Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate number: 0000028733_01

Certified AMS:	SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2,5}$
Manufacturer:	FAI Instruments s.r.l. Via Aurora, 25 00013 Fonte Nuova (Roma) Italy
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 (2002), VDI 4203-3 (2004), EN 12341 (1998), EN 14907 (2005), Guide to Demonstration of Equivalence of Ambient Air Monitoring Methods (2005), EN 15267-1 (2009), EN 15267-2 (2009).

Certification is awarded in respect of the conditions stated in this certificate (this certificate contains 12 pages).

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

German Federal Environment Agency
Dessau, 22 July 2016

Dr. Marcel Langner
Head of Section II 4.1

This certificate will expire on:
28 July 2021

TÜV Rheinland Energy GmbH
Cologne, 21 July 2016

ppa. Dr. Peter Wilbring

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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

Certificate:
0000028733_01 / 22 July 2016

Test report:	936/21207522/A of 23 March 2009
Initial certification:	29 July 2011
Expiry date:	28 July 2021
Certificate	renewal (previous certificate 0000028733 dated from 19 August 2011 with validity up to the 28th July 2016)
Publication:	BAnz. 25 August 2009, No. 125, page 2929, chap. II, No. 2.1

Approved application
The tested AMS is suitable for permanent and parallel monitoring of suspended particulate matter PM_{10} and $PM_{2.5}$ 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.

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 that this AMS is suitable for monitoring the limit value relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the installation at which it will be installed.

Basis of the certification
This certification is based on:

- test report 936/21207522/A of 23 March 2009 of TÜV Rheinland Immissionsschutz und Energiesysteme 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, page 2929, chap. II No. 2.1, Announcement by UBA from 03. August 2009:

AMS name:

SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2,5}$

Manufacturer:

FAI Instruments s.r.l., Fonte Nuova (Roma), Italy

Approval:

For continuous parallel monitoring of suspended particulate matter PM_{10} and $PM_{2.5}$ in ambient air (stationary operation).

Measuring ranges during the suitability test:

PM_{10}: 0 – 200 µg/m^3
$PM_{2.5}$: 0 – 200 µg/m^3

Software version:

Version Rel 04-08.01.65-30.02.00

Remarks:

1. The requirements according to guide “Demonstration of Equivalence of Ambient Air Monitoring Methods” are fulfilled.
2. Filter cartridges with a □-equivalent spot area of 5.20 cm² have been used for the testwork.
3. The AMS is to be calibrated on site in regular intervals by application of the gravimetric PM_{10} reference method according to DIN EN 12341.
4. The AMS is to be calibrated on site in regular intervals by application of the gravimetric $PM_{2.5}$ reference method according to DIN EN 14907.

Test report:

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Report No.: 936/21207522/A of 23 March 2009

Publication in the German Federal Gazette: BAnz. 29 July 2011, page 2725 chap. III notification 7, Announcement by UBA from 15 July 2011:

7 Notification on announcements of the Federal Environment Agency of 3 August 2009 (BAnz. p. 2929, chapter II number 2.1)

The measuring system SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$ of the company FAI Instruments s.r.l. meets the requirements of EN 12341, of EN 14907 as well as those of the Guide on Demonstration of Equivalence of Ambient Air Monitoring Methods in its version of November 2005. Furthermore the manufacturing and the quality management of the measuring system SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2,5}$ fulfills the requirements of EN 15267.

The test report on the type approval test is accessible online: www.qal1.de.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 26 March 2011

Publication in the German Federal Gazette: BAnz. 02 March 2012, p. 920, chapter V notification 2, Announcement by UBA from 23 February 2012:

2 Notification on announcements of the Federal Environment Agency of 3 August 2009 (Federal Gazette BAnz. p. 2929, chapter II, number 2.1) and 15 July 2011 (Federal Gazette BAnz. p. 2725, chapter III, notification 7)

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 a model version which applies a 1-h measuring mode. This version is distributed under the name of SWAM 5a Dual Channel Hourly Mode Monitor.

