CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040203_03

Certified AMS:	Serinus 30 for CO
Manufacturer:	ACOEM Australasia (Ecotech Pty Ltd) 1492 Ferntree Gully Road, Knoxfield, VIC, 3180 Australia
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 14626 (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 16 pages).
The present certificate replaces certificate 0000040203_02 dated 1 July 2020.

TÜVRheinland® CERTIFIED
Suitability Tested
Complying with 2008/50/EC
EN 15267
Regular Surveillance
www.tuv.com
ID 0000040203

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

German Environment Agency

Dessau, 27 June 2025

This certificate will expire on:
30 June 2030

TÜV Rheinland Energy & Environment GmbH
Cologne, 26 June 2025

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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:	936/21221977/D dated 8 October 2013
Initial certification:	1 April 2014
Expiry date:	30 June 2030
Certificate:	Renewal (of previous certificate 0000040203_02 of 1 July 2020 valid until 30 June 2025)
Publication:	BAnz AT 01.04.2014 B12, chapter IV No. 2.1

Approved application

The tested AMS is suitable for continuous immission measurement of CO in stationary use.

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 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 936/21221977/D dated 8 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 01.04.2014 B12, chapter IV No. 2.1, Announcement by UBA dated 27 February 2014:

AMS designation:
Serinus 30 for CO

Manufacturer:
Ecotech Pty Ltd., Knoxfield, Australia

Field of application:
Continuous measurement of carbon monoxide concentrations in ambient air (stationary operation)

Measuring ranges during the performance test:

Component	Certification range	Unit
Carbon monoxide	0 – 100	mg/m³

Software version:
Firmware: 2.09.0005

Restrictions:
None

Notes:
1. The measuring system must be operated inside a lockable measuring cabinet or measurement container.
2. The test report on performance testing is available on the internet at www.qal1.de.

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

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, Chap. IV notification 5, Announcement by UBA dated 25 February 2015:

5 Notification as regards Federal Environment Agency (UBA) notice of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1)

Hereafter, the Serinus 30 measuring system for CO, manufactured by Ecotech Pty Ltd., will be equipped with a new microprocessor board (CO10014). This results in modifications of the power plug as well as software changes.

The current two software versions are designated as follows:
2.20.0009 for systems using the old microprocessor board (C010001)
3.10.001 for systems using the new microprocessor board (C010014).

Statement by TÜV Rheinland Energie und Umwelt GmbH of 12 September 2014

Publication in the German Federal Gazette: BAnz AT 15.03.2017 B6, Chap. V notification 6, Announcement by UBA dated 22 February 2017:

6 Notification as regards Federal Environment Agency notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1) and of 25 February 2015 (BAnz AT 02.04.2015 B5 chapter IV notification 5)

The current software version of the Serinus 30 for CO manufactured by Ecotech Pty Ltd. for systems with micro processor board (C010001) is: V 2.31.0004.

The following software versions are approved for this instrument version:
V 2.21.0000, V 2.22.0000, V 2.23.0000, V 2.24.0000, V 2.25.0004, V 2.26.0000, V 2.27.0000, V 2.28.0000, V 2.29.0003 and V 2.30.0000.

The current software version of the Serinus 30 for CO manufactured by Ecotech Pty Ltd. for systems with micro processor board (C010014) is: V 3.48.011.

The following software versions are approved for this instrument version:
V 3.13.000, V 3.14.001, V 3.15.010, V 3.16.001, V 3.18.003, V 3.20.000, V 3.22.000, V 3.23.015, V 3.24.000, V 3.26.000, V 3.27.000, V 3.28.000, V 3.29.013, V 3.30.005, V 3.31.002, V 3.32.003, V 3.33.004, V 3.34.000, V 3.35.004, V 3.36.000, V 3.37.004, V 3.38.006, V 3.39.000, V 3.40.001, V 3.41.004, V 3.42.000, V 3.43.000, V 3.44.004, V 3.45.011, V 3.46.002, V 3.47.006.

