Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000028733_02

AMS designation:	SWAM 5a Dual Channel Monitor, SWAM 5a Dual Channel Hourly Mode Monitor for PM_{10} and $PM_{2.5}$ and SWAM 5a Monitor for PM_{10} or $PM_{2.5}$
Manufacturer:	FAI Instruments s.r.l. Via Aurora, 25 00013 Fonte Nuova (Roma) Italy
Test Laboratory:	TÜV Rheinland Energy GmbH

This is to certify that the AMS has been tested and certified according to the standards VDI 4202-1 (2002), VDI 4203-3 (2004), EN 12341 (1998), EN 14907 (2005), EN 16450 (2017), Guide to the demonstration of equivalence of ambient air monitoring methods (2010), EN 15267-1 (2009) and DIN EN 15267-2 (2009).

Certification is awarded in respect of the conditions stated in this certificate (this certificate contains 17 pages).
The present certificate replaces certificate 0000028733_01 of 22 July 2016.

TÜVRheinland® CERTIFIED

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

www.tuv.com
ID 0000028733

Publication in the German Federal Gazette (BAnz) of 25 August 2009

This certificate will expire on:
28 July 2021

German Federal Environment Agency
Dessau, 13 April 2018

Dr. Marcel Langner
Head of Section II 4.1

TÜV Rheinland Energy GmbH
Cologne, 12 April 2018

ppa. Dr. Peter Wilbring

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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.

Test Report:	936/21207522/A dated 23 March 2009
Initial certification:	29 July 2011
Expiry date:	28 July 2021
Publication:	BAnz. 25 August 2009, no. 125, page 2929, chapter II no. 2.1

Approved application
The certified AMS is suitable for continuous ambient air monitoring of suspended particulate matter, PM_{10} and $PM_{2.5}$ (stationary operation).

The suitability of the AMS for this application was assessed on the basis of a laboratory test and field tests at up to six different locations and/or periods.

The AMS is approved for an ambient temperature range of +5 °C to +40 °C.

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

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the planned operation purpose.

Basis of the certification
This certification is based on:

- Test report 936/21207522/A dated 23 March 2009 issued by TÜV Rheinland Immissionsschutz und Energiesysteme GmbH and addendum 936/21239762/A dated 22 September 2017 issued by TÜV Rheinland Energy 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. 25 August 2009, no. 125, page 2929, chapter II no. 2.1, UBA announcement of 03 August 2009:

AMS designation:
SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$

Manufacturer:
FAI Instruments s.r.l., Fonte Nuova (Rom), Italy

Field of application:
For the continuous and simultaneous ambient air monitors of the PM_{10} and $PM_{2.5}$ fractions of suspended particulate matter (stationary operation)

Measuring ranges during performance testing:
PM_{10}: 0–200 µg/m³
$PM_{2.5}$: 0–200 µg/m³

Software version:
Version Rel 04-08.01.65-30.02.00

Notes:
1. Requirements specified in Guideline “Demonstration of Equivalence of Ambient Air Monitoring Methods” are complied with.
2. Filter housings with a spot area of 5.20 cm² were used.
3. The measuring system must be calibrated on site at regular intervals by using the gravimetric PM_{10} reference method according to EN 12341.
4. The measuring system must be calibrated on site at regular intervals by using the gravimetric $PM_{2.5}$ reference method according to EN 14907.

Test Report:
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Report no. 936/21207522/A dated 23 March 2009

Publication in the German Federal Gazette: BAnz 29 July 2011, no. 113, page 2725, chapter III notification 7, UBA announcement dated 15 July 2011:

7 Notification as regards Federal Environment Agency notice of 3 August 2009 (BAnz. p. 2929, chapter II no. 2.1)

The SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$ manufactured by FAI Instruments s. r. l. complies with the requirements of EN 12341, EN 14907 and the Guideline "Demonstration of Equivalence of Ambient Air Monitoring Methods" in its November 2005 version. Furthermore, the manufacturing process and the quality management for the SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$ meets the requirements of EN 15267.

