

PRODUCT CONFORMITY CERTIFICATE

This is to certify that the

Smart Heated PM_{2.5} BAM-1020

Manufactured by:

Met One Instruments, Inc

1600 NW Washington Blvd
Grants Pass
Oregon 97526
USA

has been assessed by CSA Group
and for the conditions stated on this certificate complies with:

**MCERTS Performance Standards for Ambient Monitoring Equipment,
Published 6 December 2022**

**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_{2.5} 0 to 1000 µg/m³

Project No.: 80190316
Certificate No: CSA MC130237/05
Initial Certification: 06 December 2013
This Certificate issued: 04 December 2023
Renewal Date: 05 December 2028



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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

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

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

The requirements according to the [Guide To The Demonstration Of Equivalence Of Ambient Air Monitoring Methods](#) (GDE 2010) are fulfilled for PM_{2.5}.

Basis of Certification

This certification is based on the following test report(s) and on CSA Group'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, dated 30 October 2013
Bureau Veritas	UK Report on the Equivalence of the Smart Heated PM_{2.5} BAM-1020. Report ref AGGX5590185/BV/DH/2854 dated October 2013
TÜV Rheinland	Report on the suitability test of the ambient air quality measuring system BAM-1020 with PM _{2.5} pre-separator of the company Met One Instruments, Inc. for the component PM _{2.5} . Report number 936/21209919/A dated 26 March 2010. Report published on www.gal1.de/en/hersteller/metone.htm

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Product Certified

The Smart Heated PM_{2.5} BAM-1020 measuring system consisting of the following parts:

- USEPA style PM₁₀ sampling inlet operating at 16.67 l/min with louvered slats to prevent rain ingress;
- PM_{2.5} Sharp Cut Cyclone operating at 16.67 l/min;
- Sampling tube;
- Smart Heated Inlet (Part number BX830) set to limit the maximum relative humidity RH at the filter tape to 45 % Smart heated inlet control by Delta T was set to 'NO';
- Combined pressure and temperature sensor (Part number BX-596);
- BAM-1020 Beta Attenuation Mass Measuring system incorporating glass fibre filter tape programmed to perform hourly measurements with an 8 minute beta attenuation measurement at the beginning and end of every 42 minute sampling period;
- Vacuum pump and airflow controller set to ambient conditions;

This certificate applies to all Smart Heated PM_{2.5} BAM-1020 instruments with serial number G2757 and fitted with Software Version 3236 V5.1.0 onwards for those instruments equipped with a touch screen and with Software Version 3236-07 5.0.10 onwards for instruments not equipped with a touch screen.

Amendments to product certified

MC130237/04, dated 6 December 2022

Hardware - the addition of:

- Digital temperature sensor BX-598
- Combined pressure/temperature/humidity sensor BX-597A
- Measuring device with touch sensitive screen (BX-970, optional) with front panel USB port

Software

- The latest software version of the Smart Heated PM_{2.5} BAM-1020 measuring system for PM_{2.5} manufactured by Met One Instruments, Inc is: 3236-05 V3.14.3
- The latest software version of the measuring system with touch screen display (BX-970) manufactured by Met One Instruments, Inc is: 3236-77 V5.2.0

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Certified Performance

The instrument was evaluated for use under the following conditions:

Ambient Temperature Range: **5°C to 40°C**

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

Results are expressed as error % of certification range, unless otherwise stated.

Test	Results	MCERTS specification
Constancy of the sample volumetric flow	-2.4%	To remain constant within $\pm 3\%$ of the rated value
Tightness of the sampling system	1.4% maximum Note 2	Leakage not to exceed 1% of the sampled volume
Between sampler/instrument uncertainty for the standard method PM_{2.5}		
Full data set	0.33 $\mu\text{g}/\text{m}^3$	$\leq 2 \mu\text{g}/\text{m}^3$
<18 $\mu\text{g}/\text{m}^3$	0.34 $\mu\text{g}/\text{m}^3$	Not specified
$\geq 18 \mu\text{g}/\text{m}^3$	0.30 $\mu\text{g}/\text{m}^3$	Not specified
Between sampler/instrument uncertainty for the candidate method PM_{2.5}		
Full data set	1.38 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
<18 $\mu\text{g}/\text{m}^3$	1.05 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
$\geq 18 \mu\text{g}/\text{m}^3$	1.57 $\mu\text{g}/\text{m}^3$	$\leq 2.5 \mu\text{g}/\text{m}^3$
Expanded uncertainty calculated at 30 $\mu\text{g}/\text{m}^3$ for Instrument SN 17010		
Full data set	12.9%	$\leq 25\%$
<18 $\mu\text{g}/\text{m}^3$	11.5%	Not specified
$\geq 18 \mu\text{g}/\text{m}^3$	16.0%	$\leq 25\%$
Individual sites	Note 3	
Teddington Summer	17.1%	$\leq 25\%$
Cologne Winter	12.8%	$\leq 25\%$
Bornheim Summer	11.6%	$\leq 25\%$
Teddington Winter	10.3%	$\leq 25\%$

