

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000062069

AMS designation: 48iQ for carbon monoxide

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 (2018), 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 9 pages).



Suitability Tested
Equivalent to
2008/50/EC
EN 15267
Regular Surveillance

www.tuv.com
ID 0000062069

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

Federal Environment Agency
Dessau, 5 November 2019



Dr. Marcel Langner
Head of Section II 4.1

Expiry date:
21 July 2024

TÜV Rheinland Energy GmbH
Cologne, 4 November 2019



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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.

Test Report:	936/21242986/D dated 04 February 2019
Initial certification:	22 July 2019
Expiry date:	21 July 2024
Publication:	BAnz AT 22.07.2019 B8, chapter III number 2.1

Approved application

The certified AMS is suitable for continuous ambient air monitoring of carbon monoxide (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. 936/21242986/D dated 04 February 2019 issued by 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 number 2.1,
UBA announcement 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 performance testing:

Component	Certification range	Unit
Carbon monoxide	0–100	mg/m ³

Software version:

Version: 1.6.0.32120

Restriction:

None

Note:

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

Test Report:

TÜV Rheinland Energy GmbH, Cologne
Report no. 936/21242986/D dated 4 February 2019

Certified product

This certification 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 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 system 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 gal1.de.

Document history

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

Initial certification according to EN 15267

Certificate no. 0000062069_00: 05 November 2019
Expiry date of the certificate: 21 July 2024
Test report 936/21242986/D dated 04 February 2019
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 22.07.2019 B8, chapter III number 2.1
UBA announcement dated 28 June 2019

Expanded uncertainty laboratory, system 1

Measuring device:		481Q		Serial-No.:		1180540007	
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	0.020	u _{r,z}	0.000		
2	Repeatability standard deviation at 8h-limit value	≤ 0.4 µmol/mol	0.010	u _r	0.000		
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 ₂ O with 19 mmol/mol	≤ 1.0 µmol/mol (Zero) ≤ 1.0 µmol/mol (Span)	0.050 0.020	u _{H2O}	0.01	0.0002	
8b	Interferent CO ₂ with 500 µmol/mol	≤ 0.5 µmol/mol (Zero) ≤ 0.5 µmol/mol (Span)	-0.030 -0.110	u _{int,pos}			
8c	Interferent NO with 1 µmol/mol	≤ 0.5 µmol/mol (Zero) ≤ 0.5 µmol/mol (Span)	-0.110 -0.100	or	0.16	0.0262	
8d	Interferent N ₂ O with 50 nmol/mol	≤ 0.5 µmol/mol (Zero) ≤ 0.5 µmol/mol (Span)	-0.040 -0.070	u _{int,neg}			
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 _{s,c}	-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
Expanded uncertainty						U	0.5052
Relative expanded uncertainty						W	5.86
Maximum allowed expanded uncertainty						W _{req}	15

