

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000025926_05

Certified AMS: MCS 100 FT for CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, CH₄, TOC, O₂, H₂O, CO₂

Manufacturer: SICK AG
Nimburger Straße 11
79276 Reute
Germany

Test Institute: TÜV Rheinland Energy GmbH

**This is to certify that the AMS has been tested
and found to comply with the standards
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
(this certificate contains 25 pages).
The present certificate replaces certificate 0000025926_04 of 02 February 2015.

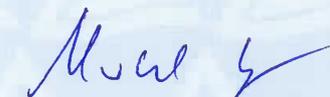


Suitability Tested
EN 15267
QAL1 Certified
Regular Surveillance

www.tuv.com
ID 0000025926

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

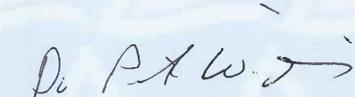
German Federal Environment Agency
Dessau, 12 February 2020



Dr. Marcel Langner
Head of Section II 4.1

This certificate will expire on:
11 February 2025

TÜV Rheinland Energy GmbH
Cologne, 11 February 2020



ppa. Dr. Peter Wilbring

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51105 Köln

Test institute accredited to EN ISO/IEC 17025:2005 by DAkkS (German Accreditation Body). This accreditation is limited to the accreditation scope defined in the enclosure to the certificate D-PL-11120-02-00.

Certificate:
0000025926_05 / 12 February 2020

Test report: 936/21214593/A of 1 October 2010
Initial certification: 12 February 2010
Expiry date: 11 February 2025
Certificate: renewal (previous 0000025926_04 dated 02 February 2015 with validity up to the 11 February 2020)
Publication: BAnz. 26. January 2011, no. 14, p. 294, chapter I no. 3.1

Approved application

The tested AMS is suitable for use at large combustion plants according to Directive 2001/80/EC, at waste incineration plants according to Directive 2000/76/EC, and other plants requiring official approval. The tested 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 the basis of a laboratory test and three field tests (field test during initial performance testing with a duration of more than one year at municipal waste incinerator 1; a second field test during the first supplementary testing with a duration of more than 6 months at municipal waste incinerator 1; and a third field test during the second supplementary testing with a duration of more than 6 months at municipal waste incinerator 2).

The AMS is approved for an ambient temperature range of +5 °C to +40 °C.

The notification of suitability of the AMS, performance testing, and the uncertainty calculation have been effected on the basis of the regulations valid at the time of performance testing. As changes in legal regulations are possible, any potential user should ensure that this AMS is suitable for monitoring the limit value and Oxygen concentration relevant to the application.

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

Basis of the certification

This certification is based on:

- test report 936/21214593/A of 1 October 2010 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- the ongoing surveillance of the product and the manufacturing process

Publication in the German Federal Gazette: BAnz. 26 January 2011, no. 14, p. 294, chapter I no. 3.1,
Announcement by UBA from 10 January 2011:

AMS designation:

MCS 100 FT for O₂, CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O, NH₃ and TOC

Manufacturer:

SICK MAIHAK GmbH, Meersburg

Field of application:

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

Measuring ranges during the performance test:

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/m ³
SO ₂	0 - 75	0 - 300	0 - 1500	-	mg/m ³
NO	0 - 200	0 - 400	0 - 2000	-	mg/m ³
NO ₂	0 - 100	-	0 - 500	-	mg/m ³
HCl	0 - 15	0 - 90	0 - 150	-	mg/m ³
HF	0 - 3	0 - 10	-	-	mg/m ³
CH ₄	0 - 50	-	0 - 150	-	mg/m ³
CO ₂	0 - 25	-	-	-	Vol.-%
H ₂ O	0 - 40	-	-	-	Vol.-%
N ₂ O	0 - 50	-	0 - 500	-	mg/m ³
NH ₃	0 - 10	0 - 50	-	-	mg/m ³
TOC	0 - 15	0 - 50	0 - 150	0 - 500	mg/m ³

