

# CERTIFICATE

## of Product Conformity (QAL1)

Certificate No.: 0000038504\_03

**Certified AMS:** 400E / T400 for O<sub>3</sub>

**Manufacturer:** Teledyne API  
9970 Carroll Canyon Road  
San Diego, CA, 92131  
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 14 pages).  
The present certificate replaces certificate 0000038504\_02 dated 05 March 2018.



Suitability Tested  
Complying with  
2008/50/EC  
EN 15267  
Regular  
Surveillance  
[www.tuv.com](http://www.tuv.com)  
ID 0000038504

Publication in the German Federal Gazette  
(BAnz) of 29 October 2005

German Environment Agency  
Dessau, 02 March 2023

This certificate will expire on:  
04 March 2028

TÜV Rheinland Energy GmbH  
Cologne, 01 March 2023



Dr. Marcel Langner  
Head of Section II 4.1



ppa. Dr. Peter Wilbring

[www.umwelt-tuv.eu](http://www.umwelt-tuv.eu)  
[tre@umwelt-tuv.eu](mailto:tre@umwelt-tuv.eu)  
Tel. + 49 221 806-5200

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.

<b>Test report:</b>	936/21207124/A1 dated 22 August 2007
<b>Initial certification:</b>	05 March 2013
<b>Expiry date:</b>	04 March 2028
<b>Certificate:</b>	Renewal (of previous certificate 0000038504_02 of 05 March 2018 valid until 04 March 2023)
<b>Publication:</b>	BAnz. 29 October 2005, No. 206, p. 15700, chapter IV No. 3.1

### **Approved application**

The tested AMS is suitable for continuous ambient air monitoring of O<sub>3</sub> (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 936/21207124/A1 dated 22 August 2007 of TÜV Immissionsschutz und Energiesysteme GmbH
- Addendum 936/21219874/D dated 11 October 2012 of TÜV Rheinland Energie und Umwelt GmbH
- Addendum 936/21221556/D dated 16 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. 29 October 2005, No. 206, p. 15700, chapter IV No. 3.1, Announcement by UBA dated 25 July 2005:

**AMS designation**

Modell 400E for O<sub>3</sub>

**Manufacturer:**

Teledyne Instruments Advanced Pollution Instrumentation Division,  
San Diego, CA 92121-2251, USA

Distributor: MLU Messtechnik für Luft und Umwelt GmbH, 45143 Essen

**Field of application:**

For the continuous measurement of ozone in ambient air (stationary operation).

**Measuring ranges during the suitability test:**

O<sub>3</sub>:           0 – 360 µg/m<sup>3</sup>  
                  0 – 500 µg/m<sup>3</sup>

**Software version:** Version C.3

**Restrictions:**

With SO<sub>2</sub> concentrations greater than 150 µg/m<sup>3</sup>, the cross-sensitivity requirements are no longer fully met.

**Test institute:**

TÜV Immissionsschutz und Energiesysteme GmbH, Cologne

TÜV Rheinland Group

Test report No.: 936/21201601/A vom 10. Juli 2005

Publication in the German Federal Gazette: BAnz. 20 April 2007, No. 75, p. 4139, chap. IV notification 7, Announcement by UBA dated 12 April 2007:

**7 Notification as regards Federal Environment Agency notice of 25 July 2005 (BAnz p. 15700)**

The model 300E measuring system for carbon monoxide and the model 400E for ozone manufactured by Teledyne Instruments, San Diego, USA, will no longer be distributed by the company named in the announcement, MLU-Monitoring für Leben und Umwelt Ges.m.b.H. in A-2340 Mödling, Austria. In the future, they will be exclusively distributed by EAS Envimet Analytical Systems Ges.m.b.H., Brunn, Austria.