The test report on performance testing is available on the internet at www.qal1.de.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 26 March 2011

Publication in the German Federal Gazette: BAnz. 2 March 2012, no. 36, p. 920, chapter V notification 2, UBA announcement dated 23 February 2012:

2 Notification as regards Federal Environment Agency notice of 3 August 2009 (BAnz. p. 2929, chapter II no. 2.1) and of 15 July 2011 (BAnz. page 2725, chapter III 7th notification)

The SWAM 5a Dual Channel Monitor ambient air measuring system for PM_{10} and $PM_{2.5}$ manufactured by FAI Instruments s.r.l can also be used in its 1-hour measurement mode version. This instrument version with 1-hour measurement mode is distributed as SWAM 5a Dual Channel Hourly Mode Monitor.

The SWAM 5a Dual Channel Hourly Mode Monitor ambient air measuring system manufactured by FAI Instruments s.r.l is distributed by Teledyne Advanced Pollution Instrumentation under the name of Model 602 BetaPlus which is identical in design.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 11 October 2011

Publication in the German Federal Gazette: BAnz. 2 March 2012, no. 36, p. 920, chapter V notification 3, UBA announcement dated 23 February 2012:

3 Notification as regards Federal Environment Agency (UBA) notices of 3 August 2009 (BAnz. p. 2929, chapter II no. 2.1) and of 15 July 2011 (BAnz. p. 2725, chapter III 7th notification)

The announcement for the SWAM 5a Dual Channel Monitor ambient air measuring system for PM_{10} and $PM_{2.5}$ manufactured by FAI Instruments s.r.l also covers the single-channel design of the ambient air monitor which is called SWAM 5a Monitor.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 3 November 2011

Publication in the German Federal Gazette: BAnz AT 05.03.2013 B10, chapter V notification 12, UBA announcement dated 12 February 2013:

12 Notification as regards Federal Environment Agency (UBA) notices of 3 August 2009 (BAnz. p. 2929, chapter II no. 2.1) and of 23 February 2012 (BAnz. p. 920, chapter V 2nd and 3rd notification)

The current software version of the SWAM 5a Dual Channel Monitor dust measuring system for PM_{10} and $PM_{2.5}$ manufactured by FAI Instruments s.r.l is:

04-09.01.85-30.02.00

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 15 October 2012

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter IV notification 8, UBA announcement dated 25 February 2015:

8 Notification as regards Federal Environment Agency (UBA) notices of 3 August 2009 (BAnz. p. 2929, chapter II no. 2.1) and of 12 February 2013 (BAnz AT 05.03.2013 B10 chapter V 12th notification)

The current software versions of the SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$ are:

04-09.01.85-30.02.00 (old micro controller, up to 2008) and

04-09.01.85-30.03.00 (new micro controller, as of 2008)

An optional Ethernet board is available for the SWAM 5a Dual Channel Hourly Mode Monitor for PM_{10} and $PM_{2.5}$ which enables the measuring system to communicate via a LAN. The current software version of the measuring system is:

05-02.08.56-30.03.00

The current software version of the SWAM 5a Monitor for PM_{10} or $PM_{2.5}$ is:

01-05.05.13-30.03.00

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 19 September 2014

Publication in the German Federal Gazette: BAnz AT 26.08.2015 B4, chapter V notification 44, UBA announcement dated 22 July 2015:

44 Notification as regards Federal Environment Agency (UBA) notices of 3 August 2009 (BAnz. p. 2934, chapter II no. 2.1) and of 25 February 2015 (BAnz AT 02.04.2015 B5 chapter IV 8th notification)

Standard sampling inlets PM10-EN12341-2014 and PM2.5-EN12341-2014 in accordance with annex A to standard EN 12314:2014 (August 2014 version) are available for the SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$, SWAM 5a Dual Channel Hourly Mode Monitor for PM_{10} and $PM_{2.5}$ and SWAM 5a Monitor for PM_{10} or $PM_{2.5}$ manufactured by FAI Instruments srl.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH
dated 17 March 2015

Publication in the German Federal Gazette: BAnz AT 26.03.2018 B8, chapter V notification 6, UBA announcement dated 21 February 2018:

6 Notification as regards Federal Environment Agency (UBA) notices of 3 August 2009 (BAnz. p. 2934, chapter II no. 2.1) and of 22 July 2015 (BAnz AT 26.08.2015 B4 chapter V 44th notification)

The SWAM 5a Dual Channel Monitor, SWAM 5a Dual Channel Hourly Mode Monitor for PM_{10} and $PM_{2.5}$ and the SWAM 5a Monitor for PM_{10} or $PM_{2.5}$ manufactured by FAI Instruments srl. meet the requirements of standard EN 16450 (July 2017 version). An addendum no. 936/21239762/A as integral part of test report is available online at www.qal1.de.

