Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000051690_03

Certified AMS:	AF22e for SO_2
Manufacturer:	ENVEA 111, Boulevard Robespierre 78304 Poissy Cedex France
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 14212 (2012), EN 14212 (2024) 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 13 pages).
The present certificate replaces certificate 0000051690_02 dated 29 July 2022.

TÜVRheinland® CERTIFIED
Suitability Tested
Complying with 2008/50/EC
EN 15267
Regular Surveillance
www.tuv.com
ID 0000051690

Publication in the German Federal Gazette (BAnz) of 1 August 2016

German Environment Agency

Dessau, 23 March 2025

This certificate will expire on:
22 March 2031

TÜV Rheinland
Energy & Environment GmbH
Cologne, 20 March 2026

Dr. Marcel Langner
Head of Section II 4

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TÜV Rheinland Energy & Environment GmbH
Am Grauen Stein
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:	936/21228317/C dated 18 December 2015 and Addendum EuL/21264142/A_V1 dated 7 February 2025
Initial certification:	1 August 2016
Expiry date:	22 March 2031
Publication:	BAnz AT 01.08.2016 B11, chapter III No. 2.1 and BAnz AT 31.10.2025 B5, chapter IV notification 36

Approved application

The tested AMS is suitable for continuous immission measurement of SO_2 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 at a location close to transport links.

The AMS is approved for an ambient temperature range of +0 °C to +40 °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 936/21228317/C dated 18 December 2015 of TÜV Rheinland Energie und Umwelt GmbH and Addendum EuL/21264142/A_V1 dated 7 February 2025 of TÜV Rheinland Energy & Environment 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 01.08.2016 B11, chapter III No. 2.1, Announcement by UBA dated 14 July 2016:

AMS designation:
AF 22e for SO_2

Manufacturer:
Environnement S.A., Poissy, France

Field of application:
For continuous monitoring of SO_2 in ambient air (stationary operation)

Measuring ranges during the performance test:

Component	Certification range	Unit
SO_2	0 – 1000	µg/m³

Software version:
Firmware: 1.0.a

Restrictions:
None

Notes:
1. The performance test also includes the Version AF 22e* instrument version without integrated display. In this case, the measured value is displayed via a PC or laptop belonging to the measuring device.
2. The report on the performance test is available online at www.qal1.de.

Test Report:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21228317/C dated 18 December 2015

Publication in the German Federal Gazette: BAnz AT 28.07.2022 B4, chap. IV notification 11, Announcement by UBA dated 28 June 2022

52 Notification as regards Federal Environment Agency (UBA) notices of 14 July 2016 (BAnz AT 01.08.2016, chapter III number 2.1) and of 9 March 2021 (BAnz AT 11.04.2022 B10, chapter III notification 20)

The AF22e*/AF22e measuring device for SO_2 from ENVEA also meets the requirements of the DIN EN 14212 (2012) and VDI 4202-1 (2018) standards.

Statement issued by TÜV Rheinland Energy GmbH dated 18 March 2022

Publication in the German Federal Gazette: BAnz AT 20.03.2023 B6, chap. IV notification 65, Announcement by UBA dated 21 February 2023

65 Notification as regards Federal Environment Agency (UBA) notices of 14 July 2016 (BAnz AT 01.08.2016 B11, chapter III number 2.1) and of 9 March 2022 (BAnz AT 11.04.2022 B10, chapter VI notification 11)

The current software version of the AF22e*/AF22e for SO_2 from ENVEA is:

v1.1.e

Furthermore, the software versions v1.1.c and v1.1.d can be used.

Statement issued by TÜV Rheinland Energy GmbH dated 9 September 2022

Publication in the German Federal Gazette: BAnz AT 19.05.2025 B3, chap. IV notification 90, Announcement by UBA dated 21 February 2023

90 Notification as regards Federal Environment Agency (UBA) notices of 14 July 2016 (BAnz AT 01.08.2016 B11, chapter III number 2.1) and of 21 February 2023 (BAnz AT 20.03.2023 B6, chapter IV notification 65)

The current software version for the AF22e*/AF22e measuring system for SO_2 from ENVEA is
v1.2.b

Software version v1.2.a can also be used. The measuring system can be equipped with a revised version of the ARM20 board.

