Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No. : 0000025930_03

Certified AMS:	Modular System MAC GMS800 for CO, NO, NO_2, SO_2, CH_4, N_2O, CO_2 and O_2
Manufacturer:	SICK AG Nimburger Str. 11 79276 Reute Germany
Test Institute:	TÜV Rheinland Energie und Umwelt GmbH

This is to certify that the AMS has been tested and found to comply with:

EN 15267-1: 2009, EN 15267-2: 2009, EN 15267-3: 2008 and EN 14181: 2004

Certification is awarded in respect of the conditions stated in this certificate (see also the following pages).

TÜVRheinland® CERTIFIED

Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000025930

Publication in the German Federal Gazette (BAnz.) of 2 March 2012

This certificate will expire on:
11 February 2020

German Federal Environment Agency
Dessau, 2 February 2015

i. A. Dr. Marcel Langner

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 30 January 2015

ppa. Dr. Peter Wilbring

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TÜV Rheinland Energie und Umwelt GmbH
Am Grauen Stein
51105 Cologne

Accreditation according to EN ISO/IEC 17025 and certified according to ISO 9001:2008.

10/221 2.08

Test report:	936/21217568/A of 18 October 2011
Initial certification:	12 February 2010
Certificate:	renewal (previous certificate 0000025930_02 of 16 March 2012 valid until 11 February 2015)
Expiry date:	11 February 2020
Publication:	BAnz. 2 March 2012, no. 36, p. 920, chapter I, no. 5.1

Approved application
The tested AMS is suitable for use at large combustion plants according to Directive 2001/80/EC, at waste incineration plants according to Directive 2000/76/EC and other plants requiring official approval. The tested ranges have been chosen with respect to the wide application of the AMS.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a field test at a municipal waste incineration plant.

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.

Any potential user should ensure that this AMS is suitable for monitoring the limit values relevant to the application.

Basis of the certification
This certification is based on:

- test report 936/21217568/A dated 18 October 2011 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. 2 March 2012, no. 36, p. 920, chapter I, no. 5.1, UBA announcement of 23 February 2012)
- publication in the German Federal Gazette (BAnz AT 23 July 2013 B4, chapter V, notifications 12 (sequential no. 12) and 13 (sequential no. 13), UBA announcement of 3 July 2013)
- publication in the German Federal Gazette (BAnz AT 5 August 2014 B11, chapter V, notification 13, UBA announcement of 17 July 2014)

AMS designation:
Modular System MAC GMS800 for CO, NO, NO_2, SO_2, CH_4, N_2O, CO_2 and O_2

Manufacturer:
SICK MAIHAK GmbH, Reute

Field of application:
For measurements at plants requiring official approval (i.e. Directive 2001/80/EC regarding large combustions plants, Directive 2000/76/EC regarding waste incineration plants)

Measuring ranges during the performance test:

Compo-nent	Module	Certification range	Supplementary measuring ranges		Unit
CO	MAC GMS800 UNOR for CO	0 – 75	0 – 750	0 – 3000	mg/m³
	MAC GMS800 MULTOR for CO	0 – 200	0 – 2000	–	mg/m³
NO	MAC GMS800 UNOR for NO	0 – 100	0 – 1000	0 – 2000	mg/m³
	MAC GMS800 MULTOR for NO	0 – 250	0 – 2500	–	mg/m³
	MAC GMS800 DEFOR for NO	0 – 50	0 – 1000	0 – 2000	mg/m³
NO_2	MAC GMS800 DEFOR for NO_2	0 – 50	0 – 500	–	mg/m³
NO_x	MAC GMS800 UNOR for NO_x	0 – 100	0 – 1000	0 – 2000	mg/m³
	MAC GMS800 MULTOR for NO_x	0 – 250	0 – 2500	–	mg/m³
SO_2	MAC GMS800 UNOR for SO_2	0 – 75	0 – 287	0 – 2000	mg/m³
	MAC GMS800 MULTOR for SO_2	0 – 250	0 – 2000	–	mg/m³
	MAC GMS800 DEFOR for SO_2	0 – 75	0 – 287	0 - 2000	mg/m³
CH_4	MAC GMS800 UNOR for CH_4	0 – 50	0 – 500	–	mg/m³
	MAC GMS800 MULTOR for CH_4	0 – 286	0 – 500	–	mg/m³
N_2O	MAC GMS800 UNOR for N_2O	0 – 50	0 – 500	–	mg/m³
CO_2	MAC GMS800 UNOR for CO_2	0 – 25	–	–	Vol.-%
	MAC GMS800 MULTOR for CO_2	0 – 25	–	–	Vol.-%
O_2	MAC GMS800 OXOR-P for O_2	0 – 25	–	–	Vol.-%
	MAC GMS800 OXOR-E for O_2	0 – 25	–	–	Vol.-%

