

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000025927_04

Certified AMS: AR 500 with ER 120 for NO₂, SO₂ and O₃

Manufacturer: Opsis AB
Skytteskogsvägen 16
24402 Furulund
Sweden

Test Institute: TÜV Rheinland Energy & Environment GmbH

**This is to certify that the AMS has been tested
and found to comply with the standards
EN 14211 (2005), EN 14212 (2005), EN 14625 (2005),
as well as EN 15267-1 (2009) and EN 15267-2 (2023).**

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 18 pages).

The present certificate replaces certificate 0000025927_03 dated 12 February 2020.



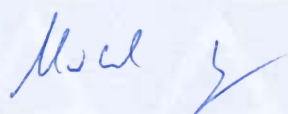
Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance
www.tuv.com
ID 0000025927

Publication in the German Federal Gazette
(BAnz) of 2 March 2012

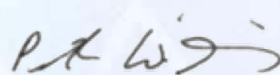
This certificate will expire on:
11 February 2030

German Environment Agency
Dessau, 10 February 2025

TÜV Rheinland Energy & Environment GmbH
Cologne, 9 February 2025



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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.

Test report: 936/21211350/B dated 7 October 2011
Initial certification: 12 February 2010
Expiry date: 11 February 2030
Certificate: Renewal (of previous certificate 0000025927_03 of 12 February 2020 valid until 11 February 2025)
Publication: BAnz. 02 March 2012, No. 36, p. 920, chapter IV No. 2.1

Approved application

The tested AMS is suitable for continuous immission measurement of NO₂, SO₂ and O₃ in stationary use.

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

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 measured values relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the intended use.

Basis of the certification

This certification is based on:

- Test report 936/21211350/B dated 7 October 2011 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. 02 March 2012, No. 36, p. 920, chapter IV No. 2.1, Announcement by UBA dated 23 February 2012:

AMS designation:

AR500 with ER120 for NO₂, SO₂ and O₃

Manufacturer:

Opsis AB, Furulund, Sweden

Field of application:

For the continuous monitoring of concentrations of nitrogen dioxide, sulphur dioxide and ozone in ambient air (stationary operation)

Measuring ranges during the performance test:

Component	Certification range	Supplementary measurement ranges	Unit
NO ₂	0 - 400	0 - 1,800	µg/m ³
SO ₂	0 - 700	0 - 1,000	µg/m ³
O ₃	0 - 360	0 - 500	µg/m ³

Software version:

7.21

Restrictions:

None

Notes:

1. The measuring path length during performance testing was 320 m.
2. The maintenance interval is four weeks.
3. Equivalence with the reference measurement methods according to the guideline „Demonstration of Equivalence of Ambient Air Monitoring Methods“ has been demonstrated for the components NO₂, SO₂ and O₃.
4. Functional tests by external sample gas feeding are possible.
5. The report on the performance test is available online at www.qal1.de.
6. Supplementary testing (Demonstration of Equivalence for the component SO₂ according the guideline “Demonstration of Equivalence of Ambient Air Monitoring Methods”) as regards Federal Environment Agency notices of 25 January 2010 (BAnz. p. 552, chapter III No. 1.1).

Test institute: TÜV Rheinland Energie und Umwelt GmbH, Cologne

Report No.: 936/21211350/B dated 7 October 2011

Publication in the German Federal Gazette: BAnz AT 05.03.2013 B10, Chap. V
notification 11, Announcement by UBA dated 12 February 2013:

**11 Notification as regards Federal Environment Agency notices
of 23 February 2012 (BAnz. p. 920, chapter IV, No. 2.1)**

The AR500 measuring system with ER120 for NO₂, SO₂ and O₃
manufactured by Opsis AB can also be operated with the transmitter/receiver units
ER 110 and ER150.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 10 October 2012

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, Chap. IV
notification 13, Announcement by UBA dated 25 February 2015:

**13 Notification as regards Federal Environment Agency (UBA) notices
of 23 February 2012 (BAnz. p. 920, chapter IV number 2.1) and
of 12 February 2013 (BAnz AT 05 March 2013 B10, chapter V notification 11)**

The step motor for the automatic grid finding type RDM 543/100A, of manufacturer
BERGER LAHR, in the AR500 measuring system with ER120 for NO₂, SO₂ and O₃,
of the company Opsis AB, was discontinued and therefore replaced by the step
motor for the automatic grid finding type RDM 545/100A of manufacturer BERGER
LAHR.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 20 September 2014

Certified product

This certificate applies to automated measurement systems conforming 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 transmitter-receiver unit, a reflector unit and an analyser. The absorbed light is transferred from the transmitter-receiver unit to the analyser via fibre optic cable.

