

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040219_02

AMS designation: Modell 48i for CO
Manufacturer: Thermo Fisher Scientific
27, Forge Parkway
Franklin, MA 02038
USA

Test Laboratory: TÜV Rheinland Energy GmbH

**This is to certify that the AMS has been tested
and found to comply with the standards:
VDI 4202-1 (2002), VDI 4203-3 (2004), EN 14626 (2012),
EN 15267-1 (2009) and EN 15267-2 (2009)**

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 15 pages).
The present certificate replaces certificate 0000040219_01 of 01 April 2019.



Suitability Tested
Equivalent to
2008/50/EC
EN 15267
Regular Surveillance
www.tuv.com
ID 0000040219

Publication in the German Federal Gazette
(BAnz) of 01 April 2014

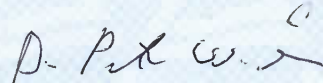
German Federal Environment Agency
Dessau, 01 July 2020



Dr. Marcel Langner
Head of Section II 4.1

This certificate will expire on:
30 June 2025

TÜV Rheinland Energy GmbH
Cologne, 30 June 2020



ppa. Dr. Peter Wilbring

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TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Köln

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

Test Report:	936/21203248/A1 of 05 January 2006
Initial certification:	01 April 2014
Expiry date:	30 June 2025
Certificate:	Renewal (of previous certificate 0000040219_01 dated 01 April 2019 valid until 30 June 2020)
Publication:	BAnz AT 01.04.2014 B12, chapter VI notification 24

Approved application

The certified AMS is suitable for continuous ambient air monitoring of CO (stationary operation).

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

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

The notification of suitability of the AMS, performance testing and the uncertainty calculation have been effected on the basis of the regulations applicable at the time of testing. As changes in legal provisions are possible, any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for monitoring the AMS readings relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the intended purpose.

Basis of the certification

This certification is based on:

- Test report no. 936/21203248/A1 of 05 January 2006 issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and Addendum 936/21221382/D dated 04 October 2013 issued by 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. 08 April 2006, no. 70, p. 2653, chapter IV number 2.2, UBA announcement dated 21 February 2006:

AMS designation:

CO analyser model 48i

Manufacturer:

Thermo Electron Corp. Franklin, MA 02038 USA and D-91056 Erlangen

Field of application:

For continuous ambient air monitoring of CO (stationary operation)

Measuring range(s) during performance testing

CO 0 - 60 mg/m³
0 - 100 mg/m³

Software:

Version: V 01.02.14.097

Test Laboratory:

TÜV Immissionsschutz und Energiesysteme GmbH, Cologne,
TÜV Rheinland Group

Test Report:

Report no.: 936/21203248/A dated 5 January 2006

Publication in the German Federal Gazette: BAnz. 20 April 2007, no. 75, p. 4139, chapter IV notification 1, UBA announcement dated 12 April 2007:

1 Notification issued by the Federal Environment Agency

Thermo Electron Corp., Franklin, USA, now trade under the new name
Thermo Fisher Scientific, Franklin, USA.

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme
GmbH, 51101 Cologne, Dr Peter Wilbring, dated 20 December 2006

Publication in the German Federal Gazette: BAnz. 20 April 2007, no. 75, p. 4139, chapter IV notification 6, UBA announcement dated 12 April 2007:

6 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653) and of 12 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 issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, 51101 Cologne, Dr Peter Wilbring, dated 14 December 2006

Publication in the German Federal Gazette: BAnz. 03 September 2008, no. 133, p. 3243, chapter IV notification 14, UBA announcement dated 12 August 2008:

14 Notification as regards Federal Environment Agency (UBA) notice of 21 February 2006 (BAnz. p. 2655)

The current software version for the Model 48i air quality monitor manufactured by Thermo Fisher Scientific is:

V 01.05.03 (106423-00)

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 10 March 2008

Publication in the German Federal Gazette: BAnz. 25 August 2009, no. 125, p. 2929, chapter III notification 18, UBA announcement dated 03 August 2009:

18 Notification as regards Federal Environment Agency (UBA) notice of 21 February 2006 (BAnz. p. 2655)

The current software version for the Model 48i air quality monitor manufactured by Thermo Fisher Scientific is:

V 01.06.01 (108458-00)

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 01 April 2009

Publication in the German Federal Gazette: BAnz. 28 July 2010, No. 111, p. 2597, chapter III notification 6, UBA announcement dated 12 July 2010:

6 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2655) and of 3 August 2009 (BAnz. p. 2936)

The Model 48i air quality monitor manufactured by Thermo Fisher Scientific can also be used with the PU1959-N86-3.07 sample gas pump manufactured by KNF.

