



Method Implementation Document for EN 13284-1

BS EN 13284-1:2002

Stationary source emissions – Determination of low range mass
concentration of dust – Part 1: Manual gravimetric method

Environment Agency

Version 2.4

December 2011



Record of amendments

Version number	Date	Amendment
2.3	Jan 11	Section 5.2: added mandatory requirement to increase the number of sample points used if the flow criteria is not compliant and an alternative location is not available
		Section 5.2: added note about the number of sample points for large ducts
		Section 6.2.6: added requirement on containers for storage of filters
		Section 8.3: revised section on determining water vapour concentration
2.4	Dec 11	Section 5.2: amended text on doubling the number of sample points at non-compliant locations.
		Section 6.2.6: amended text on material for storing filters when not in use.
		Section 8.2: added note about validation of alternative approaches.
		Section 10.6: amended requirements on overall blank and weighing uncertainties.
		Deleted information in Annex A.
		Amended requirement to record swirl test angle in Annex B.
		Deleted information in Annex G.

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 13284-1, will have met the requirements of this version of the MID by June 2012.

Feedback

Any comments or suggested improvements to this MID should be e-mailed to Rupert Standing at rupert.standing@environment-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 stack emissions monitoring organisations.

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 document supplements EN 13284-1⁽¹⁾. However, it does not re-state all the provisions of EN 13284-1 and organisations are reminded of the need to comply with the criteria detailed in EN 13284-1. The clause numbers in this document follow those of EN 13284-1 although the text from the standard is not repeated in this document. EN 13284-1 remains the authoritative document and in cases of dispute, the accreditation body will adjudicate on unresolved matters.

1 Scope

EN 13284-1 shall be used to measure particulate concentrations at stacks with Emission Limit Values (ELVs) below 50 mg/m³.

Note 1: BS ISO 9096: 2003⁽²⁾ may be used for ELVs from 50 – 1000 mg/m³.

Besides general criteria related to the measurement of particulates this standard also provides specific additional criteria to be followed when:

- measuring particulate concentrations on stacks with ELVs of 10 mg/m³ or below;
- calibrating particulate CEMs on processes where the particulate concentrations are typically less than 10 mg/m³.

Note 2: the measurement of particulates at concentrations of below 10 mg/m³ is very challenging. It is therefore necessary to provide specific criteria for MCERTS accredited organisations to follow. This is also important when calibrating particulate CEMs on processes where the particulate concentrations may be below 3 mg/m³.

Note 3: further information on calibrating particulate CEMs is available in Environment Agency TGN M20⁽³⁾.

2 Normative references

No additional requirements to BS EN 13284-1.

3 Terms and Definitions

The key for *Figure 1 – isokinetic sampling* should read as follows:

2 Radius of the bend (minimum 1.5i)

3 Internal diameter I

4 Principle

Note: besides detailing the principle of the method this section also contains requirements that must be complied with.

5 Sampling plane and sampling points

5.1 General

Details on sampling platforms requirements are provided in Environment Agency TGN M1⁽⁴⁾.

5.2 Sampling plane

The standard gives a recommendation for the sample plane location. This is not a mandatory requirement but a guide, which is useful for determining the sample plane location, when the flow profile is unknown.

(a) The maximum (angle) of flow with regard to the stack axis shall be measured and recorded for each sample point (see Annex B). If the angle of flow at any of the points are not less than 15° with regard to the stack axis, the flow criteria is not in compliance with the standard. In the absence of an alternative compliant sampling location, the sample points at which the angle of flow is not compliant shall not be sampled. This sampling deviation shall be included in the sample report.

Note 1: US EPA M2⁽⁵⁾ provides details of how to carry out a swirl test using an S-type Pitot

(b) no additional requirements to EN 13284-1

(c) The standard states that the minimum velocity of the stack gas must be larger than 5Pa if a Pitot tube is used to carry out the measurement. It is possible to carry out sampling at velocities lower than 5Pa if an anemometer is used, provided that the velocity of the stack gas is above the limit of detection of the device and it has been calibrated within the region of the expected velocity.

(d) If local negative flow is present then the sampling location is not in compliance with the standard. If an alternative location cannot be found, then the sample point(s) in areas of negative flow shall not be sampled. This sampling deviation shall be included in the sampling report.

