

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000050628

Certified AMS: Mercury Freedom System for Hg

Manufacturer: Thermo Fisher Scientific
27, Forge Parkway
Franklin, MA 02038
USA

Test Institute: TÜV Rheinland Energy GmbH

**This is to certify that the AMS has been tested and certified
according to the standards**

**EN 15267-1 (2009), EN 15267-2 (2009), EN 15267-3 (2007)
and EN 14181 (2005)**

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 6 pages).



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000050628

Publication in the German Federal Gazette
(BAnz.) of 14 March 2016

This certificate will expire on:
13 March 2021

German Federal Environment Agency
Dessau, 25 April 2016

TÜV Rheinland Energy GmbH
Cologne, 24 April 2016



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Test institute accredited to EN ISO/IEC 17025:2005 by DAkkS (German Accreditation Body).
This accreditation is limited to the accreditation scope defined in the enclosure to the certificate D-PL-11120-02-00

Test report:	936/21219281/B of 19 October 2015
Initial certification:	14 March 2016
Expiry date:	13 March 2021
Publication:	BAnz AT 14.03.2016 B7, chapter I No. 1.1,

Approved application

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III and at waste incineration plants according to Directive 2010/75/EU, chapter IV. The tested ranges have been chosen with respect to the wide application range of the AMS.

The suitability of the AMS for this application was assessed on the basis of a laboratory test, a three-month field test at a waste incineration plant and a one month field test at a lignite power station.

The probe is approved for an ambient temperature range of -20 °C to +50 °C and the analyser cabinet may only be operated within an ambient temperature range of +15 and +40 °C.

The notification of suitability of the AMS, performance testing, and the uncertainty calculation have been effected on the basis of the regulations valid at the time of performance testing. As changes in legal regulations are possible, any potential user should ensure that this AMS is suitable for monitoring the limit value relevant to the application.

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 936/21219281/B of 19 October 2015 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 14 March 2016 B7, chapter I number 1.1,
Announcement by UBA from 18 February 2016:

AMS designation:

Mercury Freedom System for Hg

Manufacturer:

Thermo Fisher Scientific, Franklin, USA

Field of application:

For measurements at combustion plants according to 13. BImSchV and
at waste incineration plants according to 17. BImSchV

Measuring ranges during the performance test:

Component	Certification range	Supplementary range		Unit
Hg	0 - 0.030	0 – 0.045	0 – 0.100	mg/m ³

Software version:

Prod: Model 80i
Version: 02.02.04.377
Firmware: 11.54.154

Restrictions:

1. The analyser cabinet may only be operated in an ambient temperature range of +15 to +40 °C.
2. Operation of the AMS and the compensation of cross-sensitivity effects requires an oxygen measuring instrument that is fitted in the same measurement path. The oxygen measurement instrument must at least be certified according to EN 15267 and operated according to the requirements of EN 14181.

Notes:

1. The maintenance interval is four weeks.
2. Testing Hg requires the application of moist test gases.
3. For regular monitoring of the AMS in operation (QAL3) as well as for annual functional testing (AST), a suitable external test gas generator (e. g. Hovacal) for Mercury test gas must be applied.
4. During performance testing, the measurement path length was 10 m in the laboratory test and in the field test.

Test report:

TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21219281/B dated 19 October 2015

Certified product

This certificate applies to automated measurement systems confirming to the following description:

Mercury Freedom System is a complex AMS, which uses for the mercury analysis the principle of atom fluorescence measurement. The sample gas is diluted for measurement. The implementation of the mercury species exciting in the sample gas is carried out thermal catalytic procedure.

