Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040213_01

Certified AMS:	Model 5014i Beta with $PM_{2.5}$-pre-separator for particulate matter $PM_{2.5}$
Manufacturer:	Thermo Fisher Scientific 27 Forge Parkway Franklin, MA 02038 USA
Test Institute:	TÜV Rheinland Energy GmbH

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

VDI 4202-1: 2010, VDI 4203-3: 2010, EN 14907: 2005,
Guide to the Demonstration of Equivalence of Ambient Air Monitoring Methods: 2010
EN 15267-1: 2009 and EN 15267-2: 2009

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

The present certificate replaces certificate 0000040213 of 29 April 2014.

TÜVRheinland® CERTIFIED

Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance

www.tuv.com
ID 0000040213

Publication in the German Federal Gazette (BAnz.) of 1 April 2014

This certificate will expire on:
30 June 2020

German Federal Environment Agency
Dessau, 1 April 2019

Dr. Marcel Langner
Head of Section II 4.1

TÜV Rheinland Energy GmbH
Cologne, 31 March 2019

ppa. Dr. Peter Wilbring

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TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Cologne

Certificate:
0000040213_01 / 1 April 2019

Test report:	936/21209885/H of 20 September 2013
Initial certification:	01 April 2014
Date of expiry:	30 June 2020
Publication:	BAnz AT 01 April 2014 B12, chapter IV, No. 6.2

Approved application
The certified AMS is suitable for permanent monitoring of suspended particulate matter $PM_{2.5}$ 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 test sites respectively time periods.

The AMS is approved for a temperature range of +5 °C to +40 °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 936/21209885/H of 20 September 2013 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 01 April 2014 B12, chapter IV, No. 6.2) Announcement by UBA from 27 February 2014

AMS designation:
Model 5014i Beta with $PM_{2.5}$-pre-separator for particulate matter $PM_{2.5}$

Manufacturer:
Thermo Fisher Scientific, Franklin, USA

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

Measuring range during the performance test:

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

Software version:
V02.00.00.232+

Restrictions:
None

Notes:

1. The requirements of the Guide “Demonstration of Equivalence of Ambient Air Monitoring Methods” are fulfilled for the measuring component $PM_{2.5}$.
2. The measuring system must be operated in a lockable measuring cabinet.
3. The measuring system must be regularly calibrated on location with the gravimetric $PM_{2.5}$ reference method according to EN 14907.
4. It is recommended to operate the measuring system with the threshold for the relative humidity being 58 %, especially at sites where the ratio of volatiles in suspended particulate matter is significantly high.
5. The performance test report can be viewed on the internet at www.qal1.de.

Test institute:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21209885/H of 20 September 2013

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

The ambient air measuring device consists of the $PM_{2,5}$ sampling head, the heated sampling tube (dynamic heating system DHS), the (optional) extension tube, the ambient air sensor (incl. radiation protection shield), the vacuum pump, the central unit 5014i incl. fiberglass filter belt, the respective corresponding connection lines, cables and adapters, the roof duct incl. flange and the manual in German.

The model 5014i Beta ambient air measuring system is based on the beat reduction measuring principle.

The particle sample passes through the $PM_{2.5}$ sampling head with a flow rate of 1 m³/h (=16.67 l/min) and flows via the heated sampling tube (DHS = dynamic heating system) to the actual model 5014i Beta measuring system.

The 5014i measuring system housing is located directly beneath the heated tube – the fine dust passes from the sampling tube into the radial tube above the radiometric assembly.

The particles are then separated on the fibreglass filter belt of the radiometric measuring system. The filter belt is located between the proportional detector and the ^{14}C beta emitter. The beta ray travels upwards through the filer belt and the accumulating dust layer. The intensity of the beta ray is reduced by the increasing dust load, which then leads to a reduced beta intensity that is measured by the proportional detector. The mass on the filter belt is calculated from the continuous integrated count rate.

In order to maintain the sample flow at its nominal value the flow and the regulation of the proportional valve are measured continuously.

The PM concentrations are shown on the display on the front of the measuring system as PM (=radiometric measurement values). The measurement values can be provided as data in a variety of output forms (analogue, digital, Ethernet).

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 Energy GmbH must be notified at the address given on page 1.