Software versions:
T825_090707_1000
PC-Software: Sopas ET 2.22 Build 2938

Restrictions:
1. Functionality of the respective combination of modules shall be verified during the checks for proper installation.
2. The maintenance interval shall be determined during the check for proper installation.

Notes:

1. Automatic calibration of zero points shall be carried out with humidified ambient air for all components except for O_2 (OXOR-P and OXOR-E) once a week.
2. Automatic span point calibration for the OXOR-P and OXOR-E (O_2) sensors shall be carried out once a week with humidified ambient air.
3. With the help of external air conditioning the AMS also fulfils the requirements at an ambient air temperature of 50 °C.
4. The measuring system may be operated with cooler type MAK10-2 manufactured by AGT Thermotechnik as well as with type CSS-V2SK manufactured by M&C.
5. With weekly adjustments using the respective internal test gas cell or edge filter (NO_2 (DEFOR)), the maintenance intervals for the modules can be extended as follows:
   - one year for the modules CO (UNOR), CH_4 (UNOR and MULTOR)
   - half a year for the modules CO (MULTOR), NO (MULTOR), SO_2 (DEFOR)
   - three months for the modules NO (UNOR) und NO_2 (DEFOR)
6. Supplementary testing (extension of the maintenance interval by using internal test gas cells) as regards Federal Environment Agency notices of 12 July 2010 (BAnz. p. 2597, chapter I, no. 2.1) and of 10 January 2011 (BAnz. p. 294, chapter IV notifications 2 and 30).

Test report:

TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report no.: 936/21217568/A of 18 October 2011

12 Notification as regards Federal Environment Agency notices regarding performance tested measuring systems manufactured by SICK MAIHAK GmbH

Seq. no.	AMS / Manufacturer	Notice	Notification	Statement of test institute
12	MAC GMS800 / SICK AG	of 23 February 2012 (BAnz. p. 920, chapter I no. 5.1)	SICK MAIHAK GmbH merged with its parent company SICK AG as of 1 January 2013. The manufacturer is now registered as SICK AG.	Statement of TÜV Rheinland Energie und Umwelt GmbH of 25 März 2013

13 Notification as regards Federal Environment Agency notices regarding performance tested measuring systems manufactured by SICK Engineering GmbH and SICK AG

Seq. no.	AMS / Manufacturer	Notice	Notification	Statement of test institute
13	MAC GMS800 / SICK AG	as regards notification 12 (sequential no. 12) of this notice	The current software version of the SOPAS ET platform for optional AMS control is: SOPAS ET 2.38.	Statement of TÜV Rheinland Energie und Umwelt GmbH of 25 March 2013

13 Notification as regards Federal Environment Agency notices of 23 February 2012 (BAnz. p. 920, chapter 1, no. 5.1), of 3 July 2013 (BAnz AT 23 July 2013 B4, chapter V, 12th notification [no.12] and 13th notification [no. 13]) and of 27 February 2014 (BAnz AT 1 April 2014 B12, chapter V, 1st correction)

The modular measuring system MAC GMS800 for CO, NO, NO_2, SO_2, CH_4, N_2O, CO_2 and O_2 manufactured by SICK AG may now also be equipped with the SCU-P100 display unit.

For the DEFOR module, an absorber cartridge is inserted into the measurement cell.

The chopper motor S/N 6026930 is replaced by motor S/N 6030437.

