

# CERTIFICATE

## of Product Conformity (QAL1)

Certificate No: 0000040333\_05

**Certified AMS:** AR 602 Z/NHg for NO, NO<sub>2</sub>, SO<sub>2</sub>, NH<sub>3</sub> and Hg as well as  
AR 602 Z/N for NO, NO<sub>2</sub>, SO<sub>2</sub> and NH<sub>3</sub>

**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 15267-1 (2009), EN 15267-2 (2023), EN 15267-3 (2007),  
as well as EN 14181 (2004).**

Certification is awarded in respect of the conditions stated in this certificate  
(this certificate contains 13 pages).  
The present certificate replaces certificate 0000040333\_04 dated 1 July 2020.



Suitability Tested  
EN 15267  
QAL1 Certified  
Regular  
Surveillance

www.tuv.com  
ID 0000040333

Publication in the German Federal Gazette  
(BAnz) of 2 April 2015

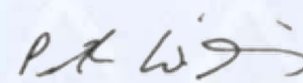
German Environment Agency

Dessau, 27 June 2025

This certificate will expire on:  
30 June 2030

TÜV Rheinland Energy &  
Environment GmbH  
Cologne, 26 June 2025

  
Dr. Marcel Langner  
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ppa. Dr. Peter Wilbring

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51105 Köln

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:** 936/21222333/C dated 8 September 2014  
**Initial certification:** 1 April 2014  
**Expiry date:** 30 June 2030  
**Certificate:** Renewal (of previous certificate 0000040333\_04 of 1 July 2020 valid until 30 June 2025)  
**Publication:** BAnz AT 02.04.2015 B5, chapter I No. 3.2

### Approved application

The tested AMS is suitable for use at plants according to Directive 2010/75/EC, chapter III (combustion plants / 13th BImSchV:2013), Directive 2010/75/EC, chapter IV (waste incineration plants / 17th BImSchV:2013), Directive 2015/2193/EC (44th BImSchV:2022), TA Luft:2002, 30th BImSchV:2009 and 27th BImSchV:2013. The measured ranges have been selected so as to ensure as broad a field of application as possible.

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 incineration plant.

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 emission limit values relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the installation at which it will be installed.

### Note

The legal regulations mentioned correspond to the current state of legislation during certification. Each user should, if necessary, in consultation with the competent authority, ensure that this AMS meets the legal requirements for the intended use. In addition, it cannot be ruled out that legal regulations governing the use of a measuring device for emission monitoring may change during the lifetime of the certificate.

### Basis of the certification

This certification is based on:

- Test report 936/21222333/C dated 8 September 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 02.04.2015 B5, chapter I No. 3.2,  
Announcement by UBA dated 25 February 2015:

**AMS designation:**

AR602Z/NHg for NO, NO<sub>2</sub>, SO<sub>2</sub>, NH<sub>3</sub> and Hg as well as  
AR602Z/N for NO, NO<sub>2</sub>, SO<sub>2</sub> and NH<sub>3</sub>

**Manufacturer:**

OPSIS AB, Furulund, Sweden

**Field of application:**

For plants requiring official approval and for plants according to the 27th BImSchV

**Measuring ranges during the performance test:**

| Component       | Certification range | supplementary range | Unit              |
|-----------------|---------------------|---------------------|-------------------|
| NO              | 0 – 150*            | 0 – 500*            | mg/m <sup>3</sup> |
| NO <sub>2</sub> | 0 – 20*             | 0 – 500*            | mg/m <sup>3</sup> |
| SO <sub>2</sub> | 0 – 75*             | 0 – 500*            | mg/m <sup>3</sup> |
| NH <sub>3</sub> | 0 – 10*             | 0 – 50*             | mg/m <sup>3</sup> |
| Hg              | 0 – 45              | 0 – 100             | µg/m <sup>3</sup> |

\* at a measurement path length of 1.0 meter

**Software version:**

7.21

**Restrictions:**

1. During performance testing, the requirement of EN 15267-3 with regard to response time was not met for the component Hg.
2. During performance testing in accordance with EN 15267-3, the requirement for the degree of protection provided by the enclosure

