Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040328_01

Certified AMS:	AC32M for NO, NO_2 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.

TÜVRheinland® CERTIFIED

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

This certificate will expire on:
30 June 2020

German Federal Environment Agency
Dessau, 1 April 2019

Dr. Marcel Langner
Head of Section II 4.1

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.	

10/221 2.08

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, NO_2 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, NO_2 and NO_x

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

Field of application:
For continuous monitoring of NO, NO_2 und NO_x in ambient air (stationary operation).

Measuring ranges during the performance test:

NO_2	0 - 400 µg/m³
NO_2	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, NO_2 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, NO_2 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 (NO_2) 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 NO_2 * molecules.

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

The return of the excited NO_2* molecules to a basic electronic condition is performed using light radiation in a spectrum of 600 to 1200 nanometres:

$$NO_2^* \rightarrow NO_2 + h\nu$$

This energy can be lost (quenching) in the sample due to a collision with certain molecules, in particular H_2O and CO_2. 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 NO_2 must first be converted to NO. A hot molybdenum converter is used to perform this reduction according to the following reaction equation:

$$2NO_2 \xrightarrow{Mo} 2NO + O_2$$

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 NO_2 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 NO_2 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 NO_2 molecules in the sample, the latter originating from the reduction of NO_2. The sum of NO + NO_2 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, NO_2 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:	Environnement AC32M		Serial-No.:		Gerät 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	0.610	$u_{r,z}$	0.10	0.0101	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	2.260	$u_{r,lh}$	0.08	0.0059	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0.300	$u_{l,lh}$	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_2O with 21 mmol/mol	≤	10 nmol/mol (Zero)	2.300	u_{H2O}	1.62	2.6327	
		≤	10 nmol/mol (Span)	1.700				
8b	Interferent CO_2 with 500 µmol/mol	≤	5.0 nmol/mol (Zero)	0.700	$u_{int,pos}$	0.86	0.7313	
		≤	5.0 nmol/mol (Span)	2.000	or			
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0.300				
		≤	5.0 nmol/mol (Span)	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	$u_{\Delta sc}$	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	nmol/mol
			Expanded uncertainty			U	6.1051	nmol/mol
			Relative expanded uncertainty			W	5.84	%
			Maximum allowed expanded uncertainty			W_{req}	15	%

Calculation of overall uncertainty lab test (Device 2)

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Measuring device:	Environnement AC32M				Serial-No.:	Gerät 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	0.640	$u_{r,z}$	0.11	0.0121	
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	2.700	$u_{r,lh}$	0.10	0.0092	
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.300	$u_{l,lh}$	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_20 with 21 mmol/mol	≤ 10 nmol/mol (Zero)	0.000	u_{H2O}	1.21	1.4546	
		≤ 10 nmol/mol (Span)	0.000				
8b	Interferent CO_2 with 500 µmol/mol	≤ 5.0 nmol/mol (Zero)	0.300	$u_{int,pos}$	0.94	0.8758	
		≤ 5.0 nmol/mol (Span)	0.000	or			
8c	Interferent NH_3 mit 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	1.300				
		≤ 5.0 nmol/mol (Span)	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	$u_{\Delta sc}$	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	%

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

Measuring device:	Environnement AC32M				Serial-No.:		Gerät 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	0.610	$u_{r,z}$	0.10	0.0101	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	2.260	$u_{r,lh}$	not considered, as √2*ur,lh = 0.1 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0.300	$u_{l,lh}$	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_20 with 21 mmol/mol	≤	10 nmol/mol (Zero)	2.300	u_{H2O}	1.62	2.6327	
		≤	10 nmol/mol (Span)	1.700				
8b	Interferent CO_2 with 500 µmol/mol	≤	5.0 nmol/mol (Zero)	0.700	$u_{int,pos}$ or $u_{int,neg}$	0.86	0.7313	
		≤	5.0 nmol/mol (Span)	2.000				
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0.300				
		≤	5.0 nmol/mol (Span)	1.300				
9	Averaging effect	≤	7.0% of measured value	1.900	u_{av}	1.15	1.3166	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	4.890	$u_{r,f}$	5.11	26.1626	
11	Long term drift at zero level	≤	5.0 nmol/mol	-0.590	$u_{d,l,z}$	-0.34	0.1160	
12	Long term drift at span level	≤	5.0% of max. of certification range	0.790	$u_{d,l,lh}$	0.48	0.2276	
18	Difference sample/calibration port	≤	1.0%	0.000	$u_{\Delta sc}$	0.00	0.0000	
21	Converter efficiency	≥	98	98.400	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	5.9843	nmol/mol
			Expanded uncertainty			U	11.9687	nmol/mol
			Relative expanded uncertainty			W	11.44	%
			Maximum allowed expanded uncertainty			W_{req}	15	%

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

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Measuring device:	Environnement AC32M			Serial-No.:	Gerät 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	0.640	$u_{r,z}$	0.11	0.0121	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	2.700	$u_{r,lh}$	not considered, as √2*ur,lh = 0.13 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0.300	$u_{l,lh}$	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_20 with 21 mmol/mol	≤	10 nmol/mol (Zero)	1.700	u_{H2O}	1.21	1.4546	
		≤	10 nmol/mol (Span)	1.300				
8b	Interferent CO_2 with 500 µmol/mol	≤	5.0 nmol/mol (Zero)	0.300	$u_{int,pos}$	0.94	0.8758	
		≤	5.0 nmol/mol (Span)	0.000				
8c	Interferent NH_3 mit 200 nmol/mol	≤	5.0 nmol/mol (Zero)	1.300	or			
		≤	5.0 nmol/mol (Span)	1.700	$u_{int,neg}$			
9	Averaging effect	≤	7.0% of measured value	0.400	u_{av}	0.24	0.0584	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	4.890	$u_{r,f}$	5.11	26.1626	
11	Long term drift at zero level	≤	5.0 nmol/mol	0.780	$u_{d,l,z}$	0.45	0.2028	
12	Long term drift at span level	≤	5.0% of max. of certification range	0.660	$u_{d,l,lh}$	0.40	0.1589	
18	Difference sample/calibration port	≤	1.0%	0.000	$u_{\Delta sc}$	0.00	0.0000	
21	Converter efficiency	≥	98	98.800	u_{EC}	1.26	1.5755	
23	Uncertainty of test gas	≤	3.0%	2.000	u_{cg}	1.05	1.0941	

Combined standard uncertainty	u_c	5.6693	nmol/mol
Expanded uncertainty	U	11.3386	nmol/mol
Relative expanded uncertainty	W	10.84	%
Maximum allowed expanded uncertainty	W_{req}	15	%

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