Expanded uncertainty laboratory, system 2

Measuring device:		481Q		Serial-No.:		1171780048	
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	$\leq 0.3 \mu\text{mol/mol}$	0.020	$u_{r,z}$	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	$\leq 0.4 \mu\text{mol/mol}$	0.030	u_r	0.01	0.0000	
3	"lack of fit" at 8h-limit value	$\leq 4.0\%$ of measured value	1.240	u_i	0.06	0.0038	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	$\leq 0.7 \mu\text{mol/mol/kPa}$	0.020	u_{gp}	0.05	0.0021	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/K}$	0.100	u_{gt}	0.22	0.0495	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/K}$	0.081	u_{st}	0.19	0.0352	
7	Sensitivity coefficient of electrical voltage at 8h-limit value	$\leq 0.3 \mu\text{mol/mol/V}$	0.000	u_v	0.00	0.0000	
8a	Interferent H ₂ O with 19 mmol/mol	$\leq 1.0 \mu\text{mol/mol (Zero)}$ $\leq 1.0 \mu\text{mol/mol (Span)}$	0.140 0.000	u_{H_2O}	0.00	0.0000	
8b	Interferent CO ₂ with 500 $\mu\text{mol/mol}$	$\leq 0.5 \mu\text{mol/mol (Zero)}$ $\leq 0.5 \mu\text{mol/mol (Span)}$	-0.220 -0.080	$u_{\text{int, pos}}$	0.09	0.0075	
8c	Interferent NO with 1 $\mu\text{mol/mol}$	$\leq 0.5 \mu\text{mol/mol (Zero)}$ $\leq 0.5 \mu\text{mol/mol (Span)}$	-0.050 -0.070	or			
8d	Interferent N ₂ O with 50 nmol/mol	$\leq 0.5 \mu\text{mol/mol (Zero)}$ $\leq 0.5 \mu\text{mol/mol (Span)}$	-0.040 0.000	$u_{\text{int, neg}}$			
9	Averaging effect	$\leq 7.0\%$ of measured value	2.000	u_{av}			
18	Difference sample/calibration port	$\leq 1.0\%$	-0.080	u_{asc}	-0.01	0.0000	
21	Uncertainty of test gas	$\leq 3.0\%$	2.000	u_{cg}	0.09	0.0074	
Combined standard uncertainty				u_c		0.3399 $\mu\text{mol/mol}$	
Expanded uncertainty				U		0.6798 $\mu\text{mol/mol}$	
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		µmol/mol		
Measured component:		CO		8h-limit value:		8.62				
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 u _r = 0 < u _{r,f}	-				
3	"lack of fit" at 8h-limit value	≤ 4.0% of measured value	1.330	u _j	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 ₂ O with 19 mmol/mol	≤ 1.0 µmol/mol (Zero)	0.050	u _{H2O}	0.01	0.0002				
8b	Interferent CO ₂ with 500 µmol/mol	≤ 1.0 µmol/mol (Zero)	0.020	u _{int,pos}						
		≤ 0.5 µmol/mol (Zero)	-0.030							
8c	Interferent NO with 1 µmol/mol	≤ 0.5 µmol/mol (Span)	-0.110	or	0.16	0.0262				
		≤ 0.5 µmol/mol (Zero)	-0.110							
		≤ 0.5 µmol/mol (Span)	-0.100							
		≤ 0.5 µmol/mol (Zero)	-0.040							
8d	Interferent N ₂ O with 50 nmol/mol	≤ 0.5 µmol/mol (Span)	-0.070	u _{int,neg}						
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				
		≤ 0.5 µmol/mol	0.430	u _{d,j,z}	0.25	0.0616				
12	Long term drift at span level	≤ 5.0% of max. of certification range	2.750	u _{d,t,8h}	0.14	0.0187				
18	Difference sample/calibration port	≤ 1.0%	-0.060	u _{asc}	-0.01	0.0000				
		≤ 3.0%	2.000	u _{cg}	0.09	0.0074				
21	Uncertainty of test gas									
Combined standard uncertainty				u _c		0.4017	µmol/mol			
Expanded standard 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		8h-limit value: 8.62		µmol/mol	
Measured component: CO		8h-limit value: 8.62		8h-limit value: 8.62		µmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
				U _{r,z}			
1	Repeatability standard deviation at zero	≤ 0.3 µmol/mol	0.020	0.00	0.0000		
2	Repeatability standard deviation at 8h-limit value	≤ 0.4 µmol/mol	0.030	not considered, as u _r = 0 < u _{r,f}	-		
3	"lack of fit" at 8h-limit value	≤ 4.0% of measured value	1.240	u _i	0.0038		
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤ 0.7 µmol/mol/kPa	0.020	u _{gp}	0.0021		
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤ 0.3 µmol/mol/K	0.100	u _{gt}	0.0495		
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤ 0.3 µmol/mol/K	0.081	u _{st}	0.0352		
7	Sensitivity coefficient of electrical voltage at 8h-limit value	≤ 0.3 µmol/mol/V	0.000	u _v	0.0000		
8a	Interferent H ₂ O with 19 mmol/mol	≤ 1.0 µmol/mol (Zero)	0.140	u _{H2O}	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}			
		≤ 0.5 µmol/mol (Span)	-0.080				
8c	Interferent NO with 1 µmol/mol	≤ 0.5 µmol/mol (Zero)	-0.050	0.09	0.0075		
		≤ 0.5 µmol/mol (Span)	-0.070	or			
8d	Interferent N ₂ O with 50 mmol/mol	≤ 0.5 µmol/mol (Zero)	-0.040	u _{int,neg}			
		≤ 0.5 µmol/mol (Span)	0.000				
9	Averaging effect	≤ 7.0% of measured value	2.000	u _{av}	0.0099		
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	1.520	u _{r,f}	0.0172		
11	Long term drift at zero level	≤ 0.5 µmol/mol	0.330	u _{d,l,z}	0.0363		
12	Long term drift at span level	≤ 5.0% of max. of certification range	0.750	u _{d,l,sh}	0.0014		
18	Difference sample/calibration port	≤ 1.0%	-0.080	u _{asc}	0.0000		
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{tg}	0.0074		
Combined standard uncertainty						u _c	µmol/mol
Expanded uncertainty						U	µmol/mol
Relative expanded uncertainty						W	%
Maximum allowed expanded uncertainty						W _{req}	%