International Labour Office Geneva

Safety in the use of asbestos

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ILO Codes of Practice

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Preface

In accordance with the decisions taken by the Governing Body of the ILO at its 219th (February-March 1982) Session, a meeting of experts was convened in Geneva from 11 to 20 October 1983 to draw up a code of practice on safety in the use of asbestos. The meeting was composed of five experts appointed following consultations with governments, five experts appointed following consultations with the Employers' group and five experts appointed following consultations with the Workers' group of the Governing Body.[1]

The Code is based on principles established by the following Conventions and Recommendations adopted by the International Labour Conference: the Occupational Cancer Convention, 1974 (No. 139), and Recommendation, 1974 (No. 147), the Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148), and Recommendation, 1977 (No. 156), and the Occupational Safety and Health Convention, 1981 (No. 155), and Recommendation, 1981 (No. 164).

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[1] The following experts took part in the meeting:

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M. D. Bouige, Directeur, Association française de 1'amiante, Paris (France).

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Mr. J. S. Oliver, Deputy Superintending Inspector of Factories, HMFI, HQ., Health and Safety Executive, London (United Kingdom).

Mr. R. K. Sharma, General Secretary, Asbestos Cement Mazdoor Sangh, Kymore (India).

Mr. A. Zverev, Chief, Department of Occupational Hygiene, Federation of Construction Workers of the USSR, Moscow (USSR).

The following international governmental and non-governmental organisations were represented:

World Health Organisation.
United Nations Environment Programme.
Commission of the European Communities.
International Organisation of Employers.
Confederation of Free Trade Unions.
World Confederation of Labour.

The practical recommendations of this code of practice are intended for the use of all those, both in the public and in the private sectors, who have responsibility for safety and health in the use of asbestos. The code is not intended to replace national laws or regulations or accepted standards. It has been drawn up with the object of providing guidance to those who may be engaged in the framing of provisions of this kind and, in particular, governmental or other public authorities, committees or management in related enterprises.

Local circumstances and technical possibilities will determine how far it is practicable to follow its provisions. Furthermore, these provisions should be read in the context of conditions in the country proposing to use this information, the scale of operation involved and technical possibilities. In this regard, the needs of the developing countries have also been taken into consideration.

The text of the code was approved for publication by the Governing Body of the ILO at its 224th (November 1983) Session.

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The Asbestos Convention, 1986 (No. 162), and Recommendation, 1986 (No. 172), were adopted by the International Labour Conference at its 72nd Session in 1986. They are available from ILO Publications, International Labour Office, CH-1211 Geneva 22, free of charge.

Contents

A. General

1. Objects, application and definitions

1.1. Objects

1.1.1. The objects of this code are:

(a) to prevent the risk of exposure to asbestos dust at work;

(b) to prevent harmful effects on the health of workers arising from exposure to asbestos dust;

(c) to provide reasonably practicable control procedures and practices for minimising occupational exposure to asbestos dust.

Possible health consequences of exposure to asbestos dust

1.1.2. There are three main health consequences associated with exposure to airborne asbestos:

(a) asbestosis: fibrosis (thickening and scarring) of the lung tissue;

(b) lung cancer: cancer of the bronchial tubes;

(c) mesothelioma: cancer of the pleura or peritoneum.

In asbestos workers, other consequences of asbestos exposure can be the development of diffuse pleural thickening and circumscribed pleural plaques which may become calcified. These are regarded as no more than evidence of exposure to asbestos dust. Other types of cancer (e.g. of the gastrointestinal tract) have been attributed to asbestos exposure though the evidence at present is inconclusive.

1.2. Application

1.2.1. This code applies to any situation or operation involving a risk of occupational exposure to airborne asbestos dust including:

(a) mining and milling asbestos;

(b) manufacture of materials or products containing asbestos;

(c) use or application of asbestos-containing products;

(d) stripping, repair or maintenance of products containing asbestos;

(e) demolition of plant or structures containing asbestos materials;

(f) transportation, storage and handling of asbestos or asbestos-containing materials;

(g) other operations involving a risk of exposure to airborne asbestos dust.

1.2.2. The provisions of this code should be considered as the basic requirements for protecting workers' health. Competent authorities are encouraged to adopt additional protective measures, based on their experience, and are also encouraged to decide when these should come into effect.

1.3. Definitions

1.3.1. For the purposes of this code:

(a) *asbestos* is defined as the fibrous form of mineral silicates belonging to the serpentine and amphibole groups of rock-forming minerals, including: actinolite, amosite (brown asbestos, cummingtonite, grunnerite), anthophyllite, chrysotile (white asbestos), crocidolite (blue asbestos), tremolite, or any mixture containing one or more of these;

(b) *asbestos dust* is defined as airborne particles of asbestos or settled particles of asbestos which may become airborne in the working environment;

(c) *respirable asbestos fibre* is defined as a particle of asbestos with a diameter of less than 3 μm and of which the length is at least three times the diameter;

(d) *workers* covers all employed persons;

(e) *workplace* covers all places where workers need to be or need to go by reason of their work and which are under the direct or indirect control of the employer;

(f) *regulations* covers all provisions given force of law by the competent authority or authorities.[1]

[1] For further information consult American Chemical Society: *Chemical Abstracts Service Registry Handbook,* Chemical Abstracts Service, PO Box 3012, Colombus, Ohio 43210, United States.

2. General duties

2.1. General duties of the competent authority

2.1.1. In the light of national conditions and practice, the competent authority should, in consultation with the most representative organisations of employers and workers, issue or approve and periodically update regulations or other suitable provisions for the protection of workers' health against hazards due to occupational exposure to asbestos dust.

2.1.2. The competent authority should have the expertise to supervise the enforcement of such regulations or provisions and to supply relevant advice and information.

2.1.3. The regulations on the prevention of airborne asbestos in the working environment should clearly define the agencies and persons responsible for carrying them out.

2.1.4. (1) The competent authority should establish those procedures which it considers necessary for the notification by the employer of working operations and workplaces where asbestos or materials containing asbestos are or will be produced, handled, processed, stored or used and any other work situations where asbestos or materials containing asbestos are being used or handled in such a manner as to cause dust.

(2) This notification may include the following information:

(a) nature and place of work;

(b) type and quantity of asbestos or materials containing asbestos;

(c) total number of workers exposed;

(d) duration or anticipated duration of the work period;

(e) protective and preventive measures to be taken.

2.1.5. Where appropriate, the competent authority should determine those dangerous working operations or techniques which should be prohibited or made subject to specific authorisation and which will require compliance with particular measures of prevention and protection.

