Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000035016_01

Certified AMS:	TEOM 1405-F Ambient Particulate Monitor with PM10 pre-separator for particulate matter PM_{10}
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 certified according to the standards

VDI 4202-1 (2010), VDI 4203-3 (2010), EN 12341 (1998), Guide to Demonstration of Equivalence of Ambient Air Monitoring Methods (2010), EN 15267-1 (2009), EN 15267-2 (2009).

Certification is awarded in respect of the conditions stated in this certificate (this certificate contains 10 pages).

TÜVRheinland® CERTIFIED

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

www.tuv.com
ID 0000035016

Publication in the German Federal Gazette (BAnz.) of 02 March 2012

This certificate will expire on:
01 March 2022

German Federal Environment Agency
Dessau, 28 February 2017

Dr. Marcel Langner
Head of Section II 4.1

TÜV Rheinland Energy GmbH
Cologne, 27 February 2017

ppa. Dr. Peter Wilbring

www.umwelt-tuv.eu
tre@umwelt-tuv.eu
Tel. + 49 221 806-5200

TÜV Rheinland Energy GmbH
Am Grauen Stein
51105 Köln

Test institute accredited to EN ISO/IEC 17025:2005 by DAkkS (German Accreditation Body).
This accreditation is limited to the accreditation scope defined in the enclosure to the certificate D-PL-11120-02-00

10/221 2.08

Test report:	936/21209885/B dated 25 November 2011
Initial certification:	02 March 2012
Expiry date:	01 March 2022
Certificate	renewal (previous certificate 0000035016 dated from 16 March 2012 with validity up to the 01 March 2017)
Publication:	BAnz. 02 March 2012, No. 36, page 920, chapter IV, No. 1.1

Approved application
The tested AMS is suitable for continuous ambient air monitoring (stationary operation).

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

The AMS is approved for a temperature range of +8 °C to +25 °C.

The notification of suitability of the AMS, performance testing, and the uncertainty calculation have been effected on the basis of the regulations valid at the time of performance testing. As changes in legal regulations are possible, any potential user should ensure in consultation with the manufacturer that this AMS is suitable for monitoring the limit value relevant to the application.

Basis of the certification
This certification is based on:

- Test report 936/21209885/B dated 25 November 2011 of TÜV Rheinland Energie und Umwelt GmbH
- Suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- The ongoing surveillance of the product and the manufacturing process

Publication in the German Federal Gazette: BAnz. 02 March 2012, No. 36, page 920, chapter IV, No. 1.1,
Announcement by UBA from 23 February 2012:

AMS name:

TEOM 1405F Ambient Particulate Monitor with PM_{10} pre-separator for particulate matter PM_{10}

Manufacturer:

Thermo Fisher Scientific, Franklin, USA

Field of application:

The AMS is approved for permanent monitoring of suspended particulate matter PM_{10} in ambient air (stationary operation).

Measuring ranges during the suitability test:

Component	Certification range	Unit
PM_{10}	0 – 1000	µg/m³

Software version:

1.55

Restrictions:

The allowed range of ambient temperature at the installation site is 8 °C to 25 °C.

Notes:

1. The requirements on the variation coefficient R^2 according standard EN 12341 were not met for the sites Teddington (Summer) and Bornheim (Summer).
2. The requirements according to guide “Demonstration of Equivalence of Ambient Air Monitoring Methods” are fulfilled for the measured component PM_{10}.
3. The measuring system is to be calibrated on site in regular intervals by application of the gravimetric PM_{10} reference method according to EN 12341.
4. The test report on the suitability test is available on the internet under www.qal1.de.

