Guidance Note EH 10
from the
Health and Safety
Executive

Asbestos – Control Limits, measurement of airborne dust concentrations and the assessment of control measures

Environmental Hygiene 10 (revised July 1984)

These Guidance Notes are published under five subject headings: Medical, Environmental Hygiene, Chemical Safety, Plant and Machinery, and General.

INTRODUCTION

1 This Guidance Note is a revision of EH 10 (revised April 1983) *Asbestos – Control Limits and measurement of airborne dust concentrations*. It replaces the information given in the earlier document and sets out in para 9 new Control Limits which have been agreed by the Health and Safety Commission in the light of information available to them. The new Control Limits come into effect from 1 August 1984, but the Commission have made it clear that employers will be expected to comply with these levels before this date wherever possible. The Health and Safety Commission have also agreed that the Health and Safety Executive will use the European Reference Method from 1 April 1984 for assessing compliance with the Control Limits. In addition, this Note gives guidance on air monitoring procedures for use with the Approved Code of Practice entitled *Work with asbestos insulation and asbestos coating*.[1]

2 It gives general guidance on the control measures to be adopted for work activities involving asbestos and on the exposure criteria which the Health and Safety Executive's inspectors will use as part of their assessment of the standards of control adopted to minimise the risks from asbestos. The exposure criteria, although important, form only part of the assessment which inspectors will make in order to determine whether, in their opinion, the requirements of the Asbestos Regulations 1969[2] (particularly Regulations 7 and 8) and Sections 2, 3 and 4 of the Health and Safety at Work etc Act 1974[3] (HSW Act) are observed. It is of course for the Courts alone to give a binding decision on the interpretation of the law.

3 The Health and Safety Commission's Asbestos Manufacturing Industry Working Group and the Construction Industry Advisory Committee are considering further measures for the control of exposure to asbestos dust. Regulations and a Code of Practice are in preparation to implement two European Community Directives[4,5] on asbestos. This Guidance Note will be revised at a later stage to take account of these developments. The Approved Code of Practice entitled *Work with asbestos insulation and asbestos coating* will be revised to take account of the requirements of the Asbestos (Licensing) Regulations[6] which come into effect on 1 August 1984.

LEGISLATION AND APPROVED CODE OF PRACTICE

4 The Asbestos Regulations 1969 apply to all factories and to other premises to which Part IV of the Factories Act 1961 applies, including construction sites, electrical stations and ships under construction or repair etc, where a process involving asbestos is undertaken, except a process in which asbestos dust cannot be given off. 'Asbestos dust' is defined in Regulation 2 as "dust consisting of or containing asbestos to such an extent as is liable to cause danger to the health of employed persons". In determining whether "asbestos dust cannot be given off", the test should be applied before precautions are taken, for example, before local exhaust ventilation is provided.

5 Where the Asbestos Regulations do not apply, there is a duty under the HSW Act to ensure, so far as is reasonably practicable, the health, safety and welfare of persons at work. Similar standards to the Asbestos Regulations should be adopted. There is also a duty to protect persons not at work against risks to health or safety arising out of or in connection with the activities of persons at work.

6 The Approved Code of Practice *Work with asbestos insulation and asbestos coating*[1] provides practical guidance on the current legislation[2,3] concerning the risk to health from asbestos during work with thermal and acoustic insulation including structural fire protection and sprayed coating.

MEDICAL EVIDENCE

7 A relationship between exposure to asbestos dust and asbestosis, asbestos related bronchial cancer and mesothelioma (cancer of the lining of the chest or abdomen) has been recognised for many years. Between 1976 and 1979 the Health and Safety Commission's Advisory Committee on Asbestos

processes in the asbestos manufacturing industry, some work activities involving asbestos cement[14,15] and asbestos insulating board[14, 16], or during stripping and delagging[1,14], it may not be possible to maintain the personal exposure of workers below the Control Limits by means of the control measures set out in paras 11-13.