Statement issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, 51105 Cologne, Dr. Peter Wilbring, dated 14 October 2006

Publication in the German Federal Gazette: BAnz. 26 January 2011, No. 14, p. 294, chap. IV notification 25, Announcement by UBA dated 10 January 2011:

**25 Notification as regards Federal Environment Agency notices of 25 July 2005 (BAnz p. 15700, chapter IV No. 3.1) and of 12 April 2007 (BAnz p. 4139, chapter IV, notification 7)**

The current software version of the Model 400E (= M400E) ambient air measuring system for O<sub>3</sub> manufactured by Teledyne Advanced Pollution Instrumentation is:  
E.3 incl. Library Version 6.3

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 29 September 2010

Publication in the German Federal Gazette: BAnz. 26 January 2011, No. 14, p. 294, chap. IV notification 26, Announcement by UBA dated 10 January 2011:

**26 Notification as regards Federal Environment Agency notices of 25 July 2005 (BAnz p. 15700, chapter IV No. 3.1) and of 12 April 2007 (BAnz p. 4139, chapter IV, notification 7)**

The Model 400E measuring system for O<sub>3</sub> manufactured by Teledyne Advanced Pollution Instrumentation is manufactured both in its old design M400E and in its new design Model T400. The new design differs from the old design only in that it has a new display, a new front plate and offers extended possibilities for communication. The current name of the new design of the measuring system is:

Model T400

The current software version of the new design of the measuring system is:

1.0.0 bld 54 incl. Library Version 7.0.0 bld 57

Statement issued by TÜV Rheinland Energie und Umwelt GmbH  
dated 29 September 2010

Publication in the German Federal Gazette: BAnz AT 05.03.2013 B10, chap. V notification 6, Announcement by UBA dated 12 February 2013

**6 Notification as regards Federal Environment Agency (UBA) notices of 25 July 2005 (BAnz p. 15700, chapter IV, No. 3.1) and of 10 January 2011 (BAnz p. 294, chapter IV, notification 25 and 26)**

The M400E/T400 versions of the measuring system for O<sub>3</sub> manufactured by Teledyne Advanced Pollution Instrumentation meet the requirements of EN 14625 (Issue July 2005). Furthermore the manufacturing process and the quality management for the M400E/T400 versions of the measuring system for O<sub>3</sub> meet the requirements of EN 15267.

The test report on performance testing, report no. 936/21207124/A1, and addendum to the test report, no. 936/21219874/D, which is an integral part of the test report, are available on the internet at [www.qal1.de](http://www.qal1.de).

The current software version of the M400E measuring system is:

E.5 incl. Library Version 6.4

The current software version of the T400 measuring system is:

1.0.4 incl. Library Version 7.0.3

Statement issued by TÜV Rheinland Energie und Umwelt GmbH  
dated 11 October 2012



Publication in the German Federal Gazette: BAnz AT 23.07.2013 B4, chap. V notification 18, Announcement by UBA dated 03 July 2013:

**18 Notification as regards Federal Environment Agency (UBA) notices of 25 July 2005 (BAnz p. 15700, chapter IV no. 2.1) and of 12 February 2013 (BAnz AT 05.03.2013 B10, chapter V notification 6)**

The M400E/T400 versions of the measuring system for O<sub>3</sub> manufactured by Teledyne Advanced Pollution Instrumentation meet the requirements of EN 14625 (December 2012 issue). An addendum as integral part of test report no. 936/21221556/D is available online at [www.qal1.de](http://www.qal1.de).

The new designation of the M400E measuring system for O<sub>3</sub> is 400E.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH  
dated 16 March 2013

Publication in the German Federal Gazette: BAnz AT 05.08.2014 B11, chap. V notification 19, Announcement by UBA dated 17 July 2014:

**19 Notification as regards Federal Environment Agency (UBA) notices of 25 July 2005 (BAnz p. 15700, chapter IV no 3.1) and of 3 July 2013 (BAnz AT 23.07.2013 B4, chapter V notification 18)**

The 400E/ T400 measuring systems for monitoring O<sub>3</sub> manufactured by Teledyne Advanced Pollution Instrumentation will be equipped with the PU3060-N811 (115/230V) vacuum pump manufactured by KNF in the future.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH  
dated 27 March 2014

Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, chap. V notification 10, Announcement by UBA dated 18 February 2016:

**10 Notification as regards Federal Environment Agency (UBA) notices of 25 July 2005 (BAnz p. 15700, chapter IV no 3.1) and of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter V notification 19)**

The current software versions of the 400E/T400 measuring system for O<sub>3</sub> manufactured by Teledyne Advanced Pollution Instrumentation are:

Package Version: 1.0.2  
Driver Version: 1.0.3

Statement issued by TÜV Rheinland Energie und Umwelt GmbH  
dated 19 October 2015

Publication in the German Federal Gazette: BAnz AT 26.03.2018 B8, chap. V notification 14,  
Announcement by UBA dated 21 February 2018:

**14 Notification as regards Federal Environment Agency (UBA) notices  
of 25 July 2005 (BAnz. p. 15 700, chapter IV no. 3.1) and  
of 18 February 2016 (BAnz AT 14.03.2016 B7, chapter V notification 10)**

The production site of the 400E/T400 air quality monitor for O<sub>3</sub>  
manufactured by Teledyne Advanced Pollution Instrumentation has moved to:

9970 Carroll Canyon Road  
San Diego, CA 92131  
USA

Statement issued by TÜV Rheinland Energy GmbH dated 17 August 2017

Publication in the German Federal Gazette: BAnz AT 26.03.2019 B7, chap. IV notification 67,  
Announcement by UBA dated 27 February 2019:

**67 Notification as regards Federal Environment Notices  
of 25 July 2005 (BAnz. p. 15700, chapter IV Number 3.1) and  
of 21 February 2018 (BAnz AT 26.03.2018 B8, chapter V notification 14)**

The current software version of the 400E/T400 measuring system for O<sub>3</sub>  
manufactured by Teledyne Advanced Pollution Instrumentation is:

Package version: 1.2.2  
Driver version: 1.0.5

Statement issued by TÜV Rheinland Energy GmbH dated 5 September 2018

Publication in the German Federal Gazette: BAnz AT 24.03.2020 B7, chap. IV notification 67, Announcement by UBA dated 24 February 2020:

**67 Notification as regards Federal Environment Agency (UBA) notices of 25 July 2005 (BAnz. p. 15700, chapter IV number 3.1) and of 27 February 2019 (BAnz AT 26.03.2019 B7, chapter IV notification 67)**

The company name has changed from Teledyne Advanced Pollution Instruments to Teledyne API.

The latest software version of the 400E/T400 measuring system for O<sub>3</sub> manufactured by Teledyne API is:

Package version: 1.3.19

Driver version: 1.0.9

This includes the following versions:

Package Version	Driver Version
1.3.18	1.0.9
1.3.17	1.0.9
1.3.12, build 458	1.0.8
1.3.11	1.0.7
1.3.5	1.0.6
1.3.4	1.0.6
1.3.1	1.0.5
1.3.0, build 429	1.0.5
1.3.0, build 426	1.0.5
1.3.0, build 415	1.0.5
1.2.12	1.0.5
1.2.11	1.0.5
1.2.8	1.0.5
1.2.7	1.0.5
1.2.6	1.0.5
1.2.3	1.0.5
1.2.2	1.0.5

