

# CERTIFICATE

about Product Conformity (QAL1)

Number of Certificate: 0000025927

**Certified AMS:** AR500 with ER120 for NO<sub>2</sub>, SO<sub>2</sub> and O<sub>3</sub>

**Manufacturer:** Opsis AB  
Skytteskogsvägen 16  
S-24402 Furulund  
Schweden

**Test Institute:** TÜV Rheinland Immissionsschutz und Energiesysteme GmbH

This is certifying 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  
(see also the following pages).



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

Publication in the German Federal Gazette  
(BAnz.) of 2010-02-12

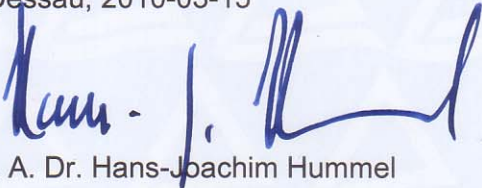
The certificate is valid until: 2015-02-11

Umweltbundesamt

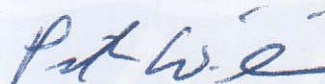
TÜV Rheinland Immissionsschutz  
und Energiesysteme GmbH

Dessau, 2010-03-15

Köln, 2010-03-10



i. A. Dr. Hans-Joachim Hummel



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Am Grauen Stein  
51105 Köln

Accreditation according to EN ISO/IEC 17025 and ISO 9001:2000.

**Test report:** 936/21211350/A of 2009-10-26  
**First certification:** 2010-02-12  
**Run of validity until:** 2015-02-11  
**Publication** BAnz. 2010-02-12, no.: 24, page: 554

**Approved application:**

The suitability of the AMS for this application was assessed on basis of a laboratory test and a field test in countrified ambience with a measuring length of 320 m. The AMS is approved for the temperature range from +5 °C to +40 °C.

Any potential user should ensure, in consultation with the manufacturer that this AMS is suitable for the planned site of operation.

**Basis of the certification**

This certification is based on the test report 936/21211350/A of 26.10.2009 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and on the relevant bodies (German Umweltbundesamt) assessment and ongoing surveillance of the product and the manufacturing process and the publication in the German Federal Gazette (BAnz.):

**AMS name:**

AR500 with ER 120 for NO<sub>2</sub>, SO<sub>2</sub> and O<sub>3</sub>

**Manufacturer:**

Opsis AB, Furulund, Schweden

**Approval:**

For stationary measuring of the concentrations of nitrogen dioxide, sulphur dioxide and ozone in ambient air

**Measuring ranges during the suitability test:**

Component	Certification range	Supplementary range	Unit
NO <sub>2</sub>	<b>0 - 400</b>	0 - 1800	µg/m <sup>3</sup>
SO <sub>2</sub>	<b>0 - 700</b>	0 - 1000	µg/m <sup>3</sup>
O <sub>3</sub>	<b>0 - 360</b>	0 - 500	µg/m <sup>3</sup>

**Software version:**

7.21

**Remarks:**

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 proven for the components NO<sub>2</sub> and O<sub>3</sub>.
4. Function tests by external sample gas feeding are possible.

**Test report:**

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln  
Report-No.: 936/21211350/A of 2009-10-26

**Certified product**

This certificate applies to automated measurement systems confirming to the following description:  
The measurement system AR500 with ER120 is working with the DOAS principle (differential optical absorption spectroscopy).

The system consists of a combined Emitter/Receiver Unit (ER120), a reflector and the analyzer unit (AR500). The captured light is led via an opto-fibre to the analyzer.

**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 certified product is found no longer to comply with the applicable European Standard, TÜV Rheinland Immissionsschutz und Energiesysteme GmbH should be notified at the address shown on page 1.

The certification mark with the ID- Number that 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 the property of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH.

With revocation of the publication the certificate loses its validity.

After the expiration of the validity of the certificate and on requests of the TÜV Rheinland Immissionsschutz und Energiesysteme 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 seen at the Internet Address: **qal1.de**.