If requirements (a) – (d) of the standard regarding the angle of flow and velocity cannot be met the sampling location is not compliant with the standard. The client shall be informed that the location does not comply with the standard (see 10.2 of the standard). An alternative compliant location shall be sought.

If after consultation with the client a suitable sampling location cannot be found then the number of sampling points on the sampling plane shall be doubled (up to a maximum of 20 sample points is normally sufficient). When the number of sample points are doubled a traverse shall be repeated to determine which ones are compliant. The sampling points, which have negative flow or the angle of flow is not less than 15° shall not be sampled. It must be stated in the monitoring report that the flow criteria is not in compliance with the standard.

5.3 Minimum number and location of sampling points

No additional requirements to EN 13284-1.

5.4 Access ports and working platform

The standard port that has been commonly installed in the UK is 100mm (4") diameter. When new ports are to be fitted on existing or new processes it is strongly recommended that they have a minimum diameter of 125mm (see Annex D of the standard).

Detailed information on sampling facilities and health and safety when working at heights are provided in Environment Agency TGN M1 and the Source Testing Association (STA) booklet Risk assessment: industrial emissions⁽⁶⁾.

6 Equipment and materials

6.1 Gas velocity, temperature, pressure and composition measurement devices

No additional requirements to EN 13284-1.

6.2 Sampling equipment

Note: Keeping sample pumps serviced and in a good state of repair is beneficial, especially when carrying out high volume sampling (i.e. between 30 – 50 litres /min).

6.2.1 No additional requirements to EN 13284-1.

6.2.2 The key for Figure 3 – *Example of in-stack filter sampling system* should read as follows:

10g – Bypass control valve

10h – Orifice plate (can be heated)

6.2.3 Titanium parts are not corrosion resistant in gas concentrations with fluoride contents above 20 ppm. An alternative material, such as stainless steel, quartz or glass shall be used under these circumstances.

6.2.4 Entry nozzle

Paragraph 4 of this section provides criteria about the relationship between nozzle wall thickness and nozzle diameter. When using a 6mm nozzle the wall thickness must be less than 0.15 mm, unless the nozzle has been validated to show compliance with EN 13284-1.

6.2.5 Suction tube (Out-stack filtration devices)

No additional requirements to EN 13284-1.

6.2.6 Filter holder

Filter holders shall not damage the filter during installation.

Note 1: filter holders that clamp the filter using a clamping ring may cause mechanical damage, which may lead to filter losses.

Note 2: there are a wide range of filter backings available for stack emissions monitoring. Some provide more support for the filter than others. A sintered backing plate would provide better support for a filter than a more open design. However, its a balance between reducing the pressure drop across the filter, ensuring a good distribution of particulate on the filter and minimising the loss of filter material.

Note 3: the NPL report “Study into the loss of material from filters used for collecting particulate matter during stack emissions monitoring” ⁽⁷⁾ provides information on the assessment of different filter holders.

When filters are not in a filter holder, they should be stored in a static free container, which is made of a material that is unaffected by the use of solvents (i.e. acetone). A glass Petri dish is a proven material. If loose particulates are dislodged mechanically from the filter these shall be recovered by rinsing with a solvent (i.e. acetone).

6.2.7 Filters

The standard notes that fibre loss can occur from the filter during initial sampling. This loss may affect the overall uncertainty. Further information is provided in Section 8.2 of this MID.

Laser cut filters shall not be used.

Note: NPL report "Study into the loss of material from filters used for collecting particulate matter during stack emissions monitoring" provides details on laser cut filters. It shows that laser cut filters have a raised edge due to the effect of the laser heating the filter material. For this reason laser filters may lose material due to mechanical damage to the fused edge when the filter is clamped in a filter holder. The loss of filter material is likely to occur during sampling and subsequent filter handling.

