



# CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000043527\_03

**Certified AMS:** 

T500U for NO<sub>2</sub>

Manufacturer:

Teledyne API

9970 Carroll Canyon Road San Diego, CA, 92131

USA

**Test Institute:** 

TÜV Rheinland Energy & Environment GmbH

This is to certify that the AMS has been tested and found to comply with the standards VDI 4202-1 (2018), EN 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 12 pages).

The present certificate replaces certificate 0000043527 02 dated 2 April 2020.



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

www.tuv.com ID 0000043527

Publication in the German Federal Gazette (BAnz) of 26 August 2015

German Environment Agency

Dessau, 28 March 2025

This certificate will expire on:

1 April 2030

TÜV Rheinland Energy & Environment GmbH Cologne, 26 March 2025

Dr. Marcel Langner Head of Section II 4 PA 65

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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.



### Certificate:

0000043527 03 / 28 March 2025



**Test report:** 

936/21224798/B dated 3 March 2015

Initial certification:

30 April 2015

**Expiry date:** 

1 April 2030

Certificate:

Renewal (of previous certificate 0000043527\_02 of

2 April 2020 valid until 1 April 2025)

**Publication:** 

BAnz AT 26.08.2015 B4, chapter III No. 1.1

### Approved application

The tested AMS is suitable for continuous immission measurement of NO<sub>2</sub> in stationary use.

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

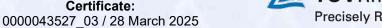
### Basis of the certification

This certification is based on:

- Test report 936/21224798/B dated 3 March 2015 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



### Certificate:





Publication in the German Federal Gazette: BAnz AT 26.08.2015 B4, chapter III No. 1.1, Announcement by UBA dated 22 July 2015:

$\Delta MS$	designation:
	acsignation.

T500U for NO<sub>2</sub>

### Manufacturer:

Teledyne API, San Diego, USA

### Field of application:

For the continuous determination of nitrogen dioxide concentrations in ambient air in stationary application

### Measuring range during the performance test:

Component	Certification range	Unit
Nitrogen dioxide	0 – 500	μg/m³

#### Software version:

Rev. 1.0.2 bld 22

### **Restrictions:**

None

#### Notes:

- 1. The performance test report is available online at www.qal1.de.
- 2. Equivalence to the reference method was demonstrated for the component NO<sub>2</sub> in accordance with the requirements of the guideline "Demonstration of Equivalence of Ambient Air Monitoring Methods".
- 3. Supplementary testing (demonstration of equivalence to the reference measurement method) as regards Federal Environment Agency notice of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter III number 2.1).

### **Test report:**

TÜV Rheinland Energie und Umwelt GmbH, Cologne Report No.: 936/21224798/B dated 3 March 2015





Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, Chap. V notification 11, Announcement by UBA dated 18 February 2016:

11 Notification as regards Federal Environment Agency (UBA) notices of 22 July 2015 (BAnz AT 26.08.2015 B4, chapter III number 1.1)

The current software versions for the measuring equipment T500U for NO<sub>2</sub> of Teledyne Advanced Pollution Instrumentation are:

package version:

1.0.0

driver version:

1.0.2

Statement of TÜV Rheinland Energie und Umwelt GmbH of 19 October 2015

Publication in the German Federal Gazette: BAnz AT 26.03.2018 B8, Chap. V notification 15, Announcement by UBA dated 21 February 2018:

Notification as regards Federal Environment Agency notices of 22 July 2015 (BAnz AT 26.08.2015 B4, chapter III number 1.1) and of 18 February 2016 (BAnz AT 14.03.2016 B7, chapter V notification 11)

The production site of the T500U air quality monitor for NO<sub>2</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 69, Announcement by UBA dated 27 February 2019:

Notification as regards Federal Environment Agency notices of 22 July 2015 (BAnz AT 26.08.2015 B4, chapter III number 1.1) and of 21 February 2018 (BAnz AT 26.03.2018 B8, chapter V notification 15)

The current software version of the T500U measuring system for NO<sub>2</sub> manufactured by Teledyne Advanced Pollution Instrumentation is:

Package version:

1.2.3

Driver version:

1.0.2

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 69, Announcement by UBA dated 24 February 2020:

