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Umwelt Bundesamt

Certificate number: 2640853-ts

TÜV SÜD Industrie Service

CERTIFICATE

on Product Conformity (QAL 1)

Certificate number: 2640853-ts

Certified AMS	Advance Optima AO2000 series for CO, NO, SO_2, N_2O, CO_2 and O_2
Manufacturer	ABB Automation GmbH Stierstädter Straße 5 60488 Frankfurt Germany

Test institute TÜV SÜD Industrie Service GmbH

This is to certify that the AMS was tested and certified subject to DIN EN 15267-1 (2009), DIN EN 15267-2 (2009), DIN EN 15267-3 (2008) and DIN EN 14181 (2004) standards

Certification applies to the conditions listed in this certificate (the certificate consists of 18 pages).

DIN EN 15267 TÜV SÜD Eignungsprüfung Valid until 03/2022 Produktion überwacht

Certificate No: 2640853-ts

Publication in the German Federal Gazette
dated 02nd March 2012

Certificate validity
until 01st March 2022

Umweltbundesamt
Dessau, 20th January 2017

Dr. Marcel Langner
Head of Section II 4.1

TÜV SÜD Industrie Service GmbH
Testing laboratory emission measurement/ calibration
Munich, 19th January 2017

Dr. Michael Waeber

TÜV®

Test report	1710933 from 30th September 2011
Initial certification	02nd March 2012
Certificate validity until	01st March 2022 (5 years)
Certificate	Renewed issue (previous certificate 1710833-ts from 2nd March 2012 valid until 1st March 2017)
Publication	BAnz 02nd March 2012, No. 36, page 920, chapter I, No. 4.2

Approved application

The AMS tested is suitable for use at plants according to Directive 2010/75/EU, chapter III (13th BImSchV), at waste incineration plants according to Directive 2010/75/EU, chapter IV (17th BImSchV), the 27. BImSchV and other plants requiring official approval. The suitability of the AMS for this application was assessed on the basis of a laboratory test and a field test over three months at a plant in compliance with the 17th BImSchV. The measuring system is authorized for the ambient temperature range from +5 °C to +40 °C.

The AMS publication, the suitability test and the performance of the uncertainty calculations were conducted based on the provisions valid at the time of testing. Due to possible amendments to legal foundations every user should ensure before use of the AMS that it is suitable for monitoring the applicable limit values.

The operator should consult the manufacturer to ensure that the AMS is suitable for the plant where it is being installed.

Certification basis

This certificate is based on:

- TÜV SÜD Industrie Service GmbH test report 1710933 from 30th march 2011
- Suitability publication by the Umweltbundesamt as responsible body
- Monitoring of the product and the manufacturing process
- Publication in the German Federal Gazette (BAnz 02nd March 2012, No. 36, page 920, chapter I, No. 4.2, UBA publication from 23th February 2012):

AMS: Advance Optima AO2000 series for CO, NO, SO_2, N_2O, CO_2 and O_2

Manufacturer: ABB Automation GmbH, Frankfurt am Main

Suitability: For plants requiring authorisation and plants in compliance with the 27th BImSchV

Measurement ranges in the suitability test:

Component	Certification range	Supplementary measurement range		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. The sum of positive influences of interferents (cross-sensitivity) exceeds 4 % of the certification range for CO concentrations above 210 mg/m³ when measuring N_2O in the certification range 0-100 mg/m³. An internal correction using an additional CO measurement channel is possible, as necessary.
2. The sum of positive influences of interferents in the measurement range 0 – 150 mg/m³ exceeds the maximum permissible upper limit of 4 % of this measurement range for N_2O-concentrations over 75 mg/m³ at the CO measurement channel of the module variation without filter cuvette. Use of the filter cuvette or an internal correction by means of an additional N_2O measurement channel is possible, as necessary.
3. The total uncertainty in the certification range at an emission limit value of 50 mg/m 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 AMS are equipped with the infrared measurement cell Uras26. They can be constructed without an oxygen measurement cell, with a paramagnetic oxygen measurement cell Magnos206 or alternatively with an electrochemical oxygen measurement cell (sensor).
2. Modules with the measurement range NO (L) must always be equipped with an oxygen measurement cell.
3. Modules with the measurement range for SO_2 from 0 - 75 mg/m³ must always be equipped with an oxygen measurement cell.

