Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000059871_02

AMS designation:	Advance Optima AO2000 Series for CO, NO, N_2O, SO_2, O_2 und CO_2
Manufacturer:	ABB Automation GmbH Stierstädter Str. 5 60488 Frankfurt Germany
Test Laboratory:	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) and EN 14181 (2014).

Certification is awarded in respect of the conditions stated in this certificate (this certificate contains 20 pages).
The present certificate replaces certificate 2640853ts of 20 January 2017.

TÜVRheinland® CERTIFIED

Suitability Tested
EN 15267
QAL1 Certified
Regular Surveillance

www.tuv.com
ID 0000059871

Publication in the German Federal Gazette (BAnz) of 02 March 2012

This certificate will expire on:
01 March 2027

German Federal Environment Agency
Dessau, 16 February 2022

TÜV Rheinland Energy GmbH
Cologne, 15 February 2022

Dr. Marcel Langner
Head of Section II 4.1

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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 certificate D-PL-11120-02-00.

10/221 2 08

Test report:	1710933 of 30 September 2011
Initial certification:	02 March 2012
Expiry date:	01 March 2027
Certificate	Renewal (of previous certificate 2640853ts of 20 January 2017 valid until 01 March 2022)
Publication:	BAnz. 02 March 2012, no. 36, p. 920, chapter I number 4.2

Approved application
The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III (13th BImSchV), chapter IV (17th BImSchV), 30th BImSchV, plants in compliance with TA Luft, plants according to the 27th BImSchV and other plants requiring official approval. 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 incinerator.

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 limit values and oxygen concentrations relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the intended purpose.

Basis of the certification
This certification is based on:

- Test report 1710933 of 30 September 2011 by TÜV Süd Industrie Service 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. 02 March 2012, no. 36, p. 920, chapter I number 4.2, UBA announcement dated 23 February 2012:

AMS designation:
Advance Optima AO2000 Series for CO, NO, SO_2, N_2O, CO_2 und O_2

Manufacturer:
ABB Automation GmbH, Frankfurt am Main

Field of application:
For plants requiring official approval and for plants according to the 27th BImSchV

Measuring ranges during performance testing:

Component	Certification range	Supplementary measuring ranges		Unit
CO	0 - 75	0 - 300	0 - 4000	mg/m³
NO	0 - 200	0 - 1000	0 - 5000	mg/m³
NO Version (L)	0 - 100	0 - 200	-	mg/m³
SO_2	0 - 75	0 - 300	0 - 8000	mg/m³
N_2O	0 - 100	0 - 6700	-	mg/m³
CO_2	0 - 20	-	-	Vol.-%
O_2	0 - 25	0 - 10	-	Vol.-%

Software versions:
Central unit: 5.1.0
Analyser module: 3.3.0

Restrictions:
1. For the N_2O measurement in the certification range 0 100 mg/m³, the sum of the positive influences of interfering components (cross-sensitivity) exceeds 4% of the certification range for CO concentrations above 210 mg/m³. An internal correction using an additional CO measuring channel is possible, as necessary.
2. At N_2O concentrations above 75 mg/m³, the sum of the positive influences of interfering components in the measuring range 0 - 150 mg/m³ exceeds the permissible amount of 4% of this measuring range at the CO measuring channel of the system variant without filter cuvette. Use of the filter cuvette or an internal correction by means of an additional N_2O measuring channel is possible, as necessary.
3. The total uncertainty in the certification range at an emission limit value of 50 mg/m³ for the component CO cannot be fulfilled.
4. The total uncertainty in the certification range at an emission limit value of 50 mg/m³ NO_2 for the component NO cannot be fulfilled.

Notes:
1. The Advance Optima AO2000 series measuring systems are equipped with the Uras26 infrared measuring cell. They can be equipped with a paramagnetic oxygen measuring cell Magnos206 without an oxygen measuring cell or alternatively with an electrochemical oxygen measuring cell (sensor).

