

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000025929_04

Certified AMS: MCA 04 for N₂O, NO₂, H₂O, HCl, CO, NO, SO₂ and O₂

Manufacturer: Dr. Födisch Umweltmesstechnik AG
Zwenkauer Straße 159
04420 Markranstädt
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)
and EN 14181 (2004).**

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 14 pages).
The present certificate replaces certificate 0000025929_03 of 02 February 2015.



Suitability Tested
EN 15267
QAL1 Certified
Regular Surveillance

www.tuv.com
ID 0000025929

Publication in the German Federal Gazette
(BAnz.) of 05 August 2014

German Federal Environment Agency
Dessau, 12 February 2020

Dr. Marcel Langner
Head of Section II 4.1

This certificate will expire on:
11 February 2025

TÜV Rheinland Energy GmbH
Cologne, 11 February 2020

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Test institute accredited to EN ISO/IEC 17025:2005 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.

Certificate:
0000025929_04 / 12 February 2020

Test report: 936/2122199/B of 3 April 2014
Initial certification: 12 February 2010
Expiry date: 11 February 2025
Certificate: renewal (previous 0000025929_03 dated 02 February 2015
with validity up to the 11 February 2020)
Publication: BAnz AT 05.08.2014 B11, chapter I no. 4.5

Approved application

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III, at waste incineration plants according to Directive 2010/75/EU, chapter IV and other plants requiring official approval. The measured ranges have been selected considering the wide application range of the AMS.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and of several field tests. A six-month field test has been performed at a municipal waste incineration plant and a six-month field test has been performed at a nitric acid plant. Also findings of investigations at a further municipal waste incineration plant and at a combustion plant for industrial residues have been used for the assessment of the emission monitoring system.

The AMS is approved for an ambient temperature range of +5 °C to +40 °C.

The notification of suitability of the AMS, performance testing, and the uncertainty calculation have been effected on the basis of the regulations valid at the time of performance testing. As changes in legal regulations are possible, any potential user should ensure that this AMS is suitable for monitoring the limit values relevant to the application.

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

Basis of the certification

This certification is based on:

- test report 936/2122199/B of 3 April 2014 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- the ongoing surveillance of the product and the manufacturing process

Publication in the German Federal Gazette: BAnz AT 05.08.2014 B11, chapter I number 4.5, Announcement by UBA from 17 July 2014:

AMS designation:

MCA 04 for N₂O, NO₂, H₂O, HCl, CO, NO, SO₂ and O₂

Manufacturer:

Dr. Födisch Umweltmesstechnik AG, Markranstädt

Field of application:

For measurements at plants requiring official approval (e.g. Directive 2010/75/EU on industrial emissions, chapters III and IV)

Measuring ranges during the performance test:

Components	Certification ranges	Supplementary ranges	Unit
H ₂ O	0 - 40	-	Vol.-%
HCl	0 - 15	0 - 90	mg/m ³
CO	0 - 75	0 - 300	mg/m ³
NO	0 - 200	0 - 395	mg/m ³
SO ₂	0 - 75	0 - 300	mg/m ³
O ₂	0 - 25	-	Vol.-%
N ₂ O	0 - 50	0 - 1000	mg/m ³
NO ₂	0 - 50	0 - 1000	mg/m ³

Software version:

MC3 Firmware V 1.83

Restrictions:

1. For SO₂ in the measuring range 0 - 75 mg/m³ the minimum requirements for the cross-sensitivity of CH₄ concentrations > 30 mg/m³ are not fulfilled.
2. The measuring system is not suitable for monitoring the component HCl at plants with NO₂-concentrations > 10 mg/m³ and N₂O concentrations > 20 mg/m³.
3. The component CO₂ is not tested for suitability in accordance with EN 15267-3. Nevertheless, it must be used in the measuring system for the purpose of interference compensation and it shall be maintained as described in the manual.
4. Requirements with regard to the determination coefficient R² in accordance with EN 15267-3 were not satisfied for the component HCl during performance testing.

Notes:

1. The measuring system uses wet sample gas.
2. The maintenance interval is three months.
3. Supplementary testing (transition to EN 15267) as regards Federal Environmental Agency notices of 28 July 2010 (BAnz p. 2597, chapter I no. 1.1) and of 12 February 2013 (BAnz AT 05.03.2013 B10, chapter V, notification 27).