4. If the analysers are operated with gas-filled calibration cells, the concentrations in the analysers should be tested in the annual function test with test gases.

5. The zero points for the oxygen measurement equipment should be tested in the annual function test with nitrogen.

6. Modules with the supplement (K) are equipped with a filter cuvette.

7. The maintenance interval is three weeks.

8. The suitability test includes the following module variations

Module variations	Uras26 - identification	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**	N_2O			
AO2020/ 2040	**CEM1200 S3**	CO	NO		
AO2020/ 2040	**CEM1200L S3**	CO	NO(L)		
AO2020/ 2040	**CEM1500 S3**	CO	CO_2		
AO2020/ 2040	**CEM1400 S3**	CO	N_2O		
AO2020/ 2040	**CEM2300 S3**	NO	SO_2		
AO2020/ 2040	**CEM2400 S3**	NO	N_2O		
AO2020/ 2040	**CEM2500 S3**	NO	CO_2		
AO2020/ 2040	**CEM2500L S3**	NO(L)	CO_2		
AO2020/ 2040	**CEM4500 S3**	N_2O	CO_2		
AO2020/ 2040	**CEM1250 S3**	CO	NO	CO_2	
AO2020/ 2040	**CEM1250L S3**	CO	NO(L)	CO_2	
AO2020/ 2040	**CEM1230 S3**	CO	SO_2	NO	
AO2020/ 2040	**CEM1230K S3**	CO(K)	SO_2(K)	NO	
AO2020/ 2040	**CEM1230L S3**	CO	SO_2	NO(L)	
AO2020/ 2040	**CEM1230KL S3**	CO(K)	SO_2(K)	NO(L)	
AO2020/ 2040	**CEM1450 S3**	CO	N_2O	CO_2	
AO2020/ 2040	**CEM2350 S3**	NO	SO_2	CO_2	
AO2020/ 2040	**CEM2450 S3**	NO	N_2O	CO_2	
AO2020/ 2040	**CEM1235 S3**	CO	SO_2	NO	CO_2
AO2020/ 2040	**CEM1235K S3**	CO(K)	SO_2(K)	NO	CO_2

Analysers, which have an additional designation S3, have the equipment 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 transfer to the system DIN EN 15267 to the publications of the Umweltbundesamt from 3rd August 2009 (BAnz. S. 2929, chapter I, number 3.4) and from 10th January 2011 (BAnz. S. 294, chapter IV, 27. notification).

Test report: TÜV SÜD Industrie Service GmbH, Munich
Report-No.: 1710933 from 30th September 2011

- Publication in the German Federal Gazette (BAnz AT 20th July 2012 B11, chapter IV, notification 28, UBA publication from 06th July 2012):

28 Notification to the publication by the Umweltbundesamt from 23rd February 2012 (BAnz page 920, chapter I number 4.2)

The current software version for the analyser module of the AO2000 series AMS from ABB Automation GmbH, Frankfurt am Main, is 3.3.2.

The current software version for the central unit of the AO2000 series AMS from ABB Automation GmbH, Frankfurt am Main, is 5.1.2.

Statement from TÜV Süd Industrie Service GmbH from 16th March 2012

- Publication in the German Federal Gazette (BAnz AT 23rd July 2013 B4, chapter V, notification 23, UBA publication from 03rd July 2013):

23 Notification to the publication by the Umweltbundesamt from 23rd February 2012 (BAnz page 920, chapter I number 4.2) and from 12th February 2013 (BAnz AT 5th March 2013 B10, chapter IV notification 28)

The current software version for the central unit of the AO2000 series AMS from ABB Automation GmbH, Frankfurt am Main, is 5.1.4.

