Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

CERTIFICATE

on Product Conformity (QAL1)

Number of Certificate: 0000025927_01

Certified AMS:	AR500 with ER120 for NO_2, SO_2 and O_3
Manufacturer:	Opsis AB Skytteskogsvägen 16 244 02 Furulund Sweden
Test Institute:	TÜV Rheinland Energie und Umwelt GmbH

This is to certify that the AMS has been tested and found to comply with:

EN 14211: 2005, EN 14212: 2005, EN 14625: 2005, EN 15267-1: 2009 and EN 15267-2: 2009

Certification is awarded in respect of the conditions stated in this certificate (also see the following pages).
The present certificate replaces Certificate No. 0000025927 of 10 March 2010

www.tuv.com TÜVRheinland® ID: 0000025927

- Certified equivalent EN method
- Complying with 2008/50/EC
- TUV approved
- Annual inspection

Publication in the German Federal Gazette (BAnz.) of 02 March 2012

Umweltbundesamt
Dessau, 16 March 2012

i. A. Dr. Hans-Joachim Hummel

The certificate is valid until:
11 February 2015

TÜV Rheinland Energie und Umwelt GmbH
Köln, 15 March 2012

ppa. Dr. Peter Wilbring

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Am Grauen Stein
51105 Köln

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

10/221 2.08

Test report:	936/21211350/B of 07 October 2011
First certification:	12 February 2010
Validity ends:	11 February 2015
Publication:	BAnz. 02 March 2012, No. 36, p. 920, chapter IV, No. 2.1

Approved application
The certified AMS is suitable for continuous ambient air monitoring (stationary operation).

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a three months field test.

The AMS is approved for a temperature range of +5 °C bis +40 °C.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for ambient air applications under which it will be operated.

Basis of the certification
This certification is based on:

- test report 936/21211350/A dated 26 October 2010 of TÜV Rheinland Energie und Umwelt GmbH
- test report 936/21211350/B dated 7 October 2011 of TÜV Rheinland Energie und Umwelt 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. 02 March 2012, No. 36, p. 920, chapter IV, No. 2.1, Announcement by UBA from 23 February 2012)

AMS name:
AR500 with ER120 for NO_2, SO_2 and O_3

Manufacturer:
Opsis AB, Furulund, Sweden

Field of application:
For stationary Measuring of the concentrations of Nitrogen Dioxide, Sulpitur Dioxide and Ozone in ambient air

Measuring ranges during the suitability test:

Component	Certification range	supplementary measurement ranges	Unit
NO_2	0 - 400	0 - 1800	µg/m³
SO_2	0 - 700	0 - 1000	µg/m³
O_3	0 - 360	0 - 500	µg/m³

Software version:
7.21

Restrictions:
None

Notes:
1. The measuring path length during the suitability test was 320 m.
2. The maintenance interval is four weeks.
3. The equivalence with the reference measurement methods according to the guideline „Demonstration of Equivalence of Ambient Air Monitoring Methods“ has been demonstrated for the components NO_2, SO_2 and O_3.
4. Function tests by external sample gas feeding are possible.
5. The test report is available on the Internet at www.qal1.de.
6. Supplementary report (Demonstration of Equivalence for the component SO_2 according the guideline „Demonstration of Equivalence of Ambient Air Monitoring Methods“) to the announcement of the UBA from 25 January 2010 (BAnz. p. 552, chapter III number 1.1).

Test report:
TÜV Rheinland Energie und Umwelt GmbH, Köln
Report No.: 936/21211350/B dated 7 October 2011

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

The measurement system AR500 operates on the basis of the Differential Optical Absorption Spectroscopy (DOAS). The DOAS measuring principle uses the characteristic radiation absorption by gaseous components for quantification of the respective concentrations.

The DOAS monitor AR500 with ER120 consists of a combined emitter/receiver unit, a reflector unit and an analyser. The absorbed light is transferred from the emitter/receiver unit to the analyser via fibre optic cable.

Combined Sender-Receiver Unit ER 120
The combined Emitter-Receiver Unit ER120 comprises the optical components, the xenon light-source and the power supply PS150 for igniting the xenon light-source.
The used high-pressure Xenon lamp is a point light source. The light is generated by ignition of ultra pure Xenon gas at a pressure of approx. 30 bar. The lamp is powered by a stabilised D.C. voltage source and requires a short high-voltage ignition pulse.
The radiation of the lamp includes the ultraviolet, visible and infrared range. The wavelengths are continuously distributed over the entire spectrum, with the exception of some peaks in the near infrared range.