Test report:

TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/2122199/B of 3 April 2014

Certified product

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

The MCA 04 multi component gas analyser is a measuring system for the continuous measurement of gas components in waste gases. It can measure up to eight components quasi-simultaneously.

The optical bench for measuring the infrared-active components consists of an infrared source with a chopper, a test cell, a rotating filter disk and a detector.

For the measurement of the infrared-active components two different measuring principles are used:

- bi-frequency method (SO₂, H₂O, NO₂) and
- gas filter correlation (CO, NO, HCl, N₂O)

For the measurement of the oxygen content in the sample gas an extractive zirconium dioxide cell is used.

The MCA 04 analyser system consists of a temperature-controlled, vented steel cabinet with partial pivoting frame and a clear door. The complete electrical equipment/electronics (electric feeding, power distribution, signal processing and SPS) as well as the gas treatment system are mounted on the mounting board and on further assembly rails.

The tested AMS consists of the following single components:

- sampling probe SP 2000 H with heated filter element
- heated sample gas line (length during supplementary testing: 15 m)
- analyser cabinet MCA 04
- software MC3 Firmware V 1.83.

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 MCA 04 is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

First performance test

Test report: 936/21203173/A of 13 July 2005
TÜV Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 29 October 2005, no. 206, p. 15700, chapter I no. 2.2
UBA announcement of 25 July 2005

Supplementary testing

Test report: 936/21203173/B of 23 December 2005
TÜV Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 8 April 2006, no. 70, p. 2653, chapter I no. 3.4
UBA announcement of 21 February 2006

Initial certification according to EN 15267*

Certificate No. 0000025929_00: 12 February 2010
Expiry date of the certificate: 11 February 2015
Test report 936/21211571/A dated 28 October 2009
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 12 February 2010, No. 24, p. 553, chapter I no. 1.4
Announcement by UBA dated 25 January 2010

Supplementary testing according to EN 15267

Certificate No. 0000025929_01: 28 July 2010
Expiry date of the certificate: 11 February 2015
Test report 936/21211571/B dated 25 March 2009
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 28 July 2010, no. 111, p. 2597, chapter I no. 1.1
Announcement by UBA dated 12 July 2010

Notifications according to EN 15267

Statement of TÜV Rheinland Energy GmbH dated 11 October 2012
Publication: BAnz AT 05.03.2013 B10, chapter V notification 27
Announcement by UBA dated 12 February 2013
(new enclosure)

Supplementary testing according to EN 15267**

Certificate No. 0000025929_02: 09 September 2014
Expiry date of the certificate: 11 February 2015
Test report 936/21221599/B dated 03 April 2014
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 05.04.2014 B11, chapter I no. 4.5
Announcement by UBA dated 17 July 2014

* Only the components N₂O and NO₂ were tested and certified.

** Testing and certification for the components CO, NO, SO₂, NO₂, N₂O, HCl, H₂O and O₂.

Renewal of the certificate

Certificate No .0000025929_03: 02 February 2015
Expiry date of the certificate: 11 February 2020 11 February 2025

Renewal of the certificate

Certificate No. 0000025929_04: 12 February 2020
Expiry date of the certificate: 11 February 2025

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

Measuring system

Manufacturer	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	150 / 152 / 128 / 116 / 355 / 368 / 155 / 154
Measuring principle	gas filter correlation

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

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	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.30 mg/m ³
Sum of negative CS at span point	-2.40 mg/m ³
Maximum sum of cross-sensitivities	-2.40 mg/m ³
Uncertainty of cross-sensitivity	-1.386 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.467 mg/m ³	0.218 (mg/m ³) ²
Lack of fit	u_{lof}	-0.389 mg/m ³	0.151 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	0.090 mg/m ³	0.008 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	-0.690 mg/m ³	0.476 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.603 mg/m ³	0.364 (mg/m ³) ²
Influence of supply voltage	u_v	0.337 mg/m ³	0.114 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-1.386 mg/m ³	1.920 (mg/m ³) ²
Influence of sample gas flow	u_p	-0.298 mg/m ³	0.089 (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 span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.93 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.77 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	7.5
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	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	150 / 152 / 128 / 116 / 355 / 368 / 155 / 154
Measuring principle	bi-frequency method