Notification as regards Federal Environment Agency (UBA) notices of 22 July 2015 (BAnz AT 26.08.2015 B4, chapter III number 1.1) and of 27 February 2019 (BAnz AT 26.03.2019 B7, chapter IV notification 69)

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

The latest software version of the T500U measuring system for NO<sub>2</sub> manufactured by Teledyne API is:

Package version:

1.3.19

Driver version:

1.0.6

This includes the following versions:

Package version	Driver version
1.3.17	1.0.6
1.3.12, build 149	1.0.5
1.3.11	1.0.4
1.3.5	1.0.3
1.3.4	1.0.3
1.0.0	1.0.2

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 T500U is an optical absorption spectrometer, which can measure  $NO_2$  directly by means of the "Cavity Attenuated Phase Shift (CAPS)" method. The CAPS method uses light from a blue Ultraviolet (UV) light emitting diode (LED) centred at 450 nm, a measurement cell with high reflectivity mirrors located at either end to provide an extensive optical path length, and a vacuum photodiode detector. These components are assembled into the optical cell which resides in a temperature-controlled oven. The oven raises the ambient temperature of the sample gas to 45 °C. This mitigates the formation of moisture on the surfaces of the mirrors while also minimizing changes in the absorption coefficient due to temperature fluctuations.  $NO_2$  is measured directly by means of optical absorption. This phenomenon is well-defined and is described by the Beer-Lambert law, where the absorbance (lost light) is directly proportional to both the path length and concentration of the absorbing gas.

$$A = \epsilon * I * c$$

(A = Absorbance,  $\varepsilon$  = molar absorptivity, I = mean light path length, c = concentration)

The T500U uses few components: an optical cell, a pair of highly reflective spherical mirrors centred at 450 nm, a light emitting diode (LED), and a vacuum photodiode detector. The LED is located behind a mirror at one end of the cell, and the detector behind the other mirror, at the opposite end of the cell. The LED emits ultraviolet (UV) light into the cell; the light reflects back and forth between the two mirrors, building intensity and running a very long path length. The long path extends the "time" or "life" of the photon through the use of precisely timed data acquisition. Coupled with a proprietary algorithm, the measured absorption is translated into a phase shift, from which the NO<sub>2</sub> concentration is calculated.





### **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 T500U is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

### Initial certification according to EN 15267

Certificate No. 0000043527\_00: 30 April 2015 Expiry date of the certificate: 1 April 2020

Test report: 936/21224798/A dated 2 October 2014

TÜV Rheinland Energie und Umwelt GmbH Publication: BAnz AT 02.04.2015 B5, chapter III number 2.1

UBA announcement dated 25 February 2015

### Supplementary testing according to EN 15267

Certificate No. 0000043527\_01: 30 September 2015

Expiry date of the certificate: 1 April 2020 Test report: 936/21224798/B dated 3 March 2015

TÜV Rheinland Energie und Umwelt GmbH

Publication: BAnz AT 26.08.2015 B4, chapter III number 1.1

UBA announcement dated 22 July 2015

### **Notifications**

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 19 October 2015 Publication: BAnz AT 14.03.2016 B7, chapter V notification 11 UBA announcement dated 18 February 2016 (Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 17 August 2017 Publication: BAnz AT 26.03.2018 B8, chapter V notification 15 UBA announcement dated 21 February 2018 (Change of production centre)

Statement issued by TÜV Rheinland Energy GmbH dated 5 September 2018 Publication: BAnz AT 26.03.2019 B7, chapter IV notification 69 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 69 UBA announcement dated 24 February 2020 (Software changes and new producer name)

#### Renewal of certificates

Certificate No. 0000043527\_02: 2 April 2020 Expiry date of the certificate: 1 April 2025

### Renewal of certificates

Certificate No. 0000043527\_03: 28 March 2025 Expiry date of the certificate: 1 April 2030