16 Where it is not possible to maintain personal exposure below the Control Limits, approved respiratory protective equipment (RPE) must be provided and worn. In addition, workers who enter areas where the concentration of asbestos dust is likely to exceed the Control Limits must be provided with and must wear approved RPE. Furthermore, it is also recommended that approved RPE should be worn during identified periods of high exposure which may occur during work activities which themselves give rise to exposures below the Control Limits (see paras 27-29) and where these peaks of exposure cannot be reduced by other means. Finally, following discussion between employers and employees, it may be decided that approved RPE should be provided and worn in other situations where the average exposure is maintained below the Control Limits.

17 The RPE selected should be adequate in terms of the protection it offers, suitable for the particular work activity and wearable for the entire period of use. It is important that the RPE selected provides adequate protection against the maximum concentration of asbestos dust in air likely to be encountered during use. A list of RPE approved for the purpose of the Asbestos Regulations 1969 is contained in the Certificate of Approval (F 2486)[17] which is published every year by HMSO. Guidance on the selection, use, cleaning, maintenance and storage of approved RPE is given in Guidance Note EH 41 *Respiratory protective equipment for use against asbestos*[18]. Additional guidance can be obtained from the Approved Code of Practice entitled *Work with asbestos insulation and asbestos coating*[1] or from British Standard 4275 (1974) *The selection, use and maintenance of respiratory protective equipment* or from local offices of the Health and Safety Executive.

18 Protective clothing including head covering should be provided for and worn by any person whose body or clothing is liable to be contaminated by asbestos. The protective clothing should be made of a material which does not readily retain asbestos dust and prevents, so far as is reasonably practicable, its penetration. It should also be without external pockets or unnecessary pleating or accessories. Clean spare clothing of appropriate sizes should be available.

19 Protective clothing should only be worn in the asbestos work area and on the contaminated side of the wash/changing rooms. So far as is reasonably practicable, it should be cleaned by vacuum cleaning equipment when the wearer leaves the work area and laundered as frequently as necessary to ensure its cleanliness and efficiency. Before it is sent to the laundry, it should be sealed in a dust tight container and marked boldly 'Asbestos contaminated clothing'. Asbestos contaminated clothing should only be sent to launderers equipped to deal with it and who know the risks to health from asbestos.

MEASUREMENT OF AIRBORNE ASBESTOS

General

20 Air monitoring is necessary to determine whether or not the personal exposure of workers is being controlled to the minimum reasonably practicable below the relevant Control Limit, and as an aid in the selection of respiratory protective equipment. In conjunction with other techniques (paras 46-50) it may also help to identify those areas where improvements in the system of work or dust control equipment are required to ensure that the personal exposure of workers is reduced to the minimum reasonably practicable.

21 Air monitoring, usually static sampling, is also necessary as part of the assessment of the effectiveness of control measures adopted for stripping and de-lagging work and, on completion of the work, of whether the work area has been adequately cleaned and decontaminated.

22 The air sampling strategy should be developed and executed by a person or persons who have adequate information, instruction and training for the task so that they can carry it out effectively. The general principles to be adopted are described in Guidance Note EH 42 *Monitoring strategies for toxic substances*[19]. Persons developing the strategy will need to be made aware of all asbestos processes at the workplace and will in particular need information and instruction about:

(a) the plant and equipment used for transporting and processing materials containing asbestos;
(b) the exhaust ventilation and other dust control equipment;
(c) the composition of materials (e.g. type of asbestos);
(d) process details; and
(e) individual employees' tasks.

Those carrying out sampling to the developed strategy should be familiar with the above points and fully conversant with the appropriate sampling techniques. This section gives guidance on methods of measurement for determining personal exposure to airborne asbestos dust (paras 23-29 and Annexe 2), for background monitoring on asbestos de-lagging operations (paras 30-42 and Annexe 3), and on the quality control procedures to be adopted by laboratories which undertake fibre-counting. Finally, this section gives guidance on other qualitative methods for assessing the effectiveness of dust control measures.

simulated work activity do not of their nature or composition generate dust. Where personal samples are taken, it is permissible to clear the filters with triacetin or by the dimethyl formamide/euparal method.

32 For most situations, it is considered to be reasonably practicable to undertake the work in such a way that the ambient level outside the enclosure and inside the enclosure after final clean up does not exceed 0.01 fibre/ml when measured by the method set out in Annexe 3.

