

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000039320_02

Certified AMS: Modell 49i for O₃

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 the standards
VDI 4202-1 (2018), EN 14625 (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 17 pages).

The present certificate replaces certificate 0000039320_01 dated 22 July 2018.



Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance
www.tuv.com
ID 0000039320

Publication in the German Federal Gazette
(BAnz) of 08 April 2006

German Environment Agency
Dessau, 14 July 2023

This certificate will expire on:
22 July 2028

TÜV Rheinland Energy GmbH
Cologne, 13 July 2023



Dr. Marcel Langner
Head of Section II 4



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TÜV Rheinland Energy GmbH
Am Grauen Stein
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:	936/21203248/B1 dated 5 January 2006 Addendum 936/21221382/A dated 21 March 2013
Initial certification:	23 July 2013
Expiry date:	22 July 2028
Certificate:	Renewal (of previous certificate 0000039320_01 of 22 July 2018 valid until 22 July 2023)
Publication:	BAnz. 08 April 2006, number 70, p. 2653, chapter IV number 3.2

Approved application

The tested AMS is suitable for continuous ambient air monitoring of O₃ (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 +5° to 40°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/B1 dated 5 January 2006 of TÜV Immissionsschutz und Energiesysteme GmbH
- Addendum 936/21221382/A dated 21 March 2013 of 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. 8 April 2006, number 70, p. 2653, chapter IV number 3.2, Announcement by UBA dated 21 February 2006:

AMS designation:

Ozone Analyzer Model 49i

Manufacturer:

Thermo Electron Corporation Franklin, MA 02038 USA and 91056 Erlangen

Field of application:

For continuous ambient air monitoring of O₃ (stationary operation)

Measuring ranges during the performance test:

O₃ 0 - 360 µg/m³
0 - 500 µg/m³

Software version:

Version: V 01.01.02.105

Test institute:

TÜV Immissionsschutz und Energiesysteme GmbH, Cologne
TÜV Rheinland Group
Report No.: 936/21203248/B1 dated 05 January 2006

Publication in the German Federal Gazette: BAnz. 20 April 2007, number 75, p. 4139, Chap. IV notification 1, Announcement by UBA dated 12 April 2007:

1 Notification of Federal Environment Agency

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

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

Publication in the German Federal Gazette: BAnz. 03 September 2008, number 133, p. 3243, Chap. IV notification 15, Announcement by UBA dated 12 August 2008:

15 Notification as regards Federal Environment Agency notice of 21 February 2006 (BAnz. p. 2655)

The current software version for the Model 49i air quality monitor manufactured by Thermo Fisher Scientific is:

V 01.05.00 (105115-00)

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 10 March 2008

Publication in the German Federal Gazette: BAnz. 25 August 2009, number 125, p. 2929, Chap. III notification 19, Announcement by UBA dated 3 August 2009:

19 Notification as regards Federal Environment Agency notice of 21 February 2006 (BAnz. p. 2655)

The current software version for the Model 49i air quality monitor manufactured by Thermo Fisher Scientific is:

V 01.06.01 (108459-00)

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

Publication in the German Federal Gazette: BAnz. 28 July 2010, number 111, p. 2597, Chap. III notification 7, Announcement by UBA dated 12 July 2010:

7 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2655) and of 3 August 2009 (BAnz. p. 2936)

The Model 49i air quality monitor manufactured by Thermo Fisher Scientific can also be used with the PU1959-N86-3.07 sample gas pump manufactured by KNF.

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

Publication in the German Federal Gazette: BAnz. 29 July 2011, number 113, p. 2725,
Chap. III notification 21, Announcement by UBA dated 15 July 2011:

**21 Notification as regards Federal Environment Agency (UBA) notices
of 12 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and
of 12 July 2010 (BAnz. p. 2597, chapter III, notification 7)**

The current software version for the Model 49i air quality monitor for O₃
manufactured by Thermo Fisher Scientific is:

V 01.06.04 (109898-00)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 30 March 2011

Publication in the German Federal Gazette: BAnz. 2 March 2012, number 36, p. 920,
Chap. V notification 1, Announcement by UBA dated 23 February 2012:

**1 Notification as regards Federal Environment Agency (UBA) notices
of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and
of 15 July 2011 (BAnz. p. 2725, chapter III, notification 21)**

The current software version for the Model 49i air quality monitor for ozone
manufactured by Thermo Fisher Scientific is:

V 01.06.08 (111276-00)

Instead of the measurement cell used so far that consists of the polyurethane-
coated aluminium tube, an alternative measurement cell can be used which
consists of an aluminium tube and an integrated FEP hose (FEP: fluorinated
ethylene propylene).