A certification mark with an ID-Number that is specific to the certified product is presented on page 1 of this certificate. This 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 Energy GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energy 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 Model 5014i Beta with $PM_{2,5}$-pre-separator for particulate matter $PM_{2,5}$ 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 0000040213: 29 April 2014
Validity of the certificate: 31 March 2019

Test report: 936/21209885/H of 20 September 2013
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 01 April 2014 B12, chapter IV, No. 6.2
Announcement by UBA from 27 February 2014

Renewal of the certificate according to ENs 15267

Certificate No 0000040213_01: 1. April 2019
Validity of the certificate: 30 June 2020

Calculation of overall uncertainty

PM2.5 5014i Beta	28% ≥ 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	19.9	207	0.972	1.070 +/- 0.013	0.216 +/- 0.220	0.61	1.24
< 18 µg m-3	25.1	156	0.856	1.113 +/- 0.034	-0.058 +/- 0.330	0.56	1.15
≥ 18 µg m-3	20.6	51	0.965	1.100 +/- 0.029	-0.952 +/- 0.902	0.76	1.69

SN1	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	Bornheim Winter	41	0.979	1.090 +/- 0.025	-0.155 +/- 0.620	21.28	56.1
	Cologne Winter	41	0.976	1.083 +/- 0.027	0.331 +/- 0.602	22.45	53.7
	Bornheim Summer	78	0.940	1.078 +/- 0.030	0.247 +/- 0.422	22.61	15.4
	Teddington Summer	55	0.834	1.023 +/- 0.057	0.028 +/- 0.487	13.12	3.6
Combined Datasets	< 18 µg m-3	163	0.842	1.138 +/- 0.035	-0.383 +/- 0.347	28.01	4.3
	≥ 18 µg m-3	52	0.963	1.118 +/- 0.030	-1.220 +/- 0.928	22.50	100.0
	All Data	215	0.969	1.089 +/- 0.013	-0.062 +/- 0.229	22.01	27.4

SN2	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	Bornheim Winter	41	0.969	1.110 +/- 0.031	-0.584 +/- 0.768	24.45	56.1
	Cologne Winter	43	0.971	1.046 +/- 0.028	1.333 +/- 0.615	22.24	53.5
	Bornheim Summer	70	0.941	0.923 +/- 0.027	1.735 +/- 0.387	13.46	15.7
	Teddington Summer	65	0.787	0.982 +/- 0.057	0.613 +/- 0.483	12.50	3.1
Combined Datasets	< 18 µg m-3	168	0.810	1.125 +/- 0.038	-0.031 +/- 0.367	28.37	4.8
	≥ 18 µg m-3	51	0.951	1.099 +/- 0.035	-1.296 +/- 1.076	21.92	100.0
	All Data	219	0.960	1.056 +/- 0.014	0.430 +/- 0.247	20.38	26.9

Calculation of overall uncertainty, slope corrected

PM2.5 5014i Beta Slope Corrected	28% ≥ 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	12.0	207	0.972	0.999 +/- 0.012	0.215 +/- 0.205	0.61	1.16
< 18 µg m-3	13.1	156	0.856	1.035 +/- 0.032	-0.005 +/- 0.309	0.56	1.07
≥ 18 µg m-3	14.6	51	0.965	1.026 +/- 0.027	-0.855 +/- 0.843	0.76	1.58

SN1	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	Bornheim Winter	41	0.979	1.018 +/- 0.023	-0.130 +/- 0.580	12.30	56.1
	Cologne Winter	41	0.976	1.011 +/- 0.025	0.325 +/- 0.563	12.47	53.7
	Bornheim Summer	78	0.940	1.005 +/- 0.028	0.254 +/- 0.394	14.12	15.4
	Teddington Summer	55	0.834	0.950 +/- 0.053	0.071 +/- 0.455	14.99	3.6
Combined Datasets	< 18 µg m-3	163	0.842	1.057 +/- 0.033	-0.301 +/- 0.325	15.20	4.3
	≥ 18 µg m-3	52	0.963	1.044 +/- 0.028	-1.102 +/- 0.867	15.36	100.0
	All Data	215	0.969	1.017 +/- 0.012	-0.043 +/- 0.214	13.05	27.4

SN2	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	Bornheim Winter	41	0.969	1.036 +/- 0.029	-0.522 +/- 0.717	15.84	56.1
	Cologne Winter	43	0.971	0.977 +/- 0.026	1.265 +/- 0.575	12.81	53.5
	Bornheim Summer	70	0.941	0.860 +/- 0.026	1.641 +/- 0.362	20.89	15.7
	Teddington Summer	65	0.787	0.910 +/- 0.053	0.631 +/- 0.451	18.17	3.1
Combined Datasets	< 18 µg m-3	168	0.810	1.044 +/- 0.035	0.040 +/- 0.343	15.74	4.8
	≥ 18 µg m-3	51	0.951	1.025 +/- 0.033	-1.160 +/- 1.005	17.88	100.0
	All Data	219	0.960	0.985 +/- 0.013	0.420 +/- 0.230	13.92	26.9