

# CERTIFICATE

## about Product Conformity (QAL1)

Number of Certificate: 0000025926\_02

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**Certified AMS:** MCS 100 FT for O<sub>2</sub>, CO, SO<sub>2</sub>, NO, NO<sub>2</sub>, HCl, HF, CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>O, N<sub>2</sub>O, NH<sub>3</sub> and TOC

**Manufacturer:** SICK MAIHAK GmbH  
Dr. Zimmermann Str. 18  
88709 Meersburg  
Germany

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**Test Institute:** TÜV Rheinland Energie und Umwelt GmbH

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

**DIN 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).

The present certificate replaces Certificate No. 0000025926\_01 of 2 August 2010



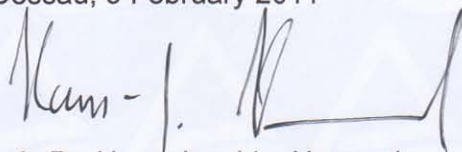
- EN 15267-3 tested
- QAL1 certified
- TÜV approved
- Annual inspection

Publication in the German Federal Gazette  
(BAnz.) of 26 January 2011

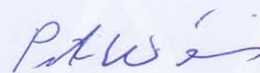
The certificate is valid until: 11 February 2015

Umweltbundesamt  
Dessau, 9 February 2011

TÜV Rheinland Energie und Umwelt GmbH  
Köln, 7 February 2011



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

**Test report:** 936/21214593/A of 1 October 2010  
**First certification:** 12 February 2010  
**Run of validity until:** 11 February 2015  
**Publication** BAnz. 26 January 2011, No. 14, page 294, Chapter I No. 3.1

#### **Approved application**

The certified AMS is suitable for use at combustion plants according to EC directive 2001-80-EC, at waste incinerations plants according to EC directive 2000-76-EC and other plants requiring official permission. The tested ranges have been chosen with respect to 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 a three months test on basis of a laboratory test and three field tests (field test during the original approval test with a duration of more than one year at a municipal waste incinerator 1, a second field test during the first additional test of more than six months duration at a municipal waste incinerator 1 and a third field test of the second additional test of more than 6 months at a municipal waste incinerator 2) of MCS 100 FT.

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 reports 936/21214593/A of TÜV Rheinland Energie und Umwelt GmbH of 1 October 2010 and 936/21210511/A of 22 March 2010, 936/21211742/A of 26 October 2009 and 936/21206925/A of 20 October 2008 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, on the relevant body (German Umweltbundesamt) assessment and ongoing surveillance of the product and the manufacturing process and the publication in the German Federal Gazette (BAnz. 26 January 2011, No. 14, p. 294, Chapter I No. 3.1, UBA publication from 10 January 2011):

#### **AMS name:**

MCS 100 FT for O<sub>2</sub>, CO, SO<sub>2</sub>, NO, NO<sub>2</sub>, HCl, HF, CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>O, N<sub>2</sub>O, NH<sub>3</sub> and TOC

#### **Manufacturer:**

SICK MAIHAK GmbH, Meersburg

#### **Approval:**

For measurements at plants requiring official permission (i. e. plants in 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	Range 3	
O <sub>2</sub>	0 - 21	-	-	-	Vol.-%
CO	0 - 75	0 - 300	0 - 1500	-	mg/m <sup>3</sup>
SO <sub>2</sub>	0 - 75	0 - 300	0 - 1500	-	mg/m <sup>3</sup>
NO	0 - 200	0 - 400	0 - 2000	-	mg/m <sup>3</sup>
NO <sub>2</sub>	0 - 100	-	0 - 500	-	mg/m <sup>3</sup>
HCl	0 - 15	0 - 90	0 - 150	-	mg/m <sup>3</sup>
HF	0 - 3	0 - 10	-	-	mg/m <sup>3</sup>
CH <sub>4</sub>	0 - 50	-	0 - 150	-	mg/m <sup>3</sup>
CO <sub>2</sub>	0 - 25	-	-	-	Vol.-%
H <sub>2</sub> O	0 - 40	-	-	-	Vol.-%
N <sub>2</sub> O	0 - 50	-	0 - 500	-	mg/m <sup>3</sup>
NH <sub>3</sub>	0 - 10	0 - 50	-	-	mg/m <sup>3</sup>
TOC	0 - 15	0 - 50	0 - 150	0 - 500	mg/m <sup>3</sup>