The software versions for the individual modules of the MAC GMS800 modular measuring system for CO, NO, NO_2, SO_2, CH_4, N_2O, CO_2 and O_2 manufactured by SICK AG are:

BCU:	9150883_3.005 Y123
SCU-P100:	9158931_WI82
UNOR/MULTOR:	9137995_3.004 XN94
OXOR:	9138052_3.002 WM48
DEFOR:	9139736_3.003 WM48
Gas module:	9137582_3.002 WM48

Statement of TÜV Rheinland Energie und Umwelt GmbH of 2 April 2014

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

The multi-component measuring system MAC GMS800 is a modular sensor system. The essential part is the instrument cabinet including the interface modules, measuring gas pump, test gas supply unit, electronic-unit and SCU/BCU control unit. It is possible to place up to three different measurement modules in this instrument cabinet. All gas sensors are able to work independently from other sensors.

Thus, the modular measurement system can be equipped according to different requirements, each with appropriate measurement modules.

The following gas senor modules have been certified so far: UNOR, MULTOR, DEFOR, OXOR.

All gas senor modules are controlled by a BUS-system. The data output and adjustment of all sensors can be observed with this system.

The following components are part of the complete system:

- heated probe (M&C SP 2000) with heated filter, test gas offering function and back-flush function,
- heated gas tube (a heated line with a length of 10 m was used during the laboratory investigations, during field investigations a heated line with a length of 50 m was used),
- instrument cabinet with interface modules, measuring gas pump, sample gas cooler, test gas supply unit, sensor modules with gas sensors, electronic-unit and SCU/BCU control unit.

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 Energie und Umwelt 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 can be applied to the product or used in publicity material for the certified product.

This document as well as the certification mark remains property of TÜV Rheinland Energie und Umwelt GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energie und Umwelt 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**.

Certification of the modular system MAC GMS800 for CO, NO, NO_2, SO_2, CH_4, N_2O, CO_2 and O_2 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.0000025930: 12 February 2010

Expiry date of the certificate: 11 February 2015

Test report: 936/21211670/A of 29 October 2009,
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Publication: BAnz. 12 February 2010, no. 24, p. 552, chapter I, no. 1.2,
UBA announcement of 25 January 2010

Supplementary testing according to EN 15267:

Certificate No. 0000025930_01: 2 August 2010

Expiry date of the certificate: 11 February 2015

Test report: 936/21211670/B of 26 March 2010,
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Publication: BAnz. 28 July 2010, no. 111, p. 2597, chapter I, no. 2.1,
UBA announcement of 12 July 2010

Supplementary testing according to EN 15267:

Certificate No. 0000025930_02: 16 March 2012

Expiry date of the certificate: 11 February 2015

Test report: 936/21217568/A of 18 October 2011,
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz. 2 March 2012, no. 36, p. 920, chapter I, no. 5.1,
UBA announcement of 23 February 2012

Notifications

Statements of TÜV Rheinland Energie und Umwelt GmbH of 24 September 2010, 5 and 8 November 2010
Publication: BAnz. 26 January 2011, no. 14, p. 294, chapter IV, notifications 2 and 30 (sequential. no. 13) (new manufacturer name, new software version)
UBA announcement of 10 January 2011

Statement of TÜV Rheinland Energie und Umwelt GmbH of 25 March 2013
Publication: BAnz AT 23 July 2013 B4, chapter V, notifications 12 (sequential no. 12) and 13 (sequential no. 13) (new manufacturer name, new software version)
UBA announcement of 3 July 2013

Statement of TÜV Rheinland Energie und Umwelt GmbH of 2 April 2014
Publication: BAnz AT 5 August 2014 B11, chapter V, notification 13 (new software version, chopper motor)
UBA announcement of 17 July 2014