A large partial volume flow from the flue is taken as sample gas. Afterwards, it is led back to the flue. From this "Fast Loop" a small sample volume flow is taken and diluted. After that, the sample volume flow is divided. A part of the sample volume flow is led through a scrubber. In the scrubber, the chemical tied mercury in the sample is separated so that the sample gas stream consists of elementary mercury Hg(0) only. The other part of the sample gas stream is led through a thermal converter. Chemically bonded mercury is changed to elementary mercury in this converter, so that all mercury in this sample gas stream is available as Hg(0). All functionalities that have been described so far are effected in the sampling probe. Both partial flows are led separately to the analyzer cabinet.

Analysis of mercury is carried out according to the principle of atomic fluorescence.

By alternating analysis of one or the other partial flow, the measuring system is able to determine total mercury content in the waste gas, part of Hg(0) in the waste gas as well as the chemically bonded Mercury in the waste gas detected by calculating the difference. Since only the total mercury content is relevant for the emission monitoring in Europe, the measuring system was operated during the entire testing in the mode of total mercury determination.

Mercury Freedom System mainly consists of the following components:

- Sampling probe model 83i with heated probe tube, a "Fast Loop" suction unit, a dilution unit and a reduction unit,
- the analyser cabinet with the following modules:
 - Mercury analyser model 80i,
 - Mercury reference gas generator model 81i,
 - a sampling control unit model 82i,
 - a hydrator for the test gas,
 - a nitrogen generator (MaxSense),
 - a compressed air processing system for zero air supply,
 - zero air processing containing of a 3-step absorber unit with filled cartridges of silica gel, a molecular sieve and charcoal.
 - Software version:

Prod:	Modell 80i
Vers.:	02.02.04.377
Firmware:	11.54.154

Additionally, the operation requires an oxygen analyser certified according to EN 15267. The oxygen analyser's signal is required for the compensation of cross-sensitivity.

QAL3/AST works require the application of a suitable external test gas generator.

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 Energy 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 Energy GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energy GmbH this document shall be returned and the certification 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 Mercury Freedom System 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. 0000050628 25 April 2016
Expiry date of the certificate: 13 March 2021

Test report: 936/21219281/B dated 19 October 2015
TÜV Rheinland Energie und Umwelt GmbH, Cologne

BAnz AT 14.03.2016 B7, chapter I number 1.1,
Announcement by UBA from 18 February 2016

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

Measuring system

Manufacturer	Thermo Fisher Scientific
AMS designation	Mercury Freedom System
Serial number of units under test	1102146924/0613917119
Measuring principle	Atomfluoreszenz

Test report

Test laboratory	936/21219281/B
Date of report	TÜV Rheinland
	2015-10-19

Measured component

Certification range	Hg	0 - 30 µg/m³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.80 µg/m³
Sum of negative CS at zero point	0.04 µg/m³
Sum of positive CS at span point	1.15 µg/m³
Sum of negative CS at span point	-0.43 µg/m³
Maximum sum of cross-sensitivities	1.15 µg/m³
Uncertainty of cross-sensitivity	u_i 0.665 µg/m³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D 0.367 µg/m³		0.135 (µg/m³)²
Lack of fit	u_{lof} 0.173 µg/m³		0.030 (µg/m³)²
Zero drift from field test	$u_{d,z}$ 0.450 µg/m³		0.203 (µg/m³)²
Span drift from field test	$u_{d,s}$ 0.520 µg/m³		0.270 (µg/m³)²
Influence of ambient temperature at span	u_t 0.300 µg/m³		0.090 (µg/m³)²
Influence of supply voltage	u_v 0.306 µg/m³		0.094 (µg/m³)²
Cross-sensitivity (interference)	u_i 0.665 µg/m³		0.442 (µg/m³)²
Influence of sample gas pressure	u_p 0.046 µg/m³		0.002 (µg/m³)²
Influence of sample gas flow	u_p 0.108 µg/m³		0.012 (µg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.242 µg/m³		0.059 (µg/m³)²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max, j})^2} \quad 1.16 \text{ µg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 2.27 \text{ µg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 30 µg/m³ **7.6**

Requirement of 2010/75/EU

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**