**Table 1:** Total expanded uncertainty with the results of the laboratory test according to EN 14211 (Component NO<sub>2</sub>) for system 1329

Device: AR500		Serial No: 1329		Component: NO <sub>2</sub>		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 <sub>r,z</sub> 0,00	0,0000				
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	2,000	U <sub>r,th</sub> 0,04	0,0015				
3	"lack of fit"	≤ 4,0% of measured value	0,800	U <sub>l,th</sub> 0,48	0,2334				
4	Sensitivity coefficient of sample gas pressure	≤ 8,0 nmol/mol/kPa	0,000	U <sub>sp</sub> 0,00	0,0000				
5	Sensitivity coefficient of sample gas temperature	≤ 3,0 nmol/mol/K	0,026	U <sub>gt</sub> 0,04	0,0016				
6	Sensitivity coefficient of surrounding temperature	≤ 3,0 nmol/mol/K	-0,050	U <sub>st</sub> -0,06	0,0036				
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	-0,021	U <sub>v</sub> -0,07	0,0046				
8a	H2O with concentration 21 nmol/mol	≤ 5,0 nmol/mol	0,000	U <sub>H2O</sub> 0,00	0,0000				
8b	CO2 with concentration 500 µmol/mol	≤ 5,0 nmol/mol	0,001	U <sub>int,pos</sub>					
8c	O3 with concentration 200 nmol/mol	≤ 2,0 nmol/mol	0,002	OR	0,2304				
8d	NH3 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,002	U <sub>int,neg</sub>					
9	Averaging effect	≤ 7,0% of measured value	-0,600	U <sub>av</sub> -0,36	0,1313				
18	Difference sample/calibration port	≤ 1,0%	0,000	U <sub>pac</sub> 0,00	0,0000				
21	Converter efficiency	≥ 98%	100,000	U <sub>CE</sub> 0,00	0,0000				
22	Increase of NO2 concentration due to residence time	≤ 4,0 nmol/mol	0,000	U <sub>ctr</sub> 0,00	0,0000				
23	Uncertainty calibration gas	≤ 3,0%	2,000	U <sub>cg</sub> 1,05	1,0941				
combined standard uncertainty						U <sub>c</sub>			nmol/mol
expanded uncertainty						U <sub>c</sub>			nmol/mol
expanded uncertainty actual						U <sub>c,rel</sub>			%
expanded uncertainty required						U <sub>req,rel</sub>			%
									15

**Table 2:** Total expanded uncertainty with the results of the laboratory test and field test according to EN 14211 (Component NO<sub>2</sub>) for system 1329

Device: AR500		Serial No: 1329		1h-limit value: 104.6		nmol/mol
Component: NO <sub>2</sub>		1h-limit value: 104.6		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 <sub>1,z</sub> 0,00	0,0000	
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	2,000	U <sub>1,h</sub> not respected because, $u_{1,h} = 0,075 < u_{1,f}$	-	
3	"lack of fit"	≤ 4,0% of measured value	0,800	U <sub>1,h</sub> 0,48	0,2334	
4	Sensitivity coefficient of sample gas pressure	≤ 8,0 nmol/mol/kPa	0,000	U <sub>gp</sub> 0,00	0,0000	
5	Sensitivity coefficient of sample gas temperature	≤ 3,0 nmol/mol/K	0,026	U <sub>gt</sub> 0,04	0,0016	
6	Sensitivity coefficient of surrounding temperature	≤ 3,0 nmol/mol/K	-0,050	U <sub>st</sub> -0,06	0,0036	
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	-0,021	U <sub>v</sub> -0,07	0,0046	
8a	H2O with concentration 21 nmol/mol	≤ 5,0 nmol/mol	0,000	U <sub>H2O</sub> 0,00	0,0000	
8b	CO2 with concentration 500 µmol/mol	≤ 5,0 nmol/mol	0,001	U <sub>int,pos</sub> 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 <sub>int,neg</sub>		
9	Averaging effect	≤ 7,0% of measured value	-0,600	U <sub>av</sub> -0,36	0,1313	
10	Reproducibility under field conditions	≤ 5,0% of the average of 3 Mon.	4,720	U <sub>r,f</sub> 4,94	24,3752	
11	Long term drift at zero level	≤ 5,0 nmol/mol	-1,420	U <sub>d,t,z</sub> -0,82	0,6721	
12	Long term drift at span level	≤ 5,0% of max. of certification range	0,430	U <sub>d,t,h</sub> 0,26	0,0674	
18	Difference sample/calibration port	≤ 1,0%	0,000	U <sub>Dsc</sub> 0,00	0,0000	
21	Converter efficiency	98%	100,000	U <sub>CE</sub> 0,00	0,0000	
22	Increase of NO2 concentration due to residence time	≤ 4,0 nmol/mol	0,000	U <sub>ctr</sub> 0,00	0,0000	
23	Uncertainty calibration gas	≤ 3,0%	2,000	U <sub>cg</sub> 1,05	1,0941	
				combined standard uncertainty	U <sub>c</sub>	7,1546
				expanded uncertainty	U <sub>c</sub>	14,3093
				expanded uncertainty actual	U <sub>c,act</sub>	13,68
				expanded uncertainty required	U <sub>req,rel</sub>	15

