

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000081151_00

Certified AMS: AO2000-Uras26 for CO, NO, SO₂, O₂ and CO₂

Manufacturer: ABB AG
Stierstädter Str. 5
60488 Frankfurt/Main
Germany

Test Institute: TÜV Rheinland Energy 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 (2009), EN 15267-3 (2007)
as well as EN 14181 (2014).

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 14 pages).



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

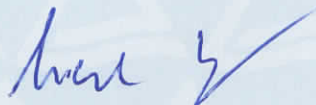
www.tuv.com
ID 0000081151

Publication in the German Federal Gazette
(BAnz) of 20 March 2023

German Environment Agency
Dessau, 25 April 2023

This certificate will expire on:
19 March 2028

TÜV Rheinland Energy GmbH
Cologne, 24 April 2023



Dr. Marcel Langner
Head of Section II 4.1



ppa. Dr. Peter Wilbring

www.umwelt-tuv.eu
tre@umwelt-tuv.eu
Tel. + 49 221 806-5200

TÜV Rheinland Energy GmbH
Am Grauen Stein
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: 936/21247320/B dated 31 August 2022
Initial certification: 20 March 2023
Expiry date: 19 March 2028
Publication: BAnz AT 20.03.2023 B6, chapter I No. 3.1

Approved application

The tested AMS is suitable for use at plants according to Directive 2010/75/EC, chapter III (13th BImSchV:2021), chapter IV (17th BImSchV:2021), Directive 2015/2193/EC (44th BImSchV:2021), 30th BImSchV:2019, TA-Luft:2021 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 8 month field test at a waste incineration plant.

The AMS is approved for an ambient temperature range of +5° 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 and oxygen concentration 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 936/21247320/B dated 31 August 2022 of TÜV Rheinland Energy 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 20.03.2023 B6, chapter I No. 3.1,
Announcement by UBA dated 21 February 2023:

AMS designation:

AO2000-Uras26 for CO, NO, SO₂, CO₂ and O₂

Manufacturer:

ABB AG, Frankfurt am Main, Deutschland

Field of application:

Modular measuring system for plants requiring official approval and plants according to the 27th BImSchV.

Measuring ranges during the performance test:

| Component | Certification range | Additional range | Unit | Maintenance interval* |
|--------------------------------|---------------------|------------------|-------------------|-----------------------|
| CO | 0 - 75 | 0 - 4,000 | mg/m ³ | 4 months |
| NO | 0 - 150 | 0 - 5,000 | mg/m ³ | 4 months |
| SO ₂ | 0 - 75 | 0 - 8,000 | mg/m ³ | 4 months |
| CO ₂ | 0 - 20 | - | Vol.-% | 4 months |
| O ₂ electrochemical | 0 - 25 | - | Vol.-% | 4 weeks |
| O ₂ paramagnetic | 0 - 25 | - | Vol.-% | 4 weeks |

* The respective maintenance interval depends on the installed modules.

Software version:

AMC Board: 3.9.8

Syscon III Board: 5.1.22

Restrictions:

None

Notes:

1. The maintenance interval is to be determined depending on the module configuration.
2. The analyzer can be used in the housing variants AO2020 (19" housing for rack mounting) and AO2040 (housing for wall mounting).
3. The measuring systems of the AO2000-Uras26 series can be equipped without an oxygen measuring cell, with the paramagnetic oxygen measuring cell AO2000-Magnos28 or alternatively with an electrochemical oxygen measuring cell.
4. The adjustment cells are not part of the performance test.

