CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000062069_01

Certified AMS:	48iQ for carbon monoxide
Manufacturer:	Thermo Fisher Scientific 27, Forge Parkway Franklin, MA 02038 USA
Test Institute:	TÜV Rheinland Energy & Environment GmbH

This is to certify that the AMS has been tested and found to comply with the standards VDI 4202-1 (2018), EN 14626 (2012), as well as EN 15267-1 (2009) and EN 15267-2 (2023).

Certification is awarded in respect of the conditions stated in this certificate (this certificate contains 12 pages).
The present certificate replaces certificate 0000062069_00 dated 5 November 2019.

TÜVRheinland® CERTIFIED
Suitability Tested
Complying with 2008/50/EC
EN 15267
Regular Surveillance
www.tuv.com
ID 0000062069

Publication in the German Federal Gazette (BAnz) of 22 July 2019

German Environment Agency

Dessau,27 June 2025

This certificate will expire on:
21 July 2029

TÜV Rheinland Energy & Environment GmbH
Cologne, 26 June 2025

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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 the certificate D-PL-11120-02-00.

Test report:	936/21242986/D dated 4 February 2019
Initial certification:	22 July 2019
Expiry date:	21 July 2029
Certificate:	Renewal (of previous certificate 0000062069_00 of 5 November 2019 valid until 21 July 2024)
Publication:	BAnz AT 22.07.2019 B8, chapter III No. 2.1

Approved application

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

The suitability of the AMS for these applications was assessed based on a laboratory test and a threemonth field test and over different time periods.

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 that this AMS is suitable for monitoring the measured values relevant to the application.

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

Basis of the certification

This certification is based on:

- Test report 936/21242986/D dated 4 February 2019 of TÜV Rheinland Energy 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 AT 22.07.2019 B8, chapter III No. 2.1, Announcement by UBA dated 28 June 2019:

AMS designation:
48iQ for carbon monoxide

Manufacturer:
Thermo Fisher Scientific, Franklin, USA

Field of application:
For continuous ambient air monitoring of carbon monoxide (stationary operation)

Measuring ranges during the performance test:

Component	Certification range	Unit
Carbon monoxide	0 – 100	mg/m³

Software version:
Version: 1.6.0.32120

Restrictions:
None

Notes:
The test report on performance testing is available on the internet at www.qal1.de.

Test institute:
TÜV Rheinland Energy GmbH, Cologne
Report No.: 936/21242986/D dated 4 February 2019

Publication in the German Federal Gazette: BAnz AT 05.08.2021 B5, Chap. IV notification 13, Announcement by UBA dated 29 June 2021:

13 Notification as regards Federal Environment Agency (UBA) notice of 28 June 2019 (BAnz AT 22.07.2019 B9, chapter III number 2.1)

The latest software version of the ambient air monitoring system 48iQ for CO manufactured by Thermo Fisher Scientific is:
01.06.10

In addition, the version 01.06.07 is available.

Statement issued by TÜV Rheinland Energy GmbH dated 25 February 2021

Publication in the German Federal Gazette: BAnz AT 28.07.2022 B4, Chap. III notification 50, Announcement by UBA dated 28 June 2022:

50 Notification as regards Federal Environment Agency (UBA) notices of 28 June 2019 (BAnz AT 22.07.2019 B9, chapter III number 2.1) and of 29 June 2021 (BAnz AT 05.08.2021 B5, chapter IV notification 13)

The current software version of the immission measuring device 48iQ for CO from Thermo Fisher Scientific is:
01.06.12 (118208-00)

Version 01.06.11 (118208-00) is also available.

Statement issued by TÜV Rheinland Energy GmbH dated 18 May 2022

Publication in the German Federal Gazette: BAnz AT 20.03.2023 B6, Chap. IV notification 83, Announcement by UBA dated 21 February 2023:

83 Notification as regards Federal Environment Agency (UBA) notices of 28 June 2019 (BAnz AT 22.07.2019, chapter III number 2.1) and of 28 June 2022 (BAnz AT 28.07.2022 B4, chapter III notification 50)

The current software version of the 48iQ ambient air measuring system for CO from Thermo Fisher Scientific is:
01.06.14.34444

In addition, the versions 01.06.13.34157 and 01.06.14.34442 are available.