Combined transmitter-receiver Unit ER 120

The combined transmitter-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, the visible, and the infrared range. The wavelengths are continuously distributed over the entire spectrum, with the exception of some peaks in the near infrared range.

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 & Environment 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 & Environment 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 & Environment 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 AR 500 mit ER 120 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_00: 10 March 2010
Expiry date of the certificate: 11 February 2015
Test report: 936/21211350/A dated 26 October 2009
TÜV Immissionsschutz und Energiesysteme GmbH
Publication: BAnz. 12 February 2010, No. 24, p. 553, chapter III number 1.1
UBA announcement dated 25 January 2010

Supplementary testing according to EN 15267

Certificate No. 0000025927_01: 16 March 2012
Expiry date of the certificate: 11 February 2015
Test report: 936/21211350/B dated 7 October 2011
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz. 02 March 2012, No. 36, p. 920, chapter IV number 2.1
UBA announcement dated 23 February 2012

Notifications

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 10 October 2012
Publication: BAnz AT 05.03.2013 B10, chapter V notification 11
UBA announcement dated 12 February 2013
(Hardware changes)

Renewal of certificates

Certificate No. 0000025927_02: 2 February 2015
Expiry date of the certificate: 11 February 2020

Notifications

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 20 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 13
UBA announcement dated 25 February 2015
(Hardware changes)

Renewal of certificates

Certificate No. 0000025927_03: 12 February 2020
Expiry date of the certificate: 11 February 2025

Renewal of certificates

Certificate No. 0000025927_04: 12 February 2025
Expiry date of the certificate: 11 February 2030

Table 1: Total expanded uncertainty with the results of the laboratory test according to EN 14211 (component NO₂) 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}	0,0000		
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	2,000	u _{r,jh}	0,04		
3	"lack of fit"	≤ 4,0% of measured value	0,800	u _{l,jh}	0,48		
4	Sensitivity coefficient of sample gas pressure	≤ 8,0 nmol/mol/kPa	0,000	u _{gp}	0,00		
5	Sensitivity coefficient of sample gas temperature	≤ 3,0 nmol/mol/K	0,026	u _{gt}	0,04		
6	Sensitivity coefficient of surrounding temperature	≤ 3,0 nmol/mol/K	-0,050	u _{st}	-0,06		
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	-0,021	u _v	-0,07		
8a	H2O with concentration 21 nmol/mol	≤ 5,0 nmol/mol	0,000	u _{H2O}	0,0000		
8b	CO2 with concentration 500 µmol/mol	≤ 5,0 nmol/mol	0,001	u _{int,pos}	0,48		
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		
18	Difference sample/calibration port	≤ 1,0%	0,000	u _{sc}	0,00		
21	Converter efficiency	≤ 98%	100,000	u _{CE}	0,00		
22	Increase of NO2 concentration due to residence time	≤ 4,0 nmol/mol	0,000	u _{dr}	0,00		
23	Uncertainty calibration gas	≤ 3,0%	2,000	u _{cg}	1,05		
				combined standard uncertainty		u _c	1,3046
				expanded uncertainty		U _c	2,6092
				expanded uncertainty actual		U _{crel}	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 NO₂) for system 1329