5. The performance test covers the following instrument variants:

| Instrument variant | Uras26 identifier | Component 1 | Component 2 | Component 3 | Component 4 |
|--------------------|-------------------|-----------------|-----------------|-----------------|-----------------|
| AO2020/2040 | CEM1000N | CO | | | |
| AO2020/2040 | CEM2000N | NO | | | |
| AO2020/2040 | CEM3000N | SO ₂ | | | |
| AO2020/2040 | CEM1200N | CO | NO | | |
| AO2020/2040 | CEM1300N | CO | SO ₂ | | |
| AO2020/2040 | CEM2300N | NO | SO ₂ | | |
| AO2020/2040 | CEM2500N | NO | CO ₂ | | |
| AO2020/2040 | CEM1230N | CO | NO | SO ₂ | |
| AO2020/2040 | CEM2350N | NO | SO ₂ | CO ₂ | |
| AO2020/2040 | CEM1235N | CO | NO | SO ₂ | CO ₂ |

In addition, the nameplate of the measuring system indicates whether an AO2000-Magnos28 oxygen measuring cell or an electrochemical sensor is installed.

Test report:

TÜV Rheinland Energy GmbH, Cologne
Report No.: 936/21247320/B dated 31 August 2022

Certified product

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

The measuring device is a modular measuring device. The AO2000-Uras26 measuring device uses the method of non-dispersive infrared photometry (NDIR) to measure the CO, NO, CO₂ and SO₂ components in this test. The concentration of the component O₂ is measured using a paramagnetic measurement principle by the already suitability-tested Magnos28. Alternatively, an electrochemical oxygen sensor from the already suitability-tested Limas21 UV can be installed. However, on the basis of the modular design of the measuring system, the most unfavorable variant with the Magnos28 was selected, as this was assumed to have the greatest influence on the Uras26.

With the NDIR principle mentioned above, the radiation absorption caused by the sample gas is recorded. The photometer consists of a thermal IR source whose radiation is passed through a measuring cuvette. The detected radiation then passes through a filter cuvette and the interference filter to the detector.

The detector is constructed as a two-layer receiver and has an optically transparent window on the back. This allows the remaining radiation to enter a second detector, which is filled with a gas corresponding to a measurement component. By selectively measuring gas-specific absorption lines (at corresponding wavelengths), individual gas components can be identified; the strength of the absorption is then a direct measure of the gas concentration. By setting up a second beam path, several measurement components can be detected simultaneously.

The measuring system has a modular design. Depending on the selected measurement components, there are different variants of the analyzer setup. From this, as shown in Table 1, all further combination possibilities can be derived.

Table 1: Possible instrument configurations of the modular measuring device AO2000

| Uras26 identifier | Component 1 | Component 2 | Component 3 | Component 4 |
|-------------------|-----------------|-----------------|-----------------|-----------------|
| CEM1000 N | CO | | | |
| CEM2000 N | NO | | | |
| CEM3000 N | SO ₂ | | | |
| CEM1200 N | CO | NO | | |
| CEM1300 N | CO | SO ₂ | | |
| CEM2300 N | NO | SO ₂ | | |
| CEM2500 N | NO | CO ₂ | | |
| CEM1230 N | CO | NO | SO ₂ | |
| CEM2350 N | CO | NO | CO ₂ | |
| CEM1235 N | CO | NO | SO ₂ | CO ₂ |

Note: A Magnos28 or alternatively an electrochemical sensor can be installed to measure the oxygen concentration.

The sample gas for the Uras26 is taken via the heated sampling probes and cooled down to 3°C in the SCC-C sample gas cooler with Wt125 for moisture separation. The two heat exchangers installed are connected in series. The concentration is determined in the actual analyzer of the system using the NDIR photometry described above.

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 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 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 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 AO2000-Uras26 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. 0000081151_00: 25 April 2023
Expiry date of the certificate: 19 March 2028
Test report 936/21247320/B dated 31 August 2022
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 20.03.2023 B6, chapter I No. 3.1
Announcement by UBA dated 21 February 2023

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

Measuring system

| | |
|-----------------------------------|------------------------|
| Manufacturer | ABB AG |
| AMS designation | AO2000-Uras26 CEM1235N |
| Serial number of units under test | 33728609/33728619 |
| Measuring principle | NDIR |

Test report

| | |
|-----------------|----------------------|
| Test laboratory | TÜV Rheinland Energy |
| Date of report | 2022-08-31 |

Measured component

| | | |
|---------------------|----|--------------------------|
| Certification range | CO | 0 - 75 mg/m ³ |
|---------------------|----|--------------------------|

