

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000039319

Certified AMS: MGS300 for CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O and NH₃
Manufacturer: MKS Instruments Inc.
651 Lowell Street,
Methuen, MA 01844
USA

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).



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

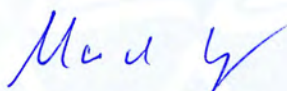
www.tuv.com
ID 0000039319

Publication in the German Federal Gazette
(BAnz.) of 23 July 2013

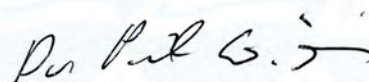
This certificate will expire on:
22 July 2018

German Federal Environment Agency
Dessau, 20 August 2013

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 19 August 2013



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

Test report:	936/21208291/A of 26 March 2013
Initial certification:	23 July 2013
Expiry date:	22 July 2018
Publication:	BAnz AT 23 July 2013 B4, chapter I, No. 3.2

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 three-month field test at a municipal waste incineration plant.

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 936/21208291/A of 26 March 2013 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 23 July 2013 B4, chapter I, No. 3.2)

AMS designation:

MGS300 for CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O and NH₃

Manufacturer:

MKS Instruments Inc., Methuen, USA

Field of application:

For measurements at plants requiring official approval (i.e. 2000/76/EC waste incineration directive and 2001/80/EC large combustion plants directive).

Measuring ranges during the performance test:

Component	Certification range	Supplementary range		Unit
HF	0 - 3	0 - 10		mg/m ³
N ₂ O	0 - 50	0 - 100	0 - 500	mg/m ³
CO	0 - 75	0 - 300	0 - 1500	mg/m ³
SO ₂	0 - 75	0 - 300	0 - 2000	mg/m ³
NO	0 - 200	0 - 400	0 - 1500	mg/m ³
NO ₂	0 - 50	0 - 100	0 - 1000	mg/m ³
HCl	0 - 15	0 - 90	0 - 200	mg/m ³
NH ₃	0 - 10	0 - 75	-	mg/m ³
CO ₂	0 - 25	-	-	Vol.-%
H ₂ O	0 - 40	-	-	Vol.-%
CH ₄	0 - 15	0 - 50	0 - 500	mg/m ³

Software versions:

MKS MG2000: V07.00.00.02

JCT MGS300 Control: 0.2

Restriction:

The requirement of Standard EN 15267-3 for protection provided by enclosures was not met during performance testing. The measuring system shall be installed protected from dust and precipitation.

Note:

The maintenance interval is four weeks.

Test report:

TÜV Rheinland Energie und Umwelt GmbH, Cologne

Report No.: 936/21208291/A of 26 March 2013

Certified product

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

The MGS300 is a multi-component gas analysing system for continuous monitoring of exhaust gases at industrial incineration plants. The gas to be measured is extracted with help of a sample gas probe from the stack. Then the gas is forwarded with a heated sample line to the heated analyser system.

For the spectral acquisition of the gas concentration a Fourier-transformed infrared spectrometer is used. The measurement device consists of the following main components:

- FTIR analyser MKS type MultiGas 2030D-29805
- System cabinet with control computer, control electronics, gas supply and data output modules
- Heated sample probe type JES301HFTIR
- Heated sample gas line with stainless steel tubing, length during the type approval 10 meters
- Heated sample gas pump type JHSS
- MGS300 Control software (for the control of general analyser functions, valve- and temperature control, visualisation of measured values)
- MG2000 software (interferometer control and calculation of measured values)

Automatic background measurement

The analysers performs a daily automatic zero adjustment with nitrogen. This adjustment lasts about 10 minutes.

Consumable gases

During the field test the measurement device was operated with nitrogen for the background cycle, with compressed air for the ejector-pump and with conditioned compressed air (dew point app. -40°C and hydrocarbon free) for the interferometer purge.