Teledyne Advanced Pollution Instrumentation, San Diego/USA distributes an identical device to the SWAM 5a Dual Channel Hourly Mode Monitor ambient air measuring system for PM_{10} and $PM_{2.5}$ manufactured by FAI Instruments s.r.l. under the name of Model 602 BetaPlus

Statement of TÜV Rheinland Energie und Umwelt GmbH of 11 October 2011

Publication in the German Federal Gazette: BAnz. 02 March 2012, p. 920, chapter V notification 3, Announcement by UBA from 23 February 2012:

3 Notification on announcements of the Federal Environment Agency of 3 August 2009 (Federal Gazette BAnz. p. 2929, chapter II, number 2.1) and 15 July 2011 (Federal Gazette BAnz. p. 2725, chapter III, notification 7)

The publication of 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 model of the ambient air measuring design called SWAM 5a Monitor for PM_{10} or $PM_{2.5}$.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 3 November 2011

Publication in the German Federal Gazette: BAnz AT 05.03.2013 B10, chapter V notification 12, Announcement by UBA from 12 February 2013:

12 Notification as regards Federal Environmental Agency notices of 3 August 2009 (Federal Gazette BAnz. p. 2929, chapter II, No. 2.1) and 23 February 2012 (Federal Gazette BAnz. p. 920, chapter V, notifications 2 and 3)

The current software version of the ambient air monitoring system for particulate matter SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2,5}$ manufactured by FAI Instruments s.r.l. is:

04-09.01.85-30.02.00

Statement of TÜV Rheinland Energie und Umwelt GmbH of 15 October 2012

Publication in the German Federal Gazette: BAnz AT 02.04.2015 B5, chapter V notification 8, Announcement by UBA from 25 February 2015:

8 Notification as regards Federal Environment Agency (UBA) notices of 3 August 2009 (Federal Gazette BAnz. p. 2929, chapter II number 2.1) and 12 February 2013 (Federal Gazette BAnz AT 05.03.2013 B10, chap. V notification 12)

The current software versions for the SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2.5}$ are:
04-09.01.85-30.02.00 (old micro controller, until 2008) and
04-09.01.85-30.03.00 (new micro controller, starting from 2008)

An optional Ethernet Board, which enables the communication with the measuring system via LAN network, is available for SWAM 5a Dual Channel Hourly Mode Monitor for PM_{10} and $PM_{2.5}$. The current software version for the measuring system is:
05-02.08.56-30.03.00
The current software version for SWAM 5a Monitor for PM_{10} and $PM_{2.5}$ is:
01-05.05.13-30.03.00

Statement of TÜV Rheinland Energie und Umwelt GmbH of 19 September 2014

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

44 Notification as regards Federal Environment Agency (UBA) notices of 3 August 2009 (Federal Gazette (BAnz.) p. 2934, chapter II number 2.1) and 25 February 2015 (Federal Gazette BAnz AT 02.04.2015 B5, chap. IV notification 8)

The measuring systems 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 are also available with standard sample ports according to Annex A of Directive EN 12341 (issue of August 2014 [German issue]). The sample ports carry the designations PM10-EN12341-2014 and PM2.5-EN12341-2014.

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

Certified product

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

SWAM 5a Dual Channel Monitor measuring system determines the mass of separated particles based on the principle of beta attenuation after passing a layer of thin material.

The SWAM 5a Dual Channel Monitor measuring system is an automatic and sequential measuring device for dust measurement on filter membranes. The system operates with two independent sampling lines. One of the sampling line was operated with a PM10 sampling inlet and the second line was operated with a PM2.5 sampling inlet during the suitability test. Different configurations are possible. Ambient air was aspirated via both sampling inlets with the help of two separate pumps. The dust-laden sampling air was then separated by the respective filter (1 x PM10, 1 x PM2.5), followed by determining the mass of the separated dust based on the radiometric principle of beta absorption. The mass of dust collected on the filters of both sampling lines was determined by a single radiometric mass determination module.

The AMS comprises two sampling inlets (PM10 & PM2.5), two inlet tubes, two vacuum pumps, a measuring device, a compressor for compressed air generation and two filter magazines (loading and unloading device) for virgin and sampled filters.

The AMS is equipped with two sampling inlets for PM10 and PM2.5. The sampling inlets are produced by the manufacturer of the AMS and are available for different flow rates (2.3 m³/h or 1 m³/h).

Sampling inlets for 2.3 m^3/h were used during the suitability test. The design of these sampling inlets conforms to the specification of the Reference Standards EN 12341 (PM10 and EN 14907 (PM2.5).

After suction and passing the sampling inlet, the particle-loaded ambient air passes through the sampling line until it hits the filter.

Optionally the sampling line may be led through a coaxial chamber flowed by ambient air if a high proportion of volatile dust components is expected. Even active heating or cooling of the sampling line is possible.

