Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000038495_02

Certified AMS:	AR650/N for CO, HCl, H_2O, CO_2, N_2O and CH_4
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).

The present certificate replaces Certificate No. 0000038495_01 of 29 April 2014

TÜVRheinland® CERTIFIED

Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000038495

Publication in the German Federal Gazette (BAnz.) of 5 August 2014

This certificate will expire on:
4 March 2018

German Federal Environment Agency
Dessau, 9 September 2014

i. A. Dr. Marcel Langner

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 8 September 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.	

Test report:	936/21220566/C of 18 February 2014
Initial certification:	5 March 2013
Expiry date:	4 March 2018
Publication:	BAnz AT 5 August 2014 B11, chapter I, no. 4.1

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 measured ranges have been selected considering 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 seven-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 936/21220566/C of 18 February 2014 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 5 August 2014 B11, chapter I, no. 4.1
  UBA announcement of 17 July 2014

AMS designation:
AR650/N for CO, HCl, H_2O, CO_2, N_2O and CH_4

Manufacturer:
OPSIS AB, Furulund, Sweden

Field of application:
For measurements at plants requiring official approval (e.g. Directive 2010/75/EU on industrial emissions, chapters III and IV)

Measuring ranges during the performance test:

Components	Certification ranges	Supplementary ranges	Units
CO	0 - 75*	0 - 500*	mg/m³
HCl	0 - 15*	0 - 90*	mg/m³
H_2O	0 - 30*	0 - 40*	Vol.-%
CO_2	0 - 30*	0 - 40*	Vol.-%
N_2O	0 - 500*	0 - 2000*	mg/m³
CH_4	0 - 20*	0 - 100*	mg/m³

* with reference to a measuring path of 1.0 m

Software version:
7.21

Restriction:
The requirement of Standard EN 15267-3 for protection provided by enclosures was not fulfilled during performance testing.

Notes:

1. The maintenance interval is three months.
2. The tested measuring path is 1 m.
3. Supplementary testing (extension of the maintenance interval) to the announcement of the Federal Environmental Agency (UBA) of 27 February 2014 (Fed. Gazette (BAnz) AT, 1 April 2014, B12, chapter I number 3.1).

Test report:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report no.: 936/21220566/C of 18 February 2014

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

The AR650/N system is an in-situ DOAS open path measuring system for the measurement of CO, HCl, H_2O, CO_2, N_2O and CH_4.

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

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

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

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

The measuring system consists of:

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

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 AR650/N für CO, HCl, H_2O, CO_2, N_2O und CH_4 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. 0000038495: 22 March 2013

Expiry date of the certificate: 4 March 2018

Test report: 936/21220566/A of 11 October 2012
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 5 March 2013 B10, chapter I, no. 5.1
UBA announcement of 12 February 2013

Supplementary testing according to EN 15267

Certificate no. 0000038495_01: 29 April 2014

Expiry date of the certificate: 4 March 2018

Test report: 936/21220566/B of 10 October 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 1 April 2014 B12, chapter I, no. 3.1
UBA announcement of 27 February 2014

Supplementary testing according to EN 15267

Certificate no. 0000038495_02: 9 September 2014

Expiry date of the certificate: 4 March 2018

Test report: 936/21220566/C of 18 February 2014
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 5 August 2014 B11, chapter I, no. 4.1
UBA announcement of 17 July 2014

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

Measuring system			
Manufacturer	Opsis AB		
Name of measuring system	AR650/N		
Serial number of the candidates	448 / 449		
Measuring principle	IR-DOAS		
Test report	936/21220566/C		
Test laboratory	TÜV Rheinland		
Date of report	2014-02-14		
Measured component	CH_4		
Certification range	0 - 20	mg/m³	