The measuring system can also be equipped with the alternative IR source type 66785 15R from the manufacturer Ohmite Dove Electronics.
To increase operational reliability, a "footprint" has been corrected on the optional analog IO board of the measuring system.

Statement issued by TÜV Rheinland Energy GmbH dated 14 September 2022

Certified product

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

The 48iQ ambient air monitor is a continuous carbon monoxide analyser designed for the continuous measurement of carbon monoxide in ambient air.
The measuring principle applied by the 48iQ ambient air monitor relies on the fact that carbon monoxide (CO) absorbs infrared light at a wave length of 4.6 µm. The gas filter correlation technique allows to selectively determine the absorption uniquely caused by CO by the ratio of sample-absorbed light to a filtered reference measurement.

Light from a broadband infrared source passes through a gas filter wheel alternating between N_2 and CO filled cells and passes through a narrow bandpass interference filter before passing into the volume-containing sample gas. Light that passes through the N_2 cell is absorbed by CO in the sample gas normally as the sample signal; light that passes through the CO cell is already blocked where CO absorbs, and so is unchanged by sample CO as the reference. This serves as a reference value. The ratio between sample and reference is determined at high speed and adjusted for light intensity and other changes to obtain accurate measurement results.

The sample is drawn into the 48iQ through the sample bulkhead. It is pulled by a single stage pump through the 48iQ DMC bench where CO is detected and then through a capillary which regulates the flow intake to approximately 1 l/min while monitoring and maintaining ambient pressure on the optical bench side. The 48iQ outputs the CO concentration to the front panel display and the analogue outputs, and also makes the data available over the serial or Ethernet connection.

The 48iQ system components include:

- Optical bench: The optical bench is an airtight bench that contains the sample gas. It also includes the mirrors that reflect infrared light multiple times across the sample path before detection, to maximize absorption. Heaters are used to maintain the optical bench at a constant temperature.
- A bandpass filter limits the light entering the optical bench to a narrow band of the infrared within which CO absorbs.
- Filter wheel motor: A gas filter wheel contains samples of CO and N_2 gas with a chopper disk. The wheel is rotated so that infrared light is periodically interrupted to produce a modulated signal upon detection. Differentiating the light through the CO and N_2 components of the wheel, in the presence of CO in the optical bench, allow the determination of sample CO absorption and concentration. The chopper motor rotates the gas filter wheel and chopper disk at a uniform speed. A separate optical switch assembly detects the position of the filter wheel for synchronizing the modulated signal and for checking the chopper motor speed.
- Detector/Preamp: The detector/preamplifier assembly converts infrared light, carrying modulation and CO sample absorption, into an amplified electrical signal that undergoes processing.
- Infrared Source: The infrared light source is a special wire-wound resistor operated at high temperature to generate broadband infrared radiation.
- Common electronics: The common electronics contain the core computational and power routing hardware and is replicated throughout other iQ series products. It also contains front panel display, the USB ports, the Ethernet port, and the I/O interfaces. All electronics operate from a universal VDC supply. The System Controller Board (SCB) contains the main processor, power supplies, and a sub-processor, and serves as the communication hub for the instrument.

- Peripheral Support System: The peripheral support system operates these additional devices that are needed, but do not require special feedback control or processing. The chassis fan provides air cooling of the active electronic components. Internal vacuum pump for generating air/sample through the instrument.
- Flow/Pressure DMC: The flow/pressure DMC is used to measure instrument pressures that assure proper flow regulation and for sample pressure within the measurement bench for pressure corrections and compensation. The DMC includes two pressure sensors.

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 & Environment 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 & Environment 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 & Environment 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: **qal1.de**.