The sampling line did neither pass through the coaxial chamber nor was it heated or cooled actively during suitability testing. It was simply wrapped in foam coating within the measuring cabinet as a means of isolation.

The two vacuum pump units take in ambient air through the sampling inlet, the sampling lines and the two filter membranes. They consist of a piston pump equipped with ballast to compensate on-line pressure fluctuations. An automatic flow rate regulation is carried out independently for each sampling line.

The sampler can be operated with other pumps (e.g. graphite vane pumps) if the required performance is guaranteed at any time.

The central unit of the AMS comprises all servo-mechanical parts as well as the pneumatic and radiometric measuring unit, and all electronic units and microprocessors for system operation, control, and monitoring. The operating panel and system display can be found on the front side of the AMS, whereas all pneumatic and electric ports as well as the communication interfaces can be found on the back. The filter magazines and inlet tubes are installed to the upper side of the AMS.

The AMS requires compressed air (200 to 300 kPa) to carry out several servo-mechanic movements such as loading and unloading of filters. For this reason the AMS is equipped with a service air compressor unit.

The AMS is operated via membrane keyboard which is combined with a display at the front side of the system. All relevant data (such as sampling time) are set via the keyboard. Furthermore it is possible to view necessary information about the current system status (ongoing sampling) as well as collected data of earlier measurements or numerous parameters for quality control purposes.

In addition to the direct communication via keyboard and display, the AMS offers a means of connection suited for a standard terminal (e.g. HyperTerminal) or a PC / modem via serial port RS-232. The AMS can be controlled, operated and parameterised through the terminal or with the help of the operating software Dr. FAI Manager, either directly via PC or indirectly via GSM modem. This provides an easy and comfortable way for reading out collected data in text format and preparation for further processing.

Measured values and status messages can be displayed via an analogue output, if desired. Moreover, the AMS provides a means to keep the operator informed about the current system status and the latest measured values via SMS.

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 SWAM 5a Dual Channel Monitor for PM_{10} and $PM_{2,5}$ is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Basis test work:

Test report: 936/21207522/A of 23 March 2009
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Publication: BAnz. 25 August 2009, No. 125, p. 2929, chapter II No. 2.1
Announcement by UBA from 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 of 23 March 2009
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne
Publication: BAnz. 29 July 2011, No. 113, p. 2725, chapter III, notification 7
Announcement by UBA from 15 July 2011

Notifications according to EN 15267
Statement of TÜV Rheinland Energie und Umwelt GmbH, Cologne of 11 October 2011
Publication: BAnz. 2 March 2012, No. 36, page 920, chapter V notification 2
Announcement by UBA from 23 February 2012
(new hardware version)

Statement of TÜV Rheinland Energie und Umwelt GmbH, Cologne of 3 November 2011
Publication: BAnz. 02 March 2012, No. 36, page 920, chapter V notification 3
Announcement by UBA from 23 February 2012
(new hardware version)

Statement of TÜV Rheinland Energie und Umwelt GmbH, Cologne of 15 October 2012
Publication: BAnz AT 05.03.2013 B10, chapter V notification 12
Announcement by UBA from 12 February 2013
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH, Cologne of 19 September 2014
Publication: BAnz AT 02.04.2015 B5, chapter IV notification 8
Announcement by UBA from 25 February 2015
(new software version)

Statement of TÜV Rheinland Energie und Umwelt GmbH, Cologne of 17 March 2015
Publication: BAnz AT 26.08.2015 B4, chapter V notification 44
Announcement by UBA from 22 July 2015
(hardware changes)

Renewal of the certificate

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

Results of the equivalence testing for the demonstration of equivalence according to the EC-Guide of November 2005

Type-approval test 936/21207522/A of 23 March 2009

Candidate 1 vs. Candidate 2

Table 1: In-between uncertainty u_{bs} for the candidates SN 127 (145) and SN 131 (149), Measured component PM_{10}

Test devices	**Site**	**No. of values**	**Uncertainty u_{bs}**
SN			µg/m³
127 / 131	Koeln, Parking lot	100	0.87
127 / 131	Bonn, Belderberg	64	0.45
145 / 149	Teddington	83	0.53
127 131	Bruehl	55	0.56
127 (145) / 131 (149)	All sites	302	0.66
Classification *via* reference values			
127 (145) / 131 (149)	Values ≥ 50 % DL (≥ 25 µg/m³)	91	0.98
127 (145) / 131 (149)	Values ≥ 50 % AL (≥ 20 µg/m³)	134	0.87
127 (145) / 131 (149)	Values < 50 % DL (< 25 µg/m³)	192	0.46
127 (145) / 131 (149)	Values < 50 % AL (< 20 µg/m³)	149	0.42

