Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No: 0000039319_04

Certified AMS:	MGS300 for CO, NO, NO_2, N_2O, SO_2, HCl, HF, NH_3, CH_4, H_2O and CO_2
Manufacturer:	MKS Instruments Inc. 651 Lowell Street, Methuen, MA 01844 USA
Test Institute:	TÜV Rheinland Energy GmbH

This is to certify that the AMS has been tested and found to comply with the standards EN 15267-1 (2009), EN 15267-2 (2009), EN 15267-3 (2007) and EN 14181 (2014).

Certification is awarded in respect of the conditions stated in this certificate (this certificate contains 17 pages).
The present certificate replaces certificate 0000039319_03 dated 22 July 2018.

TÜVRheinland® CERTIFIED

Suitability Tested
EN 15267
QAL1 Certified
Regular Surveillance

www.tuv.com
ID 0000039319

Publication in the German Federal Gazette (BAnz) of 05 August 2014

German Environment Agency
Dessau, 14 July 2023

Dr. Marcel Langner
Head of Section II 4

This certificate will expire on:
22 July 2028

TÜV Rheinland Energy GmbH
Cologne, 13 July 2023

ppa. Dr. Peter Wilbring

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TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Köln

Test institute accredited to EN ISO/IEC 17025 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.

10/221 2.08

Test report:	936/21208291/C dated 20 March 2014
Initial certification:	23 July 2013
Expiry date:	22 July 2028
Certificate:	Renewal (of previous certificate 0000039319_03 of 22 July 2018 valid until 22 July 2023)
Publication:	BAnz AT 05.08.2014 B11, chapter I No. 4.3

Approved application
The tested AMS is suitable for use at plants according to Directive 2010/75/EC, chapter III (13th BImSchV:2013), chapter IV (17th BImSchV:2013), Directive 2015/2193/EC (44th BImSchV:2019), 30th BImSchV:2009, TA-Luft:2002 and 27th BImSchV:2013. The measured ranges have been selected so as to ensure as broad a field of application as possible.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a twelve-months field test at a municipal waste incinerator.

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

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

Note:
The legal regulations mentioned correspond to the current state of legislation during certification. Each user should, if necessary, in consultation with the competent authority, ensure that this AMS meets the legal requirements for the intended use. In addition, it cannot be ruled out that legal regulations governing the use of a measuring device for emission monitoring may change during the lifetime of the certificate.

Basis of the certification
This certification is based on:

- Test report 936/21208291/C dated 20 March 2014 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 05.08.2014 B11, chapter I No. 4.3, Announcement by UBA dated 17 July 2014:

AMS designation:
MGS300 for CO, SO_2, NO, NO_2, HCl, HF, CH_4, CO_2, H_2O, N_2O and NH_3

Manufacturer: MKS Instruments Inc., Methuen, USA

Field of application:
For plants requiring official approval and for plants according to the 27th BImSchV

Measuring ranges during the performance test:

Component	Certification range	Supplementary measuring ranges		Unit
HF	0 - 3	0 - 10	-	mg/m³
N_2O	0 - 50	0 - 100	0 - 500	mg/m³
CO	0 - 75	0 - 300	0 – 1,500	mg/m³
SO_2	0 - 75	0 - 300	0 – 2,000	mg/m³
NO	0 - 200	0 - 400	0 – 1,500	mg/m³
NO_2	0 - 50	0 - 100	0 – 1,000	mg/m³
HCl	0 - 15	0 - 90	0 - 200	mg/m³
NH_3	0 - 10	0 - 75	-	mg/m³
CO_2	0 - 25	-	-	Vol.-%
H_2O	0 - 40	-	-	Vol.-%
CH_4	0 - 15	0 - 50	0 - 500	mg/m³

Software versions: MG2000: 7.2 / MGS300 Control: 1.04

Restriction:
During performance testing in accordance with EN 15267-3, the requirement for the degree of protection provided by the enclosure was not fulfilled. The measuring system has to be installed in an environment sheltered from dust and precipitation.

Notes:
1. The maintenance interval is six months.
2. Supplementary testing (extension of the maintenance interval) as regards Federal Environment Agency (UBA) notice of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter I number 3.3).

