TÜV RHEINLAND ENERGY GMBH

Report on the performance test of the AQ Guard Smart ambient air quality measuring system for indicative measurement of suspended particulate matter $PM_{2.5}$ and PM_{10} manufactured by Palas GmbH

TÜV Report: 936/21254495/A
Cologne, 31 March 2022

www.umwelt-tuv.de

tre-service@de.tuv.com

TÜV Rheinland Energy GmbH and its Ambient Air Quality department in particular
is accredited for the following activities:

- Determination of emissions and ambient air quality affected by air pollutants and odorous substances,
- Inspection of correct installation, function and calibration of continuously operating emission measuring instruments, including data evaluation and remote emission monitoring systems;
- Measurements in combustion chambers;
- Performance testing of measuring systems for continuous monitoring of emissions and ambient air, and of electronic data evaluation and remote emission monitoring systems;
- Determination of the stack height and air quality forecasts for hazardous and odorous substances;
- Determination of emissions and ambient air quality affected by noise and vibration, determination of sound power levels and noise measurements at wind turbines;

according to EN ISO/IEC 17025.

The accreditation has the DAkkS-Registration number: D-PL-11120-02-00
and is valid for the scope defined in the document attachment.

TÜV Rheinland Energy GmbH
D - 51105 Köln, Am Grauen Stein,
Tel: + 49 (0) 221 806-5200, fax: +49 (0) 221 806-1349

Blank page

Summary Overview

Palas GmbH, located in Karlsruhe, Germany, commissioned TÜV Rheinland Energy GmbH to carry out performance testing of the AQ Guard Smart measuring system for indicative measurement of suspended particulate matter $PM_{2.5}$ and PM_{10} in accordance with the following standards:

- Performance Standards for Indicative Ambient Particulate Monitors – Environment Agency, August 2017, Version 4
- European standard EN 12341, "Ambient air - Standard gravimetric measurement method for the determination of the PM_{10} or $PM_{2,5}$ mass concentration of suspended particulate matter"; German version EN 12341:2014
- Guide "Demonstration of Equivalence of Ambient Air Monitoring Methods", English version dated January 2010

The AQ Guard Smart is an optical aerosol spectrometer which determines particle size by means of scattered light analysis. A fan sucks ambient air via the sample inlet through a heated path directly to the spectrometer. The spectrometer detects particle sizes and converts the information via an algorithm into PM mass concentration.

The tests were performed in the laboratory and in a field test.

DAkkS Deutsche Akkreditierungsstelle D-PL-11120-02-00

Report on the performance test of the AQ Guard Smart ambient air quality measuring system for indicative measurement of suspended particulate matter $PM_{2.5}$ and PM_{10} manufactured by Palas GmbH

AMS designation:	AQ Guard Smart
Manufacturer:	Palas GmbH Greschbachstraße 3b 76229 Karlsruhe Germany
Test period:	12.2021 to 03.2022
Date of report:	31 March 2022
Report Number:	936/21254495/A
Editor:	Fritz Hausberg
Technical supervisor:	Guido Baum

Scope of the report:

Report:	55	pages
Appendix	62	
Manual	62	
Manual	64	pages
Total	126	pages

Table of contents

Blank page

List of tables

List of figures

1. General

1.1 Certification proposal

Based on the positive results obtained, the following recommendation on the announcement of the AMS as a certified system is put forward:

AMS designation:
AQ Guard Smart for suspended particulate matter $PM_{2.5}$ and PM_{10}

Manufacturer:
Palas GmbH, Karlruhe, Germany

Field of application:
For indicative measurement of dust in ambient air, $PM_{2,5}$ and PM_{10} fraction

Measurement ranges during performance testing:

Component	Certification range	Unit
$PM_{2.5}$	0–20 000	µg/m³
PM_{10}	0–20 000	µg/m³

Software version:
1.0.8

Restrictions:
None

Notes:
1. The maintenance interval is one year, as specified by the manufacturer.

Test Report:
TÜV Rheinland Energy GmbH, Cologne
Report no.936/21254495/A dated 31 March 2022

1.2 Summary report on test results

Summary of test results

Performance criterion	Requirement	Test result	Satis-fied	Page
5.1.1 General requirements for indicative particulate monitors	*Manufacturers are required to submit the following: Two identical, complete particulate monitoring systems • All necessary for operation under field conditions • All sampling components (including the sampling head, if provided)*	The manufacturer submitted two complete measuring systems.	yes	23
5.1.2 General requirements for indicative particulate monitors	*The particulate concentrations measured are generally expressed in density units (mass of determinand per unit volume of the ambient atmosphere). Results reported in units of mass per unit volume shall be expressed at measured temperature and pressure.*	The measuring values are output in µg/m³ at measured temperature and pressure (actual conditions).	yes	24
5.1.3 General requirements for indicative particulate monitors	*Instruments that have output readings sensitive to ambient air temperature and/or pressure shall be able to make corrections for changes in these parameters. These corrections may be carried out by using in-built pressure and temperature sensors or by using external sensors. The manufacturer shall provide the test house with information as to whether any in-built temperature and pressure corrections are being applied. Where no internal corrections are applied, the manufacturer or supplier shall provide the test house with any algorithms that are required for the conversion of the instrument readings to different ambient temperatures and pressures.*	The output readings are not sensitive to ambient air temperature or pressure.	yes	25
5.1.4 General requirements for indicative particulate monitors	*Instruments submitted for testing shall meet the requirements of all applicable EC Directives. These include: the Electro-magnetic Compatibility Directive 2014/30/EU (formerly 2004/108/EC); the Low Voltage Directive 2014/35/EU (formerly 2006/95/EC), covering electrical equipment designed for use within certain voltage limits, and; the Directive on the restriction of the use of certain hazardous substances*	The manufacturer declares compliance with the directives 2014/30/EU, 2014/35/EU and 2011/65/EU.	yes	26

	in electrical and electronic equipment (2011/65/EU). Instrument manufacturers or suppliers shall supply declarations of conformity to all relevant Directives applicable to the equipment.			
5.2 Response times	*For the response times RTrise and RTfall as defined in Section 4 (not determined as part of the performance tests) relevant estimates can be provided by the manufacturer.*	The response time RTrise and RTfall are both at minimum 1 second.	yes	28
5.3 Averaging times	*In cases where the monitor internally produces averaged results and where the averaging time Ta is selectable, then it shall be selected by the manufacturer or supplier, in consultation with the MCERTS Certification Committee and the test house(s). In most cases the averaging times specified for air quality monitoring given in Table 5.1 should be used. The averaging times actually used will be stated on the MCERTS certificate. Shorter averaging times may be required when the particulate monitors are used to assess individual source impact on ambient air quality in conjunction with the meteorological information.*	Data can be displayed with a resolution of 1 second and stored with an lowest averaging time of 10 seconds.	yes	29
5.4 Certification range	*The instrument manufacturer or supplier shall specify and agree with the MCERTS Certification Committee a certification range of concentrations over which the instrument is to be tested.*	The certification range is 0 – 20,000 µg/m³.	yes	30
5.6.3 Constancy of sample volumetric	*If the instruments are equipped with an air filter system for calibration the testing shall be carried out providing loaded filters, volumetric flow measuring device and a pressure measuring device. Three pre-loaded filters with the particulate load of approximately 0%, 50%, and 80% of the maximum permissible filter loading shall be used. For each filter the constancy of the sample volumetric flow shall be recorded every 30 minutes as a 3 minute average over the time period of at least 24 hours. For instruments that do not use filters, then the flow shall be recorded under normal operating conditions.*	The 24h-averages deviate from their rated values by less then -1.53%, all instantaneous values deviate by less than 3.2%.	yes	31

Performance criterion	Requirement	Test result	satis-fied	Page
5.6.4 Tightness of the sampling system	*The testing is normally carried out with the help of a pressure measuring device and a volumetric flow measuring system. The leak rate of the entire instrument shall be determined if it is feasible. This includes the inlet as well as the whole sampling system and the measuring system. If because of the instrument design the complete system tightness cannot be measured the leak rate can be determined separately for the sampling part and the measuring part. The leak rate can be measured by the determination of volume flow at the inlet and outlet of the system or by the pressure drop method. In the latter case the system is sealed at the inlet and evacuated by a built in or separate pump and the pressure increase due to leaks is measured over the period of 5 minutes.*	The leak test was passed in all cases.	yes	33
5.7.3 Intra instrument uncertainty	*The intra-instrument uncertainty for the reference method shall be ≤ 2.5 µg/m³* *The intra-instrument uncertainty for the candidate method shall be ≤ 5 µg/m³*	At no more than 0.692 µg/m³ the uncertainty between the reference method remains well below the permissible maximum of 5 µg/m³. At no more than 0.596 µg/m³ the uncertainty between the test specimen remains well below the permissible maximum of 5 µg/m³.	yes	34
5.7.4 Measurement uncertainty	*WCM ≤ Wdqo Measurement uncertainty defined as Wdqo= 50% for indicative instruments. The resultant expanded uncertainty is assessed for the full dataset, and the dataset split to be greater than 30 µg/m3 or 18 µg/m3 for PM10 or PM2.5 respectively. The less than or equal to subset of the data need not be evaluated.*	Without the need for any correction factors, the expanded uncertainties WAMS were below the expanded, relative uncertainty Wdqo defined for fine dust (indicative) at 50% for all data sets observed. As the axis intercept determined for system 1 is significantly different from 0, section 6.1 5.8.1 Use of correction factors/terms required the use of a correction factor.	yes	36
5.8.1 Use of correction factors/terms	*The final results can be corrected for slope and/or intercept to meet the acceptance criteria.* *Correction factors/terms (=calibration) shall be applied if the highest expanded uncertainty calculated for the tested instruments exceeds the relative expanded uncertainty specified under the requirements for data quality or the test demonstrates that the slope is significantly different from 1*	After the use of correction factors, the candidate systems met the requirements for data quality of air quality monitors for all data sets. The requirements had been met even before a correction factor was applied.	yes	46

	and/or the ordinate intercept is significantly different from 0.			
18 Maintenance interval (7.5.7)	*The maintenance interval of the AMS shall be greater or equal to two weeks.*	The maintenance interval is 1 year, as specified by the manufacturer.	yes	52

2. Task Definition

2.1 Nature of the test

Palas GmbH commissioned TÜV Rheinland Energy GmbH with performance testing of the AQ Guard Smart air quality monitor for indicative measurement of dust in ambient air, $PM_{2,5}$ and PM_{10} fraction.

2.2 Objectives

The air quality monitor is designed to determine suspended particulate matter $PM_{2.5}$ and PM_{10} in ambient air in the concentration range between 0 and 20,000 µg/m³.

The measuring system uses a spectrometer to determine the concentration of suspended particulate matter.

