

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040329

Certified AMS: AF22M for SO₂

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

Test Institute: TÜV Rheinland Energie und Umwelt 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 14212: 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).



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

www.tuv.com
ID 0000040329

Publication in the German Federal Gazette
(BAnz.) of 07 March 2008

This certificate will expire on:
31 March 2019

German Federal Environment Agency
Dessau, 29 April 2014

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 28 April 2014



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Am Grauen Stein
51105 Cologne

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

Certificate:
0000040329 / 29 April 2014

Test report: 936/21206773/A of 09 November 2007
Addendum 936/21221709/B of 28 September 2013

Initial certification: 01 April 2014

Date of expiry: 31 March 2019

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 19

Approved application

The certified AMS is suitable for continuous monitoring of sulphur dioxide in ambient air.

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 936/21206773/A of 09 November 2007 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and Addendum 936/21221709/B 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
- publication in the German Federal Gazette (BAnz. 07 March 2008, No. 38, p. 901, chapter III, No. 1.1, UBA publication from 14 February 2008)
- publication in the German Federal Gazette (BAnz AT 01 April 2014 B12, chapter VI, notification 19, UBA publication from 27 February 2014)

AMS designation:

AF22M for SO₂

Manufacturer:

Environnement S.A., Poissy Cedex, France
Distribution in Germany:
Ansyco GmbH, Karlsruhe

Field of application:

For continuous monitoring of sulphur dioxide in ambient air.

Measuring ranges during the performance test:

SO₂ 0 - 700 µg/m³
0 - 1000 µg/m³

Software version:

V1.22

Testing institute:

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
TÜV Rheinland Group
Report No.: 936/21206773/A of 9 November 2007

Notification of announcement by the German Federal Environment Agency dated 14th February 2008 (BAnz. p. 901, Chapter III Number 1.1)

The measuring system AF22M for SO₂ manufactured by Environnement fulfils the requirements of EN 14212 (November 2012). Furthermore, the manufacturing process and quality management system of the measuring system AF22M for SO₂ fulfil the requirements of EN 15267.

The test report of the performance test with report number 936/21206773/A and an addendum as an integral part of to the test report with report number 936/21221709/B 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 sample is taken by a Teflon tube connected to the back of the monitor through a pump placed at the end of the circuit. A Teflon filter provides dust protection.

The sample to be analyzed is firstly filtered by an elimination device of aromatic hydrocarbon molecule. This device consists of two concentric tubes. The internal tube is made of a special polymer. The sample to be analyzed with aromatic HC molecules comes in the internal tube. Aromatic HC molecules are transferred by permeation to the external tube with effect that the transfer is done in the direction: more HC molecules in gas to few HC molecules in gas. The pump creates a vacuum in the external tube, the partial pressure of aromatic compounds decreases due to activated charcoal filtration and molecules are evacuated to the outside of the internal tube.

The sample to be analyzed, exempt from HC molecules, is directed to a reaction chamber in which it is irradiated by an ultraviolet radiation centered at 214 nm, the absorption wavelength of SO₂ molecules. A photodiode measures the ultraviolet radiation generated by the UV lamp, through a mirror. This measurement is used during signal processing in order to compensate for any variation of the UV energy.

Molecules restore a specific fluorescence in the ultraviolet, which is optically filtered between 300 and 400 nm at the outlet in order to eliminate some interfering gases. This fluorescence is visualized by the PM tube placed near the reaction chamber.

At the start of each „zero-ref“, a shutter is placed between the UV lamp and the reaction chamber inlet for 40 seconds. This electrical zero corresponds to the PM tube darkness current and the offset voltage of the preamplifier, incorporated into the signal processing, it eliminates the possibility of drifts with temperature and time.

Then PM tube signal is amplified and is converted into digital values for processing by a microprocessor that calculates the average of measurement values, checks the alarms and carries out monitor operation diagnosis. These various values and information are displayed on an alphanumeric display unit on the monitor front panel.

The analyser AF22M measures sulphur dioxide (SO₂) in ambient air. The measuring principle is based on UV fluorescence.

The intensity of the radiation absorbed by the sulphur dioxide in the interior of an optical chamber with length L follows the principle of the Beer-Lambert law:

$$i_a = i_0 \times (1 - e^{-\alpha L c})$$

whereby “*i*₀” is the intensity at the entry to the chamber, “*α*” the characteristic absorption efficiency for SO₂ and “*c*” = [SO₂], the concentration of the gas to be analysed.