Enclosure of working area

33 Where stripping or delagging of asbestos is to be undertaken the area being stripped should, wherever reasonably practicable, be adequately enclosed and operate under slight negative pressure. Arrangements should be made for the construction of suitable entry/exit locks in the enclosure into the working area. The negative pressure in the enclosure should be maintained by the use of suitable air extraction equipment such that any leakage in the enclosure causes clean air to be drawn into the stripping area from outside. The air extraction equipment should be fitted with a high-efficiency filter and the exhausted air vented to a point outside the building where reasonably practicable.

34 Before any stripping or delagging takes place, the integrity of the enclosure should be assessed, first by a thorough visual inspection, and any obvious defects remedied. As a second stage of the assessment, a smoke generator should be used within the enclosure. Any further defects identified should be remedied before work starts.

35 Air monitoring outside the working area shortly after the start of stripping work may provide useful information on the efficiency of the enclosure, the entry/exit locks and the air extraction equipment filter and mounting where this is not vented outside the building. However, such monitoring should not be regarded as a substitute for frequent thorough visual inspections of the enclosure and the remedying of any defects identified.

Suitability of site for normal occupation

36 On completion of stripping work, the area should be thoroughly cleaned. This may involve wire brushing all surfaces from which insulation has been removed followed by the use of a vacuum cleaner fitted with a high efficiency filter[7] and provided with a range of cleaning attachments. Where vacuum cleaning cannot be used or proves ineffective in removing fine deposits of dust, wiping with moistened swabs may provide an acceptable alternative. Where such wet cleaning methods have been used, the work area should be allowed to dry before final inspection and air monitoring are undertaken. It is emphasised that air monitoring should not be undertaken until the whole work area is visually clean and all fine deposits of dust have been removed. Any surfaces which cannot be effectively cleaned should be sealed. Before the enclosure is dismantled after final clearance monitoring, its surfaces should be sealed to prevent the release of fibres during dismantling.

37 Clearance monitoring may involve static sampling or a mixture of static and personal sampling and simulated work activities. It will be necesary to take account of future work activities at the cleared site, e.g. installation of asbestos-free insulation or day to day cleaning of floors and walls, so that workers involved in these activities are not unnecessarily exposed to asbestos dust through ineffective cleaning.

Selection of sampling times and interpretation of results

38 Guidance on static sampling and analytical procedures is set out at Annexe 3. At the very low levels considered reasonably practicable to achieve outside the enclosure and during clearance sampling, the precision of the membrane filter method is very much reduced. The precision is a function of the ambient concentration of fibre and other airborne material and of the volume of air sampled. Nevertheless, the method is considered to provide adequate data for assessing the effectiveness of dust control measures and the suitability of the site for normal occupation.

39 To maximise precision, it is recommended that wherever possible a static sample of 0.5-2.0 m^3 volume should be collected over a period of 1 to 4 hours. However, in certain situations, notably outside the stripping enclosure, ambient levels of airborne dust from other parts of the site may lead to very dense samples which cannot be counted or to obscuration of fibres by the presence of other dust particles. In situations where past experience has shown that this is likely to occur, a lower sample volume may be used. This volume should be as large as is consistent with obtaining a countable slide (see Annexe 3, para 15(e)). Where static samples are collected during simulated work activities and the airborne concentration is likely to exceed the lower limit of measurement, an initial check sample of lower volume may be used down to a minimum of 120 litres. However, on final clearance samples, a minimum sample of 240 litres volume should be collected.

40 In general the sampling flow rate, up to a maximum of 8 litre/min, should be selected on the basis of the particular circumstances. This may involve the use of battery or mains operated pumps. Sampling times should normally be in the range of 1 to 4 hours.

41 Phase contrast optical microscopy cannot positively distinguish between asbestos and other organic or inorganic fibres (e.g. carpet and paper fibres, gypsum). For most practical purposes, any

of view and the other to observe. The lamp can be used by one person if it is attached to a suitable tripod.