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 23 March 2010

Publication in the German Federal Gazette: BAnz. 29 July 2011, No. 113, p. 2725, chapter III notification 20, UBA announcement dated 15 July 2011:

20 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 2.2) and of 12 July 2010 (BAnz. p. 2597, chapter III 6th notification)

The latest software version for the Model 48i air quality monitor for CO manufactured by Thermo Fisher Scientific is:
V 01.06.09 (110018-00)

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

Publication in the German Federal Gazette: BAnz AT 20.07.2012 B11, chapter IV notification 25, UBA announcement dated 06 July 2012:

25 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 2.2) and of 15 July 2011 (BAnz. p. 2725, chapter III 20th notification)

The Model 48i air quality monitor for CO manufactured by Thermo Fisher Scientific will be equipped with the PU2737-N86 vacuum pump manufactured by KNF in the future.

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

Publication in the German Federal Gazette: BAnz AT 05.03.2013 B10, chapter V notification 14, UBA announcement dated 12 February 2013:

14 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 2.2) and of 6 July 2012 (chapter IV 25th notification)

The latest software version of the model 48i air quality monitor for CO manufactured by Thermo Fisher Scientific is:

V 01.06.10 (112308-00)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 6 October 2012

Publication in the German Federal Gazette: BAnz AT 01.04.2014 B12, chapter VI notification 24, UBA announcement dated 27 February 2014:

24 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (p. 2653, chapter IV number 2.2) and of 12 February 2013 (BAnz AT 05.03.2013 B10, chapter V 14th notification)

The Model 48i air quality monitor for CO manufactured by Thermo Fisher Scientific complies with the requirements of EN 14626 (December 2012 version). Furthermore, the manufacturing process and the quality management for the Model 48 measuring system for CO meets the requirements of EN 15267.

The test report on performance testing No. 936/21203248/A1 and the addendum no. 936/21221382/D as an integral part of this report are available online at www.qal1.de.

Production of the Arcturus Bd. 101491-xx processor board has been discontinued and will be replaced by the Arcturus Bd. 110570-xx processor board.

The current software version of the measuring system is:
V 02.00.01 (113420-00)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 1 October 2013

Publication in the German Federal Gazette: BAnz AT 05.08.2014 B11, chapter V notification 22, UBA announcement dated 17 July 2014:

22 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (p. 2653, chapter IV number 2.2) and of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter VI 24th notification)

The latest software version of the model 48i measuring system for CO manufactured by Thermo Fisher Scientific is: V 02.00.03 (114182-00)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 28 March 2014

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter IV notification 18, UBA announcement dated 25 February 2015:

18 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 2.2) and of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter V 22nd notification)

The latest software version of the model 48i measuring system for CO manufactured by Thermo Fisher Scientific is:

V 02.02.00 (114624-00)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 22 September 2014

Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, chapter V notification 14, UBA announcement dated 18 February 2016:

14 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (p. 2653, chapter IV number 2.2) and of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter IV 18th notification)

The latest software version of the model 48i measuring system for CO manufactured by Thermo Fisher Scientific is:

V 02.02.03

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 22 October 2015

Certified product

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

The Model 48i CO Analyzer measures CO concentration using Gas Filter Correlation (GFC). The Model 48i operates on the principle that carbon monoxide (CO) absorbs infrared radiation at a wavelength of 4.6 microns. The measuring system belongs to the group of photometric measuring systems. The measuring principle is based on determining the light absorption by the gas to be measured in the wavelength ranges characteristic of that gas. Analysis is performed by measuring the absorption on the basis of the dependence between the gas concentration and the amount of absorbed light according to the Beer-Lambert law:

$$I = I_0 * e^{-\alpha Lc}$$

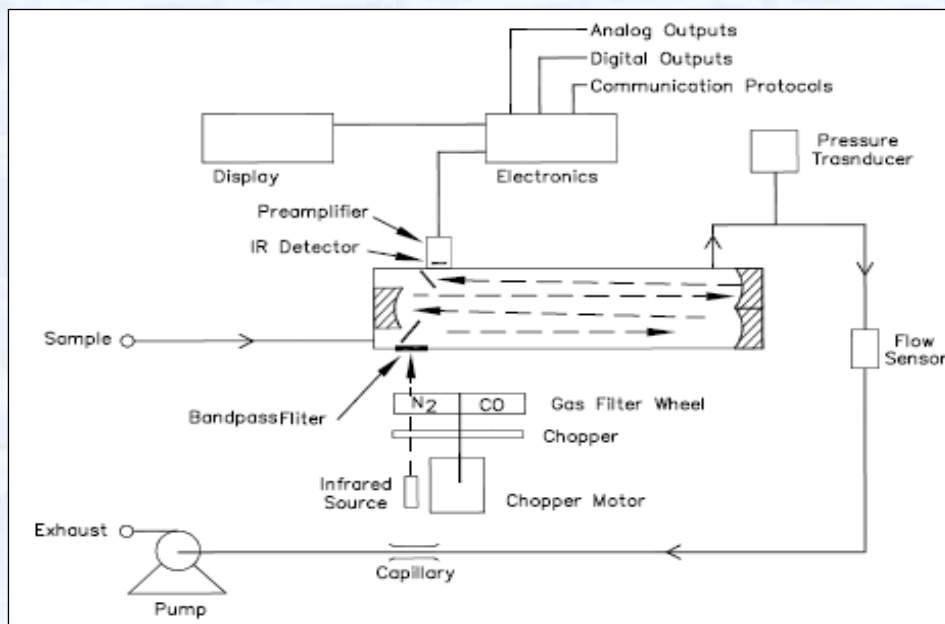
I_0 as light intensity without absorption

I as intensity with absorption

L as absorption path or distance that the light travels during absorption

c as concentration of the absorbing gas, in this case CO

α as absorption coefficient (provides information about degree of absorption)



This measuring principle corresponds to the standard reference method as described in EN 14626.

The ambient air sample is sucked through the bulkhead connection designated SAMPLE into the Model 48i measuring system. The sample flows through the optical bench. Radiation from an infrared source is chopped and then passed through a gas filter alternating between CO and N₂. The radiation then passes through a narrow band-pass interference filter and enters the optical bench where absorption by the sample gas occurs, and falls on an infrared detector.

The CO gas filter acts to produce a reference beam, which cannot be further attenuated by CO in the sample cell. The N₂ side of the filter wheel is transparent to the infrared radiation and therefore produces a measure beam which can be absorbed in the cell. The chopped detector signal is modulated by the alternation between two gas filters with a amplitude related to the concentration of CO in the sample cell. The chopped detector signal is modulated by the alternation between two gas filters with a amplitude related to the concentration of CO in the sample cell. Other gases do not cause modulation of the detector signal since they absorb the reference and measure beams equally. Thus, the GFC system responds specifically to CO.

The Model 48i outputs the CO concentration to the front panel display, the analogue outputs, and also makes the data available over the serial or Ethernet connection.

General remarks

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 manufacturing process for 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 document as well as the certification mark remains property of TÜV Rheinland Energy GmbH. Upon revocation of the publication the certificate loses its validity. After the expiration of the certificate and on request of TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must no longer be used.

The relevant version of this certificate and its expiration date are also accessible on the internet at qal1.de.