Table 1: Filter material and their strengths and limitations

Material	Strengths	Limitations
Cellulose		<ul style="list-style-type: none">cannot be exposed to temperatures above 75°Clow filter capacity for particulates
PTFE	<ul style="list-style-type: none">proven efficiencynot prone to fibre loss	<ul style="list-style-type: none">cannot be exposed to temperatures above 230°C.mechanically weakprone to curling during conditioning in ovenelectrostatic charges may effect weighing
Fibreglass	<ul style="list-style-type: none">strong mechanical properties	<ul style="list-style-type: none">reacts with acidic compounds, such as SO₃cannot be exposed to temperatures above 200°C
Quartz fibre	<ul style="list-style-type: none">thermally stableresistant to chemical reactions with flue gases, such as HF, HCl, SO₂, SO₃, H₂SO₄, NO and NO₂	<ul style="list-style-type: none">fibre loss may occurweak mechanical propertiescannot be exposed to temperatures above 700°C

Note: EN 13284-1 states that PTFE can be exposed to temperatures of up to 230°C. However, some manufacturers have lower temperature limits, with some stating a limit of 120°C.

6.2.8 Suction unit and gas metering devices

No additional requirements to EN 13284-1.

6.3 Dust deposit recovery accessories

No additional requirements to EN 13284-1.

6.4 Equipment for conditioning and weighing

No additional requirements to EN 13284-1.

7 Weighing procedure

7.1 General aspects

No additional requirements to EN 13284-1.

7.2 Pre-sampling conditioning

No additional requirement to EN 13284-1.

7.3 Weighing

The barometric pressure, temperature and humidity of the weighing room shall be recorded. When weighing is taking place, the environmental conditions shall be stable (i.e. no doors opening and closing).

A minimum of three control beakers shall be used throughout the conditioning process for the rinsing solutions. The average weight change on these shall be either added to or subtracted from the sample beakers to give a "corrected" final mass of particulate collected in the rinse.

Note: ceramic containers are proven material to use as containers for weighing the residue of evaporated rinsing solutions. PTFE weighing containers have also been used in conjunction with an anti-static gun.

7.4 Post-sampling treatment of weighed parts

No additional requirement to EN 13284-1.

7.5 Post-sampling treatment of the rinsing solutions

Note 1: the following are CEN documents about the rinsing procedure:

- CEN/TC 264 N 331 - Uncertainty of the procedure for determination of the mass of dust in the rinsing solutions ⁽⁸⁾
- CEN/TC 264 N 330 - Evaluation of a procedure for the recovery of dust deposits upstream of the filter ⁽⁹⁾

7.6 Improvement of the weighing procedure

No additional requirement to EN 13284-1.

8 Sampling procedure

8.1 General aspects

In general in stack filtration is preferred because the filter will be at stack conditions. They are also less bulky and cumbersome to operate than out of stack filtration. Therefore, the recommended approach to sampling particulates is via in stack filtration, unless:

- there are droplets in the stack gas
- the stack gas is sufficiently near to saturation to cause condensation to form on an in stack filter
- the stack gas temperature is close to or below the acid gas dew point
- the in stack filter system is greater than 10% of the area of the stack

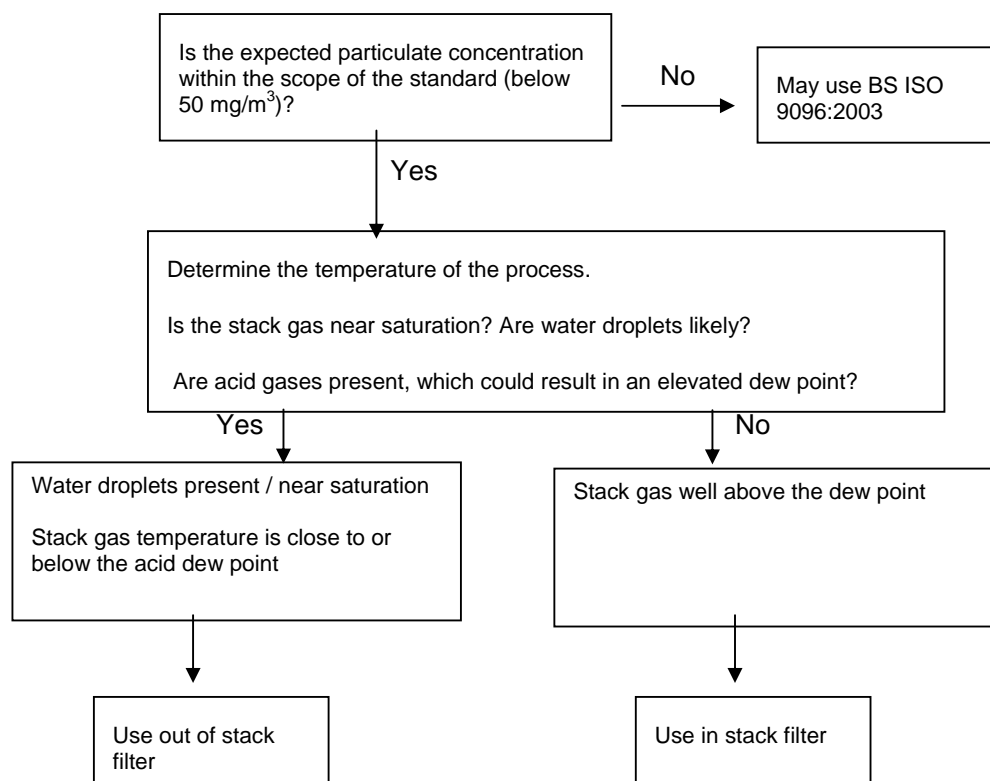
If the stack gas temperature is above 180°C and the particulates in the stack are volatile or semi-volatile, out of stack filtration may be required (see Thermal behaviour of dust section 9).

