Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040336_01

AMS designation:	Air Pollution Monitor 2 (APM-2) for suspended particulate matter PM_{10} and $PM_{2,5}$
Manufacturer:	Comde-Derenda GmbH Kieler Straße 9 14532 Stahnsdorf Germany
Test Laboratory:	TÜV Rheinland Energy GmbH

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

VDI 4202-1 (2010), VDI 4203-3 (2010), EN 12341 (1998), EN 14907 (2005), Guide to the demonstration of equivalence of ambient air monitoring methods (2010) EN 15267-1 (2009) and DIN EN 15267-2 (2009).

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 11 pages).
The present certificate replaces certificate 0000040336 of 9 September 2014.

TÜVRheinland®
CERTIFIED

Suitability Tested
Equivalent to
2008/50/EC
EN 15267
Regular Surveillance

www.tuv.com
ID 0000040336

Publication in the German Federal Gazette (BAnz) of 5 August 2014

This certificate will expire on:
4 August 2024

German Federal Environment Agency
Dessau, 5 August 2019

Dr Marcel Langner
Head of Section II 4.1

TÜV Rheinland Energy GmbH
Cologne, 4 August 2019

ppa. Dr. Peter Wilbring

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TÜV Rheinland Energy GmbH
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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:	936/21219977/A dated 26 March 2014
Initial certification:	5 August 2014
Expiry date:	4 August 2024
Publication:	BAnz AT 05.08.2014 B11, chapter III number 2.1

Approved application
The certified AMS is suitable for continuous and simultaneous ambient air monitoring of suspended particulate matter, PM_{10} and $PM_{2.5}$ (stationary operation).

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a field test performed at four different sites and/or different periods.

The AMS is approved for an ambient temperature range of -20 °C to +50 °C.

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 936/21219977/A dated 26 March 2014
  issued by TÜV Rheinland Energie und Umwelt GmbH
- Suitability announced by the German Federal Environment Agency (UBA)
  as the relevant body
- The ongoing surveillance of the product and the manufacturing process

AMS designation:
Air Pollution Monitor 2 (APM-2) for suspended particulate matter PM_{10} and $PM_{2,5}$

Manufacturer:
Comde-Derenda GmbH, Stahnsdorf

Field of application:
For continuous and simultaneous ambient air monitoring of suspended particulate matter, PM_{10} and $PM_{2.5}$ fractions (stationary sources)

Measuring ranges during performance testing:

Component	Certification range	Unit
PM_{10}	0–1 000	µg/m³
$PM_{2,5}$	0–1 000	µg/m³

Software version:
3.0.1

Restrictions:
None

Notes:

1. After applying the determined correction factors, the measuring system complies with the requirements of the Guide to the Demonstration of Equivalence of Ambient Air Monitoring Methods for the component PM_{10} and $PM_{2.5}$.
2. The candidates did not comply with the requirements for the equivalence test specified in standard EN 12341: 1998 for PM_{10}.
3. The long-term drift of the particle sensor's sensitivity could not be determined during the field test.
4. It is possible to monitor the measuring system telemetrically but it cannot be controlled that way.
5. The measuring system alternately determines the PM10 and PM2.5 fractions in suspended particulate matter. During performance testing the system switched between the two fractions every two minutes.
6. After maintenance of the photometer, the instrument must be calibrated on-site regularly using a gravimetric PM_{10} reference method in accordance with EN 12341, calibrations should be carried out seasonally.
7. After maintenance of the photometer, the instrument must be calibrated on-site regularly using a gravimetric $PM_{2,5}$ reference method in accordance with EN 14907, calibrations should be carried out seasonally.
8. The test report on performance testing is available on the internet at www.qal1.de.

