

CERTIFICATE

on Product Conformity (QAL1)

Number of Certificate: 0000037051

Certified AMS: GM32 In-Situ-Gasanalysator model Cross Duct for NO and SO₂

Manufacturer: SICK MAIHAK GmbH
Nimburger Str. 11
76276 Reute
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).



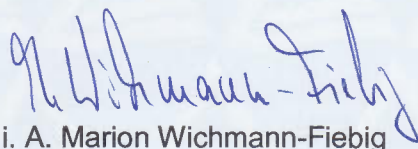
- EN 15267-3 tested
- QAL1 certified
- TUV approved
- Annual inspection

Publication in the German Federal Gazette
(BAnz.) of 20 July 2012

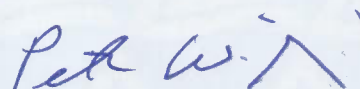
The certificate is valid until:
19 July 2017

Umweltbundesamt
Dessau, 20 August 2012

TÜV Rheinland Energie und Umwelt GmbH
Köln, 17 August 2012



i. A. Marion Wichmann-Fiebig



ppa. Dr. Peter Wilbring

www.umwelt-tuv.de / www.eco-tuv.com
teu@umwelt-tuv.de
Tel. +49 221 806-2756

TÜV Rheinland Energie und Umwelt GmbH
Am Grauen Stein
51105 Köln

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

Test report:	936/21209185/A of 07 October 2008 936/21209185/C of 06 March 2009
First certification:	20 July 2012
Validity ends:	19 July 2017
Publication:	BAnz AT 20 July 2012 B11, chapter IV, Notification 22

Approved application

The tested AMS is suitable for use at combustion plants according to EC directive 2001-80-EC, at waste incineration plants according to EC directive 2000-76-EC and other plants requiring official approval. 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 and a seven months field test at fluidised bed combustion main material mineral coal.

The AMS is approved for an ambient temperature range of -20 °C to +50 °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 936/21209185/A of 07 October 2008 and 936/21209185/C of 06 March 2009 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH
- suitability announced by the German Environmental Agency (UBA) as the relevant body
- the ongoing surveillance of the product and the manufacturing process
- publication in the German Federal Gazette: BAnz 25 August 2009, No. 125, p. 2929, chapter I, No. 3.2
- publication in the German Federal Gazette: BAnz 12 February 2010, No. 24, p. 552, chapter IV, notification 8
- publication in the German Federal Gazette: BAnz 26 January 2011, No. 14, p. 294, chapter IV, notification 1 und 30
- publication in the German Federal Gazette: BAnz 29 July 2011, No. 113, p. 2725, chapter III, notification 16
- publication in the German Federal Gazette: BAnz AT 20 July 2012 B11, chapter IV, Notification 22

AMS name:

GM32 In-Situ Gas Analyser Model Cross Duct for NO and SO₂

Manufacturer:

SICK MAIHAK GmbH, Reute

Approval:

For measurement at plants requiring official permission (i.e. plants in 2000-76-EC, waste incineration directive and 2001-80-EC, large combustion plants directive)

Measuring ranges during the suitability test:

Component	CR 1	CR 2	Unit
NO	0 - 70*	0 - 700*	mg/m ³
SO ₂	0 - 75*	0 - 1000*	mg/m ³

CR = Certification range

* With an active measuring path length of 1.86m

Or

Component	CR 1	CR 2	Unit
NO	0 - 130,2*	0 - 1302*	mg/m ³
SO ₂	0 - 139,5*	0 - 1860*	mg/m ³

CR = Certification range

* With an active measuring path length of 1.00m

Software versions:

GM32: 9125967 SL36

SOPAS ET: 02.20

Remarks:

1. A three-month period has been specified as maintenance interval.
2. The device variant "Comfort" has been tested. In terms of hardware and software, the device variant "Pro" is completely identical to the configuration tested. However, it contains only 1 instead of 2 separately calibrated measuring ranges per component. In accordance with the type coding, variant "Comfort" is identified by "C", and variant "Pro" by "P".
3. Within the context of the manufacturer's quality assurance according to QAL 3 of Directive DIN EN 14181, the signals of the internal check cycle can be used for regular checks of the zero and span points. If any values exceed specified limits, the measuring system is then checked – similarly to the annual surveillance test (AST) – by means of a filter box and a zero path adapted to on-site conditions.
4. Performance testing includes the following device variants (measured components):

Device designation according to type code	NO	SO ₂
C1 or P1		x
C2 or P2	x	x
C4 or P4	x	

"C" = device variant "Comfort"

"P" = device variant "Pro"

5. Complementary test to the announcement of the German Federal Environmental Agency of 19 February 2009 (BAnz. p. 901).

Test report:

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Report No.: 936/21209185/C of 6 March 2009

8 Notification as regards Federal Environmental Agency notices of 03 August 2009 (Federal Gazette (BAnz.), p. 2931)

The current software version implemented in the emission measuring system GM 32 in-situ gas analyser by the company SICK MAIHAK GmbH, in its cross-duct and measuring probe versions is:

GM32: 9125967 T473

Statement of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH of
9 October 2009

1 Notification as regards Federal Environmental Agency notices of 3 August 2009 (Federal Journal (BAnz. p. 2929, chapter I, no. 3.2 and 3.3) and of 25 January 2010 (BAnz. p. 552, chapter IV, notification 8)

The current software version of the emission measuring system GM 32 In-situ Analyser in its cross duct and GMP measuring probe versions by SICK Maihak GmbH is:

GM32: 9125967 U727

Effective immediately, the GMP probe version's cladding tube of the probe is extended to 45mm. The reflector in its clamp is repositioned by the same distance in relation to the measurement slit.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 4 October 2010

Excerpt from:

30 Notification as regards Federal Environmental Agency notices referring to suitability-tested AMS manufactured by SICK Engineering GmbH and SICK MAIHAK GmbH (Excerpt)

No.	AMS manufacturer	Notice	Notification	Opinion of the test institute
...
8	GM 32 In-Situ Analysator in its Cross Duct version and in its GMP probe version/SICK MAIHAK GmbH	as regards notification 1 of this notice	The current software version of the SOPAS ET platform, which controls the AMS is, SOPAS ET 2.32	TÜV Rheinland Energie und Umwelt GmbH of 08 November 2010
...

16 Notification as regards Federal Environmental Agency notices of 3 August 2009 (Federal Journal (BAnz.) p. 2929, chapter I, no. 3.2 and 3.3) and of 10 January 2011 (Federal Journal (BAnz.) p. 294, chapter IV, 1st and 30th notification)

The tracking mirror which has so far been used for the GM 32 In-Situ Gas analyser, in its Cross Duct and GMP probe version for NO and SO₂ manufactured by SICK MAIHAK GmbH may be replaced by an alternative tracking module.

The current software version is:
GM32: 9125967 V113

Statement of TÜV Rheinland Energie und Umwelt GmbH of 24 March 2011

22 Notification as regards Federal Environmental Agency notices of 3. August 2009 (BAnz. S. 2929, Chapter I, no. 3.2 und 3.3) and of 15 July 2011 (Federal Journal (BAnz.) p. 2725, chapter III, 16th notification)

The GM 32 In-Situ Gas analyser in its GMP probe and Cross Duct versions for NO and SO₂ manufactured by SICK MAIHAK GmbH as well as the production process and the quality management system for this measuring system meet the requirements of DIN EN 15267.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 20 March 2012

Certified product

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

The GM32 in-situ gas analyser continuously measures NO and SO₂ concentrations in the gas duct.

The GM32 in-situ gas analyser in its cross duct version is based on an in-situ technology with electro-optical direct measurement. Measured values are recorded directly in the gas flow without contact across the complete duct cross-section.

The GM32 SR-unit determines the concentration of the respective gases based on light absorption by the gas mixture in the active measuring path which is specific to the wavelength.

Light from the sender/receiver unit (SR-unit) passing through the measuring path in the gas duct is reflected back by a triple reflector situated at the end of the active measuring path (opposite duct side). The beam splitter diverts the returning light to the polychromatic subassembly comprising a condenser lens with slit diaphragm, optical grid and receiver element. The optical grid dissects the returning light spectrally and maps it to the receiver element consisting of a highly sensitive diode array.

The algorithms of the GM32 evaluation software process the measured signals of the receiver element together with the related parameters according to the DOAS (Differential Optical Absorption Spectroscopy) method.

In order to ensure stable measurements, the measuring system carries out a reference cycle at certain intervals (standard setting: every 60 min). This reference cycle compensates for changes in lamp intensity (e.g. through aging) and possible contamination in the SR-unit. Precisely adjusting the intensity of the spectra and recording the dark and zero point spectra (with the blanking diaphragm retracted) allows to generate an intensity spectrum which corresponds to that of a spectrum determined in a smoke-free path and hence facilitates the creation of a reference spectrum as a basis for compensation.

Furthermore, the measuring system monitors the stability of the zero and span points by means of a check cycle. Two grid filters, an NO cell and a zero point reflector which can be swivelled in are used as a measuring means for the checks.

This check cycle allows to determine possible wavelength scale drifts, resolution drifts and extinction drifts, and therefore to monitor measurement stability.