Renewal of the certificate

Certificate No. 0000025930_03: 2 February 2015

Expiry date of the certificate: 11 February 2020

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

Measuring system			
Manufacturer	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 UNOR for CO		
Serial number of the candidates	TÜV 1 / TÜV 3		
Measuring principle	NDIR		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	CO		
Certification range	0 - 75	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	1.80	mg/m³
Sum of negative CS at zero point	-1.30	mg/m³
Sum of postive CS at reference point	1.07	mg/m³
Sum of negative CS at reference point	0.00	mg/m³
Maximum sum of cross sensitivities	1.80	mg/m³
Uncertainty of cross sensitivity	1.039	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u²	
Standard deviation from paired measurements under field conditions *	u_D	0.747	mg/m³	0.558	(mg/m³)²
Lack of fit	u_{lof}	0.289	mg/m³	0.084	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.346	mg/m³	0.120	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.866	mg/m³	0.750	(mg/m³)²
Influence of ambient temperature at span	u_t	0.751	mg/m³	0.564	(mg/m³)²
Influence of supply voltage	u_v	0.115	mg/m³	0.013	(mg/m³)²
Cross sensitivity (interference)	u_i	1.039	mg/m³	1.080	(mg/m³)²
Influence of sample gas flow	u_p	-0.029	mg/m³	0.001	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	0.368	(mg/m³)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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.88	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.69	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**7.4**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 50 mg/m³**	**10.0**
Requirement of EN 15267-3	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	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 MULTOR for CO		
Serial number of the candidates	TÜV 1 / TÜV 3		
Measuring principle	NDIR		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	CO		
Certification range	0 - 200	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at reference point	6.76	mg/m³
Sum of negative CS at reference point	0.00	mg/m³
Maximum sum of cross sensitivities	6.76	mg/m³
Uncertainty of cross sensitivity	3.903	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u²	
Standard deviation from paired measurements under field conditions *	u_D	1.588	mg/m³	2.522	(mg/m³)²
Lack of fit	u_{lof}	1.155	mg/m³	1.334	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.924	mg/m³	0.854	(mg/m³)²
Span drift from field test	$u_{d,s}$	-3.002	mg/m³	9.012	(mg/m³)²
Influence of ambient temperature at span	u_t	2.406	mg/m³	5.789	(mg/m³)²
Influence of supply voltage	u_v	0.157	mg/m³	0.025	(mg/m³)²
Cross sensitivity (interference)	u_i	3.903	mg/m³	15.233	(mg/m³)²
Influence of sample gas flow	u_p	0.127	mg/m³	0.016	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	1.617	mg/m³	2.613	(mg/m³)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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	6.12	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	11.99	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 160 mg/m³**	**7.5**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 160 mg/m³**	**10.0**
Requirement of EN 15267-3	U in % of the ELV 160 mg/m³	7.5

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

Measuring system			
Manufacturer		Sick Maihak GmbH	
Name of measuring system		MAC GMS800 UNOR for NO	
Serial number of the candidates		TÜV 1 / TÜV 3	
Measuring principle		NDIR	
Test report		936/21217568/A	
Test laboratory		TÜV Rheinland	
Date of report		2011-10-18	
Measured component		NO	
Certification range		0 - 100	mg/m³

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point		1.56	mg/m³
Sum of negative CS at zero point		0.00	mg/m³
Sum of postive CS at reference point		2.46	mg/m³
Sum of negative CS at reference point		-0.73	mg/m³
Maximum sum of cross sensitivities		2.46	mg/m³
Uncertainty of cross sensitivity		1.420	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u²	
Standard deviation from paired measurements under field conditions *	u_D	1.191	mg/m³	1.418	(mg/m³)²
Lack of fit	u_{lof}	0.231	mg/m³	0.053	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-1.212	mg/m³	1.469	(mg/m³)²
Span drift from field test	$u_{d,s}$	1.732	mg/m³	3.000	(mg/m³)²
Influence of ambient temperature at span	u_t	0.529	mg/m³	0.280	(mg/m³)²
Influence of supply voltage	u_v	0.142	mg/m³	0.020	(mg/m³)²
Cross sensitivity (interference)	u_i	1.420	mg/m³	2.017	(mg/m³)²
Influence of sample gas flow	u_p	-0.104	mg/m³	0.011	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.808	mg/m³	0.653	(mg/m³)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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.99	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.85	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**11.7**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 50 mg/m³**	**20.0**
Requirement of EN 15267-3	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	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 MULTOR for NO		
Serial number of the candidates	TÜV 1 / TÜV 3		
Measuring principle	NDIR		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	NO		
Certification range	0 - 250	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	8.95	mg/m³
Sum of negative CS at zero point	-4.43	mg/m³
Sum of postive CS at reference point	3.45	mg/m³
Sum of negative CS at reference point	-3.65	mg/m³
Maximum sum of cross sensitivities	8.95	mg/m³
Uncertainty of cross sensitivity	5.167	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u²	
Standard deviation from paired measurements under field conditions *	u_D	2.241	mg/m³	5.022	(mg/m³)²
Lack of fit	u_{lof}	-1.155	mg/m³	1.334	(mg/m³)²
Zero drift from field test	$u_{d,z}$	2.742	mg/m³	7.519	(mg/m³)²
Span drift from field test	$u_{d,s}$	4.186	mg/m³	17.523	(mg/m³)²
Influence of ambient temperature at span	u_t	0.950	mg/m³	0.903	(mg/m³)²
Influence of supply voltage	u_v	0.737	mg/m³	0.543	(mg/m³)²
Cross sensitivity (interference)	u_i	5.167	mg/m³	26.701	(mg/m³)²
Influence of sample gas flow	u_p	0.277	mg/m³	0.077	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	2.021	mg/m³	4.083	(mg/m³)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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	7.98	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	15.64	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 131 mg/m³**	**11.9**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 131 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 131 mg/m³	15.0

