CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040217_04

Certified AMS:	Modell 42i for NO, NO_2 and NO_x
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 (2002), VDI 4203 (2004), EN 14211 (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 15 pages).
The present certificate replaces certificate 0000040217_02 dated 1 July 2020.

TÜVRheinland® CERTIFIED
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 Environment Agency

Dessau, 27 June 2025

This certificate will expire on:
30 June 2030

TÜV Rheinland Energy & Environment GmbH
Cologne, 26 June 2025

Dr. Marcel Langner
Head of Section II 4

ppa. Dr. Peter Wilbring

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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:	936/21203248/C1 dated 5 January 2006 and Addendum 936/21221382/B dated 21 September 2013
Initial certification:	1 April 2014
Expiry date:	30 June 2030
Certificate:	Renewal (of previous certificate 0000040217_02 of 1 July 2020 valid until 30 June 2025)
Publication:	BAnz. 08 April 2006, No. 70, p. 2653, chapter IV No. 4.1 and Banz AT 01.04.2014 B12, chapter VI notification 22

Approved application

The tested AMS is suitable for continuous immission measurement of NO, NO_2 and NO_x in stationary use.

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 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 936/21203248/C1 dated 5 January 2006 issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and Addendum 936/21221382/B dated 21 September 2013 issued by TÜV Rheinland Energie und Umwelt 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. 08 April 2006, No. 70, p. 2653, chapter IV No. 4.1, Announcement by UBA dated 21 February 2006:

AMS designation:
Analyser model 42i

Manufacturer:
Thermo Electron Corporation Franklin, MA 02038 USA and 91056 Erlangen

Field of application:
For continuous monitoring of NO, NO_2 und NO_x in ambient air (stationary operation)

Measuring ranges during the performance test:

NO_2	0 – 400	µg/m³
	0 – 500	µg/m³
NO	0 – 1,200	µg/m³

Software version:
Version: 01.03.00.094

Test institute:
TÜV Immissionsschutz und Energiesysteme GmbH, Cologne
TÜV Rheinland Group
Report No.: 936/21203248/C1 dated 5 January 2006

Publication in the German Federal Gazette: BAnz. 20. April 2007, No. 75, S. 4139, Chap. IV notification 1, Announcement by UBA dated 12 April 2007:

1 Notification of Federal Environment Agency (UBA)

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

Statement by TÜV Rheinland Immissionsschutz und Energiesysteme, 51101 Köln, Dr. Peter Wilbring, dated 20 December 2006

Publication in the German Federal Gazette: BAnz. 3 September 2008, No. 133, S. 3243, Chap. IV, notification 12, Announcement by UBA dated 12 August 2008:

12 Notification of announcement by the Federal Environment Agency (UBA) of 21 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 of 10 March 2008

Publication in the German Federal Gazette: BAnz. 25 August 2009, No. 125, S. 2929, Chap. III, notification 16, Announcement by UBA dated 3 August 2009:

16 Notification of announcement by the Federal Environment Agency (UBA) of 21 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 of 1 April 2009

Publication in the German Federal Gazette: BAnz. 28 Juli 2010, No. 111, S. 2597, Chap. III notification 4, Announcement by UBA dated 12 July 2010:

4 Notification of announcements by the Federal Environment Agency (UBA) of 21 February 2006 (BAnz. p. 2655) and 3 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 of 23 March 2010

Publication in the German Federal Gazette: BAnz AT 20.07.2012 B11, Chap. IV notification 23, Announcement by UBA dated 6 July 2012:

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

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 of 20 March 2012

Publication in the German Federal Gazette: BAnz AT 01.04.2014 B12, Chap. VI notification 22, Announcement by UBA dated 27 February 2014:

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

The measuring system model 42i for NO, NO_2 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, NO_2, 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 of 1 October 2013

Publication in the German Federal Gazette: BAnz AT 05.08.2014 B11, Chap. V notification 20, Announcement by UBA dated 17 July 2014:

20 Notification as regards Federal Environmental Agency notices of 21 February 2006 (BAnz. p. 2653, chapter IV, No. 4.1) and of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter VI, notification 22)

The current software version for the Modell 42i measuring system for monitoring NO, NO_2 and NO_x manufactured by Thermo Fisher Scientific is:
V 02.00.06 (114180-00)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 28 March 2014

