

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000062067

AMS designation: 42iQ for NO, NO₂ and NO_x

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:
VDI 4202-1 (2018), EN 14211 (2012),
EN 15267-1 (2009) and DIN EN 15267-2 (2009).

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 10 pages).



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

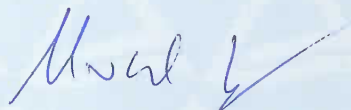
www.tuv.com
ID 0000062067

Publication in the German Federal Gazette
(BAnz) of 26 March 2019

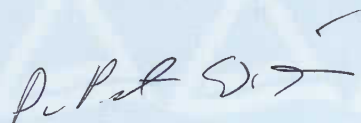
This certificate will expire on:
25 March 2024

German Federal Environment Agency
Dessau, 12 June 2019

TÜV Rheinland Energy GmbH
Cologne, 11 June 2019



Dr Marcel Langner
Head of Section II 4.1



ppa. Dr Peter Wilbring

www.umwelt-tuv.eu
tre@umwelt-tuv.eu
Phone: + 49 221 806-5200

TÜV Rheinland Energy GmbH
Am Grauen Stein
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.

Test Report:	936/21242986/C dated 2 October 2018
Initial certification:	26 March 2019
Expiry date:	25 March 2024
Publication:	BAnz AT 26.03.2019 B7, chapter III number 1.1

Approved application

The certified AMS is suitable for continuous ambient air monitoring of NO, NO₂ and NO_x (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 limit values 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/C issued by TÜV Rheinland Energy GmbH dated 2 October 2018
- 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 26.03.2019 B7, chapter III number 1.1
UBA announcement dated 27 February 2019:

AMS designation:

42iQ for NO, NO₂ and NO_x

Manufacturer:

Thermo Fisher Scientific, Franklin, USA

Field of application:

For the continuous measurement of nitrogen oxide concentrations in ambient air in stationary use

Measuring ranges during performance testing:

Component	Certification range	Unit
Nitrogen monoxide	0–1 200	µg/m ³
Nitrogen dioxide	0–500	µg/m ³

Software version:

Version: 1.6.1.32120

Restrictions:

None

Note:

This report on the performance test is available online at www.qal1.de.

Test Report:

TÜV Rheinland Energy GmbH, Cologne
Report no.:936/21242986/C dated 2 October 2018

Certified product

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

The 42iQ ambient air quality measuring system is a continuous nitrogen oxide analyser. The instrument uses the chemiluminescence method as a measuring principle.

The ambient air sample is drawn into the 42iQ through the "sample" bulkhead. The sample flows through a capillary, and then to the mode solenoid valve. The solenoid valve routes the sample either straight to the reaction chamber (NO mode) or through the NO₂-to-NO converter and then to the reaction chamber (NO_x mode). The reaction chamber pressure is measured to infer the sample flow. Pressure deviations outside of the acceptable range are reported as a fault.

Dry air enters the 42iQ through the permeation dryer, passes through a flow switch, and then through a silent discharge ozonator. The ozonator generates the ozone needed for the chemiluminescent reaction. At the reaction chamber, the ozone reacts with the NO in the sample to produce excited NO₂ molecules. A photomultiplier tube (PMT) housed in a thermoelectric cooler detects the luminescence generated during this reaction. From the reaction chamber, the exhaust travels through the ozone (O₃) converter to the pump, and is released through the vent.

NO and NO_x concentrations calculated in the NO and NO_x mode are recorded. The difference between the concentrations is used to calculate the NO₂ concentration.

The 42iQ outputs NO, NO₂, and NO_x concentrations to the front panel display and the analogue outputs, and also makes the data available over the serial or Ethernet connection.

