

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000038495_04

AMS designation: AR650/N for CO, HCl, H₂O, CO₂, N₂O and CH₄

Manufacturer: Opsis AB
Skytteskogsvägen 16
244 02 Furulund
Sweden

Test Laboratory: 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: 2004

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 13 pages).



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance


www.tuv.com
ID 0000038495

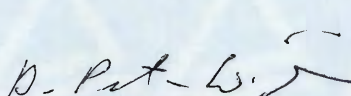
Publication in the German Federal Gazette
(BAnz) of 02 April 2015

This certificate will expire on:
04 March 2023

German Federal Environment Agency
Dessau, 05 March 2018

TÜV Rheinland Energy GmbH
Cologne, 04 March 2018


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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:	936/21220566/D dated 09 September 2014
Initial certification:	05 March 2013
Expiry date:	04 March 2023
Certificate:	Renewal (of previous certificate 0000038495_03 dated 30 April 2015 valid until 04 March 2018)
Publication:	BAnz AT 02.04.2015 B5, chapter I number 3.1

Approved application

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III (13th BImSchV), at waste incineration plants according to Directive 2010/75/EU, chapter IV (17th BImSchV), the 27th BImSchV, the 30th BImSchV and TA Luft. The measured ranges have been selected so as to cater for 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 °C 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 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.

Basis of the certification

This certification is based on:

- Test report no. 936/21220566/D dated 09 September 2014 issued by 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 02.04.2015 B5, chapter I number 3.1, UBA announcement dated 25 February 2015:

AMS designation:

AR650/N for CO, HCl, H₂O, CO₂, N₂O and CH₄

Manufacturer:

OP SIS AB, Furulund, Sweden

Field of application:

For plants requiring official approval and for plants according to the 27th BImSchV

Measuring ranges during performance testing:

Component	Certification range	Supplementary range	Unit
CO	0–75*	0–500*	mg/m ³
HCl	0–15*	0–90*	mg/m ³
H ₂ O	0–30*	0–40*	Vol.-%
CO ₂	0–30*	0–40*	Vol.-%
N ₂ O	0–500*	0–2000*	mg/m ³
CH ₄	0–20*	0–100*	mg/m ³

* referred to a measuring path of 1.0 m

Software version:

7.21

Restrictions:

During performance testing in accordance with EN 15267-3, the requirement for the degree of protection provided by the enclosure was not fulfilled.

Notes:

1. The maintenance interval is six months.
2. During performance testing, the measurement path length was 1 m in the laboratory test and 2 m in the field test.
3. Supplementary testing (extension of the maintenance interval) as regards Federal Environment Agency notice of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter I number 4.1).

Test Report:

TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report no.: 936/21220566/D dated 9 September 2014

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter IV notification 37,
UBA announcement dated 25 February 2015:

37 Notification as regards Federal Environment Agency (UBA) notice of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter I no. 4.1)

Production of the step motor used for automatic grid finding, type RDM 543/100A supplied by BERGER LAHR and implemented in the AR650/N measuring system for CO, HCl, H₂O, CO₂, N₂O and CH₄ of the company Opsis AB was discontinued and therefore replaced by the step motor for automatic grid finding, type RDM 545/100A manufactured by BERGER LAHR.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 20 September 2014

Publication in the German Federal Gazette: BAnz AT 26.08.2015 B4 chapter V notification 16,
UBA announcement dated 22 July 2015:

16 Notification as regards Federal Environment Agency notices of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter I number 4.1) and of 25 February 2015 (BAnz AT 02.04.2015, B5 chapter IV 37th notification)

The AR650/N measuring system for CO, HCl, H₂O, CO₂, N₂O and CH₄, manufactured by Opsis AB is also available with the option "ER060/062AUTO with automatic QAL3 testing system" for regular automatic functional checks based on the main component CO. The "ER060/062AUTO with automatic QAL3 testing system" option does not serve the purpose of adjusting the AMS, nor does it replace the manual zero and span point checks required during the maintenance interval. It merely provides additional information on the measuring system's status in between external test gas applications.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 23 March 2015

Certified product

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

The AR650/N system is an in-situ DOAS open path measuring system for the measurement of CO, HCl, H₂O, CO₂, N₂O and CH₄.