Test report:

TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report No.: 936/21209885/B dated 25 November 2011

Publication in the German Federal Gazette: BAnz AT 20.07.2012 B11, chapter IV notification 31
Announcement by UBA from 06 July 2012:

31 Notification as regards Federal Environmental Agency notice dated 23 February 2012 (BAnz. p. 920, chapter IV, No. 1.1)

The current software version of the TEOM 1405-F Ambient Particulate Monitor measuring system with PM_{10}-pre-separator for suspended particulate matter PM_{10}–fraction manufactured by Thermo Fisher Scientific is:

1.56

Statement of TÜV Rheinland Energie und Umwelt GmbH of dated 2 May 2012

Publication in the German Federal Gazette: BAnz AT 23.07.2013 B4, chapter V notification 19
Announcement by UBA from 03 July 2013:

19 Notification as regards Federal Environmental Agency notices dated 23 February 2012 (BAnz. p. 920, chapter IV, No. 1.1) and dated 6 July 2012 (BAnz AT 20.07.2012 B11, chapter IV notification 31)

The ambient air measuring system TEOM 1405-F Ambient Particulate Monitor with PM_{10} pre-separator for particulate matter PM_{10} manufactured by Thermo Fisher Scientific can also be operated with the vacuum pump GAST 75R647 V45-H306X.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 18 March 2013

Publication in the German Federal Gazette: BAnz AT 01.04.2014 B12, chapter VI notification 32
Announcement by UBA from 27 February 2014:

32 Notification as regards Federal Environment Agency notices dated 23 February 2012 (BAnz. p. 920, chapter IV No. 1.1) and dated 3 July 2013 (BAnz AT 23.07.2013 B4, chapter V notification 19)

The current software version of the TEOM 1405-F Ambient Particulate Monitor measuring system with PM_{10} pre-separator by Thermo Fisher Scientific for particulate matter PM_{10} is: 1.57

Statement of TÜV Rheinland Energie und Umwelt GmbH of 1 October 2013

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter IV notification 20
Announcement by UBA from 25 February 2015:

20 Notification as regards Federal Environment Agency notices dated 23 February 2012 (BAnz. p. 920, chapter IV No. 1.1) and dated 27 February 2014 (BAnz AT 01 April 2014 B12, chapter VI notification 32)

The current software version for the TEOM 1405-F Ambient Particulate Monitor measuring system with PM_{10} pre-separator, manufactured by Thermo Fisher Scientific, for the suspended particulate matter PM_{10} is: 1.70

Statement of TÜV Rheinland Energie und Umwelt GmbH of 22 September 2014

Publication in the German Federal Gazette: BAnz AT 26.08.2015 B4, chapter V notification 39
Announcement by UBA from 22 July 2015:

39 Notification as regards Federal Environment Agency notices dated 23 February 2012 (BAnz. p. 920, chapter IV No. 1.1) and dated 25 February 2015 (BAnz AT 02.04.2015 B5, chapter IV notification 20)

The current software version for the TEOM 1405-F Ambient Particulate Monitor measuring system with PM_{10} pre-separator, manufactured by Thermo Fisher Scientific, for suspended particulate matter PM_{10} is: 1.71

The switching valve of the FDMS unit was redesigned in order to improve its mechanical stability.
The measuring system can also be used with the GAST 87R647-PDS-HV-913 vacuum pump.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 17 March 2015.

Publication in the German Federal Gazette: BAnz AT 14.03.2016 B7, chapter V notification 38
Announcement by UBA from 18 February 2016:

38 Notification as regards Federal Environment Agency notices dated 23 February 2012 (BAnz. p. 920, chapter IV No. 1.1) and dated 22 July 2015 (BAnz AT 26.08.2015 B4, chapter V notification 39)

The TEOM 1405-F Ambient Particulate Monitor with PM_{10}- pre-separator manufactured by Thermo Fisher Scientific for the suspended particles PM_{10} meets the requirements stipulated in CEN/TS 16450 (August 2013 version). An addendum to test report number 936/21221597/B is available online at www.qal1.de.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 20 November 2015.