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 MGS300 for CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O and NH₃ 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. 0000039319: 20 August 2013

Expiry date of the certificate: 22 July 2018

Test report: 936/21208291/A of 26 March 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 23 July 2013 B4, chapter I, No. 3.2
Announcement by UBA from 03 July 2013

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland
	2013-03-26

Measured component

Certification range	NH ₃	0 - 10 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.24 mg/m ³
Sum of negative CS at zero point	-0.31 mg/m ³
Sum of positive CS at span point	0.08 mg/m ³
Sum of negative CS at span point	-0.36 mg/m ³
Maximum sum of cross-sensitivities	-0.36 mg/m ³
Uncertainty of cross-sensitivity	-0.208 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u ²
Repeatability standard deviation at set point *	u _r 0.115 mg/m ³	0.013 (mg/m ³) ²
Lack of fit	u _{lof} 0.035 mg/m ³	0.001 (mg/m ³) ²
Zero drift from field test	u _{d,z} 0.058 mg/m ³	0.003 (mg/m ³) ²
Span drift from field test	u _{d,s} 0.069 mg/m ³	0.005 (mg/m ³) ²
Influence of ambient temperature at span	u _t 0.153 mg/m ³	0.023 (mg/m ³) ²
Influence of supply voltage	u _v 0.038 mg/m ³	0.001 (mg/m ³) ²
Cross-sensitivity (interference)	u _i -0.208 mg/m ³	0.043 (mg/m ³) ²
Influence of sample gas flow	u _p 0.037 mg/m ³	0.001 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 0.081 mg/m ³	0.007 (mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 0.31 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 0.62 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 10 mg/m³ 6.2

Requirement of 2000/76/EC and 2001/80/EC

U in % of the ELV 10 mg/m³ 40.0 **

Requirement of EN 15267-3

U in % of the ELV 10 mg/m³ 30.0

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
The chosen value is recommended by the certification body.

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MG300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland
	2013-03-26

Measured component

Certification range	CO	0 - 75 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	-2.12 mg/m ³
Sum of positive CS at span point	1.50 mg/m ³
Sum of negative CS at span point	-1.30 mg/m ³
Maximum sum of cross-sensitivities	-2.12 mg/m ³
Uncertainty of cross-sensitivity	-1.225 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.245 mg/m ³	0.060 (mg/m ³) ²
Lack of fit	u_{lof}	0.312 mg/m ³	0.097 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	0.260 mg/m ³	0.068 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.346 mg/m ³	0.120 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.379 mg/m ³	0.144 (mg/m ³) ²
Influence of supply voltage	u_v	0.232 mg/m ³	0.054 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-1.225 mg/m ³	1.502 (mg/m ³) ²
Influence of sample gas flow	u_p	0.271 mg/m ³	0.073 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606 mg/m ³	0.368 (mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{max, j})^2} \quad 1.58 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 3.09 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 50 mg/m³ 6.2

Requirement of 2000/76/EC and 2001/80/EC

U in % of the ELV 50 mg/m³ 10.0

Requirement of EN 15267-3

U in % of the ELV 50 mg/m³ 7.5

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland 2013-03-26

Measured component

Certification range	SO ₂ 0 - 75 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.71 mg/m ³
Sum of negative CS at zero point	-1.76 mg/m ³
Sum of positive CS at span point	1.79 mg/m ³
Sum of negative CS at span point	-2.09 mg/m ³
Maximum sum of cross-sensitivities	-2.09 mg/m ³
Uncertainty of cross-sensitivity	-1.208 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	0.348 mg/m ³	0.121 (mg/m ³) ²
Lack of fit	u _{inf}	0.346 mg/m ³	0.120 (mg/m ³) ²
Zero drift from field test	u _{d,z}	-0.346 mg/m ³	0.120 (mg/m ³) ²
Span drift from field test	u _{d,s}	-0.606 mg/m ³	0.367 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.643 mg/m ³	0.413 (mg/m ³) ²
Influence of supply voltage	u _v	0.256 mg/m ³	0.066 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	-1.208 mg/m ³	1.460 (mg/m ³) ²
Influence of sample gas flow	u _n	-0.352 mg/m ³	0.124 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.606 mg/m ³	0.368 (mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 1.78 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 3.48 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 50 mg/m³ 7.0