The current software version of the SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$ is:

04-09.01.92-30.03.00

The current software version of the SWAM 5a Dual Channel Hourly Mode Monitor for PM_{10} and $PM_{2.5}$ is:

05-03.00.01-30.03.00

The current software version of the SWAM 5a Monitor for PM_{10} or $PM_{2.5}$ is:

01-05.05.17-30.03.00

Statement issued by TÜV Rheinland Energy GmbH dated 22 September 2017

Certified product

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

For mass measurement of separated particles, the SWAM 5a Dual Channel Monitor, SWAM 5a Dual Channel Hourly Mode Monitor and SWAM 5a Monitor measuring systems rely on the principle of beta attenuation observed on passing through a thin film of material.

The measuring system is available in three different instrument versions: SWAM 5a Dual Channel Monitor (PM_{10} and $PM_{2.5}$, two independent sampling lines, 24h measurement mode tested); SWAM 5a Dual Channel Hourly Monitor (PM_{10} and $PM_{2.5}$, via two independent sampling lines, 1h measurement cycle tested) and SWAM 5a Monitor (PM_{10} or $PM_{2.5}$ via a single sampling line, 24h measurement cycle tested).

The SWAM 5a Dual Channel Monitor, SWAM 5a Monitor and SWAM 5a Dual Channel Hourly Mode Monitor are automated and sequential measuring systems for the determination of particles on filter membranes. The dual channel versions use pumps to suck in ambient air via the PM_{10} sampling head on the one hand and the $PM_{2.5}$ sampling head on the other. Dust-loaded sample air is then precipitated on a filter (1 x PM_{10}, 1 x $PM_{2.5}$). The SWAM 5a Monitor version of the instrument samples air on the filter via the sampling inlet with the help of a single pump.

The determination of the mass concentration precipitated on a filter is then performed relying on the radiometric principle of beta absorption. A single radiometric mass measurement module is used to determine the dust mass deposited on the filters for the dual-channel instrument versions, too.

The SWAM 5a Dual Channel Monitor and SWAM 5a Dual Channel Hourly Mode Monitor measuring system consists of two sampling heads (PM_{10} and $PM_{2.5}$), two intake pipes, two vacuum pumps, the instrument, the compressor for generating compressed air and the two filter cartridges for virgin and sampled filters.

The SWAM 5a Monitor consists of a sampling head (PM_{10} or $PM_{2.5}$), an intake pipe, a vacuum pump, the instrument, the compressor for generating compressed air and the two filter cartridges for virgin and sampled filters.

The sampling inlets are manufactured by the instrument manufacturer and are available for various flow rates (2.3 m³/h or 1 m³/h). During performance testing, sampling inlets with a throughput of 2.3 m³/h were used which, in terms of design, complied with the standards applicable at the time of testing, namely EN 12341:1998 (PM_{10}) and EN 14907:2005 ($PM_{2.5}$). Approval extends to those sampling inlets which, in terms of their design, comply with the requirements of EN 12341:2014 (PM_{10}, $PM_{2.5}$).

Ambient air containing particles is taken in through the sampling inlet, it passes through the intake pipe and finally reaches the filter.

In situations with high amounts of volatile dust components it is possible to have the intake pipe purged co-axially with ambient air (it may alternatively heated or cooled).

As part of the test at hand, neither purging with ambient air, nor active heating or cooling of the intake pipes took place. Inside the measuring rack, the intake pipes were isolated by wrapping foamed material around it.

Ambient air is taken in through the sampling inlets, the intake pipes and the filters with the help of the vacuum pump. They consist of a piston pump with an upstream silencer filter to balance out pressure fluctuations.

In principle, it is possible to use a different pump type (e.g. graphite rotary vane pump) as long as the required pump performance is ensured at any given time.

