Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000059867

AMS designation:	LaserCEM for CO, NO, NH_3, O_2, H_2O, SO_2 and HCl
Manufacturer:	AP2E 240 Rue Louis de Broglie 13290 Aix-en-Provence France
Test Laboratory:	TÜV Rheinland Energy GmbH

This is to certify that the AMS has been tested and found to comply with the standards:
EN 15267-1: 2009, EN 15267-2: 2009, EN 15267-3: 2007 and EN 14181: 2014.

Certification is awarded in respect of the conditions stated in this certificate (this certificate contains 12 pages).

TÜVRheinland®
CERTIFIED

Suitability Tested
EN 15267
QAL1 Certified
Regular Surveillance

www.tuv.com
ID 0000059867

Publication in the German Federal Gazette (BAnz) of 22 July 2019

Federal Environment Agency
Dessau, 05 November 2019

Dr Marcel Langner
Head of Section II 4.1

Expiry date:
21 July 2024

TÜV Rheinland Energy GmbH
Cologne, 04 November 2019

ppa. Dr. Peter Wilbring

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TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Köln

Test institute accredited to EN ISO/IEC 17025:2005 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:	936/21228566/C dated 7 March 2019
Initial certification:	22 July 2019
Expiry date:	21 July 2024
Publication:	BAnz AT 22.07.2019 B8, chapter I number 1.1

Approved application
The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III (13th BImSchV), chapter IV (17th BImSchV), 30th BImSchV, plants in compliance with TA Luft and plants according to the 27th BImSchV. The measured ranges have been selected so as to ensure as broad a field of application as possible.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a three-months field test at a waste incineration plant.

The AMS is approved for an ambient temperature range of +5 °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 limit values and oxygen concentrations relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the intended purpose.

Basis of the certification
This certification is based on:

- Test report 936/21228566/C dated 7 March 2019 issued by TÜV Rheinland Energy 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 22.07.2019 B8, chapter I number 1.1, UBA announcement dated 28 June 2019:

AMS designation:
LaserCEM for CO, NO, NH_3, O_2, H_2O, SO_2 and HCl

Manufacturer:
AP2E, Aix-en-Provence, France

Field of application:
For plants requiring official approval

Measuring ranges during performance testing:

Component	Certification range	supplementary measuring ranges		Unit
CO	0–75	0–1 249	–	mg/m³
NO	0–78	0–150	0–2 008	mg/m³
NH_3	0–15	0–45	0–76	mg/m³
H_2O	0–30	0–40	–	Vol.–%
O_2	0–21	–	–	Vol.–%
SO_2	0–75	0–2 858	–	mg/m³
HCl	0–15	0–98	–	mg/m³

Software version:
3.0.8.24

Restrictions:
For the measurement of NO, the HCl concentration present in the waste gas must not exceed 50 mg/m³.

Notes:
1. The maintenance interval is four weeks.
2. Wet test gases must be used for testing NH_3 and HCl.
3. Maintenance work must be spread over several days in order to comply with the requirements for outage times specified by the 13th and 17th BImSchV.

Test Report:
TÜV Rheinland Energy GmbH, Cologne
Report no. 936/21228566/C dated 7 March 2019

Certified product
This certification applies to automated measurement systems conforming to the following description:

The LaserCEM is a multi-component measuring system which operates at low pressure and uses infrared laser spectroscopy as its measuring principle. This principle combines absorption spectroscopy enhanced by a cavity with optical feedback (OFCEAS: Optical Feedback Cavity Enhanced Absorption Spectroscopy) and low pressure sampling (LPS).

The sample gas conditioning unit consists of a heated CEM probe which comprises two components: a critical nozzle and a 2 µm filter made of sintered stainless steel. The probe is connected to a heated sample gas line which is equipped with an inner liner made of PTFE.

The AMS tested here comprises the following components:
- CEM sample probe with critical nozzle and 2 µm filter
- Heated sample gas line, temperature 80 °C, inner diameter ~ 6 mm, material PFTE
- Analyser cabinet c/w:
  - 2 LaserCEM analyser modules
  - Sample gas hoses
  - (Vacuum) pump
  - Software version 3.0.8.24

With the exemption of the heated sampling probe and the heated sample gas line, all other components are installed in a lockable measurement cabinet together with the electronics distribution and the modules.