**Software versions:**

MCS 100 FT Firmware 9114688\_TJ59  
SCU Installations-packet 9125028\_T825

**Remarks:**

1. The measuring system MCS 100 FT displays its measuring values related to dry gas under normal conditions.
2. The maintenance interval amounts to four weeks, if the components O<sub>2</sub> is integrated, if the component TOC is integrated the maintenance interval amounts to two months, if the components CO<sub>2</sub>, HF and NH<sub>3</sub> are integrated the maintenance interval amounts to three months, otherwise it is six months.
3. For the components NO<sub>2</sub> and HCl the requirements for the correlation coefficient R<sup>2</sup> according to DIN EN 15267-3 have not been fulfilled at the suitability test procedure.
4. For the components CO and HF the requirements for the total uncertainty according to DIN EN 15267-3 have not been fulfilled at the suitability test procedure.
5. For the span check (QAL3) of the components CO, SO<sub>2</sub>, NO, HCl, CH<sub>4</sub>, N<sub>2</sub>O, H<sub>2</sub>O, CO<sub>2</sub>, HF and NH<sub>3</sub> instead of test gases the automatic internal adjustment unit can be used.
6. Supplementary test (extension of the maintenance interval for the components NH<sub>3</sub> and TOC and supplementary range 0 – 50 mg/m<sup>3</sup> for NH<sub>3</sub>) to the announcement of the German Federal Environmental Agency dated 12 July 2010 (BAnz. p. 2597, chapter I, No. 1.2)

**Test report:**

TÜV Rheinland Energie und Umwelt GmbH, Köln  
Report-No.: 936/21214593/A of 1 October 2010

### **Certified product**

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

MCS 100 FT is a multi component analyser system. The gas to be measured is taken by means of a sample gas probe from the flue gas. To provide the analyser system with the sample gas from the probe a heated sample gas line is used. A Fourier transform infrared-spectrometer (FTIR-spectrometer) serves for the spectral analysis of the gas concentrations.

The sample gas is delivered by an ejector pump. The sample gas probe offers in its standard configuration the functions as automatic zero gas provision, automatic back-flush with zero adjustment and filter cleaning. The system has an independent temperature control system for all heated parts in order to prevent any condensation of flue gas within the system.

The control and evaluation system SCU (System Control Unit) is designed and adjusted to satisfy the requirements of emission control purposes as well as the requests of process measurement technology and offers standard interfaces as CAN-Bus and Field-BUS systems, as well as ModBus or ProfiBus. An Ethernet interface for the remote control of the entire measuring system facilitates the data transfer via internal and external TCP/IP networks. In this way also remote control and remote service of the measuring system are possible using the software package SOPAS ET.

The tested AMS consists of the following single components:

- heated sampling probe with heated filter, test gas port and back-flush possibility,
- heated sample gas line (length during the approval testing procedure: 36 m),
- analyser cabinet MCS 100 FT containing interface modules, heated measuring cell FTIR-analyser (Interferometer), electronics unit and the SCU control and evaluation unit,
- integrated oxygen measuring device using the zirconium-dioxide principle,
- software versions:           MCS 100 FT Firmware           9114688\_TJ59  
  SCU Installation packet           9125028\_T825

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

The certification mark with the product specific 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 Energie und Umwelt GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the validity 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 the validity is also seen at the Internet Address: **qal1.de**.