Test Report:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report no. 936/21219977/A dated 26 March 2014

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter IV notification 1, UBA announcement dated 25 February 2015:

1 Notification as regards Federal Environment Agency (UBA) notice of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter III number 2.1)

An outlet filter of the Air Pollution Monitor 2 (APM-2) measuring system for PM_{10} and $PM_{2,5}$ manufactured by Comde-Derenda GmbH has been repositioned from its former position downstream of the pump to between the mass flow sensor and the pump.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 27 September 2014

Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, chapter V notification 4,
UBA announcement dated 14 March 2016:

4 Notification as regards Federal Environment Agency (UBA) notices of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter II number 2.1) and of of 25 February 2015 (BAnz AT 02.04.2015 B5, chapter IV 1st notification)

The new software version of the APM-2 measuring system for suspended particulate matter PM_{10} and $PM_{2,5}$ manufactured by Comde-Derenda GmbH is:

Software version: 3.05.002

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 21 October 2015

Publication in the German Federal Gazette: BAnz AT 31.07.2017 B12, chapter II notification 34, UBA announcement dated 13 July 2017:

34 Notification as regards Federal Environment Agency (UBA) notices of 17 July 2014 (BAnz AT 05.08.2014 B11, chapter II number 2.1) and of 18 February 2016 (BAnz AT 14.03.2016 B7, chapter V 4th notification)

The current software version of the Air Pollution Monitor 2 (APM-2) ambient air quality measuring system for suspended particulate matter PM_{10} and $PM_{2,5}$ manufactured by Comde-Derenda GmbH is:

3.07.002

The measuring system has been equipped with a 500 ml buffer bottle for compensating pressure fluctuations caused by the sampling pump.

The optional test method for checking the photometer's sensitivity externally by feeding propane gas is no longer available.

Statement issued by TÜV Rheinland Energy GmbH dated 10 March 2017

Certified product

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

The APM-2 measuring system for monitoring suspended particulate matter in ambient air consists of a PM_{10} sampling head, a sampling pipe, a virtual impactor, the instrument with a control unit and a scattered light photometer unit, an outdoor sensor and a user manual in German.

The APM-2 measuring system uses scattered light to measure suspended particulate matter. This measuring method uses the physical characteristics of the light scattered back by micro particles. The scattered light photometer unit used consists of a laser diode with a stable intensity and a semi-conductor photodetector. As the two components are perpendicular to each other there is only one angle at which the scattered light is detected. A detector detects the light reflected by the particles within a clearly defined measuring volume. The photodetector generates a corresponding voltage signal (0-5 V), which is amplified without generating much noise and serves as a direct measure for the mass concentration of the aerosol within the measuring volume. For the purpose of adjusting the zero point, the scattered light sensor is supplied with filtered air by means of a switching device.

The particulate sample passes through the PM_{10} sampling head at a flow rate of 3.3 l/min and reaches the sampling pipe, which connects the sampling head to the virtual impactor.

The virtual impactor is located on top of the enclosure and connected to the impactor head by way of the suction pipe. Ambient air (Q1) is sucked in at 3.3 l/min by an integrated pump and divided into two flows. The splitting occurs in a section with two opposite nozzles. The lateral flow Q2 (3.1 l/min) is sucked in between the two nozzles at a right angle to the entering air flow. Particles which cannot follow the lateral flow due to their inertia maintain their direction of movement and thus reach the smaller axial flow Q3 (0.2 l/min). As a result, the flow is divided into the lateral flow, which only carries the smaller and lighter particles of the $PM_{2.5}$ fraction, and the axial flow, which carries particles with a particle size of PM_{10}. By way of a low-loss switching devices (pinch valves with straight passage), the aerosol from either axial flow (enrichment mode) or lateral flow (normal mode) reaches the scattered light sensor. Thus, in enrichment mode the APM-2 determines the PM_{10} concentration while the $PM_{2.5}$ concentration is determined in normal mode. In order to adjust the zero point, the scattered light sensor is supplied with filtered air at regular intervals.

During performance testing the measuring system was operated with an interval alternating between PM_{10} and $PM_{2.5}$ every 2 minutes. Furthermore, a zero air purge of approx. two minutes is carried out once per hour in order to adjust the zero point – this is indicated as “Flush” on the display. The collected measuring data is stored on instrument memory as well as on SD card, if available.