Requirement of 2000/76/EC and 2001/80/EC

U in % of the ELV 50 mg/m³ 20.0

Requirement of EN 15267-3

U in % of the ELV 50 mg/m³ 15.0

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MG300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland
	2013-03-26

Measured component

Certification range	NO	0 - 200 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	1.64 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	-6.30 mg/m ³
Maximum sum of cross-sensitivities	-6.30 mg/m ³
Uncertainty of cross-sensitivity	-3.637 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	0.819 mg/m ³	0.671 (mg/m ³) ²
Lack of fit	u _{lof}	0.635 mg/m ³	0.403 (mg/m ³) ²
Zero drift from field test	u _{d,z}	-0.115 mg/m ³	0.013 (mg/m ³) ²
Span drift from field test	u _{d,s}	-1.155 mg/m ³	1.334 (mg/m ³) ²
Influence of ambient temperature at span	u _t	1.249 mg/m ³	1.560 (mg/m ³) ²
Influence of supply voltage	u _v	0.579 mg/m ³	0.335 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	-3.637 mg/m ³	13.230 (mg/m ³) ²
Influence of sample gas flow	u _p	-0.818 mg/m ³	0.669 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	1.617 mg/m ³	2.613 (mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 4.56 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c \cdot k = u_c \cdot 1.96 \quad 8.95 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 131 mg/m³ 6.8

Requirement of 2000/76/EC and 2001/80/EC

U in % of the ELV 131 mg/m³ 20.0

Requirement of EN 15267-3

U in % of the ELV 131 mg/m³ 15.0

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland 2013-03-26

Measured component

Certification range	NO ₂ 0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.50 mg/m ³
Sum of negative CS at span point	-1.30 mg/m ³
Maximum sum of cross-sensitivities	-1.30 mg/m ³
Uncertainty of cross-sensitivity	-0.751 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²	
Standard deviation from paired measurements under field conditions *	u _D	0.111 mg/m ³	0.012	(mg/m ³) ²
Lack of fit	u _{lof}	0.289 mg/m ³	0.084	(mg/m ³) ²
Zero drift from field test	u _{d,z}	0.115 mg/m ³	0.013	(mg/m ³) ²
Span drift from field test	u _{d,s}	-0.346 mg/m ³	0.120	(mg/m ³) ²
Influence of ambient temperature at span	u _t	0.208 mg/m ³	0.043	(mg/m ³) ²
Influence of supply voltage	u _v	0.242 mg/m ³	0.059	(mg/m ³) ²
Cross-sensitivity (interference)	u _i	-0.751 mg/m ³	0.563	(mg/m ³) ²
Influence of sample gas flow	u _p	0.235 mg/m ³	0.055	(mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.404 mg/m ³	0.163	(mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 1.05 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 2.07 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 50 mg/m³ 4.1

Requirement of 2000/76/EC and 2001/80/EC

U in % of the ELV 50 mg/m³ 20.0

Requirement of EN 15267-3

U in % of the ELV 50 mg/m³ 15.0

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A TÜV Rheinland
Date of report	2013-03-26

Measured component

Certification range	HCl 0 - 15 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.51 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.51 mg/m ³
Sum of negative CS at span point	-0.21 mg/m ³
Maximum sum of cross-sensitivities	0.51 mg/m ³
Uncertainty of cross-sensitivity	0.294 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Repeatability standard deviation at set point *	u_r 0.102 mg/m ³	0.010 (mg/m ³) ²
Lack of fit	u_{lof} 0.063 mg/m ³	0.004 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ -0.087 mg/m ³	0.008 (mg/m ³) ²
Span drift from field test	$u_{d,s}$ 0.104 mg/m ³	0.011 (mg/m ³) ²
Influence of ambient temperature at span	u_t 0.153 mg/m ³	0.023 (mg/m ³) ²
Influence of supply voltage	u_v 0.083 mg/m ³	0.007 (mg/m ³) ²
Cross-sensitivity (interference)	u_i 0.294 mg/m ³	0.087 (mg/m ³) ²
Influence of sample gas flow	u_p 0.085 mg/m ³	0.007 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.121 mg/m ³	0.015 (mg/m ³) 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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.41 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.81 mg/m ³

Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC
Requirement of EN 15267-3

U in % of the ELV 10 mg/m³	8.1
U in % of the ELV 10 mg/m³	40.0
U in % of the ELV 10 mg/m ³	30.0

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland 2013-03-26

Measured component

Certification range	HF 0 - 3 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.07 mg/m ³
Sum of negative CS at zero point	-0.10 mg/m ³
Sum of positive CS at span point	0.04 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	-0.10 mg/m ³
Uncertainty of cross-sensitivity	-0.058 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Repeatability standard deviation at set point *	u_r 0.032 mg/m ³	0.001 (mg/m ³) ²
Lack of fit	u_{lof} 0.017 mg/m ³	0.000 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 0.012 mg/m ³	0.000 (mg/m ³) ²
Span drift from field test	$u_{d,s}$ 0.024 mg/m ³	0.001 (mg/m ³) ²
Influence of ambient temperature at span	u_t 0.058 mg/m ³	0.003 (mg/m ³) ²
Influence of supply voltage	u_v 0.012 mg/m ³	0.000 (mg/m ³) ²
Cross-sensitivity (interference)	u_i -0.058 mg/m ³	0.003 (mg/m ³) ²
Influence of sample gas flow	u_p 0.016 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.024 mg/m ³	0.001 (mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 0.10 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 0.19 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC

Requirement of EN 15267-3

U in % of the ELV 1 mg/m³ 19.3

U in % of the ELV 1 mg/m³ 40.0

U in % of the ELV 1 mg/m³ 30.0

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland
	2013-03-26

Measured component

Certification range	CH ₄
	0 - 15 mg/m ³

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.27 mg/m ³
Sum of negative CS at zero point	-0.12 mg/m ³
Sum of positive CS at span point	0.41 mg/m ³
Sum of negative CS at span point	-0.42 mg/m ³
Maximum sum of cross-sensitivities	-0.42 mg/m ³
Uncertainty of cross-sensitivity	-0.242 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Repeatability standard deviation at set point *	u _r	0.103 mg/m ³	0.011 (mg/m ³) ²
Lack of fit	u _{lof}	-0.058 mg/m ³	0.003 (mg/m ³) ²
Zero drift from field test	u _{d,z}	0.026 mg/m ³	0.001 (mg/m ³) ²
Span drift from field test	u _{d,s}	0.052 mg/m ³	0.003 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.173 mg/m ³	0.030 (mg/m ³) ²
Influence of supply voltage	u _v	0.074 mg/m ³	0.005 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	-0.242 mg/m ³	0.059 (mg/m ³) ²
Influence of sample gas flow	u _p	-0.054 mg/m ³	0.003 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.121 mg/m ³	0.015 (mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 0.36 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 0.70 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 10 mg/m³ 7.0

Requirement of 2000/76/EC and 2001/80/EC

U in % of the ELV 10 mg/m³ 30.0 **

Requirement of EN 15267-3

U in % of the ELV 10 mg/m³ 22.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
The chosen value is recommended by the certification body.

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland 2013-03-26

Measured component

Certification range	CO ₂ 0 - 25 Vol.-%
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 Vol.-%
Sum of negative CS at zero point	0.00 Vol.-%
Sum of positive CS at span point	0.40 Vol.-%
Sum of negative CS at span point	-0.30 Vol.-%
Maximum sum of cross-sensitivities	0.40 Vol.-%
Uncertainty of cross-sensitivity	0.231 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u ²	
Standard deviation from paired measurements under field conditions *	u _D	0.033 Vol.-%		0.001	(Vol.-%) ²
Lack of fit	u _{lof}	0.058 Vol.-%		0.003	(Vol.-%) ²
Zero drift from field test	u _{d,z}	0.000 Vol.-%		0.000	(Vol.-%) ²
Span drift from field test	u _{d,s}	0.144 Vol.-%		0.021	(Vol.-%) ²
Influence of ambient temperature at span	u _t	0.173 Vol.-%		0.030	(Vol.-%) ²
Influence of supply voltage	u _v	0.118 Vol.-%		0.014	(Vol.-%) ²
Cross-sensitivity (interference)	u _i	0.231 Vol.-%		0.053	(Vol.-%) ²
Influence of sample gas flow	u _p	-0.105 Vol.-%		0.011	(Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.202 Vol.-%		0.041	(Vol.-%) 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)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 0.42 \text{ Vol.-%}$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 0.82 \text{ Vol.-%}$$