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

| | |
|------------------------------------|--------------------------------|
| Sum of positive CS at zero point | 0.36 mg/m ³ |
| Sum of negative CS at zero point | -1.07 mg/m ³ |
| Sum of positive CS at span point | 0.60 mg/m ³ |
| Sum of negative CS at span point | 0.00 mg/m ³ |
| Maximum sum of cross-sensitivities | -1.07 mg/m ³ |
| Uncertainty of cross-sensitivity | u_i -0.619 mg/m ³ |

Calculation of the combined standard uncertainty

Tested parameter

| | | u^2 |
|---|------------------------------------|---|
| Lack of fit | u_D 0.350 mg/m ³ | 0.123 (mg/m ³) ² |
| Zero drift from field test | u_{lof} 0.307 mg/m ³ | 0.094 (mg/m ³) ² |
| Span drift from field test | $u_{d,z}$ -0.303 mg/m ³ | 0.092 (mg/m ³) ² |
| Influence of ambient temperature at span | $u_{d,s}$ 1.212 mg/m ³ | 1.469 (mg/m ³) ² |
| Influence of supply voltage | u_t 0.451 mg/m ³ | 0.203 (mg/m ³) ² |
| Cross-sensitivity (interference) | u_v 0.074 mg/m ³ | 0.005 (mg/m ³) ² |
| Influence of sample gas flow | u_i -0.619 mg/m ³ | 0.383 (mg/m ³) ² |
| Uncertainty of reference material at 70% of certification range | u_p -0.058 mg/m ³ | 0.003 (mg/m ³) ² |
| | u_{rm} 0.606 mg/m ³ | 0.368 (mg/m ³) ² |

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

| | | |
|---|-----------------------------------|------------------------|
| Combined standard uncertainty (u_c) | $u_c = \sqrt{\sum (u_{max,j})^2}$ | 1.66 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 3.24 mg/m ³ |

Relative total expanded uncertainty

| | | |
|---------------------------|--|-------------|
| Requirement of 2010/75/EU | U in % of the ELV 50 mg/m³ | 6.5 |
| Requirement of EN 15267-3 | U in % of the ELV 50 mg/m³ | 10.0 |
| | 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 | ABB AG |
| AMS designation | AO2000-Uras26 CEM1235N |
| Serial number of units under test | 33728609/33728619 |
| Measuring principle | Infrarotspektroskopie |

Test report

| | |
|-----------------|----------------------|
| Test laboratory | TÜV Rheinland Energy |
| Date of report | 2022-08-31 |

Measured component

| | | |
|---------------------|----|---------------------------|
| Certification range | NO | 0 - 150 mg/m ³ |
|---------------------|----|---------------------------|

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

| | |
|------------------------------------|--------------------------------|
| Sum of positive CS at zero point | 4.92 mg/m ³ |
| Sum of negative CS at zero point | -5.63 mg/m ³ |
| Sum of positive CS at span point | 4.61 mg/m ³ |
| Sum of negative CS at span point | -2.00 mg/m ³ |
| Maximum sum of cross-sensitivities | -5.63 mg/m ³ |
| Uncertainty of cross-sensitivity | u_i -3.248 mg/m ³ |

Calculation of the combined standard uncertainty

Tested parameter

| | | u^2 |
|---|-----------------------------------|--|
| Lack of fit | u_D 0.617 mg/m ³ | 0.381 (mg/m ³) ² |
| Zero drift from field test | u_{lof} 0.580 mg/m ³ | 0.336 (mg/m ³) ² |
| Span drift from field test | $u_{t,z}$ 0.606 mg/m ³ | 0.367 (mg/m ³) ² |
| Influence of ambient temperature at span | $u_{d,s}$ 2.511 mg/m ³ | 6.305 (mg/m ³) ² |
| Influence of supply voltage | u_t 1.050 mg/m ³ | 1.103 (mg/m ³) ² |
| Cross-sensitivity (interference) | u_i 0.656 mg/m ³ | 0.430 (mg/m ³) ² |
| Influence of sample gas flow | u_i -3.248 mg/m ³ | 10.550 (mg/m ³) ² |
| Uncertainty of reference material at 70% of certification range | u_n 0.808 mg/m ³ | 0.653 (mg/m ³) ² |
| | u_{tm} 1.212 mg/m ³ | 1.470 (mg/m ³) ² |