Certification of MCS 100 FT for O<sub>2</sub>, CO, SO<sub>2</sub>, NO, NO<sub>2</sub>, HCl, HF, CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>O, N<sub>2</sub>O, NH<sub>3</sub> and TOC is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

**First suitability test:**

Test report: 936/21206925/A of 20 October 2008  
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln  
Publication: BAnz. 11 March 2009, No. 38, p. 901, Chapter I No 2.2:  
Announcement by UBA from 19 February 2009.

**Initial certification according to EN 15267:**

Certificate No. 0000025926: 15 March 2010  
Validity of the certificate until: 11 February 2015  
Test report: 936/21211742/A of 26 October 2009,  
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln,  
Publication: BAnz. 12 February 2010, No. 24, p. 553, Chapter I No. 1.3:  
Announcement by UBA from 25 January 2010.

**Supplementary testing according to EN 15267:**

Certificate No. 0000025926\_01: 2 August 2010  
Validity of the certificate until: 11 February 2015  
Test report: 936/21210511/A of 22 March 2010,  
Extension about Components NH<sub>3</sub> and TOC  
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln,  
Publication: BAnz. 28 July 2010, No. 111, p. 2597, Chapter I No. 1.2:  
Announcement by UBA from 12 July 2010.

**Supplementary testing according to EN 15267:**

Certificate No. 0000025926\_02: 9 February 2011  
Validity of the certificate until: 11 February 2015  
Test report: 936/21214593/A of 1 October 2010,  
Maintenance interval extension for the components NH<sub>3</sub> and TOC  
and supplementary range 0 – 50 mg/m<sup>3</sup> for NH<sub>3</sub>  
TÜV Rheinland Energie und Umwelt GmbH, Köln,  
Publication: BAnz. 26 January 2011, No. 14, p. 294, Chapter I No. 3.1:  
Announcement by UBA from 10 January 2011.

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

**Manufacturer data**

Manufacturer	SICK MAIHAK GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	ZrO <sub>2</sub>

**TÜV Data**

Approval Report	936/21211742A / 2009-10-26
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Editor	Röllig
Date	2009-10-26

**Measurement Component**

Certificated range	O <sub>2</sub>	21	Vol.-%
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**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 positive 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	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.092 Vol.-%	0.008 (Vol.-%) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -0.081 Vol.-%	0.007 (Vol.-%) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 0.104 Vol.-%	0.011 (Vol.-%) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -0.116 Vol.-%	0.013 (Vol.-%) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 0.129 Vol.-%	0.017 (Vol.-%) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.054 Vol.-%	0.003 (Vol.-%) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 0.000 Vol.-%	0.000 (Vol.-%) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> -0.015 Vol.-%	0.000 (Vol.-%) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub> 0.170 Vol.-%	0.029 (Vol.-%) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.30 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.58 Vol.-%

**Relative total expanded uncertainty**

<b>Requirement of 2000/76/EC and 2001/80/EC**</b>	<b>U in % of the range 21 Vol.-%</b>	<b>2.8</b>
<b>Requirement of EN 15267-3</b>	<b>U in % of the range 21 Vol.-%</b>	<b>10.0</b>
		<b>7.5</b>

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

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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	CO
	75 mg/m <sup>3</sup>

**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	1.20 mg/m <sup>3</sup>
Sum of negative CS at zero point	-1.35 mg/m <sup>3</sup>
Sum of positive CS at reference point	1.28 mg/m <sup>3</sup>
Sum of negative CS at reference point	-2.63 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	-2.63 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	-1.52 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.690 mg/m <sup>3</sup>	0.476 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -0.740 mg/m <sup>3</sup>	0.548 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> -0.780 mg/m <sup>3</sup>	0.608 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> 0.300 mg/m <sup>3</sup>	0.090 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> -0.740 mg/m <sup>3</sup>	0.548 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.130 mg/m <sup>3</sup>	0.017 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> -1.518 mg/m <sup>3</sup>	2.306 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.606 mg/m <sup>3</sup>	0.368 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.23 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	4.37 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC	<b>U in % of the ELV 50 mg/m<sup>3</sup></b>	<b>8.7</b>
Requirement of EN 15267-3	<b>U in % of the ELV 50 mg/m<sup>3</sup></b>	<b>10.0</b>
	<b>U in % of the ELV 50 mg/m<sup>3</sup></b>	<b>7.5</b>