Where stack gases contain concentrations of sulphur dioxide between 2000 mg/m³ and 6000 mg/m³, sulphur trioxide and sulphuric acid are likely to form due to equilibrium reactions. Under these conditions the dew point is typically at 140°C. To prevent condensation forming on the filter, the filter system must be above 160°C during the whole measurement. Therefore, if the stack gas is not above 160°C an out of stack filter system shall be used.

Note 1: with the use of low sulphur coal and flue gas desulphurisation at coal fired power stations, sulphur dioxide concentrations above 2000 mg/m³ are not common.

Figure 1 provides a flow chart to help determine which type of sampling system to use.

Figure 1: Recommended approach to determine whether in-stack or out of stack filter is required



8.2 Preparation

A clean enclosed area shall be used for the preparation and recovery of filters.

Sections 8.2 a) and b) apply to:

- measuring particulate concentrations on stacks with ELVs of 10 mg/m³ or below;
- calibrating particulate CEMs on processes where the particulate concentrations are typically less than 10 mg/m³.

a) Removing loose material from filters

The filter shall be preconditioned by pulling clean ambient air through the filter for a specified length of time and flow rate.

A flow rate of 30 l / minute has been proven to be suitable. Different flow rates and times may be used, provided evidence is provided that further loss of filter material does not occur after conditioning.

Note 1: NPL report "Study into the loss of material from filters used for collecting particulate matter during stack emissions monitoring" provides details on preconditioning filters by pulling ambient air through them. The pre-conditioning procedure was carried out by placing the filters in a filter holder and drawing 30 l/min of laboratory air through the filters for five minutes. This reduced the effect of filter loss material.

Note 2: The study also showed that although small losses were observed with the pre-conditioned filters, there were no further losses when the filter is run for longer. The unconditioned filters continued to lose material, though at a small level.

Filters shall be installed into filter holders in the same direction for sampling, as they were when they were pre-blown.

Note 3: unlike on-site sampling the removal of loose material from filters is an activity carried out at a permanent laboratory. It is therefore an activity controlled using standard laboratory quality assurance and control. As such, alternative approaches may be used provided they have been validated to the satisfaction of the accreditation body (UKAS).

b) Filter handling

Handling of filters shall be reduced to a minimum.

Whenever possible, filters shall be installed into the filter device before going to site. Alternatively, they may be installed into a cartridge before going to site. The cartridges shall be stored in a static free sealed unit to prevent losses of material during transportation.

Note 4: NPL report "Study into the loss of material from filters used for collecting particulate matter during stack emissions monitoring" provides details on the handling of filter papers. The report showed that filters were often damaged when removing them from the filter holder. Significant losses appeared to be a result of the handling of the filters, particularly due to placing them into and out of the filter holders. Filter handling can be a major source of uncertainty in particulate monitoring, often leading to structural damage to the filters and the potential for further loss of material from the filters.