Statement issued by TÜV Rheinland Energy & Environment GmbH dated 4 October 2024

The basis for this certificate is the publication of the following announcement:

Publication in the German Federal Gazette: BAnz AT 31.10.2025 B5, chap. IV notification 36, Announcement by UBA dated 27 August 2025

36 Notification as regards Federal Environment Agency (UBA) notices of 14 July 2016 (BAnz AT 01.08.2016 B11, Chapter III Number 2.1) and of 2 April 2025 (BAnz AT 19.05.2025 B3, Chapter IV, notification 90)

The current software version for the AF22e*/AF22e measuring system for SO_2 from ENVEA is:
v1.3.a

From software version v1.3.a, the measuring system fulfils the requirements of EN 14212 (2024 version).

An addendum to the test report with the report number EuL/21264142/A_V1 can be viewed on the internet at www.qal1.de.

Statement issued by TÜV Rheinland Energy & Environment GmbH dated 20 May 2025

Certified product

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

The measuring principle of the AF22e is based on the principle of UV fluorescence.

Sampling is done by a pump at the end of the circuit via a Teflon tube attached to the back of the unit. A Teflon filter provides protection from dust.

The sample to be analysed is first passed through a carbon kicker, which removes the aromatic hydrocarbons it contains. The carbon kicker consists of two concentric tubes with the inner tube made of a special polymer.

The sample to be analysed, which contains aromatic hydrocarbons, is fed in via the inner tube. The aromatic hydrocarbon molecules reach the external tube, which is flushed with a zero air, by permeation. The hydrocarbon-free sample is then passed into a reaction chamber where it is irradiated with ultraviolet light (centred on 214 nm). The wavelength of 214 nm corresponds to the absorption wavelength of SO_2 molecules.

A photodiode measures the ultraviolet radiation generated by the UV lamp. This measurement is taken into account during signal processing to compensate for any fluctuations in UV energy.

The molecules emit a specific fluorescence in ultraviolet light, which is optically filtered between 300 and 400 nm at the output. This fluorescence is visualized by the PM tube placed near the reaction chamber.

The main switch of the measuring system and a TFT-LCD colour display with background lighting and touch screen is located at the front of the instrument. The SO_2 analyser AF22e is operated via this touch-screen display. The AF22e* version is identical to the AF22e unit version (except for the front), but does not have its own display. The AF22e* version of the unit is operated exclusively via Ethernet on an externally connected PC.

Fluid inputs and outputs as well as electrical connections are located on the rear side of the AMS.

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 request of 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 AF22e 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. 0000051690_00: 19 August 2016
Expiry date of the certificate: 31 July 2021
Test report: 936/21228317/C dated 18 December 2015
TÜV Rheinland Energie und Umwelt GmbH
Publication: BAnz AT 01.08.2016 B11, chapter III number 2.1
UBA announcement dated 14 July 2016

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 27 September 2018
Publication: BAnz AT 26.03.2019 B7, chapter IV notification 22
UBA announcement dated 27 February 2019
(Software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 1 October 2019
Publication: BAnz AT 24.03.2020 B7, chapter IV notification 26
UBA announcement dated 24 February 2020
(Software changes and new producer name formerly Environnement S.A.)