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

Measuring system			
Manufacturer	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 DEFOR for NO		
Serial number of the candidates	TÜV 2 / TÜV 4		
Measuring principle	UVRAS		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	NO		
Certification range	0 - 50	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	1.86	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at reference point	1.06	mg/m³
Sum of negative CS at reference point	-0.94	mg/m³
Maximum sum of cross sensitivities	1.86	mg/m³
Uncertainty of cross sensitivity	1.074	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.751	mg/m³	0.564	(mg/m³)²
Lack of fit	u_{lof}	-0.115	mg/m³	0.013	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.375	mg/m³	0.141	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.866	mg/m³	0.750	(mg/m³)²
Influence of ambient temperature at span	u_t	0.153	mg/m³	0.023	(mg/m³)²
Influence of supply voltage	u_v	0.233	mg/m³	0.054	(mg/m³)²
Cross sensitivity (interference)	u_i	1.074	mg/m³	1.153	(mg/m³)²
Influence of sample gas flow	u_p	0.052	mg/m³	0.003	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404	mg/m³	0.163	(mg/m³)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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.69	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.32	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 30 mg/m³**	**11.1**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 30 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 30 mg/m³	15.0

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

Measuring system			
Manufacturer	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 DEFOR for NO_2		
Serial number of the candidates	TÜV 2 / TÜV 4		
Measuring principle	UVRAS		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	NO_2		
Certification range	0 - 50	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	1.72	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at reference point	1.93	mg/m³
Sum of negative CS at reference point	-0.26	mg/m³
Maximum sum of cross sensitivities	1.93	mg/m³
Uncertainty of cross sensitivity	1.114	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Repeatability standard deviation at set point *	u_r	0.520	mg/m³	0.270	$(mg/m^3)^2$
Lack of fit	u_{lof}	-0.231	mg/m³	0.053	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	-0.693	mg/m³	0.480	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	0.866	mg/m³	0.750	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	0.458	mg/m³	0.210	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.110	mg/m³	0.012	$(mg/m^3)^2$
Cross sensitivity (interference)	u_i	1.114	mg/m³	1.242	$(mg/m^3)^2$
Influence of sample gas flow	u_p	0.030	mg/m³	0.001	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404	mg/m³	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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.78	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.50	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**7.0**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 50 mg/m³**	**20.0**
Requirement of EN 15267-3	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	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 UNOR for SO_2		
Serial number of the candidates	TÜV 2 / TÜV 4		
Measuring principle	NDIR		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	SO_2		
Certification range	0 - 75	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	2.75	mg/m³
Sum of negative CS at zero point	-1.75	mg/m³
Sum of postive CS at reference point	2.30	mg/m³
Sum of negative CS at reference point	-1.82	mg/m³
Maximum sum of cross sensitivities	2.75	mg/m³
Uncertainty of cross sensitivity	1.585	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Standard deviation from paired measurements under field conditions *	u_D	1.228	mg/m³	1.508	$(mg/m^3)^2$
Lack of fit	u_{lof}	0.410	mg/m³	0.168	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	-1.212	mg/m³	1.469	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	1.299	mg/m³	1.687	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	0.929	mg/m³	0.863	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.227	mg/m³	0.052	$(mg/m^3)^2$
Cross sensitivity (interference)	u_i	1.585	mg/m³	2.512	$(mg/m^3)^2$
Influence of sample gas flow	u_p	0.057	mg/m³	0.003	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.94	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.76	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**11.5**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 50 mg/m³**	**20.0**
Requirement of EN 15267-3	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	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 MULTOR for SO_2		
Serial number of the candidates	TÜV 1 / TÜV 3		
Measuring principle	NDIR		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	SO_2		
Certification range	0 - 250	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	9.63	mg/m³
Sum of negative CS at zero point	-2.65	mg/m³
Sum of postive CS at reference point	5.93	mg/m³
Sum of negative CS at reference point	-1.20	mg/m³
Maximum sum of cross sensitivities	9.63	mg/m³
Uncertainty of cross sensitivity	5.557	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Standard deviation from paired measurements under field conditions *	u_D	1.546	mg/m³	2.390	$(mg/m^3)^2$
Lack of fit	u_{lof}	-2.714	mg/m³	7.366	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	2.115	mg/m³	4.473	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	-3.002	mg/m³	9.012	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	2.901	mg/m³	8.416	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.839	mg/m³	0.704	$(mg/m^3)^2$
Cross sensitivity (interference)	u_i	5.557	mg/m³	30.880	$(mg/m^3)^2$
Influence of sample gas flow	u_p	-0.410	mg/m³	0.168	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	2.021	mg/m³	4.083	$(mg/m^3)^2$