2. Modules with the measuring range NO(L) must always be equipped with an oxygen measurement cell.
3. Modules with a measurement range for SO_2 of 0 - 75 mg/m³ must always be equipped with an oxygen measurement cell.
4. If the analysers are operated with calibration cuvettes, their concentrations should be checked with test gases during the annual functional test.
5. The zero points for the oxygen measurement equipment should be tested in the annual function test with nitrogen.
6. Modules with the suffix (K) are equipped with a filter cuvette.
7. The maintenance interval is three months.
8. The performance test includes the following system variations:

Device Version	URAS 26 - Identifier	Component 1	Component 2	Component 3	Component 4
AO2020/2040	CEM1000 S3	CO			
AO2020/2040	CEM2000 S3	NO			
AO2020/2040	CEM2000L S3	NO(L)			
AO2020/2040	CEM4000 S3	N2O			
AO2020/2040	CEM1200 S3	CO	NO		
AO2020/2040	CEM1200L S3	CO	NO(L)		
AO2020/2040	CEM1500 S3	CO	CO2		
AO2020/2040	CEM1400 S3	CO	N2O		
AO2020/2040	CEM2300 S3	NO	SO2		
AO2020/2040	CEM2400 S3	NO	N2O		
AO2020/2040	CEM2500 S3	NO	CO2		
AO2020/2040	CEM2500L S3	NO(L)	CO2		
AO2020/2040	CEM4500 S3	N2O	CO2		
AO2020/2040	CEM1250 S3	CO	NO	CO2	
AO2020/2040	CEM1250L S3	CO	NO(L)	CO2	
AO2020/2040	CEM1230 S3	CO	SO2	NO	
AO2020/2040	CEM1230K S3	CO(K)	SO2(K)	NO	
AO2020/2040	CEM1230L S3	CO	SO2	NO(L)	
AO2020/2040	CEM1230KL S3	CO(K)	SO2(K)	NO(L)	
AO2020/2040	CEM1450 S3	CO	N2O	CO2	
AO2020/2040	CEM2350 S3	NO	SO2	CO2	
AO2020/2040	CEM2450 S3	NO	N2O	CO2	
AO2020/2040	CEM1235 S3	CO	SO2	NO	CO2
AO2020/2040	CEM1235K S3	CO(K)	SO2(K)	NO	CO2

Analysers with the designation S3 are equipped with the new system controller (Syscon board) in version 3.
An additional statement is provided as to whether an oxygen cell Magnos206 or an electrochemical sensor has been installed.

9. Supplementary test for transferring into the system of EN 15267 as regards notices of the Federal Environment Agency (UBA) of 3 August 2009 (BAnz. p. 2929, chapter I number 3.4) and of 10 January 2011 (BAnz. p. 294, Chapter IV, 27th notification).

Test Report:

TÜV Süd Industrie Service GmbH, Munich

Report no.: 1710933 of 30 September 2011

Publication in the German Federal Gazette: BAnz AT 20.07.2012 B11, chapter IV
28th notification, UBA announcement dated 06 July 2012:

28 Notification as regards Federal Environment Agency (UBA) notice of 23 February 2012 (BAnz. p. 920, chapter I number 4.2)

The current software version of the analyser module for the measuring systems of the AO2000 series manufactured by ABB Automation GmbH, Frankfurt, is 3.3.2.

The current software version of the central unit for the measuring systems of the AO2000 series manufactured by ABB Automation GmbH, Frankfurt, is 5.1.2.

Statement issued by TÜV Süd Industrie Service GmbH dated 16 March 2012

Publication in the German Federal Gazette: BAnz AT 23.07.2013 B4, chapter V 23rd notification, UBA announcement dated 03 July 2013:

23 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 06 July 2012 (BAnz AT 20.07.2012 B11, chapter IV, 28th notification)

The current software version of the central unit for the measuring systems of the AO2000 series manufactured by ABB Automation GmbH, Frankfurt, is 5.1.4.