### Expanded uncertainty laboratory, system 1

0	lom/lomn	sertainty									100									lom/lomn	lom/lomn	%	%
SN 63 (Gerät 1)	104.6	Square of partial uncertainty	0.0001	0.0015	0.2162	0.5944	0.0093	0.8646	0.0012	1 8876	200.1		NC 00 O	0.0024		1.9461	0.0214	0.0000	1.0941	2.7424	5.4847	5.24	15
Serial-No.:	1h-limit value:	Partial uncertainty	0.01	0.04	0.47	0.77	0.10	0.93	0.03	-137	0.1		000	0.84		-1.40	-0.15	0.00	1.05	n	Π	W	Wreq
		Partia	z'h	u'.h	U, Ih	dBn	<sup>‡6</sup> n	1 <sup>5</sup> n	Λn	1	H20	U <sub>int, pos</sub>	i	5	U <sub>int, neg</sub>	^en	os⊽n	⊃∃n	u <sub>og</sub>	ncertainty	nc ertainty	ncertainty	ncertainty
		Result	0.070	0.250	0.770	0.080	0.010	0.097	0.003	0.120	-1.830	0.440	1.330	-0.030	0.290	-2.310	-0.140	100.00	2.000	standard un	Expanded uncertainty	Relative expanded uncertainty	(panded un
		Performance criterion	1.0 nmol/mol	3.0 nmol/mol	4.0% of measured value	8.0 nmol/mol/kPa	3.0 nmol/mol/K	3.0 nmol/mol/K	0.30 nmol/mol/V	10 nmol/mol (Zero)	10 nmol/mol (Span)	5.0 nmol/mol (Zero)	5.0 nmol/mol (Span)	5.0 nmol/mol (Zero)	5.0 nmol/mol (Span)	7.0% of measured value	1.0%	86	3.0%	Combined standard uncertainty	Ey	Relative ex	Maximum allowed expanded uncertainty
		P	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	ΛΙ	VI				
Teledyne T500U	ıt. NO <sub>2</sub>	Performance characteristic	Repeatability standard deviation at zero	Repeatability standard deviation at 1h-limit value	"lack of fit" at 1h-limit value	Sensitivity coefficient of sample gas pressure at 1h-limit value	Sensitivity coefficient of sample gas temperature at 1h-limit value	Sensitivity coefficient of surrounding temperature at 1h-limit value	Sensitivity coefficient of electrical voltage at 1h-limit value	Interferent H-0 with 21 mmol/mol		lon/Jomi 600 with 500 longland		In confidence OOO time IIII have about	Interestinang mit 200 mitol/mol	Averaging effect	Difference sample/calibration port	Converter efficiency	Uncertainty of test gas				
Measuring device:	Measured component:	No.	- 1	2	3	4	9	9	7	es.	3	8	3	d	8	6	18	12	23				





### Expanded uncertainty laboratory, system 2

	lom/lomn																			lom/lomn	lom/lomn	%	%
SN 65 (Gerät 2)	104.6	Square of partial uncertainty	0.0001	0.0005	0.1736	2.4029	0.0091	1.9194	0.0021	1 5732	20.10:1		0.530	0.3328		1.5779	0.0316	0.0000	1.0941	3.0525	6.1051	5.84	15
Serial-No.:	1h-limit value:	Partial uncertainty	0.01	0.02	0.42	1.55	0.10	1.39	0.05	1 25	27:1		0.70	0.13		-1.26	-0.18	00.00	1.05	n°	Ω	W	Wreq
		Partial u	Ur,z	Ur. Ih	U,Ih	<sup>d6</sup> n	Ugt	Ust	Λn	1	450	U <sub>int, pos</sub>		5	U <sub>int, neg</sub>	N <sub>av</sub>	UAsc	UEC	<sup>60</sup> n	ncertainty	ncertainty	ncertainty	ncertainty
		Result	0.050	0.150	0.690	0.160	0.010	0.143	0.004	0.000	0.000	0.470	1.090	0.030	0.170	-2.080	-0.170	100.00	2.000	Combined standard uncertainty	Expanded uncertainty	Relative expanded uncertainty	xpanded u
		Performance criterion	1.0 nmol/mol	3.0 nmol/mol	4.0% of measured value	8.0 nmol/mol/kPa	3.0 nmol/mol/K	3.0 nmol/mol/K	0.30 nmol/mol/V	10 nmol/mol (Zero)	10 nmol/mol (Span)	5.0 nmol/mol (Zero)	5.0 nmol/mol (Span)	5.0 nmol/mol (Zero)	5.0 nmol/mol (Span)	7.0% of measured value	1.0%	86	3.0%	Combined	В	Relative e	Maximum allowed expanded uncertainty
		4	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	VI	ΛΙ	VI				
Teledyne T500U	NO <sub>2</sub>	Performance characteristic	Repeatability standard deviation at zero	Repeatability standard deviation at 1h-limit value	"lack of fit" at 1h-limit value	Sensitivity coefficient of sample gas pressure at 1h-limit value	Sensitivity coefficient of sample gas temperature at 1h-limit value	Sensitivity coefficient of surrounding temperature at 1h-limit value	Sensitivity coefficient of electrical voltage at 1h-limit value	Interferent H-0 with 21 mmol/mol		Interferent CO. with 500 (mol/mol	mercial cos mar cos principals	1 1 1 IN 1 2 - 1 - 1	Interierent NH3 mit Zub nmol/mol	Averaging effect	Difference sample/calibration port	Converter efficiency	Uncertainty of test gas				
Measuring device:	Measured component:	No.	1	2	3	4	5	9	7	œ	5	8	8	0	38	6	18	21	23				