The test was performed on the basis of the following standards:

- Performance Standards for Indicative Ambient Particulate Monitors – Environment Agency, August 2017, Version 4
- European standard EN 12341, “Ambient air - Standard gravimetric measurement method for the determination of the PM_{10} or $PM_{2,5}$ mass concentration of suspended particulate matter”; German version EN 12341:2014
- Guide “Demonstration of Equivalence of Ambient Air Monitoring Methods”, English version dated January 2010

3. Description of the AMS tested

3.1 Measuring principle

The AQ Guard Smart is an optical aerosol spectrometer which determines particle size by means of scattered light analysis according to Lorenz-Mie. A fan sucks ambient air through the sample inlet through a heated path directly to the spectrometer.

The particles move separately through an optically differentiated measurement volume that is homogeneously illuminated with focused light. By using a polychromatic light source (LED) in combination with 90° scattered light detection, a precise calibration curve without any ambiguities within Mie-range can be achieved. This enables working with an extremely high resolution. Each particle generates a scattered light impulse, detected at an angle of 85° to 90° degrees. The number concentration is deducted from the number of scattered light impulses. The intensity of the scattered light is a measure for the particle size-diameter. The signal length is measured as well.

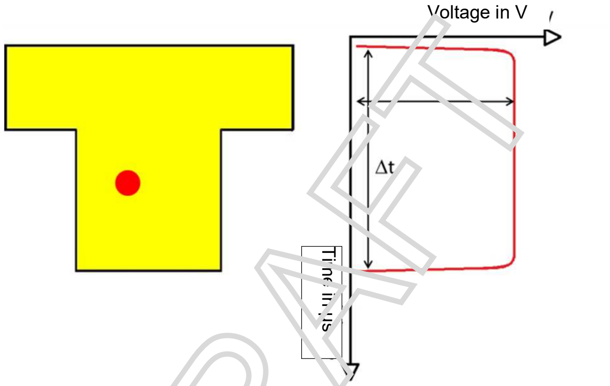

Figure 1: Measurement of scattered light signal at one single particle. Amplitude and signal length are being measured

Due to the specific T-aperture optics with simultaneous signal length measuring, border zone errors are eliminated. The term 'border zone error' refers to the merely partial illumination of particles at the end of the measuring range. This partial illumination results in the particles being classified as smaller in size than they actually are. By means of the T-aperture, particles which only fly through the T's arm (shorter signal length) can be distinguished from particles which also pass the middle part of the T (longer signal length). The latter ones have certainly been illuminated completely in the upper part. Thus, border zone errors are eliminated in the AQGuard measuring system

3.2 Functioning of the measuring system

The particle sample passes through the sample inlet at a flow rate of 1.0 l/min (operation conditions) and is led into the sampling line which connects the sampling head to the aerosol sensor. The compact IADS (Intelligent Aerosol Drying System) moisture compensation module is used in order to avoid the possible effects of condensation, especially when ambient air humidity is high. The temperature of the IADS is controlled as a function of the ambient temperature and humidity (as measured by the system). The maximum heat capacity of the compact IADS is 40 W. After passing through the compact IADS module the particle sample is led to the aerosol sensor where the actual measuring is performed.

The measuring system AQGuard Smart is equipped with integrated weather sensor for temperature, humidity and pressure.

In addition, the measuring device was equipped with gas sensors for measuring SO_2 ,NO_2, O_3 and CO. These sensors were not part of the test. The manufacturer also offers the configuration of further gas sensors. Since these configurations were not used in the test, no statement can be made about a possible influence on the PM measurement.

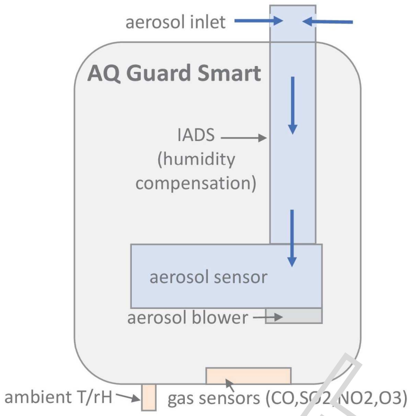

Figure 2: System principle

3.3 AMS scope and set-up

The measuring system is designed to be installed outside without any additional weather protection. The system only requires a 12 volt power supply for operation.

Figure 3: View of the AQGuard Smart

The measuring system may be operated either directly via a separate touch screen which can be connected via a cable or remotely via data interfaces over Ethernet, WiFi or cellular network (SIM-card included). The user may retrieve measurement data and system information, change parameters and perform functionality tests of the measuring system.

A zero filter can be mounted to the instrument inlet for the purpose of external zero checks. The use of this filter allows the provision of PM-free air.

To test and if necessary adjust the sensitivity of the particle sensor, the instrument shall be supplied with particles of a defined size (MonoDust 1500). The particle size distribution of this dust is monodisperse and the peak in the distribution of the raw data, which has been generated in the instrument, shall lie at the target channel given on the Monodust calibration certificate (typically 140.1). If the peak deviates from this value, the value can be adjusted. Due to this adjustment at one particle size, the sensitivity of the measuring system for all particle sizes is adjusted automatically as the instrument operates with only one A/D converter. The manufacturer recommends an annual check with MonoDust 1500.

Figure 1: MonoDust 1500 for verification / calibration of sensitivity

4. Test programme

4.1. General

The performance test was carried out using two identical instruments with the following serial numbers:

System 1 16265

System 2 16270

Software version 1.0.8 was implemented during the performance test. Algorithm PM_AQ-GUARD_0004 was used for the calculation of mass concentration for $PM_{2.5}$ and PM_{10}.

4.2 Laboratory test

The laboratory test was carried out with two identical instruments, type AQ Guard Smart, with serial numbers 16265 and 16270. Standard [1] specifies the following test programme for the laboratory test:

- Constancy of sample volumetric flow
- Tightness of the sampling system

The measured values were recorded internally. The set of raw data was downloaded and evaluated in Excel.

Chapter 6 summarizes the results of the laboratory tests.

4.3 Field test

The field test was carried out using two identical instruments with the following serial numbers:

System 1 16265
System 2 16270

Standard [2] specifies the following test programme for the field test:

- Availability
- Between-AMS uncertainty
- Expanded uncertainty
- Maintenance interval

The following instruments were used during the field test:
- Weather station (WeatherScreen PRO manufactured by dnt) for collecting meteorological data such as temperature, air pressure, humidity, wind speed, wind direction and precipitation
- reference measuring systems:
  4x SEQ 47/50 (2 for $PM_{2.5}$ and 2 for PM_{10})
- 1 mass flow meter Model 4043 (manufacturer: TSI)

During the field test, two AQGuard Smart measuring systems and four reference systems (two for $PM_{2,5}$ and two for PM_{10}) were operated simultaneously over a period of 24h.

Impaction plates of the $PM_{2.5}$ and PM_{10} sampling inlets for the reference systems were cleaned approximately every two weeks during the test period and greased with silicone grease in order to ensure reliable separation of particles.

The flow rates of the reference instruments were checked before and after each relocation using a mass flow meter in each case connected to the instrument's air inlet via a hose line.

Sites of measurement and instrument installation

Measuring systems were installed outside on the roof of the measurement container. The reference systems were placed elevated in front of the container so that the inlets are at a similar height compared to the test units.

The field test was performed at the following measurement site:

Table 1: Field test site

No.	Measurement site	Period	Description
1	Bornheim	12/2021 – 03/2022	Traffic background

The photos below show the measurement container at the field test site.

Figure 4: Field test site

In addition to the air quality measuring systems for monitoring suspended particulate matter, a data logger for meteorological data was installed at the container/measurement site. Data on air temperature, pressure, humidity, wind speed, wind direction and precipitation were continually measured.

The following dimensions describe the design of the measurement cabinet as well as the position of the sampling probes.

- Height of cabinet roof. 2.50m
- Height of the sampling system for test/ 3.70m/1.20m above cabinet roof
- Reference system 3.80m above ground
- Height of the wind vane: 4.5 m above ground level

Sampling duration

Standard EN 12341 [2] fixes the sampling time at 24 h ± 1 h.

During the entire field test, all instruments were set to a sampling time of 24 h (from 00:00 to 00:00).

Data handling

Prior to their assessment for each field test site, measured value pairs determined from reference values during the field test were submitted to a statistical Grubb's test for outliers (99%) in order to prevent distortions of the measured results from data, which evidently is implausible. Measured values pairs detected as significant outliers may be expunged from the pool of values as long as the test statistic remains above the critical value.

The following value pair has been expunged:

Table 2: Expunged value pair in line with Grubbs, reference $PM_{2,5}$

Date	Reference 1 [µg/m³]	Reference 2 [µg/m³]
26.12.2021	13.3	8.83

Filter handling – Mass measurement

The following filters were used during performance testing:

Table 3: Filter materials used

Measuring device	Filter material, type	Manufacturer
Reference devices SEQ 47/50	Emfab™, ∅ 47 mm	Pall

Filter handling was performed in compliance with EN 12341.

5. Reference Measurement Method

The following instruments were used for the field test.
4x SEQ 47/50

SEQ47/50: Sequential Sampler SEQ47/50
Manufacturer: Sven Leckel Ingenieurbüro GmbH, Berlin
$PM_{2,5}$ and PM_{10} sample inlet
No sampled filter conditioning

During the tests, the reference systems were operated in parallel with the flow controlled at 2.3 m³/h. Under normal conditions the accuracy of flow control is < 1% of the nominal flow rate.

6. Test results

6.1 5.1.1 General requirements for indicative particulate monitors

Manufacturers are required to submit the following:

- *Two identical, complete particulate monitoring systems*
- *All necessary for operation under field conditions*
- *All sampling components (including the sampling head, if provided)*

6.2 Equipment

The test of this criterion did not require any further equipment.

6.3 Testing

The two measurement sytems were checked for completeness.

6.4 Evaluation

The manufacturer delivered two complete AQGuard measuring systems. For operation, the systems require nothing but a power supply.

6.5 Assessment

The manufacturer submitted two complete measuring systems.

Criterion satisfied? yes

6.6 Detailed presentation of test results

Not required for this performance criterion

6.1 5.1.2 General requirements for indicative particulate monitors

The particulate concentrations measured are generally expressed in density units (mass of determinand per unit volume of the ambient atmosphere). Results reported in units of mass per unit volume shall be expressed at measured temperature and pressure.

6.2 Equipment

The test of this criterion did not require any further equipment.

6.3 Testing

It was checked how the measured values are output.

6.4 Evaluation

The measuring values are output in µg/m³ at measured temperature and pressure (actual conditions).

6.5 Assessment

The measuring values are output in µg/m³ at measured temperature and pressure (actual conditions).

Criterion satisfied? yes

6.6 Detailed presentation of test results

Not required for this performance criterion.