Analyser

The light is led to a spectrometer upon hitting the analyser and then refracted into its wavelength components by an internal grating. The refracted light is then projected onto a rapid scanning slit in front of a photo-multiplier detector, where a selected part of the spectrum is detected. The scanning slit allows separate recordings of all wavelengths by a single detector.

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 given address 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 is presented on page 1 of this certificate.

This document as well as the certification mark remains property of TÜV Rheinland Energie und Umwelt GmbH. With revocation of the publication the certificate looses 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 AR500 with ER120 for NO_2, SO_2 and O_3 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. 0000025927: 10 March 2010

Validity of the certificate: 11 February 2015

Test report: 936/21211350/A of 26 October 2010,
TÜV Rheinland Energie und Umwelt GmbH, Köln,

Publication: BAnz. 12 February 2010, No. 24, p.552, chapter III, Nr. 1.1:
Announcement by UBA from 25 January 2010

Supplementary testing according to EN 15267:

Certificate No. 0000025927_01:16 March 2012

Validity of the certificate: 11 February 2015

Test report: 936/21211350/B of 07 October 2011,
TÜV Rheinland Energie und Umwelt GmbH, Köln,

Publication: BAnz. 02 March 2012, No. 36, p. 920, chapter IV, No. 2.1,
Announcement by UBA from 23 February 2012.

Table 1: Total expanded uncertainty with the results of the laboratory test according to EN 14211 (Component NO_2) for system 1329

Device:	AR500			Serial No:	1329			
Component:	NO_2			1h-limit value:	104,6	nmol/mol		
No.	**Performance characteristic**		**Criterion**	**Result**	**Uncertainty**		**Square of uncertainty**	
1	Repeatability at zero	≤	1,0 nmol/mol	0,000	$u_{r,Z}$	0,00	0,0000	
2	Repeatability at concentration ct	≤	3,0 nmol/mol	2,000	$u_{r,lh}$	0,04	0,0015	
3	"lack of fit"	≤	4,0% of measured value	0,800	$u_{l,lh}$	0,48	0,2334	
4	Sensitivity coefficient of sample gas pressure	≤	8,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000	
5	Sensitivity coefficient of sample gas temperature	≤	3,0 nmol/mol/K	0,026	u_{gt}	0,04	0,0016	
6	Sensitivity coefficient of surrounding temperature	≤	3,0 nmol/mol/K	-0,050	u_{st}	-0,06	0,0036	
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	-0,021	u_V	-0,07	0,0046	
8a	H20 with concentration 21 mmol/mol	≤	5,0 nmol/mol	0,000	u_{H2O}	0,00	0,0000	
8b	CO2 with concentration 500 µmol/mol	≤	5,0 nmol/mol	0,001	$u_{int,pos}$ or $u_{int,neg}$	0,48	0,2304	
8c	O3 with concentration 200 nmol/mol	≤	2,0 nmol/mol	0,002				
8d	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,002				
9	Averaging effect	≤	7,0% of measured value	-0,600	u_{av}	-0,36	0,1313	
18	Difference sample/calibration port	≤	1,0%	0,000	$u_{s,sc}$	0,00	0,0000	
21	Converter efficiency	≥	98%	100,000	u_{CE}	0,00	0,0000	
22	Increase of NO2 concentration due to residence time	≤	4,0 nmol/mol	0,000	u_{cdr}	0,00	0,0000	
23	Uncertainty calibration gas	≤	3,0%	2,000	u_{cg}	1,05	1,0941	
					combined standard uncertainty	u_c	1,3046	nmol/mol
					expanded uncertainty	U_c	2,6092	nmol/mol
					expanded uncertainty actual	$U_{c,rel}$	**2,49**	%
					expanded uncertainty required	$U_{req,rel.}$	15	%

Table 2: Total expanded uncertainty with the results of the laboratory test and field test according to EN 14211 (Component NO_2) for system 1329