Device: AR500		Serial No: 1329		1h-limit value: 104,6		nmol/mol	
Component: NO ₂							
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty		
1	Repeatability at zero	≤ 1,0 nmol/mol	0,000	U _{r,z}	0,0000		
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	2,000	U _{r,th}	-		
3	"lack of fit"	≤ 4,0% of measured value	0,800	U _{l,h}	0,2334		
4	Sensitivity coefficient of sample gas pressure	≤ 8,0 nmol/mol/kPa	0,000	U _{sp}	0,0000		
5	Sensitivity coefficient of sample gas temperature	≤ 3,0 nmol/mol/K	0,026	U _{gt}	0,0016		
6	Sensitivity coefficient of surrounding temperature	≤ 3,0 nmol/mol/K	-0,050	U _{st}	0,0036		
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	-0,021	U _v	0,0046		
8a	H2O with concentration 21 nmol/mol	≤ 5,0 nmol/mol	0,000	U _{H2O}	0,0000		
8b	CO2 with concentration 500 µmol/mol	≤ 5,0 nmol/mol	0,001	U _{CO2, 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 _{NH3, neg}			
9	Averaging effect	≤ 7,0% of measured value	-0,600	U _{av}	-0,36		
10	Reproducibility under field conditions	≤ 5,0% of the average of 3 Mon.	4,720	U _{r,f}	4,94		
11	Long term drift at zero level	≤ 5,0 nmol/mol	-1,420	U _{l,z}	-0,82		
12	Long term drift at span level	≤ 5,0% of max. of certification range	0,430	U _{l,h}	0,26		
18	Difference sample/calibration port	≤ 1,0%	0,000	uDsc	0,000		
21	Converter efficiency	≥ 98%	100,000	uCE	0,00		
22	Increase of NO2 concentration due to residence time	≤ 4,0 nmol/mol	0,000	uctr	0,00		
23	Uncertainty calibration gas	≤ 3,0%	2,000	ucg	1,05		
combined standard uncertainty				u _c	7,1546	nmol/mol	
expanded uncertainty				U _c	14,3093	nmol/mol	
expanded uncertainty actual				U _{act,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 NO₂) for system 1330

Device: AR500		Serial No: 1330		1h-limit value:		nmol/mol	
Component: NO ₂						104,6	
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty		
1	Repeatability at zero	≤ 1,0 nmol/mol	0,100	U _{r,z}	0,0003		
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,900	U _{r,ph}	0,0004		
3	"lack of fit"	≤ 4,0% of measured value	0,000	U _{lin}	0,1313		
4	Sensitivity coefficient of sample gas pressure	≤ 8,0 nmol/mol/kPa	0,000	U _{gp}	0,0000		
5	Sensitivity coefficient of sample gas temperature	≤ 3,0 nmol/mol/K	0,000	U _{gt}	-0,05		
6	Sensitivity coefficient of surrounding temperature	≤ 3,0 nmol/mol/K	0,000	U _{st}	0,00		
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	0,000	U _v	0,24		
8a	H2O with concentration 21 mmol/mol	≤ 5,0 nmol/mol	0,000	U _{H2O}	0,0000		
8b	CO2 with concentration 500 µmol/mol	≤ 5,0 nmol/mol	0,000	U _{CO2}	0,0000		
8c	O3 with concentration 200 nmol/mol	≤ 2,0 nmol/mol	0,000	U _{O3}	0,0000		
8d	NH3 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,000	U _{NH3}	0,1764		
9	Averaging effect	≤ 7,0% of measured value	0,000	U _{av}	-0,18		
18	Difference sample/calibration port	≤ 1,0%	0,000	U _{sc}	0,00		
21	Converter efficiency	≤ 98%	100,000	U _{CE}	0,0000		
22	Increase of NO2 concentration due to residence time	≤ 4,0 nmol/mol	0,000	U _{rt}	0,0000		
23	Uncertainty calibration gas	≤ 3,0%	2,000	U _{cg}	1,0941		
		combined standard uncertainty	U _s	U _s	1,2222	nmol/mol	
		expanded uncertainty	U _e	U _e	2,4445	nmol/mol	
		expanded uncertainty actual	U _{c,rel}	U _{c,rel}	2,34	%	
		expanded uncertainty required	U _{req,rel}	U _{req,rel}	15	%	

Table 4: Total expanded uncertainty with the results of the laboratory test and field test according to EN 14211 (component NO₂) for system 1330

Device: AR500		Serial No: 1330		1h-limit value:		nmol/mol	
Component: NO ₂						104.6	
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty		
1	Repeatability at zero	≤ 1.0 nmol/mol	0.100	U _z	0.02	0.0003	
2	Repeatability at concentration ct	≤ 3.0 nmol/mol	0.900	U _{ct}	not respected because: $u_{r,h} = 0.034 < u_{r,f}$	-	
3	"lack of fit"	≤ 4.0% of measured value	0.600	U _{lf}	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 _{vt}	0.24	0.0553	
8a	H2O with concentration 21 mmol/mol	≤ 5.0 nmol/mol	0.000	U _{zco}	0.00	0.0000	
8b	CO2 with concentration 500 μmol/mol	≤ 5.0 nmol/mol	0.001	U _{in, pos}			
8c	O3 with concentration 200 nmol/mol	≤ 2.0 nmol/mol	0.002	or	0.42	0.1764	
8d	NH3 with concentration 200 nmol/mol	≤ 5.0 nmol/mol	0.000	U _{in, neg}			
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 _{rf}	4.94	24.3752	
11	Long term drift at zero level	≤ 5.0 nmol/mol	1.620	U _{dz}	0.94	0.8748	
12	Long term drift at span level	≤ 5.0% of max. of certification range	0.500	U _{dl, in}	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 _e	14.3121	nmol/mol
				expanded uncertainty actual	U _{e, 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 SO₂) for system 1329