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, Chap. IV notification 16, Announcement by UBA dated 25 February 2015:

16 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 4.1) and of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter V notification 20)

The current software version for the measuring system Model 42i for NO, NO_2 and NO_x, manufactured by Thermo Fisher Scientific, is:
V 02.02.00 (114535-00)

Statement of TÜV Rheinland Energie und Umwelt GmbH of 22 September 2014

Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, Chap. V notification 12, Announcement by UBA dated 18 February 2016:

12 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 4.1) and of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter IV notification 16)

The current software version of the measuring equipment Model 42i for NO, NO_2 and NO_x of Thermo Fisher Scientific is:
V 02.02.04

Statement of TÜV Rheinland Energie und Umwelt GmbH of 22 October 2015

Publication in the German Federal Gazette: BAnz AT 01.08.2016 B11, Chap. V notification 36, Announcement by UBA dated 14 July 2016:

36 Notification as regards Federal Environmental Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 4.1) and of 18 February 2016 (BAnz AT 14.03.2016 B7, chapter VI notification 12)

The current software version of the model 42i measuring system for NO, NO_2 and NO_x manufactured by Thermo Fisher Scientific is:
V 02.02.05

Statement by TÜV Rheinland Energie und Umwelt GmbH of 29 February 2016

Publication in the German Federal Gazette: BAnz AT 05.08.2021 B5, Chap. IV notification 8, Announcement by UBA dated 29 June 2021:

8 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 4.1) and of 14 July 2016 (BAnz AT 01.08.2016 B11, chapter V notification 36)

The latest software version of the Model 42i measuring system for NO, NO_2 and NO_x manufactured by Thermo Fisher Scientific is:
V 03.00.02
In addition to this revision number, the following interim version is also valid:
V 03.00.01

Statement by TÜV Rheinland Energy GmbH dated 25 February 2021

Publication in the German Federal Gazette: BAnz AT 28.07.2022 B4, Chap. III notification 45, Announcement by UBA dated 28 June 2022:

45 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 4.1) and of 29 June 2021 (BAnz AT 05.08.2021 B5, chapter IV notification 8)

The following hardware changes have been introduced for the Model 42i measuring device for NO, NO_2 and NO_x from Thermo Fisher Scientific:
- The measuring device can now also be equipped with the Arcturus CPU (53281) processor board.
- The measuring device can now also be equipped with a SUNON housing fan (part No. PMD2408PMB-A).
- The pump head of the measuring device can also be equipped with a new intermediate plate made of coated PTFE and a valve plate with a stainless steel flap valve.

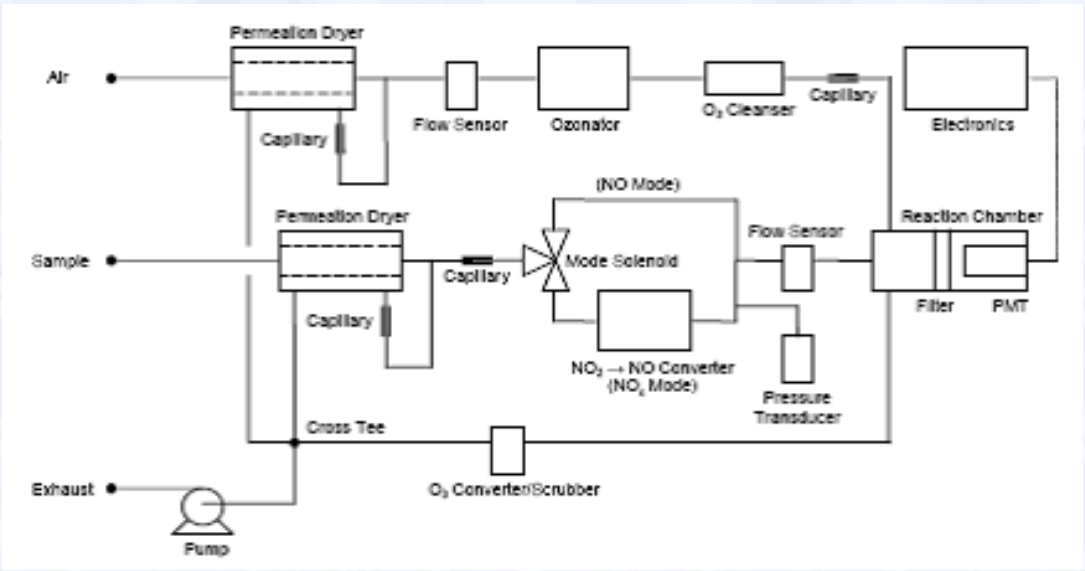
Statement issued by TÜV Rheinland Energy GmbH dated 18 May 2022