**Notes:**

1. The maintenance interval is three months for the AR602Z/NHg measuring system and six months for the AR602Z/N measuring system.
2. The measurement path length was 1 m during the lab test and 2 m during the field test.
3. The components NO, NO<sub>2</sub>, SO<sub>2</sub> and NH<sub>3</sub> are determined in-situ. The component Hg can also be measured by using the external measurement cell EX060H module (the measurement path length being 2 m) and the MX004 multiplexer module. In this setup, the measuring system is named AR602Z/NHg. If the component Hg is not included (AR602Z/N), the light path shall remain unchanged.
4. In order to perform regular span point checks for the component Hg, a test gas generator (e. g. HovaCal) must be available.
5. In order to compensate for cross-sensitivity as regards component Hg, the SO<sub>2</sub> content (displayed as XXX) in the heated measuring cell has to be determined.

6. During the laboratory and field tests, the length of the heated test gas line for the component Hg was 10 m.
7. If the component Hg is included in the measurements (AR602Z/NHg), the filters within the sampling probe shall be checked and, if necessary, replaced after revision or malfunctions occurring during waste gas scrubbing.
8. Supplementary testing (extension of the maintenance interval) as regards Federal Environment Agency (UBA) notices of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter I number 4.2).

**Test Institute:** TÜV Rheinland Energie und Umwelt GmbH, Cologne  
Report No.: 936/21222333/C dated 8 September 2014

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter I number 3.2 and chapter IV notification 36, UBA announcement dated 25 February 2015:

**36 Notification as regards Federal Environment Agency (UBA) notices of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter I number 4.2)**

The step motor for the automatic grid finding, Type RDM 543/100A manufactured by BERGER LAHR in the measuring system AR602Z/N for NO, NO<sub>2</sub>, SO<sub>2</sub> and NH<sub>3</sub> as well as AR602Z/NHg for therefore replaced by the step motor for the automatic grid finding of Type RDM 545/100A manufactured by BERGER LAHR.

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

Publication in the German Federal Gazette: BAnz AT 26.08.2015 B4, Chap. V notification 15, Announcement by UBA dated 22 July 2015:

**15 Notification as regards Federal Environment Agency (UBA) notices of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter I number 4.2) and of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter IV notification 36)**

The measuring systems AR602Z/N for SO<sub>2</sub>, NO, NO<sub>2</sub> and NH<sub>3</sub> and AR602Z/NHg for SO<sub>2</sub>, NO, NO<sub>2</sub>, NH<sub>3</sub> and Hg, manufactured by Opsis AB, are also available with the option "ER060/062AUTO with automatic QAL3 testing system" for regular automatic functional checks with the main component NO. The "ER060/062AUTO with automatic QAL3 testing system" option does not serve the purpose of adjusting the AMS, nor does it replace the manual zero and span point checks required during the maintenance interval. It solely gives information of the status of the measuring systems between the external test gas offerings.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 23 March 2015

Note:

The citation in the notification is incorrect. The citation must read:

**Notification as regards Federal Environment Agency (UBA) notice of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter I number 3.2)**

### Certified product

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

The AMS AR602Z/NHg for NO, NO<sub>2</sub>, SO<sub>2</sub>, NH<sub>3</sub> and Hg, as well as its variant the AR602Z/N for NO, NO<sub>2</sub>, SO<sub>2</sub> and NH<sub>3</sub> is an in-situ measuring system, which operates 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. With the Differential Optical Absorption Spectroscopy (DOAS), the measuring components are determined in the analyser by way of the characteristic absorption of radiation in the UV range by gaseous components.

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

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

The light collected by the receiver is led to the analyser via a fibre optic cable. This cable merely serves as a means to facilitate the installation of the analyser at a location where it is protected from dust, excessive moisture, variations in temperature etc.

The measuring system consists of:

- Analyser (AR602Z/N)
- 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 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: **gal1.de**.

