

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040328_01

Certified AMS: AC32M for NO, NO₂ and NO_x

Manufacturer: Environnement S.A.
111 Boulevard Robespierre
78304 Poissy Cedex
France

Test Institute: TÜV Rheinland Energy GmbH

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

**VDI 4202-1: 2002, VDI 4203-2: 2004, EN 14211: 2012,
EN 15267-1: 2009, 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 0000040328 of 29 April 2014.

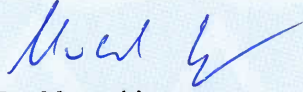


Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance

www.tuv.com
ID 0000040328

Publication in the German Federal Gazette
(BAnz.) of 20 April 2007

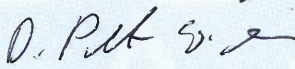
German Federal Environment Agency
Dessau, 1 April 2019



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.enviro-tuv.eu
tre@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:

0000040328_01 / 1 April 2019

Test report:

936/21205818/A of 08 December 2006
Addendum 936/21221709/A of 28 September 2013

Initial certification:

01 April 2014

Date of expiry:

30 June 2020

Publication:

BAnz AT 01 April 2014 B12, chapter VI, notification 18

Approved application

The certified AMS is suitable for continuous monitoring of NO, NO₂ and NO_x 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 936/21205818/A of 08 December 2006 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and Addendum 936/21221709/A of 28 September 2013 of TÜV Rheinland Energie und Umwelt GmbH
- suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- the on-going surveillance of the product and the manufacturing process

AMS designation:

AC32M for NO, NO₂ and NO_x

Manufacturer:

Environnement S.A., Poissy Cedex, France and Ansyco GmbH Karlsruhe, Germany

Field of application:

For continuous monitoring of NO, NO₂ und NO_x in ambient air (stationary operation).

Measuring ranges during the performance test:

NO₂ 0 - 400 µg/m³
NO₂ 0 - 500 µg/m³
NO 0 - 1200 µg/m³

Software version:

V2.45

Testing institute:

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
TÜV Rheinland Group
Report No.: 936/21205818/A of 8 December 2006

**Notification of announcement by the German Federal Environment Agency dated
12th April 2007 (BAnz. p. 4139, Chapter III Number 4.1)**

The measuring system AC32M for NO, NO₂ and NO_x manufactured by Environnement fulfils the requirements of DIN EN 14211 (November 2012). Furthermore, the manufacturing process and quality management system of the measuring system AC32M for NO, NO₂ and NO_x fulfill the requirements of EN 15267.

The test report of the performance test with report number 936/21205818/A and an addendum as an integral part of to the test report with report number 936/21221709/A can be viewed on the internet at www.qal1.de.

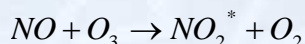
Statement by TÜV Rheinland Energie und Umwelt GmbH dated 28th September 2013

Certified product

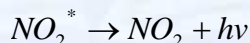
This certificate applies to automated measurement systems conforming to the following description:

The analyser AC32M measures nitrogen oxide (NO) and nitrogen dioxide (NO₂) in ambient air. The measuring principle is based on the light emission from the chemical reaction between NO and ozone in the reaction chamber, the so called chemiluminescence.

The chemiluminescence represents the oxidation of NO molecules by ozone molecules to NO₂* molecules.



The return of the excited NO₂* molecules to a basic electronic condition is performed using light radiation in a spectrum of 600 to 1200 nanometres:



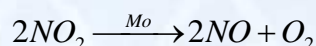
This energy can be lost (quenching) in the sample due to a collision with certain molecules, in particular H₂O and CO₂. A reduction of the temperature in the reaction chamber to approx. 200 mbar and the drying of the sample using a Perma Pure dryer reduces the likelihood of a collision which means a greater light yield and thus detection limit can be achieved.

The ozone required is generated in an internal ozone generator using stationary electrical charging in a cylindrical capacitor.

The reaction chamber is separated from the sensor by an optical red filter which only allows light beams with a wavelength of over 610 nanometres to pass through and thus suppresses the inferences caused by the hydrocarbons.

Radiation measurement is performed using a photomultiplier (PM). The electrical signal it provides is magnified and digitalized for processing by the microprocessor.

