

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040218

Certified AMS: Model 43i for SO₂

Manufacturer: Thermo Fisher Scientific
27 Forge Parkway
Franklin, MA 02038
USA

Test Institute: TÜV Rheinland Energie und Umwelt GmbH

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

**VDI 4202-1: 2002, VDI 4203-2: 2004, EN 14212: 2012,
EN 15267-1: 2009, EN 15267-2: 2009**

Certification is awarded in respect of the conditions stated in this certificate
(see also the following pages).



Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance

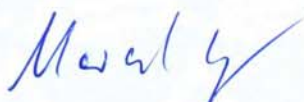
www.tuv.com
ID 0000040218

Publication in the German Federal Gazette
(BAnz.) of 08 April 2006

This certificate will expire on:
31 March 2019

German Federal Environment Agency
Dessau, 29 April 2014

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 28 April 2014



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ppa. Dr. Peter Wilbring

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Am Grauen Stein
51105 Cologne

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

Certificate:
0000040218 / 29 April 2014

Test report: 936/21203248/D1 of 07 July 2006
Addendum 936/21221382/C of 20 September 2013

Initial certification: 01 April 2014

Date of expiry: 31 March 2019

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 23

Approved application

The certified AMS is suitable for continuous monitoring of SO₂ in ambient air.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a three-month field test.

The AMS is approved for a temperature range of 0 °C to +30 °C.

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

Basis of the certification

This certification is based on:

- test report 936/21203248/D1 of 07 July 2006 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and Addendum 936/21221382/C of 20 September 2013 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- the on-going surveillance of the product and the manufacturing process
- publication in the German Federal Gazette (BAnz. 14 October 2006, No. 194, p. 6715, chapter IV, No. 2.2, UBA publication from 12 September 2006)
- publication in the German Federal Gazette (BAnz. 20 April 2007, No. 75, p. 4139, chapter IV, notification 1 and 6, UBA publication from 12 April 2007)
- publication in the German Federal Gazette (BAnz. 03 September 2008, No. 133, p. 3242, chapter IV, notification 13, UBA publication from 12 August 2008)
- publication in the German Federal Gazette (BAnz. 25 August 2009, No. 125, p. 2929, chapter III, notification 17, UBA publication from 03 August 2009)
- publication in the German Federal Gazette (BAnz. 28 July 2010, No. 111, p. 2597, chapter III, notification 5, UBA publication from 12 July 2010)
- publication in the German Federal Gazette (BAnz. 29 July 2011, No. 113, p. 2725, chapter III, notification 19, UBA publication from 15 July 2011)
- publication in the German Federal Gazette (BAnz. AT 20 July 2012 B11, chapter IV, notification 24, UBA publication from 06 July 2012)
- publication in the German Federal Gazette (BAnz AT 01 April 2014 B12, chapter VI, notification 23, UBA publication from 27 February 2014)

AMS designation:

SO₂ analyzer Model 43i

Manufacturer:

Thermo Electron Corporation Franklin, USA
Distribution:
Thermo Electron Corporation, Erlangen

Field of application:

For continuous monitoring of sulphur dioxide in ambient air.

Measuring ranges during the performance test:

SO₂ 0 - 700 µg/m³ und
0 - 1000 µg/m³

Software version:

V 01.03.00.083

Testing institute:

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne,
TÜV Rheinland Group
Bericht-Nr.: 936/21203248/D of 7 July 2006

1 Notification of the German Federal Environment Agency

The new name of Thermo Electron Corp., Franklin, USA is Thermo Fisher Scientific, Franklin, USA.

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme, 51101 Cologne, Germany, Dr. Peter Wilbring, dated 20th December 2006

6 Notification of announcements by the German Federal Environment Agency dated 21st February 2006 (BAnz. p. 2653) and 12th September 2006 (BAnz. p. 6715)

The measuring systems model 42i for nitrogen oxide, model 43i for sulphur dioxide, model 48i for carbon monoxide and model 49i for ozone, manufactured by Thermo Fisher Scientific, MA 02038, USA, are also manufactured and sold identically and to the same standards by MLU-Monitoring für Leben und Umwelt Ges.m.b.H., Mödling, Austria.

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme, 51101 Cologne, Germany, Dr. Peter Wilbring, dated 14th December 2006

13 Notification of announcement by the German Federal Environment Agency dated 12th September 2006 (BAnz. p. 6717)

The current software version of the ambient air measuring system 43i by Thermo Fisher Scientific is:

V 01.05.06 (105721-00)

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme dated 10th March 2008

17 Notification of announcement by the German Federal Environment Agency dated 12th September 2006 (BAnz. p. 6717)

The current software version of the ambient air measuring system 43i by Thermo Fisher Scientific is:

V 01.06.01 (108457-00)

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 1st April 2009

5 Notification of announcements by the German Federal Environment Agency dated 12th September 2006 (BAnz. p. 6717) and 3rd August 2009 (BAnz. p. 2936)

The ambient air measuring system model 43i by Thermo Fisher Scientific can now also be operated with a sample gas pump type PU1959-N86-3.07 manufactured by KNF.