The probability that an excited molecule fluoresces is also expressed by the following formula:

$$\frac{K_f}{K_f + K_q + K_d}$$

The intensity of the fluorescence received by the photomultiplier (PM) is thus expressed as follows:

$$i_f = G i_a \frac{K_f}{K_f + K_q + K_d}$$

whereby G is a constant which is dependent on the illuminated proportion of the chamber measured by the PM. Thus:

$$i_f = G i_0 \frac{K_f}{K_f + K_q + K_d} \times (1 - e^{-\alpha L c})$$

In this case, $\alpha L c \ll 1$ and $1 - e^{-\alpha L c}$ can be developed in the first order as follows:

$$1 - e^{-\alpha L c} \cong +\alpha L c$$

The result is thus::

$$i_f = \frac{G i_0 K_f \alpha L}{K_f + K_q + K_d} c = \beta \cdot c$$

The radiation absorbed by the PM is thus directly proportional to SO₂ concentration.

The measuring principle complies with the standard reference method as stipulated in EN 14212.

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 Energie und Umwelt 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 Energie und Umwelt GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energie und Umwelt 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 AF22M for SO₂ is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial test:

Test report: 936/21206773/A of 9 November 2007
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Publication: BAnz. 07 March 2008, No. 38, p. 901, chapter III, No. 1.1
Announcement by UBA from 14 February 2008

Initial certification according to EN 15267:

Certificate No. 0000040329: 29 April 2014

Expiration date of the certificate: 31 March 2019

Test report: 936/21206773/A of 9 November 2007
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Addendum 936/21221709/B of 28 September 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 19
Announcement by UBA from 27 February 2014

Notification:

Publication: BAnz AT 01 April 2014 B12, chapter VI, notification 19
Announcement by UBA from 27 February 2014

Calculation of overall uncertainty lab test (Device 1)

Measuring device: Environnement AF22M		Serial-No.: Gerät 1		nmol/mol	
Measured component: SO ₂		1h-limit value: 132			
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.000	U _{r,z}	0.0000
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.200	U _{r,1h}	0.0026
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-1.500	U _{l,1h}	1.3068
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	-0.140	U _{gp}	1.1384
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.023	U _{gt}	0.0307
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.310	U _{st}	5.5815
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	-0.010	U _v	0.0094
8a	Interferent H ₂ O with 21 mmol/mol	≤ 10 nmol/mol (Zero)	-0.300	U _{H2O}	2.0624
8b	Interferent H ₂ S with 200 nmol/mol	≤ 10 nmol/mol (Span)	-1.900	U _{int,pos}	
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.300		
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Span)	0.300		
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000		
8f	Interferent m-Xylene with 1 µmol/mol	≤ 5.0 nmol/mol (Span)	-0.400		
9	Averaging effect	≤ 5.0 nmol/mol (Zero)	0.400	or	1.8013
18	Difference sample/calibration port	≤ 5.0 nmol/mol (Span)	1.200		
21	Uncertainty of test gas	≤ 10 nmol/mol (Zero)	0.000	U _{int,neg}	
		≤ 7.0% of measured value	1.800	U _{av}	1.8818
		≤ 1.0%	0.190	U _{asc}	0.0629
		≤ 3.0%	2.000	U _{cg}	1.7424
		Combined standard uncertainty		u _c	3.9522
		Expanded uncertainty		U	7.9045
		Relative expanded uncertainty		W	5.99
		Maximum allowed expanded uncertainty		W _{req}	15

Calculation of overall uncertainty lab test (Device 2)

Measuring device: Environnement AF22M		Serial-No.: Gerät 2		nmol/mol	
Measured component: SO ₂		1h-limit value: 132			
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.000	U _{r,z}	0.0000
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.200	U _{r,h}	0.0027
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.100	U _{l,h}	0.0058
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.250	U _{gp}	3.6300
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.012	U _{gt}	0.0084
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.340	U _{st}	6.7140
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.010	U _v	0.0094
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	-0.100	U _{H2O}	3.0327
8b	Interferent H ₂ S with 200 nmol/mol	≤ 10 nmol/mol (Span)	-2.300	U _{int,pos}	
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000		
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Span)	1.200		
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000		
8f	Interferent m-Xylene with 1 µmol/mol	≤ 5.0 nmol/mol (Span)	0.500	or	5.7600
9	Averaging effect	≤ 7.0% of measured value	2.900	U _{int,neg}	
18	Difference sample/calibration port	≤ 1.0%	0.010	U _{av}	4.8845
21	Uncertainty of test gas	≤ 3.0%	2.000	U _{ssc}	0.0002
				U _{cg}	1.7424
				u _c	5.0784
				U	10.1568
				W	7.69
				W _{req}	15
					nmol/mol
					nmol/mol
					%
					%