In order to be measured by chemiluminescence the NO₂ must first be converted to NO. A hot molybdenum converter is used to perform this reduction according to the following reaction equation:



The sample is sucked in by a vacuum pump at the entry to the system which provides the vacuum in the reaction chamber and the Perma Pure dryer blowback.

The measurement comprises 3 cycles:

- **Reference cycle:** The sample is fed into a pre-reaction chamber (tube section) where it is mixed with ozone. The NO in the sample is oxidised into NO₂ before it flows into the reaction chamber. The signal measured by the PM without chemiluminescence can be considered a measurement with zero air and serves as a reference signal or zero signal.
- **NO cycle:** The sample is fed directly into the measuring chamber in which the NO molecules are oxidised with ozone. The signal measured by the PM is proportional to the number of NO molecules present in the sample.
- **NO_x cycle:** The sample is fed through the NO₂ converter and then mixed with ozone in the reaction chamber. The signal measured by the PM is proportional to the total number of NO and NO₂ molecules in the sample, the latter originating from the reduction of NO₂. The sum of NO + NO₂ is referred to as NO_x.

The measuring principle complies with the standard reference method stipulated in EN 14211.

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 Model AC32M for NO, NO₂ and NO_x is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial test:

Test report: 936/21205818/A of 08 December 2006
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 20 April 2007, No. 75, p. 4139, chapter III, No. 4.1
Announcement by UBA from 12 April 2007

Initial certification according to EN 15267:

Certificate No. 0000040328: 29 April 2014
Expiration date of the certificate: 31 March 2019

Test report: 936/21205818/A of 08 December 2006
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Addendum 936/21221709/A of 28 September 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 18
Announcement by UBA from 27 February 2014

Notification:

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 18
Announcement by UBA from 27 February 2014

Renewal of the certificate according to EN 15267:

Certificate No. 0000040328_01: 1 April 2019
Expiration date of the certificate: 30 June 2020

Calculation of overall uncertainty lab test (Device 1)

Measuring device:		Serial-No.:		Gerät 1	
Measured component:		1h-limit value:		104.6	
Environment AC32M		NO ₂		nmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.610	U _{r,z} 0.10	0.0101
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	2.260	U _{r,1h} 0.08	0.0059
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.300	U _{l,1h} 0.18	0.0328
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.250	U _{gp} 0.57	0.3205
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	-0.060	U _{gt} -0.14	0.0205
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.200	U _{st} 0.52	0.2679
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.086	U _v 0.26	0.0684
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	2.300 1.700	U _{H2O} 1.62	2.6327
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.700 2.000	U _{int,pos} 0.86	0.7313
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.300 1.300	U _{int,neg}	
9	Averaging effect	≤ 7.0% of measured value	1.900	U _{av} 1.15	1.3166
18	Difference sample/calibration port	≤ 1.0%	0.000	U _{ssc} 0.00	0.0000
21	Converter efficiency	≥ 98	98.40	U _{EC} 1.67	2.8009
23	Uncertainty of test gas	≤ 3.0%	2.000	U _{cg} 1.05	1.0941
Combined standard uncertainty				u _c	3.0525
Expanded uncertainty				U	6.1051
Relative expanded uncertainty				W	5.84
Maximum allowed expanded uncertainty				W _{req}	15

Calculation of overall uncertainty lab test (Device 2)

Measuring device:		Environment AC32M		Serial-No.:		Gerät 2	
Measured component:		NO ₂		1h-limit value:		104.6	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty	nmol/mol	
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.640	u _{r,z} 0.11	0.0121		
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	2.700	u _{r,h} 0.10	0.0092		
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.300	u _{l,h} 0.18	0.0328		
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.200	u _{gp} 0.45	0.2051		
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.060	u _{gt} 0.14	0.0205		
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.200	u _{st} 0.52	0.2679		
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	-0.029	u _v -0.09	0.0078		
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	0.000 0.000	u _{H2O} 1.21	1.4546		
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.300 0.000	u _{int,pos} 0.94 or	0.8758		
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	1.300 1.700	u _{int,neg}			
9	Averaging effect	≤ 7.0% of measured value	0.400	u _{av} 0.24	0.0584		
18	Difference sample/calibration port	≤ 1.0%	0.000	u _{asc} 0.00	0.0000		
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	2.3738	nmol/mol	
Expanded uncertainty				U	4.7477	nmol/mol	
Relative expanded uncertainty				W	4.54	%	
Maximum allowed expanded uncertainty				W _{req}	15	%	