Software version/s:

MCS 100 FT firmware 9114688_TJ59
SCU installation package 9125028_T825

Restrictions:

None

Notes:

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 O₂ is integrated, if the component TOC is integrated the maintenance interval amounts to two months, if the components CO₂, HF and NH₃ are integrated the maintenance interval amounts to three months, otherwise it is six months.
3. For the components NO₂ and HCl the requirements for the correlation coefficient R² 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 EN 15267-3 have not been fulfilled during performance testing.
5. For the span checks (QAL3) of components CO, SO₂, NO, HCl, CH₄, N₂O, H₂O, CO₂, HF, and NH₃ the automatic internal adjustment unit may be used as an alternative to of test gases.
6. Supplementary testing (extension of the maintenance interval for the components NH₃ and TOC and supplementary range 0 – 50 mg/m³ for NH₃) as regards German Federal Environment Agency notices of 12 July 2010 (BAnz. p. 2597, chapter I, no. 1.2).

Test report:

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

Publication in the German Federal Gazette: BAnz. 26 January 2011, no. 14, page 294, chapter IV notification 30 (sequential no. 10),
UBA announcement from 10 January 2011:

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

Seq. no.	AMS / Manufacturer	Notice	Notification	Statement of test institute
10	MCS 100 FT / SICK MAIHAK GmbH	as regards chapter I, no. 3.1 of this notice	The current version of the SOPAS ET software platform for optional control of the AMS is: SOPAS ET 2.38.	Statement of TÜV Rheinland Energie und Umwelt GmbH of 8 November 2010

Publication in the German Federal Gazette: BAnz. 29 July 2011, no. 113, p. 2725, chapter III notification 18,
UBA announcement from 15 July 2011:

18 Notification as regards Federal Environment Agency notices of 10 January 2011 (BAnz. p. 294, chapter I, no 3.1 and chapter IV 30th notification)

The current software versions for the MCS 100 FT measuring system manufactured by 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

Publication in the German Federal Gazette: BAnz. 2 March 2012, no. 36, p. 920, chapter V, notification 12,
UBA announcement from 23 February 2012:

12 Notification as regards Federal Environment Agency notices of 10 January 2011 (Federal Gazette (BAnz.) p. 294, chapter I, no. 3.1) and 15 July 2011 (Federal Gazette (BAnz.) p. 2725, chapter III 18th notification)

The MCS 100 FT multi-component measuring system manufactured by SICK MAIHAK GmbH

is equipped with a FI-detector for measuring TOC. Its construction was optimised. The ceramic insulation is now coated with Teflon.

Moreover, the MCS 100 FT measuring system was equipped with the new SCU-P100 display module. Status indicator lamps have been omitted and the operating status of the device is now shown in the display. The maintenance switch on the door has also been removed and can now be accessed via the SCU-P100. These modifications led to changes in the software version SCU-P100. The current software versions of the MCS 100 FT measuring system are:

MCS 100 FT:	9114688 UG07
SCU-P100:	9158931 V390
FID:	9140300

Statement by TÜV Rheinland Energie und Umwelt GmbH of 26 September 2011

Publication in the German Federal Gazette: BAnz AT 23.07.2013 B4, chapter V notification 12 (sequential no. 9),
UBA announcement from 3 July 2013:

12 Notification as regards Federal Environmental Agency notices regarding performance tested AMS manufactured by SICK MAIHAK GmbH

Seq. no.	AMS / Manufacturer	Notice	Notification	Statement of test institute
9	MCS 100 FT / SICK AG	of 10 January 2011 Federal Gazette (BAnz. p. 294, chapter I, no. 3.1) and of 23. February 2012 (BAnz. S. 290, chapter V, notification 12)	SICK MAIHAK GmbH merged with its parent company SICK AG as of 1 January 2013. The manufacturer is now registered as SICK AG.	Statement of TÜV Rheinland Energie und Umwelt GmbH of 25 March 2013