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**.

Certification of the Air Pollution Monitor 2 (APM-2) for suspended particulate matter PM_{10} and $PM_{2.5}$ is based on the documents listed below and the regular, continuous surveillance of the manufacturer's quality management system:

Document history

Certification of the Air Pollution Monitor 2 (APM-2) 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. 0000040336_00: 9 September 2014
Expiry date of the certificate: 4 August 2019
Test report: 936/21219977/A dated 26 March 2014
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 05.08.2014 B11, chapter III number 2.1
UBA announcement dated 17 July 2014

Notifications in accordance with EN 15267

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 27 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 1
UBA announcement dated 25 February 2015
(Design changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 21 October 2015
Publication: BAnz AT 14.03.2016 B7, chapter V notification 4
UBA announcement dated 18 February 2016
(software updates)

Statement issued by TÜV Rheinland Energy GmbH dated 10 March 2017
Publication: BAnz AT 31.07.2017 B12, chapter II notification 34
UBA announcement dated 13 July 2017
(design changes)

Renewal of the certificate in accordance with EN 15267

Certificate no. 0000040336_01: 5 August 2019
Expiry date of the certificate: 4 August 2024

Combined results of equivalence testing, S/N 3 & S/N 4
Measured component $PM_{2.5}$ after correction of the slope

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	APM-2		SN	SN 3 & SN 4	
			Limit value	30	µg/m³
Status of measured values	Slope corrected		Allowed uncertainty	25	%
All comparisons					
Uncertainty between Reference	**0.55**	**µg/m³**			
Uncertainty between Candidates	**0.71**	**µg/m³**			
	SN 3 & SN 4				
Number of data pairs	**192**				
Slope b	**1.001**	**not significant**			
Uncertainty of b	**0.013**				
Ordinate intercept a	**0.335**	**not significant**			
Uncertainty of a	**0.235**				
Expanded meas. uncertainty W_{CM}	**12.36**	**%**			
All comparisons, ≥18 µg/m³					
Uncertainty between Reference	**0.63**	**µg/m³**			
Uncertainty between Candidates	**1.13**	**µg/m³**			
	SN 3 & SN 4				
Number of data pairs	**49**				
Slope b	**0.967**				
Uncertainty of b	**0.033**				
Ordinate intercept a	**1.292**				
Uncertainty of a	**1.019**				
Expanded meas. uncertainty W_{CM}	**18.46**	**%**			
All comparisons, <18 µg/m³					
Uncertainty between Reference	**0.53**	**µg/m³**			
Uncertainty between Candidates	**0.46**	**µg/m³**			
	SN 3 & SN 4				
Number of data pairs	**143**				
Slope b	**1.137**				
Uncertainty of b	**0.032**				
Ordinate intercept a	**-1.073**				
Uncertainty of a	**0.355**				
Expanded meas. uncertainty W_{CM}	**22.20**	**%**			

