# CERTIFICATE

## of Product Conformity (QAL1)

**Certificate No.: 0000040204_03**

| | |
|---|---|
| **Certified AMS:** | Serinus 40 for NO, $NO_2$ and $NO_x$ |
| **Manufacturer:** | ACOEM Australasia (Ecotech Pty Ltd)<br>1492 Ferntree Gully Road,<br>Knoxfield, VIC, 3180<br>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 (2010), 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 16 pages).
The present certificate replaces certificate 0000040204_02 dated 1 July 2020.

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 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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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/A dated 8 October 2013 |
| **Initial certification:** | 1 April 2014 |
| **Expiry date:** | 30 June 2030 |
| **Certificate:** | Renewal (of previous certificate 0000040204_02 of 1 July 2020 valid until 30 June 2025) |
| **Publication:** | BAnz AT 01.04.2014 B12, chapter IV No. 4.1 |

## Approved application

The tested AMS is suitable for continuous immission measurement of NO, $NO_2$ and $NO_x$ 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/A 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. 4.1, Announcement by UBA dated 27 February 2014:

**AMS designation:**
Serinus 40 for NO, $NO_2$ and NOx

**Manufacturer:**
Ecotech Pty Ltd., Knoxfield, Australia

**Field of application:**
For the continuous measurement of nitrogen oxide concentrations from stationary sources in ambient air

**Measuring ranges during the performance test:**

| Component | Certification range | Unit |
|---|---|---|
| Nitrogen monoxide | 0 - 1,200 | µg/m³ |
| Nitrogen dioxide | 0 - 500 | µg/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/A dated 8 October 2013

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, Chap. IV notification 6, Announcement by UBA dated 25 February 2015:

**6 Notification as regards Federal Environment Agency (UBA) notice of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1)**

Hereafter, the Serinus 40 measuring system for NO, $NO_2$, and $NO_x$, 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 7, Announcement by UBA dated 22 February 2017:

**7 Notification as regards Federal Environment Agency notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 25 February 2015 (BAnz AT 02.04.2015 B5 chapter IV notification 6)**

The current software version of the Serinus 40 for NO, $NO_2$ and $NO_X$ 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 und V 2.30.0000.

The current software version of the Serinus 40 for NO, $NO_2$ and $NO_X$ 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 17, Announcement by UBA dated 27 February 2019:

**17 Notification as regards Federal Environment Agency notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 22 February 2017 (BAnz AT 15.03.2017 B6, chapter IV notification 7)**

The current software version of the Serinus 40 for NO, $NO_2$ and $NO_x$ 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 40 for NO, $NO_2$ and $NO_x$ 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 21, Announcement by UBA dated 24 February 2020:

**21 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 27 February 2019 (BAnz AT 26.03.2019 B7, chapter IV notification 17)**

The latest software version of the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ with microprocessor C010001 manufactured by Ecotech Pty Ltd. remains:
V 2.35.0001.

The latest software version of the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ 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 11, Announcement by UBA dated 31 March 2021:

**11 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 24 February 2020 (BAnz AT 24.03.2020 B7, chapter IV notification 21)**

The latest software version of the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ manufactured by the company Ecotech Pty Ltd. is unchanged for devices with the microprocessor board (C010001): V 2.35.0001.
The latest software version of the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ manufactured by the company Ecotech Pty Ltd. for devices with the microprocessor board (C010014) 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's display shows the software version in the following format: 2.XX or 3.XX or 4.XX.

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 5, Announcement by UBA dated 9 March 2022:

**5 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 31 March 2021 (BAnz AT 03.05.2021 B9, chapter III notification 11)**

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

The current software version of the measuring device Serinus 40 for NO, $NO_2$ and $NO_x$ of the company ACOEM Australasia for devices with the microprocessor board (C010001) is unchanged: V 2.35.0001.

The current software version of the measuring device Serinus 40 for NO, $NO_2$ and $NO_x$ of the company ACOEM Australasia for devices with the microprocessor board (C010014) is: V 4.13.0000.
Furthermore, the following software versions are approved for this instrument 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 59, Announcement by UBA dated 21 February 2023:

**59 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 9 March 2022 (BAnz AT 11.04.2022 B10, chapter VI notification 5)**

The current software version of the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ from the company ACOEM Australasia for devices with the microprocessor board (C010001) remains:
V 2.35.0001

The current software version of the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ 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.

Alternatively, the measuring system can also be operated with a converter filling made of molybdenum (Art. No.: C050019).