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

No.   Performance characteristic   Performance criterion   Result   Partial uncertainty   Square of partial uncertainty     1	Measuring device:	Teledyne T500U			ì	H	Serial-No.:	SN 63 (Gerät 1)	
Repeatability standard deviation at the imit value   S	Measured component:						1h-limit value:	104.6	lom/lomu
Repeatability standard deviation at th-firnt value	No.	Performance characteristic		Performance criterion	Result	Pa	rtial uncertainty	Square of partial uncertainty	
Tack of fit" at 11-limit value   Sensitivity coefficient of sample gas temperature at 11-limit value   Sensitivity coefficient of sample gas temperature at 11-limit value   Sensitivity coefficient of sample gas temperature at 11-limit value   Sensitivity coefficient of sample gas temperature at 11-limit value   Son monthmol/RP   0.077   U <sub>Lis</sub>   0.177   0.1544	1	Repeatability standard deviation at zero	VI	1.0 nmol/mol	0.070	Ur,z	0.01	0.0001	
Sensitivity coefficient of sample gas pressure at th-limit value   \$ 8.0 mnol/mol/kPa   0.080   u <sub>lop</sub>   0.770   0.5944     Sensitivity coefficient of sample gas pressure at th-limit value   \$ 3.0 mnol/mol/kPa   0.087   u <sub>lop</sub>   0.777   0.093     Sensitivity coefficient of sample gas temperature at th-limit value   \$ 3.0 nmol/mol/kPa   0.087   u <sub>lop</sub>   0.777   0.093     Sensitivity coefficient of surrounding temperature at th-limit value   \$ 3.0 nmol/mol/kPa   0.087   u <sub>lop</sub>   0.077   0.093     Sensitivity coefficient of surrounding temperature at th-limit value   \$ 0.0 nmol/mol/kPa   0.003   u <sub>lop</sub>   0.120   u <sub>lop</sub>   0.003     Interferent H <sub>2</sub> O with 21 mmol/mol   \$ 5.0 nmol/mol/kPa   0.130   u <sub>lop</sub>   0.130   u <sub>lop</sub>   0.130   u <sub>lop</sub>   0.130   u <sub>lop</sub>   0.003     Interferent CO <sub>2</sub> with 500 pmol/mol   \$ 5.0 nmol/mol/kPa   0.003   u <sub>lop</sub>   0.140   0.	2	Repeatability standard deviation at 1h-limit value	VI	3.0 nmol/mol	0.250	Ur.h	not considered, as \2*ur,lh = 0.05 < ur,f		
Sensitivity coefficient of sample gase pressure at 11-limit value   ≤ 8.0 moul/mol/kPa   0.080   u <sub>pp</sub>   0.77   0.5944     Sensitivity coefficient of sample gas temperature at 11-limit value   ≤ 3.0 moul/mol/kPa   0.010   u <sub>pt</sub>   0.10   0.003     Sensitivity coefficient of surrounding temperature at 11-limit value   ≤ 3.0 monl/mol/kPa   0.037   u <sub>pt</sub>   0.033   0.0012     Sensitivity coefficient of electrical voltage at 11-limit value   ≤ 0.30 monl/mol/ (2ero)   0.120   u <sub>pt</sub>   0.033   0.0012     Interferent H <sub>2</sub> 0 wth 21 moul/mol   ≤ 10 monl/mol (2ero)   0.120   u <sub>pt</sub>   0.137   1.8876     Interferent CO <sub>2</sub> with 500 moul/mol   ≤ 5.0 monl/mol (2ero)   0.030   u <sub>pt</sub>   0.044   u <sub>pt</sub>   u <sub>pt</sub>   0.044   u <sub>pt</sub>   u <sub>pt</sub>   0.044   u <sub></sub>	3	"lack of fit" at 1h-limit value	M	4.0% of measured value	0.770	UI,Ih	0.47	0.2162	
Sensitivity coefficient of sample gas temperature at th-limit value   ≤ 3.0 nmol/mol/M   0.037   u <sub>gs</sub>   0.10   0.93   0.0846	4	Sensitivity coefficient of sample gas pressure at 1h-limit value	VI	8.0 nmol/mol/kPa	080.0	Ugp	0.77	0.5944	