Publication in the German Federal Gazette: BAnz AT 23.07.2013 B4, chapter V notification 13 (sequential no. 10),
UBA announcement from 3 July 2013:

13 Notification as regards Federal Environmental Agency notices regarding performance tested AMS manufactured by SICK MAIHAK GmbH and performance tested AMS manufactured by SICK AG

Seq. no.	AMS / Manufacturer	Notice	Notification	Statement of test institute
10	MCS 100 FT / SICK AG	as regards notification 12 (sequential no. 9) of this notice	The current software version of the SOPAS ET platform for optional AMS control is: SOPAS ET 2.38.	Statement of TÜV Rheinland Energie und Umwelt GmbH of 25 March 2013

Publication in the German Federal Gazette: BAnz AT 01.04.2014 B12, chapter VI notification 17,
UBA announcement from 27 February 2014:

17 Notification as regards Federal Environment Agency notices of 10 January 2011 (BAnz. p. 294, chapter I, no. 3.1) and of 3 July 2013 (BAnz AT 23 July 2013 B4, chapter V, 13th notification [no. 10])

The current software versions of the MCS100FT measuring system manufactured by SICK AG are:

MCS100FT: 9114688 WC65
SCU: 9158931 VM19
FID: Wk16_120917_1400

Statement of TÜV Rheinland Energie und Umwelt GmbH of 30 September 2013

Publication in the German Federal Gazette: BAnz AT 26.08.2015 B4, chapter V notification 6,
UBA announcement from 22 July 2015:

6 Notification as regards Federal Environment Agency (UBA) notices of 10 January 2011 (Federal Gazette (BAnz.) p. 294, chapter I number 3.1) and of 27 February 2014 (Federal Gazette (BAnz.) AT 1 April 2014 B12, chapter VI 17th notification)

The current software versions for the MCS100FT measuring system for O₂, CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O, NH₃ and TOC, manufactured by SICK AG, are:

MCS100FT: 9191787 YHR2
SCU-P100: 9158931 X702
FID: Wk16_120917_1400

Statement of TÜV Rheinland Energie und Umwelt GmbH of 27 March 2015

Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, chapter V notification 32,
UBA announcement from 18 February 2016:

32 Notification as regards Federal Environment Agency (UBA) notices of 10 January 2011 (BAnz. p. 294, chapter I number 3.1) and of 22 July 2015 (BAnz AT 26.08.2015 B4, chapter V notification 6)

The current software versions of the measuring equipment MCS100FT for O₂, CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O, NH₃ and TOC of SICK AG is:

MCS100FT: 9191787 YHR2
SCU-P100: 9158931 X702
FID: 9185196 YH27

Statement of TÜV Rheinland Energie und Umwelt GmbH of 21 October 2015

Publication in the German Federal Gazette: BAnz AT 15.03.2017 B6, chapter V, notification 24,
UBA announcement from 22 February 2017:

24 Notification as regards Federal Environment Agency (UBA) notices of 10 January 2011 (BAnz. p. 294, chapter I number 3.1) and of 18 February 2016 (BAnz AT 14.03.2016 B7, chapter V 32nd notification)

The current software versions of the MCS100FT measuring system for O₂, CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O, NH₃ and total-C manufactured by SICK AG are:

MCS100FT: the current software version is 9191787_YNO9, moreover, software version 9191787_YKP7 is approved for the measuring system.

SCU-P100: the current software version is 9158931_YQK5, moreover, software versions 9158931_YG35 or 9158931_YHN2 are approved for the measuring system.

FID: The current software version is YH27_141124_1145.

