Umwelt
Bundes
Amt
For our Environment

TÜVRheinland®
Precisely Right.

CERTIFICATE

about Product Conformity (QAL1)

Number of Certificate: 0000025926_03

Certified AMS: MCS 100 FT for O_2, CO, SO_2, NO, NO_2, HCl, HF, CH_4, CO_2, H_2O, N_2O, NH_3 and TOC

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

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: 2007
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_02 of 9 February 2011
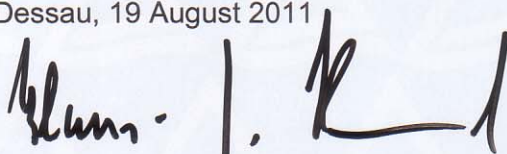
www.tuv.com
TÜVRheinland®
ID: 0000025926

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

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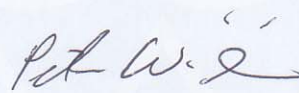(BAnz.) of 26 January 2011

The certificate is valid until:
11 February 2015

Umweltbundesamt
Dessau, 19 August 2011

TÜV Rheinland Energie und Umwelt GmbH
Köln, 17 August 2011

i. A. Dr. Hans-Joachim Hummel

ppa. Dr. Peter Wilbring

Test report:	936/21214593/A of 01 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

Authorised application

The tested 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 measurement 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 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:

- test report 936/21214593/A of TÜV Rheinland Energie und Umwelt GmbH of 01 October 2010
- test reports
    936/21210511/A of 22 March 2010,
    936/21211742/A of 26 October 2009,
    936/21206925/A of 20 October 2008 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH
- suitability announced by the German Environmental Agency (UBA) as relevant body
- the ongoing surveillance of the product and the manufacturing process
- 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)
- publication in the German Federal Gazette (BAnz. 29 July 2011, No 113, p. 2725, chapter III, notification 18, UBA publication of 15 July 2011)

AMS name:

MCS 100 FT for O_2, CO, SO_2, NO, NO_2, HCl, HF, CH_4, CO_2, H_2O, N_2O, NH_3 and TOC

Manufacturer:

SICK MAIHAK GmbH, Meersburg

Suitability:

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 measurement ranges			Unit
		Range 1	Range 2	Range 3	
O_2	0 - 21	-	-	-	Vol.-%
CO	0 - 75	0 - 300	0 - 1500	-	mg/m³
SO_2	0 - 75	0 - 300	0 - 1500	-	mg/m³
NO	0 - 200	0 - 400	0 - 2000	-	mg/m³
NO_2	0 - 100	-	0 - 500	-	mg/m³
HCl	0 - 15	0 - 90	0 - 150	-	mg/m³
HF	0 - 3	0 - 10	-	-	mg/m³
CH_4	0 - 50	-	0 - 150	-	mg/m³
CO_2	0 - 25	-	-	-	Vol.-%
H_2O	0 - 40	-	-	-	Vol.-%
N_2O	0 - 50	-	0 - 500	-	mg/m³
NH_3	0 - 10	0 - 50	-	-	mg/m³
TOC	0 - 15	0 - 50	0 - 150	0 - 500	mg/m³

Software versions:

MCS 100 FT Firmware 9114688_TJ59
SCU Installationspaket 9125028_T825

Restrictions:

None

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_2 is integrated, if the component TOC is integrated the maintenance interval amounts to two months, if the components CO_2, HF and NH_3 are integrated the maintenance interval amounts to three months, otherwise it is six months.
3. For the components NO_2 and HCl the requirements for the correlation coefficient R^2 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_2, NO, HCl, CH_4, N_2O, H_2O, CO_2, HF and NH_3 instead of test gases the automatic internal adjustment unit can be used.
6. Supplementary test (extension of the maintenance interval for the components NH_3 and TOC and supplementary range 0 – 50 mg/m³ for NH_3) 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 01 October 2010

---

18 notification on announcements of the Federal Environment Agency of 10 January 2011
(BAnz. p. 294, chapter I No 3.1 and chapter IV 30 notification).
The current software version of the AMS MCS 100 FT of SICK MAIHAK GmbH are:
MCS 100 FT: 9114688 UG07
SCU: 9125028 UP50
FID: 9140300
Statement of TÜV Rheinland Energie und Umwelt GmbH of 30 March 2011

Certified product

This certificate applies to automatic 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 (SFU-BF SPB) with heated filter (2 μm sintered metal special alloy), test gas port and back-flush possibility

- heated sample gas line (185 °C, PTFE $\varnothing_i$ = 4mm, 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 unit

- integrated oxygen measuring device using the zirconium-dioxide principle

- integrated TOC measurement with flame ionisation detector

- software versions: MCS 100 FT: 9114688_UG07
                                       SCU: 9125028_UP50
                                       FID: 9140300

General notes

This certificate is based upon the equipment tested. The manufacturer is responsible for a long-lasting compliance of the ongoing production process with the requirements of EN 15267. The manufacturer is obliged to maintain a certified quality management system to control the production of the certified product. Both product and quality management system 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 given address on page 1.

