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Guidance Note EH 10
from the
Health and Safety
Executive

# Asbestos

## control limits and measurement of airborne dust concentrations

Environmental Hygiene/10 (revised April 1983)

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 Environmental Hygiene/10 (December 1976), *Asbestos — hygiene standards and measurement of airborne dust concentrations*. It replaces the information given in the earlier document and it sets out in para 9 the control limits recommended by the Advisory Committee on Asbestos (ACA)[1] which have been agreed by the Health and Safety Commission in the light of information available to them. The ACA believed that it was inappropriate to continue to control exposure levels in terms of a 'hygiene standard' as has been done hitherto. They believed that as the objective to be achieved was the controlled and progressive reduction of the levels of exposure, the term 'hygiene standard' should be replaced by 'control limit'.*

2 It gives guidance on the exposure criteria the Health and Safety Executive's inspectors will use in determining whether, in their opinion, certain of the requirements of the Asbestos Regulations 1969[2] (particularly Regulation 7 and 8) and Sections 2, 3 and 4 of the Health and Safety at Work etc Act 1974[3] 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 are considering further measures for the control of exposure to asbestos dust. In addition, the methods of measurement are under review. If further changes are to be made, this document will be revised.

4 Part 1 deals with current legislation and control limits. Parts 2 and 3 explains how the necessary measurements may be made.

* Consequently the title of this Guidance Note is altered from the previous edition in this respect. The series number EH 10 is retained.

## PART 1 LEGISLATION AND APPROVED CODE OF PRACTICE

5 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.

6 Where the Asbestos Regulations do not apply, there is a duty under the Health and Safety at Work etc Act 1974 (HSW Act) to ensure, so far as is reasonably practicable, the health, safety and welfare of persons at work and 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, and similar standards to the Asbestos Regulations should be adopted.

7 The Approved Code of Practice *Work with asbestos insulation and asbestos coating*[4] provides practical guidance on the relevant 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

8 A relationship between exposure to asbestos dust and asbestosis, asbestos related bronchial cancer and mesothelioma has been recognised for many years. The Health and Safety Commission's Advisory Committee on Asbestos reviewed in 1976-79 all the evidence available to it at that time relating to the health risks of different types of asbestos. It concluded that there is evidence that all types of asbestos fibre are associated with asbestosis, cancer of the lung and gastro-intestinal tract, and mesothelioma (cancer of the lining of the chest and abdomen). However, it appeared that a substantial proportion of mesotheliomas in this country are probably related to exposure to crocidolite (blue asbestos) or amosite (brown asbestos). The ACA concluded that exposure to chrysotile alone has rarely been shown to cause mesothelioma. However, it considered that any change in industrial practice in the direction of the production of more finely divided chrysotile fibre is likely to increase the health risk. As far as cancer is concerned, the ACA concluded that there is an increase in risk with increasing dose, but that for all types of asbestos, 'no safe level' of exposure could be identified. Further information on the medical effects

of working with different types of asbestos and health precautions are set out in HSE Medical Series Guidance Note MS 13, *Asbestos*[5].

9 The Health and Safety Commission have decided that the following control limits, recommended by the Advisory Committee on Asbestos should be adopted with effect from 1 January 1983:

| | |
|---|---|
| for dust consisting of or containing any crocidolite | 0·2 fibre/ml when measured as a time-weighted average over any 4-hour period |
| 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 |
| 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. |

10 The control limits set out in para 9 *do not* represent safe levels which once attained make further improvements in dust control unnecessary. They represent the upper limits of permitted exposure as determined by personal air sampling techniques (see paras 19 to 24) where there is still a statutory duty to reduce exposure to a lower level where this is reasonably practicable.

11 The Health and Safety Executive will use the criteria set out in paras 9 and 10 in assessing whether there is a compliance with the relevant requirements of the Asbestos Regulations and the HSW Act.

12 For assessing compliance with the control limits, sampling should wherever possible, be carried out for the whole 4-hour period. However, where this is not reasonably practicable or appropriate, sampling should be carried out for the actual period of exposure, and this result be used for assessing compliance as though the control limit was a time-weighted average for the period of sampling. Where both long-term and short-term samples covering the same 4-hour period are available (see para 13), the results of the long-term sample should be used for assessing compliance.

13 In order to comply with the statutory duty to reduce exposure to a lower level where this is reasonably practicable, it is necessary to consider whether a further overall reduction in exposure can be achieved and, in particular, to identify any periods of peak exposure. The identification and evaluation of these peaks will require sampling periods of less than 4-hours.

