Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

CERTIFICATE

about Product Conformity (QAL1)

Number of Certificate: 0000025930

Certified AMS:	MKAS S800 for CO, NO, NO_2, SO_2, CH_4, CO_2 and O_2
Manufacturer:	SICK MAIHAK GmbH Nimburger Straße 11 79276 Reute Deutschland
Test Institute:	TÜV Rheinland Immissionsschutz und Energiesysteme GmbH

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

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 (see also the following pages).

www.tuv.com TÜVRheinland® ID: 0000025930

- EN 15267-3 tested
- QAL1 certified
- TUV approved
- Annual Inspection

Publication in the German Federal Gazette (BAnz.) of 2010-02-12

The certificate is valid until: 2015-02-11

Umweltbundesamt

Dessau, 2010-03-15

i. A. Dr. Hans-Joachim Hummel

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH

Köln, 2010-03-10

i. V. Dr. Peter Wilbring

www.umwelt-tuv.de / www.eco-tuv.com tie@umwelt-tuv.de Tel. +49 - 221 - 806 - 2275	TÜV Rheinland Immissionsschutz und Energiesysteme GmbH Am Grauen Stein 51105 Köln Accreditation according to EN ISO/IEC 17025 and ISO 9001:2000.

10/221 2.06

Test report:	936/21211670/A of 2009-10-29
First certification:	2010-02-12
Run of validity until:	2015-02-11
Publication	BAnz. 2010-02-12, no.: 24, page: 553

Approved application:
The suitability of the AMS for this application was assessed on the basis of a laboratory test and a field test on a municipal heat and power plant. The results of this test will be valid for all kinds of plants. The AMS is approved for the temperature range from +5 °C to +40 °C.

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

Basis of the certification
This certification is based on the test report 936/21211670/A of 2009-10-29 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and on the relevant bodies (German Umweltbundesamt) assessment and ongoing surveillance of the product and the manufacturing process and the publication in the German Federal Gazette (BAnz.):

AMS name:
MKAS S800 for CO, NO, NO_2, SO_2, CH_4, CO_2 and O_2

Manufacturer:
SICK MAIHAK GmbH, Reute

Approval:
Modular system for measurements at plants requiring official permission (i. e. 2000-76-EC, waste incineration directive and 2001-80-EC, large combustion plants directive)

Measuring ranges during the suitability test:

Component	Certification-range	Supplementary ranges		Unit
		range 1	range 2	
CO (UNOR)	**0 - 75**	0 - 750	0 - 3000	mg/m³
NO (UNOR)	**0 - 100**	0 - 1000	0 - 2000	mg/m³
NO (DEFOR)	**0 - 50**	0 - 1000	0 - 2000	mg/m³
NO_2 (DEFOR)	**0 - 50**	0 - 500	-	mg/m³
SO_2 (UNOR)	**0 - 75**	0 - 287	0 - 2000	mg/m³
SO_2 (DEFOR)	**0 - 75**	0 - 287	0 - 2000	mg/m³
CH_4 (UNOR)	**0 - 50**	0 - 500	-	mg/m³
CH_4 (MULTOR)*	**0 - 286**	0 - 500	-	mg/m³
CO_2 (MULTOR)	**0 - 25**	-	-	Vol.-%
O_2 (OXOR-P)	**0 - 25**	-	-	Vol.-%

* German Technical Instruction on Air Quality Control and combustion plants

Software versions:
T825_090707_1000
PC-Software: Sopas ET 2.20 Build 2766

Restriction:
The maintenance interval has to be checked during the check of correct installation.

Remarks:
1. An automatic zero point calibration with humid ambient air has to be performed weekly for all components beside O_2 (OXOR-P).
2. An automatic span point calibration with humid ambient air has to performed weekly for the sensor OXOR-P (O_2).
3. The minimum requirements are also fulfilled at an ambient air temperature of 50 °C with activated external climate control unit.

Test report:
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln
Report-No.: 936/21211670/A of 2009-10-29

Certified product
This certificate applies to automated measurement systems confirming to the following description:
The multicomponent measuring system MKAS S800 is a modular sensor system. This allows the combination of different gas-sensors with different physical measurement procedures to one measurement system. All gas sensors are able to work independent from other sensors or from the control unit. The following gas senor modules have been certified so far: UNOR, MULTOR, DEFOR, OXOR-P.

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 software version is: T825_090707_1000.

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, 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 DIN 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 certified product is found no longer to comply with the applicable European Standard, TÜV Rheinland Immissionsschutz und Energiesysteme GmbH should be notified at the address shown on page 1.