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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	SO <sub>2</sub>	75 mg/m <sup>3</sup>
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	2.03 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.38 mg/m <sup>3</sup>
Sum of positive CS at reference point	3.00 mg/m <sup>3</sup>
Sum of negative CS at reference point	-0.60 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	3.00 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	1.73 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.250 mg/m <sup>3</sup>	0.063 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -0.430 mg/m <sup>3</sup>	0.185 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 1.340 mg/m <sup>3</sup>	1.796 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -1.080 mg/m <sup>3</sup>	1.166 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> -0.650 mg/m <sup>3</sup>	0.423 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> -0.350 mg/m <sup>3</sup>	0.123 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 1.732 mg/m <sup>3</sup>	3.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.606 mg/m <sup>3</sup>	0.368 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.67 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.23 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC	<b>U in % of the ELV 50 mg/m<sup>3</sup></b>	<b>10.5</b>
Requirement of EN 15267-3	<b>U in % of the ELV 50 mg/m<sup>3</sup></b>	<b>20.0</b>
	<b>U in % of the ELV 50 mg/m<sup>3</sup></b>	<b>15.0</b>



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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	NO
	200 mg/m <sup>3</sup>

**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	1.40 mg/m <sup>3</sup>
Sum of negative CS at zero point	-5.20 mg/m <sup>3</sup>
Sum of positive CS at reference point	6.80 mg/m <sup>3</sup>
Sum of negative CS at reference point	-4.80 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	6.80 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	3.93 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Repeatability standard deviation at set point *	u <sub>r</sub> 0.780 mg/m <sup>3</sup>	0.608 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> 0.810 mg/m <sup>3</sup>	0.656 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 2.080 mg/m <sup>3</sup>	4.326 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -3.460 mg/m <sup>3</sup>	11.972 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> -1.730 mg/m <sup>3</sup>	2.993 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> -0.920 mg/m <sup>3</sup>	0.846 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 3.926 mg/m <sup>3</sup>	15.413 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 1.617 mg/m <sup>3</sup>	2.613 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max j})^2}$	6.28 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	12.31 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC	<b>U in % of the ELV 130 mg/m<sup>3</sup></b>	<b>9,5</b>
Requirement of EN 15267-3	<b>U in % of the ELV 130 mg/m<sup>3</sup></b>	<b>20,0</b>
	<b>U in % of the ELV 130 mg/m<sup>3</sup></b>	<b>15,0</b>

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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	NO <sub>2</sub> 100 mg/m <sup>3</sup>
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	4.00 mg/m <sup>3</sup>
Sum of negative CS at zero point	-2.40 mg/m <sup>3</sup>
Sum of positive CS at reference point	4.00 mg/m <sup>3</sup>
Sum of negative CS at reference point	-3.60 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	4.00 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	2.31 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 1.740 mg/m <sup>3</sup>	3.028 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -0.810 mg/m <sup>3</sup>	0.656 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 1.500 mg/m <sup>3</sup>	2.250 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -1.330 mg/m <sup>3</sup>	1.769 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 0.750 mg/m <sup>3</sup>	0.563 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> -0.350 mg/m <sup>3</sup>	0.123 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 2.309 mg/m <sup>3</sup>	5.333 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.808 mg/m <sup>3</sup>	0.653 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	3.79 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	7.43 mg/m <sup>3</sup>