### History of documents

Certification of AR 602 Z/NHg as well as AR 602 Z/N 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\_00: 29 April 2014  
Expiry date of the certificate: 31 March 2019  
Test report: 936/21222333/A dated 10 October 2013  
TÜV Rheinland Energie und Umwelt GmbH  
Publication: BAnz AT 01.04.2014 B12, chapter I number 3.2  
UBA announcement dated 27 February 2014

#### Supplementary testing according to EN 15267

Certificate No. 0000040333\_01: 9 September 2014  
Expiry date of the certificate: 8 September 2019  
Test report: 936/21222333/B dated 17 February 2014  
TÜV Rheinland Energie und Umwelt GmbH  
Publication: BAnz AT 05.08.2014 B11, chapter I number 4.2  
UBA announcement dated 17 July 2014

#### Notifications

Statement issued by TÜV Süd Industrie Service GmbH dated 20 September 2014  
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 36  
UBA announcement dated 25 February 2015  
(Hardware changes)

#### Supplementary testing according to EN 15267

Certificate No. 0000040333\_02: 30 April 2015  
Expiry date of the certificate: 31 March 2019  
Test report: 936/21222333/C dated 8 September 2014  
TÜV Rheinland Energie und Umwelt GmbH  
Publication: BAnz AT 02.04.2015 B5, chapter I number 3.2  
UBA announcement dated 25 February 2015

#### Notifications

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 20 September 2014  
Publication: BAnz AT 02.04.2015 B5, chapter I number 3.2  
UBA announcement dated 25 February 2015  
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 23 March 2015  
Publication: BAnz AT 26.08.2015 B4, chapter V notification 15  
UBA announcement dated 22 July 2015  
(Software changes)

#### Renewal of certificates

Certificate No. 0000040333\_03: 1 April 2019  
Expiry date of the certificate: 30 June 2020

#### Renewal of certificates

Certificate No. 0000040333\_04: 1 July 2020  
Expiry date of the certificate: 30 June 2025

**Renewal of certificates**

Certificate No. 0000040333\_05: 27 June 2025  
Expiry date of the certificate: 30 June 2030

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

### Measuring system

Manufacturer  
AMS designation  
Serial number of units under test  
Measuring principle

Opsis AB  
AR602Z/NHg  
1759 / 1760  
UV-DOAS

### Test report

Test laboratory  
Date of report

936/21222333/C  
TÜV Rheinland  
2014-09-08

### Measured component

Certification range

Hg  
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 positive 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

Repeatability standard deviation at set point \*  
Lack of fit  
Zero drift from field test  
Span drift from field test  
Influence of ambient temperature at span  
Influence of supply voltage  
Cross-sensitivity (interference)  
Influence of sample gas flow  
Uncertainty of reference material at 70% of certification range

|           |              | $u^2$ |          |
|-----------|--------------|-------|----------|
| $u_r$     | 0.450 µg/m³  | 0.203 | (µg/m³)² |
| $u_{lof}$ | 0.404 µg/m³  | 0.163 | (µg/m³)² |
| $u_{d,z}$ | 0.260 µg/m³  | 0.068 | (µg/m³)² |
| $u_{d,s}$ | -0.546 µg/m³ | 0.298 | (µg/m³)² |
| $u_t$     | 0.153 µg/m³  | 0.023 | (µg/m³)² |
| $u_v$     | 0.208 µg/m³  | 0.043 | (µg/m³)² |
| $u_i$     | 0.694 µg/m³  | 0.481 | (µg/m³)² |
| $u_D$     | -0.049 µg/m³ | 0.002 | (µg/m³)² |
| $u_{rm}$  | 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 ( $u_c$ )

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 1.19 \text{ µg/m}^3$$

Total expanded uncertainty

$$U = u_c \cdot k = u_c \cdot 1.96 \quad 2.33 \text{ µg/m}^3$$

### Relative total expanded uncertainty

#### Requirement of 2010/75/EU

Requirement of EN 15267-3

|                            |      |
|----------------------------|------|
| U in % of the ELV 30 µg/m³ | 7.8  |
| U in % of the ELV 30 µg/m³ | 40.0 |
| 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

|                 |               |
|-----------------|---------------|
| Test laboratory | TÜV Rheinland |
| Date of report  | 2014-09-08    |

### Measured component

|                     |                                             |
|---------------------|---------------------------------------------|
| Certification range | NH <sub>3</sub><br>0 - 10 mg/m <sup>3</sup> |
|---------------------|---------------------------------------------|