49 Though the dust lamp can, at best, only give a very general indication of the actual concentrations of airborne asbestos dust it should be regarded as the primary means for identifying sources of dust emissions and for assessing the effectiveness of dust control techniques. Photography and video recording of asbestos dust using these lamps have proved useful techniques in identifying and assessing ways of reducing dust emission.

50 Instruments are available which give a rapid reading of the dust concentration and are useful for providing an indication of the general dustiness of the air. Where it is possible to establish a correlation between the results of such instruments and the membrane filter method in particular workplaces, the instruments can provide a rough and ready measure of asbestos dust in the air. For example, they may be used to look for sources of dust emission, either from process plant or generated during manual handling, or to check that control equipment is operating satisfactorily. Short term static sampling using the membrane filter method can provide similar information. The results, however, can be influenced by a range of factors including the time workers normally spend at the process, air movement in the work area and other dust sources in the vicinity of the plant. Low results obtained by static sampling do not necessarily mean that exhaust ventilation equipment is operating effectively. Static sampling should not be regarded as an alternative to a qualitative assessment of dust control measures and work practices using the dust lamp but rather as a complement to it.

SAMPLING AND ANALYSIS OF BULK MATERIAL

51 This Note now outlines acceptable techniques for sampling and analysis of bulk materials for use with the Approved Code of Practice *Work with asbestos insulation and asbestos coating*[1].

52 Sampling and analysis of the bulk material is necessary, first, to determine the presence of asbestos, and second, to identify the type of asbestos. It is particularly important to identify the presence of any crocidolite or amosite. If, however, employers find it more convenient to treat the material as though it were crocidolite or amosite and to provide precautions appropriate for these types of asbestos, sampling and analysis need not be undertaken. It should be noted that 28 days' notice of intended stripping of crocidolite containing materials is required, although HSE inspectors may accept shorter periods of notice in some circumstances. From 1 August 1984, written notice to the appropriate enforcing authority at least 28 days before work commences (or such shorter period as that authority may allow) must be given by those persons who do not hold a licence and undertake work with asbestos insulation or asbestos coating at their own premises[27]. Prior notification may also be a condition of any licence to undertake work of this type issued by HSE[27].

53 The type and quantity of asbestos in old installations will frequently vary from one part to another, and sufficient samples should be collected to take account of any apparent variations in the material, including changes through the depth of the insulating layers. Those taking the samples must be protected from exposure to airborne asbestos dust. Only essential personnel should be present and the area marked to indicate that sampling is in progress. Soaking will greatly reduce the emission of fibre during sampling although the sample will need to be dried before analysis. The samples should be transported in sealed, impervious containers, double wrapped if necessary, and adequately identified.

54 The types of asbestos present cannot readily be identified by the appearance or colour of the bulk sample, particularly if other materials are present. Damping the surface may help to locate areas containing crocidolite (although the absence of blue colour does not guarantee absence of crocidolite). Crocidolite may be significantly changed in appearance by the action of heat. Fibre can be identified by optical microscopy[28,29], and an estimate of the proportion of the minerals in the sample can be obtained by X-ray diffraction[29,30], although optical microscopy is to be preferred because of its sensitivity. Other techniques, such as electron microscopy and infra-red spectroscopy, can also give useful information.

FURTHER ADVICE

55 Anyone needing further advice from HSE on any aspects of this Guidance Note should consult his local HSE inspector.

ANNEXE 1: Control Limits for asbestos until 31 July 1984

1 The Control Limits for the different forms of asbestos until 31 July 1984 are:

(a) for dust consisting of or containing any crocidolite	0.2 fibre/ml when measured as a time-weighted average over any 4-hour period
(b) for dust consisting of or containing any amosite but not crocidolite	0.5 fibre/ml when measured as a time-weighted average over any 4-hour period
(c) for dust consisting of or containing other types of asbestos but not crocidolite or amosite	1 fibre/ml when measured as a time-weighted average over any 4-hour period

The use of any spray to fix the dust to the filter is unnecessary and may be damaging. The clean, unexposed edge of the filter can be secured to the tin with adhesive tape, and subsequently removed with a surgical scalpel. Alternatively, the filter may be left in the holder, with the protective cap firmly in position, for transport. Care must be taken not to contaminate the filter at any stage before evaluation. The filter holder and cowl must of course be cleaned before re-use.