History of documents
Certification of 48iQ is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial certification according to EN 15267
Certificate No. 0000062069_00: 5 November 2019
Expiry date of the certificate: 21 July 2024
Test report: 936/21242986/D dated 4 February 2019
TÜV Rheinland Energy GmbH
Publication: BAnz AT 22.07.2019 B8, chapter III number 2.1
UBA announcement dated 28 June 2019

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 25 February 2021
Publication: BAnz AT 05.08.2021 B5, chapter IV notification 13
UBA announcement dated 29 June 2021
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 18 May 2022
Publication: BAnz AT 28.07.2022 B4, chapter III notification 50
UBA announcement dated 28 June 2022
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 14 September 2022
Publication: BAnz AT 20.03.2023 B6, chapter IV notification 83
UBA announcement dated 21 February 2023
(Soft- and hardware changes)

Renewal of certificates
Certificate No. 0000062069_01: 27 June 2025
Expiry date of the certificate: 21 July 2029

Expanded uncertainty laboratory, system 1

Measuring device: 48iQ | Serial-No.: 1180540007

Measured component: CO | 8h-limit value: 8.62 µmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero	≤	0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	≤	0.4 µmol/mol	0.010	u_r	0.00	0.0000	
3	"lack of fit" at 8h-limit value	≤	4.0% of measured value	1.330	u_l	0.07	0.0044	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤	0.7 µmol/mol/kPa	0.020	u_{gp}	0.05	0.0021	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.060	u_{gt}	0.13	0.0175	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.021	u_{st}	0.05	0.0023	
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_2O with 19 mmol/mol	≤	1.0 µmol/mol (Zero)	0.050	u_{H2O}	0.01	0.0002	
		≤	1.0 µmol/mol (Span)	0.020				
8b	Interferent CO_2 with 500 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.030	$u_{int,pos}$			
		≤	0.5 µmol/mol (Span)	-0.110				
8c	Interferent NO with 1 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.110	or	0.16	0.0262	
		≤	0.5 µmol/mol (Span)	-0.100				
8d	Interferent N_2O with 50 nmol/mol	≤	0.5 µmol/mol (Zero)	-0.040	$u_{int,neg}$			
		≤	0.5 µmol/mol (Span)	-0.070				
9	Averaging effect	≤	7.0% of measured value	-1.200	u_{av}	-0.06	0.0036	
18	Difference sample/calibration port	≤	1.0%	-0.060	$u_{\Delta sc}$	-0.01	0.0000	
21	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	0.09	0.0074	
					Combined standard uncertainty	u_c	0.2526	µmol/mol
					Expanded uncertainty	U	0.5052	µmol/mol
					Relative expanded uncertainty	W	5.86	%
					Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty laboratory, system 2

Measuring device: 48iQ | Serial-No.: 1171780048

Measured component: CO | 8h-limit value: 8.62 µmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty
1	Repeatability standard deviation at zero	≤	0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000
2	Repeatability standard deviation at 8h-limit value	≤	0.4 µmol/mol	0.030	u_r	0.01	0.0000
3	"lack of fit" at 8h-limit value	≤	4.0% of measured value	1.240	u_l	0.06	0.0038
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤	0.7 µmol/mol/kPa	0.020	u_{gp}	0.05	0.0021
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.100	u_{gt}	0.22	0.0495
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.081	u_{st}	0.19	0.0352
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_2O with 19 mmol/mol	≤	1.0 µmol/mol (Zero)	0.140	u_{H2O}	0.00	0.0000
		≤	1.0 µmol/mol (Span)	0.000			
8b	Interferent CO_2 with 500 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.220	$u_{int,pos}$	0.09 or $u_{int,neg}$	0.0075
		≤	0.5 µmol/mol (Span)	-0.080			
8c	Interferent NO with 1 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.050			
		≤	0.5 µmol/mol (Span)	-0.070			
8d	Interferent N_2O with 50 nmol/mol	≤	0.5 µmol/mol (Zero)	-0.040			
		≤	0.5 µmol/mol (Span)	0.000			
9	Averaging effect	≤	7.0% of measured value	2.000	u_{av}	0.10	0.0099
18	Difference sample/calibration port	≤	1.0%	-0.080	u_{Asc}	-0.01	0.0000
21	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	0.09	0.0074

Combined standard uncertainty	u_c	0.3399	µmol/mol
Expanded uncertainty	U	0.6798	µmol/mol
Relative expanded uncertainty	W	7.89	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field, system 1