Statement issued by TÜV Süd Industrie Service GmbH dated 17 March 2013

Publication in the German Federal Gazette: BAnz AT 01.04.2014 B12, chapter VI
1st notification, UBA announcement dated 27 February 2014:

1 Notification as regards Federal Environment Agency (UBA) notices of 12 September 2006 (BAnz. p. 6715, chapter I number 2.1) and of 02 March 2012 (BAnz. p. 920, chapter I number 4.2)

The analyser modules Uras26, Magnos206 and the electrochemical O_2 sensor as well as the electronic module of the Advance Optima AO2000 series manufactured by ABB Automation GmbH can be used in the following casing variations:

Casing / variation designation	Description
ST00	Electronic module (Syscon board 2+3)
S100	Uras 26 module
S1P0	Uras 26 module with O_2 sensor
S300	Magnos 206 module
ST10	Electronic module + Uras 26 module
ST1P	Electronic module + Uras 26 module with O_2 sensor
ST30	Electronic module + Magnos 206 module
S130	Uras 26 module + Magnos 206 module
UT00	Electronic module (in Syscon electronic cartridge, Syscon board 2+3)

Statement issued by TÜV Süd Industrie Service GmbH dated 30 September 2013, in conjunction with test report no. 1958844 by TÜV Süd Industrie Service GmbH dated 30 August 2013

Publication in the German Federal Gazette: BAnz AT 01.04.2014 B12, chapter VI
2nd notification, UBA announcement dated 27 February 2014:

2 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 03 July 2013 (BAnz AT 23.07.2013 B4, chapter V 23rd notification)

The current software version of the analyser module for the measuring systems of the AO2000 series manufactured by ABB Automation GmbH, Frankfurt, is 3.4.2.

Statement issued by TÜV Süd Industrie Service GmbH dated 30 September 2013

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter IV
38th notification, UBA announcement dated 25 February 2015:

38 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter VI 1st and 2nd notifcation)

The current software version of the analyser modules for the measuring systems of the AO2000 series manufactured by ABB Automation GmbH, Frankfurt, is 3.4.4.

Statement issued by TÜV Süd Industrie Service GmbH dated 18 September 2014

Publication in the German Federal Gazette: BAnz AT 15.03.2017 B6, chapter V
17th notification, UBA announcement dated 22 February 2017:

17 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter IV 38th notification)

The Advance Optima AO2000 series of measuring systems for the determination of CO, NO, SO_2, N_2O, CO_2 and O_2 manufactured by ABB Automation GmbH now has the digital interface Modbus (EIA485 and TCP/IP) according to VDI 4201 part 1 and part 3. The results of the tests are described in test report 936/21234720/A dated 4 October 2016 by TÜV Rheinland Energy GmbH.
The current software version of the system controller (Syscon) is 5.1.8.
The Syscon software version 5.1.7 can also be used.

Statement issued by TÜV Rheinland Energy GmbH dated 10 October 2016

Publication in the German Federal Gazette: BAnz AT 31.07.2017 B12, chapter II
7th notification, UBA announcement dated 13 July 2017:

7 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 22 February 2017 (BAnz AT 15.03.2017 B6, chapter V 17th notification)

The current software versions of the Advance Optima AO2000 series measuring systems for CO, NO, SO_2, N_2O, CO_2 and O_2 manufactured by ABB Automation GmbH are:
AMC board: 3.8.0
Syscon: 5.1.12.

The Impotron power supply type PSU-0261-12-14 may be used as 24V power supply.

Statement issued by TÜV Rheinland Energy GmbH dated 7 March 2017

Publication in the German Federal Gazette: BAnz AT 17.07.2018 B9, chapter III
9th notification, UBA announcement dated 03 July 2018:

9 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 13 July 2017 (BAnz AT 31.07.2017 B12, chapter II 7th notification)

The current software versions of the Advance Optima AO2000 series measuring systems for CO, NO, SO_2, N_2O, CO_2 and O_2 manufactured by ABB Automation GmbH are:
AMC board: 3.8.6
Syscon: 5.1.16

The software versions 3.8.2 and 3.8.4 for the AMC board and 5.1.14 for the Syscon are included.