The 49iQ system components include:

- Reaction chamber DMC: The reaction chamber is where the sample reacts with ozone and produces excited NO₂ that gives off a photon of energy when it decays. The reaction chamber is heated and controlled to approximately 50 °C in order to ensure the greatest instrument stability. The sample and ozone flow capillaries and a thermistor sensor are also housed in/on the reaction chamber assembly. The optical filter housed in the reaction chamber limits the spectral region viewed by the detector and eliminates possible interferences due to other chemiluminescent reactions. The photomultiplier tube (PMT) provides the infrared sensitivity required to detect the NO₂ luminescence resulting from the reaction of the ozone with the ambient air sample. Optical energy from the reaction is converted to an electrical signal by the PMT and sent to the input board that transmits it to the processor. The thermoelectric PMT cooler reduces the PMT temperature to approximately -3 °C to minimize dark current and increase instrument sensitivity.
- Ozone generator: The Ozonator generates the necessary ozone concentration required for the chemiluminescent reaction. The ozone reacts with the NO in the ambient air sample to produce the electronically excited NO₂ molecules.
- Permeation dryer: The permeation dryer provides a continuous stream of dry air to the ozonator.
- NO₂-NO converter: The converter heats molybdenum to approximately 325 °C in order to convert and detect NO₂. The converter consists of an insulated housing, heater, replaceable cartridge, and a type K thermocouple sensor.
- Common electronics: The common electronics contain the core computational and power routing hardware for the 49iQ, 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 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. 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 42iQ 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. 0000062067: 12 June 2019
Expiry date of the certificate: 25 March 2024
Test report no. 936/21242986/C dated 2 October 2018
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 26.03.2019 B7, chapter III number 1.1
UBA announcement dated 27 February 2019

Expanded uncertainty laboratory, system 1

Measuring device:	42iQ	Serial-No.:	1180540003	nmol/mol	
Measured component:	NO ₂	1h-limit value:	104.6		
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}	0.0011
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.350	U _{r,1h}	0.0003
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	1.130	U _{l,1h}	0.4657
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.300	U _{gp}	0.5468
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.000	U _{gt}	0.0000
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.601	U _{st}	2.2870
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.040	U _{vy}	0.0138
8a	Interferent H ₂ O with 19 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	0.200 -0.200	U _{H2O}	0.0075
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.600 -0.200	U _{int,pos} or	1.4929
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	1.600 2.000	U _{int,neg}	
9	Averaging effect	≤ 7.0% of measured value	-3.400	U _{av}	4.2160
18	Difference sample/calibration port	≤ 1.0%	-0.330	U _{Δ,asc}	0.1191
21	Converter efficiency	≥ 98	99.50	U _{EC}	0.2735
23	Uncertainty of test gas	≤ 3.0%	2.000	U _{cg}	1.0941
				u _c	3.2434
				U	6.4867
				W	6.20
				W _{req}	15
				Combined standard uncertainty	nmol/mol
				Expanded uncertainty	nmol/mol
				Relative expanded uncertainty	%
				Maximum allowed expanded uncertainty	%

Expanded uncertainty laboratory, system 2

Measuring device:		42/Q		Serial-No.:		1180540004		nmol/mol		
Measured component:		NO ₂		1h-limit value:		104.6				
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty					
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.250	u _{r,z}	0.06	0.0040				
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.390	u _{r,1h}	0.02	0.0004				
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.820	u _{l,1h}	0.50	0.2452				
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.290	u _{gp}	0.72	0.5152				
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.000	u _{gt}	0.00	0.0000				
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.271	u _{st}	0.68	0.4650				
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.000	u _v	0.00	0.0000				
8a	Interferent H ₂ O with 19 nmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	0.000 0.000	u _{H2O}	-0.02	0.0006				
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.000 0.200	u _{int,pos} or	1.14	1.2902				
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	1.800 2.400	u _{int,neg}						
9	Averaging effect	≤ 7.0% of measured value	-0.400	u _{av}	-0.24	0.0584				
18	Difference sample/calibration port	≤ 1.0%	-0.190	u _{Δsc}	-0.20	0.0395				
21	Converter efficiency	≥ 98	98.50	u _{EC}	1.57	2.4618				
23	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.05	1.0941				
Combined standard uncertainty						u _c	2.4857			nmol/mol
Expanded uncertainty						U	4.9714			nmol/mol
Relative expanded uncertainty						W	4.75			%
Maximum allowed expanded uncertainty						W _{req}	15			%