Statement by TÜV Rheinland Energy GmbH dated 13 October 2016

Publication in the German Federal Gazette: BAnz AT 26.03.2019 B7, Chap. IV notification 16, Announcement by UBA dated 27 February 2019:

16 Notification as regards Federal Environment Agency notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1) and of 22 February 2017 (BAnz AT 15.03.2017 B6, chapter IV notification 6)

The current software version of the Serinus 30 for CO manufactured by Ecotech Pty Ltd. for systems with micro processor board (C010001) is:
V 2.35.0001.
In addition, the following software versions have been approved for this instrument version: V 2.32.0000, V 2.33.0000, V 2.34.0000

The current software version of the Serinus 30 for CO manufactured by Ecotech Pty Ltd. for systems with micro processor board (C010014) is:
V 3.74.0003.
In addition, the following software versions have been approved for this instrument version: V 3.49.0000, V 3.51.0011, V 3.52.0000, V 3.53.0012, V 3.54.0000, V 3.55.0000, V 3.56.0001, V 3.57.0002, V 3.58.0000, V 3.59.0004, V 3.60.0005, V 3.61.0000, V 3.62.0000, V 3.63.0001, V 3.64.0000, V 3.65.0001, V 3.66.0000, V 3.67.0003, V 3.68.0009, V 3.69.0001, V 3.70.0000, V 3.71.0000.

The display of the measuring system shows the software version in the following format: 2.XX or 3.XX.

Statement by TÜV Rheinland Energy GmbH dated 10 October 2018

Publication in the German Federal Gazette: BAnz AT 24.03.2020 B7, Chap. IV notification 20, Announcement by UBA dated 24 February 2020:

20 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1) and of 27 February 2019 (BAnz AT 26.03.2019 B7, chapter IV notification 16)

The latest software version of the Serinus 30 measuring system for CO with microprocessor C010001 manufactured by Ecotech Pty Ltd. remains:
V 2.35.0001.

The latest software version of the Serinus 30 measuring system for CO with microprocessor C010014 manufactured by Ecotech Pty Ltd. is:
V 3.87.0000.
Moreover, the following software version are approved for this instrument version:
V 3.75.0003, V 3.76.0004, V 3.77.0009, V 3.78.0000, V 3.79.0001, V 3.81.0000, V 3.83.0000, V 3.84.0000, V 3.85.0001, V 3.86.0000.
The instrument's display shows the software version in the following format: 2.XX or 3.XX.

Statement by TÜV Rheinland Energy GmbH dated 20 September 2019

Publication in the German Federal Gazette: BAnz AT 03.05.2021 B9, Chap. III notification 10, Announcement by UBA dated 31 March 2021:

10 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1) and of 24 February 2020 (BAnz AT 24.03.2020 B7, chapter IV notification 20)

The latest software version of the Serinus 30 measuring system for CO with microprocessor C010001 manufactured by Ecotech Pty Ltd. is:
V 2.35.0001.
The latest software version of the Serinus 30 measuring system for CO with microprocessor C010014 manufactured by Ecotech Pty Ltd. is:
V 4.02.0000.
Furthermore, the following software versions are approved for this instrument version:
V 3.88.0000, V 3.89.0000, V 3.90.0002, V 4.00.0000, V 4.01.0000
The instrument display shows the software version in the following format: 2.XX or 3.XX or 4.XX.

The Serinus Main Controller Board (PCB) received an update from Rev. N to Rev. P. Furthermore, a power cable from the preamplifier to the detector has been replaced by a new model and the light diodes used are now electrically connected in series (previously parallel connection).

Statement by TÜV Rheinland Energy GmbH dated 14 July 2020

Publication in the German Federal Gazette: BAnz AT 11.04.2022 B10, Chap. VI notification 4, Announcement by UBA dated 9 March 2022:

4 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1) and of 31 March 2021 (BAnz AT 03.05.2021 B9, chapter III notification 10)

The company name of Ecotech Pty. Ltd. changes to ACOEM Australasia.

The current software version of the measuring device Serinus 30 for CO of the company ACOEM Australasia for devices with the microprocessor board (C010001) is unchanged: V 2.35.0001.
The current software version of the Serinus 30 measuring device for CO from ACOEM Australasia for devices with the microprocessor board (C010014) is:
V 4.13.0000.
Furthermore, the following software versions are approved for this device version:
V 4.04.0000, V 4.06.0000, V 4.07.0000, V 4.08.0000, V 4.09.0000, V 4.10.0000, V 4.11.0000.
The software version number appears in the display of the measuring device in the format 2.XX or 3.XX or 4.XX.