The certification mark with the ID-Number that can be applied to the product or used in publicity material for the certified product is presented on page 1 of this certificate.

This document as well as the certification mark remains the property of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH.
With revocation of the publication the certificate looses its validity.
After the expiration of the validity of the certificate and on requests of the TÜV Rheinland Immissionsschutz und Energiesysteme GmbH this document shall be returned and the certificate mark must not be employed anymore.

The relevant version of this certificate and the validity is also seen at the Internet Address: **qal1.de**.

Umwelt Bundes Amt
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Certificate:
0000025930 / 2010-03-10

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Unor)
Serial Number	TUV 1 / TÜV 3
Measuring Principle	NDIR
TÜV Data	
Approval Report	936/21211670/A / 2009-10-29
Editor	Schneider
Date	2009-10-29
Measurement Component	CO
Certificated range	75 mg/m³
Evaluation of the cross sensitivity (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	1.04 mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_r	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 bigger value of: "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

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Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Unor)
Serial Number	TUV 1 / TÜV 3
Measuring Principle	NDIR
TÜV Data	
Approval Report	936/21211670/A / 2009-10-29
Editor	Schneider
Date	2009-10-29
Measurement Component	NO
Certificated range	100 mg/m³

Evaluation of the cross sensitivity (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	1.42 mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_r	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 bigger value of: "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

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data			
Manufacturer		Sick Maihak	
Name of measuring system		MKAS S800 (Defor)	
Serial Number		TUV 2 / TÜV 4	
Measuring Principle		UVRAS	
TÜV Data			
Approval Report		936/21211670/A / 2009-10-29	
Editor		Schneider	
Date		2009-10-29	
Measurement Component		NO	
Certificated range		50	mg/m³
Evaluation of the cross sensitivity (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		1.07	mg/m³

Calculation of the combined standard uncertainty

Test Value		u		u²
Standard deviation from paired measurements under field conditions *	u_r	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 bigger value of: "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

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Defor)
Serial Number	TUV 2 / TÜV 4
Measuring Principle	UVRAS
TÜV Data	
Approval Report	936/21211670/A / 2009-10-29
Editor	Schneider
Date	2009-10-29
Measurement Component	NO_2
Certificated range	50 mg/m³

Evaluation of the cross sensitivity (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	1.11 mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Repeatability standard deviation at span *	u_r	0.520 mg/m³	0.270 (mg/m³)²
Lack of fit	u_{lof}	-0.231 mg/m³	0.053 (mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.693 mg/m³	0.480 (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	0.458 mg/m³	0.210 (mg/m³)²
Influence of supply voltage	u_v	0.110 mg/m³	0.012 (mg/m³)²
Cross sensitivity (interference)	u_i	1.114 mg/m³	1.242 (mg/m³)²
Influence of sample gas flow	u_p	0.030 mg/m³	0.001 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404 mg/m³	0.163 (mg/m³)²

* The bigger value of: "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

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Unor)
Serial Number	TUV 2 / TÜV 4
Measuring Principle	NDIR
TÜV Data	
Approval Report	936/21211670/A / 2009-10-29
Editor	Schneider
Date	2009-10-29
Measurement Component	SO_2
Certificated range	75 mg/m³

Evaluation of the cross sensitivity (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	1.58 mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_r	1.228 mg/m³	1.508 (mg/m³)²
Lack of fit	u_{lof}	0.410 mg/m³	0.168 (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	$u_{d,s}$	1.299 mg/m³	1.687 (mg/m³)²
Influence of ambient temperature at span	u_t	0.929 mg/m³	0.863 (mg/m³)²
Influence of supply voltage	u_v	0.227 mg/m³	0.052 (mg/m³)²
Cross sensitivity (interference)	u_i	1.585 mg/m³	2.512 (mg/m³)²
Influence of sample gas flow	u_p	0.057 mg/m³	0.003 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606 mg/m³	0.368 (mg/m³)²

* The bigger value of: "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

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Defor)
Serial Number	TÜV 2 / TÜV 4
Measuring Principle	UVRAS
TÜV Data	
Approval Report	936/21211670/A / 2009-10-29
Editor	Schneider
Date	2009-10-29
Measurement Component	SO_2
Certificated range	75 mg/m³