6.1 5.1.3 General requirements for indicative particulate monitors

Instruments that have output readings sensitive to ambient air temperature and/or pressure shall be able to make corrections for changes in these parameters. These corrections may be carried out by using in-built pressure and temperature sensors or by using external sensors. The manufacturer shall provide the test house with information as to whether any in-built temperature and pressure corrections are being applied. Where no internal corrections are applied, the manufacturer or supplier shall provide the test house with any algorithms that are required for the conversion of the instrument readings to different ambient temperatures and pressures.

6.2 Equipment

The test of this criterion did not require any further equipment.

6.3 Testing

The test of this criterion was made by document checks.

6.4 Evaluation

The output readings are not sensitive to ambient air temperature or pressure. Conversion to different ambient temperatures and pressures can be made using the known gas laws.

6.5 Assessment

The output readings are not sensitive to ambient air temperature or pressure.
Criterion satisfied? yes

6.6 Detailed presentation of test results

Not required for this performance criterion.

6.1 5.1.4 General requirements for indicative particulate monitors

Instruments submitted for testing shall meet the requirements of all applicable EC Directives. These include: the Electro-magnetic Compatibility Directive 2014/30/EU (formerly 2004/108/EC); the Low Voltage Directive 2014/35/EU (formerly 2006/95/EC), covering electrical equipment designed for use within certain voltage limits, and; the Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (2011/65/EU). Instrument manufacturers or suppliers shall supply declarations of conformity to all relevant Directives applicable to the equipment.

6.2 Equipment

The test of this criterion did not require any further equipment.

6.3 Testing

The declaration of conformitiy was checked for the demanded EC Directives.

6.4 Evaluation

The manufacturer declares compliance with the directives 2014/30/EU, 2014/35/EU and 2011/65/EU.

6.5 Assessment

The manufacturer declares compliance with the directives 2014/30/EU, 2014/35/EU and 2011/65/EU.

Criterion satisfied? yes

6.6 Detailed presentation of test results

EU- Declaration of Conformity

PALAS®

The Manufacturer

Palas GmbH
Greschbachstraße 3 b
76229 Karlsruhe
Germany

hereby declares that the products

Aerosol Spectrometers:
AQ Guard
AQ Guard Ambient
AQ Guard Smart

are in conformity with the following Directive:

2014/53/EU	Radio Equipment Directive (RED)
2011/65/EU	RoHS

The protection goals of the following Directives are observed:

2014/35/EU	Low Voltage Directive
2014/30/EU	Electromagnetic Compatibility (EMC)

The following harmonized standards have been applied:

DIN EN 61010-1:2020-03	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements (IEC 61010-1:2010 + COR:2011 + A1:2016, modified + A1:2016/COR1:2019)
DIN EN 61326-1:2013-07	Electrical Equipment for Measurement, Control and Laboratory Use. EMC Requirements. General Requirements (IEC 61326-1:2012)
DIN EN IEC 63000:2019-05	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances (IEC 63000:2016)

Karlsruhe, February 18, 2022

Dr.-Ing. Maximilian Weiß
General Manager

www.palas.de

PALASCOUNTS

6.1 5.2 Response times

For the response times RT_{rise} and RT_{fall} as defined in Section 4 (not determined as part of the performance tests) relevant estimates can be provided by the manufacturer.

6.2 Equipment

The test of this criterion did not require any further equipment.

6.3 Testing

The manufacturer provides relevant estimates.

6.4 Evaluation

The response time RT_{rise} and RT_{fall} are both dependent on the way to obtain reading. On the display of the measuring system or via remote access, the response time is 1 second.

For the so-called “promo” files, which can be converted with PDAnalyzer, the temporal resolution is 120 seconds.

For the text file and the data transfer protocols, both the averaging and the storage interval can be selected. The smallest interval here is one second, the smallest averaging 10s.

6.5 Assessment

The response time RT_{rise} and RT_{fall} are both at minimum 1 second.

Criterion satisfied? yes

6.6 Detailed presentation of test results for the rated flow

Not required for this performance criterion.

6.1 5.3 Averaging times

In cases where the monitor internally produces averaged results and where the averaging time T_a is selectable, then it shall be selected by the manufacturer or supplier, in consultation with the MCERTS Certification Committee and the test house(s). In most cases the averaging times specified for air quality monitoring given in Table 5.1 should be used. The averaging times actually used will be stated on the MCERTS certificate. Shorter averaging times may be required when the particulate monitors are used to assess individual source impact on ambient air quality in conjunction with the meteorological information.

6.2 Equipment

The test of this criterion did not require any further equipment.

6.3 Testing

The averaging time is determined.

6.4 Evaluation

On the display of the measuring device or via remote access, the averaging time is 1 second.

For the so-called “promo” files, which can be converted with PDAnalyzer, the temporal resolution is 120 seconds.

For the text file and the data transfer protocols, both the averaging and the storage interval can be selected. The smallest interval here is one second, the smallest averaging 10s.

6.5 Assessment

Data can be displayed with a resolution of 1 second and stored with an lowest averaging time of 10 seconds.

Criterion satisfied? yes

6.6 Detailed presentation of test results

Not required for this performance criterion.

6.1 5.4 Certification range

The instrument manufacturer or supplier shall specify and agree with the MCERTS Certification Committee a certification range of concentrations over which the instrument is to be tested.

6.2 Equipment

The test of this criterion did not require any further equipment.

6.3 Testing

The certification range is set.

6.4 Evaluation

The certification range is 0 – 20,000 µg/m³.

6.5 Assessment

The certification range is 0 – 20,000 µg/m³.
Criterion satisfied? yes

6.6 Detailed presentation of test results

Not required for this performance criterion.

6.1 5.6.3 Constancy of sample volumetric

If the instruments are equipped with an air filter system for calibration the testing shall be carried out providing loaded filters, volumetric flow measuring device and a pressure measuring device. Three pre-loaded filters with the particulate load of approximately 0%, 50%, and 80% of the maximum permissible filter loading shall be used. For each filter the constancy of the sample volumetric flow shall be recorded every 30 minutes as a 3 minute average over the time period of at least 24 hours. For instruments that do not use filters, then the flow shall be recorded under normal operating conditions.

6.2 Equipment

For this test, an additional reference flow meter was provided.

6.3 Testing

The AQGuard measuring system operates at a flow rate of 1 l/min.

To determine the constancy of the sample flow rate, the flow rate was recorded and evaluated with the help of a mass flow meter once over a period of 24h.

6.4 Evaluation

The average, standard deviation as well as the maximum and minimum values were determined from the measured values for the flow rate (24-hour average).

6.5 Assessment

No deviations exceeding 3.2% were found in the flow rate controls in the field (short-term value).

The results of the constancy of the sample flow rate demonstrate that all measured values determined during sampling deviate from their respective rated values by less than 3.2%. The deviation of the daily averages for the overall flow rate of 1 l/min did not exceed -1.53% of the rated value.

The 24h-averages deviate from their rated values by less then -1.53%, all instantaneous values deviate by less than 3.2%.

Criterion satisfied? yes

6.6 Detailed presentation of test results

Table 4: Performance characteristics for the overall flow rate measurement

		Device SN 16265	Device SN 16270
Mean value	l/min	0,98	0,99
Dev. from nominal value	%	-1,53	-1,43
Standard deviation	l/min	0,01	0,01
Minimum value	l/min	0,968	0,976
Maximum value	l/min	1,006	0,998

6.1 5.6.4 Tightness of the sampling system

The testing is normally carried out with the help of a pressure measuring device and a volumetric flow measuring system. The leak rate of the entire instrument shall be determined if it is feasible. This includes the inlet as well as the whole sampling system and the measuring system. If because of the instrument design the complete system tightness cannot be measured the leak rate can be determined separately for the sampling part and the measuring part. The leak rate can be measured by the determination of volume flow at the inlet and outlet of the system or by the pressure drop method. In the latter case the system is sealed at the inlet and evacuated by a built in or separate pump and the pressure increase due to leaks is measured over the period of 5 minutes. The leak rate V_L determination shall be repeated three times. It is calculated from the following formula:

$$V = \frac{\Delta P . V_g}{P_0 . \Delta t}$$

where: ΔP – pressure drop determined over the time interval Δt
P_0- pressure at time t_0
V_g- estimated total volume of the system
Δt- time interval of the pressure increment

6.2 Equipment

Zero filter

6.3 Testing

The measuring device does not use a conventional pump for sampling but a fan. For the leak test, a zero filter must therefore be mounted at the device inlet and the leak test must be started in the software.

The measuring device now waits automatically until the particle concentration is constant at 0.00 1/cm³. The fan speed is then set to the highest level. If there were any leaks, particles would now enter the measuring chamber due to the higher negative pressure. If the particle concentration remains at 0.00 1/cm³, the leak test is considered to have been passed. This is displayed in the software / on the screen.

6.4 Evaluation

The leak test was carried out in the laboratory.

6.5 Assessment

The leak test was passed in all cases.

Criterion satisfied? yes

6.6 Detailed presentation of test results

Not required for this performance criterion.

6.1 5.7.3 Intra instrument uncertainty

The intra-instrument uncertainty for the reference method shall be ≤ 2.5 µg/m³
The intra-instrument uncertainty for the candidate method shall be ≤ 5 µg/m³

6.2 Equipment

Not required for this performance criterion

6.3 Testing

The test was performed as part of the field test.

6.4 Evaluation

The performance criteria must be met for the candidate method for all data as well as for the subsets: less than and greater than or equal to 30 µg/m³ or 18 µg/m³ for PM_{10} or $PM_{2.5}$, respectively. The “greater than” data subset shall contain at least 8 data pairs. If 80 data pairs are produced still without generating the required 8 data pairs in the “greater than” subset then this is considered sufficient and the testing may be terminated.

6.5 Assessment

At no more than 0.692 µg/m³ the uncertainty between the reference method remains well below the permissible maximum of 5 µg/m³. At no more than 0.596 µg/m³ the uncertainty between the test specimen remains well below the permissible maximum of 5 µg/m³.

Criterion satisfied? yes

6.6 Detailed presentation of test results

Table 5: Intra-instrument uncertainty for the reference method

Component	Number of measurements	Uncertainty $u_{bs,RM}$
		µg/m³
$PM_{2.5}$	94	0.474
PM_{10}	94	0.692

Table 6: Intra-instrument uncertainty for the candidate method, $PM_{2.5}$

Location	Number of measurements	Uncertainty $u_{bs,CM}$
		µg/m³
Bornheim	94	0,512
> 18 µg/m³	11	0.275
≤ 18 µg/m³	82	0.292

Table 7: Intra-instrument uncertainty for the candidate method, PM_{10}

Location	**Number of measurements**	**Uncertainty $u_{bs,CM}$**
		µg/m³
Bornheim	94	0.462
> 18 µg/m³	2	0.596
≤ 18 µg/m³	81	0.480

6.1 5.7.4 Measurement uncertainty

$W_{CM} \leq W_{dqo}$ Measurement uncertainty defined as W_{dqo}= 50% for indicative instruments. The resultant expanded uncertainty is assessed for the full dataset, and the dataset split to be greater than 30 µg/m³ or 18 µg/m³ for PM_{10} or $PM_{2.5}$ respectively. The less than or equal to subset of the data need not be evaluated.