Relative total expanded uncertainty

U in % of the ELV 25 Vol.-% 3.3

Requirement of 2000/76/EC and 2001/80/EC

U in % of the ELV 25 Vol.-% 10.0 **

Requirement of EN 15267-3

U in % of the ELV 25 Vol.-% 7.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
The chosen value is recommended by the certification body.

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland 2013-03-26

Measured component

Certification range	H ₂ O 0 - 40 Vol.-%
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 Vol.-%
Sum of negative CS at zero point	0.00 Vol.-%
Sum of positive CS at span point	0.70 Vol.-%
Sum of negative CS at span point	-0.50 Vol.-%
Maximum sum of cross-sensitivities	0.70 Vol.-%
Uncertainty of cross-sensitivity	0.404 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u^2
Standard deviation from paired measurements under field conditions *	u_D	0.127 Vol.-%		0.016 (Vol.-%) ²
Lack of fit	u_{lof}	0.058 Vol.-%		0.003 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$	-0.046 Vol.-%		0.002 (Vol.-%) ²
Span drift from field test	$u_{d,s}$	0.300 Vol.-%		0.090 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.265 Vol.-%		0.070 (Vol.-%) ²
Influence of supply voltage	u_v	0.127 Vol.-%		0.016 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	0.404 Vol.-%		0.163 (Vol.-%) ²
Influence of sample gas flow	u_p	0.077 Vol.-%		0.006 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.323 Vol.-%		0.105 (Vol.-%) 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)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 0.69 \text{ Vol.-%}$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 1.35 \text{ Vol.-%}$$

Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC

Requirement of EN 15267-3

U in % of the ELV 40 Vol.-%

U in % of the ELV 40 Vol.-%

U in % of the ELV 40 Vol.-%

3.4

10.0 **

7.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
The chosen value is recommended by the certification body.

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

Measuring system

Manufacturer	MKS Instruments Inc.
AMS designation	MGS300
Serial number of units under test	Prod1 / Prod2
Measuring principle	FTIR

Test report

Test laboratory	936/21208291/A
Date of report	TÜV Rheinland
	2013-03-26

Measured component

Certification range	N ₂ O	0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.73 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	1.50 mg/m ³
Sum of negative CS at span point	-1.20 mg/m ³
Maximum sum of cross-sensitivities	1.50 mg/m ³
Uncertainty of cross-sensitivity	0.866 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	0.171 mg/m ³	0.029 (mg/m ³) ²
Lack of fit	u _{lof}	0.237 mg/m ³	0.056 (mg/m ³) ²
Zero drift from field test	u _{d,z}	0.058 mg/m ³	0.003 (mg/m ³) ²
Span drift from field test	u _{d,s}	0.289 mg/m ³	0.084 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.400 mg/m ³	0.160 (mg/m ³) ²
Influence of supply voltage	u _v	0.185 mg/m ³	0.034 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	0.866 mg/m ³	0.750 (mg/m ³) ²
Influence of sample gas flow	u _p	0.162 mg/m ³	0.026 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.404 mg/m ³	0.163 (mg/m ³) 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)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 1.14 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 2.24 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC

Requirement of EN 15267-3

U in % of the ELV 50 mg/m³

U in % of the ELV 50 mg/m³

U in % of the ELV 50 mg/m³

4.5

20.0 **

15.0

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.

The chosen value is recommended by the certification body.