General remarks
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 manufacturing process for the certified product. Both the product and the quality management system 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 document as well as the certification mark remains property of TÜV Rheinland Energy GmbH. Upon revocation of the publication the certificate loses its validity. After the expiration of the certificate and on request of TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must no longer be used.

The relevant version of this certificate and its expiration date are also accessible on the internet at **qal1.de**.

Document history

Certification of the LaserCEM measuring system is based on the documents listed below and the regular, continuous surveillance of the manufacturer's quality management system:

Initial certification according to EN 15267

Certificate no. 0000059867: 05 November 2019
Expiry date of the certificate: 21 July 2024
Test report 936/21228566/C dated 7 March 2019
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 22.07.2019 B8, chapter I number 1.1
UBA announcement dated 28 June 2019

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system			
Manufacturer		AP2E	
AMS designation		LaserCEM	
Serial number of units under test		SN2015-0120 / SN2015-0125	
Measuring principle		OFCEAS	
Test report		936/21228566/C	
Test laboratory		TÜV Rheinland	
Date of report		2019-03-07	
Measured component		CO	
Certification range		0 - 75	mg/m³
Evaluation of the cross-sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point		0.00	mg/m³
Sum of negative CS at zero point		0.00	mg/m³
Sum of postive CS at span point		0.32	mg/m³
Sum of negative CS at span point		-1.47	mg/m³
Maximum sum of cross-sensitivities		-1.47	mg/m³
Uncertainty of cross-sensitivity	u_i	-0.849	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.300	mg/m³	0.090	(mg/m³)²
Lack of fit	u_{lof}	0.433	mg/m³	0.187	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.260	mg/m³	0.068	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.909	mg/m³	0.826	(mg/m³)²
Influence of ambient temperature at span	u_t	0.404	mg/m³	0.163	(mg/m³)²
Influence of supply voltage	u_v	0.104	mg/m³	0.011	(mg/m³)²
Cross-sensitivity (interference)	u_i	-0.849	mg/m³	0.721	(mg/m³)²
Influence of sample gas flow	u_p	-0.325	mg/m³	0.106	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	0.368	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.59	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.12	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**6.2**
Requirement of 2010/75/EU	**U in % of the ELV 50 mg/m³**	**10.0**
Requirement of EN 15267-3	U in % of the ELV 50 mg/m³	7.5

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system			
Manufacturer	AP2E		
AMS designation	LaserCEM		
Serial number of units under test	SN2015-0120 / SN2015-0125		
Measuring principle	OFCEAS		
Test report	936/21228566/C		
Test laboratory	TÜV Rheinland		
Date of report	2019-03-07		
Measured component	NO		
Certification range	0 - 78	mg/m³	

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.42	mg/m³	
Sum of negative CS at zero point	0.00	mg/m³	
Sum of postive CS at span point	0.00	mg/m³	
Sum of negative CS at span point	-1.30	mg/m³	
Maximum sum of cross-sensitivities	-1.30	mg/m³	
Uncertainty of cross-sensitivity u_i	-0.752	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.721	mg/m³	0.520	(mg/m³)²
Lack of fit	u_{lof}	-0.437	mg/m³	0.191	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.315	mg/m³	0.099	(mg/m³)²
Span drift from field test	$u_{d,s}$	1.081	mg/m³	1.169	(mg/m³)²
Influence of ambient temperature at span	u_t	0.751	mg/m³	0.564	(mg/m³)²
Influence of supply voltage	u_v	0.347	mg/m³	0.120	(mg/m³)²
Cross-sensitivity (interference)	u_i	-0.752	mg/m³	0.566	(mg/m³)²
Influence of sample gas flow	u_p	0.444	mg/m³	0.197	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.630	mg/m³	0.397	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.96	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.83	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**7.7**
Requirement of 2010/75/EU	**U in % of the ELV 50 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 50 mg/m³	15.0