Statement issued by TÜV Rheinland Energy GmbH dated 8 March 2018

Publication in the German Federal Gazette: BAnz AT 24.03.2020 B7, chapter IV
5th notification, UBA announcement dated 24 February 2020:

5 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 03 July 2018 (BAnz AT 17.07.2018 B9, chapter III 9th notification)

The latest software versions of the Advance Optima AO2000 series for CO, NO, SO_2, N_2O, CO_2, and O_2 manufactured by ABB Automation GmbH are:
AMC board: 3.9.0
Syscon: 5.1.18

Statement issued by TÜV Rheinland Energy GmbH dated 13 September 2019

Publication in the German Federal Gazette: BAnz AT 05.08.2021 B5, chapter IV
23rd notification, UBA announcement dated 29 June 2021:

23 Notification as regards Federal Environment Agency (UBA) notices of 23 February 2012 (BAnz. p. 920, chapter I number 4.2) and of 24 February 2020 (BAnz AT 24.03.2020 B7, chapter IV 5th notification)

The current software versions of the Advance Optima AO2000 series measuring systems for CO, NO, SO_2, N_2O, CO_2 and O_2 manufactured by ABB Automation GmbH are:
AMC board: 3.9.2
Syscon: 5.1.20

Statement issued by TÜV Rheinland Energy GmbH dated 19 February 2021

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

The entire tested measuring system of the Advance Optima AO2000 series consists of a sample gas probe, the heated sample gas line, the sample gas cooler, the sample gas delivery unit and the Advance Optima AO2000 multi-component analyser with up to four measurement channels.
For the measurement of CO, NO, SO_2, CO_2 and N_2O, the AMS works according to the principle of non-dispersive infrared absorption (NDIR method). To measure O_2, either an electrochemical sensor or a magneto mechanical oxygen measuring cell (Magnos206) is used.

The sample gas extraction consists of a stainless steel sampling pipe with a heated ceramic filter. A heated sample gas line equipped with a PTFE core (inner diameter 6 mm) is connected to the probe. After the heated line, the sample gas enters a compressor cooler via a solenoid valve (3-way valve). The sample gas delivery unit, with integrated rotameter with flow sensor for adjusting the sample gas flows and a fine filter is downstream of the cooler. After the gas delivery unit, the sample gas enters the analyser. The solenoid valve is used to connect zero and sample gases. The solenoid valve is used to readjust the zero points for the components CO, NO, SO_2, CO_2 and N_2O as well as the span point for O_2 using ambient air. This auto-calibration is controlled by the analyser.

The entire system consists of the following components:

Probe

Manufacturer:	ABB Automation GmbH, 60488 Frankfurt
Type:	PFE 2 with ceramic filter, heated

Heated sample hose / line

Manufacturer:	ABB Automation GmbH, 60488 Frankfurt
Heated temperature:	180 °C
Length:	25 m in the field test during performance testing
Diameter:	PTFE line with 6 mm Ø (inside)

Controller

Manufacturer:	Jumo GmbH & CO. KG

Compressor cooler

Manufacturer:	ABB Automation GmbH, 60488 Frankfurt
Type:	Advance SCC-C (2 gas channels)

Sample gas delivery unit

Manufacturer:	ABB Automation GmbH, 60488 Frankfurt
Type:	Advance SCC-F (2 gas channels)

Analysers

Manufacturer:	ABB Automation GmbH, 60488 Frankfurt	
System type:	Advance Optima A02000 in versions A02020 or A02040	
Software	Central unit:	5.1 4
	Analyser modules:	3.4 4

General remarks

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 manufacturing process for 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 document as well as the certification mark remains property of TÜV Rheinland Energy GmbH. Upon revocation of the publication the certificate loses its validity. After the expiration of the certificate and on request of TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must no longer be used.

The relevant version of this certificate and its expiration date are also accessible on the internet at **qal1.de**.