<b>Relative total expanded uncertainty</b>	<b>U in % of the ELV 70 mg/m<sup>3</sup></b>	<b>10.6</b>
<b>Requirement of 2000/76/EC and 2001/80/EC</b>	<b>U in % of the ELV 70 mg/m<sup>3</sup></b>	<b>20.0</b>
Requirement of EN 15267-3	U in % of the ELV 70 mg/m <sup>3</sup>	15.0



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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	HCl	15 mg/m <sup>3</sup>
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	0.59 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.08 mg/m <sup>3</sup>
Sum of positive CS at reference point	0.50 mg/m <sup>3</sup>
Sum of negative CS at reference point	0.08 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	0.59 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	0.34 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.170 mg/m <sup>3</sup>	0.029 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> 0.170 mg/m <sup>3</sup>	0.029 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> -0.210 mg/m <sup>3</sup>	0.044 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -0.250 mg/m <sup>3</sup>	0.063 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> -0.300 mg/m <sup>3</sup>	0.090 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.060 mg/m <sup>3</sup>	0.004 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 0.341 mg/m <sup>3</sup>	0.116 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.121 mg/m <sup>3</sup>	0.015 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.62 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	1.22 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC	<b>U in % of the ELV 10 mg/m<sup>3</sup></b>	<b>12,2</b>
Requirement of EN 15267-3	<b>U in % of the ELV 10 mg/m<sup>3</sup></b>	<b>40,0</b>
	<b>U in % of the ELV 10 mg/m<sup>3</sup></b>	<b>30,0</b>

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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	HF 3 mg/m <sup>3</sup>
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	0.12 mg/m <sup>3</sup>
Sum of negative CS at zero point	-0.08 mg/m <sup>3</sup>
Sum of positive CS at reference point	0.05 mg/m <sup>3</sup>
Sum of negative CS at reference point	-0.11 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	0.12 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	0.07 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Repeatability standard deviation at set point *	u <sub>r</sub> 0.050 mg/m <sup>3</sup>	0.003 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -0.029 mg/m <sup>3</sup>	0.001 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> -0.059 mg/m <sup>3</sup>	0.003 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -0.068 mg/m <sup>3</sup>	0.005 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 0.081 mg/m <sup>3</sup>	0.007 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.023 mg/m <sup>3</sup>	0.001 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 0.069 mg/m <sup>3</sup>	0.005 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.024 mg/m <sup>3</sup>	0.001 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.15 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	0.30 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC	<b>U in % of the ELV 1 mg/m<sup>3</sup></b>	<b>30.3</b>
Requirement of EN 15267-3	<b>U in % of the ELV 1 mg/m<sup>3</sup></b>	<b>40.0</b>
	<b>U in % of the ELV 1 mg/m<sup>3</sup></b>	<b>30.0</b>



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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	CH <sub>4</sub> 50 mg/m <sup>3</sup>
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	0.55 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.25 mg/m <sup>3</sup>
Sum of positive CS at reference point	1.35 mg/m <sup>3</sup>
Sum of negative CS at reference point	-0.60 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	1.35 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	0.78 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.540 mg/m <sup>3</sup>	0.292 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -0.200 mg/m <sup>3</sup>	0.040 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> -0.720 mg/m <sup>3</sup>	0.518 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -0.870 mg/m <sup>3</sup>	0.757 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 0.400 mg/m <sup>3</sup>	0.160 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.060 mg/m <sup>3</sup>	0.004 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 0.779 mg/m <sup>3</sup>	0.608 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.404 mg/m <sup>3</sup>	0.163 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.59 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.12 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

<b>Requirement of 2000/76/EC and 2001/80/EC**</b>	<b>U in % of the ELV 20 mg/m<sup>3</sup></b>	<b>15.6</b>
Requirement of EN 15267-3	U in % of the ELV 20 mg/m <sup>3</sup>	30.0
	U in % of the ELV 20 mg/m <sup>3</sup>	22.5