Statement issued by TÜV Rheinland Energy GmbH dated 9 September 2020
Publication: BAnz AT 03.05.2021 B9, chapter III notification 20
UBA announcement dated 31 March 2021
(Software changes)

Renewal of certificates
Certificate No. 0000051690_01: 31 July 2021
Expiry date of the certificate: 31 July 2022

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 16 September 2021
Publication: BAnz AT 11.04.2022 B10, chapter VI notification 11
UBA announcement dated 9 March 2022
(Software changes)

Renewal of certificates
Certificate No. 0000051690_02: 29 July 2022
Expiry date of the certificate: 31 July 2027

Notifications
Statement issued by TÜV Rheinland Energy GmbH dated 18 March 2022
Publication: BAnz AT 28.07.2022 B4, chapter III notification 52
UBA announcement dated 28 June 2022
(Compliance with EN 14212 (2012) and VDI 4202-1 (2018))

Statement issued by TÜV Rheinland Energy GmbH dated 9 September 2022
Publication: BAnz AT 20.03.2023 B6, chapter IV notification 65
UBA announcement dated 21 February 2023
(Software changes)

Statement issued by TÜV Rheinland Energy & Environment GmbH dated 4 October 2024
Publication: BAnz AT 19.05.2025 B3, chapter IV notification 90
UBA announcement dated 2 April 2025
(Software and hardware changes)

Certificate based on a notification
Certificate No. 0000051690_03: 23 March 2026
Expiry date of the certificate: 22 March 2031
Statement issued by TÜV Rheinland Energy & Environment GmbH dated 20 May 2025
Addendum: EuL/21264142/A_V1 dated 7 February 2025
Publication: BAnz AT 31.10.2025 B5, chapter IV notification 36
UBA announcement dated 27 August 2025

Umwelt Bundesamt

Certificate:
0000051690_03 / 23 March 2026

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Expanded uncertainty laboratory (EN 14212:2012), system 1

Measuring device:	AF 22e		Serial-No.:	SN 12	
Measured component:	SO2		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	0,330	$u_{r,z}$	0,07	0,0051
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0,490	$u_{r,lh}$	0,11	0,0116
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0,920	$u_{l,lh}$	0,70	0,4916
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0,270	u_{gp}	2,20	4,8260
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0,040	u_{gt}	0,32	0,1044
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0,316	u_{st}	2,57	6,6104
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0,010	u_V	0,09	0,0090
8a	Interferent H_20 with 21 mmol/mol	≤ 10 nmol/mol (Zero)	0,490	u_{H2O}	-2,60	6,7429
		≤ 10 nmol/mol (Span)	-3,480			
8b	Interferent H_2S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0,460	$u_{int,pos}$		
		≤ 5.0 nmol/mol (Span)	0,320			
8c	Interferent NH_3 with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0,140			
		≤ 5.0 nmol/mol (Span)	-0,590			
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	0,070			
		≤ 5.0 nmol/mol (Span)	-0,110	or	2,42	5,8520
8e	Interferent NO_2 with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0,370			
		≤ 5.0 nmol/mol (Span)	0,600			
8f	Interferent m-Xylene with 1 µmol/mol	≤ 10 nmol/mol (Zero)	1,570			
		≤ 10 nmol/mol (Span)	3,270	$u_{int,neg}$		
9	Averaging effect	≤ 7.0% of measured value	5,090	u_{av}	3,88	15,0474
18	Difference sample/calibration port	≤ 1.0%	-0,330	$u_{\Delta sc}$	-0,44	0,1897
21	Uncertainty of test gas	≤ 3.0%	2,000	u_{cg}	1,32	1,7424

Combined standard uncertainty	u_c	6,4523	nmol/mol
Expanded uncertainty	U	12,9047	nmol/mol
Relative expanded uncertainty	W	9,78	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty laboratory (EN 14212:2012), system 2

