Method Implementation Document for BS EN 16911-1* - Application to manual stack emissions monitoring

*BS EN ISO 16911-1:2013 Stationary source emissions - Manual and automatic determination of velocity and volume flow rate in ducts Part1: Manual reference method

Environment Agency
Version 2
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mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

Record of amendments

Version number	Date	Amendment
2	June 17	1. Scope: removed calibration of CEMs from the scope of the MID. Added reference to PD CEN TR 17078: Guidance on the application of EN 16911-1.

Status of this document

This method implementation document may be subject to review and amendment following publication. The most recent version of this note is available on the Source Testing Association web site at:

www.S-T-A.org

Implementation date

It is expected that organisations, which hold MCERTS accreditation for BS EN 16911-1, will meet the requirements of this version of the MID by 31 December 2017.

Feedback

Any comments or suggested improvements to this MID should be e-mailed to Rupert Standring at rupert.standring@enviroment-agency.gov.uk.

Role of Method Implementation Documents

The Environment Agency recognises that European and International standards may need supplementing by Method Implementation Documents (MIDs) to ensure they are being implemented consistently.

We have established our Monitoring Certification Scheme: MCERTS to deliver quality environmental measurements. Organisations wishing to include a standard in their schedule of MCERTS accreditation shall follow the requirements of the standard and, where available, the associated MID.

It may not be necessary to produce a MID for every standard but where required they will be used to supplement standards called up by Technical Guidance Note M2. MIDs provide details on how the preferred standards shall be used for regulatory monitoring.

MIDs are produced in collaboration with organisations with an interest in stack emissions monitoring.

Copies of MIDs and further information on MCERTS including copies of performance standards and guidance can be obtained from our web-site at:

www.mcerts.net

Or from the STA web-site at:

www.S-T-A.org

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Introduction

This Method Implementation Document (MID) supplements BS EN 16911-1:2013 (referred to as EN 16911-1 in this MID). This MID does not re-state all the provisions of EN 16911-1, so it is necessary for organisations to refer to both documents. For sections of the standard, where this MID does not provide additional information, organisations are required to comply with the standard.

1 Scope

This document focuses on the measurement of average velocity across a sample plane. This applies to measurements using differential pressure based techniques, vane anemometers and hot wire anemometers.

This document does not apply to the determination of volume flow and average velocity using tracer gas dilution, transit time tracer gas or calculation methods.

When carrying out isokinetic stack emissions monitoring, it is necessary to assess that the sample plane flow profile meets the requirements of EN 15259. It is also necessary to select an appropriate extraction nozzle size based on the measured velocity at the sample points in the sample plane. EN 16911-1 is used to make these velocity measurements. If the results of isokinetic sampling are to be reported as mass emissions, then the flow rate measured during isokinetic sampling shall be used.

The MID also applies to flow measurements made to calculate mass emissions from stack emissions monitoring measurements.

This MID does not apply to the calibration of CEMs or for flow measurements made for emissions trading. Information on the application of EN 16911-1 to the calibration of CEMs and emissions trading is contained in PD CEN TR 17078.

2 Normative references

The following referenced documents are essential for the interpretation and application of this MID:

- Environment Agency MID 13284-1
- US EPA M2G

3 Terms, definitions

No additional requirements.

4 Symbols and abbreviated terms

No additional requirements.

5 Principle

No additional requirements.

6 Selection of monitoring approach

6.1 Monitoring objective

Table 1 – Selection of measurement techniques

- An L-type Pitot may be used for the determination of swirl at the measurement plane.

6.2 Choice of technique to determine point flow velocity

No additional requirements.

6.3 Choice of technique for volume flow rate and average flow determination

No additional requirements.

7 Measuring equipment

No additional requirements.

8 Performance characteristics and requirements

Table 3 – Performance requirements

- Table 3 applies to flow measurement and differential pressure reading devices.
- It is not necessary to carry out the performance tests for the whole measurement system provided the performance requirements of the flow measurement and differential pressure reading devices are demonstrated. The performance requirements of the flow measurement and differential pressure reading devices can be determined using a measurement system that is representative of a typical system.

  Note 1: It is preferable for the whole measurement system to be calibrated. However, often this may not be practical because organisations have several differential pressure measurement and reading devices, which are interchangeable between different systems. They may also use different lengths of probes and lines to connect systems together.

- It is not necessary for the stack emissions monitoring organisation to carry out the performance tests for sensitivity to ambient temperature and atmospheric pressure. However, a performance evaluation based upon the technical information provided by the manufacturer shall be carried out, where possible.

  Note 2: when carrying out flow measurements to support stack emission monitoring, ambient temperature and atmospheric pressure typically do not make a significant contribution to the overall uncertainty of the measurement, which means they can be excluded from the performance requirements.

- Traceable information on the remaining performance requirements in Table 3 can be provided by the manufacturer of the velocity flow determination technique. If this is not available from the manufacturer, the stack emissions monitoring organisation or another suitable organisation (for example a calibration laboratory) shall demonstrate that equipment meets these requirements.

  Note 3: the standard deviation of repeatability of measurement in the laboratory and the effect of angle of sensor to flow can be carried out during the routine calibration of the velocity determination equipment.

- If an L-type Pitot meets the performance requirements of ISO 3966, then its performance will meet the requirements of Table 3.

  Note 4: the uncertainty guide for L-type Pitots in ISO 3966:2008 meets the performance requirements in Table 3.

- Lowest measurable flow is the lowest value at which the sensor has been calibrated. Any use below this value shall be validated by the user before a measurement is made. The validation can be done by the stack emissions monitoring organisation or another suitable organisation (for example a calibration laboratory).