6.2 Equipment

An additional reference measurement system as described in chapter 5 of this report was used for this test.

6.3 Testing

The test was performed as part of the field test with two separate comparison sets.

6.4 Evaluation

The measurement uncertainty will be calculated according to the Guidline for the Demonstration of Equivalence of Ambient Air Monitoring Methods:

1. Of the full data set, at least 8 of the concentration values (determined with the reference method) shall be greater than 30 µg/m³ for PM_{10} and 18 µg/m³ for $PM_{2.5}$. When, due to low concentration levels, the criteria for 8 of the results to be greater than 30 µg/m³ for PM_{10}, or to be greater than 18 µg/m³ for $PM_{2,5}$ cannot be obtained, a minimum of 80 data points overall is considered sufficient.
2. The expanded uncertainty (W_{CM}) is calculated at 50 µg/m³ for PM_{10} and at 30 µg/m³ for $PM_{2.5}$ for every individual test specimen and checked against the average of the reference method. For each of the following cases, the expanded uncertainty shall not exceed 50%:
   - Full data set:
   - Datasets representing PM concentrations greater than/equal to 30 µg/m³ for PM_{10}, or concentrations greater than/equal to 18 µg/m³ for $PM_{2.5}$
   - Datasets for each individual site
3. Preconditions for acceptance of the full dataset are that the slope b is insignificantly different from $|b-1| \leq 2 \cdot u(b)$ and the intercept a is insignificantly different from 0: $|a| \leq 2 \cdot u(a)$. If these preconditions are not met, calibrations may be made using the values obtained for slope and/or intercept.

Chapter 6.1 5.8.1 Use of correction factors/terms contains an assessment for the case that the uncertainty is not complied with without applying correction factors.

The regression is calculated for:

- all sites or comparisons respectively together
- Every location or comparison separately
- For a reduced data set only taking into account concentrations greater than or equal 30 µg/m³ for PM_{10} and 18 µg/m³ for $PM_{2.5}$.

For further assessment, the uncertainty u_{c_s} resulting from a comparison of the test specimens with the reference method is described in the following equation which defines u_{CR} as a function of the fine dust concentration x_i.

$$u_{yi}^2 = \frac{RSS}{(n-2)} - u_{RM}{}^2 + [a + (b-1)L]^2$$

Where RSS is the sum of the (relative) residuals from orthogonal regression

u_{RM} =random uncertainty of the reference method; u_{RM} is calculated as $u_{bs,RM}/\sqrt{2}$, where $u_{bs,RM}$ is the between RM uncertainty of two reference instruments operated in parallel.

L = Replacement daily limit value

The algorithms for calculating axis intercept a and slope b as well as their variance by means of orthogonal regression are described in detail in the annex to [3].
The sum of (relative) residuals RSS is calculated according to the following equation:

$$RSS = \sum_{i=1}^{n} (y_i - a - bx_i)^2$$

Uncertainty u_{CR} is calculated for:

- All sites or comparisons respectively together
- Every location or comparison separately
- For a reduced data set only taking into account concentrations greater than or equal to 30 µg/m³ for PM_{10} and 18 µg/m³ for $PM_{2.5}$.

The guideline states the following prerequisite for accepting the full data set:

- The slope be is insignificantly different from 1: $|b-1| \le 2 \cdot u(b)$

and

- The axis intercept a is insignificantly different from 0: $|a| \le 2 \cdot u(a)$, where u(a) and u(b) describe the standard uncertainty of the slope and the axis intercept calculated as the square root of the variance. If the prerequisites are not met, it is possible to calibrate the measuring systems in accordance with section 4 of the Guideline 7.5.8.6 [3]. The calibration may only be performed for the full data set.

The combined uncertainty of the tested instruments for all data sets w^2_{AMS} is calculated as follows:

$$w^2_{AMS} = \frac{u^2_{yi=L}}{L^2}$$

For each data set the uncertainty w_{AMS} is calculated at a level of L = 30 µg/m³ for $PM_{2.5}$ as well as L = 50 µg/m³ for PM_{10}.

For each data set the expanded relative uncertainty of the results measured with the test specimen is calculated by multiplying w_{AMS} by an coverage factor k according to the following equation:

$$W_{AMS} = k \cdot w_{AMS}$$

Considering the large number of available test results, an expansion factor k=2 must be used.

7.5 Assessment

Without the need for any correction factors, the expanded uncertainties W_{AMS} were below the expanded, relative uncertainty W_{dqo} defined for fine dust (indicative) at 50% for all data sets observed. As the axis intercept determined for system 1 is significantly different from 0, section 6.1 5.8.1 Use of correction factors terms required the use of a correction factor.

Criterion satisfied? yes

The slope and the axis intercept is significantly different from 1 (slope) and 0 (axis intercept) for both system for $PM_{2.5}$. The slope is significantly different from 1 for both system for PM_{10}. This is why chapter 6.1 5.8.1 Use of correction factors/terms contains an additional assessment for which the corresponding calibration factor was applied to the data sets.

It should be noted here that the uncertainty W_{CM} determined without applying correction factors for all observed data sets is below the determined expanded relative uncertainty W_{dqo} of 50% for $PM_{2.5}$ and PM_{10}.

Since for PM_{10} only 2 values were greater than 30 µg/m³, no meaningful static evaluation could be made here.

6.6 Detailed presentation of test results

Table 8: Overview of equivalence testing, both systems, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.905 +/- 0.022 Significantly different from 1
Intercept	Intercept (a) = 1.228 +/- 0.231 µg m-3 Significantly different from 0
n	n = 93
R^2	R Squared = 0.948
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 13.57 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.474 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = 0.289 µg m-3
n(RM)>	Number of RM greater than 17 µg m-3 = 13
None	

Table 9: Overview of equivalence testing, system 16265, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.91 +/- 0.023 Significantly different from 1
Intercept	Intercept (a) = 1.243 +/- 0.241 µg m-3 Significantly different from 0
n	n = 93
R^2	R Squared = 0.943
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 13.02 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.474 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 13
None	

Table 10: Overview of equivalence testing, system 16270, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.902 +/- 0.021 Significantly different from 1
Intercept	Intercept (a) = 1.202 +/- 0.226 µg m-3 Significantly different from 0
n	n = 93
R^2	R Squared = 0.949
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 14.17 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.474 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 13
None	

Table 11: Overview of equivalence testing, all values >= 18 µg/m³, both systems, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.944 +/- 0.141 Not Significantly different from 1
Intercept	Intercept (a) = -0.156 +/- 3.009 µg m-3 Not Significantly different from 0
n	n = 11
R^2	R Squared = 0.802
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 15.23 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.566 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = 0.275 µg m-3
n(RM)>	Number of RM greater than 17 µg m-3 = 11
None	

Table 12: Overview of equivalence testing, all values >= 18 µg/m³, system 16265, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.93 +/- 0.149 Not Significantly different from 1
Intercept	Intercept (a) = 0.17 +/- 3.183 µg m-3 Not Significantly different from 0
n	n = 11
R^2	R Squared = 0.773
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 16.1 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.566 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 11
None	

Table 13: Overview of equivalence testing, all values >= 18 µg/m³, system 16270, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.962 +/- 0.135 Not Significantly different from 1
Intercept	Intercept (a) = -0.565 +/- 2.885 µg m-3 Not Significantly different from 0
n	n = 11
R^2	R Squared = 0.824
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 14.28 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.566 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 11
None	

Table 14: Overview of equivalence testing, all sites, both systems, PM_{10}

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.926 +/- 0.034 Significantly different from 1
Intercept	Intercept (a) = -0.435 +/- 0.615 µg m-3 Not Significantly different from 0
n	n = 83
R^2	R Squared = 0.891
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 18.68 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.692 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = 0.428 µg m-3
n(RM)>	Number of RM greater than 28 µg m-3 = 3
None	

Table 15: Overview of equivalence testing, all sites, system 16265, PM_{10}

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.928 +/- 0.035 Significantly different from 1
Intercept	Intercept (a) = -0.354 +/- 0.638 µg m-3 Not Significantly different from 0
n	n = 83
R^2	R Squared = 0.883
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 18.23 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.692 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 28 µg m-3 = 3
None	

Table 16: Overview of equivalence testing, all sites, system 16270, PM_{10}

Show Parameters on Graph in Order	
Correction	CM data not corrected
Slope	Slope (b) = 0.926 +/- 0.033 Significantly different from 1
Intercept	Intercept (a) = -0.546 +/- 0.603 µg m-3 Not Significantly different from 0
n	n = 83
R^2	R Squared = 0.895
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 19.01 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.692 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 28 µg m-3 = 3
None	