Sensitivity coefficient of surrounding temperature at 1h-limit value         ≤ 3.0 mmol/mol/Not Centrol of Sensitivity coefficient of electrical voltage at 1h-limit value         ≤ 3.0 mmol/mol/Centrol of Sensitivity coefficient of electrical voltage at 1h-limit value         ≤ 1.0 mmol/mol Centrol of Sensitivity coefficient of electrical voltage at 1h-limit value         ≤ 1.0 mmol/mol Centrol of Sensitivity coefficient of electrical voltage at 1h-limit value         ≤ 1.0 mmol/mol Centrol of Sensitivity coefficient of electrical voltage at 1h-limit value         ≤ 1.0 mmol/mol Centrol of Sensitivity coefficient of electrical voltage at 1h-limit value         ≤ 5.0 mmol/mol Centrol of Sensitivity of Sensitivity coefficient value         < 1.37         1.8876         1.8876           Interferent Co <sub>2</sub> with 500 ymol/mol         ≤ 5.0 mmol/mol (Sensitivity of Sensitivity of Sensity of Sensity Sensitivity of Sensitivity of Sensitivity of Sensitivity of Sensitivity of Se	5	Sensitivity coefficient of sample gas temperature at 1h-limit value		3.0 nmol/mol/K	0.010	Ugt	0.10	0.0093	
Sensitivity coefficient of electrical voltage at 1h-limit value         ≤         10 nmol/mol (Zero)         0.120 on 1.37         0.003         0.002         0.002         0.0012	9	Sensitivity coefficient of surrounding temperature at 1h-limit value		3.0 nmol/mol/K	260.0	Ust	0.93	0.8646	
Interferent H <sub>2</sub> 0 with 21 mmol/mol   Span   1.830   0.120	7		VI	0.30 nmol/mol/V	0.003	Λn	0.03	0.0012	
Interferent CO2 with 500 pmol/mol   2 = 5.0 mmol/mol   2 = 0.40   0.440   0.	000	Interferent Holl with 21 mmol/mol	VI	10 nmol/mol (Zero)	0.120	001	-137	1 8876	
Interferent CO2 with 500 µmol/mol   San Dimol/mol   San Dimo			V	10 nmol/mol (Span)	-1.830	HZ0			
Interferent NHs mit 200 mmol/mol   S	48	Interferent CO. with 500 umol/mol	VI	5.0 nmol/mol (Zero)	0.440	Uint, pos			
Maximum allowed expanded uncertainty of test gas   Londo/mole (Sepan)   0.290   Unit read	00	interierent CO2 with 500 pinoring	VI	5.0 nmol/mol (Span)	1.330		700	0 8823	
Averaging effect         ≤         5.0 nmol/mol (Span)         0.290 or unit need         unit need         1.3461         1.347         1.3401         1.3461 <t< td=""><td>0</td><td>Land Land All Line Control</td><td>VI</td><td>5.0 nmol/mol (Zero)</td><td>-0.030</td><td>5</td><td>0.34</td><td>0.0024</td><td></td></t<>	0	Land Land All Line Control	VI	5.0 nmol/mol (Zero)	-0.030	5	0.34	0.0024	
Reproducibility standard deviation under field conditions         ≤         7.0% of measured value         -2.310         u <sub>v,f</sub> -1.40         1.9461           Long term drift at zero level         ≤         5.0% of average over 3 months         1.21         1.27         1.6019           Long term drift at zero level         ≤         5.0 mon/mol         0.300         u <sub>d,1</sub> 0.17         0.0300           Long term drift at span level         ≤         5.0% of max. of certification range         -1.580         u <sub>d,1</sub> -0.95         0.9105           Difference sample/calibration port         ≤         5.0% of max. of certification range         -1.580         u <sub>d,1</sub> -0.15         0.014           Converter efficiency         ≥         98         1.00         u <sub>EC</sub> 0.06         0.000           Uncertainty of test gas         ≤         3.0%         2.00         u <sub>EC</sub> 0.00         0.000           Uncertainty of test gas         ≤         3.0%         1.05         u <sub>C</sub> 0.0         0.00           No contraction of test gas         ≤         3.0%         1.05         u <sub>C</sub> 0.0         0.00           No contraction of test gas         ≤         3.0%         1.0         u <sub>C</sub> 0.0	30	Interierent IVIT3 mit 200 nmol/mol	VI	5.0 nmol/mol (Span)	0.290	Uint, neg			