Statement from TÜV Süd Industrie Service GmbH from 17th March 2013

- Publication in the German Federal Gazette (BAnz AT 01st April 2014 B12, chapter VI, notification 1, UBA publication from 27th February 2014):

1 Notification to the publications by the Umweltbundesamt from 12th September 2006 (BAnz. page 6715, chapter I number 2.1) and from 2nd March 2012 (BAnz page 920, chapter I number 4.2)

The analyser modules Uras26, Magnos206 and the electrochemical O_2 sensor as well as the electronic module in the Advance Optima AO2000 series from 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	Magnos206 module
ST10	Electronic module + Uras 26 module
ST1P	Electronic module + Uras 26 module with O_2 sensor
ST30	Electronic module + Magnos206 module
S130	Uras 26 module + Magnos206 module
UT00	Electronic module (in Syscon electronic cartridge, Syscon board 2+3)

Statement from TÜV Süd Industrie Service GmbH from 30th September 2013, associated with report no. 1958844 from TÜV Süd Industrie Service GmbH from 30th August 2013

- Publication in the German Federal Gazette (BAnz AT 01st April 2014 B12, chapter VI, notification 2, UBA publication from 27th February 2014):

2 Notification to the publications by the Umweltbundesamt from 23rd February 2012 (BAnz. page 920, chapter I number 4.2) and from 3rd July 2013 (BAnz AT 23rd July 2013 B4, chapter V notification 23)

The current software version for the analyser module in the AO2000 series AMS from ABB Automation GmbH, Frankfurt am Main, is 3.4.2.

Statement from TÜV Süd Industrie Service GmbH from 30th September 2013

- Publication in the German Federal Gazette (BAnz AT 02.04.2015 B5, chapter IV, notification 38, UBA publication from 25th February 2015):

38 Notification to the publications by the Umweltbundesamt from 23rd February 2012 (BAnz. page 920, chapter number 4.2) and from 27th February 2014 (BAnz AT 01st April 2014 B12, chapter VI 1. and 2. notification)

The current software version for the analyser module in the AO2000 series AMS from ABB Automation GmbH, Frankfurt am Main, is 3.4.4.

Statement from TÜV Süd Industrie Service GmbH from 18th September 2014

Certified product

The certificate applies to AMS that comply with the following description:

The entire tested Advance Optima AO2000 series AMS consists of the sample gas extraction probe, heated sample hose, measurement gas cooler, measurement gas feeder unit and multi-component analyser Advance Optima AO2000 with up to four measurement channels. For CO, NO, SO_2, CO_2 and N_2O measurement the AMS measures to the principle of Non-Dispersive-Infrared-Absorption (NDIR). For O_2 measurement alternatively an electrochemical sensor or a magneto mechanical oxygen measurement cell (Magnos206) could be used.

The sample gas extraction system consists of a stainless steel extraction pipe with a heated ceramic filter. A sample hose, equipped with a PTFE core (inner diameter 6 mm). After the heated hose the sample gas passes to a compressor cooler by means of a magnetic three-way valve. The sample pump with integrated rotameter and flow-sensor for setting the sample gas flow and a fine filter is situated downstream of the cooler. After the sample pump, the sample gas passes into the analyser. The magnetic valve is used to connect zero and span gases. Zero points for the components CO, NO, SO_2, CO_2 and N_2O and span point for O_2 are realigned with ambient air via the magnetic valve. This auto calibration is controlled by the analyser.