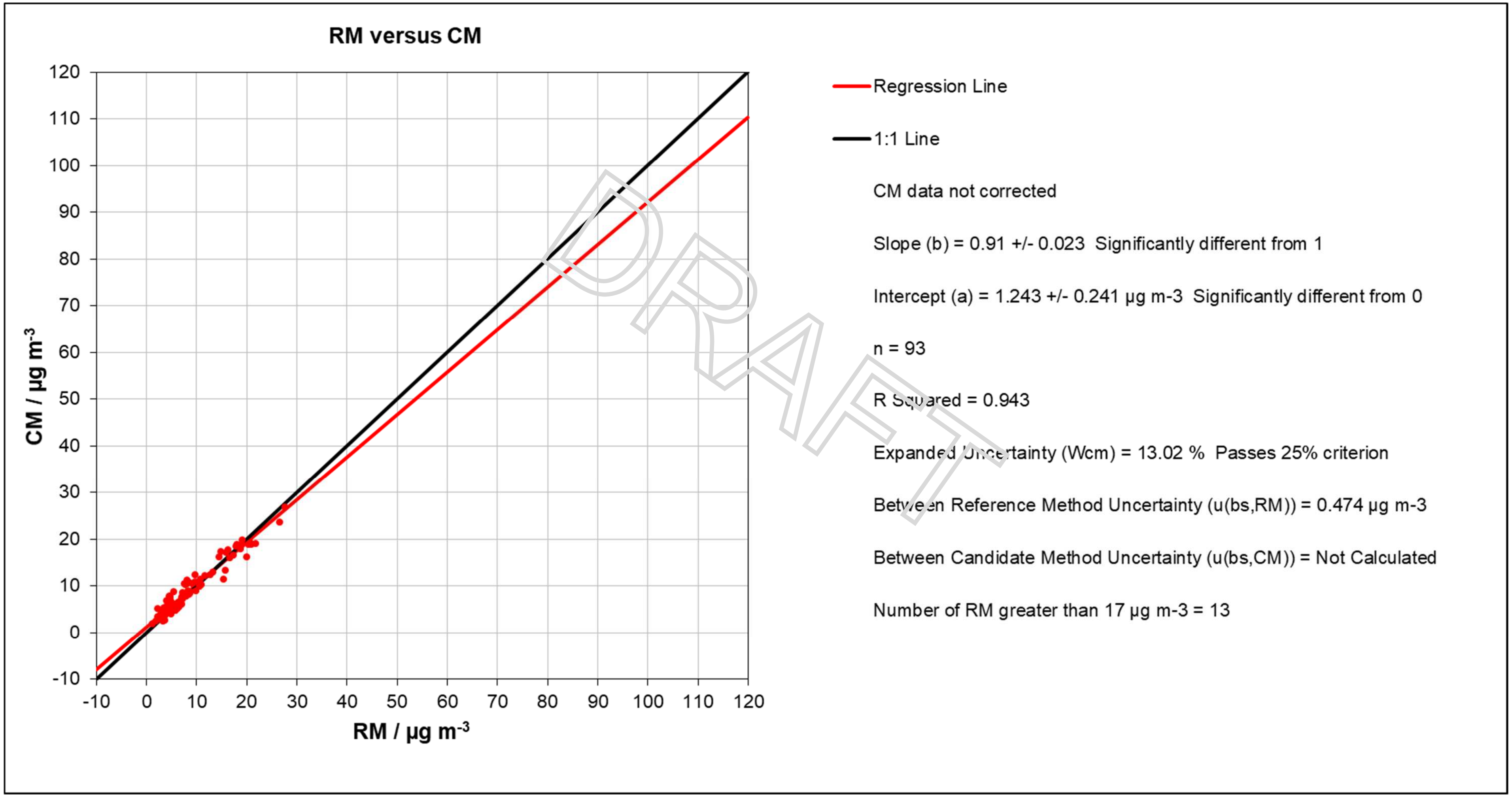

Figure 5: Reference vs. Tested instrument, system 16265, $PM_{2.5}$

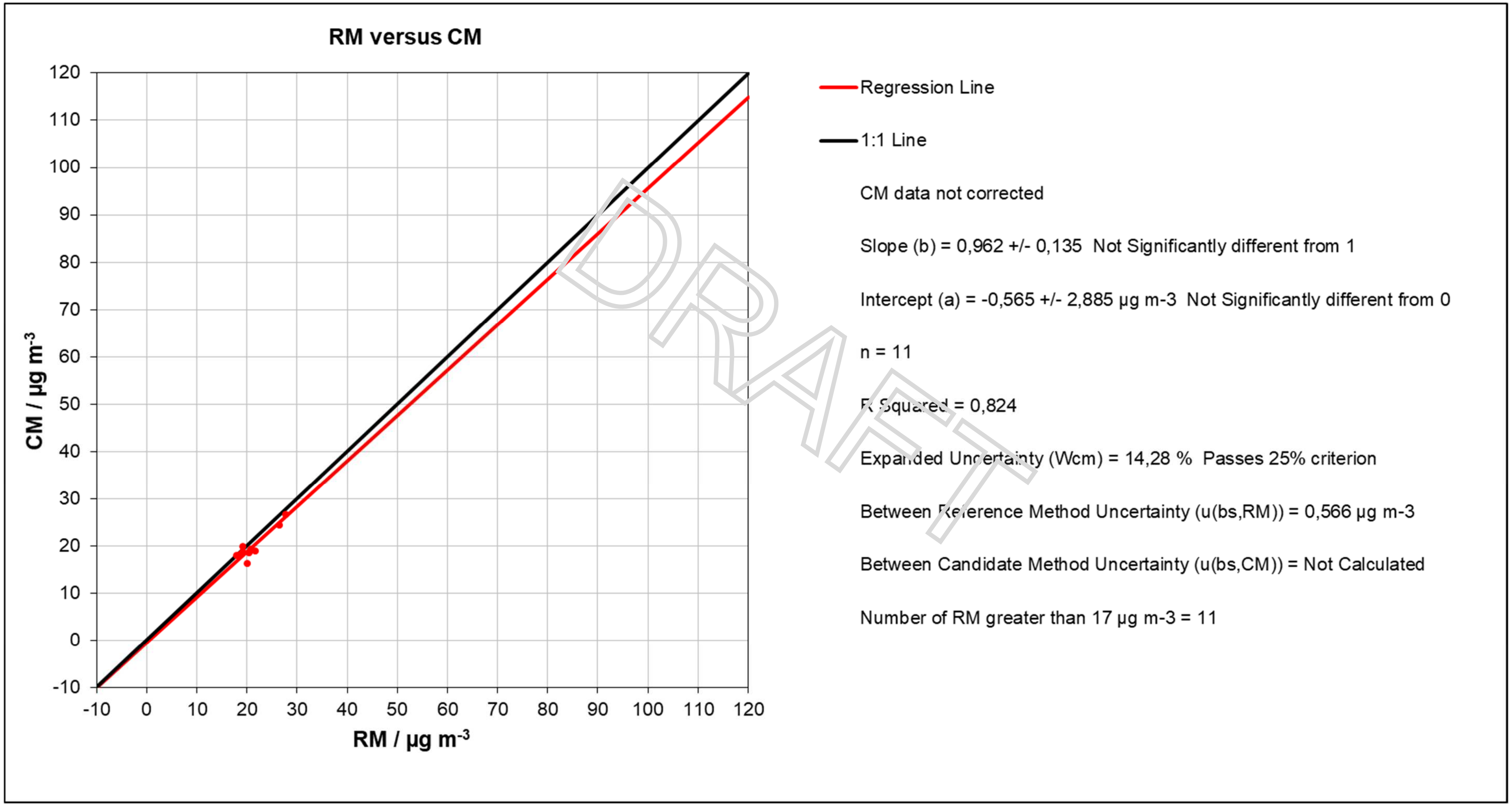

Figure 6: Reference vs. Tested instrument, system 16270, $PM_{2.5}$

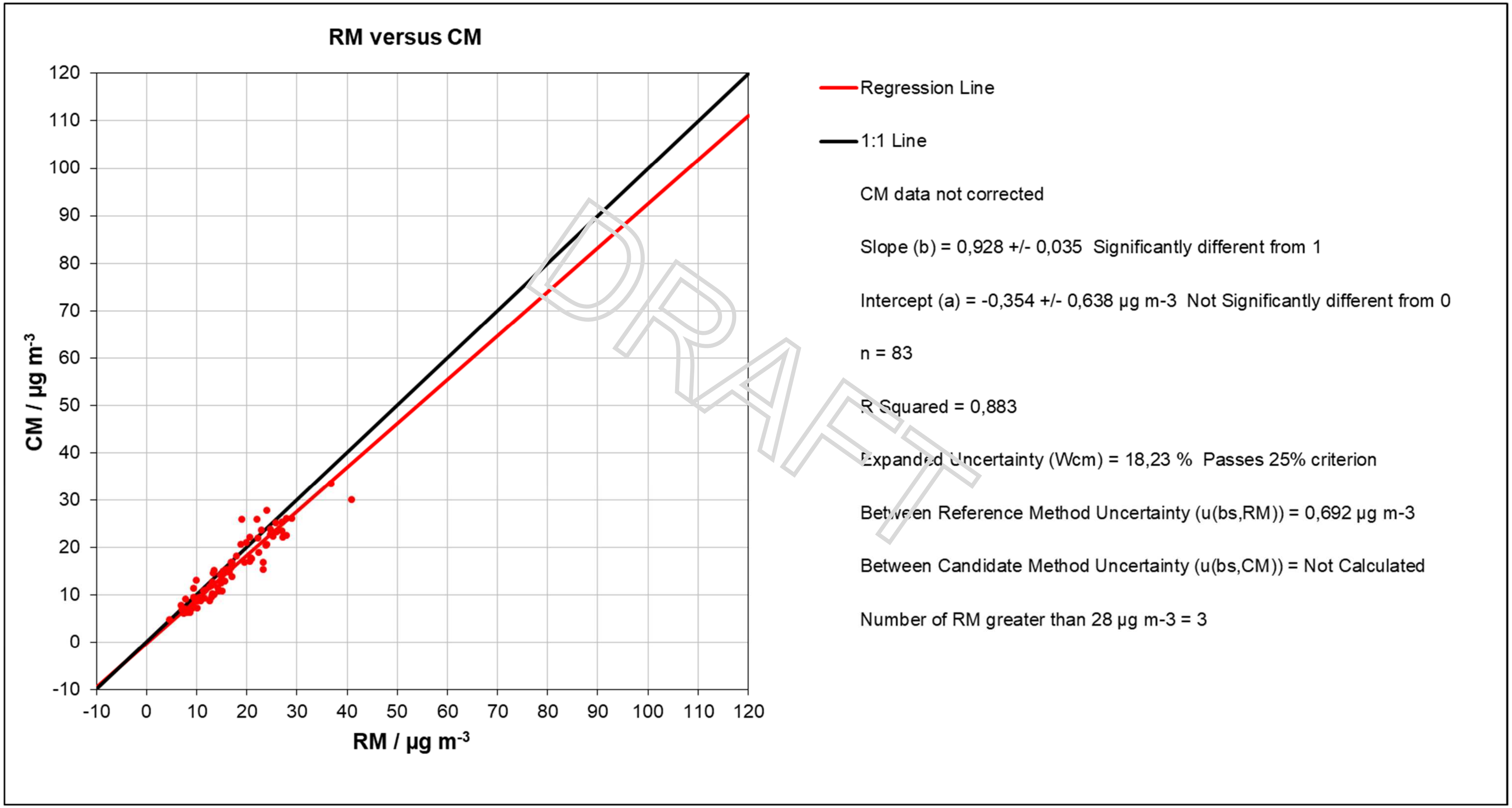

Figure 7: Reference vs. Tested instrument, system 16265, PM_{10}

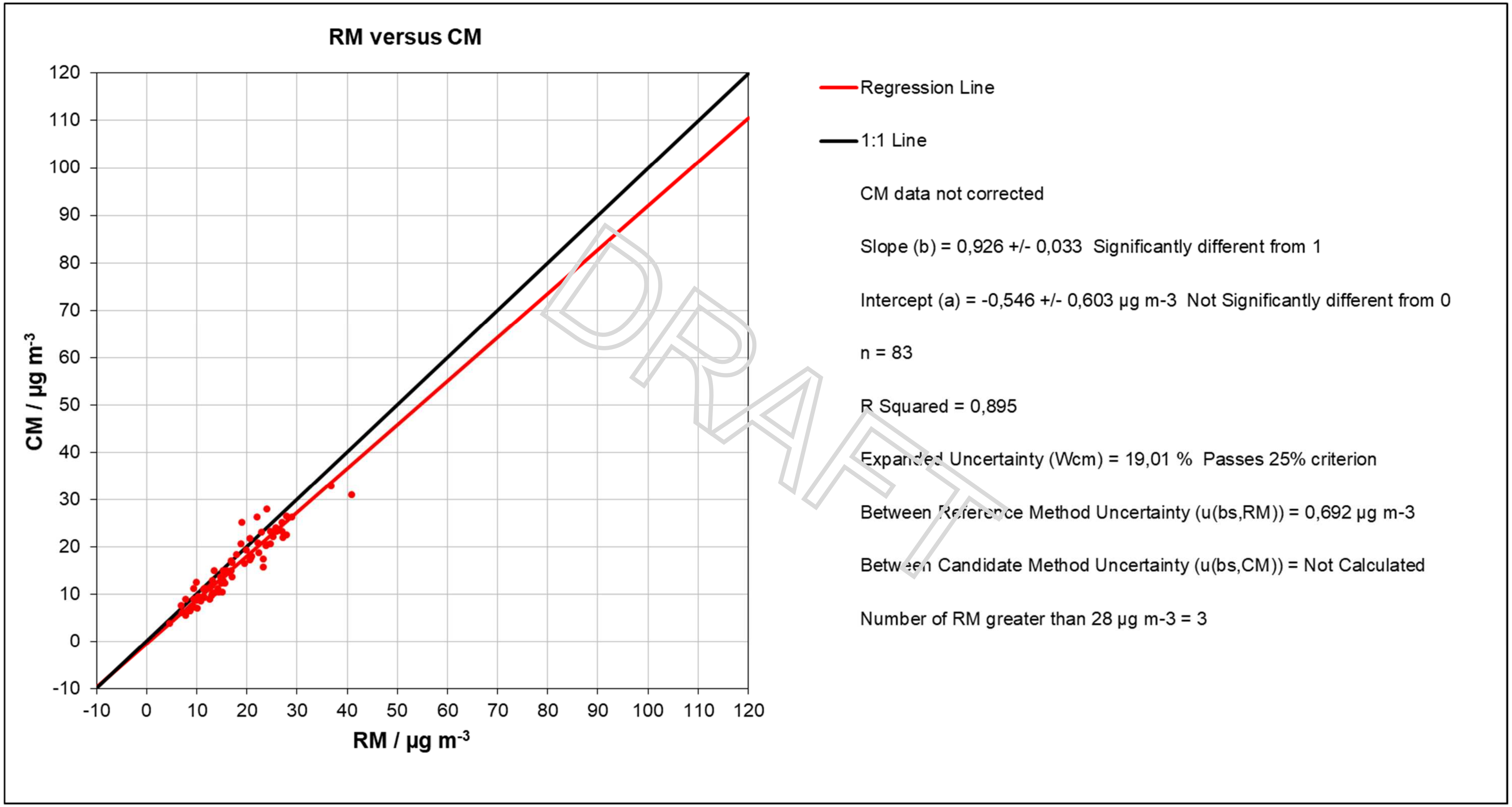

Figure 8: Reference vs. Tested instrument, system 16270, PM_{10}

6.1 5.8.1 Use of correction factors/terms

The final results can be corrected for slope and/or intercept to meet the acceptance criteria. Correction factors/terms (=calibration) shall be applied if the highest expanded uncertainty calculated for the tested instruments exceeds the relative expanded uncertainty specified under the requirements for data quality or the test demonstrates that the slope is significantly different from 1 and/or the ordinate intercept is significantly different from 0.

6.2 Equipment

Not required for this performance criterion

6.3 Testing

See chapter 6.1 5.7.4 Measurement uncertainty

6.4 Evaluation

If it emerges from the evaluation of raw that $W_{AMS} > W_{dqo}$, (i.e. AMS uncertainty > 50%) i.e. the tested instrument is not found to be equivalent with the reference method, then it is permissible to use a correction factor or term which results from the regression equation for the full data set. The corrected values have to meet the requirements for all data sets or sub data sets. Moreover, a correction may also be used for the case that $W_{AMS} \leq W_{dqo}$ in order to improve the accuracy of the tested instruments.

Three different situations may occur:

a) Slope b is not significantly different from 1: $|b-1| \leq 2u(b)$

   Axis intercept a is significantly different from 0: $|a| > 2u(a)$

b) Slope b is significantly different from 1: $|b-1| > 2u(b)$

   axis intercept a is not significantly different from 0: $|a| \leq 2u(a)$

b) Slope b is significantly different from 1: $|b-1| > 2u(b)$

   Axis intercept a is significantly different from 0: $|a| > 2u(a)$

concerning a)

The value of the axis intercept a may be used as a correction term to correct all input values y_i according to the following equation:

$$y_{i,corr} = y_i - a$$

The corrected values $y_{i,corr}$ may then serve to calculate the following new terms using linear regression:

$$y_{i,corr} = c + dx_i$$

and

$$u_{yi,corr}^2 = \frac{RSS}{(n-2)} - u_{RM}{}^2 + [c + (d-1)L]^2 + u^2(a)$$

where u(a) = uncertainty of the axis intercept a, whose value was used to determine $y_{i,corr}$.

The algorithms for calculating axis intercepts and slopes as well as their variance by means of orthogonal regression are described in detail in the annex to [3].

concerning b)

The value of the slope b may be used as a correction term to correct all input values y_i according to the following equation:

$$y_{i,corr} = \frac{y_i}{b}$$

The corrected values $y_{i,corr}$ may then serve to calculate the following new terms using a new linear regression:

$$y_{i,corr} = c + dx_i$$

and

$$u^2_{yi,corr} = \frac{RSS}{(n-2)} - u_{RM}{}^2 + [c + (d-1)L]^2 + L^2 u^2(b)$$

where u(b) = uncertainty of the original slope b, whose value was used to determine $y_{i,corr}$.

The algorithms for calculating axis intercepts and slopes as well as their variance by means of orthogonal regression are described in detail in the annex to [3].

concerning c)

The values of the slope b and the axis intercept a may be used as a correction terms to correct all input values y_i according to the following equation:

$$y_{i,corr} = \frac{y_i - a}{b}$$

The corrected values $y_{i,corr}$ may then serve to calculate the following new terms using a new linear regression:

$$y_{i,corr} = c + dx_i$$

and

$$u^2_{yi,corr} = \frac{RSS}{(n-2)} - u_{RM}{}^2 + [c + (d-1)L]^2 + L^2 u^2(b) + u^2(a)$$

where u(b) = uncertainty of the original slope b, whose value was used to determine $y_{i,corr}$ and u(a) = uncertainty of the original axis intercept a, whose value was used to determine $y_{i,corr}$.

The algorithms for calculating axis intercepts and slopes as well as their variance by means of orthogonal regression are described in detail in the annex to [3].

The values for $u_{c\_s,corr}$ are then used to calculate the combined relative uncertainty of the AMS after correction in accordance with the following equation:

$$w^2_{AMS,corr} = \frac{u^2_{corr,yi=L}}{L^2}$$

The uncertainty $w_{AMS,corr}$ for the corrected data set is calculated at the 24h limit value using y_i as concentration at the limit value.

The relative expanded uncertainty $W_{AMS,corr}$ is calculated using the following equation:

$$W_{AMS',corr} = k \cdot w_{AMS,corr}$$

Considering the large number of available test results, an expansion factor k=2 must be used.

The largest resulting uncertainty $W_{AMS,corr}$ is compared and assessed against the criteria for data quality of air quality measurements in accordance with EU Directive [8]. Two situations are conceivable:

1. $W_{AMS,corr} \leq W_{dqo}$ → The tested instrument is deemed equivalent to the reference method.

2. $W_{AMS,corr} > W_{dqo}$ → The tested instrument is not deemed equivalent to the reference method.

The expanded relative uncertainty W_{dqo} specified is 50%.

6.5 Assessment

After the use of correction factors, the candidate systems met the requirements for data quality of air quality monitors for all data sets. The requirements had been met even before a correction factor was applied.

Criterion satisfied? yes

For $PM_{2.5}$:

In evaluating the full dataset, it emerged that the slope and axis intercerpt determined for both instruments is significantly different from 1 (slope) and 0 (axis intercept).

The full data set was corrected in terms of the slope (dividing by 0.905) and axis intercept (subtracting 1.228). All data sets were re-evaluated using the corrected values.

For PM_{10}:

In evaluating the full dataset, it emerged that the slope determined for both instruments is significantly different from 1.

The full data set was corrected in terms of the slope (dividing by 0.926). All data sets were re-evaluated using the corrected values.

6.6 Detailed presentation of test results

The tables in the following show the evaluation results of the equivalence test after applying the correction factor to the full data set.

Table 17: Overview of equivalence testing, both systems, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data corrected by subtracting 1,228 then dividing by 0,905
Slope	Slope (b) = 1.003 +/- 0.024 Not Significantly different from 1
Intercept	Intercept (a) = -0.024 +/- 0.255 µg m-3 Not Significantly different from 0
n	n = 93
R^2	R Squared = 0.948
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 10.26 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.474 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = 0.319 µg m-3
n(RM)>	Number of RM greater than 17 µg m-3 = 13
None	

Table 18: Overview of equivalence testing, system 16265, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data corrected by subtracting 1,228 then dividing by 0,905
Slope	Slope (b) = 1.008 +/- 0.025 Not Significantly different from 1
Intercept	Intercept (a) = -0.008 +/- 0.266 µg m-3 Not Significantly different from 0
n	n = 93
R^2	R Squared = 0.943
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 10.75 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.474 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 13
None	

Table 19: Overview of equivalence testing, system 16270, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data corrected by subtracting 1,228 then dividing by 0,905
Slope	Slope (b) = 0.999 +/- 0.024 Not Significantly different from 1
Intercept	Intercept (a) = -0.051 +/- 0.25 µg m-3 Not Significantly different from 0
n	n = 93
R^2	R Squared = 0.949
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 10.1 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.474 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 13
None	

Table 20: Overview of equivalence testing, all values >= 18 µg/m³, both systems, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data corrected by subtracting 1,228 then dividing by 0,905
Slope	Slope (b) = 1.056 +/- 0.156 Not Significantly different from 1
Intercept	Intercept (a) = -1.786 +/- 3.324 µg m-3 Not Significantly different from 0
n	n = 11
R^2	R Squared = 0.802
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 11.28 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.566 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = 0.303 µg m-3
n(RM)>	Number of RM greater than 17 µg m-3 = 11
None	