The certification mark with the product specific ID-Number which may be applied to the product or used in promotion material of the certified product is presented on page 1 of this certificate.

This document as well as the certification mark remain property of TÜV Rheinland Energie und Umwelt GmbH. Upon revocation of the announcement the certificate loses validity. After expiration of the validity of the certificate or on request of the TÜV Rheinland Energie und Umwelt GmbH this document shall be returned and the certification mark shall longer be used.

The current version of this certificate and its validity is also listed at the Internet Address: **qal1.de**.

Umwelt
Bundes
Amt
For our Environment

TÜVRheinland®
Precisely Right.

Certification of MCS 100 FT for O_2, CO, SO_2, NO, NO_2, HCl, HF, CH_4, CO_2, H_2O, N_2O, NH_3 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
without O_2, NH_3 and TOC
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 of: 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 of: 02 August 2010

Validity of the certificate until: 11 February 2015

Test report: 936/21210511/A of 22 March 2010,
Extension about Components NH_3 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 of: 09 February 2011

Validity of the certificate until: 11 February 2015

Test report: 936/21214593/A of 01 October 2010,
Maintenance interval extension for the components NH_3 and TOC
and supplementary range   0 – 50 mg/m³ for NH_3
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.

Notification according to EN 15267

Certificate No 0000025926_03 of: 19 August 2011

Validity of the certificate until: 11 February 2015

Statement of TÜV Rheinland Energie und Umwelt GmbH from 30 March 2011 (new Software)

Publication: BAnz. 29 July 2011, No 113, p. 2725, chapter III notification 18:
Announcement by UBA from 15 July 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_2

TÜV Data

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

Measurement Component O_2

Certificated range	21	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		u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.092	Vol.-%	0.008	(Vol.-%)²
Lack of fit	u_{lof}	-0.081	Vol.-%	0.007	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	0.104	Vol.-%	0.011	(Vol.-%)²
Span drift from field test	$u_{d,s}$	-0.116	Vol.-%	0.013	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.129	Vol.-%	0.017	(Vol.-%)²
Influence of supply voltage	u_v	0.054	Vol.-%	0.003	(Vol.-%)²
Cross sensitivity (interference)	u_i	0.000	Vol.-%	0.000	(Vol.-%)²
Influence of sample gas flow	u_p	-0.015	Vol.-%	0.000	(Vol.-%)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.170	Vol.-%	0.029	(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)	$u_c = \sqrt{\sum \left(u_{max,\, j}\right)^2}$	0.30 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.58 Vol.-%

Relative total expanded uncertainty	**U in % of the range 21 Vol.-%**	**2.8**
Requirement of 2000/76/EC and 2001/80/EC**	**U in % of the range 21 Vol.-%**	**10.0**
Requirement of EN 15267-3	U in % of the range 21 Vol.-%	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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component

Certificated range	CO	
	75	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	1.20	mg/m³
Sum of negative CS at zero point	-1.35	mg/m³
Sum of postive CS at reference point	1.28	mg/m³
Sum of negative CS at reference point	-2.63	mg/m³
Maximum sum of cross sensitivities	-2.63	mg/m³
Uncertainty of cross sensitivity	-1.52	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_D	0.690 mg/m³	0.476 (mg/m³)²
Lack of fit	u_{lof}	-0.740 mg/m³	0.548 (mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.780 mg/m³	0.608 (mg/m³)²
Span drift from field test	$u_{d,s}$	0.300 mg/m³	0.090 (mg/m³)²
Influence of ambient temperature at span	u_t	-0.740 mg/m³	0.548 (mg/m³)²
Influence of supply voltage	u_v	0.130 mg/m³	0.017 (mg/m³)²
Cross sensitivity (interference)	u_i	-1.518 mg/m³	2.306 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	2.23 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	4.37 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**8.7**
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

Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component SO_2

Certificated range	75	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	2.03	mg/m³
Sum of negative CS at zero point	0.38	mg/m³
Sum of postive CS at reference point	3.00	mg/m³
Sum of negative CS at reference point	-0.60	mg/m³
Maximum sum of cross sensitivities	3.00	mg/m³
Uncertainty of cross sensitivity	1.73	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_D	0.250 mg/m³	0.063 (mg/m³)²
Lack of fit	u_{lof}	-0.430 mg/m³	0.185 (mg/m³)²
Zero drift from field test	$u_{d,z}$	1.340 mg/m³	1.796 (mg/m³)²
Span drift from field test	$u_{d,s}$	-1.080 mg/m³	1.166 (mg/m³)²
Influence of ambient temperature at span	u_t	-0.650 mg/m³	0.423 (mg/m³)²
Influence of supply voltage	u_v	-0.350 mg/m³	0.123 (mg/m³)²
Cross sensitivity (interference)	u_i	1.732 mg/m³	3.000 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j} \right)^2}$	2.67 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.23 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**10.5**
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

Umwelt Bundes Amt
For our Environment

Certificate:
0000025926_03 / 19 August 2011

TÜVRheinland®
Precisely Right.

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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component	NO	
Certificated range	200	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	1.40	mg/m³
Sum of negative CS at zero point	-5.20	mg/m³
Sum of postive CS at reference point	6.80	mg/m³
Sum of negative CS at reference point	-4.80	mg/m³
Maximum sum of cross sensitivities	6.80	mg/m³
Uncertainty of cross sensitivity	3.93	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Repeatability standard deviation at set point *	u_r	0.780 mg/m³	0.608 (mg/m³)²
Lack of fit	u_{lof}	0.810 mg/m³	0.656 (mg/m³)²
Zero drift from field test	$u_{d,z}$	2.080 mg/m³	4.326 (mg/m³)²
Span drift from field test	$u_{d,s}$	-3.460 mg/m³	11.972 (mg/m³)²
Influence of ambient temperature at span	u_t	-1.730 mg/m³	2.993 (mg/m³)²
Influence of supply voltage	u_v	-0.920 mg/m³	0.846 (mg/m³)²
Cross sensitivity (interference)	u_i	3.926 mg/m³	15.413 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	1.617 mg/m³	2.613 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	6.28 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1{,}96$	12.31 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 130 mg/m³**	**9.5**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 130 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 130 mg/m³	**15.0**

Umwelt Bundes Amt
For our Environment

Certificate:
0000025926_03 / 19 August 2011

TÜVRheinland®
Precisely Right.

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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component NO_2

Certificated range	100	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	4.00	mg/m³
Sum of negative CS at zero point	-2.40	mg/m³
Sum of postive CS at reference point	4.00	mg/m³
Sum of negative CS at reference point	-3.60	mg/m³
Maximum sum of cross sensitivities	4.00	mg/m³
Uncertainty of cross sensitivity	2.31	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_D	1.740 mg/m³	3.028 (mg/m³)²
Lack of fit	u_{lof}	-0.810 mg/m³	0.656 (mg/m³)²
Zero drift from field test	$u_{d,z}$	1.500 mg/m³	2.250 (mg/m³)²
Span drift from field test	$u_{d,s}$	-1.330 mg/m³	1.769 (mg/m³)²
Influence of ambient temperature at span	u_t	0.750 mg/m³	0.563 (mg/m³)²
Influence of supply voltage	u_v	-0.350 mg/m³	0.123 (mg/m³)²
Cross sensitivity (interference)	u_i	2.309 mg/m³	5.333 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	3.79 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1{,}96$	7.43 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 70 mg/m³**	**10.6**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 70 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 70 mg/m³	15.0

Umwelt Bundes Amt
For our Environment

Certificate:
0000025926_03 / 19 August 2011

TÜVRheinland®
Precisely Right.

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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component   HCl
Certificated range   15   mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	0.59	mg/m³
Sum of negative CS at zero point	0.08	mg/m³
Sum of postive CS at reference point	0.50	mg/m³
Sum of negative CS at reference point	0.08	mg/m³
Maximum sum of cross sensitivities	0.59	mg/m³
Uncertainty of cross sensitivity	0.34	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_D	0.170 mg/m³	0.029 (mg/m³)²
Lack of fit	u_{lof}	0.170 mg/m³	0.029 (mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.210 mg/m³	0.044 (mg/m³)²
Span drift from field test	$u_{d,s}$	-0.250 mg/m³	0.063 (mg/m³)²
Influence of ambient temperature at span	u_t	-0.300 mg/m³	0.090 (mg/m³)²
Influence of supply voltage	u_v	0.060 mg/m³	0.004 (mg/m³)²
Cross sensitivity (interference)	u_i	0.341 mg/m³	0.116 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121 mg/m³	0.015 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	0.62 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1{,}96$	1.22 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**12.2**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 10 mg/m³**	**40.0**
Requirement of EN 15267-3	U in % of the ELV 10 mg/m³	30.0

Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component HF

Certificated range	3	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	0.12	mg/m³
Sum of negative CS at zero point	-0.08	mg/m³
Sum of postive CS at reference point	0.05	mg/m³
Sum of negative CS at reference point	-0.11	mg/m³
Maximum sum of cross sensitivities	0.12	mg/m³
Uncertainty of cross sensitivity	0.07	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Repeatability standard deviation at set point *	u_r	0.050 mg/m³	0.003 (mg/m³)²
Lack of fit	u_{lof}	-0.029 mg/m³	0.001 (mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.059 mg/m³	0.003 (mg/m³)²
Span drift from field test	$u_{d,s}$	-0.068 mg/m³	0.005 (mg/m³)²
Influence of ambient temperature at span	u_t	0.081 mg/m³	0.007 (mg/m³)²
Influence of supply voltage	u_v	0.023 mg/m³	0.001 (mg/m³)²
Cross sensitivity (interference)	u_i	0.069 mg/m³	0.005 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.024 mg/m³	0.001 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	0.15 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1{,}96$	0.30 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 1 mg/m³**	**30.3**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 1 mg/m³**	**40.0**
Requirement of EN 15267-3	U in % of the ELV 1 mg/m³	30.0

Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component CH_4

Certificated range	50	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	0.55	mg/m³
Sum of negative CS at zero point	0.25	mg/m³
Sum of postive CS at reference point	1.35	mg/m³
Sum of negative CS at reference point	-0.60	mg/m³
Maximum sum of cross sensitivities	1.35	mg/m³
Uncertainty of cross sensitivity	0.78	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_D	0.540 mg/m³	0.292 (mg/m³)²
Lack of fit	u_{lof}	-0.200 mg/m³	0.040 (mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.720 mg/m³	0.518 (mg/m³)²
Span drift from field test	$u_{d,s}$	-0.870 mg/m³	0.757 (mg/m³)²
Influence of ambient temperature at span	u_t	0.400 mg/m³	0.160 (mg/m³)²
Influence of supply voltage	u_v	0.060 mg/m³	0.004 (mg/m³)²
Cross sensitivity (interference)	u_i	0.779 mg/m³	0.608 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	1.59 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.12 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 20 mg/m³**	**15.6**
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/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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component CO_2

Certificated range 25 Vol.-%

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 postive 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^2	
Standard deviation from paired measurements under field conditions *	u_D	0.360	Vol.-%	0.130	(Vol.-%)²
Lack of fit	u_{lof}	0.100	Vol.-%	0.010	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	0.300	Vol.-%	0.090	(Vol.-%)²
Span drift from field test	$u_{d,s}$	0.390	Vol.-%	0.152	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.300	Vol.-%	0.090	(Vol.-%)²
Influence of supply voltage	u_v	0.060	Vol.-%	0.004	(Vol.-%)²
Cross sensitivity (interference)	u_i	0.462	Vol.-%	0.213	(Vol.-%)²
Influence of sample gas flow	u_p	0.000	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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	0.85 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1{,}96$	1.67 Vol.-%

Relative total expanded uncertainty	**U in % of the range 25 Vol.-%**	**6.7**
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 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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component H_2O

Certificated range   40   Vol.-%

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 postive 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^2
Standard deviation from paired measurements under field conditions *	u_D	0.160 Vol.-%	0.026 (Vol.-%)²
Lack of fit	u_{lof}	0.370 Vol.-%	0.137 (Vol.-%)²
Zero drift from field test	$u_{d,z}$	-0.600 Vol.-%	0.360 (Vol.-%)²
Span drift from field test	$u_{d,s}$	0.670 Vol.-%	0.449 (Vol.-%)²
Influence of ambient temperature at span	u_t	0.280 Vol.-%	0.078 (Vol.-%)²
Influence of supply voltage	u_v	0.050 Vol.-%	0.003 (Vol.-%)²
Cross sensitivity (interference)	u_i	0.462 Vol.-%	0.213 (Vol.-%)²
Influence of sample gas flow	u_p	0.000 Vol.-%	0.000 (Vol.-%)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.323 Vol.-%	0.105 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	1.17 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.29 Vol.-%

Relative total expanded uncertainty	**U in % of the range 40 Vol.-%**	**5.7**
Requirement of 2000/76/EC and 2001/80/EC**	**U in % of the range 40 Vol.-%**	**10.0**
Requirement of EN 15267-3	U in % of the range 40 Vol.-%	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.

Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

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
Editor	C. Landgraf
Date	2009-10-26

Measurement Component N_2O

Certificated range	50	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	1.95	mg/m³
Sum of negative CS at zero point	-0.70	mg/m³
Sum of postive CS at reference point	1.75	mg/m³
Sum of negative CS at reference point	-0.80	mg/m³
Maximum sum of cross sensitivities	1.95	mg/m³
Uncertainty of cross sensitivity	1.13	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Repeatability standard deviation at set point *	u_r	0.250 mg/m³	0.063 (mg/m³)²
Lack of fit	u_{lof}	0.140 mg/m³	0.020 (mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.120 mg/m³	0.014 (mg/m³)²
Span drift from field test	$u_{d,s}$	-0.520 mg/m³	0.270 (mg/m³)²
Influence of ambient temperature at span	u_t	-0.320 mg/m³	0.102 (mg/m³)²
Influence of supply voltage	u_v	0.120 mg/m³	0.014 (mg/m³)²
Cross sensitivity (interference)	u_i	1.126 mg/m³	1.268 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	1.38 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.71 mg/m³

Relative total expanded uncertainty	**U in % of the ELV 20 mg/m³**	**13.6**
Requirement of 2000/76/EC and 2001/80/EC**	**U in % of the ELV 20 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 20 mg/m³	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.

Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

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
Editor	Steinhagen
Date	2010-03-01

Measurement Component NH_3

Certificated range	10	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	0.40	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at reference point	0.00	mg/m³
Sum of negative CS at reference point	-0.29	mg/m³
Maximum sum of cross sensitivities	0.40	mg/m³
Uncertainty of cross sensitivity	0.23	mg/m³

Calculation of the combined standard uncertainty

Test Value		u	u²
Standard deviation from paired measurements under field conditions *	u_D	0.076 mg/m³	0.006 (mg/m³)²
Lack of fit	u_{lof}	-0.035 mg/m³	0.001 (mg/m³)²
Zero drift from field test	$u_{d,z}$	0.030 mg/m³	0.001 (mg/m³)²
Span drift from field test	$u_{d,s}$	0.170 mg/m³	0.029 (mg/m³)²
Influence of ambient temperature at span	u_t	0.072 mg/m³	0.005 (mg/m³)²
Influence of supply voltage	u_v	0.072 mg/m³	0.005 (mg/m³)²
Cross sensitivity (interference)	u_i	0.231 mg/m³	0.053 (mg/m³)²
Influence of sample gas flow	u_p	0.000 mg/m³	0.000 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.081 mg/m³	0.007 (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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	0.33 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.64 mg/m³

Relative total expanded uncertainty	**U in % of the range mg/m³**	**6.4**
Requirement of 2000/76/EC and 2001/80/EC**	**U in % of the range mg/m³**	**40.0**
Requirement of EN 15267-3	U in % of the range mg/m³	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.

Umwelt Bundes Amt
For our Environment

Certificate:
0000025926_03 / 19 August 2011

TÜVRheinland®
Precisely Right.

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

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

Measurement Component

TOC		
Certificated range	15	mg/m³

Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	0.46	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at reference point	0.26	mg/m³
Sum of negative CS at reference point	0.00	mg/m³
Maximum sum of cross sensitivities	0.46	mg/m³
Uncertainty of cross sensitivity	0.27	mg/m³

Calculation of the combined standard uncertainty

Test Value		u		u²	
Standard deviation from paired measurements under field conditions *	u_D	0.046	mg/m³	0.002	(mg/m³)²
Lack of fit	u_{lof}	0.058	mg/m³	0.003	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.152	mg/m³	0.023	(mg/m³)²
Span drift from field test	$u_{d,s}$	-0.244	mg/m³	0.060	(mg/m³)²
Influence of ambient temperature at span	u_t	0.100	mg/m³	0.010	(mg/m³)²
Influence of supply voltage	u_v	0.053	mg/m³	0.003	(mg/m³)²
Cross sensitivity (interference)	u_i	0.270	mg/m³	0.073	(mg/m³)²
Influence of sample gas flow	u_p	-0.063	mg/m³	0.004	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121	mg/m³	0.015	(mg/m³)²
Variation of response factors (TOC)	u_{rf}	0.980	mg/m³	0.960	(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)	$u_c = \sqrt{\sum \left(u_{max,\,j}\right)^2}$	1.07 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.10 mg/m³

Relative total expanded uncertainty	**U in % of the ELV mg/m³**	**21.0**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV mg/m³**	**30.0**
Requirement of EN 15267-3	U in % of the ELV mg/m³	22.5