

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040202_01

Certified AMS: Serinus 10 for O₃

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 14625: 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 0000040202 of 29 April 2014

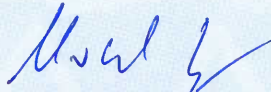


Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance

www.tuv.com
ID 0000040202

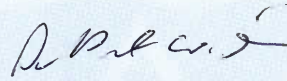
Publication in the German Federal Gazette
(BAnz.) of 1 April 2014

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

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51105 Cologne

Accreditation according to EN ISO/IEC 17025 and certified according to ISO 9001:2008.

Certificate:
0000040202_01 / 1 April 2019

Test report: 936/21221977/C 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. 1.1

Approved application

The tested AMS is suitable for the continuous measurement of ozone concentrations 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/C of 08 October 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 AT 01 April 2014 B12, chapter IV, No. 1.1
Announcement by UBA from 27 February 2014

AMS designation:

Serinus 10 for ozone

Manufacturer:

Ecotech Pty Ltd., Knoxfield, Australia

Field of application:

For continuous ambient air monitoring of O₃ (stationary operation)

Measuring range during the performance test:

Component	Certification range	Unit
Ozone	0 - 500	µg/m ³

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/C of 8 October 2013

Certified product

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

The Serinus 10 measuring system is a continuous ozone monitor which uses the method of ultraviolet photometry. The instrument is designed for the continuous measurement of ozone concentrations in ambient air.

The UV photometer determines the ozone concentration (O_3) in the sample gas at ambient pressure by detecting absorption of UV radiation in a glass absorption tube. The Serinus 10 works by the following principles and measurement methods:

- Ozon shows a strong absorption of UV light at a wavelength of 254 nm.
- Sample air is passed into the glass absorption tube (measurement cell).
- Within the measurement cell a single beam of UV radiation (from a mercury vapour lamp) passes through the sample and is absorbed by the O_3 .
- The solar blind vacuum photodiode detects any UV that is not absorbed.
- The strength of the UV signal being detected is proportional to the amount of UV light being absorbed by O_3 .
- The Serinus 10 analyser uses the Beer-Lambert relationship (Beer-Lambert law) to calculate the ozone concentration.

The Beer-Lambert law (shown below) is used to calculate the concentration of ozone from the ratio of the two light intensities measured:

$$I/I_0 = \exp(-acd)$$

where

- I is the light intensity measured with ozone in the gas sample
- I_0 is the light intensity measured with no ozone in the gas sample
- a is the ozone absorption coefficient at 253.7 nm ($1.44 \times 10^{-5} \text{ m}^2/\text{mg}$)
- c is the mass concentration of ozone in mg/m^3
- d is the optical path length in m

- O₃ is not the only gas that absorbs UV (254 nm), SO₂ and aromatic compounds also absorb radiation at this wavelength. To eliminate interferences a second cycle is performed. Sample air is passed through an ozone scrubber, removing ozone but allowing all interfering gases through. Thus it is possible to accurately measure the effect of interfering gases. This effect is then removed from the sample measurement signal which ensures accurate measurement of ozone without the influence of interferences.

The microprocessor and electronics of the Serinus 10 control, measure, and correct for all the major external variables to ensure stable and reliable operation.

The Serinus 10 Ozone Analyser uses non-dispersive ultraviolet (UV) absorption technology to measure ozone to a sensitivity of 0.5 ppb in the range of 0-20 ppm. The Serinus 10 measures O₃ with the following components and techniques:

- Mercury vapour lamp – to provide detector input.
(254 nm UV light source)
- Photodiode detector – to capture the measurement response.
Detects the ratio of transmitted light, thereby giving the concentration of ozone.
- Ozone scrubber – to establish the background response
As ozone is not the only atmospheric gas that absorbs the particular wavelength of UV light.
- A microprocessor programmed with Serinus firmware monitors the detector response and many other parameters, so that the O₃ concentration is automatically corrected for gas temperature and pressure changes and referenced to 0 °C, 20 °C or 25 °C at 1 atmosphere. This allows the Serinus 10 to sample in the most common measurement range for O₃.

The major components of the Serinus 10 are described below:

Particulate filter

The particulate filter is a Teflon 5 micron (µm) filter with a diameter of 47 mm. This filter eliminates all particles larger than 5 µm that could interfere with sample measurements.