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 17 November 2011

Publication in the German Federal Gazette: BAnz AT 20.07.2012 B11, Chap. IV notification 26, Announcement by UBA dated 06 July 2012:

26 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and of 23 February 2012 (BAnz. p. 920, chapter V notification 1)

The Model 49i air quality monitor for O₃ manufactured by Thermo Fisher Scientific will be equipped with the PU2737-N86 vacuum pump manufactured by KNF in the future.

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

Publication in the German Federal Gazette: BAnz AT 23.07.2013 B4, Chap. V notification 22, Announcement by UBA dated 3 July 2013:

22 Notification on announcements of the Federal Environmental Agency of 21 February 2006 (BAnz. p. 2929, chapter IV number 3.2) and of 6 July 2012 (BAnz. AT of 20 July 2012 B11, chapter IV, notification 26)

The Model 49i measuring system for O₃, manufactured by Thermo Fisher Scientific, fulfils the requirements of EN 14625 (December 2012).

In addition, the production and quality management system of the measuring system meet the requirements of EN 15267.

The performance test report no. 936/21203248/B1, a statement of TÜV Rheinland Energie und Umwelt GmbH dated 17 November 2011 as well as the addendum as integral part of report no. 936/21221382/A are available online at www.qal1.de.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 21 March 2013

Publication in the German Federal Gazette: BAnz AT 01.04.2014 B12, Chap. VI notification 35, Announcement by UBA dated 27 February 2014:

35 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and of 3 July 2013 (BAnz AT 23.07.2013 B4, chapter V notification 22)

Production of the Arcturus Bd. 101491-xx processor board for the Model 49i air quality monitor for O₃ manufactured by Thermo Fisher Scientific has been discontinued and replaced by the Arcturus Bd. 110570-xx processor board.

The current software version of the measuring system is:
V 02.00.00 (113421-00)

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

Publication in the German Federal Gazette: BAnz AT 05.08.2014 B11, Chap. V notification 23, Announcement by UBA dated 17 July 2014:

23 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter VI notification 35)

The detector unit of the Model 49i ozone analyzer manufactured by Thermo Fisher Scientific has been re-engineered in order to increase production safety regarding earthing/insulation.

Addendum no. 936/21221382/A to the original test report has been revised and is now available online as addendum no. 936/21221382/A1 at www.qal1.de.

The current software version of the model 49i measuring system for O₃ manufactured by Thermo Fisher Scientific is:

V 02.00.04 (114183-00)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 29 March 2014

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, Chap. IV notification 19, Announcement by UBA dated 25 February 2015:

19 Notification as regards Federal Environment Agency (UBA) notices of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter V notification 23)

The solenoid valves (SV-111747-501) that had been used so far for the Model 49i O₃ analyser manufactured by Thermo Fisher Scientific, have been replaced by new solenoid valves (KL344-T-1S1-C204).

The current software version of the model 49i measuring system for O₃ manufactured by Thermo Fisher Scientific is:

V 02.02.01 (114620-00)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 22 September 2014

Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, Chap. V
notification 15, Announcement by UBA dated 18 February 2016:

**15 Notification as regards Federal Environment Agency (UBA) notices
of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and
of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter IV notification 19)**

The current software version of the model 49i measuring system for O₃
manufactured by Thermo Fisher Scientific is:

V 02.02.06

Ventilator EBM-Papst 8314 HL may be used instead of the ventilator that has been
in use so far.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 22 October 2015

Publication in the German Federal Gazette: BAnz AT 26.03.2019 B7, Chap. IV
notification 72, Announcement by UBA dated 27 February 2019:

**72 Notification as regards Federal Environment Agency (UBA) notices
of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and
of 18 February 2016 (BAnz AT 14.03.2016 B7, chapter V notification 15)**

The model 49i ambient air quality measuring system for O₃ manufactured by Thermo
Fisher Scientific may also use connectors manufactured by HAM-LET for its gas lines
separately or in combination with those provided by Swagelok.

The default lamp intensity setting is now 50%.