Device: AR500		Serial-No.: Gerät 1 (1329)		132		nmol/mol	
Component: SO ₂		1h-limit value:					
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty		
1	Repeatability at zero	≤ 1,0 nmol/mol	0,100	u _z	0,0003		
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,100	u _{ct,lv}	0,0003		
3	"lack of fit"	≤ 4,0% of measured value	1,600	u _{lv}	1,4868		
4	Sensitivity coefficient of sample gas pressure	≤ 3,0 nmol/mol/kPa	0,000	u _{ge}	0,0000		
5	Sensitivity coefficient of sample gas temperature	≤ 1,0 nmol/mol/K	0,071	u _{gt}	0,2908		
6	Sensitivity coefficient of surrounding temperature	≤ 1,0 nmol/mol/K	-0,030	u _{st}	0,0523		
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	-0,010	u _v	0,0103		
8a	H2O with concentration 21 nmol/mol	≤ 10 nmol/mol	0,000	u _{H2O}	0,0000		
8b	H2S with concentration 200 nmol/mol	≤ 5,0 nmol/mol	-0,409	u _{int,pos}	0,1600		
8c	NH3 with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,406	0,40			
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-Xyol 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	
18	Difference sample/calibration port	≤ 1,0%	0,000	u _{bsc}	0,00	0,0000	
23	Uncertainty calibration gas	≤ 3,0%	2,000	ucg	1,32	1,7424	
				combined standard uncertainty		u _c	1,9363
				expanded uncertainty		U _c	3,8726
				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 SO₂) for system 1329

Device: AR500		Serial No.: 132		Gerat 1 (1329)		nmol/mol	
Component: SO ₂		1h-limit value:		Square of uncertainty			
No.	Performance characteristic	Criterion	Result	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, u _{r,lv} = 0,01 < u _{r,f}	-	
3	"lack of fit"	≤ 4,0% of measured value	1,600	u _{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	H2O with concentration 21 nmol/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 _{H2S, 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 _{m-xylol, 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 _{dl,z}	-0,53	0,2821	
12	Long term drift at span level	≤ 5,0% of max. of certification range	1,490	u _{dl,lv}	1,14	1,2894	
18	Differenz Proben-/Kalibriergaseingang	≤ 1,0%	0,000	u _{Dec}	0,00	0,0000	
23	Unsicherheit Prüfgas	≤ 3,0%	2,000	u _{cg}	1,32	1,7424	
		combined standard uncertainty	u _c	u _c		6,7800	nmol/mol
		expanded uncertainty	U _c	U _c		13,5600	nmol/mol
		expanded uncertainty actual	U _{act}	U _{act}		10,27	%
		expanded uncertainty required	U _{req}	U _{req}		15	%

Table 7: Total expanded uncertainty with the results of the laboratory test according to EN 14212 (component SO₂) for system 1330