Statement issued by TÜV Rheinland Energy GmbH dated 2 September 2019

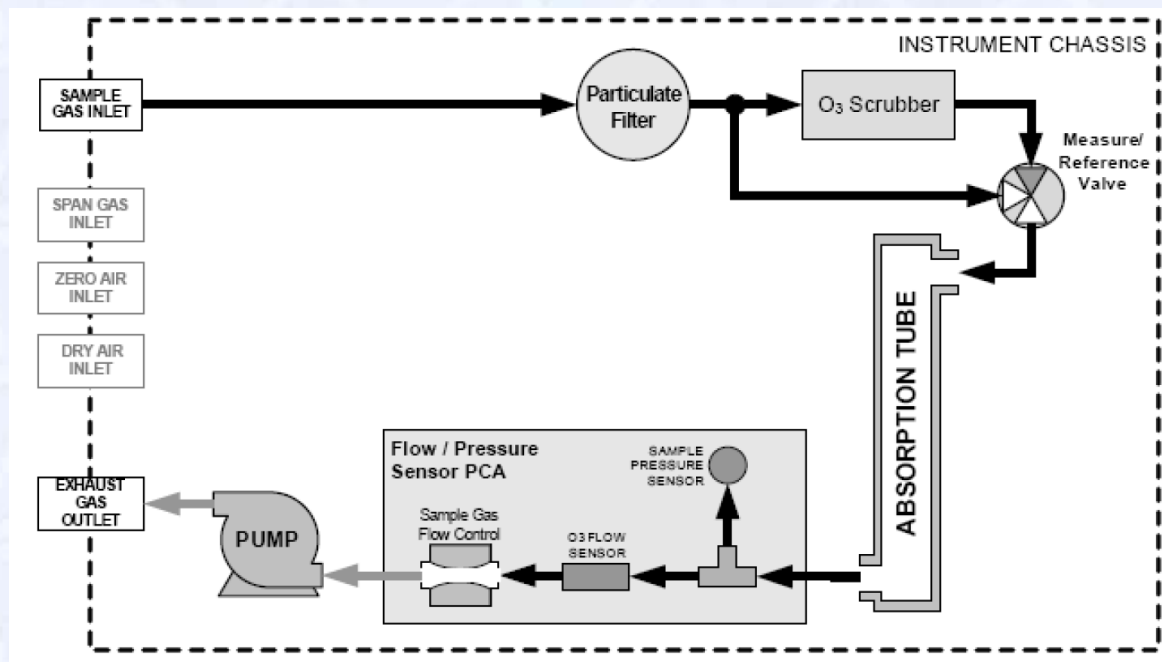


**Certified product**

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

The measuring principle of the 400E and T400 versions of the 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 253.7 nm and thus complies with the reference method described in standard EN 14625.

The schematic set-up / flow diagram of the 400E and T400 versions of the measuring system (with optional zero/span gas port) is as follows:



**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: [qal1.de](http://qal1.de).



### **History of documents**

Certification of 400E/T400 is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

### **Basic test**

Test report 936/21201601/A dated 10 July 2005  
TÜV Immissionsschutz und Energiesysteme GmbH  
Publication BAnz. 29 October 2005, No. 206, p. 15700, chapter IV number 3.1  
UBA announcement dated 25 July 2005

### **Notifications**

Statement issued by TÜV Immissionsschutz und Energiesysteme GmbH  
dated 14 December 2006  
Publication BAnz. 20 April 2007, No. 75, p. 4139, chapter IV notification 7  
UBA announcement dated 12 April 2007  
(new sales partner)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 29 September 2010  
Publication BAnz. 26 January 2011, No. 14, p. 294, chapter IV notification 25  
UBA announcement dated 10 January 2011  
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 29 September 2010  
Publication BAnz. 26 January 2011, No. 14, p. 294, chapter IV notification 26  
UBA announcement dated 10 January 2011  
(Software changes and new design)

### **Initial certification according to EN 15267**

Certificate No. 0000038504\_00: 22 March 2013  
Expiry date of the certificate: 04 March 2018  
Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 11 October 2012  
Test report 936/21201601/A dated 10 July 2005 issued by  
TÜV Immissionsschutz und Energiesysteme GmbH,  
Addendum 936/21219874/D dated 11 October 2012 issued by  
TÜV Rheinland Energie und Umwelt GmbH,  
Publication BAnz AT 05.03.2013 B10, chapter V number 6  
UBA announcement dated 12 February 2013

### **Certificate based on a notification**

Certificate No. 0000038504\_01: 20 August 2013  
Expiry date of the certificate: 04 March 2018  
Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 16 March 2013  
Test report 936/21201601/A dated 10 July 2005 issued by  
TÜV Immissionsschutz und Energiesysteme GmbH,  
Addendum 936/21219874/D dated 11 October 2012 issued by  
TÜV Rheinland Energie und Umwelt GmbH,  
Test report 936/21221556/D dated 16 March 2013 issued by  
TÜV Rheinland Energie und Umwelt GmbH,  
Publication BAnz AT 23.07.2013 B4, chapter V number 18  
UBA announcement dated 3 July 2013

