

# PRODUCT CONFORMITY CERTIFICATE

This is to certify that the

## ***TEOM 1405-DF FDMS Dichotomous monitor for PM<sub>2.5</sub> & PM<sub>10</sub>***

manufactured by:

### ***Thermo Fisher Scientific***

*27 Forge Parkway  
Franklin,  
MA 02038  
USA*

has been assessed by Sira Certification Service  
and for the conditions stated on this certificate complies with:

**MCERTS Performance Standards for Continuous Ambient Air Quality Monitoring Systems, Version 8, dated June 2012**

**MCERTS for UK Particulate Matter as set out in the Annex to the MCERTS Performance Standards for Ambient Air Quality Monitoring Systems: Requirements of the UK Competent Authority for the Equivalence Testing and Certification of Automated Continuous and Manual Discontinuous Methods that Monitor Particulate Matter in Ambient Air, Version 1.1, dated 31 July 2012**

Certification Ranges:

PM <sub>2.5</sub>	0 to 1000 µg/m <sup>3</sup>
PM <sub>10</sub>	0 to 1000 µg/m <sup>3</sup>

Project No: 16A28522 Add B  
Certificate No: Sira MC130211/01  
Initial Certification: 11 June 2013  
This Certificate Issued: 18 May 2015  
Renewal Date: 10 June 2018

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Technical Director

MCERTS is operated on behalf of the Environment Agency by

### **Sira Certification Service**

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*To authenticate the validity of this certificate please visit [www.siracertification.com/mcerts](http://www.siracertification.com/mcerts)*

## Approved Site Application

Any potential user should ensure, in consultation with the manufacturer, that the monitoring system is suitable for the intended application. For general guidance on monitoring techniques refer to the Environment Agency Monitoring Technical Guidance Notes available at [www.mcerts.net](http://www.mcerts.net)

The PM<sub>2.5</sub> and PM<sub>10</sub> field test was conducted at one site in the UK and two in Germany. The testing took place in both winter and summer months. The particulate loading at the test sites is representative of different types of areas including urban background and rural areas affected by motorway traffic..

On the basis of these tests this certificate is valid when the instrument is used for urban and rural air quality monitoring and similar applications.

The requirements according to the [Guide To The Demonstration Of Equivalence Of Ambient Air Monitoring Methods](#) (GDE 2010) are fulfilled for PM<sub>2.5</sub> and PM<sub>10</sub>.

## Basis of Certification

This certification is based on the following report(s) and on Sira's assessment and ongoing surveillance of the product and the manufacturing process:

MCERTS certification committee Report

[Certification Report and Checklist on the Evaluation of the Ambient Air Particulate Matter Test Reports Submitted for Approval and Certification within the MCERTS Scheme for UK Particulate Matter, 5 June 2013](#)

Bureau Veritas

[UK Report on the Equivalence of the PM<sub>10</sub> and PM<sub>2.5</sub> TEOM 1405-DF. Report ref AGGX5508189/BV/DH/2835 dated 5 June 2013](#)

TÜV Rheinland

Report on the suitability test of the ambient air quality measuring system TEOM 1405-DF Ambient Particulate Monitor with PM<sub>10</sub> pre-separator and virtual impactor of the company Thermo Fisher Scientific for the components PM<sub>10</sub> and PM<sub>2.5</sub>.

Report number 936/21209885/A dated 11 March 2012.

Report published on [www.qal1.de/en/hersteller/thermo.htm](http://www.qal1.de/en/hersteller/thermo.htm)

## Product Certified

The **TEOM 1405-DF Dichotomous with PM<sub>10</sub> pre-separator and virtual impactor** measuring system consists of the following parts:

- USEPA style PM<sub>10</sub> sampling inlet operating at 16.7 l min<sup>-1</sup>
- Virtual impactor
- Flow splitter
- Sampling tubes
- FDMS (Filter Dynamics Measurement Systems) tower
- TEOM (Tapered Element Oscillating Microbalance) mass sensors
- Mass Flow Controllers
- Vacuum pump

This certificate applies to all 1405DF Dichotomous instruments fitted with software version 1.56 (serial number 20014 onwards).

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## Certified Performance

Ambient temperature range: 8°C to 25°C

The data in this table relate to the instrument **with no correction** for slope and/or intercept. See Note 1.

