

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000062066_01

Certified AMS: 43iQ for SO₂

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 14212 (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 11 pages).
The present certificate replaces certificate 0000062066_00 dated 12 June 2019.



Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance
www.tuv.com
ID 0000062066

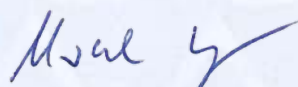
Publication in the German Federal Gazette
(BAnz) of 26 March 2019

German Environment Agency

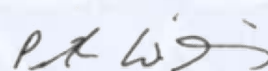
Dessau, 20 March 2024

This certificate will expire on:
25 March 2029

TÜV Rheinland
Energy & Environment GmbH
Cologne, 13 March 2024



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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/B dated 2 October 2018
Initial certification:	26 March 2019
Expiry date:	25 March 2029
Certificate:	Renewal (of previous certificate 0000062066_00 of 12 June 2019 valid until 25 March 2024)
Publication:	BAnz AT 26.03.2019 B7, chapter III No. 2.1

Approved application

The tested AMS is suitable for continuous ambient air monitoring of SO₂ (stationary operation).

The suitability of the AMS for these applications was assessed based on a laboratory test and a 3-month 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 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/B dated 2 October 2018 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 26.03.2019 B7, chapter III No. 2.1,
Announcement by UBA dated 27 February 2019:

AMS designation:

43iQ for sulphur dioxide

Manufacturer:

Thermo Fisher Scientific, Franklin, USA

Field of application:

For the continuous measurement of sulphur dioxide concentrations in ambient air
in stationary use

Measuring ranges during the performance test:

Component	Certification range	Unit
Sulphur dioxide	0 - 1,000	µg/m ³

Software version:

Version: 1.5.1.32120

Restrictions:

None

Notes:

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

Test institute:

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

Publication in the German Federal Gazette: BAnz AT 05.08.2021 B5, Chap. IV notification 11, Announcement by UBA dated 29 June 2021:

11 Notification as regards Federal Environment Agency (UBA) notice of 27 February 2019 (BAnz AT 26.03.2019, chapter III number 2.1)

The latest software version of the Thermo Fisher Scientific ambient air monitoring system 43iQ for SO₂ 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 49, Announcement by UBA dated 28 June 2022:

49 Notification as regards Federal Environment Agency (UBA) notice of 27 February 2019 (BAnz AT 26.03.2019 B7, chapter III number 2.1) and of 29 June 2021 (BAnz AT 05.08.2021 B5, chapter IV notification 11)

The current software version of the immission measuring device 43iQ for SO₂ from Thermo Fisher Scientific is:

01.06.12 (118207-00)

The version 01.06.11 (118207-00) 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 82, Announcement by UBA dated 21 February 2023:

82 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2019 (BAnz AT 26.03.2019, chapter III number 2.1) and of 28 June 2022 (BAnz AT 28.07.2022 B4, chapter III notification 49)

The current software version of the 43iQ ambient air measuring system for SO₂ from Thermo Fisher Scientific is:

01.06.14.34444

The versions 01.06.13.34160 and 01.06.14.34442 are also available.

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 15 September 2022

Certified product

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

The 43iQ is a continuous sulphur dioxide analyser. The instrument uses the UV fluorescence method as its measuring principle. It was designed for the continuous measurement of sulphur dioxide in ambient air.

The sample is drawn into the 43iQ 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 then flows into the fluorescence chamber, where pulsating UV light excites the 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 wavelengths 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 photodetector, 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 UV light.

As the sample leaves the optical chamber, it passes through a flow sensor, a capillary, and the “shell” side of the hydrocarbon kicker. The sample then flows to the pump and is exhausted out the EXHAUST bulkhead of the analyser.

The 43iQ outputs the SO₂ concentration to the front panel display and the analogue outputs, and also makes the data available over the serial or Ethernet connection.