Statement issued by TÜV Rheinland Energy GmbH dated 10 January 2019

Publication in the German Federal Gazette: BAnz AT 05.08.2021 B5, Chap. IV
notification 14, Announcement by UBA dated 29 June 2021:

**14 Notification as regards Federal Environment Agency (UBA) notices
of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and
of 27 February 2019 (BAnz AT 26.03.2019 B7, chapter IV notification 72)**

The latest software version of the Thermo Fisher Scientific measuring system Model
49i for O₃ is:

V 03.00.01

In addition to this revision number, the following interim version is also valid:

V 03.00.00

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 48, Announcement by UBA dated 28 June 2022:

**48 Notification as regards Federal Environment Agency (UBA) notices
of 21 February 2006 (BAnz. p. 2653, chapter IV number 3.2) and
of 29 June 2021 (BAnz AT 05.08.2021 B5, chapter IV notification 14)**

The following hardware changes have been introduced for the Model 49i measuring
device for O₃ 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 (Art.
No. PMD2408PMB-A).

Statement issued by TÜV Rheinland Energy GmbH dated 18 May 2022

Certified product

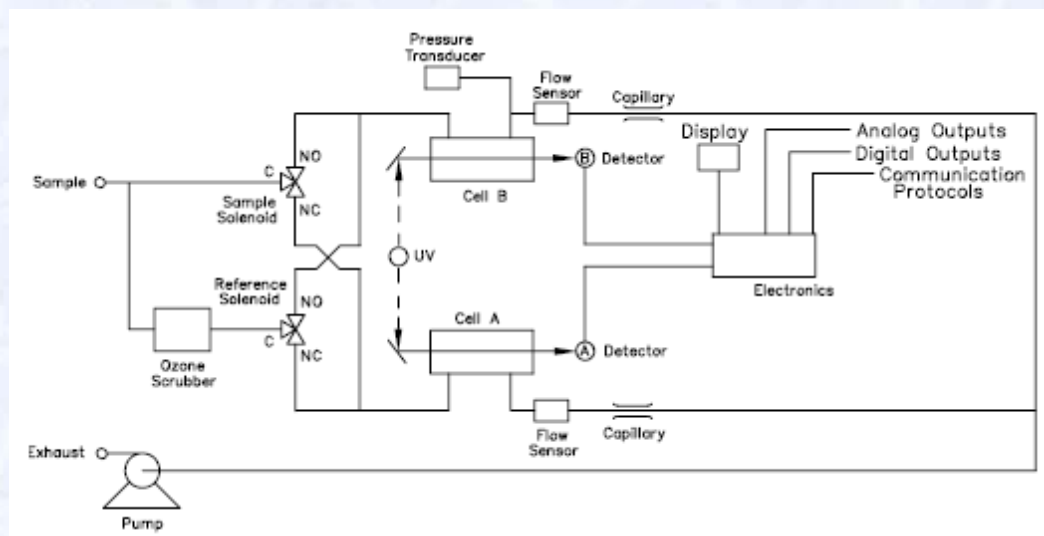
This certificate applies to automated measurement systems conforming to the following description:

The measuring principle of the Model 49i measuring system relies on the determination of light absorption caused by the gas to be measured in the ranges of wave lengths characteristic of this gas, which, for ozone, is at 254 nm (UV) and thus complies with the reference method described in standard EN 14625.

The ambient air sample is sucked through the bulkhead connection designated SAMPLE into the Model 49i measuring system and divided into two flows. One of these gas flows passes through an ozone scrubber and serves as reference gas (I_0). The reference gas then flows toward the solenoid valve. The sample gas (I) flows to the sampling solenoid valve directly. The solenoid valves alternate between reference and sample gas flows between cells A and B every ten seconds. When cell A is filled with reference gas, cell B is filled with sample gas and vice versa.

Detectors A and B measure the UV light intensities of both cells. When the solenoid valves direct the reference and sample gas to the respective opposite cell, the light intensities are disregarded for a few seconds in order to purge the cells. The Model 49i measuring system calculates the ozone concentration in each cell. The average concentration is shown on the front display and produced via analogue outputs. The measurement data are provided via serial or Ethernet interface.

The following figure illustrates the spatial configuration of the analyser assemblies.



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 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. 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 its expiration is also accessible on the internet: gal1.de.