Test Report:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21208291/C dated 20 March 2014

Publication in the German Federal Gazette: BAnz AT 26.08.2015 B4, Chap. V notification 20, Announcement by UBA dated 22 July 2015:

20 Notification as regards Federal Environment Agency (UBA) notice of 17 July 2014 (Federal Gazette BAnz AT 05.08.2014 B11, chapter I number 4.3)

The power supply and preamplifier board of the MGS300 measuring system, manufactured by MKS Instruments Inc. were redesigned. The version number of the new preamplifier board is 1040912-002. The new power supply has component number 1053932.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 25 March 2015

Publication in the German Federal Gazette: BAnz AT 20.03.2023 B6, Chap. IV notification 32, Announcement by UBA dated 21 February 2023:

32 Notification as regards Federal Environment Agency (UBA) notices of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter I number 4.3) and of 22 July 2015 (BAnz AT 26.08.2015 B4, chapter V notification 20)

The current software version of the MGS300 measuring system for CO, SO_2, NO, NO_2, HCl, HF, CH_4, CO_2, H_2O, N_2O and NH_3 from the company MKS Instruments Inc. is now the version
MG2000: 10.7,

the version of the MGS300 Control Software remains unchanged as version
01.04.

The measuring system can now also be operated with the interferometer MG 2030 Rev. G (2030G-29805).

Statement issued by TÜV Rheinland Energy GmbH dated 14 September 2022

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

The MGS300 is a multicomponent gas analyser designed to continuously monitor flue gases emitted by industrial combustion plants. The gas to be measured is extracted from the flue gas duct with a sampling probe and then transported to the analyser system via a heated sample gas line. A Fourier transform infrared spectrometer (FTIR spectrometer) is used for spectral detection. The measuring system comprises the following main components:

- FTIR Analysator MKS Type MultiGas 2030D-29805
- System rack c/w control unit, control electronics, gas supply and data output modules
- heated sampling probe type JES301HFTIR
- heated sample gas line c/w stainless steel line, 10 m long during performance testing
- heated sample gas pump type JHSS
- MGS300 Control (to control general instrument functions, valve and temperature, visualisation of measured values)
- MG2000 software (to control the interferometer and the formation of measured values)

Automatic background measurement
The measuring system performs daily zero point adjustments using nitrogen. This takes approximately 10 minutes.

Consumption gases
As part of the field test, the measuring system was operated with nitrogen for the background measurement cycle, compressed air for the ejector pump and processed compressed air (dry dew point ~-40 °C and HC-free) for purging the interferometer.

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 certification mark may be applied to the product or used in advertising materials 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 certificate mark must not be employed anymore.

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

History of documents
Certification of MGS300 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_00: 20 August 2013
Expiry date of the certificate: 22 July 2018

Test report: 936/21208291/A dated 26 March 2013
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz AT 23.07.2013 B4, chapter I number 3.2
UBA announcement dated 3 July 2013

Supplementary testing according to EN 15267
Certificate No. 0000039319_01: 29 April 2014
Expiry date of the certificate: 22 July 2018

Test report: 936/21208291/B dated 3 September 2013
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz AT 01.04.2014 B12, chapter I number 3.3
UBA announcement dated 27 February 2014

Supplementary testing according to EN 15267
Certificate No. 0000039319_02: 09 September 2014
Expiry date of the certificate: 22 July 2018

Test report: 936/21208291/C dated 20 March 2014
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz AT 05.08.2014 B11, chapter I number 4.3
UBA announcement dated 17 July 2014

Notifications
Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 25 March 2015
Publication: BAnz AT 26.08.2015 B4, chapter V notification 20
UBA announcement dated 22 July 2015
(reised power supply and pre-amplifier board)

Renewal of certificate
Certificate No. 0000039319_03: 22 July 2018
Expiry date of the certificate: 22 July 2023

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 14 September 2022
Publication: BAnz AT 20.03.2023 B6, chapter IV notification 32
UBA announcement dated 21 February 2023
(Hardware and Software changes)

Renewal of certificate
Certificate No. 0000039319_04: 14 July 2023
Expiry date of the certificate: 22 July 2028

