

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040217_01

Certified AMS: Model 42i for NO, NO₂ and NO_x

Manufacturer: Thermo Fisher Scientific
27 Forge Parkway
Franklin, MA 02038
USA

Test Institute: TÜV Rheinland Energy GmbH

**This is to certify that the AMS has been tested
and found to comply with:**

**VDI 4202-1: 2002, VDI 4203-2: 2004, EN 14211: 2012,
EN 15267-1: 2009, EN 15267-2: 2009**

Certification is awarded in respect of the conditions stated in this certificate
(see also the following pages).

The present certificate replaces certificate 0000040217 of 29 April 2014.

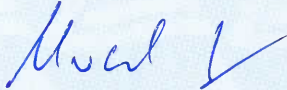


Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance

www.tuv.com
ID 0000040217

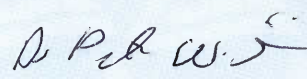
Publication in the German Federal Gazette
(BAnz.) of 8 April 2006

German Federal Environment Agency
Dessau, 1 April 2019


Dr. Marcel Langner
Head of Section II 4.1

This certificate will expire on:
30 June 2020

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 31 March 2019


ppa. Dr. Peter Wilbring

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Am Grauen Stein
51105 Cologne

Accreditation according to EN ISO/IEC 17025:2018 and certified according to ISO 9001:2015.

Certificate:
0000040217_01 / 1 April 2019

Test report: 936/21203248/C1 of 05 January 2006
Addendum 936/21221382/B of 21 September 2013

Initial certification: 01 April 2014

Date of expiry: 30 June 2020

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 22

Approved application

The certified AMS is suitable for continuous monitoring of NO, NO₂ and NO_x in ambient air (stationary operation).

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

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

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for ambient air applications at which it will be installed.

Basis of the certification

This certification is based on:

- test report 936/21203248/C1 of 05 January 2006 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and Addendum 936/21221382/B of 21 September 2013 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- the on-going surveillance of the product and the manufacturing process

AMS designation:

Analyzer Model 42i

Manufacturer:

Thermo Electron Corporation Franklin, MA 02038 USA and 91056 Erlangen

Field of application:

For continuous monitoring of NO, NO₂ und NO_x in ambient air (stationary operation).

Measuring ranges during the performance test:

NO₂ 0 - 400 µg/m³
0 - 500 µg/m³
NO 0 - 1200 µg/m³

Software:

Version: 01.03.00.094

Testing institute:

TÜV Immissionsschutz und Energiesysteme GmbH, Cologne,
TÜV Rheinland Group

Test report:

Report No.: 936/21203248/C of 5 January 2006

1 Notification of the German Federal Environment Agency

The new name of Thermo Electron Corp., Franklin, USA is Thermo Fisher Scientific, Franklin, USA.

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme, 51101 Cologne, Germany, Dr. Peter Wilbring, dated 20th Dezember 2006

6 Notification of announcements by the German Federal Environment Agency dated 21st February 2006 (BAnz. p. 2653) and 12th 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 by TÜV Rheinland Immissionsschutz und Energiesysteme, 51101 Cologne, Germany, Dr. Peter Wilbring, dated 14th December 2006

12 Notification of announcement by the German Federal Environment Agency dated 21st February 2006 (BAnz. p. 2655)

The current software version of the ambient air measuring system 42i by Thermo Fisher Scientific is:
V 01.05.01 (105646-00)

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme dated 10th March 2008

16 Notification of announcement by the German Federal Environment Agency dated 21st February 2006 (BAnz. p. 2655)

The current software version of the ambient air measuring system 42i by Thermo Fisher Scientific is:

V 01.06.01 (108456-00)

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 1st April 2009

4 Notification of announcements by the German Federal Environment Agency dated 21st February 2006 (BAnz. p. 2655) and 3rd August 2009 (BAnz. p. 2936)

The current software version of the ambient air measuring system 42i by Thermo Fisher Scientific is:

V 01.06.02 (108957-00)

The ambient air measuring system 42i by Thermo Fisher Scientific can now also be operated with a sample gas pump of type PU1961-N811-3.07 manufactured by KNF.