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,i})^2} \quad 4.65 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 9.11 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 98 mg/m³ **9,3**

U in % of the ELV 98 mg/m³ **20,0**

U in % of the ELV 98 mg/m³ **15,0**

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

Measuring system

| | |
|-----------------------------------|------------------------|
| Manufacturer | ABB AG |
| AMS designation | AO2000-Uras26 CEM1235N |
| Serial number of units under test | 33728609/33728619 |
| Measuring principle | NDIR |

Test report

| | |
|-----------------|----------------------|
| Test laboratory | 936/21247320/B |
| Date of report | TÜV Rheinland Energy |
| | 2022-08-31 |

Measured component

| | | |
|---------------------|-----------------|---------------|
| Certification range | CO ₂ | 0 - 20 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 positive CS at span point | 0.00 | Vol.-% |
| Sum of negative CS at span point | -0.17 | Vol.-% |
| Maximum sum of cross-sensitivities | -0.17 | Vol.-% |
| Uncertainty of cross-sensitivity | u_i | -0.098 Vol.-% |

Calculation of the combined standard uncertainty

Tested parameter

| | | | | u^2 |
|---|-----------|--------|--------|-----------------------------|
| | u_D | 0.057 | Vol.-% | 0.003 (Vol.-%) ² |
| Lack of fit | u_{lof} | 0.150 | Vol.-% | 0.023 (Vol.-%) ² |
| Zero drift from field test | $u_{d,z}$ | 0.058 | Vol.-% | 0.003 (Vol.-%) ² |
| Span drift from field test | $u_{d,s}$ | 0.335 | Vol.-% | 0.112 (Vol.-%) ² |
| Influence of ambient temperature at span | u_t | 0.248 | Vol.-% | 0.062 (Vol.-%) ² |
| Influence of supply voltage | u_v | 0.006 | Vol.-% | 0.000 (Vol.-%) ² |
| Cross-sensitivity (interference) | u_i | -0.098 | Vol.-% | 0.010 (Vol.-%) ² |
| Influence of sample gas flow | u_n | 0.000 | Vol.-% | 0.000 (Vol.-%) ² |
| Uncertainty of reference material at 70% of certification range | u_{rm} | 0.162 | Vol.-% | 0.026 (Vol.-%) ² |

* The larger value is used :

- "Repeatability standard deviation at set point" or
- "Standard deviation from paired measurements under field conditions"

| | | | |
|---|-----------------------------------|------|--------|
| Combined standard uncertainty (u_c) | $u_c = \sqrt{\sum (u_{max,j})^2}$ | 0.49 | Vol.-% |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 0.96 | Vol.-% |

Relative total expanded uncertainty

| | | |
|---------------------------|--------------------------------------|----------------|
| Requirement of 2010/75/EU | U in % of the range 20 Vol.-% | 4.8 |
| Requirement of EN 15267-3 | U in % of the range 20 Vol.-% | 10.0 ** |
| | U in % of the range 20 Vol.-% | 7.5 |

** The EU-directive 2010/75/EC on industrial emissions does not define requirements for this component. A value of 10.0 % was used instead.

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

Measuring system

| | |
|-----------------------------------|------------------------|
| Manufacturer | ABB AG |
| AMS designation | AO2000-Uras26 CEM1235N |
| Serial number of units under test | 33728609/33728619 |
| Measuring principle | NDIR |

Test report

| | |
|-----------------|----------------------|
| Test laboratory | TÜV Rheinland Energy |
| Date of report | 2022-08-31 |

Measured component

| | |
|---------------------|---|
| Certification range | SO ₂ 0 - 75 mg/m ³ |
|---------------------|---|