Publication in the German Federal Gazette: BAnz AT 01.08.2016 B11, chapter V notification 38,
Announcement by UBA from 14 July 2016:

38 Notification as regards Federal Environmental Agency (UBA) notices dated 23 February 2012 (BAnz. p. 920, chapter IV No. 1.1) and dated 18 February 2016 (BAnz AT 14.03.2016 B7, chapter V notification 38)

The current software version of the TEOM 1405-F Ambient Particulate Monitor with PM_{10}-pre-separator for suspended particulate matter PM_{10} manufactured by Thermo Fisher Scientific is:

1.72

Statement of TÜV Rheinland Energie und Umwelt GmbH of 29 February 2016.

Certified product

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

The ambient air measuring system TEOM 1405-F Ambient Particulate Monitor is based on the measuring principle of oscillating micro weighing.

For the weighing principle, which is used in the TEOM mass transducer in the measuring system TEOM 1405-F Ambient Particulate Monitor, the change in mass determined with the sensor, results from the measurement of the change in frequency of the tapered element.

The particle sample passes the PM_{10} pre-separator at a flow rate of 16.67 l/min (=1 m³/h). Subsequently, the flow is directed over a flow-splitter and divided into two sub-flows – the PM_{10}-flow of 3 l/min and the bypass-flow of 13.67 l/min. The PM_{10}-flow is directed to the actual measuring system TEOM 1405-F via the FDMS-unit. There it is secreted to the respective TEOM-filter (constantly heated at 30 °C) and the secreted mass of particles is quantified.

To take into account non-volatile as well as volatile particulate during the measuring, the FDMS technology is used. The FDMS-unit is placed between the flow-splitter and the measuring device TEOM 1405-F in the so called FDMS-tower. The FDMS-unit compensated automatically the part of the semi-volatile particulate using a switching valve and two operation modi – the base mode and the reference mode.

Every six minutes the switching valve changes the sampling flow rate from base to reference mode. In the base mode the sampling is done on a straight way via a dryer directly to the mass measuring. In the reference mode the air flow is directed through a cooled filter after the dryer, to remove and restrain the non-volatile and volatile part of the particulate from the sample. During normal operation the temperature of the cooler is maintained at constantly 4 °C.

Based on the mass concentration measuring during the base- and reference-modi the FDMS-system updates the 1h-average of the following results every six minutes:

Base-MC	=	Particle concentration of the particle-loaded sampling flow.
Ref-MC	=	Particle concentration of the particle-free sampling flow after passing through the cooled filter.
MC	=	Base-MC adjusted for Ref-MC Base-mass-concentration (normally positive) reference-mass-concentration (negative, in case mass of the filter evaporates).

After the mass determination the sampling flows are directed over a mass flow rate regulator. To guarantee a constant sampling volume flow at the inlet, bearing in mind the ambient temperature and pressure, the volume flow control shall be operated in the mode „active/ actual“.

The tested measuring system consists of PM_{10}-sampling inlet, flow splitter, the respective sampling tubes, a tripod to support the sample, the measuring device TEOM 1405-F incl. FDMS-tower, the vacuum pump with its respective power supply cord and cables as well as adapters, the hole in the roof incl. a flange and a manual in German/English. The software version is 1.72.

The measuring device is operated via touch screen at the front of the device. The user can retrieve data and instrument information, change parameters as well as perform tests and controls of the functionality of the measuring device.

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.

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 its expiration is also accessible on the internet: **qal1.de**.