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

Sum of positive CS at zero point	0.44	mg/m³
Sum of negative CS at zero point	-0.24	mg/m³
Sum of postive CS at reference point	0.30	mg/m³
Sum of negative CS at reference point	-0.50	mg/m³
Maximum sum of cross sensitivities	-0.50	mg/m³
Uncertainty of cross sensitivity	-0.289	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.253	mg/m³	0.064	(mg/m³)²
Lack of fit	u_{lof}	0.173	mg/m³	0.030	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.092	mg/m³	0.008	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.104	mg/m³	0.011	(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	0.053	mg/m³	0.003	(mg/m³)²
Cross sensitivity (interference)	u_i	-0.289	mg/m³	0.083	(mg/m³)²
Influence of sample pressure	u_p	0.155	mg/m³	0.024	(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}	-0.214	mg/m³	0.046	(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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.55	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.08	mg/m³

Relative total expanded uncertainty	**U in % of the range 20 mg/m³**	**5.4**
Requirement of 2010/75/EU	**U in % of the range 20 mg/m³**	**30.0 ****
Requirement of EN 15267-3	U in % of the range 20 mg/m³	22.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
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		
Name of measuring system	AR650/N		
Serial number of the candidates	448 / 449		
Measuring principle	IR-DOAS		
Test report	936/21220566/C		
Test laboratory	TÜV Rheinland		
Date of report	2014-02-14		
Measured component	CO		
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	-0.33	mg/m³	
Sum of postive CS at reference point	0.35	mg/m³	
Sum of negative CS at reference point	-0.37	mg/m³	
Maximum sum of cross sensitivities	0.63	mg/m³	
Uncertainty of cross sensitivity	0.364	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.805	mg/m³	0.648	$(mg/m^3)^2$
Lack of fit	u_{lof}	0.404	mg/m³	0.163	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	0.390	mg/m³	0.152	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	0.346	mg/m³	0.120	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	0.416	mg/m³	0.173	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.202	mg/m³	0.041	$(mg/m^3)^2$
Cross sensitivity (interference)	u_i	0.364	mg/m³	0.132	$(mg/m^3)^2$
Influence of sample pressure	u_p	0.320	mg/m³	0.102	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	0.368	$(mg/m^3)^2$
Excursion of measurement beam	u_{mb}	0.403	mg/m³	0.162	$(mg/m^3)^2$

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

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.44	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.81	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**5.6**
Requirement of 2010/75/EU	**U in % of the ELV 50 mg/m³**	**10.0**
Requirement of EN 15267-3	U in % of the ELV 50 mg/m³	7.5

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

Measuring system			
Manufacturer	Opsis AB		
Name of measuring system	AR650/N		
Serial number of the candidates	448 / 449		
Measuring principle	IR-DOAS		
Test report	936/21220566/C		
Test laboratory	TÜV Rheinland		
Date of report	2014-02-14		
Measured component	HCl		
Certification range	0 - 15	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 reference point	0.14	mg/m³
Sum of negative CS at reference point	-0.07	mg/m³
Maximum sum of cross sensitivities	0.14	mg/m³
Uncertainty of cross sensitivity	0.081	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.190	mg/m³	0.036	(mg/m³)²
Lack of fit	u_{lof}	0.058	mg/m³	0.003	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.121	mg/m³	0.015	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.139	mg/m³	0.019	(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	0.089	mg/m³	0.008	(mg/m³)²
Cross sensitivity (interference)	u_i	0.081	mg/m³	0.007	(mg/m³)²
Influence of sample pressure	u_p	0.077	mg/m³	0.006	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121	mg/m³	0.015	(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)	$u_c = \sqrt{\sum (u_{max,\,j})^2}$	0.35	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.69	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**6.9**
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

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

Measuring system					
Manufacturer		Opsis AB			
AMS designation		AR650/N			
Serial number of units under test		448 / 448			
Measuring principle		IR-DOAS			
Test report		936/21220566/C			
Test laboratory		TÜV Rheinland			
Date of report		2014-02-14			
Measured component		CO_2			
Certification range		0 - 30	Vol.-%		
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point		0.00	Vol.-%		
Sum of negative CS at zero point		0.00	Vol.-%		
Sum of postive CS at span point		0.00	Vol.-%		
Sum of negative CS at span point		0.00	Vol.-%		
Maximum sum of cross-sensitivities		0.00	Vol.-%		
Uncertainty of cross-sensitivity		0.000	Vol.-%		