The system components include:

- DMC measurement bench: The optical bench contains the main components for the optical measurement that is at the heart of determining the SO₂ concentration. In the reaction chamber pulsating light from the flash lamp excites the SO₂ molecules. A condenser lens collects and focuses light from fluorescing SO₂ molecules onto the PMT assembly.
- HC kicker: The heated hydrocarbon kicker removes hydrocarbons from the gas stream while leaving the SO₂ concentration unaffected. It operates on a selective permeation principle using differential pressure to force hydrocarbon molecules to pass through the tube wall. The differential pressure is created across the tube wall as sample gas passes through a capillary tube which reduces its pressure.
- Optical bench: The optics section provides the light source for the fluorescence reaction and optimizes the reaction with a system of lenses and mirrors. It includes a flash lamp, condensing lens, bandpass mirror assembly and light baffle.
- Flash lamp assembly: The flash lamp trigger assembly pulses the UV flash lamp at a rate of 10 times per second for improved signal-to-noise ratio and long term stability.
- PMT tube: The PMT power supply produces high voltage to operate the photomultiplier tube used in the measurement system. The output voltage is under software control. The PMT converts optical energy from the reaction to an electrical signal. This signal is sent to the input board which transmits it to the processor.
- 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 43iQ 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. 0000062066_00: 12 June 2019
Expiry date of the certificate: 25 March 2024
Test report: 936/21242986/B dated 2 October 2018
TÜV Rheinland Energy GmbH
Publication: BAnz AT 26.03.2019 B7, chapter III number 2.1
UBA announcement dated 27 February 2019

Notifications

Statement issued by TÜV Rheinland Energy GmbH dated 25 February 2021
Publication: BAnz AT 05.08.2021 B5, chapter IV notification 11
UBA announcement dated 29 June 2021
(Software change Softwareänderung)

Statement issued by TÜV Rheinland Energy GmbH dated 18 May 2022
Publication: BAnz AT 28.07.2022 B4, chapter III notification 49
UBA announcement dated 28 June 2022
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 15 September 2022
Publication: BAnz AT 20.03.2023 B6, chapter IV notification 82
UBA announcement dated 21 February 2023
(Soft- and hardware changes)

Renewal of certificate

Certificate No. 0000062066_01: 20 March 2024
Expiry date of the certificate: 25 March 2029

Expanded uncertainty laboratory, system 2

Measuring device:		Serial-No.:		1180540006	
Measured component:		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	0.260	$u_{r,z}$ 0.08	0.0062
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.550	$u_{r,h}$ 0.16	0.0267
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	2.200	$u_{l,h}$ 1.68	2.8111
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.320	u_{gp} 2.52	6.3646
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.150	u_{gt} 1.22	1.5002
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.274	u_{st} 2.16	4.6663
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.020	u_v 0.19	0.0363
8a	Interferent H ₂ O with 19 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	0.120 -3.640	u_{H_2O} -0.20	0.0381
8b	Interferent H ₂ S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.590 0.020	$u_{int,pos}$	18.5949
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.900 -2.740	4.31	
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.080 -1.680		
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	2.200 3.170		
8f	Interferent m-Xylene with 1 µmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	1.450 4.230		
9	Averaging effect	≤ 7.0% of measured value	2.100		
18	Difference sample/calibration port	≤ 1.0%	-0.380		u_{av} -0.50
21	Uncertainty of test gas	≤ 3.0%	2.000	u_{asc} -0.50 u_{cg} 1.32	0.2516 1.7424
		Combined standard uncertainty		u_c	6.2129
		Expanded uncertainty		U	12.4257
		Relative expanded uncertainty		W	9.41
		Maximum allowed expanded uncertainty		W_{req}	15