Statement issued by TÜV Rheinland Energy GmbH dated 12 October 2016

Publication in the German Federal Gazette: BAnz AT 31.07.2017 B12, chapter II, notification 22,
UBA announcement from 13 July 2017:

22 Notification as regards Federal Environment Agency (UBA) notices of 10 January 2011 (BAnz p. 294, chapter I number 3.1) and dated 22 February 2017 (BAnz AT 15.03.2017 B6, chapter V 24th notification)

The current software versions of the MCS100FT measuring system for O₂, CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O, NH₃ and total-C manufactured by SICK AG are:

MCS100FT: 9191787_YNO9
SCU-P100: 9158931_YQK5
FID: 9185196_YNO9_151125_0800

The production site of this instrument has been moved to:
SICK AG, Rengoldshauser Str. 17a, 88662 Überlingen

Statement issued by TÜV Rheinland Energy GmbH dated 8 March 2017

Publication in the German Federal Gazette: BAnz AT 17.07.2018 B9, chapter III, notification 25,
UBA announcement from 3 July 2018:

25 Notification as regards Federal Environment Agency (UBA) notices dated 10 January 2011 (BAnz. p. 294, chapter I number 3.1) and dated 13 July 2017 (BAnz AT 31.07.2017 B12, chapter II 22nd notification)

The MCS100FT measuring system for O₂, CO, SO₂, NO, NO₂, HCl, HF, CH₄, CO₂, H₂O, N₂O, NH₃ and TOC manufactured by SICK AG now provides a digital Modbus interface (TCP/IP) in accordance with VDI 4201 parts 1 and 3.

Report no. 936/21242227/A dated 2 May 2018 issued by TÜV Rheinland Energy GmbH presents the corresponding test results. The current software versions are:

MCS100FT: 9191787_YNO9,
SCU-P100: 9158931_YXS3,
FID: 9185196_YNO9_151125_0800

Statement issued by TÜV Rheinland Energy GmbH dated 2 May 2018

Certified product

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

The MCS 100 FT is a multi-component analyser system. The gas sample of the gas to be measured is taken from the flue gas duct by means of a sampling probe. A heated sample gas line is used to feed the gas to the analyser system. A Fourier transform infrared spectrometer (FTIR-spectrometer) is employed for the spectral analysis of 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 Ø_i = 4 mm, 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: MCS100FT: 9191787_YNO9
SCU-P100: 9158931_YXS3
FID: 9185196_YNO9_151125_0800

General notes

This certificate is based upon the equipment tested. The manufacturer is responsible for ensuring that on-going production complies with the requirements of the EN 15267. The manufacturer is required to maintain an approved quality management system controlling the manufacture of the certified product. Both the product and the quality management systems shall be subject to regular surveillance.

If a product of the current production does not conform to the certified product, TÜV Rheinland Energy GmbH must be notified at the address given on page 1.

A certification mark with an ID-Number that is specific to the certified product is presented on page 1 of this certificate. This certification mark may be applied to the product or used in advertising materials for the certified product.

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

The relevant version of this certificate and its expiration is also accessible on the internet: gal1.de.

History of documents

Certification of MCS 100 FT 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 O₂, NH₃ and TOC

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Publication: BAnz. 11 March 2009, no. 38, p. 901, chapter I no. 2.2

UBA announcement of 19 February 2009

Initial certification according to EN 15267

Certificate No. 0000025926: 15 March 2010

Expiry date of the certificate: 11 February 2015

Test report 936/21211742/A dated 26 October 2009,

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Publication: BAnz. 12 February 2010, no. 24, p. 553, chapter I no. 1.3

Announcement by UBA dated 25 January 2010

Supplementary testing according to EN 15267

Certificate No. 0000025926_01: 02 August 2010
Expiry date of the certificate: 11 February 2015
Test report 936/21210511/A of 22 March 2010,
extension to include the components NH₃ and TOC
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 28 July 2010, no. 111, p. 2597, chapter I no. 1.2
Announcement by UBA dated 12 July 2010