Evaluation of the cross sensitivity (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	-1.68 mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_r	1.206 mg/m³	1.454 (mg/m³)²
Lack of fit	u_{lof}	-0.404 mg/m³	0.163 (mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.606 mg/m³	0.367 (mg/m³)²
Span drift from field test	$u_{d,s}$	1.299 mg/m³	1.687 (mg/m³)²
Influence of ambient temperature at span	u_t	0.964 mg/m³	0.929 (mg/m³)²
Influence of supply voltage	u_v	0.067 mg/m³	0.004 (mg/m³)²
Cross sensitivity (interference)	u_i	-1.680 mg/m³	2.823 (mg/m³)²
Influence of sample gas flow	u_p	0.075 mg/m³	0.006 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606 mg/m³	0.368 (mg/m³)²

* The bigger value of: "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

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Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Unor)
Serial Number	TUV 2 / TÜV 4
Measuring Principle	NDIR
TÜV Data	
Approval Report	936/21211670/A / 2009-10-19
Editor	Schneider
Date	2009-10-29
Measurement Component	CH_4
Certificated range	50 mg/m³
Evaluation of the cross sensitivity (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	-1.02 mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Repeatability standard deviation at span *	ur	0.630 mg/m³	0.397 (mg/m³)²
Lack of fit	u_{lof}	0.231 mg/m³	0.053 (mg/m³)²
Zero drift from field test	$u_{d,z}$	0.520 mg/m³	0.270 (mg/m³)²
Span drift from field test	$u_{d,s}$	0.635 mg/m³	0.403 (mg/m³)²
Influence of ambient temperature at span	u_t	0.416 mg/m³	0.173 (mg/m³)²
Influence of supply voltage	u_v	0.306 mg/m³	0.094 (mg/m³)²
Cross sensitivity (interference)	u_i	-1.022 mg/m³	1.044 (mg/m³)²
Influence of sample gas flow	u_p	-0.035 mg/m³	0.001 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.404 mg/m³	0.163 (mg/m³)²

* The bigger value of: "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*[1]	**U in % of the ELV 20 mg/m³**	**30.00**
Requirement of EN 15267-3	U in % of the ELV 20 mg/m³	22.50

*[1] For this component no requirements in the EC-directives 2001/80/EC und 2000/76/EC are given. The chosen value was recommended by the certification body.

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Multor)
Serial Number	TÜV 2 / TÜV 4
Measuring Principle	NDIR
TÜV Data	
Approval Report	936/21211670/A / 2009-10-19
Editor	Schneider
Date	2009-10-29
Measurement Component	CH_4
Certificated range	286 mg/m³
Evaluation of the cross sensitivity (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	-0.86 mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Repeatability standard deviation at span *	u_r	0.620 mg/m³	0.384 (mg/m³)²
Lack of fit	u_{lof}	-1.501 mg/m³	2.253 (mg/m³)²
Zero drift from field test	$u_{d,z}$	1.156 mg/m³	1.336 (mg/m³)²
Span drift from field test	$u_{d,s}$	-2.972 mg/m³	8.833 (mg/m³)²
Influence of ambient temperature at span	u_t	2.843 mg/m³	8.083 (mg/m³)²
Influence of supply voltage	u_v	0.532 mg/m³	0.283 (mg/m³)²
Cross sensitivity (interference)	u_i	-0.859 mg/m³	0.737 (mg/m³)²
Influence of sample gas flow	u_p	0.370 mg/m³	0.137 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	2.312 mg/m³	5.344 (mg/m³)²

* The bigger value of: "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*[1]	**U in % of the ELV 100 mg/m³**	**20.00**
Requirement of EN 15267-3	U in % of the ELV 100 mg/m³	15.00

*[1] For this component no requirements in the EC-directives 2001/80/EC und 2000/76/EC are given. The chosen value was recommended by the certification body.

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Unor)
Serial Number	TUV 1 / TÜV 3
Measuring Principle	NDIR
TÜV Data	
Approval Report	936/21211670/A / 2009-10-30
Editor	Schneider
Date	2009-10-09
Measurement Component	CO_2
Certificated range	25 Vol.-%
Evaluation of the cross sensitivity (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	-0.27 Vol.-%

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_r	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 bigger value of: "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 range 25 Vol.-%**	**5.0**
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/EC und 2000/76/EC are given. The chosen value was recommended by the certification body.

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Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

Manufacturer data	
Manufacturer	Sick Maihak
Name of measuring system	MKAS S800 (Oxor-P)
Serial Number	TÜV 1 / TÜV 3
Measuring Principle	paramagnetic
TÜV Data	
Approval Report	936/21211670/A / 2009-10-29
Editor	Schneider
Date	2009-10-29
Measurement Component	O_2
Certificated range	25 Vol.-%

Evaluation of the cross sensitivity (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	0.00 Vol.-%

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_r	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 bigger value of: "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/EC und 2000/76/EC are given. The chosen value was recommended by the certification body.