The sampling unit contains all the servo mechanics, the pneumatic and beta measurement component as well as all electronic parts and microprocessors for operation, control and monitoring of the measuring system. The control panel with display is located at the front of

the system; pneumatic and electronic connections as well as communication interfaces are located at the back of the system. Filter loader/unloader housings and intake pipes are located on the upper instrument surface.

The instrument is equipped with a service air compressor able to supply compressed air (200–300 kPa) used for the servomechanisms movements (e.g. for loading/unloading filters into the relevant housing). A compressor generates the necessary compressed air.

The measuring system is operated via a membrane keypad combined with a display at the front of the instrument. This is where all necessary parameters can be adjusted (e.g. sampling time). Moreover, information regarding the current instrument status (on-going sampling), data saved on completed measurements and numerous parameters for quality assurance can be accessed here.

In addition to direct communication via the control panel/display, the system can be fully operated, controlled and parameterised via the RS-232 serial interface and a standard terminal programme (e.g. Hyperterminal) or the software components Dr. FAI Manager, either directly or indirectly via a GSM modem

The current software versions are:

SWAM 5a Dual Channel Monitor:	04-09.01.92-30.03.00
SWAM 5a Dual Channel Hourly Mode Monitor:	05-03.00.01-30.03.00
SWAM 5a Monitor:	01-05.05.17-30.03.00

The current manual versions are:

SWAM 5a Dual Channel Monitor:	02/2009 – rev. 22
SWAM 5a Dual Channel Hourly Mode Monitor:	05/2016 – rev. 01
SWAM 5a Monitor:	05/2016 – rev. 13

General remarks

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 manufacturing process for 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 document as well as the certification mark remains property of TÜV Rheinland Energy GmbH. Upon revocation of the publication the certificate loses its validity. After the expiration of the certificate and on request of TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must no longer be used.

The relevant version of this certificate and its expiration date are also accessible on the internet at **qal1.de**.

Certification of measuring systems SWAM 5a Dual Channel Monitor, SWAM 5a Dual Channel Hourly Mode Monitor for PM_{10} and $PM_{2.5}$ and SWAM 5a Monitor for PM_{10} or $PM_{2.5}$ is based on the documents listed below and the regular, continuous surveillance of the manufacturer's quality management system:

Basic testing:

Test report: 936/21207522/A dated 23 March 2009
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 25 August 2009, no. 125, p. 2929, chapter II number 2.1
UBA announcement dated 3 August 2009

Initial certification according to EN 15267

Certificate no. 0000028733: 19 August 2011
Expiry date of the certificate: 28 July 2016

Test report: 936/21207522/A dated 23 March 2009
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 29 July 2011, no. 113, p. 2725, chapter III notification 7
UBA announcement dated 15 July 2011

Notifications in accordance with EN 15267

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 11 October 2011
Publication: BAnz. 2 March 2012, no. 36, p. 920, chapter V notification 2,
UBA announcement dated 23 February 2012
(new instrument version)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 3 November 2011
Publication: BAnz. 02 March 2012, no. 36, p. 920, chapter V notification 3,
UBA announcement dated 23 February 2012
(new instrument version)

Opinion stated by TÜV Rheinland Energie und Umwelt GmbH dated 15 October 2012
Publication: BAnz AT 05.03.2013 B10, chapter V notification 12
UBA announcement dated 12 February 2013
(New software version)

Opinion stated by TÜV Rheinland Energie und Umwelt GmbH dated 19 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 8
UBA announcement dated 25 February 2015
(New software version)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 17 March 2015.
Publication: BAnz AT 26.08.2015 B4, chapter V notification 44
UBA announcement dated 22 July 2015
(hardware changes)

Renewal of the certificate

Certificate no. 0000028733_01: 22 July 2016
Expiry date of the certificate: 28 July 2021

Notifications in accordance with EN 15267

Certificate no. 0000028733_02: 13 April 2018
Expiry date of the certificate: 28 July 2021

Statement issued by TÜV Rheinland Energy GmbH dated 22 September 2017
Publication: BAnz AT 26.03.2018 B8, chapter V notification 6
UBA announcement dated 21 February 2018
(compliance with standard EN 16450 (2017), new software version)