Document history

Certification of the Advance Optima AO2000 series measuring system is based on the documents listed below and the regular, continuous surveillance of the manufacturer's quality management system:

Basic testing

Test Report: 821029 of 30 June 2006
TÜV Süd Industrie Service GmbH
Publication: Banz. 14 October 2006, no. 194, p. 6715, chapter I number 2.1
UBA announcement dated 12 September 2006

Notifications

Statement issued by TÜV Süd Industrie Service GmbH dated 12 December 2006
Publication: Banz. 20 April 2007, no. 75, p.4139, chapter IV notification 4
UBA announcement dated 12 April 2007
(Software updates)

Statement issued by TÜV Süd Industrie Service GmbH dated 06 November 2007
Publication: BAnz. 07.03.2008, no. 38, p. 901, chapter IV notification 2
UBA announcement dated 14 February 2008
(Software updates)

Statement issued by TÜV Süd Industrie Service GmbH dated 29 February 2008
Publication: BAnz. 03 September 2008, no. 133, p. 3243, chapter IV notification 17
UBA announcement dated 12 August 2008
(Software updates)

Statement issued by TÜV Süd Industrie Service GmbH dated 20 October 2008
Publication: BAnz. 11 March 2009, no. 38, p. 899, chapter IV notification 15
UBA announcement dated 19 February 2009
(Software updates)

Supplementary testing

Test report: 1249694 of 30 March 2009
TÜV Süd Industrie Service GmbH
Publication: Banz. 25 August 2009, no. 125, p. 2929, chapter I number 3.4
UBA announcement dated 03 August 2009

Notifications
Statement issued by TÜV Süd Industrie Service GmbH dated 26 October 2009
Publication: BAnz. 12 February 2010, no. 24, p. 553, chapter IV notification 20
UBA announcement dated 25 January 2010:
(Software updates)

Statement issued by TÜV Süd Industrie Service GmbH dated 28 September 2010
Publication: BAnz. 26 January 2011, no. 14, p. 294, chapter IV notification 27
UBA announcement dated 10 January 2011:
(Design changes)

Initial certification according to EN 15267

Certificate no. 1710933ts: 02 March 2012
Expiry date of the certificate: 01 March 2017
Test report: 1710933 of 30 September 2011
TÜV Süd Industrie Service GmbH
Publication: BAnz. 02 March 2012, no. 36, p. 920, chapter I number 4.2
UBA announcement dated 23 February 2012

Notifications
Statement issued by TÜV Süd Industrie Service GmbH dated 16 March 2012
Publication: BAnz AT 20.07.2012 B11, chapter IV notification 28
UBA announcement dated 06 July 2012
(Software updates)

Statement issued by TÜV Süd Industrie Service GmbH dated 17 March 2013
Publication: BAnz AT 23.07.2013 B4, chapter V notification 23
UBA announcement dated 03 July 2013
(Software updates)

Statement issued by TÜV Süd Industrie Service GmbH dated 30 September 2013
Publication: BAnz AT 01.04.2014 B12, chapter VI notification 1
UBA announcement dated 27 February 2014
(Design changes)

Statement issued by TÜV Süd Industrie Service GmbH dated 30 September 2013
Publication: BAnz AT 01.04.2014 B12, chapter VI notification 2
UBA announcement dated 27 February 2014
(Software updates)

Statement issued by TÜV Süd Industrie Service GmbH dated 18 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 38
UBA announcement dated 25 February 2015
(Software updates)

Renewal of the certificate

Certificate no. 2640853ts: 20 January 2017
Expiry date of the certificate: 01 March 2022

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 10 October 2016
Publication: BAnz AT 15.03.2017 B6, chapter V notification 17
UBA announcement dated 22 February 2017
(Software modification and extension with digital interface - Modbus EIA485 and TCP/IP)

Statement issued by TÜV Rheinland Energy GmbH dated 07 March 2017
Publication: BAnz AT 31.07.2017 B12, chapter II notification 7
UBA announcement dated 13 July 2017
(Software updates)