Zero point:

The zero point is determined by creating a zero spectrum by swivelling in a zero point reflector. This spectrum corresponds to measurement with a measuring path free from gas. The relevant measured concentration values are determined by means of the device's calibration function. A maintenance request is signalled when one of the zero values exceeds a certain limit value (in this case: 2 % of the FS).

Span point:

In addition to the zero point reflector, an internal swivel element with 2 grid filters and an NO-filled cell is swivelled in during the check cycle, and the reference value is measured. The control values are scaled to 70 % of the measuring range selected.

The median deviation of the extinction measurement of the 2 grid filters is used to calculate the reference value, and the value of (70 % + deviation) x FS is output in % for all components. A maintenance request is signalled when the limit value is exceeded (in this case: > 2 % of the FS).

The expression "concentration measuring path product" is used to describe the connection between full scale value and active measuring path length.

The concentration measuring path product is used to calculate the relevant full scale value for any active measuring path length. The measuring range indications refer to an active measuring path of 1m. In accordance with the measuring path length x, all measuring ranges are reduced or increased by the factor 1/x [m].

The table below gives some examples of such factors.

Active measuring path length or measuring gap in mm	Factor for full scale value FS
1000	FS * 1
1860	FS * 0,538
3000	FS * 0,333

Version "Pro"

As "Basis" version, plus

- Automatic mirror tracking
- Check cycle (QAL3) + CUSUM-card
- Control unit

Version "Comfort"

As "Pro" version, plus

- 2 separately calibrated measured ranges per component

Two instruments of the "Comfort" version were used for the testing at hand. In terms of hardware and software components, the version "Pro" is identical to the "comfort" version – however, there is only 1 instead of 2 calibrated measured ranges for each component.

According to the type coding, the "Comfort" version is called "C" and the "Pro" version is called "P".

The following variants of instruments are possible with regard to specific measured components

Device designation according to type code	NO	SO ₂
C1 or P1		x
C2 or P2	x	x
C4 or P4	x	

“C”= variant “Comfort“

“P”= variant “Pro“

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 validity 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 the validity is also accessible on the internet Address: **qal1.de**.

Certification of GM32 In-Situ Gas Analyser Model Cross Duct for NO and SO₂ is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial assessment

First report: 936/21209185/A of 07 October 2008
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln

Publication: BAnz. 11 March 2009, No. 38, p. 899, chapter I, No. 2.1
Federal Environmental Agency notice of 19 February 2009.

Complementary testing

Test report 936/21209185/C of 06 March 2009
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln

Publication: BAnz. 25 August 2009, No. 125, p. 2929, chapter I, No. 3.2
Federal Environmental Agency notice of 03 August 2009 (extension of the maintenance interval)

Notifications

Publication: BAnz. 12 February 2010, No. 24, p. 552, chapter IV, Notification 8
Federal Environmental Agency notice of 25 January 2010. (Update of software versions)

Publication: BAnz. 26 January 2011, No. 14, p. 294, chapter IV, Notification 1 and 30
Federal Environmental Agency notice of 10 January 2011. (Update of software versions)

Publication: BAnz. 29. July 2011, No. 113, p. 2725, chapter III, Notification 16
Federal Environmental Agency notice of 15 July 2011 (Update of software versions)

Initial certification according to EN 15267

Certificate No. 0000037051: 20 August 2012

Validity of the certificate: 19 July 2017

Statement of TÜV Rheinland Energie und Umwelt GmbH of 20 March 2012

Publication: BAnz AT 20 July 2012 B11, chapter IV, Notification 22
Announcement by UBA from 06 July 2012

Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data

Manufacturer	SICK MAIHAK
Name of measuring system	GM32, Cross-Duct
Serial Number	8043 / 8044
Measuring Principle	UV-DOAS

TÜV Data

Approval Report	936/21209185/C 2009-03-06
Editor	Pletscher
Date	2009-03-03

Measurement Component

Certificated range	SO ₂ 75 mg/m ³
--------------------	---

Evaluation of the cross sensitivity (CS)

	QE $\Delta X_{\max, j}$	
to 3 Vol.-% Oxygen	0.00	mg/m ³
to 21 Vol.-% Oxygen	0.00	mg/m ³
to 30 Vol.-% Humidity	0.00	mg/m ³
to 300 mg/m ³ Carbon monoxide	0.00	mg/m ³
to 15 Vol.-% Carbon dioxide	0.00	mg/m ³
to 50 mg/m ³ Methane	0.46	mg/m ³
to 100 mg/m ³ Dinitrogen monoxide	0.00	mg/m ³
to 300 mg/m ³ Nitrogen monoxide	- 2.01	mg/m ³
to 30 mg/m ³ Nitrogen dioxide	1.07	mg/m ³
to 20 mg/m ³ Ammonia	0.61	mg/m ³
to 200 mg/m ³ Hydrogen chloride	- 0.54	mg/m ³

