Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040333

Certified AMS:	AR602Z/NHg for NO, NO_2, SO_2, NH_3 and Hg as well as AR602Z/N for NO, NO_2, SO_2 and NH_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 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 (see also the following pages).

TÜVRheinland® CERTIFIED

Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000040333

Publication in the German Federal Gazette (BAnz.) of 01 April 2014

German Federal Environment Agency
Dessau, 29 April 2014

i. A. Dr. Marcel Langner

This certificate will expire on:
31 March 2019

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 28 April 2014

ppa. Dr. Peter Wilbring

www.umwelt-tuv.de / www.eco-tuv.com
teu@umwelt-tuv.de
Tel. +49 221 806-5200

TÜV Rheinland Energie und Umwelt GmbH
Am Grauen Stein
51105 Cologne

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

Certificate:
0000040333 / 29 April 2014

Test report:	936/21222333/A of 10 October 2013
Initial certification:	01 April 2014
Expiry date:	31 March 2019
Publication:	BAnz AT 01 April 2014 B12, chapter I, No. 3.2

Approved application
The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III, at waste incineration plants according to Directive 2010/75/EU, chapter IV and other plants requiring official approval. The tested ranges have been chosen with respect to the wide application range of the AMS.

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

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

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 936/21222333/A of 10 October 2013 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- the ongoing surveillance of the product and the manufacturing process
- publication in the German Federal Gazette (BAnz AT 01 April 2014 B12, chapter I, No. 3.2, Announcement by UBA from 27 February 2014)

AMS designation:

AR602Z/NHg for NO, NO_2, SO_2, NH_3 and Hg as well as AR602Z/N for NO, NO_2, SO_2 and NH_3

Manufacturer:

Opsis AB, Furulund, Sweden

Field of application:

For measurements at plants requiring official approval (Directive 2010/75/EU on industrial emissions, chapter III and IV)

Measuring ranges during the performance test:

Components	Certification range	Supplementary range	Units
NO	0 - 150*	0 - 500*	mg/m³
NO_2	0 - 20*	0 - 500*	mg/m³
SO_2	0 - 75*	0 - 500*	mg/m³
NH_3	0 - 10*	0 - 50*	mg/m³
Hg	0 - 45	0 - 100	µg/m³

*with reference to a measuring path of 1.0 m

Software version:

7.21

Restriction:

The requirement for response time in the performance test according to EN 15267-3 for the component Hg was not fulfilled.

Notes:

1. The maintenance interval is four weeks.
2. The measuring path tested was 1 m.
3. The components NO, NO_2, SO_2 and NH_3 were determined in situ. The component Hg may be included by connecting the external EX060H measurement cell (with a measurement path length of 2 m) and the MX004 Multiplexer modules. The measuring system is then designated as AR602Z/NHg. If the component Hg is not included (AR602Z/N), the light path must remain unchanged.
4. A test gas generator, e.g. HovaCal, must be available for regular span point control of component Hg.
5. SO_2 (displayed as XXX) must be defined in the measuring cell for cross sensitivity compensation of the component Hg.
6. In the laboratory as well as during the field test the length of the heated test gas line was 10 m for the component Hg.
7. When including the component Hg (AR602Z/NHg) the filters in the sampling probe must be checked and, if necessary, changed after revision or malfunctions during waste gas cleaning.

Test report:

TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21222333/A of 10 October 2013

Certified product

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

The AMS AR602Z/NHg for NO, NO_2, SO_2, NH_3 and Hg as well as AR602Z/N for NO, NO_2, SO_2 and NH_3 is an in-situ measuring system according to the principle of DOAS measurement. The tested measuring system consists of a light source, a receiver, a fibre optic cable and an analyser. The measuring components are determined in the analyser using characteristic radiation absorption in the UV range by gaseous components using Differential Optical Absorption Spectroscopy (DOAS).

The measuring path consists of a light path between a light emitter and a light receiver. The light source in the emitter is a xenon high pressure lamp.

The light beam generated by the emitter is aimed at the receiver. Along its path to the medium, the intensity of the light beam is influenced by dispersion and absorption in molecules and particles.

The light that reaches the receiver is transmitted to the analyser via a fibre optic cable. This cable has the sole purpose of enabling the analyser to be positioned in a place protected from dust, excessive moisture, temperature fluctuations etc.

The measuring system consists of:

- Analyser (AR602Z/N)
- Light emitter unit (EM062)
- Receiver unit (RE062)
- Fibre optic cable (OF60 R3)
- Manual

The module for measuring mercury also comprises:

- Sample gas probe SP2000 (manufacturer M&C) in Opsis yellow
- Heated sample gas pipe with interior diameter of 6 mm (length 10 m)
- Heated sample gas cell with an active measuring path length of 2.0 m, including emitter/receiver unit, converter, suction jet pump, flow monitoring, power pack and temperature control (EX060)
- Multiplexer (MX004)

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 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 can be applied to the product or used in publicity material for the certified product.