Statement by TÜV Rheinland Energy GmbH dated 20 August 2021

Publication in the German Federal Gazette: BAnz AT 20.03.2023 B6, Chap. IV notification 58, Announcement by UBA dated 21 February 2023:

58 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz. AT 01.04.2014 B12, chapter IV number 2.1) and of 9 March 2022 (BAnz AT 11.04.2022 B10, chapter VI notification 4)

The current software version of the Serinus 30 measuring system for CO from the company ACOEM Australasia for devices with the microprocessor board (C010001) remains:
V 2.35.0001

The current software version of the Serinus 30 measuring system for CO from the company ACOEM Australasia for devices with the microprocessor board (C010014) is:
V 4.18.0000.

Furthermore, the following software versions are approved for this device version:
V 4.14.0000, V 4.15.0000, V 4.16.0000, V 4.17.0000
The software version number appears in the display of the measuring system in the format 2.XX or 3.XX or 4.XX.

Statement by TÜV Rheinland Energy GmbH dated 05 September 2022

Publication in the German Federal Gazette: BAnz AT 10.05.2024 B7, Chap. V notification 44, Announcement by UBA dated 19 March 2024:

44 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1) and of 21 February 2023 (BAnz AT 20.03.2023 B6, chapter IV notification 58)

The current software version for the Serinus 30 measuring system for CO from ACOEM Australasia is unchanged for systems with the microprocessor board (C010001):
V 2.35.0001
The current software version for the Serinus 30 measuring system for CO from ACOEM Australasia is for systems with the microprocessor board (C010014):
V 4.22.0000.

The following software versions are also authorised for this device version:
V 4.19.0000, V 4.20.0000, V 4.21.0000
The software version number appears on the display of the measuring system in the format 2.XX or 3.XX or 4.XX.

Statement by TÜV Rheinland Energy GmbH dated 10 August 2023

Publication in the German Federal Gazette: BAnz AT 19.05.2025 B3, Chap. IV notification 95, Announcement by UBA dated 2 April 2025:

95 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 2.1) and of 19 March 2024 (BAnz AT 10.05.2024 B7, chapter V notification 44)

The current software version of the Serinus 30 measuring system for CO from ACOEM Australasia is unchanged for devices with the microprocessor board (C010001):
V 2.35.0001

The current software version of the Serinus 30 measuring system for CO from ACOEM Australasia for devices with the microprocessor board is (C010014):
V 4.28.0000

The following software versions are also authorised for this device version: V 4.23.0000, V 4.24.0000, V 4.25.0000, V 4.26.0000, V 4.27.0000

The software version number appears on the display of the measuring device in the format 2.XX or 3.XX or 4.XX.

Statement issued by TÜV Rheinland Energy & Environment GmbH dated 28 September 2024

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

The Serinus 30 measuring system is a continuous carbon monoxide monitor which uses the method of non-dispersive infrared photometry designed for the continuous measurement of carbon monoxide in ambient air.

Measurements are performed by means of the following components:
- microprocessor control
- proven Gas Filter Correlation (GFC)
- combined with Non-Dispersive Infrared Spectrophotometry (NDIR) technology

The CO 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 30 to accurately measure CO in all ambient applications.

Carbon monoxide is measured on the basis of the following principles and methods:
CO absorbs infrared radiation (IR) at a wavelength of approx. 4.7 µm. IR radiation (at 4.7 µm) passes through the sample air with the measurement path being 5 m. According to the Beer-Lambert law, the intensity of the received signal is proportional to the CO concentration within the sample. A band-pass filter is attached to the signal detector to ensure that only light at a wavelength of 4.7 µm is let through.

The Beer-Lambert equation is used to calculate the gas concentration from the ratio of two measured light intensities:

$$I/I_0 = \exp(-\alpha\, c\, d)$$

Where:
- I light intensity measured with CO in the gas sample
- I_0 light intensity measured with no CO in the gas sample
- α CO absorption coefficient at 253.7 nm
- c mass concentration of CO in mg/m^3
- d optical path length in m

The system includes a gas filter correlation wheel. It contains three parts which improve the accuracy of the measurements: CO-chamber, N_2-chamber and a mask.