Measuring device:	AF 22e		Serial-No.:	SN 14	
Measured component:	SO2		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	0,340	$u_{r,z}$	0,08	0,0058
2	Repeatability standard deviation at 1h-limit value	≤ 3.0 nmol/mol	0,480	$u_{r,lh}$	0,11	0,0119
3	"lack of fit" at 1h-limit value	≤ 4.0% of measured value	0,960	$u_{l,lh}$	0,73	0,5353
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤ 2.0 nmol/mol/kPa	0,410	u_{gp}	3,34	11,1282
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0,010	u_{gt}	0,08	0,0065
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤ 1.0 nmol/mol/K	0,099	u_{st}	0,81	0,6488
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤ 0.30 nmol/mol/V	0,010	u_V	0,09	0,0090
8a	Interferent H_20 with 21 mmol/mol	≤ 10 nmol/mol (Zero)	-1,100	u_{H2O}	-2,18	4,7474
		≤ 10 nmol/mol (Span)	-2,920			
8b	Interferent H_2S with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	-0,630	$u_{int,pos}$		
		≤ 5.0 nmol/mol (Span)	1,570			
8c	Interferent NH_3 with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0,110			
		≤ 5.0 nmol/mol (Span)	-1,600			
8d	Interferent NO with 500 nmol/mol	≤ 5.0 nmol/mol (Zero)	0,220			
		≤ 5.0 nmol/mol (Span)	-1,640	or	3,23	10,4533
8e	Interferent NO_2 with 200 nmol/mol	≤ 5.0 nmol/mol (Zero)	0,390			
		≤ 5.0 nmol/mol (Span)	0,870			
8f	Interferent m-Xylene with 1 µmol/mol	≤ 10 nmol/mol (Zero)	0,740			
		≤ 10 nmol/mol (Span)	3,160	$u_{int,neg}$		
9	Averaging effect	≤ 7.0% of measured value	5,250	u_{av}	4,00	16,0083
18	Difference sample/calibration port	≤ 1.0%	0,060	$u_{\Delta sc}$	0,08	0,0063
21	Uncertainty of test gas	≤ 3.0%	2,000	u_{cg}	1,32	1,7424

Combined standard uncertainty	u_c	6,7308	nmol/mol
Expanded uncertainty	U	13,4615	nmol/mol
Relative expanded uncertainty	W	10,20	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field (EN 14212:2012), system 1

Measuring device:	AF 22e					Serial-No.:	SN 12	
Measured component:	SO2					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	0,330	$u_{r,z}$	0,07	0,0051	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0,490	$u_{r,lh}$	not considered, as ur,lh = 0,1 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0,920	$u_{l,lh}$	0,70	0,4916	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	2.0 nmol/mol/kPa	0,270	u_{gp}	2,20	4,8260	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,040	u_{gt}	0,32	0,1044	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,316	u_{st}	2,57	6,6104	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0,010	u_{v}	0,09	0,0090	
8a	Interferent H_20 with 21 mmol/mol	≤	10 nmol/mol (Zero)	0,490				
		≤	10 nmol/mol (Span)	-3,480	u_{h2O}	-2,60	6,7429	
8b	Interferent H_2S with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0,460				
		≤	5.0 nmol/mol (Span)	0,320	$u_{int,pos}$			
8c	Interferent NH_3 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,140				
		≤	5.0 nmol/mol (Span)	-0,590				
8d	Interferent NO with 500 nmol/mol	≤	5.0 nmol/mol (Zero)	0,070				
		≤	5.0 nmol/mol (Span)	-0,110	or	2,42	5,8520	
8e	Interferent NO_2 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,370				
		≤	5.0 nmol/mol (Span)	0,600				
8f	Interferent m-Xylene with 1 µmol/mol	≤	10 nmol/mol (Zero)	1,570				
		≤	10 nmol/mol (Span)	3,270	$u_{int,neg}$			
9	Averaging effect	≤	7.0% of measured value	5,090	u_{av}	3,88	15,0474	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	1,240	$u_{r,f}$	1,64	2,6791	
11	Long term drift at zero level	≤	4.0 nmol/mol	0,630	$u_{d,l,z}$	0,36	0,1323	
12	Long term drift at span level	≤	5.0% of max. of certification range	0,750	$u_{d,l,lh}$	0,57	0,3267	
18	Difference sample/calibration port	≤	1.0%	-0,330	$u_{\Delta sc}$	-0,44	0,1897	
21	Uncertainty of test gas	≤	3.0%	2,000	u_{cg}	1,32	1,7424	

Combined standard uncertainty	u_c	6,6902	nmol/mol
Expanded uncertainty	U	13,3805	nmol/mol
Relative expanded uncertainty	W	10,14	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field (EN 14212:2012), system 2