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

23 Notification of announcements by the German Federal Environment Agency dated 21st February 2006 (BAnz. p. 2653, Chapter IV Number 4.1) and 12th July 2010 (BAnz. p. 2597, Chapter III 4th notification)

The operational voltage of the cooler for the photomultiplier in the ambient air measuring system 42i for NO_x by Thermo Fisher Scientific was changed from 15 V to 13 V to extend the lifecycle of the component.

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

22 Notification of announcements by the German Federal Environment Agency dated 21st February 2006 (BAnz. p. 2653, Chapter IV Number 4.1) and 6th July 2012 (BAnz AT 20.07.2012 B11, Chapter IV, 23rd notification).

The measuring system model 42i for NO, NO₂ and NO_x by Thermo Fisher Scientific fulfils the requirements of EN 14211 (November 2012). Furthermore, the manufacturing process and the quality management system of the measuring system model 42i for NO, NO₂, and NO_x fulfill the requirements of EN 15267.

The test report of the performance test with report number 936/21203248/C1 as well as an addendum as an integral part of to the test report with report number 936/21221382/B can be viewed on the internet at www.qal1.de.

The positioning of the permeation dryer before the ozone generator was changed within the measuring system.

The Arcturus Bd. 101491-xx processor board was withdrawn and replaced by the new Arcturus Bd. 110570-xx processor board.

The current software version of the measuring system is:
V 02.00.05 (113760-00)

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

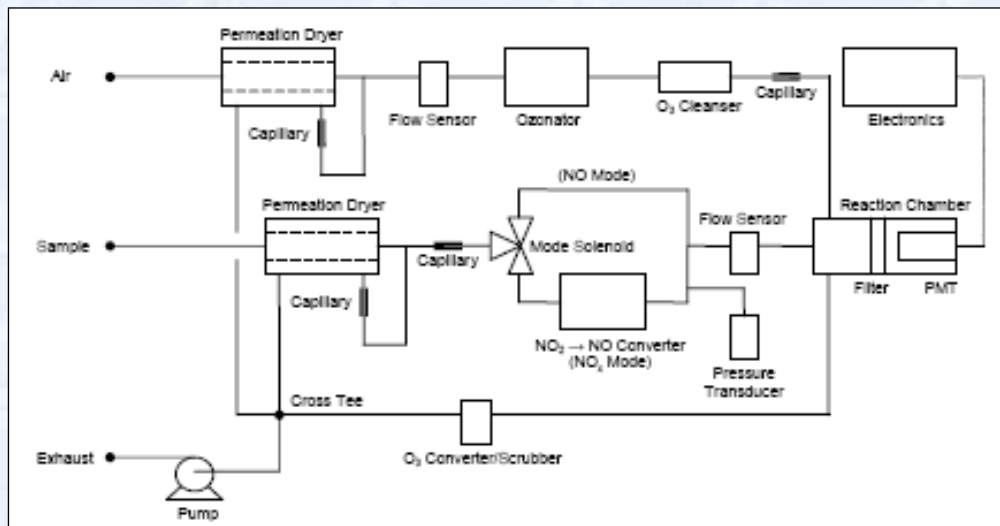
Certified product

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

The measuring system model 42i works according to the principle that nitrogen oxide (NO) and ozone (O₃) react under a characteristic luminescence. The intensity is thereby proportional to NO concentration.



The sample gas passes through a particle filter and a permeation dryer and then flows via a flow regulator and converter into the reaction chamber. The converter converts the nitrogen dioxide present in the sample gas into nitrogen monoxide at 325 °C. To do so ozone is needed, which is produced from dry air in an ozone generator. This is performed using UV radiation. A proportion of NO equivalent to the ozone concentration is oxidised to create NO₂, so called gas phase titration. A detector (PMT) which is located in a thermoelectric cooler measures the luminescence. The model 42i then calculates the NO, NO₂ and NO_x concentration.



The measuring principle complies with the standard reference method as stipulated in EN 14211.

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 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 can be applied to the product or used in publicity material for 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. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must not be employed anymore.

The relevant version of this certificate and the validity is also accessible on the internet: **qal1.de**.