Device:	AR500				Serial No:	1329				
Component:	NO_2				1h-limit value:	104,6				nmol/mol
No.	**Performance characteristic**		**Criterion**	**Result**	**Uncertainty**			**Square of uncertainty**		
1	Repeatability at zero	≤	1,0 nmol/mol	0,000	$u_{r,Z}$	0,00		0,0000		
2	Repeatability at concentration ct	≤	3,0 nmol/mol	2,000	$u_{r,lh}$	not respected because, $u_{r,lh} = 0,075 < u_{r,f}$		-		
3	"lack of fit"	≤	4,0% of measured value	0,800	$u_{l,lh}$	0,48		0,2334		
4	Sensitivity coefficient of sample gas pressure	≤	8,0 nmol/mol/kPa	0,000	u_{gp}	0,00		0,0000		
5	Sensitivity coefficient of sample gas temperature	≤	3,0 nmol/mol/K	0,026	u_{gt}	0,04		0,0016		
6	Sensitivity coefficient of surrounding temperature	≤	3,0 nmol/mol/K	-0,050	u_{st}	-0,06		0,0036		
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	-0,021	u_V	-0,07		0,0046		
8a	H20 with concentration 21 mmol/mol	≤	5,0 nmol/mol	0,000	u_{H2O}	0,00		0,0000		
8b	CO2 with concentration 500 µmol/mol	≤	5,0 nmol/mol	0,001	$u_{int,pos}$	0,48		0,2304		
8c	O3 with concentration 200 nmol/mol	≤	2,0 nmol/mol	0,002	or					
8d	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,002	$u_{int,neg}$					
9	Averaging effect	≤	7,0% of measured value	-0,600	u_{av}	-0,36		0,1313		
10	Reproducibility under field conditions	≤	5,0% of the average of 3 Mon.	4,720	$u_{r,f}$	4,94		24,3752		
11	Long term drift at zero level	≤	5,0 nmol/mol	-1,420	$u_{d,l,z}$	-0,82		0,6721		
12	Long term drift at span level	≤	5,0% of max. of certification range	0,430	$u_{d,l,lh}$	0,26		0,0674		
18	Difference sample/calibration port	≤	1,0%	0,000	uDsc	0,00		0,0000		
21	Converter efficiency	≥	98%	100,000	uCE	0,00		0,0000		
22	Increase of NO2 concentration due to residence time	≤	4,0 nmol/mol	0,000	uctr	0,00		0,0000		
23	Uncertainty calibration gas	≤	3,0%	2,000	ucg	1,05		1,0941		
					combined standard uncertainty		u_c	7,1546		nmol/mol
					expanded uncertainty		U_c	14,3093		nmol/mol
					expanded uncertainty actual		$U_{c,rel}$	**13,68**		%
					expanded uncertainty required		$U_{req,rel}$	15		%

Table 3: Total expanded uncertainty with the results of the laboratory test according to EN 14211 (Component NO_2) for system 1330

Device: AR500 Serial No: 1330

Component: NO_2 1h-limit value: 104,6 nmol/mol

No.	Performance characteristic		Criterion	Result	Uncertainty		Square of uncertainty
1	Repeatability at zero	≤	1,0 nmol/mol	0,100	$u_{r,Z}$	0,02	0,0003
2	Repeatability at concentration ct	≤	3,0 nmol/mol	0,900	$u_{r,ih}$	0,02	0,0004
3	"lack of fit"	≤	4,0% of measured value	0,000	u_{Lih}	0,36	0,1313
4	Sensitivity coefficient of sample gas pressure	≤	8,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000
5	Sensitivity coefficient of sample gas temperature	≤	3,0 nmol/mol/K	0,000	u_{gt}	-0,05	0,0025
6	Sensitivity coefficient of surrounding temperature	≤	3,0 nmol/mol/K	0,000	u_{st}	0,00	0,0000
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	0,000	u_V	0,24	0,0553
8a	H20 with concentration 21 mmol/mol	≤	5,0 nmol/mol	0,000	u_{H2O}	0,00	0,0000
8b	CO2 with concentration 500 µmol/mol	≤	5,0 nmol/mol	0,000	$u_{int,pos}$ or $u_{int,neg}$	0,42	0,1764
8c	O3 with concentration 200 nmol/mol	≤	2,0 nmol/mol	0,000			
8d	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,000			
9	Averaging effect	≤	7,0% of measured value	0,000	u_{av}	-0,18	0,0328
18	Difference sample/calibration port	≤	1,0%	0,000	$u_{\Delta sc}$	0,00	0,0000
21	Converter efficiency	≥	98%	100,000	u_{CE}	0,00	0,0000
22	Increase of NO2 concentration due to residence time	≤	4,0 nmol/mol	0,000	u_{ctr}	0,00	0,0000
23	Uncertainty calibration gas	≤	3,0%	2,000	u_{cg}	1,05	1,0941