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system					
Manufacturer		AP2E			
AMS designation		LaserCEM			
Serial number of units under test		SN2015-0120 / SN2015-0125			
Measuring principle		OFCEAS			
Test report		936/21228566/C			
Test laboratory		TÜV Rheinland			
Date of report		2019-03-07			
Measured component		NH_3			
Certification range		0 - 15	mg/m³		
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point		0.00	mg/m³		
Sum of negative CS at zero point		0.00	mg/m³		
Sum of postive CS at span point		0.22	mg/m³		
Sum of negative CS at span point		-0.19	mg/m³		
Maximum sum of cross-sensitivities		0.22	mg/m³		
Uncertainty of cross-sensitivity	u_i	0.126	mg/m³		

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.100	mg/m³	0.010	(mg/m³)²
Lack of fit	u_{lof}	0.093	mg/m³	0.009	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.156	mg/m³	0.024	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.217	mg/m³	0.047	(mg/m³)²
Influence of ambient temperature at span	u_t	0.153	mg/m³	0.023	(mg/m³)²
Influence of supply voltage	u_v	0.026	mg/m³	0.001	(mg/m³)²
Cross-sensitivity (interference)	u_i	0.126	mg/m³	0.016	(mg/m³)²
Influence of sample gas flow	u_p	-0.002	mg/m³	0.000	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121	mg/m³	0.015	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.38	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.75	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**7.5**
Requirement of 2010/75/EU	**U in % of the ELV 10 mg/m³**	**40.0**
Requirement of EN 15267-3	U in % of the ELV 10 mg/m³	30.0

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system					
Manufacturer		AP2E			
AMS designation		LaserCEM			
Serial number of units under test		SN2015-0120 / SN2015-0125			
Measuring principle		OFCEAS			
Test report		936/21228566/C			
Test laboratory		TÜV Rheinland			
Date of report		2019-03-07			
Measured component		H_2O			
Certification range		0 - 30	Vol.-%		
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point		0.00	Vol.-%		
Sum of negative CS at zero point		0.00	Vol.-%		
Sum of postive CS at span point		0.63	Vol.-%		
Sum of negative CS at span point		0.00	Vol.-%		
Maximum sum of cross-sensitivities		0.63	Vol.-%		
Uncertainty of cross-sensitivity	u_i	0.364	Vol.-%		
Calculation of the combined standard uncertainty					
Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.237	Vol.-%	0.056	(Vol.-%)²
Lack of fit	u_{lof}	0.161	Vol.-%	0.026	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	0.121	Vol.-%	0.015	(Vol.-%)²
Span drift from field test	$u_{d,s}$	-0.433	Vol.-%	0.187	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.351	Vol.-%	0.123	(Vol.-%)²
Influence of supply voltage	u_v	0.198	Vol.-%	0.039	(Vol.-%)²
Cross-sensitivity (interference)	u_i	0.364	Vol.-%	0.132	(Vol.-%)²
Influence of sample gas flow	u_p	0.025	Vol.-%	0.001	(Vol.-%)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.242	Vol.-%	0.059	(Vol.-%)²

* The larger value is used :
"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.80	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.57	Vol.-%

Relative total expanded uncertainty	**U in % of the range 30 Vol.-%**	**5.2**
Requirement of 2010/75/EU	**U in % of the range 30 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the range 30 Vol.-%	7.5

** The EU-directive 2010/75/EC on industrial emissions does not define requirements for this component.
A value of 10.0 % was used instead.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system			
Manufacturer	AP2E		
AMS designation	LaserCEM		
Serial number of units under test	SN2015-0120 / SN2015-0125		
Measuring principle	OFCEAS		
Test report	936/21228566/C		
Test laboratory	TÜV Rheinland		
Date of report	2019-03-07		
Measured component	O_2		
Certification range	0 - 21	Vol.-%	
Evaluation of the cross-sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point	0.00	Vol.-%	
Sum of negative CS at zero point	0.00	Vol.-%	
Sum of postive CS at span point	0.00	Vol.-%	
Sum of negative CS at span point	-0.34	Vol.-%	
Maximum sum of cross-sensitivities	-0.34	Vol.-%	
Uncertainty of cross-sensitivity	u_i -0.197	Vol.-%	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.091	Vol.-%	0.008	(Vol.-%)²
Lack of fit	u_{lof}	0.058	Vol.-%	0.003	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	0.029	Vol.-%	0.001	(Vol.-%)²
Span drift from field test	$u_{d,s}$	-0.058	Vol.-%	0.003	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.107	Vol.-%	0.011	(Vol.-%)²
Influence of supply voltage	u_v	0.012	Vol.-%	0.000	(Vol.-%)²
Cross-sensitivity (interference)	u_i	-0.197	Vol.-%	0.039	(Vol.-%)²
Influence of sample gas flow	u_p	0.023	Vol.-%	0.001	(Vol.-%)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.170	Vol.-%	0.029	(Vol.-%)²