The entire system consists of the following components:

Probe	
Manufacturer:	ABB Automation GmbH, D – 60488 Frankfurt
Type:	PFE 2 with ceramic filter, heated
Heated sample hose	
Manufacturer:	ABB Automation GmbH, D – 60488 Frankfurt
Heated temperature:	180 °C
Length:	25 m in the suitability tests
Diameter:	PTFE-hose with a diameter of 6 mm
Controller	
Manufacturer:	Jumo GmbH & Co. KG
Compressor cooler	
Manufacturer:	ABB Automation GmbH, D – 60488 Frankfurt
Type:	Advance SCC-C (2 gas channels)
Sample pump	
Manufacturer:	ABB Automation GmbH, D – 60488 Frankfurt
Type:	Advance SCC-F (2 gas channels)
Analyser	
Manufacturer:	ABB Automation GmbH, D – 60488 Frankfurt
System type:	Advance Optima AO2000, versions AO2020 or AO2040
Software:	Central unit: 5.1.4
	Analyser module: 3.4.4

General notes

This certificate is based on the analyser tested. The manufacturer is responsible for the continuous compliance of the production to the DIN EN 15267 requirements. The manufacturer is obliged to maintain a tested quality management system to control the manufacture of the certified product. Regular monitoring must be conducted on both the product and the quality management systems.

Should the product from the current production series no longer comply with the certified product, the Environmental Service Department of TÜV SÜD Industrie Service GmbH should be informed (address see footnote).

The certification mark, which appears on the certified product or is used in advertising materials, is presented on page 1 of this certificate.

This document and the certification mark shall remain the property of TÜV SÜD Industrie Service GmbH.

Should the publication be revoked, this certificate will become invalid. This document must be returned when the period of validity has elapsed and at the request of TÜV SÜD Industrie Service GmbH and the certification mark may no longer be used.

The current version of the certificate and its validity can also be viewed on the internet page: **qal1.de**.

The certification of the modular measuring system Advance Optima AO2000 is based on the following documents and the regular continuous monitoring of the manufacturer's quality management system:

Initial test:

Test report: 821029 from 30th June 2006
TÜV SÜD Industrie Service GmbH
Publication: BAnz 14th October 2006, number 194, page 6715, chapter number 2.1
UBA publication from 12th September 2006

1. Supplementary test:

Test report: 1249694 from 30th March 2009
TÜV SÜD Industrie Service GmbH
Publication: BAnz 25th August 2009, number 125, page 2929, chapter I number 3.4
UBA publication from 03rd August 2009

Notifications:

Statement from TÜV Süd Industrie Service GmbH from 12th December 2006
Publication: BAnz 20th April 2007, number 75, page 4139, chapter IV notification 4
UBA publication from 12th April 2007 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 06th November 2007
Publication: BAnz 07th March 2008, number 38, page 901, chapter IV notification 2
UBA publication from 14th February 2008 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 29th February 2008
Publication: BAnz 03rd September 2008, number 133, page 3242, chapter IV notification 17
UBA publication from 12th August 2008 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 20th October 2008
Publication: BAnz 11th March 2009, number 38, page 899, chapter IV notification 15
UBA publication from 19th February 2009 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 26th October 2009
Publication: BAnz 12th February 2010, number 24, page 552, chapter IV notification 20
UBA publication from 25th January 2010 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 28th September 2010
Publication: BAnz 26th January 2011, number 14, page 294, chapter IV notification 27
UBA publication from 10th January 2011 (design modification)

Initial certification according to DIN EN 15267:

Certificate no. 1710933-ts	02nd March 2012
Certificate validity until	01st March 2017 (5 years)

Report no.: 1710933 from 30.09.2011
TÜV SÜD Industrie Service GmbH
Publication: BAnz 02nd March 2012, number 36, page 920, chapter I number 4.2
UBA publication from 23rd February 2012

Notifications:

Statement from TÜV Süd Industrie Service GmbH from 16th March 2012
Publication: BAnz AT 20th July 2012 B11, chapter IV, notification 28
UBA publication from 06th July 2012 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 17th March 2013
Publication: BAnz AT 23rd July 2013 B4, chapter V, notification 23
UBA publication from 03rd July 2013 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 30th September 2013
Publication: BAnz AT 01st April 2014 B12, chapter VI, notification 1
UBA publication from 27th February 2014 (software modification)