Summary of the results for equivalence testing SWAM 5a Dual Channel Monitor, measured component $PM_{2.5}$ after correction of the slope and intercept

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a DC		SN	SN 127/145/248 & 131/149/249	
			Limit value	30	µg/m³
Status of measured values	Slope & offset corrected		Allowed uncertainty	25	%
All comparisons					
Uncertainty between Reference	**0.51**	**µg/m³**			
Uncertainty between Candidates	**0.73**	**µg/m³**			
	SN 127/145/248 & 131/149/249				
Number of data pairs	**312**				
Slope b	**1.001**	**not significant**			
Uncertainty of b	**0.011**				
Ordinate intercept a	**-0.007**	**not significant**			
Uncertainty of a	**0.189**				
Expanded meas. uncertainty W_{CM}	**12.16**	**%**			
All comparisons, ≥18 µg/m³					
Uncertainty between Reference	**0.64**	**µg/m³**			
Uncertainty between Candidates	**0.79**	**µg/m³**			
	SN 127/145/248 & 131/149/249				
Number of data pairs	**91**				
Slope b	**1.051**				
Uncertainty of b	**0.029**				
Ordinate intercept a	**-2.028**				
Uncertainty of a	**0.804**				
Expanded meas. uncertainty W_{CM}	**15.45**	**%**			
All comparisons, <18 µg/m³					
Uncertainty between Reference	**0.50**	**µg/m³**			
Uncertainty between Candidates	**0.45**	**µg/m³**			
	SN 127/145/248 & 131/149/249				
Number of data pairs	**221**				
Slope b	**0.959**				
Uncertainty of b	**0.022**				
Ordinate intercept a	**0.606**				
Uncertainty of a	**0.237**				
Expanded meas. uncertainty W_{CM}	**10.78**	**%**			

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a DC		SN	SN 127/145/248 & 131/149/249	
			Limit value	30	µg/m³
Status of measured values	Slope & offset corrected		Allowed uncertainty	25	%
Cologne, parking lot (2007)					
Uncertainty between Reference	0.67	µg/m³			
Uncertainty between Candidates	0.71	µg/m³			
	SN 127			SN 131	
Number of data pairs	45			46	
Slope b	1.029			0.995	
Uncertainty of b	0.023			0.023	
Ordinate intercept a	-0.653			-0.372	
Uncertainty of a	0.393			0.391	
Expanded meas. uncertainty W_{CM}	7.23	%		7.90	%
Bonn, Belderberg					
Uncertainty between Reference	0.46	µg/m³			
Uncertainty between Candidates	0.44	µg/m³			
	SN 127			SN 131	
Number of data pairs	41			41	
Slope b	1.025			1.052	
Uncertainty of b	0.020			0.022	
Ordinate intercept a	-1.611			-2.437	
Uncertainty of a	0.456			0.504	
Expanded meas. uncertainty W_{CM}	9.94	%		10.68	%
Bruehl					
Uncertainty between Reference	0.65	µg/m³			
Uncertainty between Candidates	0.65	µg/m³			
	SN 127			SN 131	
Number of data pairs	43			45	
Slope b	1.013			1.032	
Uncertainty of b	0.033			0.033	
Ordinate intercept a	-1.357			-1.595	
Uncertainty of a	0.509			0.534	
Expanded meas. uncertainty W_{CM}	10.83	%		10.51	%
Teddington					
Uncertainty between Reference	0.33	µg/m³			
Uncertainty between Candidates	0.45	µg/m³			
	SN 145			SN 149	
Number of data pairs	74			80	
Slope b	1.005			1.002	
Uncertainty of b	0.023			0.020	
Ordinate intercept a	0.801			1.020	
Uncertainty of a	0.290			0.252	
Expanded meas. uncertainty W_{CM}	11.94	%		11.62	%
Cologne, parking lot (2011)					
Uncertainty between Reference	0.52	µg/m³			
Uncertainty between Candidates	1.37	µg/m³			
	SN 127			SN 131	
Number of data pairs	67			53	
Slope b	1.053			1.000	
Uncertainty of b	0.027			0.032	
Ordinate intercept a	-0.904			0.277	
Uncertainty of a	0.634			0.824	
Expanded meas. uncertainty W_{CM}	17.18	%		19.17	%
Bornheim					
Uncertainty between Reference	0.65	µg/m³			
Uncertainty between Candidates	0.33	µg/m³			
	SN 248			SN 249	
Number of data pairs	57			60	
Slope b	1.084			1.094	
Uncertainty of b	0.041			0.043	
Ordinate intercept a	-0.213			-0.338	
Uncertainty of a	0.441			0.456	
Expanded meas. uncertainty W_{CM}	18.54	%		19.85	%
All comparisons, ≥18 µg/m³					
Uncertainty between Reference	0.64	µg/m³			
Uncertainty between Candidates	0.79	µg/m³			
	SN 127/145/248			SN 131/149/249	
Number of data pairs	95			95	
Slope b	1.067			1.023	
Uncertainty of b	0.029			0.029	
Ordinate intercept a	-2.358			-1.408	
Uncertainty of a	0.810			0.81	
Expanded meas. uncertainty W_{CM}	15.74	%		16.12	%
All comparisons, <18 µg/m³					
Uncertainty between Reference	0.50	µg/m³			
Uncertainty between Candidates	0.45	µg/m³			
	SN 127/145/248			SN 131/149/249	
Number of data pairs	232			230	
Slope b	0.958			0.985	
Uncertainty of b	0.021			0.024	
Ordinate intercept a	0.593			0.413	
Uncertainty of a	0.226			0.252	
Expanded meas. uncertainty W_{CM}	10.49	%		10.93	%
All comparisons					
Uncertainty between Reference	0.51	µg/m³			
Uncertainty between Candidates	0.73	µg/m³			
	SN 127/145/248			SN 131/149/249	
Number of data pairs	327			325	
Slope b	1.009	not significant		0.991	not significant
Uncertainty of b	0.011			0.011	
Ordinate intercept a	-0.118	not significant		0.137	not significant
Uncertainty of a	0.187			0.193	
Expanded meas. uncertainty W_{CM}	12.19	%		12.77	%