**Table 3:** Total expanded uncertainty with the results of the laboratory test according to EN 14211 (Component NO<sub>2</sub>) for system 1330

Device: AR500		Serial No: 1330		1330		
Component: NO <sub>2</sub>		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 <sub>1,z</sub> 0,02	0,0003	
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,900	u <sub>1,h</sub> 0,02	0,0004	
3	"lack of fit"	≤ 4,0% of measured value	0,000	u <sub>1,h</sub> 0,36	0,1313	
4	Sensitivity coefficient of sample gas pressure	≤ 8,0 nmol/mol/kPa	0,000	u <sub>gp</sub> 0,00	0,0000	
5	Sensitivity coefficient of sample gas temperature	≤ 3,0 nmol/mol/K	0,000	u <sub>gt</sub> -0,05	0,0025	
6	Sensitivity coefficient of surrounding temperature	≤ 3,0 nmol/mol/K	0,000	u <sub>st</sub> 0,00	0,0000	
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	0,000	u <sub>v</sub> 0,24	0,0553	
8a	H2O with concentration 21 mmol/mol	≤ 5,0 nmol/mol	0,000	u <sub>H2O</sub> 0,00	0,0000	
8b	CO2 with concentration 500 µmol/mol	≤ 5,0 nmol/mol	0,000	u <sub>fit,pos</sub>	0,1764	
8c	O3 with concentration 200 nmol/mol	≤ 2,0 nmol/mol	0,000	or		
8d	NH3 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,000	u <sub>fit,neg</sub>		
9	Averaging effect	≤ 7,0% of measured value	0,000	u <sub>av</sub> -0,18	0,0328	
18	Difference sample/calibration port	≤ 1,0%	0,000	u <sub>asc</sub> 0,00	0,0000	
21	Converter efficiency	≥ 98%	100,000	u <sub>CE</sub> 0,00	0,0000	
22	Increase of NO2 concentration due to residence time	≤ 4,0 nmol/mol	0,000	u <sub>ctr</sub> 0,00	0,0000	
23	Uncertainty calibration gas	≤ 3,0%	2,000	u <sub>cg</sub> 1,05	1,0941	
				combined standard uncertainty	u <sub>c</sub> 1,2222	nmol/mol
				expanded uncertainty	U <sub>c</sub> 2,4445	nmol/mol
				expanded uncertainty actual	U <sub>c,rel</sub> 2,34	%
				expanded uncertainty required	U <sub>req,rel</sub> 15	%

**Table 4:** Total expanded uncertainty with the results of the laboratory test and field test according to EN 14211 (Component NO<sub>2</sub>) for system 1330