Statement from TÜV Süd Industrie Service GmbH from 30th September 2013
Publication: BAnz AT 01st April 2014 B12, chapter VI, notification 2
UBA publication from 27th February 2014 (software modification)

Umwelt Bundesamt

Certificate number: 2640853-ts

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Statement from TÜV Süd Industrie Service GmbH from 18th September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV, notification 38
UBA publication from 25th February 2015 (software modification)

Renewed issue of the certificate:

Certificate no. 2640853-ts	02nd March 2017
Certificate validity until	01st March 2022 (5 years)

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)²*
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	$u_r = s_r$	0,013	ur < ud
Standard deviation from paired measurements under field cond.	$u_d = s_d$	0,309	0,0955
Uncertainty of reference material 2 % by 70% of ZR	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	$U_{0,95} = 1,96 \times u_c$	3,9008	mg/m³
Relativ expanded uncertainty	U	7,8	% ELV
Permissible uncertainty of EN 15267-3	(of ELV 50 mg/m³)	7,5	% ELV
Complied with requirements relating to the measurement uncertainty		no	regarding EN 15267-3
Permissible uncertainty 13. / 17. BImSchV	(of ELV 50 mg/m³)	10	% ELV
Complied with requirements 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 uncertaintymg/m³*	*Square of standard uncertainty (mg/m³)²*
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	$u_r = s_r$	0,035	ur < ud
Standard deviation from paired measurements under field cond.	$u_d = s_d$	0,944	0,8911
Uncertainty of reference material 2 % by 70% of ZR	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	$U_{0,95} = 1,96 \times u_c$	6,8771	mg/m³
Relativ expanded uncertainty	U	**21,1**	% ELV
Permissible uncertainty of EN 15267-3	(of ELV 32,6 mg/m³)	**15**	% ELV
Complied with requirements relating to the measurement uncertainty		**no**	regarding EN 15267-3
Permissible uncertainty 13. / 17. BImSchV	(of ELV 32,6 mg/m³)	**20**	% ELV
Complied with requirements 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 uncertaintymg/m³*	*Square of standard uncertainty (mg/m³)²*
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	$u_r = s_r$	0,097	ur < ud
Standard deviation from paired measurements under field cond.	$u_d = s_d$	0,525	0,2756
Uncertainty of reference material 2 % by 70% of ZR	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	$U_{0,95} = 1,96 \times u_c$	5,3739	mg/m³
Relativ expanded uncertainty	U	**10,7**	% ELV
Permissible uncertainty of EN 15267-3	(of ELV 50 mg/m³)	**15**	% ELV
Complied with requirements relating to the measurement uncertainty		**yes**	regarding EN 15267-3
Permissible uncertainty 13. / 17. BImSchV	(of ELV 50 mg/m³)	**20**	% ELV
Complied with requirements 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 uncertaintyVol.%*	*Square of standard uncertainty (Vol.%)²*
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	$u_r = s_r$	0,010	ur < ud
Standard deviation from paired measurements under field cond.	$u_d = s_d$	0,031	0,001
Uncertainty of reference material 1 % by 70% of ZR	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	$U_{0,95} = 1,96 \times u_c$	0,5964	Vol.%
Relativ expanded uncertainty	U	2,4	% 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