Table 21: Overview of equivalence testing, all values >= 18 µg/m³, system 16265, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data corrected by subtracting 1,228 then dividing by 0,905
Slope	Slope (b) = 1.042 +/- 0.165 Not Significantly different from 1
Intercept	Intercept (a) = -1.467 +/- 3.517 µg m-3 Not Significantly different from 0
n	n = 11
R^2	R Squared = 0.773
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 11.05 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.566 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 11
None	

Table 22: Overview of equivalence testing, all values >= 18 µg/m³, system 16270, $PM_{2.5}$

Show Parameters on Graph in Order	
Correction	CM data corrected by subtracting 1,228 then dividing by 0,905
Slope	Slope (b) = 1.074 +/- 0.149 Not Significantly different from 1
Intercept	Intercept (a) = -2.209 +/- 3.188 µg m-3 Not Significantly different from 0
n	n = 11
R^2	R Squared = 0.824
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 10.81 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.566 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 17 µg m-3 = 11
None	

Table 23: Overview of equivalence testing, both systems, PM_{10}

Show Parameters on Graph in Order	
Correction	CM data corrected by dividing by 0.926
Slope	Slope (b) = 1.005 +/- 0.037 Not Significantly different from 1
Intercept	Intercept (a) = -0.545 +/- 0.664 µg m-3 Not Significantly different from 0
n	n = 83
R^2	R Squared = 0.891
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 11.86 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.692 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = 0.462 µg m-3
n(RM)>	Number of RM greater than 28 µg m-3 = 3
None	

Table 24: Overview of equivalence testing, system 16265, PM_{10}

Show Parameters on Graph in Order	
Correction	CM data corrected by dividing by 0.926
Slope	Slope (b) = 1.007 +/- 0.038 Not Significantly different from 1
Intercept	Intercept (a) = -0.463 +/- 0.689 µg m-3 Not Significantly different from 0
n	n = 83
R^2	R Squared = 0.883
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 12.12 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.692 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 28 µg m-3 = 3
None	

Table 25: Overview of equivalence testing, system 16270, PM_{10}

Show Parameters on Graph in Order	
Correction	CM data corrected by dividing by 0.926
Slope	Slope (b) = 1.004 +/- 0.036 Not Significantly different from 1
Intercept	Intercept (a) = -0.661 +/- 0.65 µg m-3 Not Significantly different from 0
n	n = 83
R^2	R Squared = 0.895
Expanded Uncertainty	Expanded Uncertainty (Wcm) = 11.76 % Passes 25% criterion
u(bs,RM)	Between Reference Method Uncertainty (u(bs,RM)) = 0.692 µg m-3
u(bs,CM)	Between Candidate Method Uncertainty (u(bs,CM)) = Not Calculated
n(RM)>	Number of RM greater than 28 µg m-3 = 3
None	

6.1 18 Maintenance interval (7.5.7)

The maintenance interval of the AMS shall be greater or equal to two weeks.

6.2 Equipment

Not required for this performance criterion

6.3 Testing

The maintenance interval is the longest time period without intervention as recommended by the manufacturer. The competent body shall ensure that during this period the AMS does not need any maintenance or adjustment.

6.4 Evaluation

The manufacturer has prepared a maintenance plan for this measuring system. The shortest maintenance interval is 1 year (calibration with MonoDust, calibration of volume flow, leak check and cleaning of the inlet).

6.5 Assessment

The maintenance interval is 1 year, as specified by the manufacturer.

Criterion satisfied? yes

6.6 Detailed presentation of test results

Not required for this performance criterion.

7. Recommendations for use in practice

7.1 Work in the maintenance interval

The tested measuring systems require regular performance of the following tasks:

Every year:

- Calibration with MonoDust
- Calibration of volume flow
- Performance of a leak test
- Cleaning of the inlet

Consult the maintenance sheets in the manual for further details.

7.2 Additional maintenance tasks

Consult the manual for further details.

Environmental Protection/Air Pollution Control

Dipl.-Ing. Fritz Hausberg	Dipl.-Ing. Guido Baum

Cologne, 31 March 2022
936/21254495/A

8. Bibliography

[1] Performance Standards for Indicative Ambient Particulate Monitors – Environment Agency, August 2017, Version 4

[2] European standard EN 12341, “Ambient air - Standard gravimetric measurement method for the determination of the PM_{10} or $PM_{2,5}$ mass concentration of suspended particulate matter”; German version EN 12341:2014

[3] Guideline “Demonstration of Equivalence of Ambient Air Monitoring Methods”, English version dated January 2010

[4] Operation manual SEQ 47/50 of 2005/2021

[5] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

[6] Operating Manual – Aerosol Spectrometer AQ Guard Smart V 1.0

9. Appendix

Annex 1 Measured values from the field test sites

Start Date & Time	RM1	RM2	CM1	CM2
12/3/2021 0:00	6.52	6.80	6.66	6.65
12/4/2021 0:00	3.99	4.81	4.42	4.47
12/5/2021 0:00	5.17	4.72	4.15	4.24
12/6/2021 0:00	9.89	9.89	9.02	8.99
12/7/2021 0:00	5.44	5.08	5.92	6.03
12/8/2021 0:00	5.53	5.80	4.73	4.87
12/9/2021 0:00	5.90	6.89	5.52	5.54
12/10/2021 0:00	6.29	6.11	6.58	6.70
12/11/2021 0:00	15.90	15.45	13.46	13.83
12/12/2021 0:00	4.29	3.75	5.30	5.40
12/13/2021 0:00	3.93	3.48	2.79	2.81
12/14/2021 0:00	7.19	6.65	6.15	6.30
12/15/2021 0:00	6.47	5.11	5.26	5.34
12/16/2021 0:00	26.70	26.43	23.59	24.37
12/17/2021 0:00	15.81	15.00	11.43	11.90
12/18/2021 0:00	11.46	10.38	10.33	10.47
12/19/2021 0:00	9.37	7.56	8.17	8.31
12/20/2021 0:00	9.92	7.38	8.51	8.70
12/21/2021 0:00	19.26	20.80	16.20	16.16
12/22/2021 0:00	21.53	21.88	19.01	18.85
12/23/2021 0:00	20.44	20.25	18.82	18.59
12/24/2021 0:00	7.29	7.65	7.83	7.99
12/25/2021 0:00	5.38	5.02	4.75	4.85
12/26/2021 0:00			8.01	7.93
12/27/2021 0:00	6.02	6.19	5.22	5.30
12/28/2021 0:00	3.48	4.29	4.82	4.96
12/29/2021 0:00	3.21	3.30	3.58	3.67
12/30/2021 0:00	3.11	2.93	3.11	3.18
12/31/2021 0:00	3.57	2.94	2.60	2.60
1/1/2022 0:00	4.11	4.30	4.68	4.66
1/2/2022 0:00	5.47	4.75	5.21	5.23
1/3/2022 0:00	2.57	1.93	5.17	5.28
1/4/2022 0:00	2.73	2.45	3.36	3.39
1/5/2022 0:00	4.63	4.18	5.86	5.30
1/6/2022 0:00	7.62	7.71	10.25	10.31
1/7/2022 0:00	4.18	3.45	4.25	4.18
1/8/2022 0:00	4.54	4.36	5.62	5.51
1/9/2022 0:00	4.90	4.81	5.71	5.83
1/10/2022 0:00	12.07	11.25	12.23	12.10
1/11/2022 0:00	13.06	12.43	12.47	12.25
1/12/2022 0:00	16.97	16.15	15.99	16.04
1/13/2022 0:00	17.88	16.88	16.71	16.52
1/14/2022 0:00	20.97	20.51	19.25	19.18
1/15/2022 0:00	10.71	10.36	9.94	10.03
1/16/2022 0:00	13.25	13.07	13.08	12.92
1/17/2022 0:00	15.07	14.62	17.31	17.39
1/18/2022 0:00	9.72	9.72	10.85	11.10
1/19/2022 0:00	8.89	9.26	10.51	10.44
1/20/2022 0:00	5.26	5.42	8.79	8.92

Figure 9: Measured values, $PM_{2.5}$

1/21/2022 0:00	8.16	8.13	10.47	10.70
1/22/2022 0:00	16.50	16.12	17.84	17.95
1/23/2022 0:00	19.84	21.83	18.94	19.15
1/24/2022 0:00	7.86	7.86	7.87	7.72
1/25/2022 0:00	18.84	18.47	17.92	18.16
1/26/2022 0:00	27.65	27.64	26.98	26.69
1/27/2022 0:00	9.89	9.52	12.53	12.34
1/28/2022 0:00	7.64	6.80	8.65	8.69
1/29/2022 0:00	4.37	3.28	4.91	4.89
1/30/2022 0:00	7.91	7.00	10.48	10.53
1/31/2022 0:00	4.71	4.46	7.81	6.55
2/1/2022 0:00	3.90	3.99	6.97	6.93
2/2/2022 0:00	8.35	7.71	11.30	11.30
2/3/2022 0:00	4.90	5.35	5.44	5.38
2/4/2022 0:00	3.00	3.00	3.32	2.67
2/5/2022 0:00	4.00	4.18	4.48	4.41
2/6/2022 0:00	1.62	1.91	2.49	2.07
2/7/2022 0:00	4.29	4.02	5.96	5.83
2/8/2022 0:00	3.02	2.75	2.93	2.90
2/9/2022 0:00	6.62	6.44	6.13	5.98
2/10/2022 0:00	8.16	8.25	8.95	8.70
2/11/2022 0:00	6.98	7.07	7.59	7.45
2/12/2022 0:00	8.97	8.43	8.78	8.44
2/13/2022 0:00	8.25	8.80	8.85	8.40
2/14/2022 0:00	3.53	3.99	4.19	4.05
2/15/2022 0:00	3.08	4.17	4.49	4.35
2/16/2022 0:00	1.18	1.09	2.02	2.01
2/17/2022 0:00	4.72	4.63	7.55	7.57
2/18/2022 0:00	3.93	3.11	5.43	5.46
2/19/2022 0:00	2.21	3.11	3.83	3.83
2/20/2022 0:00	2.45	2.08	3.54	3.29
2/21/2022 0:00	2.81	3.08	4.81	4.53
2/22/2022 0:00	4.89	4.52	7.86	7.64
2/23/2022 0:00	5.80	5.90	6.16	5.93
2/24/2022 0:00	3.63	3.72	3.68	3.53
2/25/2022 0:00	5.17	4.54	6.81	6.68
2/26/2022 0:00	9.25	8.07	10.81	10.51
2/27/2022 0:00	7.71	6.71	7.32	6.89
2/28/2022 0:00	10.80	10.79	11.52	10.60
3/1/2022 0:00	14.87	13.97	16.22	14.88
3/2/2022 0:00	15.79	16.14	17.24	14.92
3/3/2022 0:00	17.87	17.77	18.47	17.26
3/4/2022 0:00	19.23	19.05	19.92	19.83
3/5/2022 0:00	17.96	18.05	18.90	18.02
3/6/2022 0:00	18.96	19.23	18.87	18.76

