CERTIFICATE

about Product Conformity (QAL1)

Number of Certificate: 0000027277

Certified AMS:	APDA-371 with $PM_{2.5}$ pre-separator

Distribution:	HORIBA Europe GmbH Hans-Mess-Str. 6 61440 Oberursel /Ts. Germany

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Test Institute: TÜV Rheinland Energie und Umwelt GmbH

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

**VDI 4202-1: 2002, VDI 4203-3: 2004, EN 14907: 2005,
Guide to Demonstration of Equivalence of Ambient Air Monitoring Methods: 2009,
EN 15267-1: 2009, EN 15267-2: 2009**

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

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ID: 0000027277

- Certified equivalent EN method
- Complying with 2008/50/EC
- TUV approved
- Annual Inspection

Publication in the German Federal Gazette
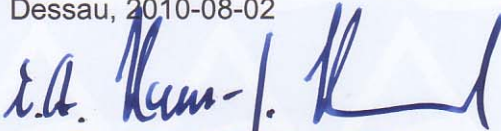(BAnz.) of 2010-07-28
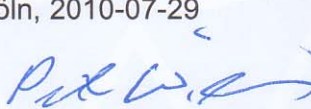
The certificate is valid until: 2015-08-01

Umweltbundesamt

Dessau, 2010-08-02

signature

i. A. Dr. Hans-Joachim Hummel

TÜV Rheinland Energie und Umwelt GmbH

Köln, 2010-07-29

signature

i. V. Dr. Peter Wilbring

Umwelt Bundes Amt
For our Environment

Certificate:
0000027277 / 2010-08-02

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Test report:	936/21209919/A of 2010-03-26
First certification:	2010-08-02
Run of validity until:	2015-08-01
Publication	BAnz. 2010-07-28, No. 111, p. 2598

Approved application:

The AMS is approved for permanent monitoring of suspended particulate matter $PM_{2.5}$ in ambient air (stationary operation). The suitability of the product for this application was assessed on the basis of a laboratory test and a field test at four different test sites respectively time periods. The AMS is approved for the temperature range from +5°C to +40°C.

Any potential user should ensure, in consultation with the manufacturer that this AMS is suitable for the ambient air application on which it will be installed.

Basis of the certification

This certification is based on the test report 936/21209919/A of 2010-03-26 of TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and on the relevant bodies (German Umweltbundesamt) assessment and ongoing surveillance of the product and the manufacturing process and the publication in the German Federal Gazette (BAnz. 2010-07-28, No. 111, p. 2598: UBA publication from 2010-07-12). The measuring system APDA-371 with $PM_{2.5}$ pre-separator of Horiba Europe GmbH is identical in construction with the measuring system BAM-1020 with $PM_{2.5}$ pre-separator of Met One Instruments Inc.

AMS name:

BAM-1020 with $PM_{2.5}$ pre-separator

Manufacturer:

Met One Instruments, Inc., Grants Pass, USA

Approval:

For permanent monitoring of suspended particulate matter $PM_{2.5}$ in ambient air (stationary operation).

Measuring ranges during the suitability test:

Component	Certification range	Supplementary range	Unit
$PM_{2.5}$	**0 – 1,000**	-	µg/m³

Software version:

Version 3236-07 5.0.10

Restriction:

During the check of the tightness of the sampling system within the scope of the suitability test, values of 1.8 % and 2.4 % have been determined. According to the minimum requirement, the leak rate shall not be greater than 1 % of the sample flow rate.

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Remarks:

1. The requirements according to guide "Demonstration of Equivalence of Ambient Air Monitoring Methods" are fulfilled for the measured component $PM_{2.5}$.

2. For the recordation of $PM_{2.5}$ the system has to be equipped with the following options: Sample heater (BX-830), PM_{10}-sampling inlet (BX-802), $PM_{2.5}$ Sharp Cut Cyclone SCC (BX-807), combined pressure and temperature sensor (BX-596) respectively as an alternative ambient temperature sensor (BX-592).

3. The cycle time during the suitability test was 1 h, i.e. an automatic filter change has been performed every hour. Each filter spot has been used one time.

4. The sampling time within the cycle time is 42 min.

5. The measuring system has to be operated in a lockable measuring cabinet.

6. The measuring system is to be calibrated on site in regular intervals by application of the gravimetric $PM_{2.5}$ reference method according to EN 14907.

7. The identical measuring system is also distributed by the company Horiba Europe GmbH, 61440 Oberursel, Germany under the name APDA-371 with $PM_{2.5}$ pre-separator.

Test report:

TÜV Rheinland Immissionsschutz und Energiesysteme, Cologne
Report-No.: 936/21209919/A of 2010-03-26

Certified product

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

The ambient air measuring system APDA-371 is based on the measuring principle of beta-attenuation.