* The larger value is used :
"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.31	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.61	Vol.-%

Relative total expanded uncertainty	**U in % of the range 21 Vol.-%**	**2.9**
Requirement of 2010/75/EU	**U in % of the range 21 Vol.-%**	**10.0 ****
Requirement of EN 15267-3	U in % of the range 21 Vol.-%	7.5

** The EU-directive 2010/75/EC on industrial emissions does not define requirements for this component.
A value of 10.0 % was used instead.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system					
Manufacturer		AP2E			
AMS designation		LaserCEM			
Serial number of units under test		SN2015-0120 / SN2015-0125			
Measuring principle		OFCEAS			
Test report		936/21228566/C			
Test laboratory		TÜV Rheinland			
Date of report		2019-03-07			
Measured component		SO_2			
Certification range		0 - 75	mg/m³		
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point		0.00	mg/m³		
Sum of negative CS at zero point		0.00	mg/m³		
Sum of postive CS at span point		1.66	mg/m³		
Sum of negative CS at span point		-0.74	mg/m³		
Maximum sum of cross-sensitivities		1.66	mg/m³		
Uncertainty of cross-sensitivity	u_i	0.957	mg/m³		

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.113	mg/m³	0.013	(mg/m³)²
Lack of fit	u_{lof}	0.866	mg/m³	0.750	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.130	mg/m³	0.017	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.866	mg/m³	0.750	(mg/m³)²
Influence of ambient temperature at span	u_t	0.850	mg/m³	0.723	(mg/m³)²
Influence of supply voltage	u_v	0.121	mg/m³	0.015	(mg/m³)²
Cross-sensitivity (interference)	u_i	0.957	mg/m³	0.916	(mg/m³)²
Influence of sample gas flow	u_p	0.189	mg/m³	0.036	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.606	mg/m³	0.368	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.89	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.71	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 50 mg/m³**	**7.4**
Requirement of 2010/75/EU	**U in % of the ELV 50 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 50 mg/m³	15.0

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system			
Manufacturer	AP2E		
AMS designation	LaserCEM		
Serial number of units under test	SN2015-0120 / SN2015-0125		
Measuring principle	OFCEAS		
Test report	936/21228566/C		
Test laboratory	TÜV Rheinland		
Date of report	2019-03-07		
Measured component	HCl		
Certification range	0 - 15	mg/m³	
Evaluation of the cross-sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point	0.07	mg/m³	
Sum of negative CS at zero point	0.00	mg/m³	
Sum of postive CS at span point	0.18	mg/m³	
Sum of negative CS at span point	0.00	mg/m³	
Maximum sum of cross-sensitivities	0.18	mg/m³	
Uncertainty of cross-sensitivity	u_i 0.103	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.058	mg/m³	0.003	(mg/m³)²
Lack of fit	u_{lof}	0.108	mg/m³	0.012	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.139	mg/m³	0.019	(mg/m³)²
Span drift from field test	$u_{d,s}$	0.208	mg/m³	0.043	(mg/m³)²
Influence of ambient temperature at span	u_t	0.100	mg/m³	0.010	(mg/m³)²
Influence of supply voltage	u_v	0.030	mg/m³	0.001	(mg/m³)²
Cross-sensitivity (interference)	u_i	0.103	mg/m³	0.011	(mg/m³)²
Influence of sample gas flow	u_p	0.025	mg/m³	0.001	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121	mg/m³	0.015	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.34	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.66	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 10 mg/m³**	**6.6**
Requirement of 2010/75/EU	**U in % of the ELV 10 mg/m³**	**40.0**
Requirement of EN 15267-3	U in % of the ELV 10 mg/m³	30.0