Certification of Model 42i for NO, NO₂ and NO_x is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial test:

Test report: 936/21203248/C1 of 05 January 2006
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 08 April 2006, No. 70, p. 2653, chapter IV, No. 4.1
Announcement by UBA from 21 February 2006

Initial certification according to EN 15267:

Certificate No. 0000040217: 29 April 2014
Expiration date of the certificate: 31 March 2019

Test report: 936/21203248/C1 of 05 January 2006
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Addendum 936/21221382/B of 21 September 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 22
Announcement by UBA from 27 February 2014

Notification:

Publication: BAnz. 20 April 2007, No. 75, p. 4139, chapter IV, notification 1 and 6
Announcement by UBA from 12 April 2007

Publication: BAnz. 03 September 2008, No. 133, p. 3243, chapter IV, notification 12
Announcement by UBA from 12 August 2008

Publication: BAnz. 25 August 2009, No. 125, p. 2929, chapter III, notification 16
Announcement by UBA from 03 August 2009

Publication: BAnz. 28 July 2010, No. 111, p. 2597, chapter III, notification 4
Announcement by UBA from 12 July 2010

Publication: BAnz AT 20 July 2012 B11, chapter IV, notification 23
Announcement by UBA from 06 July 2012

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 22
Announcement by UBA from 27 February 2014

Renewal of the certificate according to EN 15267:

Certificate No. 0000040217_01: 1 April 2019
Expiration date of the certificate: 30 June 2020

Calculation of overall uncertainty lab test (Device 1)

Measuring device:		Thermo Fisher Scientific		Serial-No.:		Device 1	
Measured component:		Modell 42i		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	0.330	U _{r,z}	0.10	0.0097	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.860	U _{r,1h}	0.05	0.0028	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-0.400	U _{l,1h}	-0.24	0.0584	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	1.580	U _{sp}	3.98	15.8064	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	-0.310	U _{gt}	-0.90	0.8075	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.390	U _{st}	1.13	1.2781	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.040	U _v	0.16	0.0264	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	0.830	U _{H2O}	0.35	0.1258	
		≤ 10 nmol/mol (Span)	-1.340				
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	-0.100	U _{int,pos}			
		≤ 5.0 nmol/mol (Span)	-2.330	or	0.38	0.1458	
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0.040	U _{int,neg}			
		≤ 5.0 nmol/mol (Span)	-1.000				
9	Averaging effect	≤ 7.0% of measured value	-2.680	U _{av}	-1.62	2.6195	
18	Difference sample/calibration port	≤ 1.0%	0.000	U _{asc}	0.00	0.0000	
21	Converter efficiency	≥ 98	98.00	U _{EC}	2.09	4.3765	
23	Uncertainty of test gas	≤ 3.0%	2.000	U _{cg}	1.05	1.0941	
Combined standard uncertainty				U _c		5.1345	
Expanded uncertainty				U		10.2691	
Relative expanded uncertainty				W		9.82	
Maximum allowed expanded uncertainty				W _{req}		15	

test (Device 2)

Calculation of overall uncertainty lab

Measuring device:		Thermo Fisher Scientific		Serial-No.:		Device 2	
Measured component:		Modell 42i		1h-limit value:		104.6 nmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.250	$u_{r,z}$	0.07	0.0056	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.360	$u_{r,1h}$	0.02	0.0005	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.500	$u_{l,1h}$	0.30	0.0912	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	1.460	u_{gp}	3.67	13.4966	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	-0.300	u_{gt}	-0.87	0.7563	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.370	u_{st}	1.07	1.1503	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.040	u_v	0.16	0.0264	
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	0.000 0.000	u_{H_2O}	0.42	0.1773	
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	-0.100	$u_{int,pos}$			
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Span)	-1.660	or	0.27	0.0705	
9	Averaging effect	≤ 5.0 nmol/mol (Zero)	0.070	$u_{int,neg}$			
18	Difference sample/calibration port	≤ 7.0% of measured value	-1.100	u_{av}	-0.66	0.4413	
21	Converter efficiency	≥ 1.0%	0.000	u_{asc}	0.00	0.0000	
23	Uncertainty of test gas	≥ 98	98.00	u_{ec}	2.09	4.3765	
		≤ 3.0%	2.000	u_{cg}	1.05	1.0941	
Combined standard uncertainty				u_c		4.6575	nmol/mol
Expanded uncertainty				U		9.3151	nmol/mol
Relative expanded uncertainty				W		8.91	%
Maximum allowed expanded uncertainty				W_{req}		15	%