combined standard uncertainty	u_c	1,2222	nmol/mol
expanded uncertainty	U_c	2,4445	nmol/mol
expanded uncertainty actual	$U_{c,rel}$	**2,34**	%
expanded uncertainty required	$U_{req,rel.}$	15	%

Table 4: Total expanded uncertainty with the results of the laboratory test and field test according to EN 14211 (Component NO_2) for system 1330

Device:	AR500			Serial No:	1330			
Component:	NO_2			1h-limit value:	104,6	nmol/mol		
No.	**Performance characteristic**		**Criterion**	**Result**	**Uncertainty**		**Square of uncertainty**	
1	Repeatability at zero	≤	1,0 nmol/mol	0,100	$u_{r,Z}$	0,02	0,0003	
2	Repeatability at concentration ct	≤	3,0 nmol/mol	0,900	$u_{r,lh}$	not respected because, $u_{r,lh} = 0{,}034 < u_{r,f}$	-	
3	"lack of fit"	≤	4,0% of measured value	0,600	$u_{l,lh}$	0,36	0,1313	
4	Sensitivity coefficient of sample gas pressure	≤	8,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000	
5	Sensitivity coefficient of sample gas temperature	≤	3,0 nmol/mol/K	-0,032	u_{gt}	-0,05	0,0025	
6	Sensitivity coefficient of surrounding temperature	≤	3,0 nmol/mol/K	0,000	u_{st}	0,00	0,0000	
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	0,073	u_V	0,24	0,0553	
8a	H20 with concentration 21 mmol/mol	≤	5,0 nmol/mol	0,000	u_{H2O}	0,00	0,0000	
8b	CO2 with concentration 500 µmol/mol	≤	5,0 nmol/mol	0,001	$u_{int,pos}$ or $u_{int,neg}$	0,42	0,1764	
8c	O3 with concentration 200 nmol/mol	≤	2,0 nmol/mol	0,002				
8d	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,000				
9	Averaging effect	≤	7,0% of measured value	-0,300	u_{av}	-0,18	0,0328	
10	Reproducibility under field conditions	≤	5,0% of the average of 3 Mon.	4,720	$u_{r,f}$	4,94	24,3752	
11	Long term drift at zero level	≤	5,0 nmol/mol	1,620	$u_{d,l,z}$	0,94	0,8748	
12	Long term drift at span level	≤	5,0% of max. of certification range	0,500	$u_{d,l,lh}$	0,30	0,0912	
18	Difference sample/calibration port	≤	1,0%	0,000	uDsc	0,00	0,0000	
21	Converter efficiency	≥	0,98	100,000	uCE	0,00	0,0000	
22	Increase of NO2 concentration due to residence time	≤	4,0 nmol/mol	0,000	uctr	0,00	0,0000	
23	Uncertainty calibration gas	≤	3,0%	2,000	ucg	1,05	1,0941	
					combined standard uncertainty	u_c	7,1561	nmol/mol
					expanded uncertainty	U_c	14,3121	nmol/mol
					expanded uncertainty actual	$U_{c,rel}$	**13,68**	%
					expanded uncertainty required	$U_{req,rel}$	15	%

Table 5: Total expanded uncertainty with the results of the laboratory test according to EN 14212 (Component SO_2) for system 1329