9 Measurement procedure

9.1 Site survey before testing

The requirement of obstructing no more that 5% of the stack sampling plane specified in the standard shall apply when carrying out measurements for flow only and for carrying out measurements at stacks with a stack sampling plane area greater than 1.5 m^2.

When carrying out flow measurements to support isokinetic sampling at stacks with an area of 1.5 m^2 or less, the area of the flow measurement assembly shall not obstruct more than 10% of the stack sampling plane area.

Note: several particulate monitoring systems integrate the differential pressure measurement device and the particulate sampling equipment. This means that the area of the sampling equipment is larger than the area of the flow measurement assembly, when measuring flow alone with a Pitot.

For stacks with a very small sample plane area it may not be possible to carry out isokinetic sampling and measure flow at the same time because the area of the sampling equipment may obstruct more than 10% of the stack sampling area. Under these circumstances a flow measurement with a standalone Pitot device can be made prior to carrying out isokinetic sampling.

9.2 Determination of sampling plane and number of measurement points

No additional requirements.

9.3 Checks before sampling

9.3.1 General

If a calibrated electronic pressure reading device is used, it does not need to be checked on-site before use with a liquid manometer or calibrated pressure sensor.

Electronic pressure measurement devices shall be calibrated in accordance with the test laboratories internal calibration schedule.

The resolution in pascals of the electronic pressure measurement device shall be at least 1 Pa.

The internal diameter of the stack shall be measured (see section 7.2 of the standard).

When carrying out measurements to support isokinetic sampling and other stack emissions monitoring methods, it is not necessary to check varying flow conditions with time by using a measurement device at a fixed point.

Note: typically velocity is monitored during isokinetic sampling, which means changes over time are accounted for when this type of sampling is carried out.

When carrying out measurements for the calibration of CEMs that measure flow, it is necessary to take account of variations in flow, as specified by the standard.

9.3.2 Pre-test leak check

A Pitot leak check shall be performed before each measurement.

The standard provides an example of how the leak check can be carried out. Stack emission monitoring organisations may follow this example, develop their own or use the procedure given in US EPA M2G.

9.3.3 Check on stagnation and reference pressure taps (S-type Pitot tube)

No additional requirements.

9.3.4 Tests of repeatability at a single point

A test of repeatability at a single point is usually not required when carrying out measurements to support isokinetic sampling because a single measurement device can be used.

9.3.5 Swirl or cyclonic flow

A swirl test shall be carried out at the sample plane at least once per measurement campaign.

The procedure for carrying out a swirl test using an S-type Pitot is given in MID EN 13284-1.

The information on velocity correction for the effect of flow direction is not needed when assessing the suitability of a sample plane's flow profile for isokinetic sampling.

9.4 Quality control

Table 4 – Performance requirements during field measurements

- Field repeatability - this is not required for measurements to support stack emissions monitoring (see 9.3.4 of this document).

- Angle of probe to measurement plane (pitch of probe) – determining this is not required for measurements to support stack emissions monitoring.

- Uncertainty in flow measurement and differential pressure reading device calibration – the relative uncertainty increases as the differential pressure decreases. Therefore, it is acceptable to demonstrate the uncertainty requirements at the full scale of detection of the differential pressure reading device. An uncertainty of ±0.5% or less of the full scale may be used. This uncertainty, expressed as a percentage of the full scale value, can then be applied to other readings. When using this approach it is important to select a differential pressure reading device that has an appropriate range (see Annex H).

9.5 Measurement of flow at locations within the measurement plane

No additional requirements.

9.6 Post-measurement quality control

No additional requirements.

10 Calculation of results

10.1 General

No additional requirements.

10.2 Measurement of velocity

No additional requirements.

10.3 Determination of the mean velocity

No additional requirements.

10.4 Correction of average velocity for wall effects

The correction of average velocity for wall effects is not required for measurements to support isokinetic sampling.

10.5 Calculation of the volume flow rate from the average velocity

No additional requirements.

10.6 Conversion of results to standard conditions

No additional requirements.

10.7 Establishment of the uncertainty of results

No additional requirements.

11 Evaluation of the method

No additional requirements.

Annexes A, B, C, D, E (normative)

No additional requirements.

Annexes F, G (informative)

No additional information.

Annex H (informative) Differential pressure measurement

H.1 General

Section H.1 of the standard provides information on the relationship between flow, differential pressure, measurement range and uncertainty.

The standard states that the basic flow formula is available in CEN / TS 14793. This is a mistake. The formula is available in ISO 10780.

The example given in Annex H.1 is incorrect. For a differential pressure of 9% of manometer scale on a 0 Pa to 2500 Pa device (i.e. 225 Pa), then:

- for a liquid manometer with 1% accuracy of reading: 225 Pa equals 2.25 Pa, not 0.225
- for an electronic manometer with an accuracy of 0.5% of full scale: 0.5% of 2500 Pa is 12.5 Pa, not 1.25 Pa.

The example provided in the standard would be suitable for a lower range manometer (i.e. 0 Pa to 250 Pa).

The standard states that there are very low resolution manometers that can read down to a 0.001 Pa. It is not necessary to measure at this very low pressure when carrying out

stack emissions monitoring. An inclined liquid manometer that is typically used for stack emissions monitoring has a resolution of about 2.5 Pa.

H.2 Liquid manometers

No additional information.

H.3 Digital manometers and other electronic devices

No additional information.

Annex I, J (informative)

No additional information.