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

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	8.22	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	16.10	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 150 mg/m³**	**10.7**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 150 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 150 mg/m³	15.0

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

Measuring system			
Manufacturer	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 DEFOR for SO_2		
Serial number of the candidates	TÜV 2 / TÜV 4		
Measuring principle	UVRAS		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	SO_2		
Certification range	0 - 75	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	mg/m³
Sum of negative CS at zero point	-0.81	mg/m³
Sum of postive CS at reference point	0.35	mg/m³
Sum of negative CS at reference point	-2.91	mg/m³
Maximum sum of cross sensitivities	-2.91	mg/m³
Uncertainty of cross sensitivity	-1.680	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Standard deviation from paired measurements under field conditions *	u_D	1.206	mg/m³	1.454	$(mg/m^3)^2$
Lack of fit	u_{lof}	-0.404	mg/m³	0.163	$(mg/m^3)^2$
Zero drift from field test	$u_{d.z}$	-0.606	mg/m³	0.367	$(mg/m^3)^2$
Span drift from field test	$u_{d.s}$	1.299	mg/m³	1.687	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	0.964	mg/m³	0.929	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.067	mg/m³	0.004	$(mg/m^3)^2$
Cross sensitivity (interference)	u_i	-1.680	mg/m³	2.823	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	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)	$u_c = \sqrt{\sum (u_{max\ j})^2}$	2.79	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.47	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**10.9**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 50 mg/m³**	**20.0**
Requirement of EN 15267-3	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		Sick Maihak GmbH	
Name of measuring system		MAC GMS800 UNOR for CH_4	
Serial number of the candidates		TÜV 2 / TÜV 4	
Measuring principle		NDIR	
Test report		936/21217568/A	
Test laboratory		TÜV Rheinland	
Date of report		2011-10-18	
Measured component		CH_4	
Certification range		0 - 50	mg/m³
Evaluation of the cross sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point		0.48	mg/m³
Sum of negative CS at zero point		-1.77	mg/m³
Sum of postive CS at reference point		0.00	mg/m³
Sum of negative CS at reference point		-0.63	mg/m³
Maximum sum of cross sensitivities		-1.77	mg/m³
Uncertainty of cross sensitivity		-1.022	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Repeatability standard deviation at set point *	u_r	0.630	mg/m³	0.397	$(mg/m^3)^2$
Lack of fit	u_{lof}	0.231	mg/m³	0.053	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	0.520	mg/m³	0.270	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	0.635	mg/m³	0.403	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	0.416	mg/m³	0.173	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.306	mg/m³	0.094	$(mg/m^3)^2$
Cross sensitivity (interference)	u_i	-1.022	mg/m³	1.044	$(mg/m^3)^2$
Influence of sample gas flow	u_p	-0.035	mg/m³	0.001	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404	mg/m³	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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.61	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.16	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 20 mg/m³**	**15.8**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 20 mg/m³**	**30.0 ****
Requirement of EN 15267-3	U in % of the ELV 20 mg/m³	22.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
A value of 30 % was used for this.