**Notifications**

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 27 March 2014  
Publication BAnz AT 05.08.2014 B11, chapter V notification 19  
UBA announcement dated 17 July 2014  
(New vacuum pump)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 19 October 2015  
Publication BAnz AT 14.03.2016 B7, chapter V notification 10  
UBA announcement dated 18 February 2016  
(Software changes)

**Renewal of certificate**

Certificate No. 0000038504\_02: 05 March 2018  
Expiry date of the certificate: 04 March 2023

**Notifications**

Statement issued by TÜV Rheinland Energy GmbH dated 17 August 2017  
Publication BAnz AT 26.03.2018 B8, chapter V notification 14  
UBA announcement dated 21 February 2018  
(Change of production site)

Statement issued by TÜV Rheinland Energy GmbH dated 5 September 2018  
Publication BAnz AT 26.03.2019 B7, chapter IV notification 67  
UBA announcement dated 27 February 2019  
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 2 September 2019  
Publication BAnz AT 24.03.2020 B7, chapter IV notification 67  
UBA announcement dated 24 February 2020  
(Software changes and new manufacturer name)

**Renewal of certificate**

Certificate No. 0000038504\_03: 02 March 2023  
Expiry date of the certificate: 04 March 2028



## Expanded uncertainty laboratory, system 1

Measuring device:		Teledyne API M400E / T400		Serial number:		SN 309	
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	0.500	$u_{r,z}$	0.13	0.0169	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	1.100	$u_{r,1h}$	0.29	0.0830	
3	"lack of fit" at 1h-limit value	≤ 4.0% of meas. value	0.700	$u_{l,1h}$	0.48	0.2352	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.380	$u_{gp}$	1.12	1.2519	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.010	$u_{gt}$	0.11	0.0120	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.060	$u_{st}$	0.22	0.0479	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.020	$u_v$	0.26	0.0652	
8a	Interferent H <sub>2</sub> O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	-0.900 -2.000	$u_{H_2O}$	-1.49	2.2271	
8b	Interferent Toluene with 0,5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.400 1.500	$u_{int,pos}$	1.85	3.4133	
8c	Interferent Xylene with 0,5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.200 1.700	$u_{int,neg}$			
9	Averaging effect	≤ 7.0% of meas. value	2.600	$u_{av}$	1.80	3.2448	
18	Difference sample/calibration port	≤ 1%	0.000	$u_{Dsc}$	0.00	0.0000	
21	Uncertainty of test gas	≤ 3%	2.000	$u_{cg}$	1.20	1.4400	
Combined standard uncertainty				$u_c$		3.4695	nmol/mol
Expanded uncertainty				U		6.9390	nmol/mol
Relative expanded uncertainty				W		5.78	%
Maximum allowed expanded uncertainty				$W_{req}$		15	%

## Expanded uncertainty laboratory, system 2

Measuring device:		Teledyne API M400E / T400		Serial number:		SN 308	
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	0.700	$u_{r,z}$	0.19	0.0354	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	1.100	$u_{r,1h}$	0.30	0.0910	
3	"lack of fit" at 1h-limit value	≤ 4.0% of meas. value	0.100	$u_{l,1h}$	0.07	0.0048	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.150	$u_{gp}$	0.44	0.1951	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.030	$u_{gt}$	0.33	0.1077	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.040	$u_{st}$	0.15	0.0213	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.020	$u_v$	0.26	0.0652	
8a	Interferent H <sub>2</sub> O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	-0.900 -1.800	$u_{H_2O}$	-1.34	1.8040	
8b	Interferent Toluene with 0,5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.100 1.200	$u_{int,pos}$	1.21	1.4700	
8c	Interferent Xylene with 0,5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	-0.300 0.900	$u_{int,neg}$			
9	Averaging effect	≤ 7.0% of meas. value	3.500	$u_{av}$	2.42	5.8800	
18	Difference sample/calibration port	≤ 1%	0.000	$u_{Dsc}$	0.00	0.0000	
21	Uncertainty of test gas	≤ 3%	2.000	$u_{cg}$	1.20	1.4400	
Combined standard uncertainty				$u_c$		3.3338	nmol/mol
Expanded uncertainty				U		6.6676	nmol/mol
Relative expanded uncertainty				W		5.56	%
Maximum allowed expanded uncertainty				$W_{req}$		15	%