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

The Model 42i operates on the principle that nitric oxide (NO) and ozone (O_3) react to produce a characteristic luminescence with an intensity linearly proportional to the NO concentration.

$$NO + O_3 \rightarrow NO_2 + O_2 + h\upsilon$$

The sample gas passes through a particle filter and a permeation dryer and reaches the reaction chamber via a flow controller and a converter. At a temperature of 325 °C, the converter converts the nitrogen dioxide contained in the sample gas into nitrogen monoxide. To this effect, ozone is required, which an ozone generator produces from dry air. This is per-formed using UV radiation. A proportion of NO equivalent to the ozone concentration is oxi-dised to produce NO_2; this is referred to as gas phase titration. The photomultiplier tube (PMT), which is located in a thermoelectric cooler, detects the luminescence. The model 42i then calculates the NO, NO_2 and NO_x concentrations.



This measuring principle corresponds to the standard reference method as described 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 & 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 Modell 42i is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Basic test
Test report: 936/21203248/C1 dated 5 January 2006
TÜV Immissionsschutz und Energiesysteme GmbH
Publication: BAnz. 08 April 2006, No. 70, p. 2653, chapter IV number 4.1
UBA announcement dated 21 February 2006

Notifications
Statement by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 20 December 2006
Publication: BAnz. 20 April 2007, No. 75, p. 4139, chapter IV notification 1
UBA announcement dated 12 April 2007
(New manufacturer name)

Statement by TÜV Immissionsschutz und Energiesysteme GmbH dated 10 March 2008
Publication: BAnz. 03 September 2008, No. 133, p. 3243, chapter IV notification 12
UBA announcement dated 12 August 2008
(Software changes)

Statement issued by TÜV Immissionsschutz und Energiesysteme GmbH dated 1 April 2009
Publication: BAnz. 25 August 2009, No. 125, p. 2929, chapter III notification 16
UBA announcement dated 3 August 2009
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 23 October 2010
Publication: BAnz. 28 July 2010, No. 111, p. 2597, chapter III notification 4
UBA announcement dated 12 July 2010
(Soft- and hardware changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 20 March 2012
Publication: BAnz AT 20.07.2012 B11, chapter IV notification 23
UBA announcement dated 6 July 2012
(Hardware changes)

Initial certification according to EN 15267
Certificate No. 0000040217_00: 29 April 2014
Expiry date of the certificate: 31 March 2019
Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 1 October 2013
Test report: 936/21203248/C1 dated 5 January 2006 and 936/21221382/B dated 21 September 2013
Publication: BAnz AT 01.04.2014 B12, chapter VI notification 22
UBA announcement dated 27 February 2014

Notifications
Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 28 March 2014
Publication: BAnz AT 05.08.2014 B11, chapter V notification 20
UBA announcement dated 17 July 2014
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 22 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 16

UBA announcement dated 25 February 2015
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 22 October 2015
Publication: BAnz AT 14.03.2016 B7, chapter V notification 12
UBA announcement dated 18 February 2016
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 29 February 2016
Publication: BAnz AT 01.08.2016 B11, chapter V notification 36
UBA announcement dated 14 July 2016
(Software changes)

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

Renewal of certificates
Certificate No. 0000040217_02: 1 July 2020
Expiry date of the certificate: 30 June 2025

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 25 February 2021
Publication: BAnz AT 05.08.2021 B5, chapter IV notification 8
UBA announcement dated 29 June 2021
(Software changeSoftwareänderung)

Statement issued by TÜV Rheinland Energy GmbH dated 18 May 2022
Publication: BAnz AT 28.07.2022 B4, chapter III notification 45
UBA announcement dated 28 June 2022
(Hardware changes)