Device: AR500		Serial No: 1330		1h-limit value: 104,6		nmol/mol
Component: NO <sub>2</sub>		1h-limit value: 104,6		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 <sub>r,z</sub>	0,02	0,0003
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,900	u <sub>r,th</sub>	not respected because, u <sub>r,th</sub> = 0,034 < u <sub>r,f</sub>	-
3	"lack of fit"	≤ 4,0% of measured value	0,600	u <sub>i,th</sub>	0,36	0,1313
4	Sensitivity coefficient of sample gas pressure	≤ 8,0 nmol/mol/kPa	0,000	u <sub>gp</sub>	0,00	0,0000
5	Sensitivity coefficient of sample gas temperature	≤ 3,0 nmol/mol/K	-0,032	u <sub>gt</sub>	-0,05	0,0025
6	Sensitivity coefficient of surrounding temperature	≤ 3,0 nmol/mol/K	0,000	u <sub>st</sub>	0,00	0,0000
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	0,073	u <sub>v</sub>	0,24	0,0563
8a	H2O with concentration 21 nmol/mol	≤ 5,0 nmol/mol	0,000	u <sub>r,z0</sub>	0,00	0,0000
8b	CO2 with concentration 500 µmol/mol	≤ 5,0 nmol/mol	0,001	u <sub>r,zpos</sub>		
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	0,000	u <sub>r,zneg</sub>	0,42	0,1764
9	Averaging effect	≤ 7,0% of measured value	-0,300	u <sub>av</sub>	-0,18	0,0328
10	Reproducibility under field conditions	≤ 5,0% of the average of 3 Mon.	4,720	u <sub>r,f</sub>	4,94	24,3752
11	Long term drift at zero level	≤ 5,0 nmol/mol	1,620	u <sub>l,z</sub>	0,94	0,8748
12	Long term drift at span level	≤ 5,0% of max. of certification range	0,500	u <sub>l,th</sub>	0,30	0,0912
18	Difference sample/calibration port	≤ 1,0%	0,000	u <sub>Dsc</sub>	0,00	0,0000
21	Converter efficiency	≥ 0,98	100,000	u <sub>CE</sub>	0,00	0,0000
22	Increase of NO2 concentration due to residence time	≤ 4,0 nmol/mol	0,000	u <sub>ct</sub>	0,00	0,0000
23	Uncertainty calibration gas	≤ 3,0%	2,000	u <sub>cg</sub>	1,05	1,0941
combined standard uncertainty				u <sub>c</sub>		7,1561
expanded uncertainty				U <sub>c</sub>		14,3121
expanded uncertainty actual				U <sub>c,rel</sub>		13,68
expanded uncertainty required				U <sub>req,rel</sub>		15

**Table 5:** Total expanded uncertainty with the results of the laboratory test according to EN 14212 (Component SO<sub>2</sub>) for system 1329

Device: AR500		Serial-No.: Gerät 1 (1329)		132		nmol/mol	
Component: SO <sub>2</sub>		1h-limit value:					
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty		
1	Repeatability at zero	≤ 1,0 nmol/mol	0,100	u <sub>r,z</sub> 0,02	0,0003		
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,100	u <sub>r,v</sub> 0,02	0,0003		
3	"lack of fit"	≤ 4,0% of measured value	1,600	u <sub>lv</sub> 1,22	1,4868		
4	Sensitivity coefficient of sample gas pressure	≤ 3,0 nmol/mol/KPa	0,000	u <sub>gp</sub> 0,00	0,0000		
5	Sensitivity coefficient of sample gas temperature	≤ 1,0 nmol/mol/K	0,071	u <sub>gt</sub> 0,54	0,2908		
6	Sensitivity coefficient of surrounding temperature	≤ 1,0 nmol/mol/K	-0,030	u <sub>st</sub> -0,23	0,0523		
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	-0,010	u <sub>v</sub> -0,10	0,0103		
8a	H2O with concentration 21 nmol/mol	≤ 10 nmol/mol	0,000	u <sub>H2O</sub> 0,00	0,0000		
8b	H2S with concentration 200 nmol/mol	≤ 5,0 nmol/mol	-0,409	u <sub>H2S</sub> 0,40	0,1600		
8c	NH3 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,406	or			
8d	NO with concentration 500 nmol/mol	≤ 5,0 nmol/mol	-0,604				
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 <sub>int,reg</sub>			
9	Averaging effect	≤ 7,0% of measured value	-0,100	u <sub>av</sub> -0,08	0,0058		
18	Difference sample/calibration port	≤ 1,0%	0,000	u <sub>pac</sub> 0,00	0,0000		
23	Uncertainty calibration gas	≤ 3,0%	2,000	ucg 1,32	1,7424		
				combined standard uncertainty	u <sub>c</sub>	1,9363	nmol/mol
				expanded uncertainty	U <sub>c</sub>	3,8726	nmol/mol
				expanded uncertainty actual	U <sub>c,rel</sub>	2,93	%
				expanded uncertainty required	U <sub>req,rel</sub>	15	%