Figure 10: Measured values, $PM_{2.5}$

Start Date & Time	RM1	RM2	CM1	CM2
12/3/2021 0:00	14.68	13.78	11.48	11.20
12/4/2021 0:00	8.35	7.35	8.98	8.87
12/5/2021 0:00	8.52	7.61	6.24	6.41
12/6/2021 0:00	15.15	14.51	12.41	12.22
12/7/2021 0:00	13.87	12.24	12.65	12.85
12/8/2021 0:00	13.24	12.52	9.43	9.62
12/9/2021 0:00	13.61	12.61	10.22	10.16
12/10/2021 0:00	11.91	10.82	9.29	9.39
12/11/2021 0:00	23.52	23.07	16.86	17.31
12/12/2021 0:00	9.46	9.46	11.34	11.23
12/13/2021 0:00	10.46	9.83	7.10	7.01
12/14/2021 0:00	13.73	13.36	9.93	10.22
12/15/2021 0:00	12.36	12.82	8.74	8.95
12/16/2021 0:00	41.12	40.49	30.02	30.94
12/17/2021 0:00	23.79	22.62	15.35	15.76
12/18/2021 0:00	15.63	14.73	12.90	12.89
12/19/2021 0:00			11.16	11.16
12/20/2021 0:00			14.29	14.55
12/21/2021 0:00			22.31	22.12
12/22/2021 0:00	27.96	26.58	22.03	21.93
12/23/2021 0:00	26.25	25.80	23.15	23.18
12/24/2021 0:00	18.61	17.09	18.12	18.40
12/25/2021 0:00	7.37	7.56	5.99	6.13
12/26/2021 0:00	10.37	9.93	8.70	8.61
12/27/2021 0:00	8.46	8.73	6.26	6.42
12/28/2021 0:00	10.18	10.27	9.21	9.43
12/29/2021 0:00	8.28	8.38	6.50	6.55
12/30/2021 0:00			6.75	6.72
12/31/2021 0:00			4.12	4.25
1/1/2022 0:00			6.41	6.58
1/2/2022 0:00			9.34	9.48
1/3/2022 0:00			10.84	11.09
1/4/2022 0:00			6.45	6.38
1/5/2022 0:00			9.48	8.58
1/6/2022 0:00	20.68	20.57	22.10	21.66
1/7/2022 0:00			9.36	9.01
1/8/2022 0:00	9.79	10.06	12.96	12.55
1/9/2022 0:00	11.24	11.52	10.75	11.01
1/10/2022 0:00	20.68	20.77	17.72	17.55
1/11/2022 0:00	16.33	16.60	14.77	14.63
1/12/2022 0:00	25.30	25.03	22.22	22.07
1/13/2022 0:00	24.49	23.31	20.67	20.44
1/14/2022 0:00	27.76	26.22	23.44	23.20
1/15/2022 0:00	11.70	11.70	11.02	11.11
1/16/2022 0:00	17.41	16.69	16.90	16.66
1/17/2022 0:00	25.22	22.58	27.81	28.00
1/18/2022 0:00	21.95	19.95	17.56	17.94
1/19/2022 0:00	23.95	21.77	23.57	22.96
1/20/2022 0:00	19.83	17.93	20.64	20.64

Figure 11: Measured values, PM_{10}

1/21/2022 0:00	23.19	21.01	25.85	26.22
1/22/2022 0:00	27.82	26.36	25.23	25.14
1/23/2022 0:00	26.45	29.18	22.43	22.54
1/24/2022 0:00	12.85	13.03	11.97	11.66
1/25/2022 0:00	29.26	28.81	26.04	26.16
1/26/2022 0:00	37.33	36.25	33.46	32.84
1/27/2022 0:00	19.24	18.59	25.89	25.09
1/28/2022 0:00	21.05	20.14	17.07	17.12
1/29/2022 0:00	9.44	9.88	8.91	8.79
1/30/2022 0:00	23.77	23.68	20.45	20.14
1/31/2022 0:00	12.80	13.79	14.56	12.43
2/1/2022 0:00	13.60	13.33	15.07	14.93
2/2/2022 0:00	22.41	22.31	18.79	18.71
2/3/2022 0:00	11.97	10.98	9.28	9.17
2/4/2022 0:00	6.98	8.43	6.95	5.52
2/5/2022 0:00	9.06	9.42	7.12	7.11
2/6/2022 0:00	4.17	4.90	4.76	3.81
2/7/2022 0:00	15.27	14.36	14.15	13.52
2/8/2022 0:00	9.64	8.65	7.84	7.55
2/9/2022 0:00	14.51	14.15	10.75	10.37
2/10/2022 0:00	15.87	16.05	15.30	14.99
2/11/2022 0:00	16.96	17.14	13.83	13.68
2/12/2022 0:00	15.23	16.05	12.88	12.25
2/13/2022 0:00	12.60	12.61	11.73	11.41
2/14/2022 0:00	10.61	10.70	9.29	8.92
2/15/2022 0:00	10.88	10.79	8.74	8.53
2/16/2022 0:00	7.07	6.80	7.72	7.65
2/17/2022 0:00	16.14	14.42	14.86	14.92
2/18/2022 0:00	12.00	11.09	10.86	11.12
2/19/2022 0:00	9.19	8.37	7.11	7.12
2/20/2022 0:00	7.25	6.99	6.72	6.10
2/21/2022 0:00	9.43	9.43	9.51	8.82
2/22/2022 0:00	16.96	16.68	15.69	14.92
2/23/2022 0:00	14.69	15.33	10.72	10.42
2/24/2022 0:00	8.62	8.89	6.80	6.82
2/25/2022 0:00	17.23	16.42	16.85	16.91
2/26/2022 0:00	20.04	18.96	16.82	16.50
2/27/2022 0:00	11.25	9.98	9.41	8.95
2/28/2022 0:00	16.32	15.06	15.14	14.19
3/1/2022 0:00	20.22	19.68	20.90	19.21
3/2/2022 0:00	25.12	24.30	23.87	20.53
3/3/2022 0:00	26.21	25.49	25.09	23.94
3/4/2022 0:00	28.21	27.66	26.00	26.52
3/5/2022 0:00	22.67	21.58	21.83	20.72
3/6/2022 0:00	25.21	24.22	22.73	23.15

Figure 12: Measured values, PM_{10}

Annex 2 Certificate of Accreditation

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

TÜV Rheinland Energy GmbH

mit seinen in der Urkundenanlage aufgeführten Messstellen und Standorten

die Kompetenz nach DIN EN ISO/IEC 17025:2018 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Bestimmung (Probenahme und Analytik) von anorganischen und organischen gas- oder partikel-förmigen Luftinhaltsstoffen im Rahmen von Emissions- und Immissionsmessungen; Probenahme von luftgetragenen polyhalogenierten Dibenzo-p-Dioxinen und Dibenzofuranen bei Emissionen und Immissionen; Probenahme von faserförmigen Partikeln bei Emissionen und Immissionen; Ermittlung von gas- oder partikelförmigen Luftinhaltsstoffen mit kontinuierlich arbeitenden Messgeräten; Bestimmung von Geruchsstoffen in Luft; Kalibrierungen und Funktionsprüfungen kontinuierlich arbeitender Messgeräte für Luftinhaltsstoffe einschließlich Systemen zur Datenauswertung und Emissionsfernüberwachung; Feuerraummessungen; Eignungsprüfungen von automatisch arbeitenden Emissions- und Immissionsmesseinrichtungen einschließlich Systemen zur Datenauswertung und Emissionsfernüberwachung; Ermittlung der Emissionen und Immissionen von Geräuschen; Bestimmung von Geräuschen in der Nachbarschaft; Ermittlung von Geräuschen und Vibrationen am Arbeitsplatz; akustische und schwingungstechnische Messungen im Eisenbahnwesen; Bestimmung von Schallleistungspegeln von zur Verwendung im Freien vorgesehenen Geräten und Maschinen nach Richtlinie 2000/14/EG und Konformitätsbewertungsverfahren; Schornsteinhöhenberechnung und Immissionsprognose auf der Grundlage der Technischen Anleitung zur Reinhaltung der Luft und der Geruchsimmissions-Richtlinie und der VDI 3783 Blatt 13; Windenergieanlagen: Bestimmung von Windpotential, Energieerträgen, Standorterträgen und Standortgüte nach EEG, standortbezogenen Turbulenzcharakteristika und Extremwinde; Schallimmissionsprognosen, Schattenwurfimmissionsberechnung und Sichtbarkeitsbestimmung; Probenahme und mikrobiologische Untersuchungen von Nutzwasser gemäß §3 Absatz 8 42. BImSchV; physikalische, physikalisch-chemische und mikrobiologische Untersuchungen von Wasser (Abwasser, Wasser aus Rückkühlwerken sowie raumlufttechnischen Anlagen); Probenahme von Abwasser; mikrobiologische und ausgewählte chemische Untersuchungen gemäß Trinkwasserverordnung; Probenahme von Roh- und Trinkwasser; ausgewählte mikrobiologische Untersuchungen von Bedarfsgegenständen und kosmetischen Mitteln; Probenahme anorganischer faserförmiger Partikel sowie von partikel- und gasförmigen luftverunreinigenden Stoffen in der Innenraumluft; ausgewählte mikrobiologische Untersuchungen in Innenräumen; Ermittlung von Aerosolen und Faserstäuben, anorganischen und organischen Gasen und Dämpfen sowie ausgewählten Parametern und/oder in ausgewählten Gebieten bei Arbeitsplatzmessungen gemäß Gefahrstoffverordnung §7, Abs. 10;
Modul Immissionsschutz

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 30.08.2019 mit der Akkreditierungsnummer D-PL-11120-02-00. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 48 Seiten.

Registrierungsnummer der Urkunde: **D-PL-11120-02-00**

Berlin, 30.08.2019

Valbuena
Im Auftrag Dipl.-Ing. Andrea Valbuena
Abteilungsleiterin

Die Urkunde samt Urkundenanlage gibt den Stand zum Zeitpunkt des Ausstellungsdatums wieder. Der jeweils aktuelle Stand des Geltungsbereiches der Akkreditierung ist der Datenbank akkreditierter Stellen der Deutschen Akkreditierungsstelle GmbH (DAkkS) zu entnehmen. https://www.dakks.de/content/datenbank-akkreditierter-stellen

Siehe Hinweise auf der Rückseite

Figure 13: Certificate of accreditation according to EN ISO/IEC 17025:2018

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
Spittelmarkt 10
10117 Berlin

Standort Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkkS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.

Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkkS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abl. L 218 vom 9. Juli 2008, S. 30).
Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Figure 14: Certificate of accreditation according to EN ISO/IEC 17025:2018 - page 2

Appendix 3: Operation manual