Supplementary testing according to EN 15267

Certificate No. 0000025926_02: 09 February 2011
Expiry date of the certificate: 11 February 2015
Test report 936/21214593/A of 1 October 2010,
extension of the maintenance interval for the components NH₃ and TOC
and supplementary range 0 – 50 mg/m³ for NH₃
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz. 26 January 2011, no. 14, p. 294, chapter I no. 3.1
Announcement by UBA dated 10 January 2011

Notifications according to EN 15267

Statement of TÜV Rheinland Energie und Umwelt GmbH of 8 November 2010
Publication: BAnz. 26 January 2011, no. 14, page 294, chapter IV, notification 30 (sequential
no. 10)
Announcement by UBA dated 10 January 2011
(new software version)

Certificate based on a notification according to EN 15267

Certificate No. 0000025926_03: 19 August 2011
Expiry date of the certificate: 11 February 2015
Statement of TÜV Rheinland Energie und Umwelt GmbH dated 30 March 2011
Test report 936/21214593/A of 1 October 2010,
Publication: BAnz. 29 July 2011, no. 113, p. 2725, chapter III notification 18
Announcement by UBA dated 15 July 2011
(new software version, display)

Notifications according to EN 15267

Statement of TÜV Rheinland Energie und Umwelt GmbH of 26 September 2011
Publication: BAnz. 2 March 2012, no. 36, p. 920, chapter V notification 12
Announcement by UBA dated 23 February 2012
(new software version, hardware changes)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 25 March 2013
Publication: BAnz AT 23.07.2013 B4, chapter V notification 12 (sequential no. 9) and 13 (se-
quential no. 10)
Announcement by UBA dated 3 July 2013
(new software version, new manufacturer name)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 30 September 2013
Publication: BAnz AT 01.04.2014 B12, chapter VI notification 17
Announcement by UBA dated 27 February 2014
(new software version)

Renewal of the certificate

Certificate No. 0000025926_04: 02 February 2015
Expiry date of the certificate: 11 February 2020

Notifications according to EN 15267

Statement of TÜV Rheinland Energie und Umwelt GmbH of 27 March 2015
Publication: BAnz AT 26.08.2015 B4, chapter V notification 6
Announcement by UBA dated 22 July 2015
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 21 October 2015
Publication: BAnz AT 14.03.2016 B7, chapter V notification 32
Announcement by UBA dated 18 February 2016
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 12 October 2016
Publication: BAnz AT 15.03.2017 B6, chapter V notification 24
Announcement by UBA dated 22 February 2017
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 8 March 2017
Publication: BAnz AT 31.07.2017 B12, chapter II, notification 22
Announcement by UBA dated 13 July 2017
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 2 May 2018
Test report 936/21242227/A of 2 May 2018,
Publication: BAnz AT 17.07.2018 B9, chapter III, notification 25
Announcement by UBA dated 3 July 2018
(new software version, supplementary digital Modbus (TCP/IP))

Renewal of the certificate

Certificate No. 0000025926_05: 12 February 2020
Expiry date of the certificate: 11 February 2025

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	936/21214593/A
Editor	Röllig
Date	2010-10-01

Measurement Component

Certificated range	O ₂	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 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 _o -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

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

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

*** At the beginning of performance testing the instruments did not have a serial number.
By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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 936/21214593/A

Editor C. Landgraf
Date 2010-10-01

Measurement Component

Certificated range CO
75 mg/m³

Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value	u	u ²
Standard deviation from paired measurements under field conditions *	u_D 0.690 mg/m ³	0.476 (mg/m ³) ²
Lack of fit	u_{lof} -0.740 mg/m ³	0.548 (mg/m ³) ²
Zero drift from field test	$u_{d.z}$ -0.780 mg/m ³	0.608 (mg/m ³) ²
Span drift from field test	$u_{d.s}$ 0.300 mg/m ³	0.090 (mg/m ³) ²
Influence of ambient temperature at span	u_t -0.740 mg/m ³	0.548 (mg/m ³) ²
Influence of supply voltage	u_v 0.130 mg/m ³	0.017 (mg/m ³) ²
Cross sensitivity (interference)	u_i -1.518 mg/m ³	2.306 (mg/m ³) ²
Influence of sample gas flow	u_p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.606 mg/m ³	0.368 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	4.37 mg/m ³