2.1.6. The competent authority should establish procedures for:

(a) the setting up of airborne asbestos exposure limits in the working environment;

(b) the standardisation of methods for monitoring airborne asbestos in the working environment;

(c) the approval of personal protective equipment.

2.1.7. The competent authority should:

(a) endeavour to promote close co-operation between employers and workers on matters of prevention;

(b) assist in providing safety and health committees, employers and workers with information on the hazards and on safety in the use of asbestos.

2.2. General duties of employers

2.2.1. The employer is responsible for the control and prevention of exposure to airborne asbestos in the working environment; the employer should therefore equip and maintain buildings, installations, machines and workplaces and organise work in such a way that the working environment is contaminated as little as possible and that the exposure of workers is limited as far as is reasonably practicable and is at least within the asbestos exposure limits.

2.2.2. The employer should notify the competent authority of those working operations and workplaces where asbestos or materials containing asbestos are present according to the terms of any authorisation procedures.

2.2.3. (1) When buildings and installations are being designed and when any technical change occurs which may affect the content of asbestos dust in the air at the workplace, the employer should stipulate and take appropriate measures to prevent, as far as is reasonably practicable, the presence of asbestos dust in the working environment.

(2) Similarly, when purchasing equipment or plant (machines, materials, vehicles, etc.), the employer should stipulate that such equipment or plant should comply with occupational safety and health standards or should be designed and safeguarded in such a manner as not to contaminate the working environment with asbestos dust.

2.2.4. (1) The employer should investigate asbestos health hazards before any production or use so as to identify the preventive measures appropriate to the hazard; without such measures, asbestos should not be produced, used or handled.

(2) The employer should establish and implement a general control programme to reduce the workers' exposure to asbestos dust.

2.2.5. (1) The employer should provide the necessary equipment and services for monitoring the working environment.

(2) All such equipment should be maintained and calibrated properly.

2.2.6. The employer should ensure the surveillance necessary to enable workers to perform their tasks in the best possible conditions with respect to occupational safety and health; in particular, provision should be made for the regular inspection and maintenance of installations, machinery and equipment to prevent the contamination of the working environment with asbestos dust.

2.2.7. (1) The employer should ensure that all workers are suitably and periodically informed of the asbestos hazards associated with the tasks assigned to them and of the measures to be taken to prevent damage to their health.

(2) This information should also be transmitted to subcontractors and their workers.

(3) In particular, provisions may be needed for newly recruited workers, foreign workers who may encounter language difficulties and for all other workers who may have difficulties in understanding written instructions.

(4) The employer should ensure that all members of the managerial staff are steadily trying to improve prevention, that they are fully aware of their duties with regard to occupational hazards from asbestos dust exposure and, in particular, that they

are appropriately trained and are constantly updating their knowledge in this field so that they may thoroughly instruct the workers regarding the precautions to be taken in their jobs and in the event of unexpected circumstances giving rise to asbestos dust.

2.2.8. The employer should provide and maintain without cost to the workers such personal protective equipment and clothing as are necessary when airborne asbestos hazards cannot be otherwise prevented or controlled.

2.2.9. The employer should inform subcontractors of the appropriate regulations and safety precautions and should ensure, so far as is reasonably practicable, that persons present at the workplace who are not under his direct control follow such regulations and take the necessary safety precautions.

2.3. General duties of workers

2.3.1. Within the limits of their responsibilities, workers should do everything in their power to prevent the presence of airborne asbestos in the working environment.

2.3.2. (1) Workers should abide by any instructions given to them in connection with the prevention of airborne asbestos in the working environment.

(2) Workers should submit themselves to medical surveillance according to national practice.

(3) Workers should wear personal samplers when necessary to measure personal exposure to asbestos dust.

(4) Workers should wear the personal protective equipment and clothing provided when either other methods for the control of asbestos dust cannot be applied or it is necessary to wear personal protective equipment and clothing in addition to other methods of control.

2.3.3. Workers should draw to the attention of management any change of circumstance in the work process which might give rise to asbestos dust exposure.

2.4. General duties of manufacturers and vendors

2.4.1. Manufacturers and vendors of equipment used in processing asbestos or materials containing asbestos should ensure that machines and equipment are provided with devices to collect asbestos dust where it is produced and has settled.

2.4.2. Manufacturers and vendors of asbestos materials or products containing asbestos should provide purchasers with instructions concerning safety in their use and should draw their attention to the hazards which may occur when these instructions are not followed.

2.4.3. When supplying, leasing or selling machinery and other equipment to developing countries for the processing of asbestos, the occupational safety. and health standards should be at least equivalent to those to the country of origin and in accordance with national requirements.

2.5. Co-operation and consultation

2.5.1. There should be full co-operation at all levels between the competent authority, scientific research institutions, employers, workers and their representatives and occupational safety and health personnel.

2.5.2. The appropriate occupational safety and health personnel according to national practice should be consulted at the design stage of new buildings and installations and before the introduction of any substantial constructional or technical change.

2.5.3. Joint safety and health committees of employers and workers should give due attention to the prevention of health hazards due to asbestos.[1]

2.5.4. (1) There should be regular consultations at plant level between the employers' and workers' representatives.

(2) These consultations should include frank and full exchanges of information on, for example:

(a) the nature of the harmful asbestos fibres to which workers are exposed and the risks which such exposure entails;

(b) the results of monitoring the working environment;

(c) the preventive action to be taken;

(d) the results of any epidemiological studies carried out, even in other countries, in similar working conditions;

(e) the results of plant inspections; and

(f) asbestos waste disposal.

2.5.5. Safety and health committees should endeavour to ensure the application of the regulations on the prevention of airborne asbestos and should acquaint themselves regularly with the results of the monitoring of the working environment.

2.5.6. In accordance with national legislation or practice, employers' and/or workers' representatives should be permitted to accompany inspectors when they are checking the application of the regulations concerning the prevention of airborne asbestos in the working environment.

[1] See ILO: Occupational Safety and Health Convention, 1981 (No. 155), and Recommandation, 1981 (No. 164).

3. Exposure limits

3.1.1. The concentrations of airborne asbestos in the working environment should not exceed the exposure limits approved by the competent authority after consultation with recognised scientific bodies and with the most representative organisations of the employers and workers concerned.

3.1.2. The aim of such exposure limits should be to eliminate or to reduce, as far as is practicable, hazards to the health of workers exposed to airborne asbestos fibres.