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 23rd März 2010

19 Notification of announcements by the German Federal Environment Agency dated 12th September 2006 (BAnz. p. 6715, Chapter IV Number 2.2) and 12th July 2010 (BAnz. p. 2597, Chapter III 5th notification)

The current software version of the ambient air measuring system model 43i for SO₂ by Thermo Fisher Scientific is:

V 01.06.07 (110959-00)

Statement by TÜV Rheinland Energie und Umwelt GmbH dated 30th March 2011

24 Notification of announcements by the German Federal Environment Agency dated 12th September 2006 (BAnz. p. 6715, Chapter IV Number 2.2) and 15th July 2011 (BAnz. p. 2725, Chapter III 19th notification)

The current software version of the ambient air measuring system model 43i for SO₂ by Thermo Fisher Scientific is 01.06.08.

The ambient air measuring system model 43i for SO₂ by Thermo Fisher Scientific will be fitted with the type PU2737-N86 vacuum pump manufactured by KNF.

Statement by TÜV Rheinland Energie und Umwelt GmbH dated 20th March 2012

23 Notification of announcements by the German Federal Environment Agency dated 12th September 2006 (BAnz. p. 6717, Chapter II Number 2.2) and 6th July 2012 (BAnz. AT 20.07.2012 B11, Chapter IV 24th notification)

The measuring system model 43i for SO₂ by Thermo Fisher Scientific fulfils the requirements of Standard EN 14212 (November 2012). Furthermore, the manufacturing process and quality management system of the measuring system model 43i for SO₂ fulfil the requirements of EN 15267.

The test report of the performance test with report number 936/21203248/D1 as well as an addendum as an integral part of the test report with report number 936/21221382/C can be viewed on the internet at www.qal1.de.

The Hamamatsu 1P28HA-5 photomultiplier was withdrawn and replaced by the new Hamamatsu R11568-15 photomultiplier.

The Arcturus Bd. 101491-xx processor board was withdrawn and replaced by the new Arcturus Bd. 110570-xx processor board.

The current software version of the measuring system is:
V 02.00.00 (113419-00)

Statement by TÜV Rheinland Energie und Umwelt GmbH dated 2nd October 2013

Certified product

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

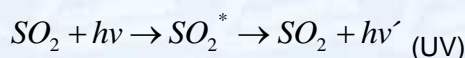
The sample is drawn into the model 43i through the sample bulkhead. The sample flows through a hydrocarbon “kicker” which removes hydrocarbons from the sample by forcing the hydrocarbon molecules to permeate through the tube wall. The SO₂ molecules pass through the hydrocarbon “kicker” unaffected.

The sample flows into the fluorescence chamber, where pulsating UV light excites the SO₂ molecules. The condensing lens focuses the pulsating UV light into the minor assembly. The minor assembly contains four selective mirrors that reflect only the wavelength which excite SO₂ molecules.

As the excited SO₂ molecules decay to lower energy states, they emit UV light that is proportional to the SO₂ concentration. The bandpass filter allows only the wavelength emitted by the excited SO₂ molecules to reach the photomultiplier tube (PMT). The PMT detects the UV light emission from the decaying SO₂ molecules. The photo detector, located at the back of the fluorescence chamber, continuously monitors the pulsating UV light source and is connected to a circuit that compensates for fluctuations in the lamp intensity.

As the sample leaves the optical chamber, it passes through a flow sensor, a capillary, and the “shell” side of the hydrocarbon kicker. The model 43i outputs the SO₂ concentration to the front panel display, the analog outputs, and also makes the data available over the serial or ethernet connection.

The function of the pulsed fluorescence analyser, model 43i, is based on the principle that SO₂ molecules absorb ultraviolet light (UV) and are excited on a certain wavelength and then reduce to a lower energy level, whereby they emit UV light on another wavelength. The following equation applies:



In the first step, the SO₂ molecules are excited by the UV light. In the second step they return to their original condition under the emission of hv'. The intensity of the fluorescence radiation is proportional to the number of SO₂ molecules in the detection volume and thus proportional to SO₂ concentration.

The measuring principle complies with the standard reference method as stipulated in EN 14212.

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 Energie und Umwelt 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 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 property of TÜV Rheinland Energie und Umwelt GmbH. With revocation of the publication the certificate loses its validity. After the expiration 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 accessible on the internet: **qal1.de**.