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/m ³	7.5

*** At the beginning of performance testing the instruments did not have a serial number. By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
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Editor	C. Landgraf
Date	2010-10-01

Measurement Component

Certificated range	SO ₂ 75 mg/m ³
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Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value	u	u ²
Standard deviation from paired measurements under field conditions *	u _D 0.250 mg/m ³	0.063 (mg/m ³) ²
Lack of fit	u _{lof} -0.430 mg/m ³	0.185 (mg/m ³) ²
Zero drift from field test	u _{d.z} 1.340 mg/m ³	1.796 (mg/m ³) ²
Span drift from field test	u _{d.s} -1.080 mg/m ³	1.166 (mg/m ³) ²
Influence of ambient temperature at span	u _t -0.650 mg/m ³	0.423 (mg/m ³) ²
Influence of supply voltage	u _v -0.350 mg/m ³	0.123 (mg/m ³) ²
Cross sensitivity (interference)	u _i 1.732 mg/m ³	3.000 (mg/m ³) ²
Influence of sample gas flow	u _p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 0.606 mg/m ³	0.368 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.23 mg/m ³

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/m ³	15.0

*** At the beginning of performance testing the instruments did not have a serial number.
By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
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Editor	C. Landgraf
Date	2010-10-01

Measurement Component

Certificated range	NO 200 mg/m ³
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Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value

	u	u ²
Repeatability standard deviation at set point *	u _r 0.780 mg/m ³	0.608 (mg/m ³) ²
Lack of fit	u _{lof} 0.810 mg/m ³	0.656 (mg/m ³) ²
Zero drift from field test	u _{d.z} 2.080 mg/m ³	4.326 (mg/m ³) ²
Span drift from field test	u _{d.s} -3.460 mg/m ³	11.972 (mg/m ³) ²
Influence of ambient temperature at span	u _t -1.730 mg/m ³	2.993 (mg/m ³) ²
Influence of supply voltage	u _v -0.920 mg/m ³	0.846 (mg/m ³) ²
Cross sensitivity (interference)	u _i 3.926 mg/m ³	15.413 (mg/m ³) ²
Influence of sample gas flow	u _p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 1.617 mg/m ³	2.613 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	12.31 mg/m ³

Relative total expanded uncertainty

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

*** At the beginning of performance testing the instruments did not have a serial number.

By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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 936/21214593/A

Editor C. Landgraf
Date 2010-10-01

Measurement Component

Certificated range NO₂
100 mg/m³

Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value	u	u ²
Standard deviation from paired measurements under field conditions *	u _D 1.740 mg/m ³	3.028 (mg/m ³) ²
Lack of fit	u _{lof} -0.810 mg/m ³	0.656 (mg/m ³) ²
Zero drift from field test	u _{d.z} 1.500 mg/m ³	2.250 (mg/m ³) ²
Span drift from field test	u _{d.s} -1.330 mg/m ³	1.769 (mg/m ³) ²
Influence of ambient temperature at span	u _t 0.750 mg/m ³	0.563 (mg/m ³) ²
Influence of supply voltage	u _v -0.350 mg/m ³	0.123 (mg/m ³) ²
Cross sensitivity (interference)	u _i 2.309 mg/m ³	5.333 (mg/m ³) ²
Influence of sample gas flow	u _p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 0.808 mg/m ³	0.653 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	7.43 mg/m ³

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/m ³	15.0

*** At the beginning of performance testing the instruments did not have a serial number.
By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
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Editor	C. Landgraf
Date	2010-10-01