**Table 6:** Total expanded uncertainty with the results of the laboratory test and field test according to EN 14212 (Component SO<sub>2</sub>) for system 1329

Device: AR500		SerialNo.: Gerät 1 (1329)		Component: SO <sub>2</sub>		1329		nmol/mol		
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty					
1	Repeatability at zero	≤ 1,0 nmol/mol	0,100	u <sub>r,z</sub>	0,02	0,0003				
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,100	u <sub>r,v</sub>	not respected because: u <sub>r,v</sub> = 0,01 < u <sub>r,f</sub>	-				
3	"lack of fit"	≤ 4,0% of measured value	1,600	u <sub>lv</sub>	1,22	1,4868				
4	Sensitivity coefficient of sample gas pressure	≤ 3,0 nmol/mol/kPa	0,000	u <sub>gp</sub>	0,00	0,0000				
5	Sensitivity coefficient of sample gas temperature	≤ 1,0 nmol/mol/K	0,071	u <sub>gt</sub>	0,54	0,2908				
6	Sensitivity coefficient of surrounding temperature	≤ 1,0 nmol/mol/K	-0,030	u <sub>st</sub>	-0,23	0,0523				
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	-0,010	u <sub>v</sub>	-0,10	0,0103				
8a	H2O with concentration 21 nmol/mol	≤ 10 nmol/mol	0,000	u <sub>H2O</sub>	0,00	0,0000				
8b	H2S with concentration 200 nmol/mol	≤ 5,0 nmol/mol	-0,409	u <sub>H2S,ppm</sub>						
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							
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 <sub>int,neg</sub>	0,40	0,1600				
9	Averaging effect	≤ 7,0% of measured value	-0,100	u <sub>av</sub>	-0,08	0,0058				
10	Reproducibility under field conditions	≤ 5,0% of the average of 3 Mon.	4,830	u <sub>r,f</sub>	6,38	40,6483				
11	Long term drift at zero level	≤ 5,0 nmol/mol	-0,920	u <sub>tl,z</sub>	-0,53	0,2821				
12	Long term drift at span level	≤ 5,0% of max. of certification range	1,490	u <sub>tl,v</sub>	1,14	1,2894				
18	Differenz Proben-/Kalibriergaseingang	≤ 1,0%	0,000	u <sub>bsc</sub>	0,00	0,0000				
23	Unsicherheit Prüfgas	≤ 3,0%	2,000	ucg	1,32	1,7424				
				combined standard uncertainty		U <sub>c</sub>	6,7800	nmol/mol		
				expanded uncertainty		U <sub>c</sub>	13,5600	nmol/mol		
				expanded uncertainty actual		U <sub>c,rel</sub>	10,27	%		
				expanded uncertainty required		U <sub>req,rel</sub>	15	%		

**Table 7:** Total expanded uncertainty with the results of the laboratory test according to EN 14212 (Component SO<sub>2</sub>) for system 1330