Document history

Certification of the Modell 48i measuring system is based on the documents listed below and the regular, continuous surveillance of the manufacturer's quality management system:

Basic testing

Test Report: 936/21203248/A1 of 05 January 2006
TÜV Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 08 April 2006, no. 70, p. 2653, chapter IV no. 2.2
UBA announcement dated 21 February 2006

Notifications

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 20 December 2006

Publication: BAnz. 20 April 2007, no. 75, p. 4139, chapter IV notification 1
UBA announcement dated 12 April 2007
(New company name)

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 14 December 2006

Publication: BAnz. 20 April 2007, no. 75, p. 4139, chapter IV notification 6
UBA announcement dated 12 April 2007
(Production and distribution by MLU)

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 10 March 2008

Publication: BAnz. 03 September 2008, no. 133, p. 3243, chapter IV notification 14
UBA announcement dated 12 August 2008
(software updates)

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 01 April 2009

Publication: 25 August 2009, no. 125, p. 2929, chapter III notification 18
UBA announcement dated 3 August 2009
(software updates)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 23 October 2010

Publication: BAnz. 28 July 2010, No. 111, p. 2597, chapter III notification 6
UBA announcement dated 12 July 2010
(Design changes)

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

Publication: BAnz 29 July 2011, No. 113, p. 2725, chapter III notification 20
UBA announcement dated 15 July 2011
(software updates)

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

Publication: BAnz AT 20.07.2012 B11, chapter IV notification 25
UBA announcement dated 6 July 2012
(Design changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 6 October 2012

Publication: BAnz AT 05.03.2013 B10, chapter V notification 14
UBA announcement dated 12 February 2013
(software updates)

Initial certification according to EN 15267

Certificate no. 0000040219: 29 April 2014
Expiry date of the certificate: 31 March 2019
Test Report: 936/21203248/A1 of 05 January 2006
TÜV Immissionsschutz und Energiesysteme GmbH, Cologne
936/21221382/D dated 4 October 2013
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz AT 01.04.2014 B12, chapter VI notification 24,
UBA announcement dated 27 February 2014

Notifications in accordance with EN 15267

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 28 March 2014
Publication: BAnz AT 05.08.2014 B11, chapter V notification 22
UBA announcement dated 17 July 2014
(software updates)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 22 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 18
UBA announcement dated 25 February 2015
(software updates)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 22 October 2015
Publication: BAnz AT 14.03.2016 B7, chapter V notification 14
UBA announcement dated 18 February 2016
(software updates)

Renewal of the certificate

Certificate no. 0000040219_01: 01 April 2019
Expiry date of the certificate: 30 June 2020

Renewal of the certificate

Certificate no. 0000040219_02: 01 July 2020
Expiry date of the certificate: 30 June 2025

Expanded uncertainty from the results obtained in the laboratory tests for analyser 1

Measuring device:		Serial-No.:		Device 1	
Thermo Fisher Scientific Modell 481		8h-limit value:		8.62	
Measured component:		Performance criterion		Square of partial uncertainty	
CO		Result		Partial uncertainty	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 0.3 µmol/mol	0.000	$U_{r,z}$ 0.00	0.0000
2	Repeatability standard deviation at 8h-limit value	≤ 0.4 µmol/mol	0.020	U_r 0.00	0.0000
3	"lack of fit" at 8h-limit value	≤ 4.0% of measured value	0.800	U_l 0.04	0.0016
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤ 0.7 µmol/mol/kPa	0.090	U_{gp} 0.22	0.0502
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤ 0.3 µmol/mol/K	0.010	U_{gt} 0.02	0.0005
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤ 0.3 µmol/mol/K	0.030	U_{st} 0.07	0.0047
7	Sensitivity coefficient of electrical voltage at 8h-limit value	≤ 0.3 µmol/mol/V	0.000	U_v 0.00	0.0000
8a	Interferent H ₂ O with 21 mmol/mol	≤ 1.0 µmol/mol (Zero)	0.040	U_{H2O} 0.03	0.0009
8b	Interferent CO ₂ with 500 µmol/mol	≤ 1.0 µmol/mol (Span)	0.000	0.04	0.0014
		≤ 0.5 µmol/mol (Zero)	-0.060		
8c	Interferent NO with 1 µmol/mol	≤ 0.5 µmol/mol (Span)	-0.010	0.04	0.0014
		≤ 0.5 µmol/mol (Zero)	0.000		
8d	Interferent N ₂ O with 50 mmol/mol	≤ 0.5 µmol/mol (Span)	-0.010	0.04	0.0014
		≤ 0.5 µmol/mol (Zero)	0.170		
9	Averaging effect	≤ 0.5 µmol/mol (Span)	0.060	$U_{int,neg}$	
18	Difference sample/alibration port	≤ 7.0% of measured value	-5.970	U_{av} -0.30	0.0883
21	Uncertainty of test gas	≤ 1.0%	0.000	U_{asc} 0.00	0.0000
		≤ 3.0%	2.000	U_{sg} 0.09	0.0074
		Combined standard uncertainty		u_c	0.3937
		Expanded uncertainty		U	0.7875
		Relative expanded uncertainty		W	9.14
		Maximum allowed expanded uncertainty		W_{req}	15