Device:	AR500			Serial-No.:	Gerät 1 (1329)			
Component:	SO_2			1h-limit value:	132			nmol/mol
No.	**Performance characteristic**		**Criterion**	**Result**	**Uncertainty**		**Square of uncertainty**	
1	Repeatability at zero	≤	1,0 nmol/mol	0,100	$u_{r,Z}$	0,02	0,0003	
2	Repeatability at concentration ct	≤	3,0 nmol/mol	0,100	$u_{r,tv}$	0,02	0,0003	
3	"lack of fit"	≤	4,0% of measured value	1,600	$u_{l,lv}$	1,22	1,4868	
4	Sensitivity coefficient of sample gas pressure	≤	3,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000	
5	Sensitivity coefficient of sample gas temperature	≤	1,0 nmol/mol/K	0,071	u_{gt}	0,54	0,2908	
6	Sensitivity coefficient of surrounding temperature	≤	1,0 nmol/mol/K	-0,030	u_{st}	-0,23	0,0523	
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	-0,010	u_V	-0,10	0,0103	
8a	H20 with concentration 21 mmol/mol	≤	10 nmol/mol	0,000	u_{H2O}	0,00	0,0000	
8b	H2S with concentration 200 nmol/mol	≤	5,0 nmol/mol	-0,409	$u_{int,pos}$			
8c	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,406				
8d	NO with concentration 500 nmol/mol	≤	5,0 nmol/mol	-0,604	or	0,40	0,1600	
8e	NO2 with concentration 200 nmol/mol	≤	5,0 nmol/mol	-0,404	$u_{int,neg}$			
8f	m-Xylol with concentration 1 µmol/mol	≤	10 nmol/mol	1,421				
9	Averaging effect	≤	7,0% of measured value	-0,100	u_{av}	-0,08	0,0058	
18	Difference sample/calibration port	≤	1,0%	0,000	u_{Dsc}	0,00	0,0000	
23	Uncertainty calibration gas	≤	3,0%	2,000	ucg	1,32	1,7424	
					combined standard uncertainty	u_c	1,9363	nmol/mol
					expanded uncertainty	U_c	3,8726	nmol/mol
					expanded uncertainty actual	$U_{c,rel}$	**2,93**	%
					expanded uncertainty required	$U_{req,rel.}$	15	%

Table 6: Total expanded uncertainty with the results of the laboratory test and field test according to EN 14212 (Component SO_2) for system 1329

Device:	AR500			Serial-No.:	Gerät 1 (1329)		
Component:	SO_2			1h-limit value:	132		nmol/mol

No.	Performance characteristic		Criterion	Result	Uncertainty			Square of uncertainty	
1	Repeatability at zero	≤	1,0 nmol/mol	0,100	$u_{r,Z}$	0,02		0,0003	
2	Repeatability at concentration ct	≤	3,0 nmol/mol	0,100	$u_{r,lV}$	not respected because, ur,lv = 0,01 < ur,f		-	
3	"lack of fit"	≤	4,0% of measured value	1,600	$u_{l,lv}$	1,22		1,4868	
4	Sensitivity coefficient of sample gas pressure	≤	3,0 nmol/mol/kPa	0,000	u_{gp}	0,00		0,0000	
5	Sensitivity coefficient of sample gas temperature	≤	1,0 nmol/mol/K	0,071	u_{gt}	0,54		0,2908	
6	Sensitivity coefficient of surrounding temperature	≤	1,0 nmol/mol/K	-0,030	u_{st}	-0,23		0,0523	
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	-0,010	u_V	-0,10		0,0103	
8a	H20 with concentration 21 mmol/mol	≤	10 nmol/mol	0,000	u_{H2O}	0,00		0,0000	
8b	H2S with concentration 200 nmol/mol	≤	5,0 nmol/mol	-0,409	$u_{Int,pos}$				
8c	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,406					
8d	NO with concentration 500 nmol/mol	≤	5,0 nmol/mol	-0,604	or	0,40		0,1600	
8e	NO2 with concentration 200 nmol/mol	≤	5,0 nmol/mol	-0,404					
8f	m-Xylol with concentration 1 µmol/mol	≤	10 nmol/mol	1,421	$u_{Int,neg}$				
9	Averaging effect	≤	7,0% of measured value	-0,100	u_{av}	-0,08		0,0058	
10	Reproducibility under field conditions	≤	5,0% of the average of 3 Mon.	4,830	$u_{r,f}$	6,38		40,6483	
11	Long term drift at zero level	≤	5,0 nmol/mol	-0,920	$u_{d,l,z}$	-0,53		0,2821	
12	Long term drift at span level	≤	5,0% of max. of certification range	1,490	$u_{d,l,lv}$	1,14		1,2894	
18	Differenz Proben-/Kalibriergaseingang	≤	1,0%	0,000	u_{Dsc}	0,00		0,0000	
23	Unsicherheit Prüfgas	≤	3,0%	2,000	ucg	1,32		1,7424	
						combined standard uncertainty	u_c	6,7800	nmol/mol
						expanded uncertainty	U_c	13,5600	nmol/mol
						expanded uncertainty actual	$U_{c,rel}$	**10,27**	%
						expanded uncertainty required	$U_{req,rel.}$	15	%