Summary of the results for equivalence testing SWAM 5a Dual Channel Monitor, Measured component PM_{10} after correction of the slope

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a DC		SN	SN 127/145/248 & 131/149/249	
			Limit value	50	µg/m³
Status of measured values	Slope corrected		Allowed uncertainty	25	%
All comparisons					
Uncertainty between Reference	0.75	µg/m³			
Uncertainty between Candidates	0.63	µg/m³			
	SN 127/145/248 & 131/149/249				
Number of data pairs	404				
Slope b	0.999	not significant			
Uncertainty of b	0.009				
Ordinate intercept a	-0.240	not significant			
Uncertainty of a	0.228				
Expanded meas. uncertainty W_{CM}	8.85	%			
All comparisons, ≥30 µg/m³					
Uncertainty between Reference	0.78	µg/m³			
Uncertainty between Candidates	1.14	µg/m³			
	SN 127/145/248 & 131/149/249				
Number of data pairs	83				
Slope b	1.111				
Uncertainty of b	0.030				
Ordinate intercept a	-5.296				
Uncertainty of a	1.307				
Expanded meas. uncertainty W_{CM}	13.36	%			
All comparisons, <30 µg/m³					
Uncertainty between Reference	0.74	µg/m³			
Uncertainty between Candidates	0.43	µg/m³			
	SN 127/145/248 & 131/149/249				
Number of data pairs	321				
Slope b	0.962				
Uncertainty of b	0.015				
Ordinate intercept a	0.527				
Uncertainty of a	0.276				
Expanded meas. uncertainty W_{CM}	8.74	%			

