

Characterization of air quality —

Part 4: Stationary source emissions —

Section 4.2 Method for the determination of asbestos plant emissions by fibre count measurement

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Environmental and Pollution Standards Policy Committee (EPC/-) to Technical Committee EPC/35, upon which the following bodies were represented:

- Association of Consulting Scientists
- British Coal Corporation
- British Gas plc
- British Steel plc
- Department of Health
- Department of the Environment (Her Majesty's Inspectorate of Pollution)
- Department of Trade and Industry (Laboratory of the Government Chemist)
- Department of Trade and Industry (Warren Spring Laboratory)
- Electricity Supply Industry in England and Wales
- GAMBICA (BEAMA Ltd.)
- Health and Safety Executive
- Institute of Occupational Hygiene
- Institute of Petroleum
- Institution of Environmental Health Officers
- Institution of Gas Engineers
- Lead Development Association
- National Society for Clean Air
- Society of Chemical Industry

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Asbestos Information Centre Ltd.
- Asbestosis Research Council
- Filtration Society
- Institute of Energy
- Institution of Chemical Engineers

This British Standard, having been prepared under the direction of the Environmental and Pollution Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 30 August 1991

© BSI 07-1999

The following BSI references relate to the work on this standard:
Committee reference EPC/35
Draft for comment 90/57222 DC

ISBN 0 580 19809 X

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 Definitions	1
3 Principle	1
4 Apparatus	2
5 Facilities at the sampling site	6
6 Site work prior to sampling	8
7 Sampling procedure	10
8 Analytical procedures	11
9 Method of calculation	11
10 Presentation and interpretation of results	12
Appendix A Safety precautions	13
Appendix B Care of apparatus	13
Appendix C Incorrect circumstances	14
Appendix D Typical site data sheet	15
Appendix E Typical presentation of results	16
Appendix F Accuracy and precision of method	16
Figure 1 — Sampling train	2
Figure 2 — Typical access port with probe support/port sealer	3
Figure 3 — Typical sample nozzle and filter holder designs	4
Figure 4 — Typical sampling time graph for 4 mm diameter nozzle	5
Figure 5 — Position of sampling points	7
Figure 6 — Typical velocity/sampling rate/nozzle size setting chart	9
Table 1 — Sampling location distances from obstacles	14
Publication(s) referred to	Inside back cover

Foreword

This Section of BS 6069 has been prepared under the direction of the Environment and Pollution Standards Policy Committee and is based on ISO/DIS 10397 “*Stationary source emissions — Determination of asbestos plant emissions — Method by fibre count measurement*”. At the request of Her Majesty’s Inspectorate of Pollution, it is being published as a British Standard, for use in the UK in advance of publication of the ISO standard.

BS 6069 is being published in a series of Parts and Sections that will generally correspond to particular international standards arising from the UK participation in the work of ISO/TC 146. This Section of BS 6069 is one of several, relating to stationary source emissions, that are being published as Sections of BS 6069-4. Methods concerning workplace atmospheres are being published as Sections of BS 6069-3. Topics relating to other aspects of air quality characterization will be published as further Parts or Sections of BS 6069.

The following Parts of BS 6069 have already been published:

- *Part 1: Units of measurement;*
- *Part 2: Glossary.*

Methods for the determination of particular constituents of ambient air are being published as Parts of BS 1747.

This Section of BS 6069 is essentially made up of two parts: sampling of the asbestos-containing emissions; and fibre counting. Unfortunately the accuracy of the analysis (fibre counting) is such that it adversely affects the accuracy of the whole method. Therefore it is vitally important that the analytical aspects are carried out by experienced analysts, who have been specially trained, in conjunction with an approved quality control scheme.

Although this method has been produced to deal specifically with fibre emissions from asbestos works, it can equally be applied to other processes dealing with fibrous materials. Indeed many asbestos works are using substitute fibres and, therefore, may at times produce mixed fibre emissions. Where this is probable, or where there is a need to identify which fibres are asbestos and which are not, it will be necessary to employ more sophisticated techniques for fibre identification; such techniques are not covered in this Part of BS 6069.

It should be noted that, at present, there are differences in the way asbestos fibres and non-asbestos fibres are assessed, especially in the workplace. These differences, however, should not affect the way this method is used to assess the effectiveness of arrestment plant.

This Part of BS 6069 is intended to be used not only to give a quantitative concentration of fibres in emissions from asbestos works, but also as a means of showing the effectiveness or otherwise of the operation of dust and fibre collection equipment.

Because of the relatively short duration of sampling, the method is fairly sensitive to process fluctuations and, therefore, a full record of test parameters is required.

The analytical technique used in this method follows that described in the Health and Safety Executive document MDHS 39/3.

The information presented in appendices A to F is for background information only and does not form an integral part of the standard.

WARNING. Breathing asbestos dust is dangerous to health and precautions have to be taken during the sampling and measurement. Particular note has to be taken of the Control of Asbestos at Work Regulations 1987 (S.I. 2115, 1987). Safety precautions are described in Appendix A.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 18, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Section of BS 6069 describes a method, using a fibre count technique, for the assessment of fibre concentrations in flowing gas streams in ducts, chimneys or flues from asbestos-using industrial processes.