Sum of positive cross sensitivities	2.14	mg/m ³
Sum of negative cross sensitivities	- 2.55	mg/m ³

Calculation of the combined standard uncertainty

Test Value	$\Delta X_{\max, j}$		u	u ²	
Standard deviation from paired measurements under field conditions *	0.68	mg/m ³	u _r	0.68	0.462
Lack of fit	0.45	mg/m ³	u _{inf}	0.26	0.068
Zero drift from field test	1.43	mg/m ³	u _{d, z}	0.82	0.677
Span drift from field test	- 1.58	mg/m ³	u _{d, s}	-0.91	0.827
Influence of ambient temperature at span	0.38	mg/m ³	u _t	0.22	0.047
Influence of supply voltage	0.53	mg/m ³	u _v	0.30	0.092
Cross sensitivity (interference) **	- 2.55	mg/m ³	u _i	-1.47	2.168
Influence of sample pressure	0.00	mg/m ³	u _n	0.00	0.000
Uncertainty of reference material at 70% of certification range	1.05	mg/m ³	u _{rm}	0.61	0.368
Excursion of measurement beam	1.28	mg/m ³	u _{mb}	0.74	0.542

* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

** The absolute value of the Sum of negative cross sensitivity is greater than Sum of positive cross sensitivity

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{\max, j})^2}$	2.29	mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	4.49	mg/m ³

Relative total expanded uncertainty	U in % of the ELV 35 mg/m³	12.8
Requirement of 2000/76/EC and 2001/80/EC	U in % of the ELV 35 mg/m³	20.0
Requirement of EN 15267-3	U in % of the ELV 35 mg/m ³	15.0

Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

1

Manufacturer data

Manufacturer	SICK MAIHAK
Name of measuring system	GM32, Cross-Duct
Serial Number	8043 / 8044
Measuring Principle	UV-DOAS

TÜV Data

Approval Report	936/21209185/C 2009-03-06
Editor	Pletscher
Date	2009-03-03

Measurement Component

Certificated range	NO 70 mg/m ³
--------------------	----------------------------

Evaluation of the cross sensitivity (CS)

	QE $\Delta X_{max, j}$	
to 3 Vol.-% Oxygen	0.00	mg/m ³
to 21 Vol.-% Oxygen	0.00	mg/m ³
to 30 Vol.-% Humidity	0.00	mg/m ³
to 300 mg/m ³ Carbon monoxide	- 0.34	mg/m ³
to 15 Vol.-% Carbon dioxide	0.00	mg/m ³
to 50 mg/m ³ Methane	0.29	mg/m ³
to 100 mg/m ³ Dinitrogen monoxide	0.49	mg/m ³
to 30 mg/m ³ Nitrogen dioxide	0.49	mg/m ³
to 20 mg/m ³ Ammonia	0.57	mg/m ³
to 1000 mg/m ³ Sulphur dioxide	- 0.66	mg/m ³
to 200 mg/m ³ Hydrogen chloride	1.40	mg/m ³
Sum of positive cross sensitivities	3.23	mg/m ³
Sum of negative cross sensitivities	- 1.00	mg/m ³

Calculation of the combined standard uncertainty

Test Value	$\Delta X_{max, j}$		u	u ²
Standard deviation from paired measurements under field conditions *	0.47 mg/m ³		u _r 0.47	0.221
Lack of fit	0.63 mg/m ³		u _{inf} 0.36	0.132
Zero drift from field test	0.42 mg/m ³		u _{dr, z} 0.24	0.059
Span drift from field test	- 1.61 mg/m ³		u _{dr, s} -0.93	0.864
Influence of ambient temperature at span	0.42 mg/m ³		u _t 0.24	0.059
Influence of supply voltage	0.21 mg/m ³		u _v 0.12	0.015
Cross sensitivity (interference) **	3.23 mg/m ³		u _i 1.87	3.486
Influence of sample pressure	0.00 mg/m ³		u _n 0.00	0.000
Uncertainty of reference material at 70% of certification range	0.98 mg/m ³		u _{rm} 0.57	0.320
Excursion of measurement beam	- 0.70 mg/m ³		u _{mb} -0.40	0.163

* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

** The absolut value of the Sum of positiv cross sensitivity is greater than the Sum of negativ cross sensitivity

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max, j})^2}$	2.31	mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	4.52	mg/m ³

Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC	U in % of the ELV 40 mg/m³	11.3
Requirement of EN 15267-3	U in % of the ELV 40 mg/m³	20.0
	U in % of the ELV 40 mg/m³	15.0