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

Performance characteristic	*Uncertainty*	*Value standard uncertaintyVol.-%*	*Square of standard uncertainty (Vol.-%)²*
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	$u_r = s_r$	0,010	ur < ud
Standard deviation from paired measurements under field cond.	$u_d = s_d$	0,031	0,001
Uncertainty of reference material 2 % by 70% of ZR	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	$U_{0,95} = 1,96 \times u_c$	1,0588	Vol.-%
Relativ expanded uncertainty	U	5,3	% ZR
Permissible uncertainty of EN 15267-3	(of ZR 20 Vol.-%)	7,5	% ZR
Complied with requirements relating to the measurement uncertainty		yes	regarding EN 15267-3
Permissible uncertainty 13. / 17. BImSchV	(of ZR 20 Vol.-%)	10	% ZR
Complied with requirements 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 uncertaintymg/m³*	*Square of standard uncertainty (mg/m³)²*
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	$u_r = s_r$	0,147	ur < ud
Standard deviation from paired measurements under field cond.	$u_d = s_d$	1,325	1,7556
Uncertainty of reference material 2 % by 70% of ZR	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	$U_{0,95} = 1,96 \times u_c$	12,3417	mg/m³
Relativ expanded uncertainty	U	9,5	% ELV
Permissible uncertainty of EN 15267-3	(of ELV 130,4 mg/m³)	15	% ELV
Complied with requirements relating to the measurement uncertainty		yes	regarding EN 15267-3
Permissible uncertainty 13. / 17. BImSchV	(of ELV 130,4 mg/m³)	20	% ELV
Complied with requirements 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 uncertaintymg/m³*	*Square of standard uncertainty (mg/m³)²*
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	$u_r = s_r$	0,083	ur < ud
Standard deviation from paired measurements under field cond.	$u_d = s_d$	0,650	0,4225
Uncertainty of reference material 1 % by 70% of ZR	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	$U_{0,95} = 1,96 \times u_c$	5,4958	mg/m³
Relativ expanded uncertainty	U	5,5	% ELV
Permissible uncertainty of EN 15267-3	(of ELV 100 mg/m³)	15,0	% ELV
Complied with requirements relating to the measurement uncertainty		yes	regarding EN 15267-3
Permissible uncertainty 13. / 17. BImSchV	(of ELV 100 mg/m³)	20	% ELV
Complied with requirements 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)

Verfahrenskenngröße	*Unsicherheit*	*Wert der Standardunsicherheit in Vol.%*	*Quadrat der Standardunsicherheit in (Vol.%)²*
Lack-of-fit	u_{lof}	0,017	0,0003
Nullpunktdrift	$u_{d,z}$	-0,010	0,0001
Referenzpunktdrift	$u_{d,s}$	0,030	0,0009
Einfluss der Umgebungstemperatur am Referenzpunkt	u_t	0,047	0,0022
Einfluss des Probegasdruckes	u_p		
Einfluss des Probegasvolumenstroms	u_f	0,081	0,0066
Einfluss der Netzspannung	u_v	0,014	0,00020
Querempfindlichkeit	u_i	-0,060	0,0036
Wiederholstandardabweichung am Referenzpunkt	$u_r = s_r$	0,001	ur < ud
Standardabweichung aus Doppelbestimmungen	$u_d = s_d$	0,044	0,0019
Unsicherheit des Prüfgases 1 % bei 70% vom ZB	u_{rm}	0,175	0,0306
Auswander des Messlichtstrahls	u_{mb}		
Konverterwirkungsgrad bei NOx	u_{ce}		
Änderung der Responsfaktoren (TOC)	u_{rf}		
		Summe	0,0464
Kombinierte Standardunsicherheit	$u_c = \sqrt{\sum (u_i)^2}$	0,2154	Vol.%
Erweiterte Unsicherheit	$U_{0,95} = 1,96 \times u_c$	0,4222	Vol.%
Relative erweiterte Unsicherheit	U	**1,7**	% ZB
Geforderte Messunsicherheit nach EN 15267-3	(bei ZB 25 Vol.%)	**7,5**	% ZB
Anforderung bezüglich der Messunsicherheit eingehalten		**ja**	bezüglich EN 15267-3
Geforderte Messunsicherheit 13. / 17. BImSchV	(bei ZB 25 Vol.%)	**10**	% ZB
Anforderung bezüglich der Messunsicherheit eingehalten		**ja**	bezüglich 13. / 17. BImSchV