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 (SO₂) 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 10 Ozone 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. 0000040202: 29 April 2014
Validity of the certificate until: 31 March 2019

Test report: 936/21221977/C of 08 October 2019
TÜV Rheinland Energie und Umwelt GmbH, Köln
Publication: BAnz AT 01 April 2014 B12, chapter IV, No. 1.1
Announcement by UBA from 27 February 2014

Renewal of the certificate according to EN 15267:

Certificate No. 0000040202_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 10		Serial-No.: 13-0091 (Device 1)		120		nmol/mol		
Measured component: O ₃		1h-alert threshold:						
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty			
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.320	u _{r,z}	0.0055			
2	Repeatability standard deviation at 1h-alert threshold	≤ 3.0 nmol/mol	0.160	u _{r,th}	0.0014			
3	"lack of fit" at 1h-alert threshold	≤ 4.0% of measured value	1.380	u _{lf,th}	0.9141			
4	Sensitivity coefficient of sample gas pressure at 1h-alert threshold	≤ 2.0 nmol/mol/kPa	0.060	u _{gp}	0.3811			
5	Sensitivity coefficient of sample gas pressure at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.130	u _{gt}	2.2089			
6	Sensitivity coefficient of surrounding temperature at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.421	u _{st}	9.9431			
7	Sensitivity coefficient of electrical voltage at 1h-alert threshold	≤ 0.30 nmol/mol/V	0.010	u _v	0.0152			
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	2.700 -0.670	u _{H2O}	-0.40			
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero)	1.880	u _{int,pos}	2.83			
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Span)	0.380	or		8.0082		
		≤ 5.0 nmol/mol (Zero)	2.510					
		≤ 5.0 nmol/mol (Span)	4.530	u _{int,neg}				
9	Averaging effect	≤ 7.0% of measured value	-1.570	u _{av}	-1.09			
18	Difference sample/calibration port	≤ 1.0%	-0.370	u _{asc}	-0.44			
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.20			
				Combined standard uncertainty		nmol/mol		
				Expanded uncertainty		nmol/mol		
				Relative expanded uncertainty		%		
				Maximum allowed expanded uncertainty		%		
				u _c		4.9454		
				U		9.8909		
				W		8.24		
				W _{req}		15		