The system tested consists of a light source, a receiver, an opto-fibre cable and an opto-analyser. The analyser consists of a spectrometer, a detection system, electronics for the operation of the grating and a computer for evaluation and signal processing.

The measuring section is composed of the optical path between a light transmitter and a light receiver. The light beam is generated by a high-pressure xenon lamp.

The light beam is directed to the receiver. On its path through the medium, the intensity of the light beam is affected by scattering and absorption in the molecules and particles.

The collected light from the receiver is routed to the analyser via a fibre optic cable. This cable is only to enable the preparation of the analyser at a location protected from dust, excessive moisture, temperature variations, etc.

The measuring system consists of:

- Analyser (AR650/N)
- Light emitter unit (EM062)
- Receiver unit (RE062)
- Fibre optic cable (OF 100B)

The current software version is:

7.21

The current manual version is:

Version 3, dated July 2015

General remarks

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 manufacturing process for 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 document as well as the certification mark remains property of TÜV Rheinland Energy GmbH. Upon revocation of the publication the certificate loses its validity. After the expiration of the certificate and on request of TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must no longer be used.

The relevant version of this certificate and its expiration date are also accessible on the internet at qal1.de.

Certification of the AR650/N measuring system is based on the documents listed below and the regular, continuous surveillance of the manufacturer's quality management system:

Initial certification according to EN 15267

Certificate no. 0000038495: 22 March 2013
Expiry date of the certificate: 04 March 2018

Test report: 936/21220566/A dated 11 October 2012
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 05.03.2013 B10, chapter I number 5.1
UBA announcement dated 12 February 2013

Supplementary testing according to EN 15267

Certificate no. 0000038495_01: 29. April 2014
Expiry date of the certificate: 04 March 2018

Test report: 936/21220566/B dated 10 October 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 01.04.2014 B12, chapter I number 3.1
UBA announcement dated 27 February 2014

Certificate no. 0000038495_02: 09 September 2014
Expiry date of the certificate: 04 March 2018

Test report: 936/21220566/C dated 18 February 2014
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 05.08.2014 B11, chapter I number 4.1
UBA announcement dated 17 July 2014

Certificate no. 0000038495_03: 30 April 2015
Expiry date of the certificate: 04 March 2018

Test report: 936/21220566/D dated 09 September 2014
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 02.04.2015 B5, chapter I number 3.1
UBA announcement dated 25 February 2015

Notifications in accordance with EN 15267

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 20 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 37
UBA announcement dated 25 February 2015
(discontinued production and replacement of the step motor)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 23 March 2015
Publication: BAnz AT 26.08.2015 B4, chapter V notification 16
UBA announcement dated 22 July 2015
(additional option for automated functional testing)

Renewal of the certificate

Certificate no. 0000038495_04:	05 March 2018
Expiry date of the certificate:	04 March 2023

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

Measuring system

Manufacturer	Opsis AB
AMS designation	AR650/N
Serial number of units under test	448 / 449
Measuring principle	IR-DOAS

Test report

Test laboratory	936/21220566/D TÜV Rheinland
Date of report	2014-09-09

Measured component

Certification range	CH ₄ 0 - 20 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.44 mg/m ³
Sum of negative CS at zero point	-0.24 mg/m ³
Sum of positive CS at span point	0.30 mg/m ³
Sum of negative CS at span point	-0.50 mg/m ³
Maximum sum of cross-sensitivities	-0.50 mg/m ³
Uncertainty of cross-sensitivity	-0.289 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			U ²
Repeatability standard deviation at set point *	U _r	0.253 mg/m ³	0.064 (mg/m ³) ²
Lack of fit	U _{lof}	0.173 mg/m ³	0.030 (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}	0.104 mg/m ³	0.011 (mg/m ³) ²
Influence of ambient temperature at span	U _t	0.100 mg/m ³	0.010 (mg/m ³) ²
Influence of supply voltage	U _v	0.053 mg/m ³	0.003 (mg/m ³) ²
Cross-sensitivity (interference)	U _i	-0.289 mg/m ³	0.083 (mg/m ³) ²
Influence of sample gas pressure	U _p	0.155 mg/m ³	0.024 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	U _{rm}	0.162 mg/m ³	0.026 (mg/m ³) ²
Excursion of measurement beam	U _{mb}	-0.214 mg/m ³	0.046 (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)	$U_c = \sqrt{\sum (u_{max,i})^2}$	0.56 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.09 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 20 mg/m ³	5.5
Requirement of EN 15267-3	U in % of the range 20 mg/m ³	30.0 **
	U in % of the range 20 mg/m ³	22.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 30 % was used for this.