The principle of the radiometric determination of mass is based on the physical law of attenuation of beta-rays when passing a thin layer of material. There is the following relationship:

$$c\left(\frac{\mu g}{m^3}\right) = \frac{10^6 \, A(cm^2)}{Q\left(\frac{l}{min}\right)\Delta t(min)\mu\left(\frac{cm^2}{g}\right)} \ln\left(\frac{I_0}{i}\right)$$

with:

C	particle-mass concentration	A	sampling area for particles (filter spot)
Q	sampling flow rate	Δt	sampling time
μ	mass absorption coefficient	I_0	beta count rate at the beginning (clean)
I	beta count at the end (collect)		

The radiometric determination of mass is calibrated in the factory and is checked within the scope of internal quality assurance hourly at the zero point (clean filter spot) and at the reference point (built-in reference foil) during operation. With the help of the generated data, measured values at zero and reference point can be easily affiliated. They can be compared with any stability requirements (drift effects) respectively with the nominal value for the reference foil (factory setting).

One measurement cycle (incl. automatic check of the radiometric measurement) consists of the following steps (setting: measuring time for radiometry 8 min):

1. The initial count of the clean filter tape I_0 is performed at the beginning of the cycle for a period of eight minutes.

2. The filter tape is advanced four windows and the sampling (vacuum pumping) begins on the spot in which I_0 was just measured. Air is drawn through this spot on the filter tape for approximately 42 minutes.

3. At the same time the second count I_1 occurs (at a point on the tape 4 windows back) for a period of eight minutes. The purpose of the measurement is to perform the verification for instrument drift caused by varying external parameters such as temperature and relative humidity. A third count I_2 occurs with the reference membrane extended over the same place on the tape. Eight minutes before the end of sampling time, another count I_{1x} occurs on the same point of the tape. With the help of I_1 and I_{1x}, the stability at the zero point can be monitored.

4. After sampling, the filter tape is moved back four windows to measure the beta ray absorption through the section that has collected dust (I_3). Finally the concentration calculation is performed to complete the cycle.

5. The next cycle begins with step 1.

The measuring system APDA-371 with PM_{10} pre-separator is already suitability-tested and published. The measuring system, which is certified with this certificate is equipped with a $PM_{2.5}$ pre-separator.

General notes:
This certificate is based upon the equipment tested. The manufacturer is responsible for ensuring that on-going production complies with the European Standard defined in this certificate. 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 certified product is found no longer to comply with the applicable European Standard, TÜV Rheinland Energie und Umwelt GmbH should be notified immediately at the address shown on page 1.

The certification mark that 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 the property of TÜV Rheinland Energie und Umwelt GmbH. With revocation of the publication the certificate looses its validity. After the validity 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 seen at the Internet Address: **qal1.de**.

Certification of the APDA-371 with $PM_{2.5}$ pre-separator 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. 0000027277:   2010-08-02

Validity of the certificate: 2015-08-01

Test report: 936/21209919/A of 2010-03-26,
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Köln,

Publication: BAnz. 2010-07-28, No. 111, p. 2598: Announcement by UBA from 2010-07-12.

Results of the equivalence test for the demonstration of equivalence according to the EC-Guide of July 2009

$PM_{2.5}$ Smart Heated BAM	33.1% > 17 µg m-3	Orthogonal Regression				Between Instrument Uncertainties	
	W_{CM} / %	n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	Reference	Candidate
All Data	12.6	248	0.967	1.000 +/- 0.012	0.764 +/- 0.204	0.33	1.38
< 18 µg m-3	9.8	174	0.889	0.971 +/- 0.025	1.066 +/- 0.267	0.34	1.05
> 18 µg m-3	15.9	74	0.926	1.031 +/- 0.033	-0.068 +/- 0.919	0.30	1.57

SN 17010	Dataset	Orthogonal Regression				Limit Value of 30 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^{-3}
Individual Datasets	Teddington Summer	78	0.931	0.994 +/- 0.030	1.822 +/- 0.372	17.11	19.2
	Cologne Winter	75	0.957	0.980 +/- 0.024	0.960 +/- 0.512	12.79	56.0
	Bornheim Summer	53	0.941	1.052 +/- 0.036	-0.962 +/- 0.527	11.61	20.8
	Teddington Winter	45	0.991	0.970 +/- 0.014	-0.182 +/- 0.300	10.28	35.6
Combined Datasets	< 18 µg m^{-3}	175	0.849	0.955 +/- 0.028	1.137 +/- 0.306	11.46	4.6
	> 18 µg m^{-3}	76	0.907	0.984 +/- 0.035	0.584 +/- 0.975	16.02	100.0
	All Data	251	0.957	0.969 +/- 0.013	0.989 +/- 0.226	12.90	33.5

SN 17011	Dataset	Orthogonal Regression				Limit Value of 30 µg m^{-3}	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 17 µg m^{-3}
Individual Datasets	Teddington Summer	78	0.955	1.016 +/- 0.025	1.018 +/- 0.308	14.66	19.2
	Cologne Winter	75	0.977	1.061 +/- 0.019	0.430 +/- 0.405	17.91	56.0
	Bornheim Summer	57	0.901	1.134 +/- 0.048	-1.498 +/- 0.727	23.91	21.1
	Teddington Winter	43	0.992	0.991 +/- 0.014	0.630 +/- 0.293	7.41	32.6
Combined Datasets	< 18 µg m^{-3}	178	0.881	1.021 +/- 0.026	0.634 +/- 0.286	13.44	4.5
	> 18 µg m^{-3}	75	0.929	1.092 +/- 0.034	-1.108 +/- 0.952	19.03	100.0
	All Data	253	0.966	1.041 +/- 0.012	0.377 +/- 0.214	16.28	32.8