Filter clearing and mounting

9 The principle of the method is that the filter is immersed in hot acetone vapour, which condenses on the filter, collapsing its pores and making it transparent, and sticking it to the slide. Use of the vessel described in para 10 below creates a region of vapour confined by the cooling coil, reducing the risk of fire. The cleared filter is then treated with triacetin and covered with a glass cover slip. The triacetin gives high contrast with asbestos fibres and good optical contact between the filter and cover slip. Practice mounting of clean filters is recommended to gain proficiency before a real sample is used. When the filters used for sampling have been exposed to high humidity, clarity may be improved by drying them before exposure to the acetone.

10. A tall, narrow, flat-bottomed, metal vessel is required for boiling the acetone, with a cooling coil near the top (Fig 2). The lid should have a stiff wire cradle attached to hold the microscope slide securely. The coil carries cold water and confines most of the acetone vapour to the lower part of the vessel.

11 A source of heat which cannot ignite any acetone vapour, such as a recirculating oil bath, is required. A water bath may be unsatisfactory because large amounts of water vapour make the filter less clear. Mounting must normally be carried out in a fume cupboard, with a lip at the opening to contain any spilled acetone. A fine-tipped micropipette is required to dispense the triacetin.

12 CAUTION: Acetone vapour is highly flammable (and slightly toxic, with a recommended occupational exposure limit of 2400 mg/m^3 (8-hr TWA)). The quantity of acetone used should be kept to a minimum, it should not be left in the apparatus when this is not in use, nor should it be left boiling when clearing is not actually in progress. The lid should be kept in place whenever possible. The equipment should only be used in a fume cupboard, unless exceptional circumstances make this impossible. The equipment must then be used in a well-ventilated area. In any case, sources of ignition must be kept well away from the equipment, and a no smoking rule must be enforced.

13 The cooling water is turned on, about 30 ml acetone is put into the vessel, the lid is replaced, and the vessel placed on a source of heat free from risk of igniting any acetone vapour. When the acetone boils, the lid is removed, a microscope slide is placed in the cradle, and the membrane filter is placed centrally on the slide, sample side up, with the grid bars parallel to the slide edges. The lid is replaced, thus lowering the slide into the vapour in the vessel; the filter should clear immediately, and the slide is then removed. After a wait of a few minutes to allow the acetone to evaporate, a micropipette is used to place a drop of triacetin on the filter or cover slip, enough to cover the whole filter when the cover slip is in place, without excessive overflow round the edges. The cover slip is gently lowered onto the filter at an angle, so that all the air is expelled: it should not be pressed onto the filter.

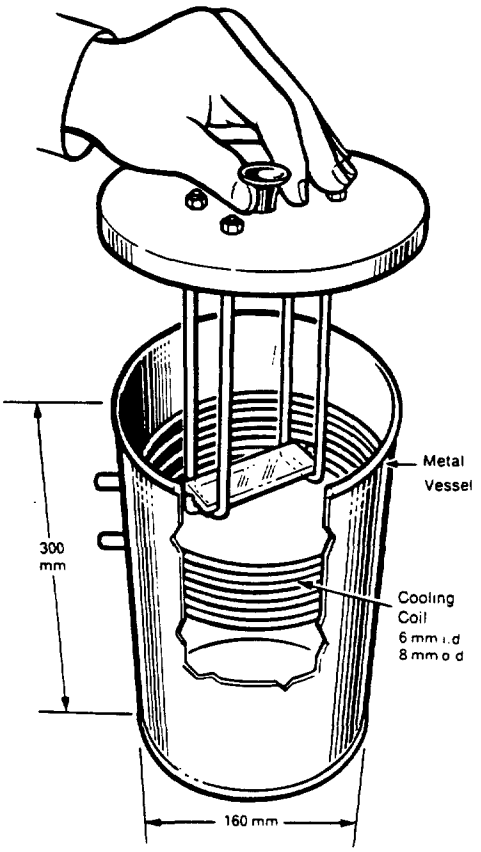

Fig 2-Vessel for acetone clearing

14 The filter becomes less granular in appearance with time for the first few hours after clearing. The slide should therefore normally be left for 24 hours before counting. If a result is required quickly, the slide can be heated for 15 minutes at about 50°C and then counted. Painting the edge of the cover slip with nail varnish may improve the keeping qualities, although the mounted slide will in any case usually be kept for a year or more without noticeable deterioration. Some

(e) if more than one-eighth of a graticule area is covered by an agglomerate of fibres and/or particles, the graticule area must be rejected and another counted;

(f) at least 100 fibres must be counted and a minimum of 20 graticule areas examined. No more than 100 graticule areas need to be examined.