3.1.3. In accordance with national legislation and practice, the exposure levels of airborne asbestos in the working environment should be established

(a) by legislation; or

(b) by collective agreement or by any other agreements drawn up between employers and workers; or

(c) by any other channel approved by the competent authority after consultation with the most representative employers' and workers' organisations.

3.1.4. The exposure limits should be periodically reviewed in the light of technological progress and advances in technical and medical knowledge concerning the health hazards associated with exposure to asbestos dust and particularly in the light of results of workplace monitoring.[1]

[1] The exposure limits for airborne asbestos in the working environment adopted in various countries are presented in Appendix A.

4. Monitoring in the workplace

4.1. General

4.1.1. Airborne concentrations of asbestos should be measured in all places of work where a risk of exposure to asbestos dust might occur.

4.1.2. (1) In order to identify the sources of asbestos dust emission and to determine the extent of asbestos dust exposure, static and personal monitoring should be carried out when asbestos or products containing asbestos are produced, handled or used in such a manner as to be liable to emit airborne dust.

(2) Bulk analysis of the materials should be performed if data on composition are not otherwise available.

4.1.3. Manufacturers of asbestos-containg products should make available results of detailed monitoring of representative exposures which could result from the main foreseeable uses (including misuse) of their products; such monitoring data should be available to the users and, if appropriate, could remove the need for them to conduct their own monitoring.

4.2. Static monitoring

4.2.1. In order to obtain indications of the spatial and temporal distribution of airborne asbestos throughout the general atmosphere of the working area, air samples should be taken:

(a) close to sources of emission in order to evaluate dust concentrations or the standard of engineering controls;

(b) at various places in the working area to ascertain dissemination of asbestos dust; and

(c) from working areas which represent typical exposure.

4.3. Personal monitoring

4.3.1. In order to evaluate the risk to the individual worker, air samples should be collected in the worker's breathing zone by means of personal samplers. Sampling should be carried out while the work process is in operation.

4.3.2. Where concentrations of airborne asbestos may vary from one work operation or phase to another, dust sampling should be done in such a manner that the average, and in any case the maximum, level of exposure of each individual worker can be determined.

4.3.3. (1) Personal sampling should be carried out at various times throughout the work shift and, where necessary, should be supplemented by short-term sampling during periods of peak emission.

(2) Exposure profiles of particular jobs or occupational categories should be constructed from the air-sampling data of different operations and from the workers' exposure time in these jobs.

4.4. Measuring methods

4.4.1. Concentrations of airborne asbestos should be measured according to standardised procedures in fibres per millilitre of air or in milligrams per cubic metre (mg/m³).

4.4.2. Laboratory modifications of the method should be validated by reference to quality control programmes.

4.4.3. In so far as is possible, the methods and instruments used for monitoring the working environment should be the same as those used for establishing or revising the exposure limits. If different methods are used, the results should be appropriately amended.

4.4.4. The measurement of airborne asbestos fibre concentrations in fibres per millilitre in the workplace air should be made by the membrane filter method using phase contrast light microscopy as described in Appendix B. All respirable fibres over 5 µm in length should be counted by this method.

4.4.5. The measurement of airborne dust concentrations (mg/m³) in the workplace air should be made by gravimetric method as described in Appendix C. The mass of the collected total dust should be determined and, by analysis, the type of asbestos and its mass percentage.

4.4.6. In general, direct-reading instruments such as particle counters and dust photometers should be used only for static monitoring and engineering applications. For reliable evaluation of working conditions, these instruments should be carefully calibrated with the workplace dust in question and the results should be related regularly to the membrane filter method.

4.5. Monitoring strategy

4.5.1. (1) A systematic measuring programme should be drawn up to evaluate whether exposure of workers to asbestos dust is being kept under control. Preferably, personal monitoring should be included in the programme m order to measure fibre concentration. In addition, static sampling is necessary where relevant.

(2) The aims of this programme should be:

(a) to ensure that the health of the workers is efficiently protected;

(b) to ensure that the preventive actions which have been taken are still effective;

(c) to ensure that the levels, as measured previously, remain unchanged or fall;

(d) to ensure that any changes made in manufacturing processes or work practices will not lead to an excessive exposure to asbestos dust; and

(e) to promote the implementation of more efficient preventive measures.

4.5.2. (1) When an initial occupational safety and health survey is to be carried out, a preliminary visit to the workplace should be made in order to determine the possible sources of exposure to airborne asbestos, to decide whether a major survey or a continuous monitoring programme is needed and, in particular, to establish the place and time at which samples are to be taken.

(2) The representatives of the workers assigned to the work in question, the supervisor and occupational safety and health personnel should be consulted.

4.5.3. (1) The monitoring of airborne asbestos concentrations in the working environment should be performed only by skilled personnel with adequate equipment and technical training.

(2) It should be the duty of the employer to arrange for regular inspection, maintenance and calibration of the measuring equipment.

4.5.4. The service responsible for monitoring the working environment should be kept informed about any change in plant, equipment, process, materials or work practices likely to bring about any substantial alteration in levels of exposure to asbestos dust.

4.6. Record keeping

4.6.1. Records should be kept by the employer on aspects of asbestos dust exposure. Such records should be clearly marked by date, work area and plant location.

4.6.2. (1) All relevant data from measurements of airborne asbestos in the working environment should be systematically recorded.

(2) The workers, or their representatives, should have access to these records.

(3) Besides the numerical results of measurements, the monitoring data should include, for example:

(a) the composition and trade names of materials containing asbestos;

(b) the location, nature, dimensions and other distinctive features of the workplace where static measurements were made; the exact location at which personal monitoring measurements were made and the names and job titles of the workers involved;

(c) the source or sources of airborne asbestos emission, their location and the type of work and operations being performed during sampling;

(d) relevant information on the functioning of the process, engineering controls, ventilation and weather conditions with respect to emission of asbestos dust;

(e) sampling instrument used, its accessories and the method of analysis;

(f) the date and exact time of sampling;

(g) the duration of the workers' exposure, the use or non-use of respiratory protection and other comments relating to the exposure evaluation;

(h) the names of the persons responsible for the sampling and for the analytical determinations.

4.6.3. Individual results of concentration measurements should be recorded and in appropriate cases the time-weighted averages (TWAs) of exposure concentration should be calculated and presented.

4.6.4. Access to records of asbestos dust exposure should be available to exposed workers and, except where such access infringes on trade secrets, to trade unions and government agencies.