### Evaluation of the cross-sensitivity (CS)

(system with largest CS)

|                                    |                         |
|------------------------------------|-------------------------|
| Sum of positive CS at zero point   | 0.18 mg/m <sup>3</sup>  |
| Sum of negative CS at zero point   | -0.10 mg/m <sup>3</sup> |
| Sum of positive CS at span point   | 0.23 mg/m <sup>3</sup>  |
| Sum of negative CS at span point   | -0.10 mg/m <sup>3</sup> |
| Maximum sum of cross-sensitivities | 0.23 mg/m <sup>3</sup>  |
| Uncertainty of cross-sensitivity   | 0.133 mg/m <sup>3</sup> |

### Calculation of the combined standard uncertainty

#### Tested parameter

|                                                                 |                  |                         | U <sup>2</sup>                          |
|-----------------------------------------------------------------|------------------|-------------------------|-----------------------------------------|
| Repeatability standard deviation at set point *                 | U <sub>r</sub>   | 0.090 mg/m <sup>3</sup> | 0.008 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Lack of fit                                                     | U <sub>lof</sub> | 0.040 mg/m <sup>3</sup> | 0.002 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Zero drift from field test                                      | U <sub>d,z</sub> | 0.069 mg/m <sup>3</sup> | 0.005 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Span drift from field test                                      | U <sub>d,s</sub> | 0.110 mg/m <sup>3</sup> | 0.012 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of ambient temperature at span                        | U <sub>t</sub>   | 0.058 mg/m <sup>3</sup> | 0.003 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of supply voltage                                     | U <sub>v</sub>   | 0.071 mg/m <sup>3</sup> | 0.005 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Cross-sensitivity (interference)                                | U <sub>i</sub>   | 0.133 mg/m <sup>3</sup> | 0.018 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of sample gas pressure                                | U <sub>p</sub>   | 0.088 mg/m <sup>3</sup> | 0.008 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Uncertainty of reference material at 70% of certification range | U <sub>rm</sub>  | 0.081 mg/m <sup>3</sup> | 0.007 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Excursion of measurement beam                                   | U <sub>mb</sub>  | 0.115 mg/m <sup>3</sup> | 0.013 (mg/m <sup>3</sup> ) <sup>2</sup> |

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

|                                                 |                                   |                        |
|-------------------------------------------------|-----------------------------------|------------------------|
| Combined standard uncertainty (u <sub>c</sub> ) | $u_c = \sqrt{\sum (u_{max,i})^2}$ | 0.28 mg/m <sup>3</sup> |
| Total expanded uncertainty                      | $U = u_c * k = u_c * 1.96$        | 0.55 mg/m <sup>3</sup> |

### Relative total expanded uncertainty

#### Requirement of 2010/75/EU

#### Requirement of EN 15267-3

|                                        |         |
|----------------------------------------|---------|
| U in % of the ELV 10 mg/m <sup>3</sup> | 5.5     |
| U in % of the ELV 10 mg/m <sup>3</sup> | 40.0 ** |
| U in % of the ELV 10 mg/m <sup>3</sup> | 30.0    |

\*\* The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.  
A value of 40 % was used for this.

## 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

|                 |               |
|-----------------|---------------|
| Test laboratory | TÜV Rheinland |
| Date of report  | 2014-09-08    |

### Measured component

|                     |                                 |
|---------------------|---------------------------------|
| Certification range | NO<br>0 - 150 mg/m <sup>3</sup> |
|---------------------|---------------------------------|

### Evaluation of the cross-sensitivity (CS)

(system with largest CS)

|                                    |                         |
|------------------------------------|-------------------------|
| Sum of positive CS at zero point   | 0.00 mg/m <sup>3</sup>  |
| Sum of negative CS at zero point   | 0.00 mg/m <sup>3</sup>  |
| Sum of positive CS at span point   | 0.00 mg/m <sup>3</sup>  |
| Sum of negative CS at span point   | 0.00 mg/m <sup>3</sup>  |
| Maximum sum of cross-sensitivities | 0.00 mg/m <sup>3</sup>  |
| Uncertainty of cross-sensitivity   | 0.000 mg/m <sup>3</sup> |

