

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000081151_01

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).
The present certificate replaces certificate 0000081151_00 dated 25 April 2023.



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000081151

Publication in the German Federal Gazette
(BAnz) of 02 August 2023

German Environment Agency
Dessau, 05 September 2023

This certificate will expire on:
01 August 2028

TÜV Rheinland Energy GmbH
Cologne, 04 September 2023



Dr. Marcel Langner
Head of Section II 4



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/D dated 31 January 2023
Initial certification: 20 March 2023
Expiry date: 01 August 2028
Publication: BAnz AT 02.08.2023 B7, chapter I No. 3.1

Approved application

The tested AMS is suitable for use at plants according to Directive 2010/75/EC, chapter III (combustion plants / 13th BImSchV:2021), chapter IV (waste incineration plants / 17th BImSchV:2021), Directive 2015/2193/EC (44th BImSchV:2022), 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 twelve 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/D dated 31 January 2023 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 02.08.2023 B7, chapter I No. 3.1,
Announcement by UBA dated 05 July 2023:

AMS designation:

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

Manufacturer:

ABB AG, Frankfurt am Main, Germany

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	6 months
NO	0 - 150	0 - 5,000	mg/m ³	6 months
SO ₂	0 - 75	0 - 8,000	mg/m ³	6 months
CO ₂	0 - 20	-	Vol.-%	6 months
O ₂ electrochemical	0 - 25	-	Vol.-%	4 weeks
O ₂ paramagnetic	0 - 25	-	Vol.-%	4 weeks

* The maintenance interval is determined on the module configuration.

Software versions:

AMC Board: 3.9.8

Syscon III Board: 5.1.22

Restrictions:

None

Notes:

1. The maintenance interval must be determined depending on the module configuration.
2. The analyser 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 the electrochemical oxygen measuring cell from Limas21 UV.
4. The adjustment/calibration cells are not part of the performance test.

5. The performance test covers the following instrument variants:

Instrument variant	Uras-26 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 device indicates whether an AO2000-Magnos28 oxygen measuring cell or an electrochemical sensor is installed.

6. Supplementary test (maintenance interval extension) with regard to the announcement of the Federal Environment Agency (UBA) dated 21 February 2023 (BAnz AT 20.03.2023 B6, chapter I number 3.1).

Test institute: TÜV Rheinland Energy GmbH, Cologne
Report No.: 936/21247320/D dated 31 January 2023

Certified product

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

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, the 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: To measure the oxygen concentration, a Magnos28 or alternatively the electrochemical sensor of the Limas21 UV can be installed.

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: gal1.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
Publication: BAnz AT 20.03.2023 B6, chapter I number 3.1
UBA announcement dated 21 February 2023

Supplementary testing according to EN 15267

Certificate No. 0000081151_01: 05 September 2023
Expiry date of the certificate: 01 August 2028
Test report: 936/21247320/D dated 31 January 2023
TÜV Rheinland Energy GmbH
Publication: BAnz AT 02.08.2023 B7, chapter I number 3.1
UBA announcement dated 5 July 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	936/21247320/D TÜV Rheinland Energy
Date of report	2023-01-31

Measured component

Certification range	CO 0 - 75 mg/m ³
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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_{inf} 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	$u_{t,s}$ 1.256 mg/m ³	1.578	(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_b -0.058 mg/m ³	0.003	(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)

$$u_c = \sqrt{\sum (u_{max, j})^2} \quad 1.69 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 3.31 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 50 mg/m ³	6,6
U in % of the ELV 50 mg/m ³	10,0
U in % of the ELV 50 mg/m ³	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	NDIR

Test report

Test laboratory	936/21247320/D TÜV Rheinland Energy
Date of report	2023-01-31

Measured component

Certification range	CO ₂ 0 - 20 Vol.-%
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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	$u_{d,s}$	0,346 Vol.-%	0,120 (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_b	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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0,50 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0,97 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 20 Vol.-%	4,9
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.