4.6.5. Records regarding all aspects of asbestos dust exposure should be maintained, as far as is practicable, for a 30-year period following termination of employment. Records dealing with asbestos sources, product composition and asbestos content, environmental concentrations in the workplace and medical information may be reduced to microfilm for storage. All chest radiographs should be retained as originally collected.

4.7. Interpretation of data

4.7.1. Any purely numerical exposure estimates should be interpreted only when considered in relation to duration of exposure and other circumstances of work.

4.8. Application of monitoring data

4.8.1. When asbestos dust exposure limits are exceeded, the necessary remedial action should be taken as rapidly as possible in consultation with the workers' representatives.

4.8.2. The relevant monitoring procedures should continue to be applied even if previous results did not exceed the exposure limits.

4.8.3. In the event that monitoring discloses levels which are in excess of the exposure limits, employers should inform the workers of the excess and of the action to be taken.

4.8.4. Warning signs and instructions for appropriate means of protection should be provided at each location where concentrations of airborne asbestos fibres may exceed the exposure limits.

5. General preventive methods

5.1. Alternative materials

5.1.1. Whenever possible, harmful substances should be replaced by substances which offer the same technical advantages but which are harmless or less harmful.

5.1.2. When safety considerations call for alternative materials, account should be taken of all health hazards associated with the manufacture, handling, use, transportation, storage and disposal of the alternatives proposed.

5.1.3. When alternative materials for asbestos are being chosen, primary consideration should be given to their associated health hazards; and regard should also be paid to the technological and economic circumstances which determine the need for the alternatives.

5.2. Methods of control

5.2.1. All appropriate and practicable measures of engineering, work practice and administrative control should be taken to eliminate or to reduce the exposure of workers to asbestos dust in the working environment to the lowest possible level.

5.2.2. Engineering controls should include mechanical handling, ventilation and redesign of the process to eliminate, contain or collect asbestos dust emissions by such means as:

(a) process separation, automation or enclosure;

(b) bonding asbestos fibres with other materials to prevent dust generation;

(c) general ventilation of the working areas with clean air;

(d) local ventilation of processes, operations, equipment and tools for the prevention of dust dissemination;

(e) use of wet methods where appropriate;

(f) separate workplaces for certain processes.

5.2.3. Appropriate work practices should be followed where materials or processes are used which may give rise to asbestos dust in the working environment. Such work practices should include:

(a) requirements to use and maintain process machinery, installations, equipment, tools, local exhausts and ventilation systems in accordance with instructions;

(b) damping where appropriate of asbestos products and materials at workplaces before processing, handling, using, machining, cleaning, stripping or removing;

(c) regular cleaning of machinery and work areas by appropriate methods;

(d) proper use of personal protective equipment.

5.3. Control programme

5.3.1. Each employer, after consultation with workers' representatives, should establish and implement a general control programme to reduce the exposure of workers to asbestos dust.

5.3.2. Where appropriate, the programme should take due account of the specific features based on the evaluation of each workplace and should include in written form at least the following:

(a) a description of each operation in which airborne asbestos is emitted, the processes and machinery used, the materials handled, the control devices, the number of exposed workers, the job responsibilities of each worker, the operating procedures and the maintenance practices;

(b) a description of the specific means for controlling exposure to asbestos dust;

(c) engineering plans, safety data sheets, study reports or other relevant technical information;

(d) air monitoring data on the efficiency of control measures;

(e) a description of the work practices or administrative controls needed; and

(f) a detailed schedule for implementation of the control programme.

5.3.3. (1) Upon request, the written programme should be made available at the workplace to the labour inspector and the workers' representatives.

(2) The written programme should be regularly revised and updated to reflect the current status of technical and other developments.

(3) The employer should define and assign technical responsibilities in this connection.

5.3.4. Where appropriate in large enterprises, specified departments, branches or persons should have special duties in the implementation of the control programme, particularly in connection with

(a) the design of new buildings, equipment, processes and materials;

(b) the purchase of materials, products, machinery or equipment;

(c) the contracts for the supply and maintenance of ventilation systems and other engineering controls;

(d) the information and training given to the workers; and

(e) the purchase and maintenance of personal protective equipment and the provision of instructions in regard to its use.

5.4. Design and installation

5.4.1. The materials, processes and equipment should be so designed that the exposure of workers to asbestos dust is eliminated or reduced to the lowest practicable level.

5.4.2. Manufacturers of machinery, equipment and materials should provide information concerning the nature and level of asbestos dust emissions as well as the means of control.

5.4.3. Workrooms should be designed, built and maintained in such a manner as to

(a) separate the hazardous operations from the remainder of the premises;

(b) reduce as far as possible surfaces on which asbestos dust and waste may accumulate;

(c) facilitate the cleaning of floors, walls, ceilings and machinery; and

(d) facilitate the collection of asbestos dust which may escape in the event of an incident.

5.4.4. (1) Direct handling of asbestos or materials containing asbestos should be avoided by the use, where practicable, of automatic processes or by remote control systems.

(2) Where practicable, total process enclosures which prevent the emission of asbestos dust should be designed and constructed.

(3) These enclosures should be supplemented with internal exhaust ventilation to create negative pressure inside the enclosure.

5.4.5. Where practicable, building materials such as boards, sheets and plates should be so designed, prefabricated and packed in the factory that no further cutting, drilling or other machining is needed by the user.

5.4.6. Measurements of asbestos dust emission and of the exposure of workers to asbestos dust should be made as soon as the machinery and equipment have been installed in order to establish that the standard required by the competent authority in those respects has been achieved.

5.5. Local exhaust ventilation

5.5.1. (1) Where total enclosure of the dust-producing process is not practicable, local exhaust ventilation equipment should be provided and maintained.

(2) For efficient operation, the exhaust ventilation should be located as close as possible to the source of dust emission by the use of captor hoods, booths or enclosures.

(3) The local exhaust systems should be designed to collect and remove all dust-laden air.

(4) Openings in the enclosures should be as small as possible while still allowing access to the necessary work operation.

(5) In the case of captor hoods and booths, the ventilation equipment should be so constructed that air turbulence and eddies created by the work process or by the workers do not prevent the effective removal of dust.

5.5.2. Local exhaust ventilation (or other effective methods) should be used for such factory operations as, by way of example:

(a) feeding, conveying, crushing, milling, screening, mixing or bagging of asbestos materials;

(b) carding, spinning, weaving, sewing and cutting of asbestos textiles; and

(c) cutting, punching, drilling, sawing, grinding or machining of asbestos cement and friction materials.