- The CO window contains a certain saturation (40%) of CO which acts as a reference beam – absorbing a known amount of light.
- The N_2 window, containing 100% N_2, does not absorb IR at 4.7 microns at all and is used during normal CO measurement.
- The mask totally blocks the light source and is used to determine background signals and the strength of other signals relative to each other and the background.

The carbon monoxide analyser consists of five main modules:
The pneumatics to transfer sample and exhaust gas,
The sensors for the measurement of carbon monoxide (optical cell) and other relevant parameters,
The control system which encompasses all circuit boards controlling sensors and pneumatic,
The power supply which supplies power for all the instrument processors,
The communication module to access data.

Particle 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 sample gas pump mentioned above was used for 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, operation of the Serinus 40 (NO_x) requires one sample gas pump per analyser.

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 Serinus 30 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. 0000040203_00: 29 April 2014
Expiry date of the certificate: 31 March 2019
Test report: 936/21221977/D dated 8 October 2013
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz AT 01.04.2014 B12, chapter IV number 2.1
UBA announcement dated 27 February 2014

Notifications
Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 12 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 5
UBA announcement dated 25 February 2015
(Soft- and hardware changes)

Statement issued by TÜV Rheinland Energy GmbH dated 13 October 2016
Publication: BAnz AT 15.03.2017 B6, chapter V notification 6
UBA announcement dated 22 February 2017
(Software changes)

Renewal of certificates
Certificate No. 0000040203_01: 1 April 2019
Expiry date of the certificate: 30 June 2020

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 10 October 2018
Publication: BAnz AT 26.03.2019 B7, chapter IV notification 16
UBA announcement dated 27 February 2019
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 20 September 2019
Publication: BAnz AT 24.03.2020 B7, chapter IV notification 20
UBA announcement dated 24 February 2020
(Software changes)

Renewal of certificates
Certificate No. 0000040203_02: 1 July 2020
Expiry date of the certificate: 30 June 2025

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 14 July 2020
Publication: BAnz AT 03.05.2021 B9, chapter III notification 10
UBA announcement dated 31 March 2021
(Soft- and hardware changes)

Statement issued by TÜV Rheinland Energy GmbH dated 20 August 2021
Publication: BAnz AT 11.04.2022 B10, chapter VI notification 4
UBA announcement dated 9 March 2022
(Software changes and new producer name formerly Ecotech Pty. Ltd.)

Statement issued by TÜV Rheinland Energy GmbH dated 5 September 2022
Publication: BAnz AT 20.03.2023 B6, chapter IV notification 58
UBA announcement dated 21 February 2023
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 10 August 2023
Publication: BAnz AT 10.05.2024 B7, chapter V notification 44
UBA announcement dated 19 March 2024
(Software changes)

Renewal of certificates

Certificate No. 0000040203_03:	27 June 2025
Expiry date of the certificate:	30 June 2030

Expanded uncertainty laboratory, system 1

Measuring device:	Ecotech Serinus 30	Serial-No.:	12-1183 (Device 1)	
Measured component	CO	8h-limit value:	8.62	µmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero	≤	0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	≤	0.4 µmol/mol	0.030	u_r	0.01	0.0000	
3	"lack of fit" at 8h-limit value	≤	4.0% of measured value	0.860	u_l	0.04	0.0018	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤	0.7 µmol/mol/kPa	0.040	u_{gp}	0.09	0.0087	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.000	u_{gt}	0.00	0.0000	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.040	u_{st}	0.09	0.0083	
7	Sensitivity coefficient of electrical voltage at 8h-limit value	≤	0.3 µmol/mol/V	0.001	u_{sv}	0.00	0.0000	
8a	Interferent H_20 with 21 mmol/mol	≤	1.0 µmol/mol (Zero)	0.100	u_{H2O}	0.07	0.0055	
		≤	1.0 µmol/mol (Span)	0.230				
8b	Interferent CO_2 with 500 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.050	$u_{int,pos}$			
		≤	0.5 µmol/mol (Span)	0.000				
8c	Interferent NO with 1 µmol/mol	≤	0.5 µmol/mol (Zero)	0.010	or	0.06	0.0039	
		≤	0.5 µmol/mol (Span)	-0.110				
8d	Interferent N_2O with 50 nmol/mol	≤	0.5 µmol/mol (Zero)	0.010	$u_{int,neg}$			
		≤	0.5 µmol/mol (Span)	0.010				
9	Averaging effect	≤	7.0% of measured value	-0.080	u_{av}	0.00	0.0000	
18	Difference sample/calibration port	≤	1.0%	-0.090	u_{dsc}	-0.01	0.0001	
21	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	0.09	0.0074	