Certification of Model 43i for SO₂ is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial test:

Test report: 936/21203248/D1 of 07 July 2006
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Publication: BAnz. 14 Oktober 2006, No. 194, p. 6715, chapter IV, No. 2.2
Announcement by UBA from 12 September 2006

Initial certification according to EN 15267:

Certificate No. 0000040219: 29 April 2014

Expiration date of the certificate: 31 March 2019

Test report: 936/21203248/D1 of 07 July 2006
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Addendum 936/21221382/C of 20 September 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 23
Announcement by UBA from 27 February 2014

Notification:

Publication: BAnz. 20 April 2007, No. 75, p. 4139, chapter IV, notification 1 and 6
Announcement by UBA from 12 April 2007

Publication: BAnz. 03 September 2008, No. 133, p. 3242, chapter IV, notification 13
Announcement by UBA from 12 August 2008

Publication: BAnz. 25 August 2009, No. 125, p. 2929, chapter III, notification 17
Announcement by UBA from 03 August 2009

Publication: BAnz. 28 July 2010, No. 111, p. 2597, chapter III, notification 5
Announcement by UBA from 12 July 2010

Publication: BAnz. 29 July 2011, No. 113, p. 2725, chapter III, notification 19
Announcement by UBA from 15 July 2011

Publication: BAnz AT 20 July 2012 B11, chapter IV, notification 24
Announcement by UBA from 06 July 2012

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 23
Announcement by UBA from 27 February 2014

Calculation of overall uncertainty lab test (Device 1)

Measuring device:		Thermo Fisher Scientific Modell 43i		Serial-No.:		Device 1	
Measured component:		SO2		1h-limit value:		132	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty	nmol/mol	
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.230	$u_{r,z}$	0.06	0.0041	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.470	$u_{r,1h}$	0.13	0.0173	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-0.400	$u_{l,1h}$	-0.30	0.0929	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.040	u_{gp}	0.30	0.0929	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.080	u_{gt}	-0.71	0.5065	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.188	u_{st}	1.67	2.7972	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	-0.020	u_v	-0.20	0.0411	
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero)	0.300	u_{H_2O}	0.02	0.0005	
8b	Interferent H ₂ S with 200 nmol/mol	≤ 10 nmol/mol (Span)	0.030	or	6.24	38.8800	
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	1.130				
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Span)	0.530				
		≤ 5.0 nmol/mol (Zero)	-0.600				
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Span)	0.770				
		≤ 5.0 nmol/mol (Zero)	0.100				
8f	Interferent m-Xylene with 1 µmol/mol	≤ 5.0 nmol/mol (Span)	-0.230				
		≤ 5.0 nmol/mol (Zero)	2.770				
9	Averaging effect	≤ 5.0 nmol/mol (Span)	2.030				
		≤ 10 nmol/mol (Zero)	7.400				
18	Difference sample/calibration port	≤ 7.0% of measured value	-3.300	$u_{int,neg}$	-2.51	6.3249	
21	Uncertainty of test gas	≤ 1.0%	0.000	u_{av}	0.00	0.0000	
		≤ 3.0%	2.000	u_{sc}	1.32	1.7424	
				Combined standard uncertainty	u_c	7.1063	
				Expanded uncertainty	U	14.2127	
				Relative expanded uncertainty	W	10.77	
				Maximum allowed expanded uncertainty	W_{req}	15	

Calculation of overall uncertainty lab test (Device 2)

Measuring device:		Thermo Fisher Scientific Modell 43i		Serial-No.:		Device 2	
Measured component:		SO2		1h-limit value:		132	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty	nmol/mol	
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.130	$u_{r,z}$	0.04	0.0014	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.390	$u_{r,h}$	0.11	0.0124	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-0.400	$u_{l,h}$	-0.30	0.0929	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.050	u_{gp}	0.38	0.1452	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.210	u_{gt}	-1.87	3.4901	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.256	u_{st}	2.28	5.1866	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	-0.020	u_v	-0.20	0.0411	
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero)	-0.470	u_{H2O}	0.02	0.0005	
8b	Interferent H ₂ S with 200 nmol/mol	≤ 10 nmol/mol (Span)	0.030	$u_{int,pos}$			
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Span)	1.230				
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	-1.270	or	6.62	43.8536	
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Span)	0.200				
8f	Interferent m-Xylene with 1 µmol/mol	≤ 5.0 nmol/mol (Zero)	-0.230	$u_{int,neg}$			
9	Averaging effect	≤ 5.0 nmol/mol (Span)	2.130				
18	Difference sample/calibration port	≤ 10 nmol/mol (Zero)	7.570	u_{av}	-2.71	7.3608	
21	Uncertainty of test gas	≤ 7.0% of measured value	-3.560	u_{asc}	0.13	0.0174	
		≤ 3.0%	2.000	u_{cg}	1.32	1.7424	
		Combined standard uncertainty		u_c		7.8705	
		Expanded uncertainty		U		15.7410	
		Relative expanded uncertainty		W		11.92	
		Maximum allowed expanded uncertainty		W_{req}		15	