5.5.3. (1) The design of local exhaust ventilation systems for any particular process requires special expertise and should therefore be referred to a suitably qualified person.

(2) The nature and quantity of dust emission should be taken into consideration when:

(a) enclosures are designed;

(b) equipment for air movement, ducting and dust filtration is selected;

(c) air flow rates and capture velocities are calculated; and

(d) monitoring instruments are chosen.

5.5.4. (1) The supplier of the exhaust ventilation system should test the installation in the presence of the workers' representative and provide the purchaser and the workers' representative with a copy of the test figures obtained.

(2) Checks on the performance of the exhaust system should be made periodically with smoke tests or air flow measurements or by comparing the static pressure readings in the system with the readings recorded at the same points upon commissioning.

(3) A certificate of effectiveness should be issued and made available for inspection.

(4) Asbestos dust collected by the filtration equipment should be removed regularly under conditions which have strict regard to occupational safety and health.

5.5.5. All types of dust control equipment should be inspected by a technically competent person under conditions specified by the competent authority.

5.5.6. It should also be the duty of the employer to ensure that such equipment is at all times operated, maintained and serviced in the prescribed manner.

5.6. General ventilation

5.6.1. Where appropriate in conjunction with local exhaust ventilation the entire work area should be supplied with clean air to replace the air as it is exhausted and to reduce airborne asbestos concentrations.

5.6.2. The flow rates of general ventilation should be sufficient to change the air of the workplace according to safety and health requirements.

5.6.3. The exhausted air should be efficiently filtered and should not be recirculated back to the working environment, except when the following provisions are fulfilled:

(a) the airborne asbestos concentration is substantially less than the exposure level and does not add to the exposure;

(b) the filtration and ventilation system is regularly checked and maintained;

(c) the air quality is monitored by adequate instruments;

(d) the process has been approved by the competent authority according to national practice.

6. Personal protection

6.1. Respiratory equipment

Provision and use

6.1.1. The use of respiratory equipment should be regarded only as a temporary or emergency measure and not as an alternative to technical control.

6.1.2. A sufficient and suitable supply of equipment should be available in the workplace.

6.1.3. Such equipment should be provided for all workers employed in any situation where levels of airborne asbestos fibre exceed or are liable to exceed the exposure limits.

6.1.4. Workers should be informed when concentrations of airborne asbestos fibre reach such levels.

6.1.5. When workers have been so informed, they should use the equipment provided.

6.1.6. Workers required to wear protective equipment should be fully instructed in its use.

6.1.7. Employers should provide supervision to ensure that the equipment is properly used.

6.1.8. All respiratory equipment should be provided and maintained by the employer without cost to the worker.

Selection

6.1.9. Only those types of respiratory equipment which have been tested and approved by the competent authorities should be worn.

6.1.10. (1) The competent authorities should provide guide-lines for classifying the range of concentrations for which each type of respiratory equipment is recommended. For example:

(a) air-purifying respirators of the negative pressure (half face mask) type;

(b) positive pressure respiratory equipment;

(c) direct air-line breathing apparatus.

(2) The equipment should be selected, in consultation with workers' representatives, on the basis of the maximum concentration of airborne asbestos likely to be encountered.

6.1.11. Where alternative respirators providing the same standard of protection are available, employers should offer workers a choice to ensure maximum comfort in use.

6.1.12. Where an adequate facial seal cannot be ensured (e.g. as in the case of bearded workers), a positive-pressure respirator should be worn, but full protection will not be achieved.

Training

6.1.13. All workers required to use respiratory equipment should be instructed in its use.

6.1.14. Instruction should be given on the following points:

(a) the reasons for the use of the equipment, and the importance of using it conscientiously;

(b) the circumstances in which it should be used and how these circumstances should be recognised;

(c) the manner in which the equipment operates;

(d) the correct method of use and of checking the fit;

(e) the method of checking for correct operation;

(f) the need for regular servicing.

Cleaning, maintenance and storage

6.1.15. Respirators should be issued for the exclusive use of the workers to whom they are supplied.

6.1.16. Respirators should be regularly cleaned and serviced by appropriately trained operators before reissue.

6.1.17. A suitable container, such as a metal box or plastic bag, should be provided for the storage of individual respirators when not in use.

6.1.18. Cleaning should be undertaken weekly or more often when the respirator is in regular use. Pre-filters on filtered air respirators should be changed and filters should be checked on each occasion.

6.1.19. A record should be kept for each respirator or air-line apparatus showing the worker to whom it is issued and the dates on which it is cleaned and serviced.

6.1.20. A record of training and instruction in the use of respiratory protective equipment should be made for each worker concerned.

6.1.21. Where respiratory protection is used, this fact should be recorded on the monitoring records of dust exposure for the particular job.

6.2. Protective clothing

Provision and use

6.2.1. Where personal clothing may become contaminated with asbestos dust, the employer, in accordance with national regulations and in consultation with workers' representatives, should provide appropriate works clothing.

6.2.2. Where airborne asbestos levels necessitate the use of respirators, special protective clothing should also be provided and worn.

6.2.3. Such special protective clothing should cover completely all works clothing so that no asbestos dust is retained when the protective clothing is removed. Suitable head covering should also be provided.

6.2.4. When re-usable protective or works clothing is provided, separate locker rooms should be available so that contaminated clothing can be stored separately from personal clothing.

6.2.5. (1) Vacuum cleaners for preliminary de-dusting of protective or works clothing should be provided at the entrance to the locker room in which such clothing is removed and stored.

(2) Where a respirator has been worn, it should be removed only after de-dusting.

6.2.6. (1) Shower or washroom facilities should be provided and should be sited between the contaminated and clean locker rooms.

(2) Such facilities should be cleaned regularly.

6.2.7. Personal clothing should be removed, stored or put on only in the clean locker room.

6.2.8. Regular cleaning and inspection of the contaminated locker room should be undertaken to ensure that no accumulation of asbestos dust occurs.

6.2.9. Special protective clothing should not be worn outside the workplace or contaminated locker room.

Laundering

6.2.10. Provision should be made by the employer for the laundering of protective clothing and works clothing by the undertaking.

6.2.11. Such clothing should be laundered under controlled conditions to prevent the emission of airborne asbestos during handling, transport and laundering.

6.2.12. Where contaminated clothing is sent for laundering outside the factory, it should be packed in dust-proof containers, such as plastic bags, and such containers should be secured at the neck.