Measurement Component

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

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

Calculation of the combined standard uncertainty

Test Value	u	u ²
Standard deviation from paired measurements under field conditions *	u_D 0.170 mg/m ³	0.029 (mg/m ³) ²
Lack of fit	u_{lof} 0.170 mg/m ³	0.029 (mg/m ³) ²
Zero drift from field test	$u_{d.z}$ -0.210 mg/m ³	0.044 (mg/m ³) ²
Span drift from field test	$u_{d.s}$ -0.250 mg/m ³	0.063 (mg/m ³) ²
Influence of ambient temperature at span	u_t -0.300 mg/m ³	0.090 (mg/m ³) ²
Influence of supply voltage	u_v 0.060 mg/m ³	0.004 (mg/m ³) ²
Cross sensitivity (interference)	u_i 0.341 mg/m ³	0.116 (mg/m ³) ²
Influence of sample gas flow	u_p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.121 mg/m ³	0.015 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	1.22 mg/m ³

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/m ³	30.0

*** At the beginning of performance testing the instruments did not have a serial number.
By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
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Editor	C. Landgraf
Date	2010-10-01

Measurement Component

Certificated range	HF 3 mg/m ³
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Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value

	u	u ²
Repeatability standard deviation at set point *	u _r 0.050 mg/m ³	0.003 (mg/m ³) ²
Lack of fit	u _{lof} -0.029 mg/m ³	0.001 (mg/m ³) ²
Zero drift from field test	u _{d.z} -0.059 mg/m ³	0.003 (mg/m ³) ²
Span drift from field test	u _{d.s} -0.068 mg/m ³	0.005 (mg/m ³) ²
Influence of ambient temperature at span	u _t 0.081 mg/m ³	0.007 (mg/m ³) ²
Influence of supply voltage	u _v 0.023 mg/m ³	0.001 (mg/m ³) ²
Cross sensitivity (interference)	u _i 0.069 mg/m ³	0.005 (mg/m ³) ²
Influence of sample gas flow	u _p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 0.024 mg/m ³	0.001 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	0.30 mg/m ³

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/m ³	30.0

*** At the beginning of performance testing the instruments did not have a serial number. By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
Editor	C. Landgraf
Date	2010-10-01

Measurement Component

Certificated range	CH ₄ 50 mg/m ³
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Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value

	u	u ²
Standard deviation from paired measurements under field conditions * u _D	0.540 mg/m ³	0.292 (mg/m ³) ²
Lack of fit u _{lof}	-0.200 mg/m ³	0.040 (mg/m ³) ²
Zero drift from field test u _{d,z}	-0.720 mg/m ³	0.518 (mg/m ³) ²
Span drift from field test u _{d,s}	-0.870 mg/m ³	0.757 (mg/m ³) ²
Influence of ambient temperature at span u _t	0.400 mg/m ³	0.160 (mg/m ³) ²
Influence of supply voltage u _v	0.060 mg/m ³	0.004 (mg/m ³) ²
Cross sensitivity (interference) u _i	0.779 mg/m ³	0.608 (mg/m ³) ²
Influence of sample gas flow u _p	0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range u _{rm}	0.404 mg/m ³	0.163 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.12 mg/m ³

Relative total expanded uncertainty

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

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

*** At the beginning of performance testing the instruments did not have a serial number.
By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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 ₂	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 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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	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**	U in % of the range 25 Vol.-%	6.7
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	10.0 **

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

*** At the beginning of performance testing the instruments did not have a serial number.
By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
Editor	C. Landgraf
Date	2010-10-01

Measurement Component

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

Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC**	U in % of the range 40 Vol.-%	5.7
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. A value of 10 % was used for this.