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	APM-2		SN	SN 3 & SN 4	
			Limit value	30	µg/m³
Status of measured values	Slope corrected		Allowed uncertainty	25	%
		0			
Uncertainty between Reference	0.54	µg/m³			
Uncertainty between Candidates	0.71	µg/m³			
	SN 3			SN 4	
Number of data pairs	52			52	
Slope b	0.931			0.962	
Uncertainty of b	0.019			0.019	
Ordinate intercept a	1.148			1.495	
Uncertainty of a	0.424			0.435	
Expanded meas. uncertainty W_{CM}	13.83	%		12.92	%
		0			
Uncertainty between Reference	0.62	µg/m³			
Uncertainty between Candidates	0.96	µg/m³			
	SN 3			SN 4	
Number of data pairs	51			51	
Slope b	1.037			1.097	
Uncertainty of b	0.031			0.032	
Ordinate intercept a	-0.948			-0.964	
Uncertainty of a	0.706			0.725	
Expanded meas. uncertainty W_{CM}	15.33	%		20.40	%
		0			
Uncertainty between Reference	0.53	µg/m³			
Uncertainty between Candidates	0.62	µg/m³			
	SN 3			SN 4	
Number of data pairs	46			44	
Slope b	1.054			1.113	
Uncertainty of b	0.044			0.049	
Ordinate intercept a	-0.279			-0.232	
Uncertainty of a	0.493			0.553	
Expanded meas. uncertainty W_{CM}	11.76	%		22.72	%
		0			
Uncertainty between Reference	0.52	µg/m³			
Uncertainty between Candidates	0.36	µg/m³			
	SN 3			SN 4	
Number of data pairs	45			45	
Slope b	1.150			1.133	
Uncertainty of b	0.050			0.051	
Ordinate intercept a	-1.383			-1.482	
Uncertainty of a	0.565			0.567	
Expanded meas. uncertainty W_{CM}	22.45	%		18.78	%
		All comparisons, ≥18 µg/m³			
Uncertainty between Reference	0.63	µg/m³			
Uncertainty between Candidates	1.13	µg/m³			
	SN 3			SN 4	
Number of data pairs	49			49	
Slope b	0.949			0.986	
Uncertainty of b	0.032			0.034	
Ordinate intercept a	1.074			1.497	
Uncertainty of a	1.002			1.05	
Expanded meas. uncertainty W_{CM}	18.25	%		20.15	%
		All comparisons, <18 µg/m³			
Uncertainty between Reference	0.53	µg/m³			
Uncertainty between Candidates	0.46	µg/m³			
	SN 3			SN 4	
Number of data pairs	145			143	
Slope b	1.114			1.165	
Uncertainty of b	0.031			0.034	
Ordinate intercept a	-1.015			-1.179	
Uncertainty of a	0.345			0.375	
Expanded meas. uncertainty W_{CM}	18.31	%		26.94	%
		All comparisons			
Uncertainty between Reference	0.55	µg/m³			
Uncertainty between Candidates	0.71	µg/m³			
	SN 3			SN 4	
Number of data pairs	194			192	
Slope b	0.976	not significant		1.027	significant
Uncertainty of b	0.013			0.013	
Ordinate intercept a	0.396	not significant		0.269	not significant
Uncertainty of a	0.228			0.245	
Expanded meas. uncertainty W_{CM}	11.97	%		14.57	%

Combined results of equivalence testing, S/N 3 & S/N 4
Measured component: PM_{10} after a correction of the slope/intercept

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010				
Candidate	APM-2	SN	SN 3 & SN 4	
		Limit value	50	µg/m³
Status of measured values	Slope and Offset corrected	Allowed uncertainty	25	%
All comparisons				
Uncertainty between Reference	**0.58**	**µg/m³**		
Uncertainty between Candidates	**1.30**	**µg/m³**		
	SN 3 & SN 4			
Number of data pairs	**193**			
Slope b	**1.001**	**not significant**		
Uncertainty of b	**0.021**			
Ordinate intercept a	**-0.023**	**not significant**		
Uncertainty of a	**0.514**			
Expanded measured uncertainty WCM	**13.55**	**%**		
All comparisons, ≥30 µg/m³				
Uncertainty between Reference	**0.72**	**µg/m³**		
Uncertainty between Candidates	**2.33**	**µg/m³**		
	SN 3 & SN 4			
Number of data pairs	**33**			
Slope b	**1.061**			
Uncertainty of b	**0.065**			
Ordinate intercept a	**-2.800**			
Uncertainty of a	**2.744**			
Expanded measured uncertainty WCM	**18.84**	**%**		
All comparisons, <30 µg/m³				
Uncertainty between Reference	**0.55**	**µg/m³**		
Uncertainty between Candidates	**0.99**	**µg/m³**		
	SN 3 & SN 4			
Number of data pairs	**160**			
Slope b	**0.998**			
Uncertainty of b	**0.041**			
Ordinate intercept a	**0.114**			
Uncertainty of a	**0.768**			
Expanded measured uncertainty WCM	**12.39**	**%**		