6.2.13. Such containers should be clearly and suitably identified as containing asbestos-contaminated clothing.

6.2.14. When a contract laundry is employed, care should be taken that the contractor fully understands the precautions necessary for handling asbestos-contaminated clothing.

6.2.15. The laundering of protective or works clothing in workers' homes should be strictly prohibited.

7. Cleaning of premises and plant

7.1. General

7.1.1. Every employer should ensure, as far as is practicable, that the work premises are maintained in a clean state and are free of asbestos waste.

7.1.2. All machinery, plant and equipment should be kept free from dust, together with all external surfaces of exhaust ventilation equipment and all internal surfaces of the building.

7.1.3. (1) Cleaning should be carried out as far as is practicable by vacuum-cleaning equipment or by some other means in such a way that asbestos dust neither escapes nor is discharged into the air of the workplace.

(2) Where required, suitable extension hoses should be fitted to the vacuum-cleaning equipment.

7.1.4. (1) Where cleaning by a dustless method is impracticable, workers undertaking the cleaning should wear appropriate protective clothing and respiratory equipment.

(2) Such cleaning should be carried out as far as is practicable when no other workers are present. If it is necessary for other workers to be present, they should also wear protective equipment.

7.2. Floors

7.2.1. Floors should be regularly cleared of accumulated dust and waste material.

7.2.2. Floor cleaning should be carried out by vacuum equipment or by some other means that causes no secondary dust generation. Where mechanical sweepers are used, they should if necessary be modified to ensure that the cleaning operation does not generate airborne dust.

7.2.3. (1) Floor surfaces should be kept in good repair and cracked or broken surfaces should be repaired.

(2) Concrete surfaces should, where practicable, be treated to produce a surface which can be satisfactorily cleaned of dust.

7.3. Walls

7.3.1. New buildings should be constructed in such a way that their walls have smooth surfaces. Walls of existing buildings should be rendered smooth as far as is practicable.

7.3.2. Walls should be cleaned annually or more frequently should this be necessitated by the nature of the building or the process.

7.3.3. (1) Walls should be cleaned either by vacuum cleaner or by washing.

(2) If washing is undertaken, the asbestos-containing waste water should be disposed of suitably.

(3) Care should be taken that waste water containing asbestos fibres does not dry out on the floor below.

7.4. Machinery and equipment

7.4.1. Where machinery is fitted with exhaust equipment, the exhaust ventilation should be in operation while cleaning is in progress.

7.4.2. Cleaning should be carried out, wherever practicable, by vacuum cleaner.

7.4.3. Parts of equipment inaccessible to the vacuum cleaner should be cleaned out with oiled brushes, where practicable, and vacuum equipment should be used to take up the material so removed.

7.4.4. Machinery and equipment should, where practicable, be cleaned at the end of each shift. The interval between cleaning should never exceed one week.

7.5. Overhead structures

7.5.1. The overhead structures of new buildings should be constructed with smooth surfaces and high ledges should be avoided.

7.5.2. Where practicable, dust should be removed by vacuum cleaner, with extension hoses being used as required, or by some other means that causes no secondary dust generation.

7.5.3. Where dustless methods of cleaning are not practicable, protective clothing and respiratory equipment should be worn by all present in the building.

7.5.4. When overhead cleaning is taking place, equipment should be covered by plastic sheeting.

7.6. Vacuum-cleaning equipment

7.6.1. Only vacuum equipment with appropriate filters should be used for collecting asbestos dust and waste and such equipment should be so designed that the dust cannot escape from the equipment back into the workplace.

7.6.2. Since portable equipment necessarily involves locating the collecting unit within the workplace, a suitable high-efficiency filter should be used.

7.6.3. The collection bags within the vacuum-cleaning units should be disposable.

7.6.4. (1) If a collection bag within a portable cleaner bursts during use, the unit should be removed from the workplace, if possible into the open.

(2) The burst bag and its contents should be removed and placed inside an impermeable bag by an operator wearing protective clothing and respiratory equipment.

(3) The interior of the cleaner should then be cleared of dust, where practicable with the use of another vacuum cleaner.

7.6.5. The collected material should be disposed of in accordance with the provisions of this code of practice.

8. Packaging, transport and storage

8.1. Initial packing of fibre

8.1.1. Asbestos fibre should always be packed in impermeable bags.

8.1.2. Where water-soluble bags are used, they should not be transferred from one container to another but should be transported in closed containers.

8.1.3. Plastic material used for bags should incorporate an ultra-violet inhibitor to protect the bags from sunlight and thus prevent deterioration during trans-shipment.

8.1.4. Bags should be closed by either heat-sealing or stitching. If stitched, the stitching should be at not less than two stitches per centimetre.

8.1.5. All bags should be printed with an approved label identifying the contents as asbestos and carrying a health warning.

8.2. Packaging for transport

8.2.1. Packaging for transport should eliminate the handling of individual bags as far as is practicable and should minimise damage to bags which could result in spillage.

8.2.2. Before being transported, bags should be assembled as unit loads.

8.2.3. Unit loads should be stabilised and protected from damage by the use of plastic covers. These should be applied as shrink or stretch wrapping, or should be strapped into position.

8.2.4. The top of the unit as well as the four sides should be covered by plastic which should incorporate an ultra-violet inhibitor.

8.2.5. Where small tonnages are being carried in mixed cargo vessels, the bags should be stacked on pallets where practicable in an interlocked fashion.

8.2.6. The bags should be securely attached to the pallet by the shrink wrapping, or other technique, used to form the unit load.

8.2.7. The size of the pallet should be such that the bags overhang on all sides to prevent adjacent bags from being damaged during the course of loading.

8.2.8. (1) Where very large shipments are to be stowed, pallets should not be used because of the risk of damage to bags during loading or unloading or from cargo movement during the voyage.

(2) An alternative is to support the unit load on a base of plastic sheeting with disposable webbing straps which are then secured over the top of the load for use in lifting. Once removed from the ship, these unit loads should be placed on pallets for further handling.

8.3. Transport

8.3.1. Where practicable, unit loads other than in very large shipments should be stacked on pallets and carried in closed road vehicles or railway wagons for overland shipment and in closed containers for overseas shipment.

8.3.2. Where practicable, loading and unloading should be carried out by forklift truck or by some other equally effective method, to prevent the handling of single bags and therefore the risk of damaging bags.

8.3.3. Hooks and other sharp equipment should not be used on bags or unit loads.

8.3.4. Loads carried in containers should be so stacked as to reduce the risk of damage to bags from the wooden pallets.

8.3.5. All vehicles used for the transport of asbestos should be properly cleaned after they have been unloaded.

8.3.6. A vacuum cleaner should be used for cleaning. Where this is not practicable, surfaces should be thoroughly wetted before being swept.