Device: AR500		Serial-No.: Gerät 2 (1330)		1h-limit value: 132		nmol/mol
Component: SO <sub>2</sub>						
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty	
1	Repeatability at zero	≤ 1,0 nmol/mol	0,000	U <sub>r,z</sub> 0,00	0,0000	
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,100	U <sub>r,iv</sub> 0,02	0,0003	
3	"lack of fit"	≤ 4,0% of measured value	1,400	U <sub>lv</sub> 1,07	1,1384	
4	Sensitivity coefficient of sample gas pressure	≤ 3,0 nmol/mol/kPa	0,000	U <sub>gp</sub> 0,00	0,0000	
5	Sensitivity coefficient of sample gas temperature	≤ 1,0 nmol/mol/K	0,011	U <sub>gt</sub> 0,08	0,0070	
6	Sensitivity coefficient of surrounding temperature	≤ 1,0 nmol/mol/K	-0,060	U <sub>st</sub> -0,46	0,2091	
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	0,010	U <sub>v</sub> 0,10	0,0103	
8a	H2O with concentration 21 nmol/mol	≤ 10 nmol/mol	0,000	U <sub>H2O</sub> 0,00	0,0000	
8b	H2S with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,503	U <sub>Int,pos</sub>		
8c	NH3 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,203	or	1,5129	
8d	NO with concentration 500 nmol/mol	≤ 5,0 nmol/mol	0,202			
8e	NO2 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,401			
8f	m-XyloI with concentration 1 µmol/mol	≤ 10 nmol/mol	0,809	U <sub>Int,neg</sub>		
9	Averaging effect	≤ 7,0% of measured value	0,100	U <sub>av</sub> 0,08	0,0058	
18	Difference sample/calibration port	≤ 1,0%	0,000	U <sub>psc</sub> 0,00	0,0000	
23	Uncertainty calibration gas	≤ 3,0%	2,000	0	1,7424	
				combined standard uncertainty	U <sub>c</sub>	2,1509 nmol/mol
				expanded uncertainty	U <sub>c</sub>	4,3017 nmol/mol
				expanded uncertainty actual	U <sub>c,rel</sub>	3,26 %
				expanded uncertainty required	U <sub>req,rel</sub>	15 %

**Table 8:** Total expanded uncertainty with the results of the laboratory test and field test according to EN 14212 (Component SO<sub>2</sub>) for system 1330

Device: AR500		Serial-No.: Gerät 2 (1330)		132		nmol/mol	
Component: SO <sub>2</sub>		1h-limit value:					
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty		
1	Repeatability at zero	≤ 1,0 nmol/mol	0,000	u <sub>r,z</sub> 0,00	0,0000		
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,100	u <sub>r,v</sub> not respected because: u <sub>r,v</sub> = 0,01 < u <sub>r,f</sub>	-		
3	"lack of fit"	≤ 4,0% of measured value	1,400	u <sub>lv</sub> 1,07	1,1384		
4	Sensitivity coefficient of sample gas pressure	≤ 3,0 nmol/mol/kPa	0,000	u <sub>gp</sub> 0,00	0,0000		
5	Sensitivity coefficient of sample gas temperature	≤ 1,0 nmol/mol/K	0,011	u <sub>gt</sub> 0,08	0,0070		
6	Sensitivity coefficient of surrounding temperature	≤ 1,0 nmol/mol/K	-0,060	u <sub>st</sub> -0,46	0,2091		
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	0,010	u <sub>v</sub> 0,10	0,0103		
8a	H2O with concentration 21 nmol/mol	≤ 10 nmol/mol	0,000	u <sub>h2o</sub> 0,00	0,0000		
8b	H2S with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,503	u <sub>h2s,pos</sub>	1,5129		
8c	NH3 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,203	or			
8d	NO with concentration 500 nmol/mol	≤ 5,0 nmol/mol	0,202				
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 <sub>h2o,reg</sub>			
9	Averaging effect	≤ 7,0% of measured value	0,100	u <sub>av</sub> 0,08	0,0058		
10	Reproducibility under field conditions	≤ 5,0% of the average of 3 Mon.	4,830	u <sub>r,f</sub> 6,38	40,6483		
11	Long term drift at zero level	≤ 5,0 nmol/mol	1,160	u <sub>d,lz</sub> 0,67	0,4485		
12	Long term drift at span level	≤ 5,0% of max. of certification range	-2,070	u <sub>d,lv</sub> -1,58	2,4887		
18	Differenz Proben-/Kalibergasgang	≤ 1,0%	0,000	u <sub>disc</sub> 0,00	0,0000		
23	Unsicherheit Prüfgas	≤ 3,0%	2,000	0	1,7424		
combined standard uncertainty				u <sub>c</sub>	6,9434	nmol/mol	
expanded uncertainty				U <sub>c</sub>	13,8869	nmol/mol	
expanded uncertainty actual				U <sub>c,rel</sub>	10,52	%	
expanded uncertainty required				U <sub>req,rel</sub>	15	%	