Combined uncertainty, laboratory and field, system 1

Measuring device:		43IQ		Serial-No.:		1180540005	
Measured component:		SO ₂		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	0.210	u _{r,z}	0.06	0.0040	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.420	u _{r,h}	not considered, as u _{r,h} = 0,12 < u _{r,f}	-	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	2.400	u _{l,h}	1.83	3.3454	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.380	u _{gp}	3.00	8.9751	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.120	u _{gt}	0.98	0.9601	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.339	u _{st}	2.67	7.1429	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.020	u _v	0.19	0.0363	
8a	Interferent H ₂ O with 19 mmol/mol	≤ 10 nmol/mol (Zero)	0.160				
		≤ 10 nmol/mol (Span)	-3.840				
8b	Interferent H ₂ S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.320	u _{H2O}	-2.91	8.4754	
		≤ 5.0 nmol/mol (Span)	1.370	u _{int,pos}			
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.790				
		≤ 5.0 nmol/mol (Span)	-1.010				
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0.080				
		≤ 5.0 nmol/mol (Span)	-0.460				
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	1.760				
		≤ 5.0 nmol/mol (Span)	4.170				
8f	Interferent m-Xylene with 1 µmol/mol	≤ 10 nmol/mol (Zero)	1.570				
		≤ 10 nmol/mol (Span)	3.120	u _{int,neg}			
9	Averaging effect	≤ 7.0% of measured value	1.600	u _{av}	1.22	1.4868	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	0.460	u _r	0.61	0.3687	
11	Long term drift at zero level	≤ 4.0 nmol/mol	0.580	u _{l,z}	0.33	0.1121	
12	Long term drift at span level	≤ 5.0% of max. of certification range	0.550	u _{l,h}	0.42	0.1757	
18	Difference sample/calibration port	≤ 1.0%	-0.490	u _{ssc}	-0.65	0.4184	
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.32	1.7424	
				Combined standard uncertainty		u _c	7.6609 nmol/mol
				Expanded standard uncertainty		U	15.3217 nmol/mol
				Relative expanded uncertainty		W	11.61 %
				Maximum allowed expanded uncertainty		W _{req}	15 %

Combined uncertainty, laboratory and field, system 2

Measuring device:		431Q		Serial-No.:		1180540006	
Measured component:		SO ₂		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	0.260	U _{r,z}	0.08	0.0062	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.550	U _{r,1h}	not considered, as $u_{r,1h} = 0,16 < u_{r,f}$	-	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	2.200	U _{l,1h}	1.68	2.8111	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.320	U _{sp}	2.52	6.3646	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.150	U _{gt}	1.22	1.5002	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.274	U _{st}	2.16	4.6663	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.020	U _v	0.19	0.0363	
8a	Interferent H ₂ O with 19 nmol/mol	≤ 10 nmol/mol (Zero)	0.120				
		≤ 10 nmol/mol (Span)	-3.640	U _{h2o}	-0.20	0.0381	
8b	Interferent H ₂ S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.590				
		≤ 5.0 nmol/mol (Span)	0.020	U _{h2s,pos}			
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.900				
		≤ 5.0 nmol/mol (Span)	-2.740				
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.080				
		≤ 5.0 nmol/mol (Span)	-1.680	or	4.31	18.5949	
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	2.200				
		≤ 5.0 nmol/mol (Span)	3.170				
8f	Interferent m-Xylene with 1 µmol/mol	≤ 10 nmol/mol (Zero)	1.450	U _{h2o,neg}			
		≤ 10 nmol/mol (Span)	4.230				
9	Averaging effect	≤ 7.0% of measured value	2.100	U _{av}	1.60	2.5613	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	0.460	U _{r,f}	0.61	0.3687	
11	Long term drift at zero level	≤ 4.0 nmol/mol	1.030	U _{l,i,z}	0.59	0.3536	
12	Long term drift at span level	≤ 5.0% of max. of certification range	-0.510	U _{d,i,1h}	-0.39	0.1511	
18	Difference sample/calibration port	≤ 1.0%	-0.380	U _{1,sc}	-0.50	0.2516	
21	Uncertainty of test gas	≤ 3.0%	2.000	U _{sg}	1.32	1.7424	
Combined standard uncertainty				U _c		6.2806	nmol/mol
Expanded uncertainty				U		12.5613	nmol/mol
Relative expanded uncertainty				W		9.52	%
Maximum allowed expanded uncertainty				W _{req}		15	%