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

Measured component

Certification range	H ₂ O	0 - 40 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	0.40	Vol.-%
Sum of negative CS at span point	0.00	Vol.-%
Maximum sum of cross-sensitivities	0.40	Vol.-%
Uncertainty of cross-sensitivity	0.231	Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u^2
Repeatability standard deviation at set point *	u_r	0.129	Vol.-%	0.017 (Vol.-%) ²
Lack of fit	u_{lof}	0.208	Vol.-%	0.043 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$	0.000	Vol.-%	0.000 (Vol.-%) ²
Span drift from field test	$u_{d,s}$	0.180	Vol.-%	0.032 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.252	Vol.-%	0.064 (Vol.-%) ²
Influence of supply voltage	u_v	0.114	Vol.-%	0.013 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	0.231	Vol.-%	0.053 (Vol.-%) ²
Influence of sample gas flow	u_p	-0.226	Vol.-%	0.051 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u_{mm}	0.323	Vol.-%	0.105 (Vol.-%) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.61	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.20	Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 40 Vol.-%	3.0
Requirement of EN 15267-3	U in % of the range 40 Vol.-%	10.0 **
	U in % of the range 40 Vol.-%	7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
The value used was 10 %.

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

Measuring system

Manufacturer	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	150 / 152 / 128 / 116 / 355 / 368 / 155 / 154
Measuring principle	gas filter correlation

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

Measured component

Certification range	HCl	0 - 15 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.24 mg/m ³
Sum of negative CS at zero point	-0.60 mg/m ³
Sum of positive CS at span point	0.46 mg/m ³
Sum of negative CS at span point	-0.59 mg/m ³
Maximum sum of cross-sensitivities	-0.60 mg/m ³
Uncertainty of cross-sensitivity	-0.346 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.239 mg/m ³	0.057 (mg/m ³) ²
Lack of fit	u_{lof}	-0.167 mg/m ³	0.028 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	-0.160 mg/m ³	0.026 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.250 mg/m ³	0.063 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.289 mg/m ³	0.084 (mg/m ³) ²
Influence of supply voltage	u_v	0.097 mg/m ³	0.009 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-0.346 mg/m ³	0.119 (mg/m ³) ²
Influence of sample gas flow	u_p	-0.083 mg/m ³	0.007 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{m}	0.121 mg/m ³	0.015 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.64 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.25 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 10 mg/m³	12.5
Requirement of EN 15267-3	U in % of the ELV 10 mg/m³	40.0
	U in % of the ELV 10 mg/m³	30.0

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

Measuring system

Manufacturer	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	355 / 368
Measuring principle	bi-frequency method

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

Measured component

Certification range	N ₂ O	0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	-1.74 mg/m ³
Sum of positive CS at span point	1.40 mg/m ³
Sum of negative CS at span point	-0.70 mg/m ³
Maximum sum of cross-sensitivities	-1.74 mg/m ³
Uncertainty of cross-sensitivity	1.005 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	2.746 mg/m ³	7.541 (mg/m ³) ²
Lack of fit	u _{lof}	-0.115 mg/m ³	0.013 (mg/m ³) ²
Zero drift from field test	u _{d,z}	0.400 mg/m ³	0.160 (mg/m ³) ²
Span drift from field test	u _{d,s}	0.580 mg/m ³	0.336 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.361 mg/m ³	0.130 (mg/m ³) ²
Influence of supply voltage	u _v	0.276 mg/m ³	0.076 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	1.005 mg/m ³	1.010 (mg/m ³) ²
Influence of sample gas flow	u _p	-0.066 mg/m ³	0.004 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.404 mg/m ³	0.163 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	3.07 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	6.02 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 50 mg/m³	12.0
Requirement of EN 15267-3	U in % of the range 50 mg/m³	20.0 **
	U in % of the range 50 mg/m³	15.0

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
The value used was 20 %.

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

Measuring system

Manufacturer	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	150 / 152 / 128 / 116 / 355 / 368 / 155 / 154
Measuring principle	gas filter correlation

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

Measured component

Certification range	NO	0 - 200 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	3.76 mg/m ³
Sum of negative CS at zero point	-6.26 mg/m ³
Sum of positive CS at span point	4.70 mg/m ³
Sum of negative CS at span point	-7.90 mg/m ³
Maximum sum of cross-sensitivities	-7.90 mg/m ³
Uncertainty of cross-sensitivity	-4.561 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	1.925 mg/m ³	3.706 (mg/m ³) ²
Lack of fit	u_{lof}	0.346 mg/m ³	0.120 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	0.580 mg/m ³	0.336 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	1.390 mg/m ³	1.932 (mg/m ³) ²
Influence of ambient temperature at span	u_t	1.258 mg/m ³	1.583 (mg/m ³) ²
Influence of supply voltage	u_v	0.473 mg/m ³	0.224 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-4.561 mg/m ³	20.803 (mg/m ³) ²
Influence of sample gas flow	u_p	1.155 mg/m ³	1.334 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_m	1.617 mg/m ³	2.613 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 5.71 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 11.20 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 98 mg/m³ 11.4