### Calculation of the combined standard uncertainty

#### Tested parameter

|                                                                 |                                    | $u^2$                                   |
|-----------------------------------------------------------------|------------------------------------|-----------------------------------------|
| Repeatability standard deviation at set point *                 | $u_r$ 0.600 mg/m <sup>3</sup>      | 0.360 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Lack of fit                                                     | $u_{lof}$ -0.635 mg/m <sup>3</sup> | 0.403 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Zero drift from field test                                      | $u_{d,z}$ 0.779 mg/m <sup>3</sup>  | 0.607 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Span drift from field test                                      | $u_{d,s}$ -1.386 mg/m <sup>3</sup> | 1.921 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of ambient temperature at span                        | $u_t$ 0.100 mg/m <sup>3</sup>      | 0.010 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of supply voltage                                     | $u_v$ 0.123 mg/m <sup>3</sup>      | 0.015 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Cross-sensitivity (interference)                                | $u_i$ 0.000 mg/m <sup>3</sup>      | 0.000 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of sample gas pressure                                | $u_p$ 0.367 mg/m <sup>3</sup>      | 0.135 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Uncertainty of reference material at 70% of certification range | $u_{rm}$ 1.212 mg/m <sup>3</sup>   | 1.470 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Excursion of measurement beam                                   | $u_{mb}$ -0.537 mg/m <sup>3</sup>  | 0.288 (mg/m <sup>3</sup> ) <sup>2</sup> |

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty ( $u_c$ )

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 2.28 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 4.47 \text{ mg/m}^3$$

### Relative total expanded uncertainty

#### Requirement of 2010/75/EU

Requirement of EN 15267-3

|                                               |             |
|-----------------------------------------------|-------------|
| <b>U in % of the ELV 100 mg/m<sup>3</sup></b> | <b>4.5</b>  |
| <b>U in % of the ELV 100 mg/m<sup>3</sup></b> | <b>20.0</b> |
| U in % of the ELV 100 mg/m <sup>3</sup>       | 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

|                 |                |
|-----------------|----------------|
| Test laboratory | 936/21222333/C |
| Date of report  | TÜV Rheinland  |
|                 | 2014-09-08     |

### Measured component

|                     |                          |
|---------------------|--------------------------|
| Certification range | NO <sub>2</sub>          |
|                     | 0 - 20 mg/m <sup>3</sup> |

### Evaluation of the cross-sensitivity (CS)

(system with largest CS)

|                                    |                          |
|------------------------------------|--------------------------|
| Sum of positive CS at zero point   | 0.52 mg/m <sup>3</sup>   |
| Sum of negative CS at zero point   | -0.13 mg/m <sup>3</sup>  |
| Sum of positive CS at span point   | 0.46 mg/m <sup>3</sup>   |
| Sum of negative CS at span point   | -0.57 mg/m <sup>3</sup>  |
| Maximum sum of cross-sensitivities | -0.57 mg/m <sup>3</sup>  |
| Uncertainty of cross-sensitivity   | -0.329 mg/m <sup>3</sup> |

### Calculation of the combined standard uncertainty

#### Tested parameter

|                                                                      |                  |                          | u <sup>2</sup>                          |
|----------------------------------------------------------------------|------------------|--------------------------|-----------------------------------------|
| Standard deviation from paired measurements under field conditions * | u <sub>D</sub>   | 0.053 mg/m <sup>3</sup>  | 0.003 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Lack of fit                                                          | u <sub>lof</sub> | 0.081 mg/m <sup>3</sup>  | 0.007 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Zero drift from field test                                           | u <sub>d,z</sub> | 0.150 mg/m <sup>3</sup>  | 0.023 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Span drift from field test                                           | u <sub>d,s</sub> | 0.185 mg/m <sup>3</sup>  | 0.034 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of ambient temperature at span                             | u <sub>t</sub>   | 0.058 mg/m <sup>3</sup>  | 0.003 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of supply voltage                                          | u <sub>v</sub>   | 0.058 mg/m <sup>3</sup>  | 0.003 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Cross-sensitivity (interference)                                     | u <sub>i</sub>   | -0.329 mg/m <sup>3</sup> | 0.108 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of sample gas pressure                                     | u <sub>p</sub>   | 0.088 mg/m <sup>3</sup>  | 0.008 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Uncertainty of reference material at 70% of certification range      | u <sub>rm</sub>  | 0.162 mg/m <sup>3</sup>  | 0.026 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Excursion of measurement beam                                        | u <sub>mb</sub>  | 0.144 mg/m <sup>3</sup>  | 0.021 (mg/m <sup>3</sup> ) <sup>2</sup> |