*** At the beginning of performance testing the instruments did not have a serial number. By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
Editor	C. Landgraf
Date	2010-10-01

Measurement Component

Certificated range	N ₂ O	50 mg/m ³
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Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value

	u	u ²
Repeatability standard deviation at set point *	u _r 0.250 mg/m ³	0.063 (mg/m ³) ²
Lack of fit	u _{lof} 0.140 mg/m ³	0.020 (mg/m ³) ²
Zero drift from field test	u _{d,z} -0.120 mg/m ³	0.014 (mg/m ³) ²
Span drift from field test	u _{d,s} -0.520 mg/m ³	0.270 (mg/m ³) ²
Influence of ambient temperature at span	u _t -0.320 mg/m ³	0.102 (mg/m ³) ²
Influence of supply voltage	u _v 0.120 mg/m ³	0.014 (mg/m ³) ²
Cross sensitivity (interference)	u _i 1.126 mg/m ³	1.268 (mg/m ³) ²
Influence of sample gas flow	u _p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 0.404 mg/m ³	0.163 (mg/m ³) 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/m ³
Total expanded uncertainty	U = u _c * k = u _c * 1.96	2.71 mg/m ³

Relative total expanded uncertainty

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

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

*** At the beginning of performance testing the instruments did not have a serial number. By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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	936/21214593/A
Editor	Steinhagen
Date	2010-10-01

Measurement Component

Certificated range	NH ₃ 10 mg/m ³
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Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value

	u	u ²
Standard deviation from paired measurements under field conditions *	u _D 0.076 mg/m ³	0.006 (mg/m ³) ²
Lack of fit	u _{lof} -0.035 mg/m ³	0.001 (mg/m ³) ²
Zero drift from field test	u _{d,z} 0.030 mg/m ³	0.001 (mg/m ³) ²
Span drift from field test	u _{d,s} 0.170 mg/m ³	0.029 (mg/m ³) ²
Influence of ambient temperature at span	u _t 0.072 mg/m ³	0.005 (mg/m ³) ²
Influence of supply voltage	u _v 0.072 mg/m ³	0.005 (mg/m ³) ²
Cross sensitivity (interference)	u _i 0.231 mg/m ³	0.053 (mg/m ³) ²
Influence of sample gas flow	u _p 0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 0.081 mg/m ³	0.007 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.64 mg/m ³

Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC	U in % of the range mg/m³	6.4
Requirement of EN 15267-3	U in % of the range mg/m³	40.0 **
	U in % of the range mg/m³	30.0

** For this component no requirements in the EC-directives 2001/80/EC und 2000/76/EC are given.

A value of 40 % was used for this.

*** At the beginning of performance testing the instruments did not have a serial number.

By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.

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
Editor	Steinhagen
Date	2010-03-01

Measurement Component

Certificated range	15 mg/m ³
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Evaluation of the cross sensitivity (CS)

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

Calculation of the combined standard uncertainty

Test Value	u	u ²
Standard deviation from paired measurements under field conditions *	u _D 0.046 mg/m ³	0.002 (mg/m ³) ²
Lack of fit	u _{lof} 0.058 mg/m ³	0.003 (mg/m ³) ²
Zero drift from field test	u _{d.z} 0.152 mg/m ³	0.023 (mg/m ³) ²
Span drift from field test	u _{d.s} -0.244 mg/m ³	0.060 (mg/m ³) ²
Influence of ambient temperature at span	u _t 0.100 mg/m ³	0.010 (mg/m ³) ²
Influence of supply voltage	u _v 0.053 mg/m ³	0.003 (mg/m ³) ²
Cross sensitivity (interference)	u _i 0.270 mg/m ³	0.073 (mg/m ³) ²
Influence of sample gas flow	u _p -0.063 mg/m ³	0.004 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm} 0.121 mg/m ³	0.015 (mg/m ³) ²
Variation of response factors (TOC)	u _{rf} 0.980 mg/m ³	0.960 (mg/m ³) 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/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.10 mg/m ³

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/m ³	22.5

*** At the beginning of performance testing the instruments did not have a serial number. By the time the final tests were carried out, the instruments TUEV 3 (0736005) and TUEV 4 (0736006) had been assigned the aforementioned serial numbers.