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

Measuring system			
Manufacturer		Sick Maihak	
Name of measuring system		MAC GMS800 MULTOR for CH_4	
Serial number of the candidates		TÜV 2 / TÜV 4	
Measuring principle		NDIR	
Test report		936/21217568/A	
Test laboratory		TÜV Rheinland	
Date of report		2011-10-18	
Measured component		CH_4	
Certification range		0 - 286	mg/m³

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at reference point	1.06	mg/m³
Sum of negative CS at reference point	-1.49	mg/m³
Maximum sum of cross sensitivities	-1.49	mg/m³
Uncertainty of cross sensitivity	-0.859	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Repeatability standard deviation at set point *	u_r	0.620	mg/m³	0.384	$(mg/m^3)^2$
Lack of fit	u_{lof}	-1.501	mg/m³	2.253	$(mg/m^3)^2$
Zero drift from field test	$u_{d,z}$	1.156	mg/m³	1.336	$(mg/m^3)^2$
Span drift from field test	$u_{d,s}$	-2.972	mg/m³	8.833	$(mg/m^3)^2$
Influence of ambient temperature at span	u_t	2.843	mg/m³	8.083	$(mg/m^3)^2$
Influence of supply voltage	u_v	0.532	mg/m³	0.283	$(mg/m^3)^2$
Cross sensitivity (interference)	u_i	-0.859	mg/m³	0.737	$(mg/m^3)^2$
Influence of sample gas flow	u_p	0.370	mg/m³	0.137	$(mg/m^3)^2$
Uncertainty of reference material at 70% of certification range	u_{rm}	2.312	mg/m³	5.344	$(mg/m^3)^2$

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

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	5.23	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	10.26	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 100 mg/m³**	**10.3**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 100 mg/m³**	**30.0 ****
Requirement of EN 15267-3	U in % of the ELV 100 mg/m³	22.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
A value of 30 % was used for this.

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

Measuring system			
Manufacturer	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 UNOR for N_2O		
Serial number of the candidates	TÜV 2 / TÜV 4		
Measuring principle	NDIR		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	N_2O		
Certification range	0 - 50	mg/m³	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.93	mg/m³
Sum of negative CS at zero point	-1.41	mg/m³
Sum of postive CS at reference point	0.00	mg/m³
Sum of negative CS at reference point	-0.65	mg/m³
Maximum sum of cross sensitivities	-1.41	mg/m³
Uncertainty of cross sensitivity	-0.814	mg/m³

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.410	mg/m³	0.168	(mg/m³)²
Lack of fit	u_{lof}	0.231	mg/m³	0.053	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.318	mg/m³	0.101	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.866	mg/m³	0.750	(mg/m³)²
Influence of ambient temperature at span	u_t	0.436	mg/m³	0.190	(mg/m³)²
Influence of supply voltage	u_v	0.172	mg/m³	0.030	(mg/m³)²
Cross sensitivity (interference)	u_i	-0.814	mg/m³	0.663	(mg/m³)²
Influence of sample gas flow	u_p	0.052	mg/m³	0.003	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404	mg/m³	0.163	(mg/m³)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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.46	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.85	mg/m³

Relative total expanded uncertainty	**U in % of the range 50 mg/m³**	**5.7**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the range 50 mg/m³**	**20.0 ****
Requirement of EN 15267-3	U in % of the range 50 mg/m³	15.0

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
A value of 20 % was used for this.