Test	Results	MCERTS specification
Constancy of the sample volumetric flow	-0.001%	To remain constant within $\pm 3\%$ of the rated value
Tightness of the sampling system	3.25% maximum Note 2	Leakage not to exceed 1% of the sampled volume
Between sampler/instrument uncertainty for the standard method		
<b>PM<sub>2.5</sub></b>		
Full data set	0.55 $\mu\text{g}/\text{m}^3$	$\leq 2 \mu\text{g}/\text{m}^3$
<18 $\mu\text{g}/\text{m}^3$	0.54 $\mu\text{g}/\text{m}^3$	Not specified
$\geq 18 \mu\text{g}/\text{m}^3$	0.56 $\mu\text{g}/\text{m}^3$	Not specified
<b>PM<sub>10</sub></b>		
Full data set	0.56 $\mu\text{g}/\text{m}^3$	$\leq 2 \mu\text{g}/\text{m}^3$
<30 $\mu\text{g}/\text{m}^3$	0.55 $\mu\text{g}/\text{m}^3$	Not specified
$\geq 30 \mu\text{g}/\text{m}^3$	0.60 $\mu\text{g}/\text{m}^3$	Not specified
Between sampler/instrument uncertainty for the candidate method		
<b>PM<sub>2.5</sub></b>		
Full data set	0.76 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
<18 $\mu\text{g}/\text{m}^3$	0.64 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
$\geq 18 \mu\text{g}/\text{m}^3$	1.05 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
<b>PM<sub>10</sub></b>		
Full data set	0.75 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
<30 $\mu\text{g}/\text{m}^3$	0.68 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
$\geq 30 \mu\text{g}/\text{m}^3$	1.06 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$

Test	Results	MCERTS specification
Expanded uncertainty calculated at 30 µg/m <sup>3</sup> for <b>Instrument SN 20014</b>		
<b>PM<sub>2.5</sub></b>		
Full data set	16.4%	≤25%
<18 µg/m <sup>3</sup>	24.4%	Not specified
≥18 µg/m <sup>3</sup>	19.6%	≤25%
Individual sites	Note 3	
Bornheim Winter	20.5%	≤25%
Cologne Winter	16.1%	≤25%
Bornheim Summer	23.7%	≤25%
Teddington	15.7%	≤25%
Expanded uncertainty calculated at 30 µg/m <sup>3</sup> for <b>Instrument SN 20116</b>		
<b>PM<sub>2.5</sub></b>		
Full data set	12.5%	≤25%
<18 µg/m <sup>3</sup>	24.6%	Not specified
≥18 µg/m <sup>3</sup>	15.7%	≤25%
Individual sites		
Bornheim Winter	11.0%	≤25%
Cologne Winter	13.2%	≤25%
Bornheim Summer	21.9%	≤25%
Teddington	15.6%	≤25%

Test	Results	MCERTS specification
Expanded uncertainty calculated at 50 µg/m <sup>3</sup> for <b>Instrument SN 20014</b>		
<b>PM<sub>10</sub></b>		
Full data set	12.2%	≤25%
<30 µg/m <sup>3</sup>	13.0%	Not specified
≥30 µg/m <sup>3</sup>	14.90%	≤25%
Individual sites		
Bornheim Winter	16.8%	≤25%
Cologne Winter	10.6%	≤25%
Bornheim Summer	21.4%	≤25%
Teddington	15.4%	≤25%
Expanded uncertainty calculated at 50 µg/m <sup>3</sup> for <b>Instrument SN 20116</b>		
<b>PM<sub>10</sub></b>		
Full data set	10.8%	≤25%
<30 µg/m <sup>3</sup>	13.9%	Not specified
≥30 µg/m <sup>3</sup>	12.4%	≤25%
Individual sites		
Bornheim Winter	11.1%	≤25%
Cologne Winter	9.6%	≤25%
Bornheim Summer	23.8%	≤25%
Teddington	13.0%	≤25%
Maintenance interval <b>PM<sub>2.5</sub> &amp; PM<sub>10</sub></b>	Four weeks	≥ Two weeks
Data Availability ( <b>SN20014</b> )	98.2%	≥90%
Data Availability ( <b>SN20116</b> )	99.1%	≥90%
Number of UK Tests	1	≥1
Number of Reference Methods	2	≥1

Note 1: For the PM<sub>2.5</sub> data, as the intercept was statistically significantly different from zero based upon 2 standard deviations, test results were also subjected to correction coefficients for intercept. Expanded uncertainties for the Candidate Method were calculated for both uncorrected datasets as well as data that have been adjusted for intercept. The CM fulfills the relevant Data Quality Objective of EU Directive 2008/50/EC when used without correction, though the highest individual expanded uncertainty specified in the Guide to GDE2010 (required to be below 25 %) is reduced if correction for intercept by subtracting 1.212 µg/m<sup>3</sup> is employed. Intercept correction is not required in order to make the instrument equivalent, but it is essential that thorough and frequent ongoing QAQC procedures are employed (as prescribed in prEN12341:2013 and prCEN/TS16450:2013) including to precisely quantify analyser baseline performance and ensure the continued correct operation of the FDMS drier.