The blank filters should be similarly mounted and counted. If more than 3 fibres per 100 graticule areas are found on the blank, the airborne measurement should be regarded as a rough estimate only, and the source of the blank count investigated.

20 The diameter of the exposed area of the filter should be measured. An accurate method is to use the normal filter holder and cowl to sample from a cloud of dark coloured dust, and then to mount the filter on a slide in the standard manner. The slide is placed on the microscope stage, and the filter observed at low magnification while a diameter is traversed by moving the stage. The distance moved can be obtained from the stage vernier scale. Two diameters should be measured, and three filters should be checked in this way. Differences of more than a millimetre may indicate an unsatisfactory clearing technique. The gross appearance of the filter may also show any fault with the filter holder, for example a leak or uneven deposit. The procedure should be repeated if the filter holder or O-ring type is changed.

21 The airborne concentration is given by

$$(1000ND^2)/(Vnd^2) \text{ fibre/ml}$$

where: N is the number of fibres counted,
n is the number of graticule areas examined,
D (mm) is the diameter of the exposed areas of the filter,
d (μm) is the diameter of the Walton-Beckett graticule as measured with the stage micrometer,
V (litres) is the volume of air sampled.

ANNEXE 3: Air monitoring procedures for use with the Approved Code of Practice *Work with asbestos insulation and asbestos coating*

1 In general, the monitoring of airborne concentrations of asbestos outside the work area or for assessing the suitability of the site for normal occupation at the end of the work can most effectively be undertaken by static sampling. Where personal sampling is undertaken, the procedure set out in Annexe 2 should be adopted; filters in this case may be cleared with triacetin or by the dimethyl formamide/euparal method.

Sampling

2 Samples for assessment must be taken by drawing a known volume of dust-laden air through a 25-mm cellulose ester membrane filter with a printed grid and of pore size 0.8 to 1.2 μm using a battery or mains operated pump. The pump must give a smooth flow and be capable of being set to an appropriate flowrate for the particular circumstances (in the range 1 to 8 litre/min) through the membrane filter and of maintaining this to within ± 10% for the duration of sampling. The sampling time must be measured to within 2%.

3 Flow measurement to this accuracy will require the use of a calibrated external flowmeter (2%) for all measurements. Any flowmeter built into the pump may not be sufficiently accurate (but may still be useful during sampling as an indicator that the instrument is working).

4 An open-faced filter holder, preferably fitted with an electrically conducting cylindrical cowl, must be used. The cowl should extend between 33 mm and 44 mm in front of the filter and expose a circular area of the filter at least 20 mm in diameter. A suitable design is shown in Fig 1 at Annexe 2.

5 To minimise contamination, the filter should be loaded into the holders, unloaded and analysed in an area free of asbestos contamination. Flat-tipped metal tweezers should be used for handling the filters. The entrance to the loaded holder and cowl should be closed with a protective cap or a bung during transport through contaminated areas. For every 25 filters (or part of 25) used, one filter should be treated as a blank. Where possible, it should be loaded into a filter holder but should not have the protective cap removed or have air drawn through it. It should subsequently be mounted and counted. If more than one batch of filters is used, at least one blank should be taken from each batch.

6 To allow the pump to warm up, it should be attached to a loaded filter holder with flexible tubing and allowed to run at the chosen flowrate for 15 minutes so that the flowrate can steady (experience may show warm-up to be unnecessary with some types of stabilised flow pumps, although the flow precision in para 2 must be met). The filter is then discarded and a new one fitted in such a way that the dust sample is collected on the gridded side. The flow is then readjusted to the chosen flowrate using a calibrated airflow meter. A satisfactory procedure is to connect the calibrated meter to the entrance of the cowl or filter holder by a bung and tube. The pump should then be switched off and a protective cap fitted to the cowl or filter holder entrance.