8.3 Pre measurements

There are two approaches to obtaining a water vapour concentration:

Option 1: The water vapour concentration is measured before particulate monitoring using EN 14790⁽¹⁰⁾. This concentration is used to determine the isokinetic rate during the test. It is also used when calculating the measurement result(s), provided the water vapour conditions are stable and well characterised.

Note 1: if the water vapour concentration is variable, there is a risk that the water vapour for the process being monitored may change. This may lead to the isokinetic rate during the test being incorrect, which may mean the result(s) does not comply with EN 13284-1.

Note 2: CEMs data may show that a process has stable water vapour conditions.

Option 2: The water vapour concentration is determined before the particulate test and also during the particulate test. The water vapour concentration determined before the test is

used to estimate the isokinetic rate required during the particulate test. The water vapour concentration measured during the particulate test is used for determining the water vapour to be applied when calculating the measurement result(s).

When using Option 2 is it important that the water vapour concentration used to calculate the isokinetic rate is reliable. This concentration can be obtained in the following ways:

- carry out EN 14790 (this approach shall be used on a stack where the water vapour concentration is unknown or where the water vapour concentration is variable);
- use an expected water vapour concentration based on previous monitoring campaigns or where it is known that the water vapour concentration is at ambient conditions (this shall only be done if the water vapour conditions are stable and well characterised).

Note 3: if the water vapour concentration is estimated before the particulate test using information from previous monitoring campaigns, there is a risk that the water vapour for the process being monitored may have changed. This may lead to the isokinetic rate during the test(s) not meeting the criteria specified in EN 13284-1.

For stable and well characterised stack gas emissions, where it is known that the water vapour concentration is at ambient conditions or has been previously confirmed to be less than 5% volume / volume concentration, it is not necessary to determine the water vapour concentration by measurement.

If droplets are present in stack gas emissions Option 1 shall be followed, using Annex A of BS EN 14790 to determine water vapour concentration.

Note 4: the approach used in Annex A is for the measurement of water vapour only. It does not include the droplets.

8.4 Sampling procedure

a) a leak check of the sampling equipment shall be carried out by sealing the nozzle and starting the suction device before and after sampling. The leak rate and the vacuum at which the leak was performed at shall be stated in the measurement report.

The method described in the standard for checking leaks continuously while monitoring using gas analysers cannot be used to check leaks before and after sampling.

Note 1: an oxygen analyser could be used to measure the stack gas oxygen directly from the stack while another oxygen analyser could measure the exhaust gas from the particulate sampling train. The two readings should be the same if there is no leak in the sample train. However, this only checks leaks on the equipment outside of the gas stream. It would not indicate if there was a leak in the equipment inside the gas stream, such as an in-stack filter holder.

When using USE EPA method 5⁽¹¹⁾ style manual sampling trains the leak check procedure shall also include the section of the sampling train from the pump to the orifice meter. This shall be leak-checked prior to initial use and after transporting to a new location.

Note 2: details of the leak check procedure is provided in US EPA method 5.

b) when using in-stack filtration the filtration device collects particulates at the stack gas temperature. To prevent condensation forming on the filter, the filtration device has to be externally pre-heated to a temperature above the stack gas temperature before it can be used.

If the filtration system is not preheated before being placed in the stack, it is acceptable to preheat in the stack gas. If this approach is taken the filtration system shall be heated in the stack gas until it reaches stack gas temperature. The nozzle shall be inserted into the stack in the opposite direction to the flow of the stack gas.

Note 3: It is crucial that condensation does not occur on the filter housing during sampling. This is most likely to occur when a cold in stack filter head is placed into a hot stack gas. VDI 2066⁽¹²⁾ states that if the filter device is placed in the stack to heat up, it is left for a minimum of one hour before sampling can begin.

If having heated the filter device to the stack temperature, condensation forms on the filter during the test, out of stack filtration should be used. If condensation has formed the test is invalid and shall be repeated.

Note 4: if condensation does occur on the filter, the sample vacuum may increase. This may prevent the sample system from achieving the correct sample volume flow rates. Also, condensation on the filter may lead to filter loss, especially when the filter is removed from the filter backing.

c) high volume sampling increases the mass of particulate collected over a specified sampling time. When measuring stacks with ELVs of less than 10 mg/m³ the largest nozzle size (preferably 8mm or above), that can be used to sample within the isokinetic range specified in EN 13284, shall be used. This may require the sample train to be run at sample volume flow rates of between 30 - 50 litres/min.