Berechnung der Gesamtunsicherheit nach DIN EN 14181 und DIN EN 15267-3

Messeinrichtung

Hersteller	ABB AG
Bezeichnung der Messeinrichtung	AO2000-Uras26 CEM1235N
Seriennummer der Prüflinge	33728609/33728619
Messprinzip	NDIR

Prüfbericht

Prüfinstitut	936/21247320/D TÜV Rheinland Energy
Berichtsdatum	31.01.2023

Messkomponente

Zertifizierungsbereich ZB	NO 0 - 150 mg/m ³
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Bewertung der Querempfindlichkeiten (QE)

(System mit größter QE)

Summe positive QE am Null-Punkt	4.92 mg/m ³
Summe negative QE am Null-Punkt	-5.63 mg/m ³
Summe positive QE am Ref.-Punkt	4.61 mg/m ³
Summe negative QE am Ref.-Punkt	-2.00 mg/m ³
Maximale Summe von Querempfindlichkeiten	-5.63 mg/m ³
Messunsicherheit der Querempfindlichkeit	u_i -3.248 mg/m ³

Berechnung der erweiterten Messunsicherheit

Prüfgröße

Prüfgröße		u^2
Standardabweichung aus Doppelbestimmungen *	u_D 0.617 mg/m ³	0.381 (mg/m ³) ²
Linearität / Lack-of-fit	u_{lof} 0.580 mg/m ³	0.336 (mg/m ³) ²
Nullpunktdrift aus Feldtest	$u_{d,z}$ 0.606 mg/m ³	0.367 (mg/m ³) ²
Referenzpunktdrift aus Feldtest	$u_{d,s}$ 2.511 mg/m ³	6.305 (mg/m ³) ²
Einfluss der Umgebungstemperatur am Referenzpunkt	u_t 1.050 mg/m ³	1.103 (mg/m ³) ²
Einfluss der Netzspannung	u_v 0.656 mg/m ³	0.430 (mg/m ³) ²
Querempfindlichkeit	u_i -3.248 mg/m ³	10.550 (mg/m ³) ²
Einfluss des Probegasvolumenstrom	u_n 0.808 mg/m ³	0.653 (mg/m ³) ²
Unsicherheit des Referenzmaterials bei 70% des ZB	u_m 1.212 mg/m ³	1.470 (mg/m ³) ²

* Der größere der Werte wird verwendet:

"Wiederholstandardabweichung am Referenzpunkt" oder
"Standardabweichung aus Doppelbestimmungen"

Kombinierte Standardunsicherheit (u_c)

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

Erweiterte Unsicherheit

$$U = u_c * k = u_c * 1,96 \quad 9.11 \text{ mg/m}^3$$

Relative erweiterte Messunsicherheit

Anforderung nach 2010/75/EU

Anforderung nach DIN EN 15267-3

U in % vom Grenzwert 98 mg/m³ **9,3**

U in % vom Grenzwert 98 mg/m³ **20,0**

U in % vom Grenzwert 98 mg/m³ 15,0

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

Measuring system

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

Test report

Test laboratory	936/21247320/D TÜV Rheinland Energy
Date of report	2023-01-31

Measured component

Certification range	NO 0 - 150 mg/m ³
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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_{inf} 0.580 mg/m ³	0.336 (mg/m ³) ²
Span drift from field test	$u_{d,z}$ -0.606 mg/m ³	0.367 (mg/m ³) ²
Influence of ambient temperature at span	$u_{d,s}$ 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_n 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)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 4.23 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 8.29 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 98 mg/m ³	8,5
Requirement of 2010/75/EU	20,0
Requirement of EN 15267-3	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	TÜV Rheinland Energy
Date of report	2023-01-31

Measured component

Certification range	SO ₂ 0 - 75 mg/m ³
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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_{inf} -0.229 mg/m ³	0.052 (mg/m ³) ²
Span drift from field test	$u_{d,z}$ -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_v 0.265 mg/m ³	0.070 (mg/m ³) ²
Cross-sensitivity (interference)	u_i -1.585 mg/m ³	2.512 (mg/m ³) ²
Influence of sample gas flow	u_b 0.289 mg/m ³	0.084 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	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)	$u_c = \sqrt{\sum (u_{max, j})^2}$	2.34 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	4.59 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	9,2
Requirement of EN 15267-3	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	936/21247320/D
Date of report	TÜV Rheinland Energy
	2023-01-31

Measured component

Certification range	SO ₂	0 - 75 mg/m ³
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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_{inf} 0.143 mg/m ³	0.020 (mg/m ³) ²
Span drift from field test	$u_{t,z}$ -0.520 mg/m ³	0.270 (mg/m ³) ²
Influence of ambient temperature at span	$u_{t,s}$ -1.256 mg/m ³	1.578 (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_n -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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.35 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	4.62 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	9,2
Requirement of EN 15267-3	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 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.-%
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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_{inf}	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.