8.3.7. Where the wrapping of a bag is damaged and spillage of asbestos is likely, suitable protective clothing and respiratory equipment should be provided and worn.

8.4. Damaged loads and bags

8.4.1. Suitable adhesive tape should be available for the repair of damaged loads.

8.4.2. Damaged loads should be repaired immediately.

8.4.3. Damaged bags which are not part of unit loads should be repaired with tape and, if need be, placed in a second impermeable bag which should be sealed and clearly identified before being forwarded.

8.5. Warehousing

8.5.1. Before final storage, all units should be carefully inspected for cleanliness and for damage.

8.5.2. All bags should be stacked on pallets.

8.5.3. All damaged bags should be repaired immediately.

8.5.4. (1) All units having loose asbestos or other debris on them should be cleaned as soon as possible by vacuum equipment or by some other means that causes no secondary dust generation.

(2) The worker should be provided with appropriate protective clothing and respiratory equipment.

8.5.5. Final storage should be in a warehouse. If outside storage cannot be avoided, units should be protected by tarpaulins, black plastic sheeting or other suitable covering.

9. The disposal of asbestos waste

9.1. Waste avoidance

9.1.1. The creation of asbestos waste should be minimised by the adoption of the most effective production techniques.

9.2. Waste collection

Dust

9.2.1. The measures outlined below should be carried out or other equally effective means should be used.

9.2.2. Bagging of outlets from dust collection hoppers should be designed to make bag-changing easy and to minimise dust leakage.

9.2.3. Bag-changing should be carried out only by persons who have been properly trained for this operation.

9.2.4. Bags of translucent material such as polyethylene should be used wherever practicable so that the dust level can be seen and overfilling can be avoided.

9.2.5. Water-soluble paper sacks should not be used where any risk exists of deterioration by wetting before final disposal.

9.2.6. (1) When filled, the bags should be sealed to prevent the escape of dust during subsequent handling.

(2) Plastic bags should be twisted tightly and folded over and the neck should be secured in the folded position by a wire tie, adhesive tape or some other effective method.

(3) Paper sacks should be folded over twice and stapled along the folded edge.

9.2.7. Suitable protective clothing and respirators should be worn when bags on a dust collector are changed.

Loose fibre, swarf, floor sweepings

9.2.8. Loose fibre handled by fixed extraction systems should, wherever practicable, be returned to the production process.

9.2.9. Swarf accumulating around and under machinery should be cleaned by suitable vacuum cleaners.

9.2.10. Loose materials collected by other means should be placed in impermeable bags and the bags should be sealed.

Waste materials from fixing or removing insulation

9.2.11. Where fixing or stripping operations are being carried out, floor surfaces should be covered with plastic sheeting which can be folded to form sealed containers.

9.2.12. Wherever practicable, provision should be made in the design of machines for the automatic removal of offcuts and for their collection in disposable receptacles which can be sealed and removed.

9.2.13. Where automatic removal and collection is not practicable, suitable receptacles which can be closed should be provided.

9.2.14. The supply of receptacles should be sufficient to prevent receptacles from being overfilled.

9.2.15. Receptacles should be sited to minimise asbestos dust emissions in use. Material should be placed in the receptacles in a controlled manner.

9.2.16. If asbestos dust emissions from the receptacle occur during use, a dust-extraction hood should be provided to prevent the escape of asbestos dust into the workplace.

9.2.17. Where offcuts and rejects need to be broken down before disposal, this should be done mechanically under suitable exhaust ventilation, wherever practicable.

9.2.18. (1) If breakage by mechanical means is not practicable, the work should be performed in a separate area so that asbestos dust cannot escape to other work areas.

(2) If appropriate, the material should be wetted in order to minimise asbestos dust emission and workers engaged in this task should wear suitable protective clothing and respirators.

Offcuts, broken pieces and rejects of high-density materials

9.2.19. Hard waste, such as bonded asbestos, asbestos cement, jointings and bitumastic rubber residues, should be stored in such a manner as to ensure that it will not be abraded or crushed while awaiting disposal.

Sacks or bags which have contained asbestos

9.2.20. (1) Sacks or bags which have contained loose asbestos fibres should be disposed of by grinding, melting or bagging.

(2) Grinding or melting should be carried out under closed conditions adjacent to the bag-opening station.

9.2.21. Where bagging is employed, the used sacks or bags should be collected under strict dust control conditions in impermeable containers, such as unused plastic bags, and such containers should be closed and sealed.

9.2.22. Bags which have contained asbestos fibre should not be reused for this purpose, but such bags can be recycled.

Wet waste: asbestos sludge or slurry

9.2.23. Asbestos waste in the form of sludge or slurry should preferably be recycled or loaded into specially designed carriers or other containers in such a way as to ensure that no spillage which may subsequently dry out occurs.

9.3. Identification and isolation of waste

9.3.1. All asbestos waste awaiting disposal should be adequately identified by markings on the bag or receptacle.

9.3.2. Asbestos waste awaiting disposal should be stored in such a way that it is not exposed to damage likely to cause spillage.

9.3.3. Asbestos waste should not be mixed with other waste for which there are no special disposal requirements. Where practicable, a special area should be set aside for its storage.

9.4. Transport of waste

9.4.1. Asbestos waste, whether loose or in sealed containers, should be transported to the disposal point in such a way that no asbestos dust is emitted into the air during transport.

9.4.2. In the event of accidental spillage (for example, as the result of a road accident) during transport to the disposal site, action appropriate to the extent of the spillage should be taken immediately.

9.4.3. Where the amount of spilled material is small, the waste should be collected into its original receptacle and reloaded without delay.

9.4.4. If the spillage is substantial and the material dusty, it should be wetted if practicable and covered immediately. The material should then be removed and during this process appropriate safety precautions, which may include the use of protective clothing and respiratory equipment, should be taken.

9.4.5. Written instructions on the action to be taken in the event of accidental spillage should be issued to drivers of vehicles carrying asbestos waste.

9.5. Disposal of waste

9.5.1. Before a site is used for the disposal of asbestos waste, care should be taken to establish that the site is both suitable and acceptable for the purpose.

9.5.2. The disposal site chosen should have vehicular access to the working face, or to a hole or trench dug to receive the asbestos waste.

9.5.3. The waste should wherever practicable be deposited at the foot of the working face of the landfill site or at the bottom of an excavation dug for it.