Expanded uncertainty from the results obtained in the laboratory tests for analyser 2

Measuring device: Thermo Fisher Scientific Modell 481		Serial-No.: Device 2			
Measured component: CO		8h-limit value: 8.62 $\mu\text{mol/mol}$			
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	$\leq 0.3 \mu\text{mol/mol}$	0.000	$u_{r,z}$	0.0000
2	Repeatability standard deviation at 8h-limit value	$\leq 0.4 \mu\text{mol/mol}$	0.020	u_r	0.0000
3	"lack of fit" at 8h-limit value	$\leq 4.0\%$ of measured value	-0.300	u_l	0.0002
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	$\leq 0.7 \mu\text{mol/mol/kPa}$	0.090	u_{sp}	0.0502
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/K}$	0.040	u_{gt}	0.0084
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/K}$	0.030	u_{st}	0.0047
7	Sensitivity coefficient of electrical voltage at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/V}$	0.000	u_v	0.0000
8a	Interferent H ₂ O with 21 mmol/mol	$\leq 1.0 \mu\text{mol/mol (Zero)}$ $\leq 1.0 \mu\text{mol/mol (Span)}$	-0.020 0.000	u_{H_2O}	0.0002
8b	Interferent CO ₂ with 500 $\mu\text{mol/mol}$	$\leq 0.5 \mu\text{mol/mol (Zero)}$ $\leq 0.5 \mu\text{mol/mol (Span)}$	0.000 -0.020	u_{CO_2}	
8c	Interferent NO with 1 $\mu\text{mol/mol}$	$\leq 0.5 \mu\text{mol/mol (Zero)}$ $\leq 0.5 \mu\text{mol/mol (Span)}$	0.000 -0.030	0.07	0.0052
8d	Interferent N ₂ O with 50 mmol/mol	$\leq 0.5 \mu\text{mol/mol (Zero)}$ $\leq 0.5 \mu\text{mol/mol (Span)}$	0.000 0.130	u_{N_2O}	
9	Averaging effect	$\leq 7.0\%$ of measured value	-4.560	u_{av}	0.0515
18	Difference sample/calibration port	$\leq 1.0\%$	0.000	u_{sc}	0.0000
21	Uncertainty of test gas	$\leq 3.0\%$	2.000	u_{tg}	0.0074
		Combined standard uncertainty		u_c	0.3577
		Expanded uncertainty		U	0.7153
		Relative expanded uncertainty		W	8.30
		Maximum allowed expanded uncertainty		W_{req}	15

Expanded uncertainty from the results obtained in the laboratory and field tests for analyser 1