This method is intended to be used to determine fibre concentrations from a wide range of processes where it is known that regulated fibres are present in emissions. No attempt is made to identify asbestos fibre types separately from other fibres.

NOTE 1 If fibre identification is required, then reference should be made to the use of electron microscopy and the Health and Safety Executive.

NOTE 2 This method may be used to check that dust collection equipment used to trap asbestos fibres, or prevent their escaping into the atmosphere, is working properly and effectively.

NOTE 3 This method is suitable for measuring fibre concentrations as described in European Community Council Directive No. 87/217/EEC on the prevention and reduction of environmental pollution by asbestos.

The range of application of the method for concentrations of fibres in ducts is about 0.05 fibres/mL to 10 fibres/mL, although this range may vary slightly according to the sampled volume which, in turn, will depend on duct velocities and the sampling apparatus used. Appendix A gives safety precautions to be considered when carrying out the method described in this British Standard. Information on the accuracy and precision of the method is given in Appendix F. Appendix C gives information on sampling and measurement when the criteria given in this method cannot be met.

NOTE 4 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard, the following definitions apply.

2.1

aspect ratio

ratio of the length of a fibre to its width

2.2

access port

a hole in the duct, provided with a flanged or threaded socket, through which a sampling probe is inserted along the sampling line

2.3

cumulative sampling

the collection of a single composite sample obtained by sampling for the required period at each sampling point in turn

2.4

duct

a chimney, stack or ducting at the outlet of dust-collecting equipment carrying asbestos fibre laden gases

2.5

fibre concentration

the number of regulated fibres per millilitre of gas

2.6

fibre count technique

a method for counting the number of regulated fibres present on a membrane filter and the calculation of fibre concentrations

2.7

hydraulic diameter

for a rectangular duct, the hydraulic diameter, D_h , is given by the following formula:

$$D_h = \frac{4 \times \text{area of the sampling plane}}{\text{perimeter of the sampling plane}}$$

2.8

isokinetic sampling

sampling at a rate such that the velocity and direction of the gas entering the sampling nozzle is the same as that of the gas in the duct just prior to the sampling point

2.9

pump

a fan, vacuum pump or other apparatus used for extracting a sample of gas from ducts or chimneys

2.10

regulated fibres

fibres that meet the following criteria :
length $\geq 5 \mu\text{m}$; diameter $\leq 3 \mu\text{m}$; minimum aspect ratio 3 : 1

2.11

sampling line

the imaginary line on which the sampling points are located.

3 Principle

A sampling probe is inserted into a moving gas stream and a known volume is withdrawn isokinetically. The sampled gas is passed through a filter medium which removes particulate matter (including fibres) from the gas stream. The filter is treated so as to make it transparent when viewed under a microscope, and then the number of fibres are counted in a precise number of fields as viewed using a phase contrast optical microscope.

Knowing the volume of gas sampled, the cross-sectional area of the filter, the number of regulated fibres counted, and the cross-sectional area of each field, the concentration of fibres in the moving gas stream can then be calculated.

4 Apparatus

4.1 General. Use a sampling train for sampling regulated fibres as shown in Figure 1. The apparatus to be used shall be as described in 4.2 to 4.15. The apparatus shall be constructed of materials, e.g. stainless steel, capable of withstanding the conditions under which they will be used, shall be portable or transportable, and shall be capable of sampling isokinetically (see 9.3) at a steady rate.

NOTE 1 Access ports will be needed on the duct to enable sampling to take place.

NOTE 2 Useful information on the care of the apparatus is given in Appendix B.

4.2 Sampling probe (including nozzle and fibre collector), complying with the following requirements.

The probe tube shall be rigid and tubular and shall be attached to the sample nozzle and filter holder and of sufficient length to enable these to be inserted into the duct through an access port, to reach all sample points. It shall be provided with a mechanism for sealing the access port in such a way that ingress of ambient air or escape of duct gases are kept to a minimum.

NOTE 1 This sealing mechanism can also act as a support and means for securing the probe in the correct sampling positions. A typical design is shown in Figure 2.

In practice, the sample nozzle shall be sharp edged, but short enough to minimize the possibility of fibre deposition (see Figure 3). Also it shall be robust, to prevent damage by general use, and shall give even distribution of fibres over the filter.

NOTE 2 The examples shown in Figure 3 have been evaluated to ensure even distribution of fibres over the membrane filter.

The diameter of the nozzle at the entrance shall be not less than 4 mm.

No reduction shall be made in the internal diameter over a distance of one diameter of the entry section. Any subsequent changes in bore diameter shall be tapered rather than stepped, and joints shall be smooth to prevent fibre deposition. Any bends in this section shall have a minimum radius of 1.5 times the nozzle bore diameter. The internal surfaces of the nozzle and any tubing prior to the filter shall be to a smoothness of $\leq 0.2 \mu\text{m}$ to prevent deposition of fibres.

A range of different sized nozzles shall be available so that samples can be withdrawn isokinetically from gas streams in ducts over a range of velocities (see 6.5.1 and Figure 4).

The fibre collector shall be situated as close as is convenient behind the sample nozzle to minimize deposition. (See Figure 3.)

4.3 Fibre collector, which shall be a membrane filter (comprising mixed esters), with an efficiency of capture of greater than 98 % for $3 \mu\text{m}$ size particles, and of diameter 25 mm or 37 mm.