This document as well as the certification mark remains property of TÜV Rheinland Energie und Umwelt GmbH. With revocation of the publication the certificate loses its validity. After the expiration 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 its expiration is also accessible on the internet: **qal1.de**.

Certification of AR602Z/NHg for NO, NO_2, SO_2, NH_3 and Hg as well as AR602Z/N for NO, NO_2, SO_2 and NH_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. 0000040333: 29 April 2014

Expiry date of the certificate: 31 March 2019

Test report: 936/21222333/A of 10 October 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 01 April 2014 B12, chapter I, No. 3.2
Announcement by UBA from 27 February 2014

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

Measuring system		
Manufacturer	Opsis AB	
AMS designation	AR602Z/NHg	
Serial number of units under test	1759 / 1760	
Measuring principle	UV-DOAS	
Test report	936/21222333/A	936/21222333/B
Test laboratory	TÜV Rheinland	TÜV Rheinland
Date of report	2013-10-10	2014-02-14
Measured component	Hg	
Certification range	0 - 45 µg/m³	

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

Sum of positive CS at zero point	0.00	µg/m³
Sum of negative CS at zero point	-0.50	µg/m³
Sum of postive CS at span point	1.00	µg/m³
Sum of negative CS at span point	-1.10	µg/m³
Maximum sum of cross-sensitivities	1.20	µg/m³
Uncertainty of cross-sensitivity	0.694	µg/m³

Calculation of the combined standard uncertainty

Tested parameter				u²	
Repeatability standard deviation at set point *	u_r	0.450	µg/m³	0.203	(µg/m³)²
Lack of fit	u_{lof}	0.404	µg/m³	0.163	(µg/m³)²
Zero drift from field test	$u_{d,z}$	0.260	µg/m³	0.068	(µg/m³)²
Span drift from field test	$u_{d,s}$	-0.546	µg/m³	0.298	(µg/m³)²
Influence of ambient temperature at span	u_t	0.153	µg/m³	0.023	(µg/m³)²
Influence of supply voltage	u_v	0.208	µg/m³	0.043	(µg/m³)²
Cross-sensitivity (interference)	u_i	0.694	µg/m³	0.481	(µg/m³)²
Influence of sample gas flow	u_p	-0.049	µg/m³	0.002	(µg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.364	µg/m³	0.132	(µg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.19	µg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.33	µg/m³

Relative total expanded uncertainty	**U in % of the ELV 30 µg/m³**	**7.8**
Requirement of 2010/75/EU	**U in % of the ELV 30 µg/m³**	**40.0**
Requirement of EN 15267-3	U in % of the ELV 30 µg/m³	30.0

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

Measuring system			
Manufacturer	Opsis AB		
AMS designation	AR602Z/N		
Serial number of units under test	1759 / 1760		
Measuring principle	UV-DOAS		
Test report	936/21222333/A	936/21222333/B	
Test laboratory	TÜV Rheinland	TÜV Rheinland	
Date of report	2013-10-10	2014-02-14	
Measured component	NH_3		
Certification range	0 - 10	mg/m³	

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

Sum of positive CS at zero point	0.18	mg/m³
Sum of negative CS at zero point	-0.10	mg/m³
Sum of postive CS at span point	0.23	mg/m³
Sum of negative CS at span point	-0.10	mg/m³
Maximum sum of cross-sensitivities	0.23	mg/m³
Uncertainty of cross-sensitivity	0.133	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.090	mg/m³	0.008	(mg/m³)²
Lack of fit	u_{lof}	0.040	mg/m³	0.002	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.052	mg/m³	0.003	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.110	mg/m³	0.012	(mg/m³)²
Influence of ambient temperature at span	u_t	0.058	mg/m³	0.003	(mg/m³)²
Influence of supply voltage	u_v	0.071	mg/m³	0.005	(mg/m³)²
Cross-sensitivity (interference)	u_i	0.133	mg/m³	0.018	(mg/m³)²
Influence of sample gas pressure	u_p	0.088	mg/m³	0.008	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.081	mg/m³	0.007	(mg/m³)²
Excursion of measurement beam	u_{mb}	0.115	mg/m³	0.013	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,\,j})^2}$	0.28	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.55	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**5.5**
Requirement of 2010/75/EU	**U in % of the ELV 10 mg/m³**	**40.0****
Requirement of EN 15267-3	U in % of the ELV 10 mg/m³	30.0

**For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
The chosen value is recommended by the certification body.

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

Measuring system			
Manufacturer		Opsis AB	
AMS designation		AR602Z/N	
Serial number of units under test		1759 / 1760	
Measuring principle		UV-DOAS	
Test report		936/21222333/A	936/21222333/B
Test laboratory		TÜV Rheinland	TÜV Rheinland
Date of report		2013-10-10	2014-02-14
Measured component		NO	
Certification range		0 - 150 mg/m³	