Measuring device: Thermo Fisher Scientific Modell 48i		Serial-No.: Device 1	
Measured component: CO		8h-limit value: 8.62 $\mu\text{mol/mol}$	
No.	Performance characteristic	Performance criterion	Result
1	Repeatability standard deviation at zero	$\leq 0.3 \mu\text{mol/mol}$	0.000
2	Repeatability standard deviation at 8h-limit value	$\leq 0.4 \mu\text{mol/mol}$	0.020
3	"lack of fit" at 8h-limit value	$\leq 4.0\%$ of measured value	0.800
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	$\leq 0.7 \mu\text{mol/mol/kPa}$	0.090
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/K}$	0.010
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/K}$	0.030
7	Sensitivity coefficient of electrical voltage at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/V}$	0.000
8a	Interferent H ₂ O with 21 mmol/mol	$\leq 1.0 \mu\text{mol/mol (Zero)}$	0.000
		$\leq 1.0 \mu\text{mol/mol (Span)}$	0.040
8b	Interferent CO ₂ with 500 $\mu\text{mol/mol}$	$\leq 0.5 \mu\text{mol/mol (Zero)}$	-0.060
		$\leq 0.5 \mu\text{mol/mol (Span)}$	-0.010
8c	Interferent NO with 1 $\mu\text{mol/mol}$	$\leq 0.5 \mu\text{mol/mol (Zero)}$	0.000
		$\leq 0.5 \mu\text{mol/mol (Span)}$	-0.010
8d	Interferent N ₂ O with 50 nmol/mol	$\leq 0.5 \mu\text{mol/mol (Zero)}$	0.170
		$\leq 0.5 \mu\text{mol/mol (Span)}$	0.060
9	Averaging effect	$\leq 7.0\%$ of measured value	-5.970
10	Reproducibility standard deviation under field conditions	$\leq 5.0\%$ of average over 3 months	3.530
11	Long term drift at zero level	$\leq 0.5 \mu\text{mol/mol}$	0.500
12	Long term drift at span level	$\leq 5.0\%$ of max. of certification range	-2.590
18	Difference sample/calibration port	$\leq 1.0\%$	0.000
21	Uncertainty of test gas	$\leq 3.0\%$	2.000
Combined standard uncertainty			0.0074
Expanded standard uncertainty			0.5895 $\mu\text{mol/mol}$
Relative expanded uncertainty			1.1791 $\mu\text{mol/mol}$
Maximum allowed expanded uncertainty			15 %

Expanded uncertainty from the results obtained in the laboratory and field tests for
analyser 2

Measuring device:		Thermo Fisher Scientific Modell 48i		Serial-No.:		Device 2	
Measured component:		CO		8h-limit value:		8.62	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty	µmol/mol	
1	Repeatability standard deviation at zero	≤ 0.3 µmol/mol	0.000	u _{r,z}	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	≤ 0.4 µmol/mol	0.020	u _r	not considered, as ur = 0 < ur,f	-	
3	"lack of fit" at 8h-limit value	≤ 4.0% of measured value	-0.300	u _l	-0.01	0.0002	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤ 0.7 µmol/(mol/kPa)	0.090	u _{sp}	0.22	0.0502	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤ 0.3 µmol/(mol/K)	0.040	u _{gt}	0.09	0.0084	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤ 0.3 µmol/(mol/K)	0.030	u _s	0.07	0.0047	
7	Sensitivity coefficient of electrical voltage at 8h-limit value	≤ 0.3 µmol/(mol/V)	0.000	u _v	0.00	0.0000	
8a	Interferent H ₂ O with 21 mmol/mol	≤ 1.0 µmol/mol (Zero)	0.000	u _{H2O}	-0.01	0.0002	
8b	Interferent CO ₂ with 500 µmol/mol	≤ 1.0 µmol/mol (Span)	-0.020	u _{int,pos}			
8c	Interferent NO with 1 µmol/mol	≤ 0.5 µmol/mol (Zero)	0.000	or			
8d	Interferent N ₂ O with 50 nmol/mol	≤ 0.5 µmol/mol (Span)	0.130	u _{int,neg}	0.07	0.0052	
9	Averaging effect	≤ 7.0% of measured value	-4.560	u _{av}	-0.23	0.0515	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	3.530	u _{r,f}	0.30	0.0926	
11	Long term drift at zero level	≤ 0.5 µmol/mol	0.500	u _{l,z}	0.29	0.0833	
12	Long term drift at span level	≤ 5.0% of max. of certification range	1.840	u _{l,sh}	0.09	0.0084	
18	Difference sample/calibration port	≤ 1.0%	0.000	u _{ssc}	0.00	0.0000	
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{sg}	0.09	0.0074	
				Combined standard uncertainty		u _c	µmol/mol
				Expanded uncertainty		U	µmol/mol
				Relative expanded uncertainty		W	%
				Maximum allowed expanded uncertainty		W _{req}	%