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a DC		SN	SN 127/145/248 & 131/149/249	
			Limit value	50	µg/m³
Status of measured values	Slope corrected		Allowed uncertainty	25	%
Cologne, parking lot (2007)					
Uncertainty between Reference	1.12	µg/m³			
Uncertainty between Candidates	0.83	µg/m³			
	SN 127			SN 131	
Number of data pairs	98			100	
Slope b	1.070			1.021	
Uncertainty of b	0.012			0.011	
Ordinate intercept a	-0.306			0.394	
Uncertainty of a	0.321			0.295	
Expanded meas. uncertainty W_{CM}	14.16	%		7.77	%
Bonn, Belderberg					
Uncertainty between Reference	0.53	µg/m³			
Uncertainty between Candidates	0.43	µg/m³			
	SN 127			SN 131	
Number of data pairs	62			62	
Slope b	1.076			1.060	
Uncertainty of b	0.020			0.019	
Ordinate intercept a	-1.113			-0.986	
Uncertainty of a	0.542			0.513	
Expanded meas. uncertainty W_{CM}	12.64	%		10.25	%
Bruehl					
Uncertainty between Reference	0.77	µg/m³			
Uncertainty between Candidates	0.54	µg/m³			
	SN 127			SN 131	
Number of data pairs	51			53	
Slope b	0.996			0.985	
Uncertainty of b	0.026			0.024	
Ordinate intercept a	-1.815			-1.594	
Uncertainty of a	0.614			0.570	
Expanded meas. uncertainty W_{CM}	10.43	%		11.20	%
Teddington					
Uncertainty between Reference	0.45	µg/m³			
Uncertainty between Candidates	0.50	µg/m³			
	SN 145			SN 149	
Number of data pairs	73			79	
Slope b	0.901			0.921	
Uncertainty of b	0.020			0.020	
Ordinate intercept a	2.370			1.927	
Uncertainty of a	0.379			0.371	
Expanded meas. uncertainty W_{CM}	11.75	%		9.91	%
Cologne, parking lot (2011)					
Uncertainty between Reference	0.59	µg/m³			
Uncertainty between Candidates	0.83	µg/m³			
	SN 127			SN 131	
Number of data pairs	69			66	
Slope b	0.982			0.983	
Uncertainty of b	0.021			0.024	
Ordinate intercept a	-1.574			-1.966	
Uncertainty of a	0.728			0.836	
Expanded meas. uncertainty W_{CM}	13.53	%		15.44	%
Bornheim					
Uncertainty between Reference	0.63	µg/m³			
Uncertainty between Candidates	0.33	µg/m³			
	SN 248			SN 249	
Number of data pairs	56			59	
Slope b	0.991			0.990	
Uncertainty of b	0.031			0.032	
Ordinate intercept a	-0.575			-0.723	
Uncertainty of a	0.553			0.568	
Expanded meas. uncertainty W_{CM}	7.88	%		8.57	%
All comparisons, ≥30 µg/m³					
Uncertainty between Reference	0.78	µg/m³			
Uncertainty between Candidates	1.14	µg/m³			
	SN 127/145/248			SN 131/149/249	
Number of data pairs	86			85	
Slope b	1.137			1.085	
Uncertainty of b	0.031			0.031	
Ordinate intercept a	-6.111			-4.605	
Uncertainty of a	1.330			1.32	
Expanded meas. uncertainty W_{CM}	14.07	%		13.56	%
All comparisons, <30 µg/m³					
Uncertainty between Reference	0.74	µg/m³			
Uncertainty between Candidates	0.43	µg/m³			
	SN 127/145/248			SN 131/149/249	
Number of data pairs	323			334	
Slope b	0.964			0.964	
Uncertainty of b	0.015			0.015	
Ordinate intercept a	0.547			0.428	
Uncertainty of a	0.281			0.272	
Expanded meas. uncertainty W_{CM}	8.52	%		8.71	%
All comparisons					
Uncertainty between Reference	0.75	µg/m³			
Uncertainty between Candidates	0.63	µg/m³			
	SN 127/145/248			SN 131/149/249	
Number of data pairs	409			419	
Slope b	1.010	not significant		0.986	not significant
Uncertainty of b	0.009			0.009	
Ordinate intercept a	-0.376	not significant		-0.069	not significant
Uncertainty of a	0.237			0.223	
Expanded meas. uncertainty W_{CM}	9.17	%		9.23	%

Summary of the results for equivalence testing SWAM 5a Dual Channel Hourly Mode Monitor, Measured component $PM_{2.5}$, raw data