Reproducibility standard deviation under field conditions   5.0% of average over 3 months   1.210   u <sub>c,f</sub>   1.27   1.6019	6	Averaging effect	VI	7.0% of measured value	-2.310	Uav	-1.40	1.9461	
Long term drift at zero level   ≤ 5.0% of max. of certification range   1.580   u <sub>d,1</sub> h   0.095   0.9105     Long term drift at span level   ≤ 5.0% of max. of certification range   -1.580   u <sub>d,1</sub> h   -0.95   0.9105     Difference sample/calibration port   ≤ 1.0%   1.0%   1.0%   1.0%   0.015   0.0214     Converter efficiency   ≥ 98   1.05   0.00   0.0000     Uncertainty of test gas   ≤ 3.0%   2.00   u <sub>co</sub>   1.05   1.0941     Combined expanded uncertainty   U   6.3435     Relative expanded uncertainty   W <sub>req</sub>   6.06     Maximum allowed expanded uncertainty   W <sub>req</sub>   15	10	Reproducibility standard deviation under field conditions	VI	5.0% of average over 3 months	1.210	Ur.f	1.27	1.6019	
Long term drift at span level         ≤ 5.0% of max. of certification range         -1.580         u <sub>d,1</sub> m         -0.95         0.9105           Difference sample/calibration port         ≤ 1.0% of max. of certification range         -0.140         u <sub>sco</sub> -0.15         0.0214           Converter efficiency         ≥ 98         1.06         u <sub>co</sub> 0.00         0.000           Uncertainty of test gas         ≤ 3.0%         2.00         u <sub>co</sub> 1.05         1.0941           Combined expanded uncertainty         U         6.3435           Expanded uncertainty         V/v <sub>ec</sub> 6.06           Maximum allowed expanded uncertainty         V/v <sub>ec</sub> 15	11	Long term drift at zero level	VI	5.0 nmol/mol	0.300	Ud,I,z	0.17	0.0300	
Difference sample/calibration port         ≤         1.0%         -0.140         u <sub>sc</sub> -0.15         0.0214           Converter efficiency         ≥         98         1.00         u <sub>c</sub> 0.00         0.000           Uncertainty of test gas         ≤         3.0%         2.00         u <sub>c</sub> 1.05         1.0941           Combined expanded uncertainty of test gas         ≤         3.777         0         6.3435           Maximum allowed expanded uncertainty         W <sub>req</sub> V <sub>req</sub> 6.06	12	Long term drift at span level		5.0% of max. of certification range	-1.580	Ud.I.Ih	-0.95	0.9105	
Converter efficiency         ≥         98         100.000         0.000         0.0000           Uncertainty of test gas         ≤         3.0%         2.000         μ <sub>op</sub> 1.05         1.0941           Combined strandard uncertainty         U         3.1717           Maximum allowed expanded uncertainty         W         6.3435           Maximum allowed expanded uncertainty         W <sub>req</sub> 15	18	Difference sample/calibration port	VI	1.0%	-0.140	UASC	-0.15	0.0214	
Uncertainty of test gas         ≤         3.0%         2.000         u <sub>op</sub> 1.05         1.0941           Combined strandard uncertainty         u <sub>o</sub> 3.1717           Expanded uncertainty         U         6.3435           Maximum allowed expanded uncertainty         W <sub>req</sub> 6.06           15         15	21	Converter efficiency	Λ	86	100.000	UEC	0.00	0.0000	
U 6.3435 W 6.06 Wreq 15	23	Uncertainty of test gas	VI	3.0%	2.000	Uog	1.05	1.0941	
U 6.3435 W 6.06 Wreq 15				Combined	tandard un	certainty	Uc	3.1717	lom/lomn
W 6.06 Wreq 15				9	panded un	certainty	n	6.3435	lom/lomu
W <sub>req</sub> 15				Relative ex	panded un	certainty	W	90.9	%
			ľ	Maximum allowed ex	panded un	certainty	Wreq	15	%