Measuring device:	AF 22e					Serial-No.:	SN 14	
Measured component:	SO2					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	0,340	$u_{r,z}$	0,08	0,0058	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0,480	$u_{r,lh}$	not considered, as ur,lh = 0,1 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	0,960	$u_{l,lh}$	0,73	0,5353	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	2.0 nmol/mol/kPa	0,410	u_{gp}	3,34	11,1282	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,010	u_{gt}	0,08	0,0065	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,099	u_{st}	0,81	0,6488	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0,010	u_{v}	0,09	0,0090	
8a	Interferent H_20 with 21 mmol/mol	≤	10 nmol/mol (Zero)	-1,100				
		≤	10 nmol/mol (Span)	-2,920	u_{h2O}	-2,18	4,7474	
8b	Interferent H_2S with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0,630				
		≤	5.0 nmol/mol (Span)	1,570	$u_{int,pos}$			
8c	Interferent NH_3 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,110				
		≤	5.0 nmol/mol (Span)	-1,600				
8d	Interferent NO with 500 nmol/mol	≤	5.0 nmol/mol (Zero)	0,220				
		≤	5.0 nmol/mol (Span)	-1,640	or	3,23	10,4533	
8e	Interferent NO_2 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,390				
		≤	5.0 nmol/mol (Span)	0,870				
8f	Interferent m-Xylene with 1 µmol/mol	≤	10 nmol/mol (Zero)	0,740				
		≤	10 nmol/mol (Span)	3,160	$u_{int,neg}$			
9	Averaging effect	≤	7.0% of measured value	5,250	u_{av}	4,00	16,0083	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	1,240	$u_{r,f}$	1,64	2,6791	
11	Long term drift at zero level	≤	4.0 nmol/mol	0,740	$u_{d,l,z}$	0,43	0,1825	
12	Long term drift at span level	≤	5.0% of max. of certification range	-0,570	$u_{d,l,lh}$	-0,43	0,1887	
18	Difference sample/calibration port	≤	1.0%	0,060	$u_{\Delta sc}$	0,08	0,0063	
21	Uncertainty of test gas	≤	3.0%	2,000	u_{cg}	1,32	1,7424	

Combined standard uncertainty	u_c	6,9528	nmol/mol
Expanded uncertainty	U	13,9056	nmol/mol
Relative expanded uncertainty	W	10,53	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty laboratory (EN 14212:2024), system 1

Measuring device:	AF22e				Serial-No.:	SN 12 / 2535	
Measured component:	SO2				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	0,330	$u_{r,z}$	0,07	0,01
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0,490	$u_{r,lh}$	0,11	0,01
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	1,870	$u_{l,lh}$	1,43	2,03
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	2.0 nmol/mol/kPa	0,610	u_{gp}	3,31	10,95
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,020	u_{gt}	0,19	0,04
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,187	u_{st}	1,78	3,15
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0,010	u_V	0,09	0,01
8a	Interferent H_2O with 21 mmol/mol	≤	10 nmol/mol (Zero)	0,490	u_{H2O}	-2,60	6,74
		≤	10 nmol/mol (Span)	-3,480			
8b	Interferent H_2S with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0,460	$u_{int,pos}$		
		≤	5.0 nmol/mol (Span)	0,320			
8c	Interferent NH_3 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,140			
		≤	5.0 nmol/mol (Span)	-0,590			
8d	Interferent NO with 500 nmol/mol	≤	5.0 nmol/mol (Zero)	0,070			
		≤	5.0 nmol/mol (Span)	-0,110	or	2,42	5,85
8e	Interferent NO_2 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,370			
		≤	5.0 nmol/mol (Span)	0,600			
8f	Interferent m-Xylene with 1 µmol/mol	≤	10 nmol/mol (Zero)	1,570			
		≤	10 nmol/mol (Span)	3,270	$u_{int,neg}$		
9	Averaging effect	≤	7.0% of measured value	5,090	u_{av}	3,88	15,05
18	Difference sample/calibration port	≤	1.0%	-0,330	$u_{\Delta sc}$	-0,44	0,19
21	Uncertainty of test gas	≤	3.0%	2,000	u_{cg}	1,32	1,74

