pump, which is operated with compressed air, continually draws sample gas from the flue gas duct via a heated sampling probe (180°). Stack gas passes by a heated filter. Instrument air serves to dilute flue gas at a constant ratio. Subsequently, a partial stream of diluted gas is passed through a thermocatalytic converter. All mercury compounds are converted to elemental mercury. After its conversion, mercury in the diluted gas stream passes through a heated sample gas line and is led to the detector inside the analyser cabinet. Mercury concentration is determined by means of atomic absorption of UV radiation at a wavelength of 253.7 nm with amalgamation and a gold trap for capturing and separating the sample matrix.

The SM-4 measuring system consists of the following components:

- sampling conditioning system including a probe, filter, dilution system, a thermocatalytic reactor, a vaporizer for the test gas generator and a control unit
- a heated sample gas line with a bundle containing supply lines for sample gas as well as other transmission media for the probe and the sample gas generator (length of 15 m during the suitability test)
- an analyser cabinet with a bypass pump, a detector, a control unit for a calibration gas generator
- The software version of the measuring system is 6.37D.

The sampling system and the sample conditioning system of the SM-4 measuring system are directly mounted to the sampling probe. Sample gas is extracted from the stack at a low flow rate of 12 l/h and passed through the probe filter in order to remove dust particles from the sample gas. Subsequently, a critical nozzle is used to dilute the sample gas by a factor of 50. This serves to reduce the effects of cross-sensitivities and the concentration of interferents to tolerable levels. After purification and dilution, the sample gas is led through a thermocatalytic reactor. Inside the reactor, the entire mercury contained in the sample gas is converted to elemental mercury. Subsequently, the sample gas is transported to the analyser cabinet via the sampling probe line. The gas is transported via an ejector operated with compressed air, which is also located at the probe. The converter, ejector, critical nozzle and particle filter are installed in a heater with a temperature of 200°. The converter itself is heated to 400°. The entire sample gas path of the measuring system is cleaned with purge air at each cycle (every 4 minutes).

Also integrated in the probe is a sample gas generator, which serves to feed test gas directly to the probe of the measuring system. The test gas generator continuously vaporises a solution containing Hg in a special vaporiser and mixes it with a specific carrier gas (purge air). This is then brought to the test item. Variation of the carrier gas flow rate, the liquid flow rate and the concentration of the solution allows for adjusting the concentration of the test gas. The carrier gas flow rate and the liquid flow rate are fixed and continuously monitored during the application of the test gas. Additionally, the probe controller unit is installed at the measurement site near the probe. This control unit primarily contains temperature controllers.

The analyser cabinet contains the photometer in order to determine the Hg-concentration, together with the amalgamation unit, transmission media supply for the measuring system and the control unit for the test gas generator as well as electronics and the instrument reading.

During cyclical operation, the SM-4 measuring system works with amalgamation steps. One cycle is made up by 6 steps. Each step is displayed clearly.

Sampling (90 s), Zeroing (12 s), heating of the gold trap (23 s), first of the gold trap (45 s including zero point), cleaning of the gold trap after the measurement (25 s), second cooling phase (45 s).

General notes

This certificate is based upon the equipment tested. The manufacturer is responsible for ensuring that on-going production complies with the requirements of the EN 15267. The manufacturer is required to maintain an approved quality management system controlling the manufacture of the certified product. Both the product and the quality management systems shall be subject to regular surveillance.

If a product of the current production does not conform to the certified product, TÜV Rheinland Energie und Umwelt GmbH must be notified at the address given on page 1.

A certification mark with an ID-Number that is specific to the certified product is presented on page 1 of this certificate. This can be applied to the product or used in publicity material for the certified product.

This document as well as the certification mark remains property of TÜV Rheinland Energie und Umwelt GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energie und Umwelt GmbH this document shall be returned and the certificate mark must not be employed anymore.

The relevant version of this certificate and its expiration is also accessible on the internet: **qal1.de**.

Certification of SM-4 for Hg is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial certification according to EN 15267:

Certificate No. 0000036948: 20 August 2012

Expiry date of the certificate: 19 July 2017

Test report: 936/21213740/A vom 26 March 2012
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 20 July 2012 B11, chapter I, No. 2.1
Announcement by UBA from 06 July 2012

Supplementary testing according to EN 15267:

Certificate No. 0000036948_01: 22 March 2013

Expiry date of the certificate: 19 July 2017

Test report: 936/21213740/B of 13 October 2012
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 05 March 2013 B10, chapter I, No. 2.1
Announcement by UBA from 12 February 2013

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system			
Manufacturer	Mercury Instruments GmbH IMT Innovative Messtechnik GmbH		
Name of measuring system	SM-4		
Serial number of the candidates	706 / 707		
Measuring principle	UV-Measurement with dillution, catalytic sample treatment and amalgamation		
Test report	936/21213740/B		
Test laboratory	TÜV Rheinland		
Date of report	2012-10-13		
Measured component	Hg		
Certification range	0 - 45	µg/m³	

Evaluation of the cross sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point	0.00	µg/m³	
Sum of negative CS at zero point	0.00	µg/m³	
Sum of postive CS at reference point	1.71	µg/m³	
Sum of negative CS at reference point	-1.58	µg/m³	
Maximum sum of cross sensitivities	1.71	µg/m³	
Uncertainty of cross sensitivity	0.990	µg/m³	

Calculation of the combined standard uncertainty					
Standard deviation from paired measurements under field conditio	u_D			u^2	
Standard deviation from paired measurements under field conditions *	u_D		µg/m³	0.155	(µg/m³)²
Lack of fit	u_{lof}		µg/m³	0.213	(µg/m³)²
Zero drift from field test	$u_{d,z}$		µg/m³	0.043	(µg/m³)²
Span drift from field test	$u_{d,s}$	0.753	µg/m³	0.567	(µg/m³)²
Influence of ambient temperature at span	u_t	0.557	µg/m³	0.310	(µg/m³)²
Influence of supply voltage	u_v	0.225	µg/m³	0.051	(µg/m³)²
Influence of sample pressure	u_p		µg/m³	0.000	(µg/m³)²
Influence of sample gas flow	u_h		µg/m³	0.000	(µg/m³)²
Variation of response factors (TOC)	u_{rf}		µg/m³	0.000	(µg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.57	µg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.07	µg/m³

Relative total expanded uncertainty	**U in % of the ELV 30 µg/m³**	**10.2**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 30 µg/m³**	**40.0**
Requirement of EN 15267-3	U in % of the ELV 30 µg/m³	30.0