Statement issued by TÜV Rheinland Energy GmbH dated 08 March 2018
Publication: BAnz AT 17.07.2018 B9, chapter III notification 9
UBA announcement dated 03 July 2018
(Software updates)

Statement issued by TÜV Rheinland Energy GmbH dated 13 September 2019
Publication: BAnz AT 24.03.2020 B7, chapter IV notification 5
UBA announcement dated 24 February 2020
(Software updates)

Statement issued by TÜV Rheinland Energy GmbH dated 19 February 2021
Publication: BAnz AT 05.08.2021 B5, chapter IV notification 23
UBA announcement dated 29 June 2021
(Software updates)

Renewal of the certificate

Certificate no. 0000059871_02: 16 February 2022
Expiry date of the certificate: 01 March 2027

Calculation of total uncertainty for QAL1 testing to DIN EN 14181 and DIN EN 15267-3

Total uncertainty for the measurement component CO in the measuring range 0 – 75 mg/m³

Performance Characteristic	Uncertainty	Value standard uncertainty (mg/m³)	Square of standard uncertainty (mg/m³)
Lack-of-fit	u_{lof}	-0,074	0,0055
Zero drift from field test	$u_{d,z}$	0,520	0,2704
Span drift from field test	$u_{d,s}$	-0,866	0,75
Influence of ambient temperature at span	u_t	0,749	0,561
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	0,281	0,079
Influence of supply voltage	u_v	0,132	0,0174
Cross-sensitivity (interference)	u_i	-1,039	1,0795
Repeatability standard deviation at span point	$u_r = s_r$	0,013	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	0,309	0,0955
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	1,050	1,1025
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	3,9608
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	1,9902	mg/m³
Total expanded uncertainty	$u_{0,95} = 1,96 \cdot u_c$	3,9008	mg/m³
Relative total expanded uncertainty	U	7,8	% ELV
Required measurement uncertainty according to EN 15267	(of ELV 50 mg/m³)	7,5	% ELV
Complied with requirement relating to the measurement uncertainty		no	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of ELV 50 mg/m³)	10	% ELV
Complied with requirement relating to the measurement uncertainty		yes	regarding 13. / 17. BImSchV

Total uncertainty for the measurement component NO in the measuring range 0 – 100 mg/m³

Performance Characteristic	Uncertainty	Value standard uncertainty (mg/m³)	Square of standard uncertainty (mg/m³)
Lack-of-fit	u_{lof}	0,133	0,0177
Zero drift from field test	$u_{d,z}$	-0,299	0,0894
Span drift from field test	$u_{d,s}$	1,155	1,334
Influence of ambient temperature at span	u_t	2,014	4,0562
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	0,294	0,0864
Influence of supply voltage	u_v	0,151	0,0228
Cross-sensitivity (interference)	u_i	-1,963	3,8534
Repeatability standard deviation at span point	$u_r = s_r$	0,035	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	0,944	0,8911
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	1,400	1,96
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	12,311
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	3,5087	mg/m³
Total expanded uncertainty	$u_{0,95} = 1,96 \cdot u_c$	6,8771	mg/m³
Relative total expanded uncertainty	U	21,1	% ELV
Required measurement uncertainty according to EN 15267	(of ELV 32,6 mg/m³)	15	% ELV
Complied with requirement relating to the measurement uncertainty		no	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of ELV 32,6 mg/m³)	20	% ELV
Complied with requirement relating to the measurement uncertainty		no	regarding 13. / 17. BImSchV

Total uncertainty for the measurement component SO_2 in the measuring range 0 – 75 mg/m³