Device: AR500		Serial-No.: Gerät 2 (1330)		132		nmol/mol	
Component: SO ₂		1h-limit value:					
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty		
1	Repeatability at zero	≤ 1,0 nmol/mol	0,000	U _{r,z}	0,0000		
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,100	U _{r,lv}	0,0003		
3	"lack of fit"	≤ 4,0% of measured value	1,400	U _{lv}	1,1384		
4	Sensitivity coefficient of sample gas pressure	≤ 3,0 nmol/mol/kPa	0,000	U _{gp}	0,0000		
5	Sensitivity coefficient of sample gas temperature	≤ 1,0 nmol/mol/K	0,011	U _{gt}	0,0070		
6	Sensitivity coefficient of surrounding temperature	≤ 1,0 nmol/mol/K	-0,060	U _{st}	0,2091		
7	Sensitivity coefficient of electrical voltage	≤ 0,30 nmol/mol/V	0,010	U _v	0,0103		
8a	H2O with concentration 21 nmol/mol	≤ 10 nmol/mol	0,000	U _{H2O}	0,0000		
8b	H2S with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,503	U _{int,pos}	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	U _{int,neg}			
8f	m-Xylol with concentration 1 µmol/mol	≤ 10 nmol/mol	0,809				
9	Averaging effect	≤ 7,0% of measured value	0,100	U _{av}	0,0058		
18	Difference sample/calibration port	≤ 1,0%	0,000	U _{bac}	0,0000		
23	Uncertainty calibration gas	≤ 3,0%	2,000	0	1,7424		
				combined standard uncertainty	U _c	2,1509	nmol/mol
				expanded uncertainty	U _s	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 SO₂) for system 1330

Device: AR500		Serial-No.:		Gerät 2 (1330)		nmol/mol
Component: SO ₂		1h-limit value:		132		
No.	Performance characteristic	Criterion	Result	Uncertainty	Square of uncertainty	
1	Repeatability at zero	≤ 1,0 nmol/mol	0,000	u _z	0,00	0,0000
2	Repeatability at concentration ct	≤ 3,0 nmol/mol	0,100	u _{iv}	not respected because, u _{r,iv} = 0,01 < u _{r,f}	-
3	"lack of fit"	≤ 4,0% of measured value	1,400	u _{iv}	1,07	1,1384
4	Sensitivity coefficient of sample gas pressure	≤ 3,0 nmol/mol/kPa	0,000	u _{sp}	0,00	0,0000
5	Sensitivity coefficient of sample gas temperature	≤ 1,0 nmol/mol/K	0,011	u _{st}	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	H2O with concentration 21 nmol/mol	≤ 10 nmol/mol	0,000	u _{sc0}	0,00	0,0000
8b	H2S with concentration 200 nmol/mol	≤ 5,0 nmol/mol	0,503	u _{rel,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 _{rel,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	1,160	u _{sl,z}	0,67	0,4485
12	Long term drift at span level	≤ 5,0% of max. of certification range	-2,070	u _{sl,iv}	-1,58	2,4887
18	Differenz Proben-/Kalibergasgang	≤ 1,0%	0,000	u _{pc}	0,00	0,0000
23	Unsicherheit Prüfgas	≤ 3,0%	2,000	0	1,32	1,7424
combined standard uncertainty				u _c		6,9434
expanded uncertainty				U _c		13,8869
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 O₃) for system 1329

Device: AR500		Serial 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}	0,0013
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,600	u _{r,v}	0,0120
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	0,400	u _{lv}	0,0768
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u _{gp}	0,0000
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,014	u _{gt}	0,0212
6	Variations in surrounding temperature	1,0 nmol/mol/K	0,150	u _{st}	0,2700
7	Variations in electrical voltage	0,30 nmol/mol/V	-0,010	u _{lv}	0,0147
8a	Interference H2O with 21 nmol/mol	10 nmol/mol	0,000	u _{H2O}	0,0000
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	2,147	u _{tol,pos}	2,1573
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	0,397	or u _{tol,neg}	
9	Averaging effect	7,0% of measured value	0,200	u _{av}	0,0192
18	Difference sample/calibration port	1,0%	0,000	u _{sc}	0,0000
23	Uncertainty test gas	3,0%	2,000	ucg	1,4400
		Combined standard uncertainty	u _c	u _c	2,0031
		Expanded uncertainty	U _c	U _c	4,0062
		Expanded uncertainty actual	U _{c,rel}	U _{c,rel}	3,34
		Expanded uncertainty required	U _{req,rel}	U _{req,rel}	15

Table 10: Total expanded uncertainty with the results of the laboratory test and field test according to EN 14625 (component O₃) for system 1329