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.058	Vol.-%	0.003	(Vol.-%)²
Lack of fit	u_{lof}	0.173	Vol.-%	0.030	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	0.121	Vol.-%	0.015	(Vol.-%)²
Span drift from field test	$u_{d,s}$	0.139	Vol.-%	0.019	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.058	Vol.-%	0.003	(Vol.-%)²
Influence of supply voltage	u_v	0.012	Vol.-%	0.000	(Vol.-%)²
Cross-sensitivity (interference)	u_i	0.000	Vol.-%	0.000	(Vol.-%)²
Influence of sample gas pressure	u_p	0.011	Vol.-%	0.000	(Vol.-%)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.242	Vol.-%	0.059	(Vol.-%)²
Excursion of measurement beam	u_{mb}	0.115	Vol.-%	0.013	(Vol.-%)²

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

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.38	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.74	Vol.-%

Relative total expanded uncertainty	**U in % of the range 30 Vol.-%**	**2.5**
Requirement of 2010/75/EU	**U in % of the range 30 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the range 30 Vol.-%	7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
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			AR650/N		
Serial number of units under test			448 / 449		
Measuring principle			IR-DOAS		
Test report			936/21220566/C		
Test laboratory			TÜV Rheinland		
Date of report			2014-02-14		
Measured component			H_2O		
Certification range			0 - 30	Vol.-%	
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point			0.00	Vol.-%	
Sum of negative CS at zero point			0.00	Vol.-%	
Sum of postive CS at span point			0.20	Vol.-%	
Sum of negative CS at span point			0.00	Vol.-%	
Maximum sum of cross-sensitivities			0.20	Vol.-%	
Uncertainty of cross-sensitivity			0.116	Vol.-%	

Calculation of the combined standard uncertainty

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

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

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.63	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.24	Vol.-%

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

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
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			AR650/N		
Serial number of units under test			448 / 449		
Measuring principle			IR-DOAS		
Test report			936/21220566/C		
Test laboratory			TÜV Rheinland		
Date of report			2014-02-14		
Measured component			N_2O		
Certification range			0 - 500	mg/m³	
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point			17.20	mg/m³	
Sum of negative CS at zero point			-10.10	mg/m³	
Sum of postive CS at span point			19.30	mg/m³	
Sum of negative CS at span point			-13.00	mg/m³	
Maximum sum of cross-sensitivities			19.30	mg/m³	
Uncertainty of cross-sensitivity			11.143	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	7.452	mg/m³	55.532	$(mg/m^3)^2$
Lack of fit	u_{lof}	-2.309	mg/m³	5.331	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	4.041	mg/m³	16.330	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	4.907	mg/m³	24.079	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	0.954	mg/m³	0.910	$(mg/m^3)^2$
Influence of supply voltage	u_v	2.586	mg/m³	6.687	$(mg/m^3)^2$
Cross-sensitivity (interference)	u_i	11.143	mg/m³	124.163	$(mg/m^3)^2$
Influence of sample gas pressure	u_p	0.832	mg/m³	0.692	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	4.041	mg/m³	16.333	$(mg/m^3)^2$
Excursion of measurement beam	u_{mb}	5.225	mg/m³	27.301	$(mg/m^3)^2$

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

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	16.65	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	32.64	mg/m³

Relative total expanded uncertainty	**U in % of the range 500 mg/m³**	**6.5**
Requirement of 2010/75/EU	**U in % of the range 500 mg/m³**	**20.0 ****
Requirement of EN 15267-3	U in % of the range 500 mg/m³	15.0

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
The chosen value is recommended by the certification body.