### Combined uncertainty, laboratory and field, system 1

Measuring device:	Teledyne API M400E / T400	Serial number:	SN 309
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	0.500	$u_{r,z}$	0.13	0.0169
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	1.100	$u_{r,1h}$	not considered, as $u_{r,1h} = 0.28 < u_{r,f}$	-
3	"lack of fit" at 1h-limit value	≤ 4.0% of meas. value	0.700	$u_{l,1h}$	0.48	0.2352
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.380	$u_{sp}$	1.12	1.2519
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.010	$u_{gt}$	0.11	0.0120
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.060	$u_{st}$	0.22	0.0479
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.020	$u_v$	0.26	0.0652
8a	Interferent H <sub>2</sub> O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	-0.800 -2.000	$u_{H2O}$	-1.49	2.2271
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.400 1.500	$u_{int,pos}$	1.85	3.4133
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.200 1.700	$u_{int,neg}$		
9	Averaging effect	≤ 7.0% of meas. value	2.600	$u_{av}$	1.80	3.2448
10	Reproducibility standard deviation under field conditions	≤ 5.0% of 3 month average	2.690	$u_{r,f}$	3.23	10.4200
11	Long term drift at zero level	≤ 5.0 nmol/mol	0.900	$u_{d,l,z}$	0.52	0.2700
12	Long term drift at 1h-limit value	≤ 5.0% of max. of cert. range	3.700	$u_{d,l,1h}$	2.56	6.5712
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				$u_c$	5.4051	nmol/mol
Expanded uncertainty				U	10.8103	nmol/mol
Relative expanded uncertainty				W	9.01	%
Maximum allowed expanded uncertainty				$W_{req}$	15	%

### Combined uncertainty, laboratory and field, system 2

Measuring device:	Teledyne API M400E / T400	Serial number:	SN 308
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	0.700	$u_{r,z}$	0.19	0.0354
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	1.100	$u_{r,1h}$	not considered, as $u_{r,1h} = 0.3 < u_{r,f}$	-
3	"lack of fit" at 1h-limit value	≤ 4.0% of meas. value	0.100	$u_{l,1h}$	0.07	0.0048
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.150	$u_{sp}$	0.44	0.1951
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.030	$u_{gt}$	0.33	0.1077
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.040	$u_{st}$	0.15	0.0213
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.020	$u_v$	0.26	0.0652
8a	Interferent H <sub>2</sub> O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	-0.900 -1.800	$u_{H2O}$	-1.34	1.8040
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.100 1.200	$u_{int,pos}$	1.21	1.4700
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	-0.300 0.900	$u_{int,neg}$		
9	Averaging effect	≤ 7.0% of meas. value	3.500	$u_{av}$	2.42	5.8800
10	Reproducibility standard deviation under field conditions	≤ 5.0% of 3 month average	2.690	$u_{r,f}$	3.23	10.4200
11	Long term drift at zero level	≤ 5.0 nmol/mol	-0.500	$u_{d,l,z}$	-0.29	0.0833
12	Long term drift at 1h-limit value	≤ 5.0% of max. of cert. range	-3.700	$u_{d,l,1h}$	-2.56	6.5712
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				$u_c$	5.3007	nmol/mol
Expanded uncertainty				U	10.6015	nmol/mol
Relative expanded uncertainty				W	8.83	%
Maximum allowed expanded uncertainty				$W_{req}$	15	%