

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000043527_03

Certified AMS: T500U for NO₂

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

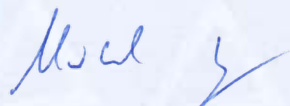
Publication in the German Federal Gazette
(BAnz) of 26 August 2015

German Environment Agency

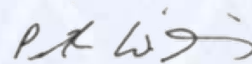
Dessau, 28 March 2025

This certificate will expire on:
1 April 2030

TÜV Rheinland Energy &
Environment GmbH
Cologne, 26 March 2025



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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:	936/21224798/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 NO₂ 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

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

AMS designation:

T500U for NO₂

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/m ³

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 NO₂ 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 NO₂
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:

**15 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 NO₂ 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:

**69 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 NO₂
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:

69 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 NO₂ 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 NO₂ 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. NO₂ 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.

$$A = \varepsilon * l * c$$

(A = Absorbance, ε = molar absorptivity, l = 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 NO₂ 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

Measuring device: Teledyne T5000		Serial-No.:	SN 63 (Gerät 1)	nmol/mol	
Measured component: NO ₂		1h-limit value:		104.6	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.070	u _z	0.001
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.250	u _{in}	0.0015
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.770	u _{in}	0.2162
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.080	u _{sp}	0.5944
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.010	u _t	0.0093
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.097	u _t	0.8646
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.003	u _v	0.0012
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	0.120	u _{H2O}	1.8876
		≤ 10 nmol/mol (Span)	-1.830		
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	0.440	u _{int,pos}	
		≤ 5.0 nmol/mol (Span)	1.330	or	0.8824
		≤ 5.0 nmol/mol (Zero)	-0.030		
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Span)	0.290	u _{int,neg}	
9	Averaging effect	≤ 7.0% of measured value	-2.310	u _{av}	1.9461
18	Difference sampler/calibration port	≤ 1.0%	-0.140	u _{sc}	0.0214
21	Converter efficiency	≥ 98	100.00	u _{ec}	0.0000
23	Uncertainty of test gas	≤ 3.0%	2.000	u _{sg}	1.0941
Combined standard uncertainty				u _c	2.7424
Expanded uncertainty				U	5.4847
Relative expanded uncertainty				W	5.24
Maximum allowed expanded uncertainty				W _{req}	15

Expanded uncertainty laboratory, system 2

Measuring device:		Serial-No.:		SN 65 (Gerät 2)	
Measured component:		1h-limit value:		104.6	
Teledyne T5000		NO ₂		nmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.050	u _{r,z}	0.0001
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.150	u _{r,1h}	0.0005
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.690	u _{l,1h}	0.1736
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.160	u _{gp}	2.4029
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.010	u _{gt}	0.0091
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.143	u _{st}	1.9194
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.004	u _v	0.0021
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero)	0.000	u _{H2O}	1.5732
8b	Interferent CO ₂ with 500 µmol/mol	≤ 10 nmol/mol (Span)	0.000	u _{int,pos} or	0.5329
		≤ 5.0 nmol/mol (Zero)	0.470		
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Span)	1.090	u _{int,neg}	0.5329
		≤ 5.0 nmol/mol (Zero)	0.030		
9	Averaging effect	≤ 5.0 nmol/mol (Span)	0.170	u _{av}	1.5779
		≤ 5.0 nmol/mol (Zero)	0.170		
18	Difference sample/calibration port	≤ 7.0% of measured value	-2.080	u _{Δs,c}	0.0316
21	Converter efficiency	≥ 98	100.00	u _{EC}	0.0000
23	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.0941
Combined standard uncertainty				u _c	3.0625
Expanded uncertainty				U	6.1051
Relative expanded uncertainty				W	5.84
Maximum allowed expanded uncertainty				W _{req}	15

Combined uncertainty, laboratory and field, system 1

Measuring device: Teledyne T5000		Serial-No.: SN 63 (Gerät 1)		1h-limit value: 104.6		nmol/mol	
Measured component: NO ₂		1h-limit value:		1h-limit value:		1h-limit value:	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.070	u _{r,z}	0.001		
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.250	u _{r,1h}	-	not considered, as $\sqrt{2} \cdot u_{r,1h} = 0.05 < u_{r,f}$	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.770	u _{i,1h}	0.47	0.2162	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.080	u _{gp}	0.77	0.5944	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.010	u _{gt}	0.10	0.0093	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.097	u _{st}	0.93	0.8646	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.003	u _v	0.03	0.0012	
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero)	0.120	u _{H2O}	-1.37	1.8876	
		≤ 10 nmol/mol (Span)	-1.830				
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	0.440	u _{int,pos}			
		≤ 5.0 nmol/mol (Span)	1.330	or	0.94	0.8824	
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0.030				
		≤ 5.0 nmol/mol (Span)	0.290	u _{int,neg}			
9	Averaging effect	≤ 7.0% of measured value	-2.310	u _{av}	-1.40	1.9461	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	1.210	u _{r,f}	1.27	1.6019	
11	Long term drift at zero level	≤ 5.0 nmol/mol	0.300	u _{d,z}	0.17	0.0300	
12	Long term drift at span level	≤ 5.0% of max. of certification range	-1.580	u _{d,1h}	-0.95	0.9105	
18	Difference sample/calibration port	≤ 1.0%	-0.140	u _{asc}	-0.15	0.0214	
21	Converter efficiency	≥ 98	100.000	u _{ec}	0.00	0.0000	
23	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.05	1.0941	
Combined standard uncertainty				u _c		3.1717	
Expanded uncertainty				U		6.3435	
Relative expanded uncertainty				W		6.06	
Maximum allowed expanded uncertainty				W _{req}		15	

Combined uncertainty, laboratory and field, system 2

Measuring device:		Teledyne T5000		Serial-No.:		SN 65 (Gerät 2)		nmol/mol		
Measured component:		NO ₂		1h-limit value:		104.6				
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty					
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.050	u _{r,z}	0.01	0.0001				
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.150	u _{r,1h}	not considered, as $\sqrt{2} \cdot u_{r,1h} = 0.03 < u_{r,f}$	-				
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.690	u _{l,1h}	0.42	0.1736				
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.160	u _{gp}	1.55	2.4029				
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.010	u _{gt}	0.10	0.0091				
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.143	u _{st}	1.39	1.9194				
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.004	u _v	0.05	0.0021				
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	0.220 -1.670	u _{H2O}	-1.25	1.5732				
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.470 1.090	u _{int,pos} or	0.73	0.5329				
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.030 0.170	u _{int,neg}						
9	Averaging effect	≤ 7.0% of measured value	-2.080	u _{av}	-1.26	1.5779				
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	1.210	u _{r,f}	1.27	1.6019				
11	Long term drift at zero level	≤ 5.0 nmol/mol	0.280	u _{d,z}	0.16	0.0261				
12	Long term drift at span level	≤ 5.0% of max. of certification range	-1.820	u _{d,1h}	-1.10	1.2080				
18	Difference sample/calibration port	≤ 1.0%	-0.170	u _{asc}	-0.18	0.0316				
21	Converter efficiency	≥ 98	100.000	u _{ec}	0.00	0.0000				
23	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.05	1.0941				
Combined standard uncertainty				u _c		3.4861	nmol/mol			
Expanded uncertainty				U		6.9722	nmol/mol			
Relative expanded uncertainty				W		6.67	%			
Maximum allowed expanded uncertainty				W _{req}		15	%			