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

Measuring device:	Teledyne T500U			X	ŧ.	Serial-No.:	SN 65 (Gerät 2)	
Measured component:	NO <sub>2</sub>					1h-limit value:	104.6	lom/lomu
No.	Performance characteristic	Performance criterion		Result	Pa	Partial uncertainty	Square of partial uncertainty	
-	Repeatability standard deviation at zero	s 1.0 nmol/mol	lou	0.050	Ur,z	0.01	0.0001	
2	Repeatability standard deviation at 1h-limit value	s 3.0 nmol/mol	lou	0.150	Ur.In	not considered, as $\sqrt{2^*}$ ur,lh = 0.03 < ur,f	4	
3	"lack of fit" at 1h-limit value	4.0% of measured value	ed value	0.690	UI.Ih	0.42	0.1736	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	s 8.0 nmol/mol/kPa	/kPa	0.160	dBn	1.55	2.4029	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	X.0 nmol/mol/K	J/K	0.010	Ugt	0.10	0.0091	
9	Sensitivity coefficient of surrounding temperature at 1h-limit value	3.0 nmol/mol/K	J/K	0.143	Ust	1.39	1.9194	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	V)lom/lmol/V	V/lot	0.004	Λn	0.05	0.0021	
800	Interferent H <sub>2</sub> 0 with 21 mm ol/mol	< 10 nmol/mol (Zero)		0.220	Uhao	-125	1 5732	
		10 nmol/mol (Span)		-1.670	0745			
48	Interpret CO. with 600 in almol	< 5.0 nmol/mol (Zero)	(Zero)	0.470	Uint, pos			
00	Interferent CO2 with 500 pillolinion	< 5.0 nmol/mol (Span)	(Span)	1.090		0.7.0	0000	
	000 0	< 5.0 nmol/mol (Zero)	(Zero)	0.030	10	0.73	0.5529	
သွ	Interferent IVH3 mit ZUU nmol/mol	< 5.0 nmol/mol (Span)	(Span)	0.170	Uint, neg			
6	Averaging effect	7.0% of measured value		-2.080	Uav	-1.26	1.5779	
10	Reproducibility standard deviation under field conditions	5.0% of average over 3 months	er 3 months	1.210	Ur,f	1.27	1.6019	
11	Long term drift at zero level	s 5.0 nmol/mol	lon	0.280	Ud.I.z	0.16	0.0261	
12	Long term drift at span level	5.0% of max. of certification range	Н	-1.820	Ud,I,Ih	-1.10	1.2080	
18	Difference sample/calibration port	> 1.0%		-0.170	UASC	-0.18	0.0316	
21	Converter efficiency	86 ~		100.000	UEC	0.00	0.0000	
23	Uncertainty of test gas	≥ 3.0%		2.000	Ucg	1.05	1.0941	
			Combined standard uncertainty	indard un	certainty	n°	3.4861	nmol/mol
			Exp	anded un	Expanded uncertainty	n	6.9722	lom/lomu
			Relative expanded uncertainty	anded un	certainty	W	6.67	%
		Maxir	Maximum allowed expanded uncertainty	anded un	certainty	Wreq	15	%