Statement by TÜV Rheinland Energy GmbH dated 5 September 2022

Publication in the German Federal Gazette: BAnz AT 10.05.2024 B7, Chap. V notification 45, Announcement by UBA dated 19 March 2024:

**45 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 21 February 2023 (BAnz AT 20.03.2023 B6, chapter IV notification 59)**

The current software version for the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ from ACOEM Australasia is unchanged for systems with the microprocessor board (C010001): V 2.35.0001

The current software version for the Serinus 40 measuring system for NO, $NO_2$ and $NO_x$ 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 device in the format 2.XX or 3.XX or 4.XX.

Statement issued by TÜV Rheinland Energy GmbH dated 15 December 2023

Publication in the German Federal Gazette: BAnz AT 19.05.2025 B3, Chap. IV notification 96, Announcement by UBA dated 2 April 2025:

**96 Notification as regards Federal Environment Agency (UBA) notices of 27 February 2014 (BAnz AT 01.04.2014 B12, chapter IV number 4.1) and of 19 March 2024 (BAnz AT 10.05.2024 B7, chapter V notification 45)**

The current software version of the Serinus 40 measuring system for NO, NO2 and NOx from ACOEM Australasia is unchanged for devices with the microprocessor board (C010001):
V 2.35.0001

The current software version of the Serinus 40 measuring system for NO, NO2 and NOx from ACOEM Australasia is for devices with the microprocessor board (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 40 measuring system is a continuous nitrogen oxide monitor. The measuring principle relies on the chemiluminescence method. It was designed for the continuous measurement 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 NOx (total concentration of NO and $NO_2$) is measured.
The $NO_2$ concentration is then calculated by subtracting the NO value from the measured NOx 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
- The control system which encompasses all circuit boards controlling sensors and pneumatic,
- power supply for all processes in the analyser
- communication module for data access

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.

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

**Bluetooth**
This facilitates remote access to the analyser from Android devices via the “Serinus Remote” app. Via Bluetooth, it is possible to control and parameterise the analyser, download data and create real time charts.

**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 (NOX) 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 40 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_00: 29 April 2014
Expiry date of the certificate: 31 March 2019
Test report: 936/21221977/A dated 8 October 2013
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz AT 01.04.2014 B12, chapter IV number 4.1
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 6
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 7
UBA announcement dated 22 February 2017
(Software changes)

**Renewal of certificates**
Certificate No. 0000040204_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 17
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 21
UBA announcement dated 24 February 2020
(Software changes)

**Renewal of certificates**
Certificate No. 0000040204_02: 27 June 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 11
UBA announcement dated 31 March 2021
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 20 August 2021
Publication: BAnz AT 11.04.2022 B10, chapter VI notification 5
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 59
UBA announcement dated 21 February 2023
(Software changes)

Statement issued by TÜV Rheinland Energy & Environment GmbH dated 15 December 2023
Publication: BAnz AT 10.05.2024 B7, chapter V notification 45
UBA announcement dated 19 March 2024
(Software changes)

**Renewal of certificates**

| | |
|---|---|
| Certificate No. 0000040204_03: | 27 June 2025 |
| Expiry date of the certificate: | 30 June 2030 |

## Expanded uncertainty laboratory, system 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 $H_2O$ 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 | $u_{int,pos}$ or $u_{int,neg}$ | 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 | | | |
| | | ≤ | 5.0 nmol/mol (Span) | 0.800 | | | |
| 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 | $u_{ssc}$ | -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 laboratory, system 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 $H_2O$ 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 | $u_{int,pos}$ | 0.38 | 0.1434 |
| | | ≤ | 5.0 nmol/mol (Span) | 0.430 | or | | |
| 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 % |

## Combined uncertainty, laboratory and field, system 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 $\sqrt{2}*u_{r,lh} = 0,01 < u_{r,f}$ | - | |
| 3 | "lack of fit" at 1h-limit value | ≤ | 4.0% of measured value | 0.720 | $u_{l,h}$ | 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 $H_2O$ 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 | $u_{int,pos}$ or $u_{int,neg}$ | 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 | | | | |
| | | ≤ | 5.0 nmol/mol (Span) | 0.800 | | | | |
| 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 | $u_{d,l,h}$ | 1.52 | 2.2977 | |
| 18 | Difference sample/calibration port | ≤ | 1.0% | -0.260 | $u_{dsc}$ | -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 | % |

## Combined uncertainty, laboratory and field, system 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 | $u_{lh}$ | 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 | $u_{d,lz}$ | 0.33 | 0.1121 |
| 12 | Long term drift at span level | ≤ | 5.0% of max. of certification range | | 2.550 | $u_{d,lh}$ | 1.54 | 2.3715 |
| 18 | Difference sample/calibration port | ≤ | 1.0% | | 0.230 | $u_{sso}$ | 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 | $u_{tg}$ | 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 % |