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

| | |
|------------------------------------|--------------------------------|
| Sum of positive CS at zero point | 2.30 mg/m ³ |
| Sum of negative CS at zero point | -2.75 mg/m ³ |
| Sum of positive CS at span point | 2.10 mg/m ³ |
| Sum of negative CS at span point | -1.80 mg/m ³ |
| Maximum sum of cross-sensitivities | -2.75 mg/m ³ |
| Uncertainty of cross-sensitivity | u_i -1.585 mg/m ³ |

Calculation of the combined standard uncertainty

Tested parameter

| | | u^2 |
|---|------------------------------------|---|
| Lack of fit | u_D 0.484 mg/m ³ | 0.234 (mg/m ³) ² |
| Zero drift from field test | u_{lof} -0.229 mg/m ³ | 0.052 (mg/m ³) ² |
| Span drift from field test | $u_{t,z}$ -0.823 mg/m ³ | 0.677 (mg/m ³) ² |
| Influence of ambient temperature at span | $u_{t,s}$ 1.212 mg/m ³ | 1.469 (mg/m ³) ² |
| Influence of supply voltage | u_t 0.265 mg/m ³ | 0.070 (mg/m ³) ² |
| Cross-sensitivity (interference) | u_v 0.145 mg/m ³ | 0.021 (mg/m ³) ² |
| Influence of sample gas flow | u_i -1.585 mg/m ³ | 2.512 (mg/m ³) ² |
| Uncertainty of reference material at 70% of certification range | u_b 0.289 mg/m ³ | 0.084 (mg/m ³) ² |
| | u_m 0.606 mg/m ³ | 0.368 (mg/m ³) ² |

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,i})^2} \quad 2.34 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 4.59 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 50 mg/m³ 9,2

U in % of the ELV 50 mg/m³ 20,0

U in % of the ELV 50 mg/m³ 15,0

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

Measuring system

| | |
|-----------------------------------|--------------------------|
| Manufacturer | ABB AG |
| AMS designation | AO2000 - Uras26 CEM2300N |
| Serial number of units under test | 33728509/33728519 |
| Measuring principle | NDIR |

Test report

| | |
|-----------------|----------------------|
| Test laboratory | TÜV Rheinland Energy |
| Date of report | 2022-08-31 |

Measured component

| | | |
|---------------------|----|---------------------------|
| Certification range | NO | 0 - 150 mg/m ³ |
|---------------------|----|---------------------------|

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

| | |
|------------------------------------|--------------------------------|
| Sum of positive CS at zero point | 4.59 mg/m ³ |
| Sum of negative CS at zero point | -5.54 mg/m ³ |
| Sum of positive CS at span point | 4.70 mg/m ³ |
| Sum of negative CS at span point | -0.80 mg/m ³ |
| Maximum sum of cross-sensitivities | -5.54 mg/m ³ |
| Uncertainty of cross-sensitivity | u_i -3.196 mg/m ³ |

Calculation of the combined standard uncertainty

Tested parameter

| | | u^2 |
|---|------------------------------------|--|
| Lack of fit | u_D 1.157 mg/m ³ | 1.339 (mg/m ³) ² |
| Zero drift from field test | u_{lof} 0.580 mg/m ³ | 0.336 (mg/m ³) ² |
| Span drift from field test | $u_{t,z}$ -0.433 mg/m ³ | 0.187 (mg/m ³) ² |
| Influence of ambient temperature at span | $u_{t,s}$ 1.645 mg/m ³ | 2.706 (mg/m ³) ² |
| Influence of supply voltage | u_t 1.090 mg/m ³ | 1.188 (mg/m ³) ² |
| Cross-sensitivity (interference) | u_v 0.487 mg/m ³ | 0.237 (mg/m ³) ² |
| Influence of sample gas flow | u_i -3.196 mg/m ³ | 10.214 (mg/m ³) ² |
| Uncertainty of reference material at 70% of certification range | u_b 0.173 mg/m ³ | 0.030 (mg/m ³) ² |
| | u_m 1.212 mg/m ³ | 1.470 (mg/m ³) ² |