History of documents

Certification of Modell 49i 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/B1 dated 5 January 2006
TÜV Immissionsschutz und Energiesysteme GmbH
Publication: BAnz. 08 April 2006, number 70, p. 2653, chapter IV number 3.2
UBA announcement dated 21 February 2006

Notifications

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 20 December 2006

Publication: BAnz. 20 April 2007, number 75, p. 4139, chapter IV notification 1
UBA announcement dated 12 April 2007
(change of company name)

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH dated 10 March 2008

Publication: BAnz. 03 September 2008, number 133, p. 3243, chapter IV notification 15
UBA announcement dated 12 August 2008
(Software changes)

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

Publication: BAnz. 25 August 2009, number 125, p. 2929, chapter III notification 19
UBA announcement dated 3 August 2009
(Software changes)

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

Publication: BAnz. 28 July 2010, number 111, p. 2597, chapter III notification 7
UBA announcement dated 12 July 2010
(pump)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 30 March 2011
Publication: BAnz. 29 July 2011, number 113, p. 2725, chapter III notification 21
UBA announcement dated 15 July 2011
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 17 November 2011
Publication: BAnz. 02 March 2012, number 36, p. 920, chapter V notification 1
UBA announcement dated 23 February 2012
(Software measurement cell)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 20 March 2012
Publication: BAnz AT 20.07.2012 B11, chapter IV notification 26
UBA announcement dated 6 July 2012
(pump)

Initial certification according to EN 15267

Certificate No. 0000039320_00: 20 August 2013
Expiry date of the certificate: 22 July 2018

Test report: 936/21203248/B1 dated 5 January 2006
TÜV Immissionsschutz und Energiesysteme GmbH
Addendum 936/21221382/A vom 21 March 2013
der TÜV Rheinland Energie und Umwelt GmbH

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 21 March 2013
Publication: BAnz AT 23.07.2013 B4, chapter V number 22
UBA announcement dated 3 July 2013

Notifications

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 1 October 2013
Publication: BAnz AT 01.04.2014 B12, chapter VI notification 35
UBA announcement dated 27 February 2014
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 29 March 2014
Publication: BAnz AT 05.08.2014 B11, chapter V notification 23
UBA announcement dated 17 July 2014
(revision of the addendum and 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 19
UBA announcement dated 25 February 2015
(replacement of the solenoid valve and 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 15
UBA announcement dated 18 February 2016
(Software changes and alternative fan)

Renewal of certificate

Certificate No. 0000039320_01: 22 July 2018
Expiry date of the certificate: 22 July 2023

Notifications

Statement issued by TÜV Rheinland Energy GmbH dated 10 January 2019
Publication: BAnz AT 26.03.2019 B7, chapter IV notification 72
UBA announcement dated 27 February 2019
(Hardware changes)

Statement issued by TÜV Rheinland Energy GmbH dated 25 February 2021
Publication: BAnz AT 05.08.2021 B5, chapter IV notification 14
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 48
UBA announcement dated 28 June 2022
(Hardware changes)

Renewal of certificate

Certificate No. 0000039320_02: 14 July 2023
Expiry date of the certificate: 22 July 2028

Expanded uncertainty laboratory, system 1

Measuring device:		Thermo Fisher Scientific Model 491		Serial number:		Gerät 1	
Measured component:		O3		1h-Alert threshold:		120 nmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0,100	$u_{r,z}$	0,03	0,0007	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0,100	$u_{r,1h}$	0,03	0,0007	
3	"lack of fit" at 1h-limit value	≤ 4.0% of meas. value	1,500	$u_{l,1h}$	1,04	1,0800	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0,100	u_{gp}	1,04	1,0800	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0,054	u_{gt}	0,56	0,3149	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0,230	u_{st}	-1,59	2,5392	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0,020	u_v	0,30	0,0885	
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	-0,980 -1,640	u_{H_2O}	-1,07	1,1427	
8b	Interferent Toluene with 0,5 µmol/mol	≤ 5.0 nmol/mol (Zero)	0,100	$u_{int,pos}$			
8c	Interferent Xylene with 0,5 µmol/mol	≤ 5.0 nmol/mol (Span)	0,970	or	0,79	0,6280	
		≤ 5.0 nmol/mol (Zero)	0,100				
9	Averaging effect	≤ 5.0 nmol/mol (Span)	0,940	$u_{int,neg}$			
		≤ 7.0% of meas. value	3,150	u_{av}	2,18	4,7628	
18	Difference sampler/calibration port	≤ 1%	0,000	u_{asc}	0,00	0,0000	
21	Uncertainty of test gas	≤ 3%	2,000	u_{cg}	1,20	1,4400	
				Combined standard uncertainty	u_c	3,6163 nmol/mol	
				Expanded uncertainty	U	7,2326 nmol/mol	
				Relative expanded uncertainty	W	6,03 %	
				Maximum allowed expanded uncertainty	W_{req}	15 %	