7 The filter holder should ideally be fixed at a height of 1 to 2 metres above the floor. The filter holder should face downwards and have an unobstructed entry. In some circumstances a higher concentration may be expected at certain areas of the site; in such cases the sampler should be positioned in those areas expected to give the higher result. At the start of the sampling period, the protective cap should be

Evaluation of samples

14 The microscope must be set up according to the manufacturer's instructions, and its performance checked at the beginning of each day or shorter period of use with an HSE/NPL phase contrast test slide Mark 2. The microscopist must be able to see group 5 on the slide when the microscope is used as specified by the manufacturer. The fine focus and condenser focus may need readjustment before a sample is counted. The object-plane diameter of the Walton-Beckett graticule should occasionally be checked using a stage micrometer. The diameter should be approximately 100 µm (see para 16), but the measured diameter must be used in calculations.

15 The slide with the mounted filter is then set up on the microscope, and the fibres on the filter are counted according to the following rules:

(a) graticule areas for counting are chosen at random within the exposed area of the filter. The fine focus must be adjusted for each new area, and may need to be changed from fibre to fibre;

(b) a countable fibre is defined as any object which is longer than 5 µm, with a width less than 3 µm, and a length/width ratio greater than 3:1, which does not touch or appear to touch a particle with a maximum diameter greater than 3 µm. A countable fibre with both ends within the graticule area is recorded as one fibre; a countable fibre with only one end within the area is recorded as half a fibre;

(c) a split fibre is taken to be one countable fibre if it meets the definition in (b) above; otherwise it should be ignored (A split fibre is defined as an agglomerate of fibres which at one or more points on its length appears to be solid and undivided but which at other points appears to divide into separate strands. The width is measured across the undivided part, not the split part.);

(d) fibres in a bundle are counted individually if they can be distinguished sufficiently to determine that they meet the definition in (b). If no individual fibres meeting the definition can be distinguished, the bundle is one countable fibre if the bundle as a whole meets the definition in (b);

(e) if more than one-eighth of a graticule area is covered by an agglomerate of fibres and/or particles, the graticule must be rejected and another counted;

(f) 200 graticule areas must be counted.

The blank filters should be similarly mounted and counted. If more than 3 fibres per 100 graticule areas are found on the blank, the airborne measurement obtained from other filters in the batch may approach 0.01 fibre/ml due to the blank count alone. It is recommended that, under such conditions, that batch of filters should not be used.

16 The diameter of the exposed area of the filter should be measured. An accurate method is to use the normal filter holder and cowl if used to sample from a cloud of dark coloured dust, and then to mount the filter on a slide in the standard manner. The slide is placed on the microscope stage, and the filter observed at low magnification while a diameter is traversed by moving the stage. The distance moved can be obtained from the stage vernier scale. Two diameters should be measured, and three filters should be checked in this way. Differences of more than a millimetre may indicate an unsatisfactory clearing technique. The gross appearance of the filter may also show any fault with the filter holder, for example a leak or uneven deposit. The procedure should be repeated if the filter holder or O-ring type is changed.

17 The airborne concentration is given by

$$(1000ND^2)/(Vnd^2) \text{ fibre/ml}$$

where: N is the number of fibres counted,
n is the number of graticule areas examined,
D (mm) is the diameter of the exposed areas of the filter,
d (µm) is the diameter of the Walton-Beckett graticule as measured with the stage micrometer,
V (litres) is the volume of air sampled.

Where the measured airborne concentration is less than 0.01 fibre/ml, the result should be recorded as 'less than 0.01 fibre/ml'.