**Engineering control and provision of respiratory protective equipment**

14 These control limits need to be achieved by means of engineering control where reasonably practicable. Where it is not reasonably practicable to maintain the personal exposure of the worker below the numerical control limits in para 9 by means of engineering controls then suitable approved respiratory protective equipment must be provided and worn.

15 A list of respiratory protective equipment approved for the purpose of the Asbestos Regulations 1969 is published every year as Form F2486[6]. Only approved equipment which is suitable for the anticipated conditions with a nominal efficiency such that the concentration of asbestos in the air breathed by the worker does not exceed the relevant control limit. Guidance on the selection, use, cleaning, maintenance and storage of respiratory protective equipment is contained in the Approved Code of Practice *Work with asbestos insulation and asbestos coating*[4]. Additional guidance on the selection and use of respiratory protective equipment can be obtained from local offices of the HSE.

## PART 2 MEASUREMENT OF AIRBORNE ASBESTOS

**General**

16 Air monitoring is necessary to determine whether or not control of the personal exposure of workers to the relevant control limit for asbestos is being achieved; and also to identify those areas where improvements in the system of work or engineering control equipment need to be made to ensure that the personal exposure of workers is reduced to the minimum that is reasonably practicable.

17 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. 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 machinery used for transporting and processing asbestos – containing materials;

(b) the composition of materials (e.g. type of asbestos);

(c) process details; and

(d) individual employees' tasks.

**Membrane filter method for airborne asbestos dust**

18 Paragraphs 19 to 24 describe the method used to determine the concentration of airborne asbestos dust to which persons are exposed at work.

19 Samples for assessment are taken by drawing a known volume of dust-laden air through a 25 mm diameter cellulose ester membrane filter of pore size 0·8 to 1·2 μm using a battery-operated pump. The membrane filter method is most accurate for deposit densities on the filter of between 100 and 1000 fibres/mm$^2$, and this should be taken into account in choosing the flowrate. For example, this density range would require a flowrate for a 4-hour sample onto a 25 mm filter from a concentration of 1 fibre/ml of between about 0·15 and 1·5 litres/min. The flow should be measured and controlled so that the accuracy of the total volume sampled is known to within 5%. This normally requires the use of a calibrated flowmeter for all measurements. Any flowmeter built into the pump

may not be sufficiently accurate, but can still be used during sampling as an indicator that the instrument is working.

20 The filter holder should be of a design that will give a uniform deposit at the flowrate used. To minimise contamination, the filter should be loaded into the holders, unloaded and analysed in an area free from asbestos contamination. The loaded heads should be covered with a protective cap during transport through asbestos-contaminated areas.

21 The pump should be attached to a loaded filter holder using flexible tubing, and the flow adjusted to the chosen rate using a calibrated airflow meter. The pump should be allowed to run for 15 minutes before sampling to allow the flowrate to steady – experience may show this to be unnecessary with some types of modern *stabilised flow pumps*. A clean filter holder loaded with a clean filter should then be fitted and the flow readjusted to the required rate. The pump should then be switched off and a protective cap fitted to the filter holder.

22 The filter holder should be fixed to the upper lapel or shoulder of the worker's clothing within 300 mm of his nose or mouth. Wherever possible, the same sampler position should be adopted for each worker. Some circumstances may lead to a higher concentration to be expected on one side of the worker than the other, in which case the sampler should be positioned on the side expected to give the higher result. At the start of the sampling period, the protective cap should be removed from the filter holder the pump started, and the time noted. The flowrate should be checked periodically (e.g. hourly) during sampling and readjusted to the chosen rate. Operating experience may show this to be unnecessary with some types of pump, but it is still advisable to check working conditions and that the equipment is functioning. Relevant information for use in interpreting the results (e.g. work in progress, conditions of plant) should be recorded during the sampling period. At the end of the period the time should be noted, the pump switched off, and the protective cap replaced on the filter holder.

23 After the sampling period, the filter may be carefully removed from its holder, and placed in a clean degreased tin or similar holder for transport. 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.