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

| | | |
|---|-----------------------------------|------------------------|
| Combined standard uncertainty (u_c) | $u_c = \sqrt{\sum (u_{max,i})^2}$ | 4.21 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 8.25 mg/m ³ |

Relative total expanded uncertainty

| | | |
|---------------------------|--|-------------|
| Requirement of 2010/75/EU | U in % of the ELV 98 mg/m³ | 8,4 |
| Requirement of EN 15267-3 | U in % of the ELV 98 mg/m³ | 20,0 |
| | U in % of the ELV 98 mg/m³ | 15,0 |

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

Measuring system

| | |
|-----------------------------------|------------------------|
| Manufacturer | ABB AG |
| AMS designation | AO2000-Uras26 CEM2300N |
| Serial number of units under test | 33728509/33728519 |
| Measuring principle | NDIR |

Test report

| | |
|-----------------|----------------------|
| Test laboratory | TÜV Rheinland Energy |
| Date of report | 2022-08-31 |

Measured component

| | |
|---------------------|--------------------------|
| SO ₂ | |
| Certification range | 0 - 75 mg/m ³ |

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

| | |
|------------------------------------|--------------------------------|
| Sum of positive CS at zero point | 2.06 mg/m ³ |
| Sum of negative CS at zero point | -2.93 mg/m ³ |
| Sum of positive CS at span point | 1.90 mg/m ³ |
| Sum of negative CS at span point | -1.60 mg/m ³ |
| Maximum sum of cross-sensitivities | -2.93 mg/m ³ |
| Uncertainty of cross-sensitivity | u_i -1.693 mg/m ³ |

Calculation of the combined standard uncertainty

Tested parameter

| | | u^2 |
|---|------------------------------------|---|
| Lack of fit | u_D 0.416 mg/m ³ | 0.173 (mg/m ³) ² |
| Zero drift from field test | u_{lof} 0.143 mg/m ³ | 0.020 (mg/m ³) ² |
| Span drift from field test | $u_{t,z}$ -0.476 mg/m ³ | 0.227 (mg/m ³) ² |
| Influence of ambient temperature at span | $u_{t,s}$ -0.606 mg/m ³ | 0.367 (mg/m ³) ² |
| Influence of supply voltage | u_t 0.451 mg/m ³ | 0.203 (mg/m ³) ² |
| Cross-sensitivity (interference) | u_v 0.218 mg/m ³ | 0.048 (mg/m ³) ² |
| Influence of sample gas flow | u_i -1.693 mg/m ³ | 2.866 (mg/m ³) ² |
| Uncertainty of reference material at 70% of certification range | u_b -0.139 mg/m ³ | 0.019 (mg/m ³) ² |
| | u_m 0.606 mg/m ³ | 0.368 (mg/m ³) ² |

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,i})^2} \quad 2.07 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 4.06 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

| | |
|--|-------------|
| U in % of the ELV 50 mg/m ³ | 8,1 |
| U in % of the ELV 50 mg/m ³ | 20,0 |
| U in % of the ELV 50 mg/m ³ | 15,0 |

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

Measuring system

| | |
|-----------------------------------|---|
| Manufacturer | ABB Automation GmbH |
| AMS designation | AO2000-Magnos28 |
| Serial number of units under test | 33633146 / 32679405 / 33633136 / 33633156 |
| Measuring principle | Paramagnetism |

Test report

| | |
|-----------------|---------------------------------|
| Test laboratory | 936/21236694/C TÜV Rheinland |
| Date of report | 2018-03-07 |

Measured component

| | |
|---------------------|---------------------------------|
| Certification range | O ₂ 0 - 25 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 positive 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 | u_i 0.000 Vol.-% |