Renewal of certificates
Certificate No. 0000040217_03: 27 June 2025
Expiry date of the certificate: 30 June 2030

Renewal of certificates
Certificate No. 0000040217_04: 27 June 2025
Expiry date of the certificate: 30 June 2030
(Certificate correction, status of guidelines updated)

Expanded uncertainty laboratory, system 1

Measuring device:	Thermo Fisher Scientific	Serial-No.:	Device 1	
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	0.330	$u_{r,z}$	0.10	0.0097	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0.860	$u_{r,lh}$	0.05	0.0028	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	-0.400	$u_{l,lh}$	-0.24	0.0584	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	8.0 nmol/mol/kPa	1.580	u_{gp}	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_20 with 21 mmol/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				
		≤	5.0 nmol/mol (Span)	-1.000	$u_{int,neg}$			
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	$u_{\Delta sc}$	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	nmol/mol
				Expanded uncertainty	U		10.2691	nmol/mol
				Relative expanded uncertainty	W		9.82	%
				Maximum allowed expanded uncertainty	W_{req}		15	%

Expanded uncertainty laboratory, system 2

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	$u_{r,lh}$	0.02	0.0005	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0.500	$u_{l,lh}$	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_20 with 21 mmol/mol	≤	10 nmol/mol (Zero)	0.000	u_{H2O}	0.42	0.1773	
		≤	10 nmol/mol (Span)	0.000				
8b	Interferent CO_2 with 500 µmol/mol	≤	5.0 nmol/mol (Zero)	-0.100	$u_{int,pos}$	0.27	0.0705	
		≤	5.0 nmol/mol (Span)	-1.660	or			
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0.070				
		≤	5.0 nmol/mol (Span)	-1.000	$u_{int,neg}$			
9	Averaging effect	≤	7.0% of measured value	-1.100	u_{av}	-0.66	0.4413	
18	Difference sample/calibration port	≤	1.0%	0.000	$u_{\Delta sc}$	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		4.6575	nmol/mol
				Expanded uncertainty	U		9.3151	nmol/mol
				Relative expanded uncertainty	W		8.91	%
				Maximum allowed expanded uncertainty	W_{req}		15	%

Combined uncertainty, laboratory and field, system 1

Measuring device:	Thermo Fisher Scientific				Serial-No.:		Device 1	
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	0.330	$u_{r,z}$	0.10	0.0097	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0.860	$u_{r,lh}$	not considered, as √2*ur,lh = 0.07 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	-0.400	$u_{l,lh}$	-0.24	0.0584	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	8.0 nmol/mol/kPa	1.580	u_{gp}	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_2O with 21 mmol/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	$u_{int,pos}$ or $u_{int,neg}$	0.38	0.1458	
		≤	5.0 nmol/mol (Span)	-2.330				
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0.040				
		≤	5.0 nmol/mol (Span)	-1.000				
9	Averaging effect	≤	7.0% of measured value	-2.680	u_{av}	-1.62	2.6195	
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	-0.640	$u_{d,l,z}$	-0.37	0.1365	
12	Long term drift at span level	≤	5.0% of max. of certification range	5.000	$u_{d,l,lh}$	3.02	9.1176	
18	Difference sample/calibration port	≤	1.0%	0.000	$u_{\Delta sc}$	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	7.1993	nmol/mol
				Expanded uncertainty		U	14.3986	nmol/mol
				Relative expanded uncertainty		W	13.77	%
				Maximum allowed expanded uncertainty		W_{req}	15	%

Certificate:
0000040217_04 / 27 June 2025

Combined uncertainty, laboratory and field, system 2

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	$u_{r,lh}$	not considered, as √2*ur,lh = 0.03 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0.500	$u_{l,lh}$	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_20 with 21 mmol/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	$u_{int,pos}$	0.27	0.0705	
		≤	5.0 nmol/mol (Span)	-1.660	or			
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0.070				
		≤	5.0 nmol/mol (Span)	-1.000	$u_{int,neg}$			
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	$u_{d,l,z}$	0.66	0.4332	
12	Long term drift at span level	≤	5.0% of max. of certification range	5.000	$u_{d,l,lh}$	3.02	9.1176	
18	Difference sample/calibration port	≤	1.0%	0.000	$u_{\Delta sc}$	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	%