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	APM-2		SN	SN 3 & SN 4	
			Limit value	50	µg/m³
Status of measured values	Slope and Offset corrected		Allowed uncertainty	25	%
0					
Uncertainty between Reference	**0.54**	**µg/m³**			
Uncertainty between Candidates	**1.41**	**µg/m³**			
	SN 3			**SN 4**	
Number of data pairs	**52**			**52**	
Slope b	**0.953**			**1.006**	
Uncertainty of b	**0.023**			**0.022**	
Ordinate intercept a	**1.785**			**2.520**	
Uncertainty of a	**0.625**			**0.596**	
Expanded measured uncertainty W_{CM}	**10.65**	**%**		**15.00**	**%**
0					
Uncertainty between Reference	**0.38**	**µg/m³**			
Uncertainty between Candidates	**1.76**	**µg/m³**			
	SN 3			**SN 4**	
Number of data pairs	**51**			**51**	
Slope b	**0.967**			**1.069**	
Uncertainty of b	**0.051**			**0.055**	
Ordinate intercept a	**-0.523**			**-1.146**	
Uncertainty of a	**1.511**			**1.641**	
Expanded measured uncertainty W_{CM}	**19.25**	**%**		**20.76**	**%**
0					
Uncertainty between Reference	**0.60**	**µg/m³**			
Uncertainty between Candidates	**1.09**	**µg/m³**			
	SN 3			**SN 4**	
Number of data pairs	**47**			**45**	
Slope b	**0.873**			**0.978**	
Uncertainty of b	**0.040**			**0.044**	
Ordinate intercept a	**2.123**			**1.622**	
Uncertainty of a	**0.750**			**0.828**	
Expanded measured uncertainty W_{CM}	**18.93**	**%**		**9.59**	**%**
0					
Uncertainty between Reference	**0.76**	**µg/m³**			
Uncertainty between Candidates	**0.44**	**µg/m³**			
	SN 3			**SN 4**	
Number of data pairs	**45**			**45**	
Slope b	**0.969**			**1.008**	
Uncertainty of b	**0.065**			**0.065**	
Ordinate intercept a	**-1.719**			**-2.154**	
Uncertainty of a	**1.281**			**1.287**	
Expanded measured uncertainty W_{CM}	**16.42**	**%**		**12.16**	**%**
All comparisons, ≥30 µg/m³					
Uncertainty between Reference	**0.72**	**µg/m³**			
Uncertainty between Candidates	**2.33**	**µg/m³**			
	SN 3			**SN 4**	
Number of data pairs	**33**			**33**	
Slope b	**1.028**			**1.095**	
Uncertainty of b	**0.064**			**0.066**	
Ordinate intercept a	**-3.024**			**-2.618**	
Uncertainty of a	**2.701**			**2.81**	
Expanded measured uncertainty W_{CM}	**19.65**	**%**		**21.03**	**%**
All comparisons, <30 µg/m³					
Uncertainty between Reference	**0.55**	**µg/m³**			
Uncertainty between Candidates	**0.99**	**µg/m³**			
	SN 3			**SN 4**	
Number of data pairs	**162**			**160**	
Slope b	**0.946**			**1.053**	
Uncertainty of b	**0.038**			**0.044**	
Ordinate intercept a	**0.486**			**-0.325**	
Uncertainty of a	**0.714**			**0.826**	
Expanded measured uncertainty W_{CM}	**14.64**	**%**		**16.26**	**%**
All comparisons					
Uncertainty between Reference	**0.58**	**µg/m³**			
Uncertainty between Candidates	**1.30**	**µg/m³**			
	SN 3			**SN 4**	
Number of data pairs	**195**			**193**	
Slope b	**0.958**	**significant**		**1.045**	**significant**
Uncertainty of b	**0.020**			**0.022**	
Ordinate intercept a	**0.190**	**not significant**		**-0.253**	**not significant**
Uncertainty of a	**0.485**			**0.543**	
Expanded measured uncertainty W_{CM}	**15.03**	**%**		**16.38**	**%**