Combined standard uncertainty	u_c	6,77	nmol/mol
Expanded uncertainty	U	13,53	nmol/mol
Relative expanded uncertainty	W	10,25	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Expanded uncertainty laboratory (EN 14212:2024), system 2

Measuring device:	AF22e				Serial-No.:	SN 14 / 2537	
Measured component:	SO2				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	0,340	$u_{r,z}$	0,08	0,01
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0,480	$u_{r,lh}$	0,11	0,01
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	2,250	$u_{l,lh}$	1,71	2,94
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	2.0 nmol/mol/kPa	0,370	u_{gp}	2,01	4,03
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,020	u_{gt}	0,19	0,04
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,189	u_{st}	1,79	3,22
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0,010	u_V	0,09	0,01
8a	Interferent H_2O with 21 mmol/mol	≤	10 nmol/mol (Zero)	-1,100	u_{H2O}	-2,18	4,75
		≤	10 nmol/mol (Span)	-2,920			
8b	Interferent H_2S with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0,630	$u_{int,pos}$		
		≤	5.0 nmol/mol (Span)	1,570			
8c	Interferent NH_3 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,110			
		≤	5.0 nmol/mol (Span)	-1,600			
8d	Interferent NO with 500 nmol/mol	≤	5.0 nmol/mol (Zero)	0,220			
		≤	5.0 nmol/mol (Span)	-1,640	or	3,23	10,45
8e	Interferent NO_2 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,390			
		≤	5.0 nmol/mol (Span)	0,870			
8f	Interferent m-Xylene with 1 µmol/mol	≤	10 nmol/mol (Zero)	0,740			
		≤	10 nmol/mol (Span)	3,160	$u_{int,neg}$		
9	Averaging effect	≤	7.0% of measured value	5,250	u_{av}	4,00	16,01
18	Difference sample/calibration port	≤	1.0%	0,060	$u_{\Delta sc}$	0,08	0,01
21	Uncertainty of test gas	≤	3.0%	2,000	u_{cg}	1,32	1,74

Combined standard uncertainty	u_c	6,57	nmol/mol
Expanded uncertainty	U	13,15	nmol/mol
Relative expanded uncertainty	W	9,96	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field (EN 14212:2024), system 1

Measuring device:	AF22e				Serial-No.:	SN 12 / 2535	
Measured component:	SO2				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	0,330	$u_{r,z}$	0,07	0,01	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0,490	$u_{r,lh}$	not considered, as ur,lh = 0,1 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	1,870	$u_{l,lh}$	1,43	2,03	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	2.0 nmol/mol/kPa	0,610	u_{gp}	3,31	10,95	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,020	u_{gt}	0,19	0,04	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,187	u_{st}	1,78	3,15	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0,010	u_V	0,09	0,01	
8a	Interferent H_2O with 21 mmol/mol	≤	10 nmol/mol (Zero)	0,490				
		≤	10 nmol/mol (Span)	-3,480	u_{H2O}	-2,60	6,74	
8b	Interferent H_2S with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0,460				
		≤	5.0 nmol/mol (Span)	0,320	$u_{int,pos}$			
8c	Interferent NH_3 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,140				
		≤	5.0 nmol/mol (Span)	-0,590				
8d	Interferent NO with 500 nmol/mol	≤	5.0 nmol/mol (Zero)	0,070				
		≤	5.0 nmol/mol (Span)	-0,110	or	2,42	5,85	
8e	Interferent NO_2 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,370				
		≤	5.0 nmol/mol (Span)	0,600				
8f	Interferent m-Xylene with 1 µmol/mol	≤	10 nmol/mol (Zero)	1,570				
		≤	10 nmol/mol (Span)	3,270	$u_{int,neg}$			
9	Averaging effect	≤	7.0% of measured value	5,090	u_{av}	3,88	15,05	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	0,640	$u_{r,f}$	0,84	0,71	
11	Long term drift at zero level	≤	4.0 nmol/mol	0,630	$u_{d,l,z}$	0,36	0,13	
12	Long term drift at span level	≤	5.0% of max. of certification range	0,750	$u_{d,l,lh}$	0,57	0,33	
18	Difference sample/calibration port	≤	1.0%	-0,330	$u_{\Delta sc}$	-0,44	0,19	
21	Uncertainty of test gas	≤	3.0%	2,000	u_{cg}	1,32	1,74	