*Evaluation of samples*

24 The term 'fibre' referred to in para 9 means particles of length greater than 5 μm, diameter of less than 3 μm and having a length to breadth ratio of at least 3:1, observed by transmitted light under phase contrast conditions at a magnification of approximately 500x, using a 40x objective with a numerical aperture of 0·65 – 0·70, against a background with r.i. between 1·43 – 1·50. The number of fibres conforming to this definition should be counted on a representative area of the filter using phase contrast optical microscopy, and the airborne concentration calculated from the number counted, the area examined, the area of the filter, and the volume of air collected. The procedure is outlined in Technical Note 1 of the Asbestosis Research Council[7]. It is important to ensure that the microscope equipment is of satisfactory standard and is properly adjusted (this can be checked with a phase contrast test slide.)

Other methods of monitoring airborne asbestos dust

25 The control limits referred to in para 9 refer to the personal exposure of workers as determined by the method set out in paras 20 to 25. Additional valuable information can be obtained from other monitoring methods which give an indication of the level and sources of airborne asbestos dust in the workplace.

26 Instruments are available which give an immediate reading of the total 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, 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 samples using the membrane filter method can provide similar information.

27 The dust lamp (a device for illuminating by forward scattering light) has the advantage, over other techniques, of making visible very fine dust particles thus enabling the observer to identify sources of dust emission and to follow movement of the dust cloud. The method is described in Certificate of Approval No APT (F2363)[8]. The dust lamp may be used in conjunction with video equipment to enable a critical appraisal of existing work practices and engineering controls to identify ways of reducing dust emission.

## PART 3 SAMPLING AND ANALYSIS OF BULK MATERIAL

28 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*.[4]

29 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 that where *any* crocidolite is present, the more stringent precautions should be applied and notification made in accordance with Regulation 6 of the Asbestos Regulations.[3] If, however, employers find it more convenient to treat the material as though it was crocidolite, and to provide precautions appropriate for this type of asbestos, then sampling and analysis need not be undertaken.

30 The type and quantity of asbestos in old installations will frequently vary from one part to another, and it is essential that the samples collected are representative. Sampling should take into account 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. Soaking will greatly reduce the emission of fibre during sampling. Wet bulk samples can be analysed without difficulty. The samples should be transported in sealed, impervious containers double if necessary, and adequately identified.

31 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. Fibres can be identified using optical microscopy[9,10], and an estimate of the proportion of the minerals in the sample can be obtained using X-ray diffraction[10,11]. Accurate X-ray diffraction measurement is difficult at low levels (less than a few per cent) as it cannot in general distinguish between fibrous and non-fibrous forms of mineral, so that this analysis should be supported by a microscopical examination. Other techniques, such as electron microscopy and infra-red spectroscopy can also give useful information.

## FURTHER ADVICE

32 Anyone needing further advice from the HSE on any aspects of this Guidance Note (e.g. training of persons to carry out air sampling, obtaining suitable sampling equipment, identifying analytical laboratories) is advised to consult his local HSE inspector who should be able to assist either directly or by putting the enquirer in touch with an appropriate person.

## REFERENCES


1 Health and Safety Commission. Asbestos — Volume 1: Final Report of the Advisory Committee
HMSO ISBN 0 11 883293 X

2 *The Asbestos Regulations 1969*, SI 1969 No 690
HMSO ISBN 0 11 090690 X

3 *The Health and Safety at Work etc Act 1974*, Chapter 37,
HMSO ISBN 0 10 543774 3

4 Health and Safety Commission. *Work with asbestos insulation and asbestos coating*. Approved Code of Practice and Guidance Note and text of the Asbestos Regulations and extracts from the Health and Safety at Work etc Act. (Revised June 1983)
HMSO ISBN 0 11 883687 0

5 *Health and Safety Executive. Medical Series* Guidance Note MS13, *Asbestos*
HMSO (under revision)

6 F2486 (1982) (revised) Certificate of approval (Respiratory Protective Equipment) 1982
HMSO ISBN 0 11 883680 3

7 Technical Note 1 of the Asbestosis Research Council. AIC, Sackville House, 40 Piccadilly, London W1V 9PA

8 F2363. Certificate of approval No API [particulars to be contained in report of the result of thorough examination and test of exhaust ventilation system]
HMSO ISBN 0 11 883354 5

9 L J Monkman, *Ann. Occup. Hyg.*, 22 (1979) 127-139

10 Technical Note 3 of the Asbestosis Research Council. AIC, Sackville House, 40 Piccadilly, London W1V 9PA

11 M Taylor, *The Analyst*, 103 (1978) 1009-1020


## FURTHER INFORMATION

This Guidance Note is produced by the Health and Safety Executive. Further advice on this or any other publications produced by the Executive is obtainable from Baynards House, 1 Chepstow Place, London W2 4TF, or from Area Offices of the HSE.


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