Calculation of the combined standard uncertainty

Tested parameter

| | | | | u^2 |
|--|-----------|---------------|--|-----------------------------|
| Standard deviation from paired measurements under field conditions * | u_D | 0.056 Vol.-% | | 0.003 (Vol.-%) ² |
| Lack of fit | u_{lof} | 0.017 Vol.-% | | 0.000 (Vol.-%) ² |
| Zero drift from field test | $u_{d,z}$ | 0.115 Vol.-% | | 0.013 (Vol.-%) ² |
| Span drift from field test | $u_{d,s}$ | -0.115 Vol.-% | | 0.013 (Vol.-%) ² |
| Influence of ambient temperature at span | u_t | 0.030 Vol.-% | | 0.001 (Vol.-%) ² |
| Influence of supply voltage | u_v | 0.006 Vol.-% | | 0.000 (Vol.-%) ² |
| Cross-sensitivity (interference) | u_i | 0.000 Vol.-% | | 0.000 (Vol.-%) ² |
| Influence of sample gas flow | u_b | -0.057 Vol.-% | | 0.003 (Vol.-%) ² |
| Uncertainty of reference material at 70% of certification range | u_{rm} | 0.202 Vol.-% | | 0.041 (Vol.-%) ² |

* The larger value is used :

- "Repeatability standard deviation at set point" or
- "Standard deviation from paired measurements under field conditions"

| | | |
|---|-----------------------------------|-------------|
| Combined standard uncertainty (u_c) | $u_c = \sqrt{\sum (u_{max,j})^2}$ | 0.27 Vol.-% |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 0.54 Vol.-% |

Relative total expanded uncertainty

| | | |
|---------------------------|--------------------------------------|----------------|
| Requirement of 2010/75/EU | U in % of the range 25 Vol.-% | 2.1 |
| Requirement of EN 15267-3 | U in % of the range 25 Vol.-% | 10.0 ** |
| | U in % of the range 25 Vol.-% | 7.5 |

** The EU-directive 2010/75/EC on industrial emissions does not define requirements for this component. A value of 10.0 % was used instead.

Total uncertainty¹⁾ for the measurement component O₂ in the measuring range 0 – 25 Vol.-%

| Performance characteristic | Uncertainty | Value standard uncertainty Vol. % | Square of standard uncertainty Vol. % ² |
|--|------------------------------|-----------------------------------|--|
| Lack-of-fit | u_{lof} | -0,092 | 0,0085 |
| Zero drift from field test | $u_{d,z}$ | -0,110 | 0,0121 |
| Span drift from field test | $u_{d,s}$ | 0,035 | 0,0012 |
| Influence of ambient temperature at span | u_t | 0,240 | 0,0576 |
| Influence of sample gas pressure | u_p | | |
| Influence of sample gas flow | u_f | -0,021 | 0,0004 |
| Influence of supply voltage | u_v | 0,004 | 0,00000 |
| Cross-sensitivity (interference) | u_i | 0,196 | 0,0385 |
| Repeatability standard deviation at span | $u_r = s_r$ | 0,032 | 0,001 |
| Standard deviation from paired measurements under field cond. | $u_d = s_d$ | 0,028 | $u_d < u_r$ |
| Uncertainty of reference material 1 % by 70% of ZR | u_{rm} | 0,101 | 0,0102 |
| Excursion of measurement beam | u_{mb} | | |
| Converter efficiency for AMS measuring NOx | u_{ce} | | |
| Variation of response factors (TOC) | u_{rf} | | |
| | | total | 0,1295 |
| Combined standard uncertainty | $u_c = \sqrt{\sum (u_i)^2}$ | 0,3599 | Vol. % |
| Total expanded uncertainty | $U_{0,95} = 1,96 \times u_c$ | 0,7054 | Vol. % |
| Relativ expanded uncertainty | U | 2,8 | % CR |
| Permissible uncertainty of EN 15267-3 | (of CR 25 Vol. %) | 7,5 | % CR |
| Complied with requirements relating to the measurement uncertainty | | yes | regarding EN 15267-3 |
| Permissible uncertainty 13. / 17. BImSchV | (of CR 25 Vol. %) | 10 | % CR |
| Complied with requirements relating to the measurement uncertainty | | yes | regarding 13. / 17. BImSchV |

¹⁾ Note: The table shown for the uncertainty of the oxygen component is taken from the Test report TÜV Süd No. 2694203 Table 122 from March 2017.