Note 5: high volume sampling was assessed by the STA and the Environment Agency at the Health and Safety Laboratory's wind tunnel facility⁽¹³⁾.

Note 6: high volume sampling may be more difficult to achieve with:

- negative pressure in the stack
- long sample lines (umbilical line)
- increasing particulate on the filter
- increasing moisture in drying materials (e.g. silica gel)

Note 7: the size and shape of silica gel can affect the ability to sample at high flow rates. According to the STA, silica gel beads (2 – 5 mm diameter) are proven at high sample flow rates. Granular shaped silica gel is prone to breaking down into finer particles. The finer particles may get sucked into the sample pump and cause the efficiency of the pump to be reduced.

d– e) no additional requirements to EN 13284-1.

f) flow variations in the stack shall be checked while sampling at each sampling point during the sampling exercise.

g) – l) no additional requirements to EN 13284-1.

8.5 Recovery of deposits upstream of the filter

Particulates shall be recovered from each individual test.

The amount of particulate recovered from rinsing shall be included in the measurement report.

8.6 Overall blank sample

The dry residue value of the acetone blank must be quoted in the report separately from the overall blank.

9 Thermal behaviour of dusts

Note 1: EN 13284-1 states that the effect of volatile particulates is controlled by conditioning the filter and / or filter holder to a fixed temperature (normally 180°C). Any dust that is volatile above this temperature will be driven off during conditioning. This means the method measures particulates that are not volatile below 180°C.

This is to ensure that volatile particulates are reported consistently. As the volatile material is controlled by heating of the filter and or filter holder after sampling, there is usually no need to fix the sampling temperature during the test (i.e. by using out of stack filtration).

Note 2: Using out of stack filtration to measure particulates in stack gases above 180°C means that any volatile components of the dust are standardised at this temperature (i.e. those that are volatile or semi-volatile above this temperature pass through the filter and those that are not are collected).

Note 3: US EPA have an out stack (M5) and in stack method (M17)⁽¹⁴⁾. These are applied based on the following criteria:

- if the stack is near saturation or has water droplets or has a small diameter, M5 is used
- if the particulate concentrations in the stack gas vary because of temperature, M5 is used
- if the particulate concentrations in the stack gas are independent of temperature, M17 is used.

The application of in stack verses out of stack in the US is therefore predominantly based on the effect of temperature on particulates. The theory being that for some emissions sources the particulates are volatile or semi-volatile, which means the higher the temperature the less the particulate concentration will be. This means it is difficult to compare different emissions sources because they may be measured at different temperatures (i.e. different points in a stack). The US methods therefore use out of stack filtration with the filter set at a fixed temperature. For example, all coal fired power stations would be sampled with an out of stack filter configuration and a fixed filtration temperature, which would mean their particulate emissions could be compared.

Note 4: The German standard, VDI 2066, specifies that in stack filtration should be used wherever possible.

10 Validation of results

10.1 General

No additional requirements to EN 13284-1.

10.2 Parameters depending on the stationary source

In practice precisely following the requirements of the method can be difficult due to the following factors related to the sample location:

- limited access to the required number of sample lines
- limited access to sample points, which may restrict the number of points that can be used
- poor positioning of the sample plane, which may result in the flow criteria not being met

In these circumstances the estimation of the uncertainty relating to the results of a specific stack emission measurement exercise are complicated and not possible to quantify. This means the affect of the sample location on the measurement uncertainty shall not be taken into account when reporting the uncertainty. In these cases qualifying remarks explaining the deviations from the standard shall be included in the monitoring report and it shall be clearly stated in the report that the sample location requirements were not met and the results were not produced in compliance with the standard.

Note: The following documents have been produced by the STA and NPL:

- QGN00-1 Example uncertainty for particulate measurements for BS EN 13284-1⁽¹⁵⁾
- Uncertainty calculation for EN 13284-1 Determination of low range mass concentration of dust, manual Gravimetric Method⁽¹⁶⁾

10.3 Leak check

No additional requirements to EN 13284-1.

10.4 Isokinetic rate

No additional requirements to EN 13284-1.