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

Measuring device: Ecotech Serinus 10		Serial No.: 13-0090 (Device 2)		120		nmol/mol	
Measured component: O ₃		1h-alert threshold:					
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.600	u _{r,z}	0.14	0.0188	
2	Repeatability standard deviation at 1h-alert threshold	≤ 3.0 nmol/mol	0.400	u _{r,lv}	0.09	0.0086	
3	"lack of fit" at 1h-alert threshold	≤ 4.0% of measured value	1.160	u _{lv}	0.80	0.6459	
4	Sensitivity coefficient of sample gas pressure at 1h-alert threshold	≤ 2.0 nmol/mol/kPa	0.040	u _{gp}	0.41	0.1694	
5	Sensitivity coefficient of sample gas temperature at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.140	u _{gt}	1.61	2.5931	
6	Sensitivity coefficient of surrounding temperature at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.206	u _{st}	1.59	2.5147	
7	Sensitivity coefficient of electrical voltage at 1h-alert threshold	≤ 0.30 nmol/mol/V	0.020	u _v	0.25	0.0606	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	-0.010	u _{H2O}	0.53	0.2791	
		≤ 10 nmol/mol (Span)	0.720				
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero)	2.020	u _{int,pos}			
		≤ 5.0 nmol/mol (Span)	0.820	or	2.70	7.3008	
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero)	2.680	u _{int,neg}			
		≤ 5.0 nmol/mol (Span)	3.860				
9	Averaging effect	≤ 7.0% of measured value	-0.540	u _{av}	-0.37	0.1400	
18	Difference sample/calibration port	≤ 1.0%	0.220	u _{psc}	0.26	0.0697	
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.20	1.4400	
Combined standard uncertainty				u _c		3.9039	
Expanded uncertainty				U		7.8079	
Relative expanded uncertainty				W		6.51	
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 10		Serial-No.: 13-0091 (Device 1)		120		nmol/mol	
Measured component: O ₃		1h-alert threshold:		1h-alert threshold:		nmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.320	U _{r,z}	0.07	0.0055	
2	Repeatability standard deviation at 1h-alert threshold	≤ 3.0 nmol/mol	0.160	U _{r,h}	not considered, as U _{r,h} = 0.03 < U _{r,f}	-	
3	"lack of fit" at 1h-alert threshold	≤ 4.0% of measured value	1.380	U _{l,h}	0.96	0.9141	
4	Sensitivity coefficient of sample gas pressure at 1h-alert threshold	≤ 2.0 nmol/mol/kPa	0.060	U _{sp}	0.62	0.3811	
5	Sensitivity coefficient of sample gas temperature at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.130	U _{gt}	1.49	2.2089	
6	Sensitivity coefficient of surrounding temperature at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.421	U _{gt}	3.15	9.9431	
7	Sensitivity coefficient of electrical voltage at 1h-alert threshold	≤ 0.30 nmol/mol/V	0.010	U _v	0.12	0.0152	
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	2.700 -0.670	U _{H2O}	-0.40	0.1595	
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	1.880 0.380	U _{int,pos} or	2.83	8.0082	
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	2.510 4.530	U _{int,neg}			
9	Averaging effect	≤ 7.0% of measured value	-1.570	U _{av}	-1.09	1.1832	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	1.950	U _{r,f}	2.34	5.4756	
11	Long term drift at zero level	≤ 5.0 nmol/mol	1.810	U _{d,z}	1.05	1.0920	
12	Long term drift at span level	≤ 5.0% of max. of certification range	-2.250	U _{d,h}	-1.56	2.4300	
18	Difference sample/calibration port	≤ 1.0%	-0.370	U _{asc}	-0.44	0.1971	
21	Uncertainty of test gas	≤ 3.0%	2.000	U _{cg}	1.20	1.4400	
Combined standard uncertainty				U _c		5.7839	nmol/mol
Expanded standard uncertainty				U		11.5678	nmol/mol
Relative expanded uncertainty				W		9.64	%
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 10		Serial-No.: 13-0090 (Device 2)		120		nmol/mol	
Measured component: O ₃		1h-alert threshold:					
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty u _{i,z}	Partial uncertainty not considered, as u _{i,th} = 0.09 < u _{i,f}	Square of partial uncertainty	
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.600		0.14	0.0188	
2	Repeatability standard deviation at 1h-alert threshold	≤ 3.0 nmol/mol	0.400	u _{i,th}		-	
3	"lack of fit" at 1h-alert threshold	≤ 4.0% of measured value	1.160	u _{i,th}	0.80	0.6459	
4	Sensitivity coefficient of sample gas pressure at 1h-alert threshold	≤ 2.0 nmol/mol/kPa	0.040	u _{sp}	0.41	0.1694	
5	Sensitivity coefficient of sample gas temperature at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.140	u _{gt}	1.61	2.5931	
6	Sensitivity coefficient of surrounding temperature at 1h-alert threshold	≤ 1.0 nmol/mol/K	0.206	u _{st}	1.59	2.5147	
7	Sensitivity coefficient of electrical voltage at 1h-alert threshold	≤ 0.30 nmol/mol/V	0.020	u _v	0.25	0.0606	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	-0.010 0.720	u _{H2O}	0.53	0.2791	
8b	Interferent Toluene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	2.020 0.820	u _{tol,pos} or	2.70	7.3008	
8c	Interferent Xylene with 0.5 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	2.680 3.860	u _{tol,neg}			
9	Averaging effect	≤ 7.0% of measured value	-0.540	u _{av}	-0.37	0.1400	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	1.950	u _{r,f}	2.34	5.4756	
11	Long term drift at zero level	≤ 5.0 nmol/mol	1.470	u _{d,l,z}	0.85	0.7203	
12	Long term drift at span level	≤ 5.0% of max. of certification range	-2.440	u _{d,l,h}	-1.69	2.8577	
18	Difference sampler/calibration port	≤ 1.0%	0.220	u _{asc}	0.26	0.0687	
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{eg}	1.20	1.4400	
Combined standard uncertainty					u _c	4.9281	nmol/mol
Expanded uncertainty					U	9.8561	nmol/mol
Relative expanded uncertainty					W	8.21	%
Maximum allowed expanded uncertainty					W _{req}	15	%