Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040204_01

Certified AMS:	Serinus 40 for NO, NO_2 and NO_x
Manufacturer:	Ecotech Pty Ltd. 1492 Ferntree Gully Road Knoxfield, VIC, 3180 Australia
Test Institute:	TÜV Rheinland Energy GmbH

This is to certify that the AMS has been tested and found to comply with:

VDI 4202-1: 2010, VDI 4203-3: 2010, EN 14211: 2012, EN 15267-1: 2009 and EN 15267-2: 2009

Certification is awarded in respect of the conditions stated in this certificate (see also the following pages).
The present certificate replaces certificate 0000040204 of 29 April 2014

TÜVRheinland® CERTIFIED

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

www.tuv.com
ID 0000040204

Publication in the German Federal Gazette (BAnz.) of 1 April 2014

German Federal Environment Agency
Dessau, 1 April 2019

Dr. Marcel Langner
Head of Section II 4.1

This certificate will expire on:
30 June 2020

TÜV Rheinland Energy GmbH
Cologne, 31 March 2019

ppa. Dr. Peter Wilbring

www.umwelt-tuv.de / www.eco-tuv.com
teu@umwelt-tuv.de
Tel. +49 221 806-5200

TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Cologne

Accreditation according to EN ISO/IEC 17025:2018 and certified according to ISO 9001:2015.

Certificate:
0000040204_01 / 1 April 2019

Test report:	936/21221977/A of 08 October 2013
Initial certification:	01 April 2014
Date of expiry:	30 June 2020
Publication:	BAnz AT 01 April 2014 B12, chapter IV, No. 4.1

Approved application
The tested AMS is suitable for the continuous measurement of concentrations of nitrogen oxides in ambient air (stationary operation).

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

The AMS is approved for a temperature range of 0 °C to +30 °C.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for ambient air applications at which it will be installed.

Basis of the certification
This certification is based on:

- test report 936/21221977/A of 08 October 2013 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environnement Agency (UBA) as the relevant body
- the ongoing surveillance of the product and the manufacturing process
- publication in the German Federal Gazette: BAnz AT 01 April 2014 B12, chapter IV, No. 4.1
  Announcement by UBA from 27 February 2014

AMS designation:
Serinus 40 for NO, NO_2 and NO_x

Manufacturer:
Ecotech Pty Ltd., Knoxfield, Australia

Field of application:
Continuous measurement of concentrations of nitrogen oxides in ambient air (stationary operation)

Measuring range during the performance test:

Component	Certification range	Unit
Nitrogen monoxide	0 - 1200	µg/m³
Nitrogen dioxide	0 - 500	µg/m³

Software version:
Firmware: 2.09.0005

Restrictions:
None

Notes:
1. The measuring system has to be operated in a lockable measuring cabinet or container.
2. The test report on the performance test is available online at www.qal1.de.

Test institute:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21221977/A of 8 October 2013

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

The Serinus 40 ambient air measuring system continuously monitors concentrations of nitrogen oxides by means of the chemiluminescence method. The instrument is designed for the continuous measuring of NO, NO_2 and NO_x in ambient air.

Nitric oxides are measured on the basis of chemiluminescence detection of gas phases. Sample air enters the reaction cell via two separate (alternating) paths; the NO and NO_X channels.

In the first path, NO reacts with ozone as follows:

$$NO + O_3 \rightarrow NO_2^* + O_2$$

In the second path, the gas first passes through the delay coil and then through the NO_2/NO converter so that it reaches the reaction cell after the gas in the first path. At that time NO_X (total concentration of NO and NO_2) is measured.
The NO_2 concentration is then calculated by subtracting the NO value from the measured NO_X value.

This reaction releases energy in the form of chemiluminescent radiation at a wavelength of 1100 nm, which is filtered by the optical band-pass filter and detected by the photomultiplier tube (PMT).

The detected level of chemiluminescence is directly proportional to the NO concentration in the sample.

The nitrogen oxides analyser consists of five main modules:

- pneumatics for channelling sample and exhaust gas (incl. valve manifolds)
- sensors for measuring nitrogen oxides (reaction cell module) and other relevant parameters
- control unit consisting of printed circuit boards for the control of sensors and pneumatics
- power supply for all processes in the analyser
- communication module for data access

Particulate filter
The particle filter is a 5 µm Teflon filter with a diameter of 47 mm. This filter removes all particles > 5 µm, which might affect the measurements.

Permeation dryer for drying the sample gas
After the particle filter there are two serially-connected permeation dryers in the sample gas line. During performance testing, these dryers were integrated into the analyser and therefore shall be considered as part of the tested measuring system. The dryers remove moisture from the sample gas and thereby reduce the amount of interference caused by moisture.

Sample gas pump

Manufacturer: Thomas, type: 617CD22-194 C

During performance testing the above-mentioned sample gas pump was used in the laboratory as well as in the field test. As far as the models Serinus 10 (ozone), Serinus 30 (CO) and Serinus 50 (SO_2) are concerned, one pump can be operated with up to two analysers. However, for the Serinus 40 (NO_X) one sample gas pump per analyser is required.