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			017151632 / 016842381		
Measuring principle			FTIR		
Test report			936/21208291/C		
Test laboratory			TÜV Rheinland		
Date of report			2014-03-20		
Measured component			CH_4		
Certification range			0 - 15	mg/m³	
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point			0.27	mg/m³	
Sum of negative CS at zero point			-0.12	mg/m³	
Sum of postive CS at span point			0.41	mg/m³	
Sum of negative CS at span point			-0.42	mg/m³	
Maximum sum of cross-sensitivities			-0.42	mg/m³	
Uncertainty of cross-sensitivity			-0.242	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.103	mg/m³	0.011	(mg/m³)²
Lack of fit	u_{lof}	-0.058	mg/m³	0.003	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.078	mg/m³	0.006	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.113	mg/m³	0.013	(mg/m³)²
Influence of ambient temperature at span	u_t	0.173	mg/m³	0.030	(mg/m³)²
Influence of supply voltage	u_v	0.074	mg/m³	0.005	(mg/m³)²
Cross-sensitivity (interference)	u_i	-0.242	mg/m³	0.059	(mg/m³)²
Influence of sample gas flow	u_p	-0.054	mg/m³	0.003	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121	mg/m³	0.015	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.38	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.75	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**7.5**
Requirement of 2010/75/EU	**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

** EU Directive 2010/75/EU does not define requirements for this component.
A value of 30.0 % was used instead.

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	017151632 / 016842381
Measuring principle	FTIR
Test report	936/21208291/C
Test laboratory	TÜV Rheinland
Date of report	2014-03-20
Measured component	CO
Certification range	0 - 75 mg/m³

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	mg/m³
Sum of negative CS at zero point	-2.12	mg/m³
Sum of postive CS at span point	1.50	mg/m³
Sum of negative CS at span point	-1.30	mg/m³
Maximum sum of cross-sensitivities	-2.12	mg/m³
Uncertainty of cross-sensitivity	-1.225	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.245	mg/m³	0.060	(mg/m³)²
Lack of fit	u_{lof}	0.312	mg/m³	0.097	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.260	mg/m³	0.068	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.346	mg/m³	0.120	(mg/m³)²
Influence of ambient temperature at span	u_t	0.379	mg/m³	0.144	(mg/m³)²
Influence of supply voltage	u_v	0.232	mg/m³	0.054	(mg/m³)²
Cross-sensitivity (interference)	u_i	-1.225	mg/m³	1.502	(mg/m³)²
Influence of sample gas flow	u_p	0.271	mg/m³	0.073	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	0.368	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.58	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.09	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**6.2**
Requirement of 2010/75/EU	**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	017151632 / 016842381
Measuring principle	FTIR
Test report	936/21208291/C
Test laboratory	TÜV Rheinland
Date of report	2014-03-20
Measured component	CO_2
Certification range	0 - 25 Vol.-%

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 postive 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	$u_{d,z}$	0.014	Vol.-%	0.000	(Vol.-%)²
Span drift from field test	$u_{d,s}$	0.159	Vol.-%	0.025	(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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.42	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.83	Vol.-%

Relative total expanded uncertainty	**U in % of the ELV 25 Vol.-%**	**3.3**
Requirement of 2010/75/EU	**U in % of the ELV 25 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the ELV 25 Vol.-%	7.5

** EU Directive 2010/75/EU does not define requirements for this component.
A value of 10.0 % was used instead.

Certificate:
0000039319_04 / 14 July 2023

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		017151632 / 016842381			
Measuring principle		FTIR			
Test report		936/21208291/C			
Test laboratory		TÜV Rheinland			
Date of report		2014-03-20			
Measured component		H_2O			
Certification range		0 - 40	Vol.-%		
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 postive 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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.69	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.35	Vol.-%

Relative total expanded uncertainty	**U in % of the ELV 40 Vol.-%**	**3.4**
Requirement of 2010/75/EU	**U in % of the ELV 40 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the ELV 40 Vol.-%	7.5

** EU Directive 2010/75/EU does not define requirements for this component.
A value of 10.0 % was used instead.

Certificate:
0000039319_04 / 14 July 2023

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	017151632 / 016842381		
Measuring principle	FTIR		
Test report	936/21208291/C		
Test laboratory	TÜV Rheinland		
Date of report	2014-03-20		
Measured component	HCl		
Certification range	0 - 15	mg/m³	
Evaluation of the cross-sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point	0.51	mg/m³	
Sum of negative CS at zero point	0.00	mg/m³	
Sum of postive CS at span point	0.51	mg/m³	
Sum of negative CS at span point	-0.21	mg/m³	
Maximum sum of cross-sensitivities	0.51	mg/m³	
Uncertainty of cross-sensitivity	0.294	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.102	mg/m³	0.010	(mg/m³)²
Lack of fit	u_{lof}	0.063	mg/m³	0.004	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.087	mg/m³	0.008	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.147	mg/m³	0.022	(mg/m³)²
Influence of ambient temperature at span	u_t	0.153	mg/m³	0.023	(mg/m³)²
Influence of supply voltage	u_v	0.083	mg/m³	0.007	(mg/m³)²
Cross-sensitivity (interference)	u_i	0.294	mg/m³	0.087	(mg/m³)²
Influence of sample gas flow	u_p	0.085	mg/m³	0.007	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121	mg/m³	0.015	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.43	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.84	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**8.4**
Requirement of 2010/75/EU	**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