GUIDANCE NOTES

General Series

GS 1 Fumigation using methyl bromide
GS 2 Metrication of construction safety regulations
GS 3 Fire in the storage and industrial use of cellular plastics
GS 4 Safety in pressure testing
GS 5 Entry into confined spaces
GS 6 Avoidance of danger from overhead electrical lines
GS 7 Accidents to children on construction sites
GS 8 Articles for substances for use at work - guidance for designers, manufacturers, importers, suppliers, erectors and installers
GS 9 Road transport in factories
GS10 Roofwork: prevention of falls
GS11 Whisky cask racking
GS12 Effluent storage on farms
GS13 Reporting of accidents to pupils and students
GS14 Provision of sanitary conveniences and washing facilities in agriculture
GS15 General access scaffolds
GS16 Gas flooding fire extinguishing systems: toxic hazards and precautions
GS17 Safe custody and handling of stock bulls on farms and at artificial insemination centres
GS18 Commercial ultra-violet tanning equipment
GS19 General precations aboard ships being fitted out or under repair
GS20 Fire precautions in pressurised workings
GS21 Assessment of radio frequency ignition hazards

Chemical Safety Series

CS 1 Industrial use of flammable gas detectors
CS 2 The storage of highly flammable liquids
CS 3 Storage and use of sodium chlorate
CS 4 The keeping of LPG in cylinders and similar containers
CS 5 The storage of LPG at fixed installations
CS 6 The storage and use of LPG on construction sites

Plant and Machinery Series

PM 1 Guarding of portable pipe-threading machines
PM 2 Guards for planing machines
PM 3 Erection and dismantling of tower cranes
PM 4 Safety at high temperature dyeing machines
PM 5 Automatically controlled steam and hot water boilers
PM 6 Dough dividers
PM 7 Lifts
PM 8 Passenger carrying paternosters
PM 9 Access to tower cranes
PM10 Tripping devices for radial and heavy vertical drilling machines
PM13 Zinc embrittlement of austenitic stainless steel
PM14 Safety in the use of cartridge operated tools
PM15 Safety in the use of timber pallets
PM16 Eyebolts
PM17 Pneumatic nailing and stapling tools
PM18 Locomotive boilers
PM19 Use of lasers for display purposes
PM20 Cable-laid slings and grommets
PM21 Safety in the use of woodworking machines
PM22 Mounting of abrasive wheels
PM23 Photo-electric safety systems
PM24 Safety at rack and pinion hoists
PM25 Vehicle finishing units: fire and explosion hazards
PM26 Safety at lift landings
PM27 Construction hoists
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PM29 Electrical hazards from steam/water pressure cleaners etc
PM30 Suspended access equipment
PM31 Chain saws
PM32 The safe use of portable electrical apparatus
PM33 Safety of bandsaws in the food industry
PM34 Safety in the use of escalators

Medical Series

MS 3 Skin tests in dermatitis and occupational chest disease
MS 4 Organic dust surveys
MS 5 Lung funtion
MS 6 Chest x-rays in dust disease
MS 7 Colour vision
MS 8 Isocyanates - medical surveillance
MS 9 Byssinosis
MS10 Beat conditions and tenosynovitis
MS12 Mercury - medical surveillance
MS13 Asbestos
MS15 Welding
MS16 Training of offshore sick-bay attendants ('rig-medics')
MS17 Biological monitoring of workers exposed to organophosphorous pesticides
MS18 Health surveillance by routine procedures
MS20 Pre-employment health screening

Environmental Hygience Series

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EH 4 Aniline - health and safety precautions
EH 5 Trichloroethylene - health and safety precautions
EH 6 Chromic acid concentrations in air
EH 7 Petroleum based adhesives in building operations
EH 8 Arsenic - health and safety precautions
EH 9 Spraying of highly flammable liquids
EH10 Asbestos - control limits, measurement of airborne dust concentrations and the assessment of control measures
EH11 Arsine - health and safety precautions
EH12 Stibine - health and safety precautions
EH13 Beryllium - health and safety precautions
EH14 Level of training for technicians making noise surveys
EH16 Isocyanates: toxic hazards and precautions
EH17 Mercury - health and safety precautions
EH18 Toxic substances, a precautionary policy
EH19 Antimony - health and safety precautions
EH20 Phosphine - health and safety precautions
EH21 Carbon dust - health and safety precautions
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HMSO £2.75p
ISBN 0 11 883596 3

First published 1984
Printed in the UK for HMSO
C150 6/84