Performance Characteristic	Uncertainty	Value standard uncertainty (mg/m³)	Square of standard uncertainty (mg/m³)
Lack-of-fit	u_{lof}	-0,087	0,0076
Zero drift from field test	$u_{d,z}$	0,260	0,0676
Span drift from field test	$u_{d,s}$	-1,169	1,3666
Influence of ambient temperature at span	u_t	1,123	1,2611
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	0,697	0,4858
Influence of supply voltage	u_v	0,313	0,098
Cross-sensitivity (interference)	u_i	1,689	2,8527
Repeatability standard deviation at span point	$u_r = s_r$	0,097	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	0,525	0,2756
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	1,050	1,1025
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	7,5175
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	2,7418	mg/m³
Total expanded uncertainty	$u_{0,95} = 1{,}96 \cdot u_c$	5,3739	mg/m³
Relative total expanded uncertainty	U	10,7	% ELV
Required measurement uncertainty according to EN 15267	(of ELV 50 mg/m³)	15	% ELV
Complied with requirement relating to the measurement uncertainty		yes	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of ELV 50 mg/m³)	20	% ELV
Complied with requirement relating to the measurement uncertainty		yes	regarding 13. / 17. BImSchV

Total uncertainty for the measurement component O_2 in the measuring range 0 – 25 Vol.-% (version with electrochemical oxygen cell)

Performance Characteristic	Uncertainty	Value standard uncertainty (Vol.-%)	Square of standard uncertainty (Vol.-%)
Lack-of-fit	u_{lof}	0,017	0,0003
Zero drift from field test	$u_{d,z}$	-0,060	0,0036
Span drift from field test	$u_{d,s}$	0,050	0,0025
Influence of ambient temperature at span	u_t	0,223	0,0497
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	0,035	0,0012
Influence of supply voltage	u_v	0,018	0,00030
Cross-sensitivity (interference)	u_i	0,058	0,0034
Repeatability standard deviation at span point	$u_r = s_r$	0,010	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	0,031	0,001
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	0,175	0,0306
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	0,0926
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	0,3043	Vol.-%
Total expanded uncertainty	$u_{0,95} = 1{,}96 \cdot u_c$	0,5964	Vol.-%
Relative total expanded uncertainty	U	2,4	% CR
Required measurement uncertainty according to EN 15267	(of CR 25 Vol.-%)	7,5	% CR
Complied with requirement relating to the measurement uncertainty		yes	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of CR 25 Vol.-%)	10	% CR
Complied with requirement relating to the measurement uncertainty		yes	regarding 13. / 17. BImSchV

Total uncertainty for the measurement component CO_2 in the measuring range 0 – 20 Vol.-%

Performance Characteristic	Uncertainty	Value standard uncertainty (Vol.-%)	Square of standard uncertainty (Vol.-%)
Lack-of-fit	u_{lof}	0,040	0,0016
Zero drift from field test	$u_{d,z}$	0,010	0,0001
Span drift from field test	$u_{d,s}$	-0,210	0,0441
Influence of ambient temperature at span	u_t	0,432	0,1866
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	-0,197	0,0388
Influence of supply voltage	u_v	0,007	0,0000
Cross-sensitivity (interference)	u_i	0,000	0,0000
Repeatability standard deviation at span point	$u_r = s_r$	0,010	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	0,031	0,001
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	0,140	0,0196
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	0,2918
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	0,5402	Vol.-%
Total expanded uncertainty	$u_{0,95} = 1,96 \cdot u_c$	1,0588	Vol.-%
Relative total expanded uncertainty	U	5,3	% CR
Required measurement uncertainty according to EN 15267	(of CR 25 Vol.-%)	7,5	% CR
Complied with requirement relating to the measurement uncertainty		yes	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of CR 25 Vol.-%)	10	% CR
Complied with requirement relating to the measurement uncertainty		yes	regarding 13. / 17. BImSchV

Total uncertainty for the measurement component NO in the measuring range 0 – 200 mg/m³