Combined uncertainty, laboratory and field, system 1

Measuring device:		Serial number:		Gerät 1	
Thermo Fisher Scientific Model 491		120		nmol/mol	
Measured component:		1h-Alert threshold:			
O3					
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0,100	$u_{r,z}$	0,0007
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0,100	$u_{r,h}$	-
3	"lack of fit" at 1h-limit value	≤ 4.0% of meas. value	1,500	$u_{l,h}$	1,0800
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0,100	u_{sp}	1,0800
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0,054	u_{gt}	0,3149
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0,230	u_{st}	2,5392
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0,020	u_v	0,0885
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	-0,980	u_{H_2O}	1,1427
		≤ 10 nmol/mol (Span)	-1,640		
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero)	0,100	$u_{tol,pos}$	
		≤ 5.0 nmol/mol (Span)	0,970	or	0,6280
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero)	0,100	$u_{xt,neg}$	
		≤ 5.0 nmol/mol (Span)	0,940		
9	Averaging effect	≤ 7.0% of meas. value	3,150	u_{av}	4,7628
10	Reproducibility standard deviation under field conditions	≤ 5.0% of 3 month average	0,826	$u_{r,f}$	0,9825
11	Long term drift at zero level	≤ 5.0 nmol/mol	1,000	$u_{d,l,z}$	0,3333
12	Long term drift at 1h-limit value	≤ 5.0% of max. of cert. range	1,450	$u_{d,l,h}$	1,0092
18	Difference sampler/calibration port	≤ 1%	0,000	$u_{A,sc}$	0,0000
21	Uncertainty of test gas	≤ 3%	2,000	u_{cg}	1,4400
Combined standard uncertainty				u_c	3,9245
Expanded standard uncertainty				U	7,8490
Relative expanded uncertainty				W	6,54
Maximum allowed expanded uncertainty				W_{req}	15

Combined uncertainty, laboratory and field, system 2

Measuring device:		Thermo Fisher Scientific Model 49i		Serial number:		Gerät 2	
Measured component:		O3		1h-Alert threshold:		120	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty	nmol/mol	
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0,100	u _{r,z}	0,03	0,0007	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0,100	u _{r,h}	not considered, as u _{r,h} = 0,02 < u _{r,f}	-	
3	"lack of fit" at 1h-limit value	≤ 4.0% of meas. value	1,600	u _{l,h}	1,11	1,2288	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0,090	u _{gp}	0,94	0,8748	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0,003	u _{gt}	0,03	0,0010	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0,290	u _{st}	-2,01	4,0368	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0,030	u _v	0,45	0,1992	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	-0,800	u _{H2O}	-0,99	0,9819	
		≤ -1,570					
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero)	0,070	u _{int,pos}			
		≤ 5.0 nmol/mol (Span)	0,540	or	0,43	0,1864	
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero)	0,040	u _{int,neg}			
		≤ 5.0 nmol/mol (Span)	0,500				
9	Averaging effect	≤ 7.0% of meas. value	3,760	u _{av}	2,61	6,7860	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of 3 month average	0,826	u _{r,f}	0,99	0,9825	
11	Long term drift at zero level	≤ 5.0 nmol/mol	1,040	u _{l,z}	0,60	0,3605	
12	Long term drift at 1h-limit value	≤ 5.0% of max. of cert. range	-1,480	u _{l,h}	-1,03	1,0514	
18	Difference sample/calibration port	≤ 1%	0,000	u _{asc}	0,00	0,0000	
21	Uncertainty of test gas	≤ 3%	2,000	u _{cg}	1,20	1,4400	
				Combined standard uncertainty		u _c	4,2579
				Expanded uncertainty		U	8,5159
				Relative expanded uncertainty		W	7,10
				Maximum allowed expanded uncertainty		W _{req}	15