Combined standard uncertainty	u_c	0.1892	µmol/mol
Expanded uncertainty	U	0.3784	µmol/mol
Relative expanded uncertainty	W	4.39	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty laboratory, system 2

Measuring device:	Ecotech Serinus 30			Serial-No.:	13-0093 (Device 2)		
Measured component:	CO			8h-limit value:	8.62		µmol/mol
No.	**Performance characteristic**	**Performance criterion**	**Result**	**Partial uncertainty**		**Square of partial uncertainty**	
1	Repeatability standard deviation at zero	≤ 0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	≤ 0.4 µmol/mol	0.000	u_r	0.00	0.0000	
3	"lack of fit" at 8h-limit value	≤ 4.0% of measured value	0.930	u_l	0.05	0.0021	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤ 0.7 µmol/mol/kPa	0.030	u_{gp}	0.07	0.0049	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤ 0.3 µmol/mol/K	0.000	u_{gt}	0.00	0.0000	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤ 0.3 µmol/mol/K	0.046	u_{st}	0.10	0.0109	
7	Sensitivity coefficient of electrical voltage at 8h-limit value	≤ 0.3 µmol/mol/V	0.001	u_V	0.00	0.0000	
8a	Interferent H_2O with 21 mmol/mol	≤ 1.0 µmol/mol (Zero)	-0.110	u_{H2O}	-0.07	0.0046	
		≤ 1.0 µmol/mol (Span)	0.090				
8b	Interferent CO_2 with 500 µmol/mol	≤ 0.5 µmol/mol (Zero)	0.050	$u_{int,pos}$	0.06	0.0035	
		≤ 0.5 µmol/mol (Span)	0.050				
8c	Interferent NO with 1 µmol/mol	≤ 0.5 µmol/mol (Zero)	0.080	or			
		≤ 0.5 µmol/mol (Span)	0.050				
8d	Interferent N_2O with 50 nmol/mol	≤ 0.5 µmol/mol (Zero)	0.000	$u_{int,neg}$			
		≤ 0.5 µmol/mol (Span)	0.000				
9	Averaging effect	≤ 7.0% of measured value	-1.550	u_{av}	-0.08	0.0060	
18	Difference sample/calibration port	≤ 1.0%	-0.170	u_{asc}	-0.01	0.0002	
21	Uncertainty of test gas	≤ 3.0%	2.000	u_{cg}	0.09	0.0074	
				Combined standard uncertainty	u_c	0.1992	µmol/mol
				Expanded uncertainty	U	0.3983	µmol/mol
				Relative expanded uncertainty	W	4.62	%
				Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field, system 1

Measuring device:	Ecotech Serinus 30				Serial-No.:	12-1183 (Device 1)		
Measured component:	CO				8h-limit value:	8.62	µmol/mol	
No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero	≤	0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	≤	0.4 µmol/mol	0.030	u_r	not considered, as ur = 0 < ur, f	-	
3	"lack of fit" at 8h-limit value	≤	4.0% of measured value	0.860	u_l	0.04	0.0018	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤	0.7 µmol/mol/kPa	0.040	u_{gp}	0.09	0.0087	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.000	u_{gt}	0.00	0.0000	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.040	u_{st}	0.09	0.0083	
7	Sensitivity coefficient of electrical voltage at 8h-limit value	≤	0.3 µmol/mol/V	0.001	u_V	0.00	0.0000	
8a	Interferent H_2O with 21 mmol/mol	≤	1.0 µmol/mol (Zero)	0.230	u_{H2O}	0.07	0.0055	
		≤	1.0 µmol/mol (Span)	0.100				
8b	Interferent CO_2 with 500 µmol/mol	≤	0.5 µmol/mol (Zero)	-0.050	$u_{int,pos}$	0.06	0.0039	
		≤	0.5 µmol/mol (Span)	0.000				
8c	Interferent NO with 1 µmol/mol	≤	0.5 µmol/mol (Zero)	0.010	or			
		≤	0.5 µmol/mol (Span)	-0.110				
8d	Interferent N_2O with 50 nmol/mol	≤	0.5 µmol/mol (Zero)	0.010	$u_{int,neg}$			
		≤	0.5 µmol/mol (Span)	0.010				
9	Averaging effect	≤	7.0% of measured value	-0.080	u_{av}	0.00	0.0000	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	3.450	$u_{r,f}$	0.30	0.0884	
11	Long term drift at zero level	≤	0.5 µmol/mol	-0.230	$u_{d,l,z}$	-0.13	0.0176	
12	Long term drift at span level	≤	5.0% of max. of certification range	0.640	$u_{d,l,8h}$	0.03	0.0010	
18	Difference sample/calibration port	≤	1.0%	-0.090	u_{dsc}	-0.01	0.0001	
21	Uncertainty of test gas	≤	3.0%	2.000	u_{bg}	0.09	0.0074	
					Combined standard uncertainty	u_c	0.3779	µmol/mol
					Expanded uncertainty	U	0.7559	µmol/mol
					Relative expanded uncertainty	W	8.77	%
					Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field, system 2