Calculation of overall uncertainty lab and field test (Device 1)

Measuring device:		Serial-No.:		Gerät 1	
Measured component:		1h-limit value:		104.6	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.610	U _{r,z}	0.0101
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	2.260	U _{r,1h}	-
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.300	U _{l,1h}	0.0328
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 8.0 nmol/mol/kPa	0.250	U _{gp}	0.3205
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 3.0 nmol/mol/K	-0.060	U _{gt}	0.0205
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 3.0 nmol/mol/K	0.200	U _{st}	0.2679
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.086	U _v	0.0684
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero) ≤ 10 nmol/mol (Span)	2.300 1.700	U _{H2O}	2.6327
8b	Interferent CO ₂ with 500 µmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.700 2.000	U _{int,pos} or	0.7313
8c	Interferent NH ₃ mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero) ≤ 5.0 nmol/mol (Span)	0.300 1.300	U _{int,neg}	
9	Averaging effect	≤ 7.0% of measured value	1.900	U _{av}	1.3166
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	4.890	U _{r,f}	26.1626
11	Long term drift at zero level	≤ 5.0 nmol/mol	-0.590	U _{d,l,z}	0.1160
12	Long term drift at span level	≤ 5.0% of max. of certification range	0.790	U _{d,l,h}	0.2276
18	Difference sample/calibration port	≤ 1.0%	0.000	U _{ssc}	0.0000
21	Converter efficiency	≥ 98	98.400	U _{EC}	2.8009
23	Uncertainty of test gas	≤ 3.0%	2.000	U _{cg}	1.0941
Combined standard uncertainty				U _c	5.9843
Expanded standard uncertainty				U	11.9687
Relative expanded uncertainty				W	11.44
Maximum allowed expanded uncertainty				W _{req}	15

Calculation of overall uncertainty lab and field test (Device 2)

Measuring device:		Serial-No.:		Gerät 2	
Environment: AC32M		1h-limit value:		104.6	
Measured component: NO ₂		Performance criterion		Square of partial uncertainty	
No.	Performance characteristic	Result	Partial uncertainty	nmol/mol	
1	Repeatability standard deviation at zero	0.640	U _{r,z}	0.11	0.0121
2	Repeatability standard deviation at 1h-limit value	2.700	U _{r,1h}	not considered, as $\sqrt{2} \cdot u_{r,1h} = 0.13 < u_{r,f}$	-
3	"lack of fit" at 1h-limit value	0.300	U _{f,1h}	0.18	0.0328
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	0.200	U _{gp}	0.45	0.2051
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	0.060	U _{gt}	0.14	0.0205
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	0.200	U _{st}	0.52	0.2679
7	Sensitivity coefficient of electrical voltage at 1h-limit value	-0.029	U _v	-0.09	0.0078
8a	Interferent H ₂ O with 21 mmol/mol	1.700	U _{H2O}	1.21	1.4546
8b	Interferent CO ₂ with 500 µmol/mol	0.300	U _{CO2,pos}		
8c	Interferent NH ₃ mit 200 nmol/mol	1.300	U _{NH3,neg}	0.94	0.8758
9	Averaging effect	0.400	U _{av}	0.24	0.0584
10	Reproducibility standard deviation under field conditions	4.890	U _{r,f}	5.11	26.1626
11	Long term drift at zero level	0.780	U _{gl,z}	0.45	0.2028
12	Long term drift at span level	0.660	U _{gl,1h}	0.40	0.1589
18	Difference sample/calibration port	0.000	U _{ASC}	0.00	0.0000
21	Converter efficiency	98.800	U _{EC}	1.26	1.5755
23	Uncertainty of test gas	2.000	U _{cg}	1.05	1.0941
		Combined standard uncertainty		u _c	5.6693
		Expanded uncertainty		U	11.3386
		Relative expanded uncertainty		W	10.84
		Maximum allowed expanded uncertainty		W _{req}	15