**Table 9:** Total expanded uncertainty with the results of the laboratory test according to EN 14625 (Component O<sub>3</sub>) for system 1329

Device:		AR500		Serial No.		Gerät 1 (1329)		nmol/mol	
Measured component:		O <sub>3</sub>		hourly alert threshold		120			
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty				
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	U <sub>r,z</sub> 0,04	0,0013				
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,600	U <sub>r,iv</sub> 0,11	0,0120				
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	0,400	U <sub>l,iv</sub> 0,28	0,0768				
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	U <sub>gp</sub> 0,00	0,0000				
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,014	U <sub>gt</sub> 0,15	0,0212				
6	Variations in surrounding temperature	1,0 nmol/mol/K	0,150	U <sub>st</sub> 0,52	0,2700				
7	Variations in electrical voltage	0,30 nmol/mol/V	-0,010	U <sub>v</sub> -0,12	0,0147				
8a	Interference H2O with 21 nmol/mol	10 nmol/mol	0,000	U <sub>H2O</sub> 0,00	0,0000				
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	2,147	U <sub>int,pos</sub> 1,47	2,1573				
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	0,397	or U <sub>int,neg</sub>					
9	Averaging effect	7,0% of measured value	0,200	U <sub>av</sub> 0,14	0,0192				
18	Difference sample/calibration port	1,0%	0,000	U <sub>bac</sub> 0,00	0,0000				
23	Uncertainty test gas	3,0%	2,000	ucg 1,20	1,4400				
		Combined standard uncertainty		U <sub>c</sub>	2,0031	nmol/mol			
		Expanded uncertainty		U <sub>c</sub>	4,0062	nmol/mol			
		Expanded uncertainty actual		U <sub>c,rel</sub>	<b>3,34</b>	%			
		Expanded uncertainty required		U <sub>req,rel</sub>	15	%			

**Table 10** Total expanded uncertainty with the results of the laboratory test and field test according to EN 14625 (Component O<sub>3</sub>) for system 1329

Device: AR500		Serial No. Gerät 1 (1329)		120 nmol/mol	
Measured component: O <sub>3</sub>		hourly alert threshold			
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	u <sub>r,z</sub>	0,0013
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,600	u <sub>r,iv</sub>	-
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	0,400	u <sub>liv</sub>	0,0768
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u <sub>gp</sub>	0,0000
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,014	u <sub>gt</sub>	0,0212
6	Variations in surrounding temperature	1,0 nmol/mol/K	0,150	u <sub>st</sub>	0,2700
7	Variations in electrical voltage	0,30 nmol/mol/V	-0,010	u <sub>v</sub>	0,0147
8a	Interference H2O with 21 nmol/mol	10 nmol/mol	0,000	u <sub>H2O</sub>	0,0000
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	2,147	u <sub>tol, pos</sub>	2,1573
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	0,397	or u <sub>tol, neg</sub>	
9	Averaging effect	7,0% of measured value	0,200	u <sub>av</sub>	0,0192
10	Reproducibility standard deviation in field	5,0% of average of 3 month	2,410	u <sub>r,f</sub>	8,3637
11	Long term drift at zero	5,0 nmol/mol	1,460	u <sub>tl,z</sub>	0,7105
12	Long term drift at span level	5,0% of range	-2,450	u <sub>tl,iv</sub>	2,8812
18	Difference sample/calibration port	1,0%	0,000	u <sub>Dsc</sub>	0,0000
23	Uncertainty test gas	3,0%	2,000	u <sub>cg</sub>	1,4400
Combined standard uncertainty				u <sub>c</sub>	3,9945
Expanded uncertainty				U <sub>c</sub>	7,9890
Expanded uncertainty actual				U <sub>c,rel</sub>	6,66
Expanded uncertainty required				U <sub>req,rel</sub>	15