Table 7: Total expanded uncertainty with the results of the laboratory test according to EN 14212 (Component SO_2) for system 1330

Device:	AR500			Serial-No.:	Gerät 2 (1330)		
Component:	SO_2			1h-limit value:	132		nmol/mol

No.	Performance characteristic		Criterion	Result	Uncertainty		Square of uncertainty
1	Repeatability at zero	≤	1,0 nmol/mol	0,000	$u_{r,Z}$	0,00	0,0000
2	Repeatability at concentration ct	≤	3,0 nmol/mol	0,100	$u_{r,N}$	0,02	0,0003
3	"lack of fit"	≤	4,0% of measured value	1,400	u_{LN}	1,07	1,1384
4	Sensitivity coefficient of sample gas pressure	≤	3,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000
5	Sensitivity coefficient of sample gas temperature	≤	1,0 nmol/mol/K	0,011	u_{gt}	0,08	0,0070
6	Sensitivity coefficient of surrounding temperature	≤	1,0 nmol/mol/K	-0,060	u_{st}	-0,46	0,2091
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	0,010	u_V	0,10	0,0103
8a	H20 with concentration 21 mmol/mol	≤	10 nmol/mol	0,000	u_{H2O}	0,00	0,0000
8b	H2S with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,503	$u_{int,pos}$		
8c	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,203			
8d	NO with concentration 500 nmol/mol	≤	5,0 nmol/mol	0,202	or	1,23	1,5129
8e	NO2 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,401			
8f	m-Xylol with concentration 1 µmol/mol	≤	10 nmol/mol	0,809	$u_{int,neg}$		
9	Averaging effect	≤	7,0% of measured value	0,100	u_{av}	0,08	0,0058
18	Difference sample/calibration port	≤	1,0%	0,000	u_{Dsc}	0,00	0,0000
23	Uncertainty calibration gas	≤	3,0%	2,000	0	1,32	1,7424

combined standard uncertainty	u_c	2,1509	nmol/mol
expanded uncertainty	U_c	4,3017	nmol/mol
expanded uncertainty actual	$U_{c,rel}$	**3,26**	%
expanded uncertainty required	$U_{req,rel.}$	15	%

Table 8: Total expanded uncertainty with the results of the laboratory test and field test according to EN 14212 (Component SO_2) for system 1330

Device:	AR500			Serial-No.:	Gerät 2 (1330)				
Component:	SO_2			1h-limit value:	132				nmol/mol
No.	**Performance characteristic**		**Criterion**	**Result**	**Uncertainty**			**Square of uncertainty**	
1	Repeatability at zero	≤	1,0 nmol/mol	0,000	$u_{r,Z}$	0,00		0,0000	
2	Repeatability at concentration ct	≤	3,0 nmol/mol	0,100	$u_{r,lv}$	not respected because, ur,lv = 0,01 < ur,f		-	
3	"lack of fit"	≤	4,0% of measured value	1,400	$u_{l,lv}$	1,07		1,1384	
4	Sensitivity coefficient of sample gas pressure	≤	3,0 nmol/mol/kPa	0,000	u_{gp}	0,00		0,0000	
5	Sensitivity coefficient of sample gas temperature	≤	1,0 nmol/mol/K	0,011	u_{gt}	0,08		0,0070	
6	Sensitivity coefficient of surrounding temperature	≤	1,0 nmol/mol/K	-0,060	u_{st}	-0,46		0,2091	
7	Sensitivity coefficient of electrical voltage	≤	0,30 nmol/mol/V	0,010	u_V	0,10		0,0103	
8a	H20 with concentration 21 mmol/mol	≤	10 nmol/mol	0,000	u_{H2O}	0,00		0,0000	
8b	H2S with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,503	$u_{int,pos}$				
8c	NH3 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,203					
8d	NO with concentration 500 nmol/mol	≤	5,0 nmol/mol	0,202	or	1,23		1,5129	
8e	NO2 with concentration 200 nmol/mol	≤	5,0 nmol/mol	0,401					
8f	m-Xylol with concentration 1 µmol/mol	≤	10 nmol/mol	0,809	$u_{int,neg}$				
9	Averaging effect	≤	7,0% of measured value	0,100	u_{av}	0,08		0,0058	
10	Reproducibility under field conditions	≤	5,0% of the average of 3 Mon.	4,830	u_{rf}	6,38		40,6483	
11	Long term drift at zero level	≤	5,0 nmol/mol	1,160	$u_{d,l,z}$	0,67		0,4485	
12	Long term drift at span level	≤	5,0% of max. of certification range	-2,070	$u_{d,l,lv}$	-1,58		2,4887	
18	Differenz Proben-/Kalibriergaseingang	≤	1,0%	0,000	u_{bsc}	0,00		0,0000	
23	Unsicherheit Prüfgas	≤	3,0%	2,000	0	1,32		1,7424	
						combined standard uncertainty	u_c	6,9434	nmol/mol
						expanded uncertainty	U_c	13,8869	nmol/mol
						expanded uncertainty actual	$U_{c,rel}$	**10,52**	%
						expanded uncertainty required	$U_{req,rel}$	15	%