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Test	Results	MCERTS specification
Expanded uncertainty calculated at 30 µg/m ³ for Instrument SN 17011		
Full data set	16.3%	≤25%
<18 µg/m ³	13.4%	Not specified
≥18 µg/m ³	19.0%	≤25%
Individual sites		
Teddington Summer	14.7%	≤25%
Cologne Winter	17.9%	≤25%
Bornheim Summer	23.9%	≤25%
Teddington Winter	7.4%	≤25%
Maintenance interval PM_{2.5}	One Month	≥Two weeks
Data Availability (SN17010)	97.9%	≥90%
Data Availability (SN17011)	99.0%	≥90%
Number of UK Tests	2	≥1
Number of Reference Methods	2	≥1

Note 1: 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 fulfils the relevant Data Quality Objective of EU Directive 2008/50/EC when used without correction, though the highest individual expanded uncertainty specified in GDE2010 as being required to be below 25 % is marginally reduced if correction for intercept by subtracting 0.764 µg/m³ is employed. Intercept correction is not required in order to make the instrument equivalent, but it is essential that thorough and frequent on-going QA/QC procedures are employed (as prescribed in fprEN 12341:2013 and CEN/TS16450) including to precisely quantify analyser baseline performance by operating periodic zero checks with a HEPA filter on the inlet.

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PM _{2.5} Smart BAM-1020	Calculated slope of all paired data	Calculated intercept of all paired data	Expanded uncertainty of all paired data	Range of individual expanded uncertainties
Uncorrected data	1.000	0.764	12.6%	7.4% to 23.9%
Data corrected for intercept by subtracting 0.764	1.000	0.000	11.6%	7.6% to 20.7%

- Note 2: The value quoted in the Bureau Veritas report and referenced herein differs from that reported in the TÜV Rheinland report. The leak test data was reprocessed to allow for the increased propensity for leaks under reduced vacuum. This methodology has been approved by the German Certification Committee, and the statement that the leak test exceeded the required tolerance has been removed from the TÜV certificate. The greatest leak detected is 1.4%, which when expressed to zero decimal places meets the requirement of " $\leq 1\%$ ". This level of leak is not considered significant enough to warrant any concern to the detriment of the measurement quality under normal operation. It is recommended that the filter tape is periodically checked for evidence of damage that would indicate a potential leak which would necessitate the cleaning of the filter gripping mechanism.
- 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.
- 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 Smart Heated PM_{2.5} BAM-1020 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 EN 16450.

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Description

The Smart Heated PM_{2.5} BAM-1020 Ambient Particulate Monitor is used to sample PM_{2.5} by using a 16.7 l/min USEPA style PM₁₀ inlet followed by a PM_{2.5} sharp cut cyclone. The system uses smart heating technology in order to limit the maximum relative humidity RH at the filter tape to 45 %. The instrument utilizes glass fibre tape.

The ambient air measuring system BAM-1020 is based on the measuring principle of beta-attenuation. The principle of the radiometric determination of mass is based on the physical law of attenuation of beta-rays when passing a thin layer of material. There is the following relationship:

$$C = \frac{10^6 A (\text{cm}^2)}{Q \mu \text{D}t (\text{min}) m} \ln \frac{I_0}{I}$$

where:

- C particle-mass concentration;
- A sampling area for particles (filter spot);
- Q sampling flow rate;
- Dt sampling time;
- μ mass absorption coefficient;
- I_0 beta count rate at the beginning (clean);
- I beta count at the end (collect).

The radiometric determination of mass is calibrated in the factory. During routine operation of the instrument this is checked hourly both on the clean filter prior to collection of the sample and using the built-in reference foil. The values obtained can be compared with any stability requirements (such as drift effects) relative to the values obtained during factory calibration.

One measurement cycle (incl. automatic check of the radiometric measurement) consists of the following steps (setting: measuring time for radiometry 8 min):

1. The initial count of the clean filter tape I_0 is performed at the beginning of the cycle for a period of eight minutes.
2. The filter tape is advanced four windows and the sampling (vacuum pumping) begins on the spot in which I_0 was just measured. Air is drawn through this spot on the filter tape for approximately 42 minutes.
3. At the same time the second count I_1 occurs (at a point on the tape 4 windows back) for a period of 8 minutes. The purpose of the measurement is to perform the verification for instrument drift caused by varying external parameters such as temperature and relative humidity. A third count I_2 occurs with the reference membrane extended over the same place on the tape. Eight minutes before the end of sampling time, another count I_{1x} occurs on the same point of the tape. With the help of I_1 and I_{1x} , the stability at the zero point can be monitored.

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4. After sampling, the filter tape is moved back four windows to measure the beta ray absorption through the section that has collected dust (I3). Finally the concentration calculation is performed to complete the cycle.
5. The next cycle begins with step 1.

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 CSA Group Testing UK Ltd Certificates'.
2. The design of the product certified is held and maintained by TÜV Rheinland for certificate No. CSA MC130237.
3. If a certified product is found not to comply, CSA Group should be notified immediately at the address shown on this certificate.
4. The certification marks that can be applied to the product or used in publicity material are defined in 'Regulations Applicable to the Holders of CSA Group Testing UK Ltd Certificates'.
5. This document remains the property of CSA Group and shall be returned when requested by CSA Group.

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