Umwelt Bundes Amt
For our Environment

TÜVRheinland®
Precisely Right.

CERTIFICATE

about Product Conformity (QAL1)

Number of Certificate: 0000025926_01

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 Straße 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:

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 of 2010-02-12

www.tuv.com TÜVRheinland® ID: 0000025926

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

Publication in the German Federal Gazette (BAnz.) of 2010-07-28

The certificate is valid until: 2015-02-11

Umweltbundesamt

Dessau, 2010-08-02

i. A. Dr. Hans-Joachim Hummel

TÜV Rheinland Energie und Umwelt GmbH

Köln, 2010-07-29

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TÜV Rheinland Energie und Umwelt GmbH
Am Grauen Stein
51105 Köln

Accreditation according to EN ISO/IEC 17025:2005 and certification according to EN ISO 9001:2008

10/221 2.08

Test report:	936/21210511/A of 2010-03-22
First certification:	2010-02-12
Run of validity until:	2015-02-11
Publication	BAnz. 2010-07-28, No. 111, p. 2597

Approved application:
The certified AMS is suitable for use at combustion plants according to EC directive 2001-80-EC, at waste incinerations according to EC directive 2000-76-EC and other plants requiring official permission. The certification 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 three months duration at a municipal waste incinerator 1 and a third field test of the second additional test of more than 3 months at a municipal waste incinerator 2) of MCS 100 FT.

The AMS is approved for a temperature range of +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 936/21210511/A dated 2010-03-22, 936/21211742/A dated 2009-10-26 and 936/21206925/A dated 2008-10-20 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, 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. 2010-07-28, No. 111, p. 2597: UBA publication from 2010-07-12):

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

Approval:
For measurements at plants requiring official permission (i. e. and 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_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	-	-	-	mg/m³
TOC	0 - 15	0 - 50	0 - 150	0 - 500	mg/m³

Software versions:

MCS 100 FT Firmware 9114688_TJ59
SCU Installations-packet 9125028_T825
Sopas ET Version 2.20 Build 2766

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, NH_3 and TOC are integrated, if the components CO_2 and HF 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 and HF instead of test gases the automatic internal adjustment unit can be used.
6. Supplementary test (extension by the component NH_3 and TOC) to the publications of the German Federal Environmental Agency dated 2009-02-19 (BAnz. p. 901) and 2010-01-25 (BAnz. p. 553).

Test report:

TÜV Rheinland Immissionsschutz und Energiesysteme, Köln
Report-No.: 936/21210511/A of 2010-03-22

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 (SFU-BF SPB) with heated filter (2 µm sintered metal, special alloy), test gas port and back-flush possibility,
- sample gas line (PTFE $\varnothing_i$ = 4 mm) heated up to 185 °C (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,
- integrated flame ionisation detector for TOC measuring,
- software versions: MCS 100 FT Firmware 9114688_TJ59
  SCU Installations-packet 9125028_T825
  Sopas ET Version 2.20 Build 2766.

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 Energie und Umwelt 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 Energie und Umwelt 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 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 the MCS 100 FT measuring system for measuring the components 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:

Initial certification according to EN 15267:

Certificate No. 0000025926: 2010-02-12

Validity of the certificate: 2015-02-11

Test report: 936/21211742/A of 2009-10-26,
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln,

Publication: BAnz. 2010-02-12, No. 24, p. 553: Announcement by UBA from 2010-01-25.

Supplementary testing according to EN 15267:

Certificate No. 0000025926_01:2010-07-28

Validity of the certificate: 2015-02-11

Test report: 936/21211511/A of 2010-03-22,
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln,

Publication: BAnz. 2010-07-28, No. 111, p. 2597: Announcement by UBA from 2010-07-12.

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

Manufacturer data	
Manufacturer	SICK MAIHAK GmbH
Name of measuring system	TÜV 3 / TÜV 4
Serial Number	0736005 / 0736006
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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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 10 mg/m³**	**21.0**
Requirement of 2000/76/EC and 2001/80/EC	**U in % of the ELV 10 mg/m³**	**30,0**
Requirement of EN 15267-3	U in % of the ELV 10 mg/m³	22,5

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	TÜV 1 / TÜV 2 / TÜV 3 / TÜV 4
Serial Number	TÜV 1 / TÜV2 / 0736005 / 0736006
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_r	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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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 10 mg/m³**	**6.4**
Requirement of 2000/76/EC and 2001/80/EC**	**U in % of the range 10 mg/m³**	**40,0**
Requirement of EN 15267-3	U in % of the range 10 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.

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	u²
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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.30 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.58 Vol.-%

Relative total expanded uncertainty	**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	CO
Certificated range	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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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

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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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

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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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

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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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

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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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

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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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

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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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	u²
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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.85 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1{,}96$	1.67 Vol.-%

Relative total expanded uncertainty	**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	u²
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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.17 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.29 Vol.-%

Relative total expanded uncertainty	**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.

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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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.