**Table 11:** Total expanded uncertainty with the results of the laboratory test according to EN 14625 (Component O<sub>3</sub>) for system 1330

Device:		Serial No.		Gerät 2 (1330)	
Measured component:		hourly alert threshold		120	
O <sub>3</sub>		hourly alert threshold		120	
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	u <sub>r,z</sub> 0,04	0,0013
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,400	u <sub>r,lv</sub> 0,07	0,0053
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	-0,300	u <sub>lv</sub> -0,21	0,0432
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u <sub>gp</sub> 0,00	0,0000
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,007	u <sub>gt</sub> 0,07	0,0053
6	Variations in surrounding temperature	1,0 nmol/mol/K	-0,120	u <sub>st</sub> -0,42	0,1728
7	Variations in electrical voltage	0,30 nmol/mol/V	0,010	u <sub>v</sub> 0,12	0,0147
8a	Interference H <sub>2</sub> O with 21 nmol/mol	10 nmol/mol	0,000	u <sub>H<sub>2</sub>O</sub> 0,00	0,0000
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	0,396	u <sub>int,pos</sub> 1,72	2,9416
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	2,574	or u <sub>int,neg</sub>	
9	Averaging effect	7,0% of measured value	-0,900	u <sub>av</sub> -0,62	0,3888
18	Difference sample/calibration port	1,0%	0,000	u <sub>Disc</sub> 0,00	0,0000
23	Uncertainty test gas	3,0%	2,000	0	1,4400
		Combined standard uncertainty		u <sub>c</sub>	2,2390
		Expanded uncertainty		U <sub>c</sub>	4,4780
		Expanded uncertainty actual		U <sub>c,rel</sub>	3,73
		Expanded uncertainty required		U <sub>req,rel</sub>	15

**Table 12** Total expanded uncertainty with the results of the laboratory test and field test according to EN 14625 (Component O<sub>3</sub>) for system 1330

Device: AR500		Serial No. Gerät 2 (1330)	120	nmol/mol
Measured component: O <sub>3</sub>		hourly alert threshold		
No.	Performance characteristic	Criterion	Result	Square of uncertainty
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200	0,0013
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,400	-
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	-0,300	0,0432
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	0,0000
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,007	0,0053
6	Variations in surrounding temperature	1,0 nmol/mol/K	-0,120	0,1728
7	Variations in electrical voltage	0,30 nmol/mol/V	0,010	0,0147
8a	Interference H2O with 21 nmol/mol	10 nmol/mol	0,000	0,0000
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	0,396	2,9416
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	2,574	0,3888
9	Averaging effect	7,0% of measured value	-0,900	0,3888
10	Reproducibility standard deviation in field	5,0% of average of 3 month	2,410	8,3637
11	Long term drift at zero	5,0 nmol/mol	-1,840	1,1285
12	Long term drift at span level	5,0% of range	2,900	4,0368
18	Difference sample/calibration port	1,0%	0,000	0,0000
23	Uncertainty test gas	3,0%	2,000	1,4400
Combined standard uncertainty			U <sub>c</sub>	4,3054
Expanded standard uncertainty			U <sub>c</sub>	8,6109
Expanded uncertainty actual			U <sub>c,rel</sub>	7,18
Expanded uncertainty required			U <sub>req,rel</sub>	15