Combined uncertainty, laboratory and field, system 1

Measuring device:		Serial-No.:		1180540003	
Measured component:		1h-limit value:		104.6	
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}	0.0011
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.350	u _{r,1h}	-
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	1.130	u _{i,1h}	0.4657
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.300	u _{gp}	0.5468
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.000	u _{gt}	0.0000
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.601	u _{st}	2.2870
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.040	u _v	0.0138
8a	Interferent H ₂ O with 19 mmol/mol	≤ 10 nmol/mol (Zero)	0.200	u _{H2O}	0.0075
		≤ 10 nmol/mol (Span)	-0.200		
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	0.600	u _{int,pos}	
		≤ 5.0 nmol/mol (Span)	-0.200	OR	1.4929
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	1.600		
		≤ 5.0 nmol/mol (Span)	2.000	u _{int,neg}	
9	Averaging effect	≤ 7.0% of measured value	-3.400	u _{av}	4.2160
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	2.440	u _{r,f}	6.5139
11	Long term drift at zero level	≤ 5.0 nmol/mol	1.200	u _{d,l,z}	0.4800
12	Long term drift at span level	≤ 5.0% of max. of certification range	0.240	u _{d,l,1h}	0.0210
18	Difference sample/calibration port	≤ 1.0%	-0.330	u _{ssc}	0.1191
21	Converter efficiency	≥ 98	99.500	u _{EC}	0.2735
23	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.0941
Combined standard uncertainty				u _c	4.1873
Expanded uncertainty				U	8.3746
Relative expanded uncertainty				W	8.01
Maximum allowed expanded uncertainty				W _{req}	15

Combined uncertainty, laboratory and field, system 2

Measuring device:		42IQ		Serial-No.:		1180540004	
Measured component:		NO ₂		1h-limit value:		104.6	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty	nmol/mol	
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.250	U _{r,z}	0.06	0.0040	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.390	U _{r,1h}	not considered, as $\sqrt{2} \cdot u_{r,1h} = 0.02 < u_{r,f}$	-	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.820	U _{l,1h}	0.50	0.2452	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.290	U _{sp}	0.72	0.5152	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.000	U _{gt}	0.00	0.0000	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.271	U _{st}	0.68	0.4650	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.000	U _v	0.00	0.0000	
8a	Interferent H ₂ O with 19 nmol/mol	≤ -0.200 ≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	-0.200 0.600	U _{H2O}	-0.02	0.0006	
8b	Interferent CO ₂ with 500 µmol/mol	≤ 0.000 ≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.000 0.200 1.800	U _{int,pos} or	1.14	1.2902	
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 2.400 ≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	2.400	U _{int,neg}			
9	Averaging effect	≤ 7.0% of measured value	-0.400	U _{av}	-0.24	0.0584	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	2.440	U _{r,f}	2.55	6.5139	
11	Long term drift at zero level	≤ 5.0 nmol/mol	1.200	U _{q,l,z}	0.69	0.4800	
12	Long term drift at span level	≤ 5.0% of max. of certification range	0.640	U _{q,l,1h}	0.39	0.1494	
18	Difference sample/calibration port	≤ 1.0%	-0.190	U _{asc}	-0.20	0.0395	
21	Converter efficiency	≥ 98	98.500	U _{ec}	1.57	2.4618	
23	Uncertainty of test gas	≤ 3.0%	2.000	U _{cg}	1.05	1.0941	
Combined standard uncertainty				U _c		3.6498	nmol/mol
Expanded uncertainty				U		7.2996	nmol/mol
Relative expanded uncertainty				W		6.98	%
Maximum allowed expanded uncertainty				W _{req}		15	%