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

Measuring system

Manufacturer	Opsis AB
Name of measuring system	AR650/N
Serial number of the candidates	448 / 449
Measuring principle	IR-DOAS

Test report

Test laboratory	936/21220566/D TÜV Rheinland
Date of report	2014-09-09

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	-0.33 mg/m ³
Sum of positive CS at reference point	0.35 mg/m ³
Sum of negative CS at reference point	-0.37 mg/m ³
Maximum sum of cross sensitivities	0.63 mg/m ³
Uncertainty of cross sensitivity	0.364 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.805 mg/m ³	0.648 (mg/m ³) ²
Lack of fit	u_{lof}	0.404 mg/m ³	0.163 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	0.390 mg/m ³	0.152 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.476 mg/m ³	0.227 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.416 mg/m ³	0.173 (mg/m ³) ²
Influence of supply voltage	u_v	0.202 mg/m ³	0.041 (mg/m ³) ²
Cross sensitivity (interference)	u_i	0.364 mg/m ³	0.132 (mg/m ³) ²
Influence of sample pressure	u_p	0.320 mg/m ³	0.102 (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
Excursion of measurement beam	u_{mb}	0.403 mg/m ³	0.162 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

$$u_c = \sqrt{\sum (u_{max,j})^2}$$

Combined standard uncertainty (u_c)		1.47 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.89 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	5.8
Requirement of EN 15267-3	U in % of the ELV 50 mg/m ³	10.0
	U in % of the ELV 50 mg/m ³	7.5

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

Measuring system

Manufacturer	Opsis AB
Name of measuring system	AR650/N
Serial number of the candidates	448 / 449
Measuring principle	IR-DOAS

Test report

Test laboratory	936/21220566/D TÜV Rheinland
Date of report	2014-09-09

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	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at reference point	0.14 mg/m ³
Sum of negative CS at reference point	-0.07 mg/m ³
Maximum sum of cross sensitivities	0.14 mg/m ³
Uncertainty of cross sensitivity	0.081 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Repeatability standard deviation at set point *	u_r	0.190 mg/m ³	0.036 (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	$u_{d,z}$	0.052 mg/m ³	0.003 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.113 mg/m ³	0.013 (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	0.089 mg/m ³	0.008 (mg/m ³) ²
Cross sensitivity (interference)	u_i	0.081 mg/m ³	0.007 (mg/m ³) ²
Influence of sample pressure	u_p	0.077 mg/m ³	0.006 (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
Excursion of measurement beam	u_{mb}	0.115 mg/m ³	0.013 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

$$u_c = \sqrt{\sum (u_{max,j})^2}$$

Combined standard uncertainty (u_c)		0.33 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.64 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 10 mg/m³	6.4
Requirement of EN 15267-3	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	Opsis AB
AMS designation	AR650/N
Serial number of units under test	448 / 449
Measuring principle	IR-DOAS