Measuring device: Ecotech Serinus 30 — Serial-No.: 13-0093 (Device 2)

Measured component: CO — 8h-limit value: 8.62 µmol/mol

No.	Performance characteristic		Performance criterion	Result	Partial uncertainty		Square of partial uncertainty	
1	Repeatability standard deviation at zero	≤	0.3 µmol/mol	0.020	$u_{r,z}$	0.00	0.0000	
2	Repeatability standard deviation at 8h-limit value	≤	0.4 µmol/mol	0.000	u_r	not considered, as ur = 0 < ur,f	-	
3	"lack of fit" at 8h-limit value	≤	4.0% of measured value	0.930	u_l	0.05	0.0021	
4	Sensitivity coefficient of sample gas pressure at 8h-limit value	≤	0.7 µmol/mol/kPa	0.030	u_{gp}	0.07	0.0049	
5	Sensitivity coefficient of sample gas temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.000	u_{gt}	0.00	0.0000	
6	Sensitivity coefficient of surrounding temperature at 8h-limit value	≤	0.3 µmol/mol/K	0.046	u_{st}	0.10	0.0109	
7	Sensitivity coefficient of electrical voltage at 8h-limit value	≤	0.3 µmol/mol/V	0.001	u_V	0.00	0.0000	
8a	Interferent H_2O with 21 mmol/mol	≤	1.0 µmol/mol (Zero)	0.090	u_{H2O}	-0.07	0.0046	
		≤	1.0 µmol/mol (Span)	-0.110				
8b	Interferent CO_2 with 500 µmol/mol	≤	0.5 µmol/mol (Zero)	0.050	$u_{int,pos}$	0.06	0.0035	
		≤	0.5 µmol/mol (Span)	0.050				
8c	Interferent NO with 1 µmol/mol	≤	0.5 µmol/mol (Zero)	0.080	or			
		≤	0.5 µmol/mol (Span)	0.050				
8d	Interferent N_2O with 50 nmol/mol	≤	0.5 µmol/mol (Zero)	0.000	$u_{int,neg}$			
		≤	0.5 µmol/mol (Span)	0.000				
9	Averaging effect	≤	7.0% of measured value	-1.550	u_{av}	-0.08	0.0060	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	3.450	$u_{r,f}$	0.30	0.0884	
11	Long term drift at zero level	≤	0.5 µmol/mol	-0.470	$u_{d,l,z}$	-0.27	0.0736	
12	Long term drift at span level	≤	5.0% of max. of certification range	-0.900	$u_{d,l,8h}$	-0.04	0.0020	
18	Difference sample/calibration port	≤	1.0%	-0.170	u_{use}	-0.01	0.0002	
21	Uncertainty of test gas	≤	3.0%	2.000	u_{bg}	0.09	0.0074	
					Combined standard uncertainty	u_c	0.4514	µmol/mol
					Expanded uncertainty	U	0.9028	µmol/mol
					Relative expanded uncertainty	W	10.47	%
					Maximum allowed expanded uncertainty	W_{req}	15	%