Table 9: Total expanded uncertainty with the results of the laboratory test according to EN 14625 (Component O_3) for system 1329

Device:	AR500	Seriel No.	Gerät 1 (1329)		
Measured component:	O_3	hourly alert threshold	120		nmol/mol

No.	Performance characteristic	Criterion	Result	Uncertainty		Square of uncertainty	
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	$u_{r,Z}$	0,04	0,0013	
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,600	$u_{r,hv}$	0,11	0,0120	
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	0,400	$u_{l,hv}$	0,28	0,0768	
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000	
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,014	u_{gt}	0,15	0,0212	
6	Variations in surrounding temperature	1,0 nmol/mol/K	0,150	u_{st}	0,52	0,2700	
7	Variations in electrical voltage	0,30 nmol/mol/V	-0,010	u_V	-0,12	0,0147	
8a	Interference H20 with 21 mmol/mol	10 nmol/mol	0,000	u_{H2O}	0,00	0,0000	
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	2,147	$u_{int,pos}$ or $u_{int,neg}$	1,47	2,1573	
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	0,397				
9	Averaging effect	7,0% of measured value	0,200	u_{av}	0,14	0,0192	
18	Difference sample/calibration port	1,0%	0,000	u_{Dsc}	0,00	0,0000	
23	Uncertainty test gas	3,0%	2,000	ucg	1,20	1,4400	

Combined standard uncertainty	u_c	2,0031 nmol/mol
Expanded uncertainty	U_c	4,0062 nmol/mol
Expanded uncertainty actual	$U_{c,rel}$	**3,34** %
Expanded uncertainty required	$U_{req,rel}$	15 %

Table 10 Total expanded uncertainty with the results of the laboratory test and field test according to EN 14625 (Component O_3) for system 1329

Device:	AR500			Seriel No.		Gerät 1 (1329)	
Measured component:	O_3		hourly alert threshold		120		nmol/mol
No.	**Performance characteristic**	**Criterion**	**Result**	**Uncertainty**		**Square of uncertainty**	
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	$u_{r,Z}$	0,04	0,0013	
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,600	$u_{r,lv}$	not respected because, ur,lv = 0,1 < ur,f	-	
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	0,400	$u_{l,lv}$	0,28	0,0768	
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000	
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,014	u_{gt}	0,15	0,0212	
6	Variations in surrounding temperature	1,0 nmol/mol/K	0,150	u_{st}	0,52	0,2700	
7	Variations in electrical voltage	0,30 nmol/mol/V	-0,010	u_V	-0,12	0,0147	
8a	Interference H20 with 21 mmol/mol	10 nmol/mol	0,000	u_{H2O}	0,00	0,0000	
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	2,147	$u_{int,pos}$ or $u_{int,neg}$	1,47	2,1573	
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	0,397				
9	Averaging effect	7,0% of measured value	0,200	u_{av}	0,14	0,0192	
10	Reproducibility standard deviation in field	5,0% of average of 3 month	2,410	$u_{r,f}$	2,89	8,3637	
11	Long term drift at zero	5,0 nmol/mol	1,460	$u_{d,l,z}$	0,84	0,7105	
12	Long term drift at span level	5,0% of range	-2,450	$u_{d,l,lv}$	-1,70	2,8812	
18	Difference sample/calibration port	1,0%	0,000	uDsc	0,00	0,0000	
23	Uncertainty test gas	3,0%	2,000	ucg	1,20	1,4400	
				Combined standard uncertainty	u_c	3,9945	nmol/mol
				Expanded uncertainty	U_c	7,9890	nmol/mol
				Expanded uncertainty actual	$U_{c,rel}$	**6,66**	%
				Expanded uncertainty required	$U_{req,rel}$	15	%