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a DC HM		SN	SN 111 & SN 112	
			Limit value	30	µg/m³
Status of measured values	Raw data		Allowed uncertainty	25	%
All comparisons					
Uncertainty between Reference	0.52	µg/m³			
Uncertainty between Candidates	0.74	µg/m³			
	SN 111 & SN 112				
Number of data pairs	61				
Slope b	0.998	not significant			
Uncertainty of b	0.016				
Ordinate intercept a	0.685	not significant			
Uncertainty of a	0.393				
Expanded meas. uncertainty W_{CM}	10.40	%			
Cologne, parking lot (2011)					
Uncertainty between Reference	0.52	µg/m³			
Uncertainty between Candidates	0.74	µg/m³			
	SN 111			SN 112	
Number of data pairs	68			61	
Slope b	1.005			0.992	
Uncertainty of b	0.018			0.018	
Ordinate intercept a	0.657			0.901	
Uncertainty of a	0.429			0.428	
Expanded meas. uncertainty W_{CM}	12.03	%		11.32	%

Summary of the results for equivalence testing SWAM 5a Dual Channel Hourly Mode Monitor, Measured component PM_{10}, raw data

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a DC HM		SN	SN 111 & SN 112	
			Limit value	50	µg/m³
Status of measured values	Raw data		Allowed uncertainty	25	%
All comparisons					
Uncertainty between Reference	0.59	µg/m³			
Uncertainty between Candidates	0.73	µg/m³			
	SN 111 & SN 112				
Number of data pairs	63				
Slope b	0.972	not significant			
Uncertainty of b	0.016				
Ordinate intercept a	-0.305	not significant			
Uncertainty of a	0.548				
Expanded measured uncertainty WCM	9.33	%			
Cologne, parking lot (2011)					
Uncertainty between Reference	0.59	µg/m³			
Uncertainty between Candidates	0.73	µg/m³			
	SN 111			SN 112	
Number of data pairs	71			63	
Slope b	0.982			0.965	
Uncertainty of b	0.018			0.015	
Ordinate intercept a	-0.079			-0.314	
Uncertainty of a	0.634			0.535	
Expanded measured uncertainty W_{CM}	8.76	%		10.36	%

Summary of the results for equivalence testing, SWAM 5a Monitor, Measured component $PM_{2.5}$, raw data

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a		SN	SN 331 & SN 333	
			Limit value	30	µg/m³
Status of measured values	Raw data		Allowed uncertainty	25	%
All comparisons					
Uncertainty between Reference	0.65	µg/m³			
Uncertainty between Candidates	0.56	µg/m³			
	SN 331 & SN 333				
Number of data pairs	40				
Slope b	0.971	not significant			
Uncertainty of b	0.041				
Ordinate intercept a	0.235	not significant			
Uncertainty of a	0.455				
Expanded meas. uncertainty W_{CM}	9.53	%			
Bornheim					
Uncertainty between Reference	0.65	µg/m³			
Uncertainty between Candidates	0.56	µg/m³			
	SN 331		SN 333		
Number of data pairs	40		60		
Slope b	0.976		1.031		
Uncertainty of b	0.038		0.047		
Ordinate intercept a	0.157		-0.022		
Uncertainty of a	0.419		0.491		
Expanded meas. uncertainty W_{CM}	8.50	%	13.26	%	

Summary of the results for equivalence testing, SWAM 5a Monitor, Measured component PM_{10}, raw data

Comparison candidate with reference according to Guide "Demonstration of Equivalence Of Ambient Air Monitoring Methods", January 2010					
Candidate	SWAM 5a		SN	SN 329 & SN 330	
			Limit value	50	µg/m³
Status of measured values	Raw data		Allowed uncertainty	25	%
All comparisons					
Uncertainty between Reference	0.63	µg/m³			
Uncertainty between Candidates	0.63	µg/m³			
	SN 329 & SN 330				
Number of data pairs	59				
Slope b	1.007	not significant			
Uncertainty of b	0.035				
Ordinate intercept a	-0.900	not significant			
Uncertainty of a	0.627				
Expanded measured uncertainty WCM	7.84	%			
Bornheim					
Uncertainty between Reference	0.63	µg/m³			
Uncertainty between Candidates	0.63	µg/m³			
	SN 329		SN 330		
Number of data pairs	59		59		
Slope b	1.012		1.006		
Uncertainty of b	0.037		0.036		
Ordinate intercept a	-1.111		-0.746		
Uncertainty of a	0.648		0.636		
Expanded measured uncertainty W_{CM}	8.09	%	7.86	%	