Test report

Test laboratory	936/21220566/D TÜV Rheinland
Date of report	2014-09-09

Measured component

Certification range	CO ₂ 0 - 30 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	0.00 Vol.-%
Sum of negative CS at span point	0.00 Vol.-%
Maximum sum of cross-sensitivities	0.00 Vol.-%
Uncertainty of cross-sensitivity	0.000 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u^2
Standard deviation from paired measurements under field conditions *	u_D	0.058 Vol.-%		0.003 (Vol.-%) ²
Lack of fit	u_{lof}	0.173 Vol.-%		0.030 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$	0.156 Vol.-%		0.024 (Vol.-%) ²
Span drift from field test	$u_{d,s}$	0.139 Vol.-%		0.019 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.058 Vol.-%		0.003 (Vol.-%) ²
Influence of supply voltage	u_v	0.012 Vol.-%		0.000 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	0.000 Vol.-%		0.000 (Vol.-%) ²
Influence of sample gas pressure	u_p	0.011 Vol.-%		0.000 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.242 Vol.-%		0.059 (Vol.-%) ²
Excursion of measurement beam	u_{mb}	0.115 Vol.-%		0.013 (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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.39 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.77 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 30 Vol.-%	2.6
Requirement of EN 15267-3	U in % of the range 30 Vol.-%	10.0 **
		7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 10% was used for this.

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

Measuring system

Manufacturer	Opsis AB
AMS designation	AR650/N
Serial number of units under test	448 / 449
Measuring principle	IR-DOAS

Test report

Test laboratory	936/21220566/D
Date of report	TÜV Rheinland
	2014-09-09

Measured component

Certification range	H ₂ O	0 - 30 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	0.20	Vol.-%
Sum of negative CS at span point	0.00	Vol.-%
Maximum sum of cross-sensitivities	0.20	Vol.-%
Uncertainty of cross-sensitivity	0.116	Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u^2
Standard deviation from paired measurements under field conditions *	u_D	0.218	Vol.-%	0.048 (Vol.-%) ²
Lack of fit	u_{lof}	0.173	Vol.-%	0.030 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$	0.156	Vol.-%	0.024 (Vol.-%) ²
Span drift from field test	$u_{d,s}$	0.225	Vol.-%	0.051 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.058	Vol.-%	0.003 (Vol.-%) ²
Influence of supply voltage	u_v	0.099	Vol.-%	0.010 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	0.116	Vol.-%	0.013 (Vol.-%) ²
Influence of sample gas pressure	u_p	0.036	Vol.-%	0.001 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.242	Vol.-%	0.059 (Vol.-%) ²
Excursion of measurement beam	u_{mb}	0.403	Vol.-%	0.162 (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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.63	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.24	Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 30 Vol.-%	4.1
Requirement of EN 15267-3	U in % of the range 30 Vol.-%	10.0 **
		7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 10 % was used for this.

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

Measuring system

Manufacturer	Opsis AB
AMS designation	AR650/N
Serial number of units under test	448 / 449
Measuring principle	IR-DOAS

Test report

Test laboratory	936/21220566/D
Date of report	TÜV Rheinland
	2014-09-09

Measured component

Certification range	N ₂ O	0 - 500 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	17.20 mg/m ³
Sum of negative CS at zero point	-10.10 mg/m ³
Sum of positive CS at span point	19.30 mg/m ³
Sum of negative CS at span point	-13.00 mg/m ³
Maximum sum of cross-sensitivities	19.30 mg/m ³
Uncertainty of cross-sensitivity	11.143 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Repeatability standard deviation at set point *	u _r	7.452 mg/m ³	55.532 (mg/m ³) ²
Lack of fit	u _{lof}	-2.309 mg/m ³	5.331 (mg/m ³) ²
Zero drift from field test	u _{d,z}	4.041 mg/m ³	16.330 (mg/m ³) ²
Span drift from field test	u _{d,s}	4.907 mg/m ³	24.079 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.954 mg/m ³	0.910 (mg/m ³) ²
Influence of supply voltage	u _v	2.586 mg/m ³	6.687 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	11.143 mg/m ³	124.163 (mg/m ³) ²
Influence of sample gas pressure	u _p	0.832 mg/m ³	0.692 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	4.041 mg/m ³	16.333 (mg/m ³) ²
Excursion of measurement beam	u _{mb}	5.225 mg/m ³	27.301 (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)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 16.65 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 32.64 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the range 500 mg/m³ 6.5

Requirement of 2010/75/EU

U in % of the range 500 mg/m³ 20.0 **

Requirement of EN 15267-3

U in % of the range 500 mg/m³ 15.0

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 20 % was used for this.