Table 11: Total expanded uncertainty with the results of the laboratory test according to EN 14625 (Component O_3) for system 1330

Device:	AR500	Seriel No.	Gerät 2 (1330)		
Measured component:	O_3	hourly alert threshold	120	nmol/mol	

No.	Performance characteristic	Criterion	Result	Uncertainty		Square of uncertainty	
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	$u_{r,Z}$	0,04	0,0013	
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,400	$u_{r,h}$	0,07	0,0053	
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	-0,300	$u_{l,h}$	-0,21	0,0432	
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000	
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,007	u_{gt}	0,07	0,0053	
6	Variations in surrounding temperature	1,0 nmol/mol/K	-0,120	u_{st}	-0,42	0,1728	
7	Variations in electrical voltage	0,30 nmol/mol/V	0,010	u_V	0,12	0,0147	
8a	Interference H20 with 21 mmol/mol	10 nmol/mol	0,000	u_{H2O}	0,00	0,0000	
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	0,396	$u_{int,pos}$ or $u_{int,neg}$	1,72	2,9416	
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	2,574				
9	Averaging effect	7,0% of measured value	-0,900	u_{av}	-0,62	0,3888	
18	Difference sample/calibration port	1,0%	0,000	u_{Dsc}	0,00	0,0000	
23	Uncertainty test gas	3,0%	2,000	0	1,20	1,4400	
				Combined standard uncertainty	u_c	2,2390	nmol/mol
				Expanded uncertainty	U_c	4,4780	nmol/mol
				Expanded uncertainty actual	$U_{c,rel}$	**3,73**	%
				Expanded uncertainty required	$U_{req,rel}$	15	%

Table 12 Total expanded uncertainty with the results of the laboratory test and field test according to EN 14625 (Component O_3) for system 1330

Device:	AR500			Seriel No.	Gerät 2 (1330)		
Measured component:	O_3		hourly alert threshold		120		nmol/mol
No.	**Performance characteristic**	**Criterion**	**Result**	**Uncertainty**		**Square of uncertainty**	
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	$u_{r,Z}$	0,04	0,0013	
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,400	$u_{r,lv}$	not respected, because ur,lv = 0,07 < ur,f	-	
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	-0,300	$u_{l,lv}$	-0,21	0,0432	
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u_{gp}	0,00	0,0000	
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,007	u_{gt}	0,07	0,0053	
6	Variations in surrounding temperature	1,0 nmol/mol/K	-0,120	u_{st}	-0,42	0,1728	
7	Variations in electrical voltage	0,30 nmol/mol/V	0,010	u_V	0,12	0,0147	
8a	Interference H20 with 21 mmol/mol	10 nmol/mol	0,000	u_{H2O}	0,00	0,0000	
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	0,396	$u_{int,pos}$ or $u_{int,neg}$	1,72	2,9416	
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	2,574				
9	Averaging effect	7,0% of measured value	-0,900	u_{av}	-0,62	0,3888	
10	Reproducibility standard deviation in field	5,0% of average of 3 month	2,410	$u_{r,f}$	2,89	8,3637	
11	Long term drift at zero	5,0 nmol/mol	-1,840	$u_{d,l,z}$	-1,06	1,1285	
12	Long term drift at span level	5,0% of range	2,900	$u_{d,l,lv}$	2,01	4,0368	
18	Difference sample/calibration port	1,0%	0,000	uDsc	0,00	0,0000	
23	Uncertainty test gas	3,0%	2,000	0	1,20	1,4400	
				Combined standard uncertainty	u_c	4,3054	nmol/mol
				Expanded uncertainty	U_c	8,6109	nmol/mol
				Expanded uncertainty actual	$U_{c,rel}$	**7,18**	%
				Expanded uncertainty required	$U_{req,rel.}$	15	%