Device: AR500		Serial No.		Gerat 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}	0,0013
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,600	u _{r,lv}	-
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	0,400	u _{lv}	0,0768
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u _{gp}	0,0000
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,014	u _{gt}	0,0212
6	Variations in surrounding temperature	1,0 nmol/mol/K	0,150	u _{st}	0,2700
7	Variations in electrical voltage	0,30 nmol/mol/V	-0,010	u _{lv}	0,0147
8a	Interference H2O with 21 mmol/mol	10 nmol/mol	0,000	u _{H2O}	0,0000
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	2,147	u _{tol,pos}	2,1573
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	0,397	or u _{tol,neg}	
9	Averaging effect	7,0% of measured value	0,200	u _{av}	0,0192
10	Reproducibility standard deviation in field	5,0% of average of 3 month	2,410	u _{rf}	8,3637
11	Long term drift at zero	5,0 nmol/mol	1,460	u _{cl,z}	0,7105
12	Long term drift at span level	5,0% of range	-2,450	u _{cl,lv}	2,8812
18	Difference sample/calibration port	1,0%	0,000	u _{dsc}	0,0000
23	Uncertainty test gas	3,0%	2,000	ucg	1,4400
Combined standard uncertainty			u _c	u _c	3,9945
Expanded uncertainty			U _e	U _e	7,9890
Expanded uncertainty actual			U _{cl,rel}	U _{cl,rel}	6,66
Expanded uncertainty required			U _{req,rel}	U _{req,rel}	15

Table 11: Total expanded uncertainty with the results of the laboratory test according to EN 14625 (component O₃) for system 1330

Device: AR500		Serial No.		Gerät 2 (1330)		nmol/mol
Measured component: O ₃		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 _{r,z}	0,0013	
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,400	u _{r,lv}	0,0053	
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	-0,300	u _{lv}	0,0432	
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000	u _{gp}	0,0000	
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,007	u _{gt}	0,0053	
6	Variations in surrounding temperature	1,0 nmol/mol/K	-0,120	u _{st}	0,1728	
7	Variations in electrical voltage	0,30 nmol/mol/V	0,010	u _v	0,0147	
8a	Interference H2O with 21 nmol/mol	10 nmol/mol	0,000	u _{H2O}	0,0000	
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	0,396	u _{Int,pos}	1,72 2,9416	
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	2,574	or u _{Int,neg}		
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 _{Disc}	0,00	0,0000
23	Uncertainty test gas	3,0%	2,000	0	1,20	1,4400
				Combined standard uncertainty		u _c
				Expanded uncertainty		U _c
				Expanded uncertainty actual		U _{c,rel}
				Expanded uncertainty required		U _{req,rel}
						2,2390
						4,4780
						3,73
						15

Table 12: Total expanded uncertainty with the results of the laboratory test and field test according to EN 14625 (component O₃) for system 1330

Device: AR500		Serial No.		Gerät 2 (1330)		120		nmol/mol	
Measured component: O ₃		hourly alert threshold		Uncertainty		Square of uncertainty			
No.	Performance characteristic	Criterion	Result	U _z	U _z	U _z	U _z	U _z	U _z
1	Repeatability standard deviation at zero	1,0 nmol/mol	0,200		0,04		0,0013		
2	Repeatability standard deviation at ct	3,0 nmol/mol	0,400		not respected, because $u_{r,lv} = 0,07 < u_{r,f}$				
3	"lack of fit" at the hourly alert threshold value	4,0% of measured value	-0,300		-0,21		0,0432		
4	Variations in sample gas pressure	2,0 nmol/mol/kPa	0,000		0,00		0,0000		
5	Variations in sample gas temperature	1,0 nmol/mol/K	0,007		0,07		0,0053		
6	Variations in surrounding temperature	1,0 nmol/mol/K	-0,120		-0,42		0,1728		
7	Variations in electrical voltage	0,30 nmol/mol/V	0,010		0,12		0,0147		
8a	Interference H ₂ O with 21 nmol/mol	10 nmol/mol	0,000		0,00		0,0000		
8b	Interference Toluol with 0,5 µmol/mol	5,0 nmol/mol	0,396		1,72		2,9416		
8c	Interference Xylol with 0,5 µmol/mol	5,0 nmol/mol	2,574		or $u_{r,lv}$ neg				
9	Averaging effect	7,0% of measured value	-0,900		-0,62		0,3888		
10	Reproducibility standard deviation in field	5,0% of average of 3 month	2,410		2,89		8,3637		
11	Long term drift at zero	5,0 nmol/mol	-1,840		-1,06		1,1285		
12	Long term drift at span level	5,0% of range	2,900		2,01		4,0368		
18	Difference sample/calibration port	1,0%	0,000		0,00		0,0000		
23	Uncertainty test gas	3,0%	2,000		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		%