Combined standard uncertainty	u_c	6,85	nmol/mol
Expanded uncertainty	U	13,70	nmol/mol
Relative expanded uncertainty	W	10,38	%
Maximum allowed expanded uncertainty	W_{req}	15	%

Combined uncertainty, laboratory and field (EN 14212:2024), system 2

Measuring device:	AF22e				Serial-No.:	SN 14 / 2537	
Measured component:	SO2				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	0,340	$u_{r,z}$	0,08	0,01	
2	Repeatability standard deviation at 1h-limit value	≤	3.0 nmol/mol	0,480	$u_{r,lh}$	not considered, as ur,lh = 0,1 < ur,f	-	
3	"lack of fit" at 1h-limit value	≤	4.0% of measured value	2,250	$u_{l,lh}$	1,71	2,94	
4	Sensitivity coefficient of sample gas pressure at 1h-limit value	≤	2.0 nmol/mol/kPa	0,370	u_{gp}	2,01	4,03	
5	Sensitivity coefficient of sample gas temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,020	u_{gt}	0,19	0,04	
6	Sensitivity coefficient of surrounding temperature at 1h-limit value	≤	1.0 nmol/mol/K	0,189	u_{st}	1,79	3,22	
7	Sensitivity coefficient of electrical voltage at 1h-limit value	≤	0.30 nmol/mol/V	0,010	u_V	0,09	0,01	
8a	Interferent H_2O with 21 mmol/mol	≤	10 nmol/mol (Zero)	-1,100				
		≤	10 nmol/mol (Span)	-2,920	u_{H2O}	-2,18	4,75	
8b	Interferent H_2S with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	-0,630				
		≤	5.0 nmol/mol (Span)	1,570	$u_{int,pos}$			
8c	Interferent NH_3 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,110				
		≤	5.0 nmol/mol (Span)	-1,600				
8d	Interferent NO with 500 nmol/mol	≤	5.0 nmol/mol (Zero)	0,220				
		≤	5.0 nmol/mol (Span)	-1,640	or	3,23	10,45	
8e	Interferent NO_2 with 200 nmol/mol	≤	5.0 nmol/mol (Zero)	0,390				
		≤	5.0 nmol/mol (Span)	0,870				
8f	Interferent m-Xylene with 1 µmol/mol	≤	10 nmol/mol (Zero)	0,740				
		≤	10 nmol/mol (Span)	3,160	$u_{int,neg}$			
9	Averaging effect	≤	7.0% of measured value	5,250	u_{av}	4,00	16,01	
10	Reproducibility standard deviation under field conditions	≤	5.0% of average over 3 months	0,640	$u_{r,f}$	0,84	0,71	
11	Long term drift at zero level	≤	4.0 nmol/mol	0,740	$u_{d,l,z}$	0,43	0,18	
12	Long term drift at span level	≤	5.0% of max. of certification range	-0,570	$u_{d,l,lh}$	-0,43	0,19	
18	Difference sample/calibration port	≤	1.0%	0,060	$u_{\Delta sc}$	0,08	0,01	
21	Uncertainty of test gas	≤	3.0%	2,000	u_{cg}	1,32	1,74	

Combined standard uncertainty	u_c	6,65	nmol/mol
Expanded uncertainty	U	13,31	nmol/mol
Relative expanded uncertainty	W	10,08	%
Maximum allowed expanded uncertainty	W_{req}	15	%