Requirement of 2010/75/EU

U in % of the ELV 98 mg/m³ 20.0

Requirement of EN 15267-3

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	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	355 / 368
Measuring principle	bi-frequency method

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

Measured component

Certification range	NO ₂	0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	1.66 mg/m ³
Sum of negative CS at zero point	-0.21 mg/m ³
Sum of positive CS at span point	1.75 mg/m ³
Sum of negative CS at span point	-0.65 mg/m ³
Maximum sum of cross-sensitivities	1.75 mg/m ³
Uncertainty of cross-sensitivity	1.010 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	0.078 mg/m ³	0.006 (mg/m ³) ²
Lack of fit	u _{lof}	0.520 mg/m ³	0.270 (mg/m ³) ²
Zero drift from field test	u _{d,z}	-0.120 mg/m ³	0.014 (mg/m ³) ²
Span drift from field test	u _{d,s}	0.070 mg/m ³	0.005 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.208 mg/m ³	0.043 (mg/m ³) ²
Influence of supply voltage	u _v	0.261 mg/m ³	0.068 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	1.010 mg/m ³	1.020 (mg/m ³) ²
Influence of sample gas flow	u _p	-0.102 mg/m ³	0.010 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{mm}	0.404 mg/m ³	0.163 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.27 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.48 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 20 mg/m³	12.4
Requirement of EN 15267-3	U in % of the ELV 20 mg/m³	20.0
	U in % of the ELV 20 mg/m³	15.0

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

Measuring system

Manufacturer	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	150 / 152 / 128 / 116 / 355 / 368 / 155 / 154
Measuring principle	zirconium dioxide measurement

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

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	0.000	Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u^2
Standard deviation from paired measurements under field conditions *	u_D	0.074	Vol.-%	0.005 (Vol.-%) ²
Lack of fit	u_{lof}	0.058	Vol.-%	0.003 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$	0.100	Vol.-%	0.010 (Vol.-%) ²
Span drift from field test	$u_{d,s}$	0.090	Vol.-%	0.008 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.047	Vol.-%	0.002 (Vol.-%) ²
Influence of supply voltage	u_v	0.071	Vol.-%	0.005 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	0.000	Vol.-%	0.000 (Vol.-%) ²
Influence of sample gas flow	u_p	-0.107	Vol.-%	0.011 (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 span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.29	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.58	Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 25 Vol.-%	2.3
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/EU on industrial emissions provides no requirements for this component.
The value used was 10 %.

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

Measuring system

Manufacturer	Dr. Födisch Umweltmesstechnik AG
AMS designation	MCA 04
Serial number of units under test	150 / 152 / 128 / 116 / 355 / 368 / 155 / 154
Measuring principle	bi-frequency method

Test report

Test laboratory	936/21221599/B
Date of report	TÜV Rheinland
	2014-04-03

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	2.93 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	3.00 mg/m ³
Sum of negative CS at span point	-2.60 mg/m ³
Maximum sum of cross-sensitivities	3.00 mg/m ³
Uncertainty of cross-sensitivity	1.732 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	1.196 mg/m ³	1.430 (mg/m ³) ²
Lack of fit	u _{lof}	0.714 mg/m ³	0.510 (mg/m ³) ²
Zero drift from field test	u _{d,z}	0.820 mg/m ³	0.672 (mg/m ³) ²
Span drift from field test	u _{d,s}	-1.000 mg/m ³	1.000 (mg/m ³) ²
Influence of ambient temperature at span	u _t	1.106 mg/m ³	1.223 (mg/m ³) ²
Influence of supply voltage	u _v	0.515 mg/m ³	0.265 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	1.732 mg/m ³	3.000 (mg/m ³) ²
Influence of sample gas flow	u _p	0.126 mg/m ³	0.016 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{mm}	0.606 mg/m ³	0.368 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 2.91 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 5.71 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2010/75/EU

U in % of the ELV 50 mg/m³ **11.4**

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**