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

Measuring device:		Environment: AF22M		Serial No.:		Gerät 1	
Measured component:		SO ₂		1h-limit value:		132	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty	nmol/mol	
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.000	u _{r,z}	0.000		
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.200	u _{r,h}	not considered, as u _{r,h} = 0.05 < u _{r,f}		
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	-1.500	u _{l,h}	-1.14	1.3068	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	-0.140	u _{gp}	-1.07	1.1384	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.023	u _{gt}	-0.18	0.0307	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.310	u _{st}	2.36	5.5815	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	-0.010	u _v	-0.10	0.0094	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	-0.300				
		≤ 10 nmol/mol (Span)	-1.900				
8b	Interferent H ₂ S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.300	u _{H2O}	-1.44	2.0624	
		≤ 5.0 nmol/mol (Span)	0.300	u _{int,pos}			
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000				
		≤ 5.0 nmol/mol (Span)	-0.400				
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.400				
		≤ 5.0 nmol/mol (Span)	1.200				
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000				
		≤ 5.0 nmol/mol (Span)	0.700				
8f	Interferent m-Xylene with 1 µmol/mol	≤ 10 nmol/mol (Zero)	0.000				
		≤ 10 nmol/mol (Span)	0.100	u _{int,neg}			
9	Averaging effect	≤ 7.0% of measured value	1.800	u _{av}	1.37	1.8818	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	2.240	u _{r,f}	2.96	8.7427	
11	Long term drift at zero level	≤ 4.0 nmol/mol	-0.610	u _{d,l,z}	-0.35	0.1240	
12	Long term drift at span level	≤ 5.0% of max. of certification range	-0.940	u _{d,l,h}	-0.72	0.5132	
18	Difference sample/calibration port	≤ 1.0%	0.190	u _{asc}	0.25	0.0629	
21	Uncertainty of test gas	≤ 3.0%	2.000	u _{cg}	1.32	1.7424	
Expanded standard uncertainty				u _e	4.9997	nmol/mol	
Relative expanded uncertainty				U	9.9995	%	
Maximum allowed expanded uncertainty				W _{reg}	7.58	%	

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

Measuring device: Environnement AF22M		Serial-No.: Gerät 2		1h-limit value: 132		nmol/mol	
Measured component: SO ₂		1h-limit value:		132		nmol/mol	
No.	Performance characteristic	Performance criterion	Result	Partial uncertainty	Square of partial uncertainty		
1	Repeatability standard deviation at zero	≤ 1.0 nmol/mol	0.000	U _{r,z}	0.000		
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0.200	U _{r,1h}	not considered, as $u_{r,1h} = 0.05 < u_{r,f}$		
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0.100	U _{f,1h}	0.08	0.0058	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0.250	U _{gp}	1.91	3.6300	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	-0.012	U _{gt}	-0.09	0.0084	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0.340	U _{st}	2.59	6.7140	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0.010	U _v	0.10	0.0094	
8a	Interferent H ₂ O with 21 nmol/mol	≤ 10 nmol/mol (Zero)	-0.100				
		≤ 10 nmol/mol (Span)	-2.300	U _{H2O}	-1.74	3.0327	
8b	Interferent H ₂ S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000				
		≤ 5.0 nmol/mol (Span)	1.200	U _{H2S,pos}			
8c	Interferent NH ₃ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000				
		≤ 5.0 nmol/mol (Span)	0.500				
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.500				
		≤ 5.0 nmol/mol (Span)	1.900	or	2.40	5.7600	
8e	Interferent NO ₂ with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0.000				
		≤ 5.0 nmol/mol (Span)	-0.100				
8f	Interferent m-Xylene with 1 µmol/mol	≤ 10 nmol/mol (Span)	0.500	U _{int,neg}			
9	Averaging effect	≤ 7.0% of measured value	2.900	U _{av}	2.21	4.8845	
10	Reproducibility standard deviation under field conditions	≤ 5.0% of average over 3 months	2.240	U _{r,f}	2.96	8.7427	
11	Long term drift at zero level	≤ 4.0 nmol/mol	-0.690	U _{d,l,z}	-0.40	0.1587	
12	Long term drift at span level	≤ 5.0% of max. of certification range	2.460	U _{d,l,h}	1.87	3.5148	
18	Difference sample/calibration port	≤ 1.0%	0.010	U _{asc}	0.01	0.0002	
21	Uncertainty of test gas	≤ 3.0%	2.000	U _{eg}	1.32	1.7424	
Combined standard uncertainty						U _c	6.1809
Expanded uncertainty						U	12.3618
Relative expanded uncertainty						W	9.37
Maximum allowed expanded uncertainty						W _{req}	15