1405-DF PM <sub>2.5</sub> Data	Calculated slope of all paired data	Calculated intercept of all paired data (µg/m <sup>3</sup> )	Expanded uncertainty of all paired data	Range of individual expanded uncertainties
Uncorrected data	0.997	1.212	14.0%	11.0% to 23.7%
Data corrected for intercept by subtracting 1.212	0.997	0.000	11.8%	7.7% to 22.5%

For the PM<sub>10</sub> data, as the intercept was statistically significantly different from zero based upon 2 standard deviations, test results were also subjected to correction coefficients for intercept. Expanded uncertainties for the Candidate Method were calculated for both uncorrected datasets as well as data that have been adjusted for intercept. The CM fulfills the relevant Data Quality Objective of EU Directive 2008/50/EC when used without correction, though the highest individual expanded uncertainty specified in GDE 2010 (required to be below 25 %) is reduced if correction for intercept by subtracting 1.078 µg/m<sup>3</sup> is employed. Intercept correction is not required in order to make the instrument equivalent, but it is essential that thorough and frequent ongoing QAQC procedures are employed (as prescribed in prEN12341:2013 and prCEN/TS16450:2013) including to precisely quantify analyser baseline performance and ensure the continued correct operation of the FDMS drier.

1405-DF PM <sub>10</sub> Data	Calculated slope of all paired data	Calculated intercept of all paired data (µg/m <sup>3</sup> )	Expanded uncertainty of all paired data	Range of individual expanded uncertainties
Uncorrected data	1.016	1.078	11.2%	9.6% to 23.8%
Data corrected for intercept by subtracting 1.078	1.016	0.000	8.9%	7.0% to 19.7%

Note 2: The leak test procedure for the 1405-F and the 1405-DF is an internal manufacturer's procedure, implemented in the instruments in order to avoid serious damage to the instrument. The check on tightness must be performed using this internal procedure. All of the leak tests conducted passed the manufacturer's leak test specifications.

Note 3: A study of pollution climate by Bureau Veritas relevant to sites in the UK and Germany has demonstrated that in all cases the particulate geometric mean criteria are met and at least one site meets the lower threshold and higher threshold criterion for wind speed, ambient temperature, ambient dew point and semi volatile nitrate content. The pollution climate criteria are satisfied for all the equivalence tests.

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Note 4 For the purposes of quality control of these monitors in the field, as with all PM instruments that are not the reference method, the 1405 series FDMSs should be calibrated on a test site at intervals against the gravimetric reference methods EN 12341 or EN 14907 as applicable, and as given in the recommendations of the GDE 2010 and prEN16450.

### Description:

The TEOM 1405-DF Dichotomous Ambient Particulate Monitor with FDMS is a mass measurement monitor that incorporates the Tapered Element Oscillating Microbalance (TEOM) to measure particulate matter mass concentrations continuously. The TEOM 1405-DF Monitor draws ambient air through a sample filter for collection at a constant flow rate. The monitor continuously weighs the filter calculating near real-time mass concentrations.

The 1405-DF Dichotomous Ambient Particulate Monitor is used to sample PM<sub>10</sub> by using a 16.7 l min<sup>-1</sup> USEPA style PM<sub>10</sub> inlet followed by a virtual impactor to split the PM<sub>10</sub> in to PM<sub>Coarse</sub> and PM<sub>2.5</sub>. Two FDMS systems automatically determine the mass concentration measurements that account for both non-volatile and volatile PM components for each size fraction.

In addition, the TEOM 1405-DF utilizes FDMS technology to provide a representative determination of the mass concentrations of both the PM<sub>2.5</sub> and PM<sub>Coarse</sub>, accounting for both non-volatile and volatile PM components.

The sensor unit contains the two mass measurement hardware systems that monitor particles that continuously accumulate on both PM<sub>2.5</sub> and PM<sub>Coarse</sub> particulate filters. PM<sub>Coarse</sub> and PM<sub>2.5</sub> particulate, split by a virtual impactor, each accumulate on the system's exchangeable TEOM filters. By maintaining a flow rate of 1.67 l/min through the coarse sample flow channel and 3 l/min through the PM<sub>2.5</sub> sample channel, and measuring the total mass accumulated on each of the TEOM filters, the device can calculate the mass concentrations of PM<sub>2.5</sub>, PM<sub>Coarse</sub>, and PM<sub>10</sub> sample streams in near real-time.

### General Notes

1. This certificate is based upon the equipment tested. The Manufacturer is responsible for ensuring that on-going production complies with the standard(s) and performance criteria 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 system shall be subject to regular surveillance according to 'Regulations Applicable to the Holders of Sira Certificates'. The design of the product certified is defined in the Sira Design Schedule for certificate No. Sira MC130211/00
2. If certified product is found not to comply, Sira Certification Service should be notified immediately at the address shown on this certificate.
3. The Certification Marks that can be applied to the product or used in publicity material are defined in 'Regulations Applicable to the Holders of Sira Certificates'.
4. This document remains the property of Sira and shall be returned when requested by the company.

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