10.5 Deposits of dust on non-weighed parts upstream the filter.

Particulates shall be recovered from each individual test.

10.6 Overall blank

The standard requires the blank to be less than 10% of the ELV. This criteria is based on measuring stack gases with ELVs of 10 mg/m³ and above. Some installations have ELVs of 5mg/m³. Under these circumstances the blank value shall be below 20% of the ELV.

The overall weighing uncertainty shall be less than 5% of the daily ELV for sites regulated under the Waste Incineration Directive (WID) and less than 5% of the ELV for other sites.

Note: the overall weighing uncertainty applies to both the filter and rinsing procedures.

Where installations have ELVs of 5 mg/m³ or less, it may not be practical to meet the 5% of ELV requirement. Under these circumstances, a minimum one hour sample time shall used.

Example calculation of sample volume for the 5% of ELV requirement:

Daily ELV = 10 mg/m³

5 % of ELV = 0.5 mg/m³

Overall weighing uncertainty = 0.4 mg

Minimum sample volume required = Overall weighing uncertainty / 5% of the ELV

Therefore, a minimum of 0.8 m³ should be sampled to ensure this requirement is met

11 Calculation

11.1 Sampling volumetric flow rate

No additional requirements to EN 13284-1.

11.2 Dust concentration

No additional requirements to EN 13284-1.

12 Performance characteristics of the method

12.1 General aspects

No additional requirements to EN 13284-1.

12.2 Experimental data

No additional requirements to EN 13284-1.

12.3 Comments

No additional requirements to EN 13284-1.

13 Test report

The report shall include the reporting details stated in the MCERTS performance standard for organisations⁽¹⁷⁾.

Annex A (normative) Requirements related to the working platform

No additional requirements to EN 13284-1.

Annex B (normative) Determination of flow direction with Pitot tubes

When using an S Type Pitot the swirl test is carried out using the following procedure:

- 1) Level and zero the manometer
- 2) Connect a S Type Pitot tube to the manometer and leak-check the system
- 3) Position the S Type Pitot tube at each traverse point, in succession, so that the planes of the face openings of the Pitot tube are perpendicular to the stack cross-sectional plane (when the S Type Pitot tube is in this position, it is at 0° reference)
- 4) Note the differential pressure reading at each traverse point
- 5) If a null (zero) Pitot reading is obtained at 0° reference at a given traverse point, an acceptable flow condition exists at that point
- 6) If the Pitot reading is not zero at 0° reference, rotate the Pitot tube (up to ±90° yaw angle), until a null reading is obtained
- 7) Determine if the angle of rotation is less than 15° at each sample point

Note 1: a device, such as a port adaptor, can be marked to show if the angle of rotation is <15°. However, if the angle of rotation is measured to the nearest degree, it is necessary to use a device, such as an inclinometer.

Note 2: measuring the angle of rotation to the nearest degree is considered good practice and under some circumstances may be requested by the Regulatory Authority.

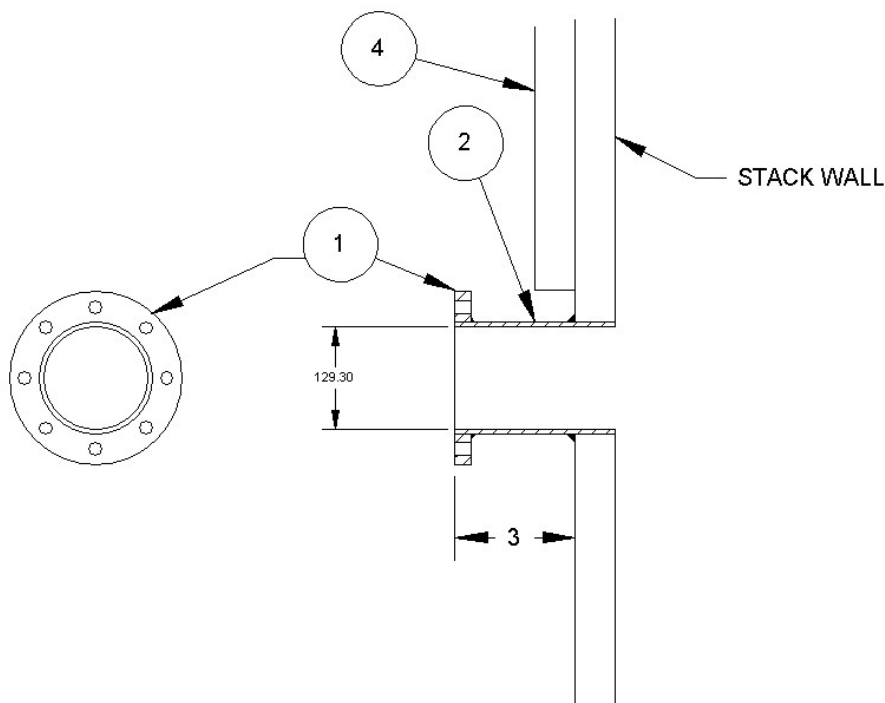
- 8) Apply the swirl test to each sample point
- 9) If the value of rotation is less than 15° at each sample point, the overall flow condition in the stack is acceptable