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

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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	CO <sub>2</sub>	25 Vol.-%
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	0.23 Vol.-%
Sum of negative CS at zero point	-0.73 Vol.-%
Sum of positive CS at reference point	0.80 Vol.-%
Sum of negative CS at reference point	-0.78 Vol.-%
Maximum sum of cross sensitivities	0.80 Vol.-%
Uncertainty of cross sensitivity	0.46 Vol.-%

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.360 Vol.-%	0.130 (Vol.-%) <sup>2</sup>
Lack of fit	u <sub>lof</sub> 0.100 Vol.-%	0.010 (Vol.-%) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 0.300 Vol.-%	0.090 (Vol.-%) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> 0.390 Vol.-%	0.152 (Vol.-%) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 0.300 Vol.-%	0.090 (Vol.-%) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.060 Vol.-%	0.004 (Vol.-%) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 0.462 Vol.-%	0.213 (Vol.-%) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 Vol.-%	0.000 (Vol.-%) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.202 Vol.-%	0.041 (Vol.-%) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.85 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	1.67 Vol.-%

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC**	<b>U in % of the range 25 Vol.-%</b>	<b>6.7</b>
Requirement of EN 15267-3	<b>U in % of the range 25 Vol.-%</b>	<b>10.0</b>
	<b>U in % of the range 25 Vol.-%</b>	<b>7.5</b>

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



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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	H <sub>2</sub> O	40 Vol.-%
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	0.80 Vol.-%
Sum of negative CS at zero point	-0.20 Vol.-%
Sum of positive CS at reference point	0.76 Vol.-%
Sum of negative CS at reference point	-0.76 Vol.-%
Maximum sum of cross sensitivities	0.80 Vol.-%
Uncertainty of cross sensitivity	0.46 Vol.-%

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions * u <sub>D</sub>	0.160 Vol.-%	0.026 (Vol.-%) <sup>2</sup>
Lack of fit u <sub>lof</sub>	0.370 Vol.-%	0.137 (Vol.-%) <sup>2</sup>
Zero drift from field test u <sub>d,z</sub>	-0.600 Vol.-%	0.360 (Vol.-%) <sup>2</sup>
Span drift from field test u <sub>d,s</sub>	0.670 Vol.-%	0.449 (Vol.-%) <sup>2</sup>
Influence of ambient temperature at span u <sub>t</sub>	0.280 Vol.-%	0.078 (Vol.-%) <sup>2</sup>
Influence of supply voltage u <sub>v</sub>	0.050 Vol.-%	0.003 (Vol.-%) <sup>2</sup>
Cross sensitivity (interference) u <sub>i</sub>	0.462 Vol.-%	0.213 (Vol.-%) <sup>2</sup>
Influence of sample gas flow u <sub>p</sub>	0.000 Vol.-%	0.000 (Vol.-%) <sup>2</sup>
Uncertainty of reference material at 70% of certification range u <sub>m</sub>	0.323 Vol.-%	0.105 (Vol.-%) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max j})^2}$	1.17 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.29 Vol.-%

**Relative total expanded uncertainty**

<b>Requirement of 2000/76/EC and 2001/80/EC**</b>	<b>U in % of the range 40 Vol.-%</b>	<b>5.7</b>
Requirement of EN 15267-3	U in % of the range 40 Vol.-%	10.0
		7.5

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

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

**Manufacturer data**

Manufacturer	Sick Maihak GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21206925A / 2008-10-20
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Editor	C. Landgraf
Date	2009-10-26

**Measurement Component**

Certificated range	N <sub>2</sub> O	50 mg/m <sup>3</sup>
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	1.95 mg/m <sup>3</sup>
Sum of negative CS at zero point	-0.70 mg/m <sup>3</sup>
Sum of positive CS at reference point	1.75 mg/m <sup>3</sup>
Sum of negative CS at reference point	-0.80 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	1.95 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	1.13 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Repeatability standard deviation at set point *	u <sub>r</sub> 0.250 mg/m <sup>3</sup>	0.063 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> 0.140 mg/m <sup>3</sup>	0.020 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> -0.120 mg/m <sup>3</sup>	0.014 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -0.520 mg/m <sup>3</sup>	0.270 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> -0.320 mg/m <sup>3</sup>	0.102 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.120 mg/m <sup>3</sup>	0.014 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 1.126 mg/m <sup>3</sup>	1.268 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.404 mg/m <sup>3</sup>	0.163 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.38 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.71 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