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 can be applied to the product or used in publicity material for the certified product is presented on page 1 of this certificate.

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 the validity is also accessible on the internet: **qal1.de**.

Certification of Serinus 40 nitrogen oxide Analyzer 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. 0000040204: 29 April 2014
Validity of the certificate until: 31 March 2019

Test report: 936/21221977/A of 08 October 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 01 April 2014 B12, chapter IV, No. 4.1
Announcement by UBA from 27 February 2014

Renewal of the certificate according to EN 15267:

Certificate No. 0000040204_01: 1 April 2019
Validity of the certificate until: 30 June 2020

Expanded uncertainty based on the results of the laboratory testing of Device 1

Measuring device: Ecotech Serinus 40 — Serial-No.: 13-0095 (Device 1)

Measured component: NO_2 — 1h-limit value: 104.6 nmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero		≤ 1.0 nmol/mol	0.310	$u_{r,z}$	0.06	0.0035	
2	Repeatability standard deviation at 1h-limit value		≤ 3.0 nmol/mol	0.270	$u_{r,lh}$	0.01	0.0001	
3	"lack of fit" at 1h-limit value		≤ 4.0% of measured value	0.720	u_{lih}	0.43	0.1891	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value		≤ 8.0 nmol/mol/kPa	1.290	u_{gp}	3.56	12.6928	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value		≤ 3.0 nmol/mol/K	0.040	u_{gt}	0.09	0.0086	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value		≤ 3.0 nmol/mol/K	0.620	u_{st}	1.55	2.3938	
7	Sensitivity coefficient of electrical voltage at 1h-limit value		≤ 0.30 nmol/mol/V	0.045	u_V	0.13	0.0171	
8a	Interferent H_20 with 21 mmol/mol		≤ 10 nmol/mol (Zero)	0.090	u_{H2O}	0.01	0.0001	
			≤ 10 nmol/mol (Span)	-0.300				
8b	Interferent CO_2 with 500 µmol/mol		≤ 5.0 nmol/mol (Zero)	-0.470	$u_{int,pos}$	0.09	0.0086	
			≤ 5.0 nmol/mol (Span)	1.430				
8c	Interferent NH_3 mit 200 nmol/mol		≤ 5.0 nmol/mol (Zero)	0.000	or			
			≤ 5.0 nmol/mol (Span)	0.800	$u_{int,neg}$			
9	Averaging effect		≤ 7.0% of measured value	-1.350	u_{av}	-0.82	0.6647	
18	Difference sample/calibration port		≤ 1.0%	-0.260	$u_{\Delta sc}$	-0.27	0.0740	
21	Converter efficiency		≥ 98	98.90	u_{EC}	1.15	1.3239	
23	Uncertainty of test gas		≤ 3.0%	2.000	u_{cg}	1.05	1.0941	
					Combined standard uncertainty	u_c	4.2981	nmol/mol
					Expanded uncertainty	U	8.5963	nmol/mol
					Relative expanded uncertainty	W	8.22	%
					Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty based on the results of the laboratory testing of Device 2

Measuring device: Ecotech Serinus 40 — Serial-No.: 13-0094 (Device 2)

Measured component: NO_2 — 1h-limit value: 104.6 nmol/mol

No.	Performance characteristic		Performance criterion		Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero		≤	1.0 nmol/mol	0.190	$u_{r,z}$	0.04	0.0014	
2	Repeatability standard deviation at 1h-limit value		≤	3.0 nmol/mol	0.190	$u_{r,lh}$	0.01	0.0001	
3	"lack of fit" at 1h-limit value		≤	4.0% of measured value	0.840	$u_{l,lh}$	0.51	0.2573	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value		≤	8.0 nmol/mol/kPa	1.970	u_{gp}	5.37	28.8054	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value		≤	3.0 nmol/mol/K	0.450	u_{gt}	1.02	1.0438	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value		≤	3.0 nmol/mol/K	0.240	u_{st}	0.60	0.3647	
7	Sensitivity coefficient of electrical voltage at 1h-limit value		≤	0.30 nmol/mol/V	0.006	u_V	0.02	0.0003	
8a	Interferent H_20 with 21 mmol/mol		≤	10 nmol/mol (Zero)	0.000	u_{H2O}	-0.26	0.0700	
			≤	10 nmol/mol (Span)	0.000				
8b	Interferent CO_2 with 500 µmol/mol		≤	5.0 nmol/mol (Zero)	0.600	$u_{int,pos}$	or 0.38	0.1434	
			≤	5.0 nmol/mol (Span)	0.430				
8c	Interferent NH_3 mit 200 nmol/mol		≤	5.0 nmol/mol (Zero)	-0.240	$u_{int,neg}$			
			≤	5.0 nmol/mol (Span)	1.410				
9	Averaging effect		≤	7.0% of measured value	-1.310	u_{av}	-0.79	0.6259	
18	Difference sample/calibration port		≤	1.0%	0.230	$u_{\Delta sc}$	0.24	0.0579	
21	Converter efficiency		≥	98	98.80	u_{EC}	1.26	1.5755	
23	Uncertainty of test gas		≤	3.0%	2.000	u_{cg}	1.05	1.0941	