Annex C (normative) Methods and rules for determining the positions of sampling points in circular and rectangular ducts

No additional requirements to EN 13284-1.

Annex D (informative) Examples of suitable access ports for sampling equipment

Recommended access port design



Key

1. Flange BS 10 - 125 mm (5")
2. Pipe stub 125 mm (5")
3. The STA recommend that the pipe stub length should be a minimum of 100 mm from the stack wall
4. Recommendation that a unistrut is fitted vertically to centre line of sample port on the stack wall for positioning of a monorail system

Annex E (normative) Proven design of the entry nozzle

Figure E.1 and E.2 in Annex E of the standard are examples of nozzle designs. Providing the bend radius of the nozzle is greater than 1.5 times the diameter of the tube and the straight length before the bend is greater than 30mm other designs can be used, such as gooseneck.

Annex F (normative) Summary of the requirements

Note: when the requirement for sampling location is followed by (recommended) this is informative and is only a recommendation.

Annex G (informative) Sampling volume, flow rate and duration

No additional requirements to EN 13284-1.

Annex H (informative) Examples of weighing bias

No additional requirements to EN 13284-1.

Bibliography

- (1) BS EN 13284-1:2002 - Determination of low range mass concentration of dust – Part 1: Manual gravimetric method
- (2) ISO 9096:2003 - Stationary source emissions — Determination of concentration and mass flow rate of particulate material in gas-carrying ducts — Manual gravimetric method.
- (3) Environment Agency Technical Guidance Note M20 – Quality assurance of continuous emission monitoring systems – application of BS EN 14181 and BS EN 13284-2. Available from www.mcerts.net
- (4) Environment Agency Technical Guidance Note M1 - Sampling requirements for stack-emission monitoring. Available from www.mcerts.net
- (5) US EPA Method 2 Determination of stack gas velocity and volumetric flow rate (Type S Pitot tube). Available from the US EPA website.
- (6) Risk assessment: Industrial emissions, Source Testing Association.
- (7) Study into the loss of material from filters used for collecting particulate matter during stack emissions monitoring, NPL report.
- (8) CEN/TC 264 N 331 - Uncertainty of the procedure for determination of the mass of dust in the rinsing solutions. Available from the Source Testing Association.
- (9) CEN/TC 264 N 330 - Evaluation of a procedure for the recovery of dust deposits upstream of the filter. Available from the Source Testing Association.
- (10) BS EN 14790:2005 Stationary source emissions – determination of water vapour in ducts.
- (11) US EPA method 5 Determination of particulate matter from stationary sources. Available from the US EPA website.
- (12) VDI 2066 Particulate matter measurement, dust measurement in flowing gases, gravimetric determination of dust load.
- (13) STA and EA wind tunnel test at HSL Buxton 12 – 16 February 2007. Available from the Source Testing Association.
- (14) US EPA method 17 Determination of particulate matter from stationary sources. Available from the US EPA website.
- (15) QGN00-1 Example uncertainty for particulate measurements for BS EN 13284-1. Available from the Source Testing Association.
- (16) Uncertainty calculation for EN 13284-1 Determination of low range mass concentration of dust, Manual Gravimetric Method, Available from the Source Testing Association.
- (17) MCERTS, Manual stack emissions monitoring, Performance standard for organisations. Environment Agency. Available from www.mcerts.net.