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u<sub>c</sub>)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 0.49 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c \cdot k = u_c \cdot 1.96 \quad 0.95 \text{ mg/m}^3$$

### Relative total expanded uncertainty

#### Requirement of 2010/75/EU

Requirement of EN 15267-3

|                                          |      |
|------------------------------------------|------|
| U in % of the range 20 mg/m <sup>3</sup> | 4.8  |
| U in % of the range 20 mg/m <sup>3</sup> | 20.0 |
| U in % of the range 20 mg/m <sup>3</sup> | 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

|                 |                |
|-----------------|----------------|
| Test laboratory | 936/21222333/C |
| Date of report  | TÜV Rheinland  |
|                 | 2014-09-08     |

### Measured component

|                     |                          |
|---------------------|--------------------------|
| Certification range | SO <sub>2</sub>          |
|                     | 0 - 75 mg/m <sup>3</sup> |

### Evaluation of the cross-sensitivity (CS)

(system with largest CS)

|                                    |                          |
|------------------------------------|--------------------------|
| Sum of positive CS at zero point   | 0.00 mg/m <sup>3</sup>   |
| Sum of negative CS at zero point   | -0.27 mg/m <sup>3</sup>  |
| Sum of positive CS at span point   | 0.73 mg/m <sup>3</sup>   |
| Sum of negative CS at span point   | -1.47 mg/m <sup>3</sup>  |
| Maximum sum of cross-sensitivities | -1.47 mg/m <sup>3</sup>  |
| Uncertainty of cross-sensitivity   | -0.849 mg/m <sup>3</sup> |

### Calculation of the combined standard uncertainty

#### Tested parameter

|                                                                      |                  |                          | u <sup>2</sup>                          |
|----------------------------------------------------------------------|------------------|--------------------------|-----------------------------------------|
| Standard deviation from paired measurements under field conditions * | u <sub>D</sub>   | 0.189 mg/m <sup>3</sup>  | 0.036 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Lack of fit                                                          | u <sub>lof</sub> | 0.271 mg/m <sup>3</sup>  | 0.073 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Zero drift from field test                                           | u <sub>d,z</sub> | 0.520 mg/m <sup>3</sup>  | 0.270 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Span drift from field test                                           | u <sub>d,s</sub> | 0.390 mg/m <sup>3</sup>  | 0.152 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of ambient temperature at span                             | u <sub>t</sub>   | 0.208 mg/m <sup>3</sup>  | 0.043 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of supply voltage                                          | u <sub>v</sub>   | 0.085 mg/m <sup>3</sup>  | 0.007 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Cross-sensitivity (interference)                                     | u <sub>i</sub>   | -0.849 mg/m <sup>3</sup> | 0.720 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Influence of sample gas pressure                                     | u <sub>p</sub>   | 0.184 mg/m <sup>3</sup>  | 0.034 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Uncertainty of reference material at 70% of certification range      | u <sub>rm</sub>  | 0.606 mg/m <sup>3</sup>  | 0.368 (mg/m <sup>3</sup> ) <sup>2</sup> |
| Excursion of measurement beam                                        | u <sub>mb</sub>  | -0.277 mg/m <sup>3</sup> | 0.077 (mg/m <sup>3</sup> ) <sup>2</sup> |

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u<sub>c</sub>)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 1.33 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c \cdot k = u_c \cdot 1.96 \quad 2.62 \text{ mg/m}^3$$

### Relative total expanded uncertainty

#### Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 50 mg/m<sup>3</sup> **5.2**

U in % of the ELV 50 mg/m<sup>3</sup> **20.0**

U in % of the ELV 50 mg/m<sup>3</sup> **15.0**