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		017151632 / 016842381	
Measuring principle		FTIR	
Test report		936/21208291/C	
Test laboratory		TÜV Rheinland	
Date of report		2014-03-20	
Measured component		HF	
Certification range		0 - 3	mg/m³
Evaluation of the cross-sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point		0.07	mg/m³
Sum of negative CS at zero point		-0.10	mg/m³
Sum of postive CS at span point		0.04	mg/m³
Sum of negative CS at span point		0.00	mg/m³
Maximum sum of cross-sensitivities		-0.10	mg/m³
Uncertainty of cross-sensitivity		-0.058	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.032	mg/m³	0.001	(mg/m³)²
Lack of fit	u_{lof}	0.017	mg/m³	0.000	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.016	mg/m³	0.000	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.024	mg/m³	0.001	(mg/m³)²
Influence of ambient temperature at span	u_t	0.058	mg/m³	0.003	(mg/m³)²
Influence of supply voltage	u_v	0.012	mg/m³	0.000	(mg/m³)²
Cross-sensitivity (interference)	u_i	-0.058	mg/m³	0.003	(mg/m³)²
Influence of sample gas flow	u_p	0.016	mg/m³	0.000	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.024	mg/m³	0.001	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.10	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.19	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 1 mg/m³**	**19.4**
Requirement of 2010/75/EU	**U in % of the ELV 1 mg/m³**	**40.0**
Requirement of EN 15267-3	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	017151632 / 016842381
Measuring principle	FTIR
Test report	936/21208291/C
Test laboratory	TÜV Rheinland
Date of report	2014-03-20
Measured component	N_2O
Certification range	0 - 50 mg/m³

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.73	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at span point	1.50	mg/m³
Sum of negative CS at span point	-1.20	mg/m³
Maximum sum of cross-sensitivities	1.50	mg/m³
Uncertainty of cross-sensitivity	0.866	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.171	mg/m³	0.029	(mg/m³)²
Lack of fit	u_{lof}	0.237	mg/m³	0.056	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.087	mg/m³	0.008	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.404	mg/m³	0.163	(mg/m³)²
Influence of ambient temperature at span	u_t	0.400	mg/m³	0.160	(mg/m³)²
Influence of supply voltage	u_v	0.185	mg/m³	0.034	(mg/m³)²
Cross-sensitivity (interference)	u_i	0.866	mg/m³	0.750	(mg/m³)²
Influence of sample gas flow	u_p	0.162	mg/m³	0.026	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404	mg/m³	0.163	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.18	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.31	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**4.6**
Requirement of 2010/75/EU	**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

** EU Directive 2010/75/EU does not define requirements for this component.
A value of 20.0 % was used instead.

Certificate:
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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			017151632 / 016842381		
Measuring principle			FTIR		
Test report			936/21208291/C		
Test laboratory			TÜV Rheinland		
Date of report			2014-03-20		
Measured component			NH_3		
Certification range			0 - 10	mg/m³	
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point			0.24	mg/m³	
Sum of negative CS at zero point			-0.31	mg/m³	
Sum of postive CS at span point			0.08	mg/m³	
Sum of negative CS at span point			-0.36	mg/m³	
Maximum sum of cross-sensitivities			-0.36	mg/m³	
Uncertainty of cross-sensitivity			-0.208	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.115	mg/m³	0.013	$(mg/m^3)^2$
Lack of fit	u_{lof}	0.035	mg/m³	0.001	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	-0.075	mg/m³	0.006	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	0.069	mg/m³	0.005	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	0.153	mg/m³	0.023	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.038	mg/m³	0.001	$(mg/m^3)^2$
Cross-sensitivity (interference)	u_i	-0.208	mg/m³	0.043	$(mg/m^3)^2$
Influence of sample gas flow	u_p	0.037	mg/m³	0.001	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	0.081	mg/m³	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)	$u_c = \sqrt{\sum (u_{max,\,j})^2}$	0.32	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.62	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**6.2**
Requirement of 2010/75/EU	**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