Certification of TEOM 1405-F Ambient Particulate Monitor with PM10 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. 0000035016: 16 March 2012
Expiry date of the certificate: 01 March 2017

Test report: 936/21209885/B dated 25 November 2011
TÜV Rheinland Energie und Umwelt GmbH, Köln
Publication: BAnz. 02 March 2012, No. 36, page 920, chapter IV, No. 1.1
Announcement by UBA from 23 February 2012

Notifications according to EN 15267

Statement of TÜV Rheinland Energie und Umwelt GmbH dated 2 May 2012
Publication: BAnz AT 20.07.2012 B11, chapter IV notification 31
Announcement by UBA from 06 July 2012
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH dated 18 March 2013
Publication: : BAnz AT 23.07.2013 B4, chapter V notification 19
Announcement by UBA from 03 July 2013
(hardware addition)

Statement of TÜV Rheinland Energie und Umwelt GmbH dated 1 October 2013
Publication: BAnz AT 01.04.2014 B12, chapter VI notification 32
Announcement by UBA from 27 February 2014
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH dated 22 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 20
Announcement by UBA from 25 February 2015
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH dated 17 March 2015
Publication: BAnz AT 26.08.2015 B4, chapter V notification 39
Announcement by UBA from 22 July 2015
(new software version and hardware addition)

Statement of TÜV Rheinland Energie und Umwelt GmbH dated 20 November 2015
Publication: BAnz AT 14.03.2016 B7, chapter V notification 38
Announcement by UBA from 18 February 2016
(addition of new regulation)

Statement of TÜV Rheinland Energie und Umwelt GmbH dated 29 February 2016
Publication: BAnz AT 01.08.2016 B11, chapter V notification 38
Announcement by UBA from 14 July 2016
(new software version)

Renewal of the certificate

Certificate No. 0000035016_01:	28 February 2017
Expiry date of the certificate:	01 March 2022

PM10 1405F FDMS	23,3% > 28 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	8,4	215	0,973	0,994 +/- 0,011	0,395 +/- 0,291	0,48	1,09
< 30 µg m-3	12,0	169	0,882	1,055 +/- 0,028	-0,567 +/- 0,501	0,46	1,03
> 30 µg m-3	9,5	46	0,963	0,992 +/- 0,029	0,218 +/- 1,274	0,55	1,35

SN 20006	Dataset	Orthogonal Regression				Limit Value of 50 µg m-3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m-3
Individual Datasets	Teddington Summer	42	0,895	1,112 +/- 0,057	0,055 +/- 0,883	23,71	2,4
	Cologne Winter	74	0,987	0,992 +/- 0,013	0,327 +/- 0,461	6,23	55,4
	Bornheim Summer	55	0,931	1,134 +/- 0,041	-2,097 +/- 0,750	20,10	3,6
	Teddington Winter	66	0,987	0,959 +/- 0,014	-1,549 +/- 0,337	15,22	16,7
Combined Datasets	< 30 µg m-3	186	0,860	1,069 +/- 0,029	-1,377 +/- 0,528	12,26	2,2
	> 30 µg m-3	51	0,966	0,986 +/- 0,026	-0,104 +/- 1,147	9,36	100,0
	All Data	237	0,970	0,994 +/- 0,011	-0,170 +/- 0,294	9,01	23,2

SN 20107	Dataset	Orthogonal Regression				Limit Value of 50 µg m-3	
		n_{c-s}	r^2	Slope (b) +/- u_b	Intercept (a) +/- u_a	W_{CM} / %	% > 28 µg m-3
Individual Datasets	Teddington Summer	57	0,927	1,065 +/- 0,039	0,807 +/- 0,605	17,19	1,8
	Cologne Winter	74	0,978	1,005 +/- 0,017	0,710 +/- 0,609	9,35	55,4
	Bornheim Summer	54	0,906	1,112 +/- 0,047	-0,860 +/- 0,859	21,03	3,7
	Teddington Winter	45	0,983	0,934 +/- 0,019	0,108 +/- 0,455	14,07	13,3
Combined Datasets	< 30 µg m-3	184	0,886	1,052 +/- 0,026	-0,062 +/- 0,467	13,06	2,2
	> 30 µg m-3	46	0,949	1,010 +/- 0,034	-0,139 +/- 1,526	11,60	100,0
	All Data	230	0,970	0,996 +/- 0,011	0,795 +/- 0,292	9,07	21,7