Performance Characteristic	Uncertainty	Value standard uncertainty (mg/m³)	Square of standard uncertainty (mg/m³)
Lack-of-fit	u_{lof}	0,831	0,6906
Zero drift from field test	$u_{d,z}$	0,346	0,1197
Span drift from field test	$u_{d,s}$	2,887	8,3348
Influence of ambient temperature at span	u_t	3,705	13,727
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	1,316	1,7319
Influence of supply voltage	u_v	0,338	0,1142
Cross-sensitivity (interference)	u_i	-2,310	5,3361
Repeatability standard deviation at span point	$u_r = s_r$	0,147	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	1,325	1,7556
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	2,800	7,84
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	39,6499
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	6,2968	mg/m³
Total expanded uncertainty	$u_{0,95} = 1{,}96 \cdot u_c$	12,3417	mg/m³
Relative total expanded uncertainty	U	9,5	% ELV
Required measurement uncertainty according to EN 15267	(of ELV 130,4 mg/m³)	15	% ELV
Complied with requirement relating to the measurement uncertainty		yes	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of ELV 130,4 mg/m³)	20	% ELV
Complied with requirement relating to the measurement uncertainty		yes	regarding 13. / 17. BImSchV

Total uncertainty for the measurement component N_2O in the measuring range 0 – 100 mg/m³

Performance Characteristic	Uncertainty	Value standard uncertainty (mg/m³)	Square of standard uncertainty (mg/m³)
Lack-of-fit	u_{lof}	0,064	0,0041
Zero drift from field test	$u_{d,z}$	-0,231	0,0534
Span drift from field test	$u_{d,s}$	1,328	1,7636
Influence of ambient temperature at span	u_t	0,741	0,5491
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	0,508	0,2581
Influence of supply voltage	u_v	0,060	0,0036
Cross-sensitivity (interference)	u_i	2,078	4,3181
Repeatability standard deviation at span point	$u_r = s_r$	0,083	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	0,650	0,4225
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	0,700	0,49
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	7,8625
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	2,804	mg/m³
Total expanded uncertainty	$u_{0,95} = 1,96 \cdot u_c$	5,4958	mg/m³
Relative total expanded uncertainty	U	5,5	% ELV
Required measurement uncertainty according to EN 15267	(of ELV 100 mg/m³)	15	% ELV
Complied with requirement relating to the measurement uncertainty		yes	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of ELV 100 mg/m³)	20	% ELV
Complied with requirement relating to the measurement uncertainty		yes	regarding 13. / 17. BImSchV

Total uncertainty for the measurement component O_2 in the measuring range 0 – 25 Vol.-% (version with magneto mechanical oxygen cell)

Performance Characteristic	Uncertainty	Value standard uncertainty (Vol.-%)	Square of standard uncertainty (Vol.-%)
Lack-of-fit	u_{lof}	0,017	0,0003
Zero drift from field test	$u_{d,z}$	-0,010	0,0001
Span drift from field test	$u_{d,s}$	0,030	0,0009
Influence of ambient temperature at span	u_t	0,047	0,0022
Influence of sample gas pressure	u_p		
Influence of sample gas flow	u_f	0,081	0,0066
Influence of supply voltage	u_v	0,014	0,00020
Cross-sensitivity (interference)	u_i	-0,060	0,0036
Repeatability standard deviation at span point	$u_r = s_r$	0,001	$u_r < u_d$
Standard deviation from paired measurements under field conditions	$u_d = s_d$	0,044	0,0019
Uncertainty of reference material 2 % at 70% of certification range	u_{rm}	0,175	0,0306
Excursion of measurement beam	u_{mb}		
Converter efficiency for AMS measuring NOx	u_{ce}		
Variation of response factors (TOC)	u_{rf}		
		total	0,0464
Combined standard uncertainty	$u_c = \sqrt{\sum (u_i)^2}$	0,2154	Vol.-%
Total expanded uncertainty	$u_{0,95} = 1{,}96 \cdot u_c$	0,4222	Vol.-%
Relative total expanded uncertainty	U	1,7	% CR
Required measurement uncertainty according to EN 15267	(of CR 25 Vol.-%)	7,5	% CR
Complied with requirement relating to the measurement uncertainty		yes	regarding EN 15256-3
Required measurement uncertainty according to 13./17. BImSchV	(of CR 25 Vol.-%)	10	% CR
Complied with requirement relating to the measurement uncertainty		yes	regarding 13. / 17. BImSchV