<b>Requirement of 2000/76/EC and 2001/80/EC**</b>	<b>U in % of the ELV 20 mg/m<sup>3</sup></b>	<b>13.6</b>
Requirement of EN 15267-3	U in % of the ELV 20 mg/m <sup>3</sup>	20.0
	U in % of the ELV 20 mg/m <sup>3</sup>	15.0

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



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

**Manufacturer data**

Manufacturer	SICK MAIHAK GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 1, TUEV 2, TUEV 3, TUEV 4
Measuring Principle	FTIR

**TÜV Data**

Approval Report	936/21210511/A / 2010-03-22
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Editor	Steinhagen
Date	2010-03-01

**Measurement Component**

Certificated range	NH <sub>3</sub> 10 mg/m <sup>3</sup>
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	0.40 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.00 mg/m <sup>3</sup>
Sum of positive CS at reference point	0.00 mg/m <sup>3</sup>
Sum of negative CS at reference point	-0.29 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	0.40 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	0.23 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.076 mg/m <sup>3</sup>	0.006 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -0.035 mg/m <sup>3</sup>	0.001 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 0.030 mg/m <sup>3</sup>	0.001 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> 0.170 mg/m <sup>3</sup>	0.029 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 0.072 mg/m <sup>3</sup>	0.005 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.072 mg/m <sup>3</sup>	0.005 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 0.231 mg/m <sup>3</sup>	0.053 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>m</sub> 0.081 mg/m <sup>3</sup>	0.007 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.33 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.64 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC**	U in % of the range mg/m <sup>3</sup>	6.4
Requirement of EN 15267-3	U in % of the range mg/m <sup>3</sup>	40,0
	U in % of the range mg/m <sup>3</sup>	30,0

\*\* For this component no requirements in the EC-directives 2001/80/EG und 2000/76/EG are given. The chosen value is recommended by the certification body.

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

**Manufacturer data**

Manufacturer	SICK MAIHAK GmbH
Name of measuring system	MCS 100 FT
Serial Number	TUEV 3, TUEV 4
Measuring Principle	FID

**TÜV Data**

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**Measurement Component**

Certificated range	TOC
	15 mg/m <sup>3</sup>

**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	0.46 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.00 mg/m <sup>3</sup>
Sum of positive CS at reference point	0.26 mg/m <sup>3</sup>
Sum of negative CS at reference point	0.00 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	0.46 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	0.27 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 0.046 mg/m <sup>3</sup>	0.002 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> 0.058 mg/m <sup>3</sup>	0.003 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 0.152 mg/m <sup>3</sup>	0.023 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -0.244 mg/m <sup>3</sup>	0.060 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 0.100 mg/m <sup>3</sup>	0.010 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.053 mg/m <sup>3</sup>	0.003 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 0.270 mg/m <sup>3</sup>	0.073 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> -0.063 mg/m <sup>3</sup>	0.004 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub> 0.121 mg/m <sup>3</sup>	0.015 (mg/m <sup>3</sup> ) <sup>2</sup>
Variation of response factors (TOC)	u <sub>rf</sub> 0.980 mg/m <sup>3</sup>	0.960 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.07 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.10 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

<b>Requirement of 2000/76/EC and 2001/80/EC</b>	<b>U in % of the ELV mg/m<sup>3</sup></b>	<b>21.0</b>
Requirement of EN 15267-3	U in % of the ELV mg/m <sup>3</sup>	30,0
	U in % of the ELV mg/m <sup>3</sup>	22,5

The chosen value is recommended by the certification body.