Measuring device: 48iQ — Serial-No.: 1180540007

Measured component: CO — 8h-limit value: 8.62 µmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero	≤	0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	≤	0.4 µmol/mol	0.010	u_r	not considered, as ur = 0 < ur,f	-	
3	"lack of fit" at 8h-limit value	≤	4.0% of measured value	1.330	u_l	0.07	0.0044	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤	0.7 µmol/mol/kPa	0.020	u_{gp}	0.05	0.0021	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.060	u_{gt}	0.13	0.0175	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.021	u_{st}	0.05	0.0023	
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_2O with 19 mmol/mol	≤	1.0 µmol/mol (Zero)	0.050	u_{H2O}	0.01	0.0002	
		≤	1.0 µmol/mol (Span)	0.020				
8b	Interferent CO_2 with 500 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.030	$u_{int,pos}$	or 0.16	0.0262	
		≤	0.5 µmol/mol (Span)	-0.110				
8c	Interferent NO with 1 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.110				
		≤	0.5 µmol/mol (Span)	-0.100				
8d	Interferent N_2O with 50 nmol/mol	≤	0.5 µmol/mol (Zero)	-0.040	$u_{int,neg}$			
		≤	0.5 µmol/mol (Span)	-0.070				
9	Averaging effect	≤	7.0% of measured value	-1.200	u_{av}	-0.06	0.0036	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	1.520	$u_{r,f}$	0.13	0.0172	
11	Long term drift at zero level	≤	0.5 µmol/mol	0.430	$u_{d,l,z}$	0.25	0.0616	
12	Long term drift at span level	≤	5.0% of max. of certification range	2.750	$u_{d,l,8h}$	0.14	0.0187	
18	Difference sample/calibration port	≤	1.0%	-0.060	$u_{\Delta sc}$	-0.01	0.0000	
21	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	0.09	0.0074	
					Combined standard uncertainty	u_c	0.4017	µmol/mol
					Expanded uncertainty	U	0.8033	µmol/mol
					Relative expanded uncertainty	W	9.32	%
					Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field, system 2

Measuring device: 48iQ — Serial-No.: 1171780048

Measured component: CO — 8h-limit value: 8.62 µmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty
1	Repeatability standard deviation at zero	≤	0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000
2	Repeatability standard deviation at 8h-limit value	≤	0.4 µmol/mol	0.030	u_r	not considered, as ur = 0 < ur,f	-
3	"lack of fit" at 8h-limit value	≤	4.0% of measured value	1.240	u_l	0.06	0.0038
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤	0.7 µmol/mol/kPa	0.020	u_{gp}	0.05	0.0021
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.100	u_{gt}	0.22	0.0495
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.081	u_{st}	0.19	0.0352
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_2O with 19 mmol/mol	≤	1.0 µmol/mol (Zero)	0.140	u_{H2O}	0.00	0.0000
		≤	1.0 µmol/mol (Span)	0.000			
8b	Interferent CO_2 with 500 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.220	$u_{int,pos}$	0.09	0.0075
		≤	0.5 µmol/mol (Span)	-0.080			
8c	Interferent NO with 1 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.050	or		
		≤	0.5 µmol/mol (Span)	-0.070			
8d	Interferent N_2O with 50 nmol/mol	≤	0.5 µmol/mol (Zero)	-0.040			
		≤	0.5 µmol/mol (Span)	0.000	$u_{int,neg}$		
9	Averaging effect	≤	7.0% of measured value	2.000	u_{av}	0.10	0.0099
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	1.520	$u_{r,f}$	0.13	0.0172
11	Long term drift at zero level	≤	0.5 µmol/mol	0.330	$u_{d,l,z}$	0.19	0.0363
12	Long term drift at span level	≤	5.0% of max. of certification range	0.750	$u_{d,l,8h}$	0.04	0.0014
18	Difference sample/calibration port	≤	1.0%	-0.080	$u_{\Delta sc}$	-0.01	0.0000
21	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	0.09	0.0074

Combined standard uncertainty	u_c	0.4127 µmol/mol
Expanded uncertainty	U	0.8254 µmol/mol
Relative expanded uncertainty	W	9.58 %
Maximum allowed expanded uncertainty	W_{req}	15 %