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

Sum of positive CS at zero point	0.00	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at span point	0.00	mg/m³
Sum of negative CS at span point	0.00	mg/m³
Maximum sum of cross-sensitivities	0.00	mg/m³
Uncertainty of cross-sensitivity	0.000	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.600	mg/m³	0.360	(mg/m³)²
Lack of fit	u_{lof}	-0.635	mg/m³	0.403	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.520	mg/m³	0.270	(mg/m³)²
Span drift from field test	$u_{d,s}$	-1.039	mg/m³	1.080	(mg/m³)²
Influence of ambient temperature at span	u_t	0.100	mg/m³	0.010	(mg/m³)²
Influence of supply voltage	u_v	0.123	mg/m³	0.015	(mg/m³)²
Cross-sensitivity (interference)	u_i	0.000	mg/m³	0.000	(mg/m³)²
Influence of sample gas pressure	u_p	0.367	mg/m³	0.135	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	1.212	mg/m³	1.470	(mg/m³)²
Excursion of measurement beam	u_{mb}	-0.537	mg/m³	0.288	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.01	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.94	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 100 mg/m³**	**3.9**
Requirement of 2010/75/EU	**U in % of the ELV 100 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 100 mg/m³	15.0

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

Measuring system			
Manufacturer		Opsis AB	
AMS designation		AR602Z/N	
Serial number of units under test		1759 / 1760	
Measuring principle		UV-DOAS	
Test report		936/21222333/A	936/21222333/B
Test laboratory		TÜV Rheinland	TÜV Rheinland
Date of report		2013-10-10	2014-02-14
Measured component		NO_2	
Certification range		0 - 20 mg/m³	

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

Sum of positive CS at zero point		0.52	mg/m³
Sum of negative CS at zero point		-0.13	mg/m³
Sum of postive CS at span point		0.46	mg/m³
Sum of negative CS at span point		-0.57	mg/m³
Maximum sum of cross-sensitivities		-0.57	mg/m³
Uncertainty of cross-sensitivity		-0.329	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.053	mg/m³	0.003	(mg/m³)²
Lack of fit	u_{lof}	0.081	mg/m³	0.007	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.150	mg/m³	0.023	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.162	mg/m³	0.026	(mg/m³)²
Influence of ambient temperature at span	u_t	0.058	mg/m³	0.003	(mg/m³)²
Influence of supply voltage	u_v	0.058	mg/m³	0.003	(mg/m³)²
Cross-sensitivity (interference)	u_i	-0.329	mg/m³	0.108	(mg/m³)²
Influence of sample gas pressure	u_p	0.088	mg/m³	0.008	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.162	mg/m³	0.026	(mg/m³)²
Excursion of measurement beam	u_{mb}	0.144	mg/m³	0.021	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.48	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.94	mg/m³

Relative total expanded uncertainty	**U in % of the range 20 mg/m³**	**4.7**
Requirement of 2010/75/EU	**U in % of the range 20 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the range 20 mg/m³	15.0

Umwelt Bundesamt

Certificate:
0000040333 / 29 April 2014

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

Measuring system		
Manufacturer	Opsis AB	
AMS designation	AR602Z/N	
Serial number of units under test	1759 / 1760	
Measuring principle	UV-DOAS	
Test report	936/21222333/A	936/21222333/B
Test laboratory	TÜV Rheinland	TÜV Rheinland
Date of report	2013-10-10	2014-02-14
Measured component	SO_2	
Certification range	0 - 75 mg/m³	

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

Sum of positive CS at zero point	0.00	mg/m³
Sum of negative CS at zero point	-0.27	mg/m³
Sum of postive CS at span point	0.73	mg/m³
Sum of negative CS at span point	-1.47	mg/m³
Maximum sum of cross-sensitivities	-1.47	mg/m³
Uncertainty of cross-sensitivity	-0.849	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.189	mg/m³	0.036	(mg/m³)²
Lack of fit	u_{lof}	0.271	mg/m³	0.073	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.260	mg/m³	0.068	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.390	mg/m³	0.152	(mg/m³)²
Influence of ambient temperature at span	u_t	0.208	mg/m³	0.043	(mg/m³)²
Influence of supply voltage	u_v	0.085	mg/m³	0.007	(mg/m³)²
Cross-sensitivity (interference)	u_i	-0.849	mg/m³	0.720	(mg/m³)²
Influence of sample gas pressure	u_p	0.184	mg/m³	0.034	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	0.368	(mg/m³)²
Excursion of measurement beam	u_{mb}	-0.277	mg/m³	0.077	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.26	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.46	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**4.9**
Requirement of 2010/75/EU	**U in % of the ELV 50 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 50 mg/m³	15.0