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

Measuring system			
Manufacturer	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 UNOR for CO_2		
Serial number of the candidates	TÜV 1 / TÜV 3		
Measuring principle	NDIR		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	CO_2		
Certification range	0 - 25	Vol.-%	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	Vol.-%
Sum of negative CS at zero point	-0.47	Vol.-%
Sum of postive CS at reference point	0.00	Vol.-%
Sum of negative CS at reference point	0.00	Vol.-%
Maximum sum of cross sensitivities	-0.47	Vol.-%
Uncertainty of cross sensitivity	-0.271	Vol.-%

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.156	Vol.-%	0.024	(Vol.-%)²
Lack of fit	u_{lof}	-0.144	Vol.-%	0.021	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	-0.188	Vol.-%	0.035	(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	0.300	Vol.-%	0.090	(Vol.-%)²
Influence of supply voltage	u_v	0.049	Vol.-%	0.002	(Vol.-%)²
Cross sensitivity (interference)	u_i	-0.271	Vol.-%	0.074	(Vol.-%)²
Influence of sample gas flow	u_p	0.017	Vol.-%	0.000	(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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.64	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.25	Vol.-%

Relative total expanded uncertainty	**U in % of the ELV 25 Vol.-%**	**5.0**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 25 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the ELV 25 Vol.-%	7.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
A value of 10 % was used for this.

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

Measuring system	
Manufacturer	Sick Maihak GmbH
Name of measuring system	MAC GMS800 OXOR-P for O_2
Serial number of the candidates	TÜV 1 / TÜV 3
Measuring principle	paramagnetic
Test report	936/21217568/A
Test laboratory	TÜV Rheinland
Date of report	2011-10-18
Measured component	O_2
Certification range	0 - 25 Vol.-%

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	Vol.-%
Sum of negative CS at zero point	0.00	Vol.-%
Sum of postive CS at reference point	0.00	Vol.-%
Sum of negative CS at reference 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		u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.084	Vol.-%	0.007	(Vol.-%)²
Lack of fit	u_{lof}	-0.040	Vol.-%	0.002	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	0.120	Vol.-%	0.014	(Vol.-%)²
Span drift from field test	$u_{d,s}$	0.120	Vol.-%	0.014	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.110	Vol.-%	0.012	(Vol.-%)²
Influence of supply voltage	u_v	0.003	Vol.-%	0.000	(Vol.-%)²
Cross sensitivity (interference)	u_i	0.000	Vol.-%	0.000	(Vol.-%)²
Influence of sample gas flow	u_p	-0.023	Vol.-%	0.001	(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)	$u_c = \sqrt{\sum (u_{max\ j})^2}$	0.30	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.59	Vol.-%

Relative total expanded uncertainty	**U in % of the range 25 Vol.-%**	**2.4**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the range 25 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	7.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
A value of 10 % was used for this.

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

Measuring system			
Manufacturer	Sick Maihak GmbH		
Name of measuring system	MAC GMS800 OXOR-E for O_2		
Serial number of the candidates	TÜV 2 / TÜV 4		
Measuring principle	electrochemical cell		
Test report	936/21217568/A		
Test laboratory	TÜV Rheinland		
Date of report	2011-10-18		
Measured component	O_2		
Certification range	0 - 25	Vol.-%	

Evaluation of the cross sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	Vol.-%
Sum of negative CS at zero point	0.00	Vol.-%
Sum of postive CS at reference point	0.33	Vol.-%
Sum of negative CS at reference point	0.00	Vol.-%
Maximum sum of cross sensitivities	0.33	Vol.-%
Uncertainty of cross sensitivity	0.191	Vol.-%

Calculation of the combined standard uncertainty

Tested parameter		u		u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.108	Vol.-%	0.012	(Vol.-%)²
Lack of fit	u_{lof}	0.058	Vol.-%	0.003	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	0.120	Vol.-%	0.014	(Vol.-%)²
Span drift from field test	$u_{d,s}$	0.120	Vol.-%	0.014	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.127	Vol.-%	0.016	(Vol.-%)²
Influence of supply voltage	u_v	0.030	Vol.-%	0.001	(Vol.-%)²
Cross sensitivity (interference)	u_i	0.191	Vol.-%	0.036	(Vol.-%)²
Influence of sample gas flow	u_p	0.029	Vol.-%	0.001	(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)	$u_c = \sqrt{\sum (u_{max\ j})^2}$	0.37	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.73	Vol.-%

Relative total expanded uncertainty	**U in % of the range 25 Vol.-%**	**2.9**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the range 25 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	7.5

** For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given.
A value of 10 % was used for this.