Calculation of overall uncertainty lab and field test (Device 1)

Measuring device:		Thermo Fisher Scientific		Device 1	
Measured component:		Modell 42i		104.6	
		Serial-No.:		1h-limit value:	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.330	$u_{r,z}$	0.0097
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.860	$u_{r,h}$	-
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-0.400	$u_{l,h}$	0.0584
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	1.580	u_{gp}	15.8064
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	-0.310	u_{gt}	0.8075
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.390	u_{st}	1.2781
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.040	u_v	0.0264
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	0.830	u_{H_2O}	0.1258
		≤ 10 nmol/mol (Span)	-1.340		
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	-0.100	$u_{int,pos}$	
		≤ 5.0 nmol/mol (Span)	-2.330	or	0.1458
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0.040		
		≤ 5.0 nmol/mol (Span)	-1.000	$u_{int,reg}$	
9	Averaging effect	≤ 7.0% of measured value	-2.680	u_{av}	2.6195
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	3.850	$u_{r,f}$	16.2175
11	Long term drift at zero level	≤ 5.0 nmol/mol	-0.640	$u_{d,l,z}$	0.1365
12	Long term drift at span level	≤ 5.0% of max. of certification range	5.000	$u_{d,l,h}$	9.1176
18	Difference sample/calibration port	≤ 1.0%	0.000	u_{asc}	0.0000
21	Converter efficiency	≤ 98	98.000	u_{cc}	4.3765
23	Uncertainty of test gas	≤ 3.0%	2.000	u_{cg}	1.0941
Combined standard uncertainty				u_c	7.1993
Expanded uncertainty				U	14.3986
Relative expanded uncertainty				W	13.77
Maximum allowed expanded uncertainty				W_{req}	15

Calculation of overall uncertainty lab and field test (Device 2)

Calculation of overall uncer-

Measuring device:		Thermo Fisher Scientific		Serial-No.:		Device 2	
Measured component:		Modell 42i		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}	0.07	0.0056	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.360	U _{r,1h}	not considered, as $\sqrt{2} \cdot U_{r,1h} = 0.03 < U_{r,f}$	-	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.500	U _{l,1h}	0.30	0.0912	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	1.460	U _{sp}	3.67	13.4966	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	-0.300	U _{gt}	-0.87	0.7563	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.370	U _{st}	1.07	1.1503	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.040	U _v	0.16	0.0264	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	0.870	U _{H2O}	0.42	0.1773	
		≤ 10 nmol/mol (Span)	-1.000				
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	-0.100	U _{int,pos}			
		≤ 5.0 nmol/mol (Span)	-1.660	or	0.27	0.0705	
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.070	U _{int,neg}			
		≤ 5.0 nmol/mol (Span)	-1.000				
9	Averaging effect	≤ 7.0% of measured value	-1.100	U _{av}	-0.66	0.4413	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	3.850	U _{r,f}	4.03	16.2175	
11	Long term drift at zero level	≤ 5.0 nmol/mol	1.140	U _{l,1,z}	0.66	0.4332	
12	Long term drift at span level	≤ 5.0% of max. of certification range	5.000	U _{l,1,h}	3.02	9.1176	
18	Difference sample/calibration port	≤ 1.0%	0.000	U _{asc}	0.00	0.0000	
21	Converter efficiency	≥ 98	98.000	U _{EC}	2.09	4.3765	
23	Uncertainty of test gas	≤ 3.0%	2.000	U _{cg}	1.05	1.0941	
Combined standard uncertainty				U _c		6.8891	nmol/mol
Expanded uncertainty				U		13.7782	nmol/mol
Relative expanded uncertainty				W		13.17	%
Maximum allowed expanded uncertainty				W _{req}		15	%