** EU Directive 2010/75/EU does not define requirements for this component.
A value of 40.0 % was used instead.

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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	017151632 / 016842381
Measuring principle	FTIR
Test report	936/21208291/C
Test laboratory	TÜV Rheinland
Date of report	2014-03-20
Measured component	NO
Certification range	0 - 200 mg/m³

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	1.64	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at span point	0.00	mg/m³
Sum of negative CS at span point	-6.30	mg/m³
Maximum sum of cross-sensitivities	-6.30	mg/m³
Uncertainty of cross-sensitivity	-3.637	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.819	mg/m³	0.671	(mg/m³)²
Lack of fit	u_{lof}	0.635	mg/m³	0.403	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.231	mg/m³	0.053	(mg/m³)²
Span drift from field test	$u_{d,s}$	-1.155	mg/m³	1.334	(mg/m³)²
Influence of ambient temperature at span	u_t	1.249	mg/m³	1.560	(mg/m³)²
Influence of supply voltage	u_v	0.579	mg/m³	0.335	(mg/m³)²
Cross-sensitivity (interference)	u_i	-3.637	mg/m³	13.230	(mg/m³)²
Influence of sample gas flow	u_p	-0.818	mg/m³	0.669	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	1.617	mg/m³	2.613	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	4.57	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	8.95	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 131 mg/m³**	**6.8**
Requirement of 2010/75/EU	**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

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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	017151632 / 016842381		
Measuring principle	FTIR		
Test report	936/21208291/C		
Test laboratory	TÜV Rheinland		
Date of report	2014-03-20		
Measured component	NO_2		
Certification range	0 - 50	mg/m³	
Evaluation of the cross-sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point	0.00	mg/m³	
Sum of negative CS at zero point	0.00	mg/m³	
Sum of postive CS at span point	0.50	mg/m³	
Sum of negative CS at span point	-1.30	mg/m³	
Maximum sum of cross-sensitivities	-1.30	mg/m³	
Uncertainty of cross-sensitivity	-0.751	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.111	mg/m³	0.012	(mg/m³)²
Lack of fit	u_{lof}	0.289	mg/m³	0.084	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.115	mg/m³	0.013	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.462	mg/m³	0.213	(mg/m³)²
Influence of ambient temperature at span	u_t	0.208	mg/m³	0.043	(mg/m³)²
Influence of supply voltage	u_v	0.242	mg/m³	0.059	(mg/m³)²
Cross-sensitivity (interference)	u_i	-0.751	mg/m³	0.563	(mg/m³)²
Influence of sample gas flow	u_p	0.235	mg/m³	0.055	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404	mg/m³	0.163	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.10	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.15	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**4.3**
Requirement of 2010/75/EU	**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

Certificate:
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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			017151632 / 016842381		
Measuring principle			FTIR		
Test report			936/21208291/C		
Test laboratory			TÜV Rheinland		
Date of report			2014-03-20		
Measured component			SO_2		
Certification range			0 - 75	mg/m³	
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point			0.71	mg/m³	
Sum of negative CS at zero point			-1.76	mg/m³	
Sum of postive CS at span point			1.79	mg/m³	
Sum of negative CS at span point			-2.09	mg/m³	
Maximum sum of cross-sensitivities			-2.09	mg/m³	
Uncertainty of cross-sensitivity			-1.208	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.348	mg/m³	0.121	(mg/m³)²
Lack of fit	u_{lof}	0.346	mg/m³	0.120	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.346	mg/m³	0.120	(mg/m³)²
Span drift from field test	$u_{d,s}$	-0.606	mg/m³	0.367	(mg/m³)²
Influence of ambient temperature at span	u_t	0.643	mg/m³	0.413	(mg/m³)²
Influence of supply voltage	u_v	0.256	mg/m³	0.066	(mg/m³)²
Cross-sensitivity (interference)	u_i	-1.208	mg/m³	1.460	(mg/m³)²
Influence of sample gas flow	u_p	-0.352	mg/m³	0.124	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	0.368	(mg/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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.78	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.48	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**7.0**
Requirement of 2010/75/EU	**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