Table 2: In-between uncertainty u_{bs} for the candidates SN 127 (145) and SN 131 (149), Measured component $PM_{2.5}$

Test device	Site	No. of Values	Uncertainty u_{bs}
SN			µg/m³
127 / 131	Koeln, Parking lot	100	0.69
127 / 131	Bonn, Belderberg	64	0.42
145 / 149	Teddington	83	0.44
127 131	Bruehl	55	0.63
127 (145) / 131 (149)	All sites	302	0.57
Classification *via* reference values			
127 (145) / 131 (149)	Values ≥ 50 % AL 1 (≥ 12,5 µg/m³)	107	0.57
127 (145) / 131 (149)	Values ≥ 50 % AL 2 (≥ 10 µg/m³)	127	0.54
127 (145) / 131 (149)	Values < 50 % AL 1 (< 12,5 µg/m³)	94	0.36
127 (145) / 131 (149)	Values < 50 % AL 2 (< 10 µg/m³)	74	0.38

Candidate vs. Reference

Table 2: Summary and assessment of the extended measurement uncertainties W_{CM} during field test, measured component PM_{10}, raw data

PM_{10} **Site**	**Limit** µg/m³	**Slope b** (µg/m³)/(µg/m³)	**Ordinate intercept a** µg/m³	**u_{c_s} at the limit** µg/m³	**w_{CM}** %	**W_{CM}** %	**$W_{CM} \leq W_{dqo}$** (W_{dqo} = 25 %)
Koeln, Parking lot	50	1.10	0.06	5.21	10.41	20.82	Yes
	40	1.10	0.06	4.25	10.64	21.27	Yes
Bonn	50	1.12	-1.11	5.29	10.57	21.14	Yes
	40	1.12	-1.11	4.14	10.35	20.69	Yes
Teddington	50	0.96	2.27	1.45	2.90	5.79	Yes
	40	0.96	2.27	1.54	3.86	7.71	Yes
Bruehl	50	1.04	-1.82	1.62	3.24	6.48	Yes
	40	1.04	-1.82	1.59	3.98	7.97	Yes
All sites	50	1.08	-0.35	4.29	8.58	17.15	Yes
	40	1.08	-0.35	3.57	8.92	17.85	Yes
values ≥ 50 % DL (≥ 25 µg/m³)	50	1.17	-3.64	5.13	10.25	20.51	Yes
values ≥ 50 % AL (≥ 20 µg/m³)	40	1.16	-3.17	3.79	9.48	18.96	Yes

Table 3: Summary and assessment of the extended measurement uncertainties W_{CM} during field test, measured component $PM_{2.5}$, raw data

$PM_{2.5}$ **Site**	**Limit** µg/m³	**Slope b** (µg/m³)/(µg/m³)	**Ordinate intercept a** µg/m³	**u_{c_s} at the limit** µg/m³	**w_{CM}** %	**W_{CM}** %	**$W_{CM} \leq W_{dqo}$** (W_{dqo} = 25 %)
Koeln, Parking lot	25	0.98	-0.14	1.07	4.28	8.57	Yes
	20	0.98	-0.14	1.03	5.17	10.34	Yes
Bonn	25	1.01	-1.60	1.79	7.14	14.29	Yes
	20	1.01	-1.60	1.82	9.11	18.22	Yes
Teddington	25	0.97	1.28	1.41	5.66	11.31	Yes
	20	0.97	1.28	1.48	7.39	14.77	Yes
Bruehl	25	0.97	-0.86	1.98	7.93	15.86	Yes
	20	0.97	-0.86	1.86	9.32	18.64	Yes
All sites	25	0.95	0.45	1.67	6.67	13.35	Yes
	20	0.95	0.45	1.56	7.80	15.61	Yes
values ≥ 50 % AL 1 (≥ 12,5 µg/m³)	25	1.03	-1.46	-0.74	7.05	14.11	Yes
values ≥ 50 % AL 2 (≥ 10 µg/m³)	20	1.01	-0.99	1.76	8.79	17.57	Yes