Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040336

Certified AMS:	Air Pollution Monitor 2 (APM-2) for PM_{10} and $PM_{2.5}$
Manufacturer:	Comde-Derenda GmbH Kieler Straße 9 14532 Stahnsdorf Germany
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: 2010; VDI 4203-3: 2010, EN 12341: 1998, EN 14907: 2005; Guide to Demonstration of Equivalence of Ambient Air Monitoring Methods: 2010 EN 15267-1: 2009 und EN 15267-2: 2009

Certification is awarded in respect of the conditions stated in this certificate (see also the following pages).

TÜVRheinland®
CERTIFIED

Suitability Tested
Complying with
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 2019

German Federal Environment Agency
Dessau, 9 September 2014

i. A. Dr. Marcel Langner

TÜV Rheinland Energie und Umwelt GmbH
Cologne, 8 September 2014

ppa. Dr. Peter Wilbring

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

10/221 2.08

Umwelt Bundesamt

Certificate:
0000040336 / 9 September 2014

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Test report:	936/21219977/A of 26 March 2014
Initial certification:	5 August 2014
Date of expiry:	4 August 2019
Publication:	BAnz AT 5 August 2014 B11, chapter III, no. 2.1

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

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

The AMS is approved for a temperature range of -20 °C to +50 °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 936/21219977/A of 26 March 2014 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 AT 5 August 2014 B11, chapter III, no. 2.1
  UBA announcement of 17 July 2014

AMS designation:
Air Pollution Monitor 2 (APM-2) for PM_{10} and $PM_{2.5}$

Manufacturer:
Comde-Derenda GmbH, Stahnsdorf

Field of application:
For the continuous monitoring of the PM_{10} and $PM_{2.5}$ fractions in suspended particulate matter in ambient air (stationary operation).

Measuring ranges during the performance test:

Components	Certification range	Unit
PM_{10}	0 - 1000	µg/m³
$PM_{2.5}$	0 - 1000	µg/m³

Software version:
3.0.1

Restrictions:
None

Notes:

1. The requirements as stipulated in the guidance document “Demonstration of Equivalence of Ambient Air Monitoring Methods” are fulfilled for the measured components PM_{10} and $PM_{2.5}$ after the determined correction factors/correction terms have been implemented.
2. The requirements for the equivalence test according to Standard EN 12341: 1998 for PM_{10} were not fulfilled by the candidates.
3. The long term drift of the sensitivity of the particle sensor could not be determined during the field test.
4. The measuring system can be controlled telemetrically but not operated.
5. The measuring system alternately determines the PM_{10} and $PM_{2.5}$ fractions in suspended particulate matter. During performance testing the system switched between the two fractions every two minutes.
6. After maintenance of the photometer has been completed, the measuring system shall be calibrated on site using the gravimetric PM_{10} reference method according to EN 12341. If possible, calibrations should be carried out seasonally.
7. After maintenance of the photometer has been completed, the measuring system shall be calibrated on site using the gravimetric $PM_{2.5}$ reference method according to EN 14907. If possible, calibrations should be carried out seasonally.
8. The report on the performance test is available online at www.qal1.de.

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

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

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

The APM-2 monitoring system for monitoring suspended particulate matter in ambient air is based on the measuring principle of scattered light analysis. This measuring method uses the physical characteristics of the light scattered back by micro particles. The scattered light photometer unit consists of a laser diode with stable intensity and a semiconductor-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 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 are stored on device memory as well as on SD card, if available.

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 Air Pollution Monitor 2 (APM-2) for PM_{10} and $PM_{2.5}$ 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. 0000040336: 9 September 2014

Expiration date of the certificate: 4 August 2019

Test report: 936/21219977/A of 26 March 2014
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 5 August 2014 B11, chapter III, no. 2.1
UBA announcement of 17 July 2014

Results of the equivalence test for systems SN 3 & SN 4 for the measured component $PM_{2.5}$ after correction of 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	%

Results of the equivalence test for systems SN 3 & SN 4 for the measured component $PM_{2.5}$ after correction of 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**	**%**		

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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**	**%**