Combined standard uncertainty	u_c	5.8345	nmol/mol
Expanded uncertainty	U	11.6690	nmol/mol
Relative expanded uncertainty	W	11.16	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty based on the results of the laboratory and field testing of Device 1

Measuring device: Ecotech Serinus 40 — Serial-No.: 13-0095 (Device 1)

Measured component: NO_2 — 1h-limit value: 104.6 nmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero	≤	1.0 nmol/mol	0.310	$u_{r,z}$	0.06	0.0035	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0.270	$u_{r,lh}$	not considered, as $\sqrt{2}$*ur,lh = 0,01 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0.720	$u_{l,lh}$	0.43	0.1891	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	8.0 nmol/mol/kPa	1.290	u_{gp}	3.56	12.6928	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	3.0 nmol/mol/K	0.040	u_{gt}	0.09	0.0086	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	3.0 nmol/mol/K	0.620	u_{st}	1.55	2.3938	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0.045	u_V	0.13	0.0171	
8a	Interferent H_20 with 21 nmol/mol	≤	10 nmol/mol (Zero)	0.090	u_{H2O}	0.01	0.0001	
		≤	10 nmol/mol (Span)	-0.300				
8b	Interferent CO_2 with 500 µmol/mol	≤	5.0 nmol/mol (Zero)	-0.470	$u_{int,pos}$	0.09	0.0086	
		≤	5.0 nmol/mol (Span)	1.430				
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0.000	or			
		≤	5.0 nmol/mol (Span)	0.800	$u_{int,neg}$			
9	Averaging effect	≤	7.0% of measured value	-1.350	u_{av}	-0.82	0.6647	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	3.550	$u_{r,f}$	3.71	13.7886	
11	Long term drift at zero level	≤	5.0 nmol/mol	-0.510	$u_{d,l,z}$	-0.29	0.0867	
12	Long term drift at span level	≤	5.0% of max. of certification range	2.510	$u_{d,l,lh}$	1.52	2.2977	
18	Difference sample/calibration port	≤	1.0%	-0.260	$u_{\Delta sc}$	-0.27	0.0740	
21	Converter efficiency	≥	98	98.900	u_{EC}	1.15	1.3239	
23	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	1.05	1.0941	
					Combined standard uncertainty	u_c	5.8861	nmol/mol
					Expanded uncertainty	U	11.7723	nmol/mol
					Relative expanded uncertainty	W	11.25	%
					Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty based on the results of the laboratory and field testing of Device 2

Measuring device: Ecotech Serinus 40 — Serial-No.: 13-0094 (Device 2)

Measured component: NO_2 — 1h-limit value: 104.6 nmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty
1	Repeatability standard deviation at zero	≤	1.0 nmol/mol	0.190	$u_{r,z}$	0.04	0.0014
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0.190	$u_{r,lh}$	not considered, as $\sqrt{2}*u_{r,lh} = 0,01 < u_{r,f}$	-
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0.840	$u_{l,lh}$	0.51	0.2573
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	8.0 nmol/mol/kPa	1.970	u_{gp}	5.37	28.8054
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	3.0 nmol/mol/K	0.450	u_{gt}	1.02	1.0438
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	3.0 nmol/mol/K	0.240	u_{st}	0.60	0.3647
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0.006	u_V	0.02	0.0003
8a	Interferent H_2O with 21 mmol/mol	≤	10 nmol/mol (Zero)	-0.300	u_{H2O}	-0.26	0.0700
		≤	10 nmol/mol (Span)	-0.570			
8b	Interferent CO_2 with 500 µmol/mol	≤	5.0 nmol/mol (Zero)	0.600	$u_{int,pos}$ or $u_{int,neg}$	0.38	0.1434
		≤	5.0 nmol/mol (Span)	0.430			
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0.240			
		≤	5.0 nmol/mol (Span)	1.410			
9	Averaging effect	≤	7.0% of measured value	-1.310	u_{av}	-0.79	0.6259
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	3.550	$u_{r,f}$	3.71	13.7886
11	Long term drift at zero level	≤	5.0 nmol/mol	0.580	$u_{d,l,z}$	0.33	0.1121
12	Long term drift at span level	≤	5.0% of max. of certification range	2.550	$u_{d,l,lh}$	1.54	2.3715
18	Difference sample/calibration port	≤	1.0%	0.230	$u_{\Delta sc}$	0.24	0.0579
21	Converter efficiency	≥	98	98.800	u_{EC}	1.26	1.5755
23	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	1.05	1.0941
					Combined standard uncertainty	u_c	7.0932	nmol/mol
					Expanded uncertainty	U	14.1864	nmol/mol
					Relative expanded uncertainty	W	13.56	%
					Maximum allowed expanded uncertainty	W_{req}	15	%