Calculation of overall uncertainty lab and field test (Device 1)

Measuring device: Thermo Fisher Scientific Modell 43i		Serial-No.: Device 1		1h-limit value: 132		nmol/mol	
Measured component: SO2		1h-limit value: 132		1h-limit value: 132		nmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.230	U _{r,z}	0.06	0.0041	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.470	U _{r,1h}	not considered, as U _{r,1h} = 0,13 < U _{r,f}	-	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-0.400	U _{l,1h}	-0.30	0.0929	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.040	U _{sp}	0.30	0.0929	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.080	U _{gt}	-0.71	0.5065	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.188	U _{st}	1.67	2.7972	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	-0.020	U _v	-0.20	0.0411	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	0.300				
8b	Interferent H ₂ S with 200 nmol/mol	≤ 10 nmol/mol (Span)	0.030	U _{h,20}	0.02	0.0005	
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	1.130	U _{int,pos}			
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Span)	0.530				
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0.600				
8f	Interferent m-Xylene with 1 µmol/mol	≤ 5.0 nmol/mol (Span)	0.770				
9	Averaging effect	≤ 5.0 nmol/mol (Zero)	0.100				
10	Reproducibility standard deviation under field conditions	≤ 5.0 nmol/mol (Span)	-0.230		6.24	38.8800	
11	Long term drift at zero level	≤ 5.0 nmol/mol (Zero)	2.770	or			
12	Long term drift at span level	≤ 5.0 nmol/mol (Span)	2.030	U _{int,neg}			
18	Difference sample/calibration port	≤ 10 nmol/mol (Span)	7.470	U _{av}	-2.51	6.3249	
21	Uncertainty of test gas	≤ 7.0% of measured value	-3.300	U _{r,f}	5.15	26.5019	
		≤ 5.0% of average over 3 months	3.900	U _{gl,z}	0.20	0.0385	
		≤ 4.0 nmol/mol	0.340	U _{gl,1h}	1.67	2.7856	
		≤ 5.0% of max. of certification range	2.190	U _{asc}	0.00	0.0000	
		≤ 1.0%	0.000	U _{cg}	1.32	1.7424	
		≤ 3.0%	2.000				
		Combined standard uncertainty		U _c		8.9336	nmol/mol
		Expanded uncertainty		U		17.8671	nmol/mol
		Relative expanded uncertainty		W		13.54	%
		Maximum allowed expanded uncertainty		W _{req}		15	%

Calculation of overall uncertainty lab and field test (Device 2)

Measuring device:		Thermo Fisher Scientific Modell 43i		Serial-No.:		Device 2		nmol/mol	
Measured component:		SO2		1h-limit value:		132			
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty				
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.130	u _{r,z}	0.0014				
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.390	u _{r,1h}	-	not considered, as u _{r,1h} = 0,11 < u _{r,f}			
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-0.400	u _{l,1h}	0.0929				
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.050	u _{sp}	0.1452				
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.210	u _{gt}	3.4901				
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.256	u _{st}	5.1866				
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	-0.020	u _y	0.0411				
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero)	-0.470						
		≤ 10 nmol/mol (Span)	0.030	u _{H2O}	0.0005				
8b	Interferent H ₂ S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.530						
		≤ 5.0 nmol/mol (Span)	1.230	u _{H2S,pos}					
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	-1.270						
		≤ 5.0 nmol/mol (Span)	0.200						
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0.230						
		≤ 5.0 nmol/mol (Span)	-0.400						
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	2.130						
		≤ 5.0 nmol/mol (Span)	2.670						
8f	Interferent m-xylene with 1 µmol/mol	≤ 10 nmol/mol (Zero)	7.570						
		≤ 10 nmol/mol (Span)	7.370	u _{int,neg}					
9	Averaging effect	≤ 7.0% of measured value	-3.560	u _{av}	7.3608				
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	3.900	u _{r,f}	26.5019				
11	Long term drift at zero level	≤ 4.0 nmol/mol	0.340	u _{d,lz}	0.0385				
12	Long term drift at span level	≤ 5.0% of max. of certification range	2.700	u _{d,lh}	4.2340				
18	Difference sample/calibration port	≤ 1.0%	0.100	u _{Δsc}	0.0174				
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.7424				
Combined standard uncertainty				u _c	9.6284	nmol/mol			
Expanded uncertainty				U	19.2569	nmol/mol			
Relative expanded uncertainty				W	14.59	%			
Maximum allowed expanded uncertainty				W _{req}	15	%			