9.5.4. Where the waste has to be deposited from above the working face, or into an excavation, care should be taken to prevent spillage from bags.

9.5.5. When deposited, all waste other than high-density waste should be covered to an acceptable depth (for example 20-25 cm (8-10 in)) as soon as possible. No asbestos waste should be left uncovered at the end of a working day.

9.5.6. Final covering of asbestos waste should be to a minimum depth of 2 metres (6 ft 6 in).

9.5.7. If wet waste is deposited, it should be covered in the same way as dry waste to prevent the escape of asbestos dust on drying out.

9.5.8. Wet pits should not normally be used for the disposal of any asbestos waste other than high-density material.

9.5.9. Where high-density waste is deposited on a dry site, care should be taken to ensure that it is not ground to dust by the passage of vehicles over it.

9.6. Personal protection and hygiene

9.6.1. Workers occupied in the collection, transport or disposal of asbestos waste who may be at risk of exposure to airborne asbestos should be provided with suitable protective clothing and respiratory equipment.

9.6.2. Where vehicles and reusable receptacles and covers have been in contact with asbestos waste, they should be cleaned after use by means of a vacuum cleaner or by an alternative dustless method.

9.7. Supervision

9.7.1. (1) Where an undertaking disposes of its own asbestos waste, written instructions should be issued to the workers concerned.

(2) Periodic supervision should be undertaken to ensure that the necessary safety precautions are being followed.

9.7.2. If a waste disposal contractor is employed, the relevant sections of the code should be incorporated in the contract.

9.7.3. The contract should state that the contractor is responsible for ensuring that safety measures are observed at the disposal site.

9.7.4. Periodic checks should also be made by the undertaking to ensure that the contractor is observing the code.

9.7.5. Besides what has already been stated, appropriate measures should be taken to prevent pollution of the soil, subsoil, air and water.

10. Supervision of the health of workers

10.1. General

10.1.1. Workers whose jobs involve exposure to asbestos dust should be provided with health supervision.[1]

10.1.2. This supervision is designed for the individual and collective benefit of workers.

10.1.3. Workers submitting themselves to supervision of their health should have the following rights:

(a) confidentiality of personal and medical information;

(b) full and detailed explanations of the purposes and results of the supervision;

(c) the right to refuse invasive medical procedures which infringe the integrity of their bodies.

10.1.4. A medical examination of the worker potentially exposed to asbestos dust should take place upon recruitment or prior to assignment to a place of work involving exposure to asbestos dust.

10.1.5. Supervision of health should be provided at no expense to the exposed worker, and medical examinations should, so far as is practicable, be conducted during working hours.

10.1.6. Results of medical examinations should not be used to discriminate unfairly against the worker or prospective employee.

10.1.7. Health supervision should also include:

(a) advice to and care of individual workers;

(b) health education;

(c) identification of workers requiring workers' compensation;

(d) statistics of occupational disease;

(e) research.

10.2. Organisation

10.2.1. Workers' health supervision should include:

(a) pre-assignment medical examinations;

(b) periodic medical examinations;

(c) medical examination on, and where practicable following, cessation of employment.

10.2.2. The objectives of the pre-assignment medical examination should be:

(a) to determine any condition which would be a contraindication to occupational exposure to asbestos dust;

[1] Recommendations concerning medical examinations are given in Appendix D.

(b) to establish baseline records for the future supervision of the health of workers;

(c) to educate and advise workers about the risks associated with exposure to asbestos dust.

10.2.3. The objectives of the periodic medical examination should be:

(a) to detect the earliest signs of asbestos-related disease;

(b) to detect any significant change in health status relative to the baseline examination;

(c) to continue to educate and advise workers about health risks and to ensure that appropriate preventive measures are being taken to minimise risk.

10.2.4. (1) Workers should be informed of the results of their medical examination. They should be informed if, in the occupational physician's opinion, they are suffering from an asbestos-related disease.

(2) Copies of the worker's medical record should be made available to the worker or, upon the request of the worker, to his physician.

10.2.5. (1) The medical records of workers should be maintained by the appropriate physician.

(2) It is recognised that governmental agencies which have authority and responsibility for occupational health research, and which will maintain the confidentiality of the medical record, may be given access to such records for specific research investigations.

11. Information, labelling, education and training

11.1. General

11.1.1. Because of the importance as a risk factor of cigarette smoking interacting with asbestos, particularly in relation to bronchogenic carcinoma, specific information regarding the importance of cigarette smoking as a risk factor m this disease and in causing other health effects should be provided to all groups concerned with occupational exposure to asbestos dust.

11.2. Labelling of products and of risk areas

11.2.1. All asbestos-containing products should have an internationally recognised warning symbol designating the product as asbestos-containing and warning the user that inhalation of asbestos dust may cause serious damage to health.

11.2.2. Where practicable, asbestos-containing products should be accompanied by a safety data sheet or other approved form, containing such information as:

(a) the product designation on both front and back of the sheet or form to facilitate filing and retrieval;

(b) the name and address of the manufacturer or supplier of the product;

(c) the chemical or widely recognised common name of all asbestos ingredients;

(d) the approximate percentage by weight or volume (indicate basis) which asbestos bears to the whole mixture;

(e) health hazard data including dangerous properties of asbestos;

(f) detailed procedures for the cleaning up and safe disposal of leaked or spilled asbestos, including procedures for the proper labelling and disposal of containers retaining residues or contaminated materials;

(g) requirements for personal protective equipment, such as respirators and protective clothing;

(h) any other general precautionary information on handling the product.

11.2.3. All workplaces where asbestos dust may cause a hazard should be clearly indicated as an asbestos dust exposure area through the use of a well-displayed sign which identifies the hazard and the associated health effects.

11.2.4. The information on warning labels and signs should be written in the vernacular language understood by the workers.

11.3. Education and training

11.3.1. (1) All workers should, on employment and periodically, be provided with education and training in regard to sources of asbestos dust exposure, potential health effects, risks associated with asbestos dust exposure and smoking, and methods of prevention.

(2) This education and training should be provided by the employer and written, oral, visual and worker participation approaches should be used in order to ensure adequate awareness of health risks, methods of prevention and proper work practices.

11.3.2. All categories of personnel involved in the prevention of the asbestos-related diseases – such as managers, technicians, trade union representatives, labour inspectors, administrators, safety and health personnel, etc. – should be given appropriate training.

11.3.3. Specialised training in sampling, in analytical methods and in engineering aspects of asbestos dust exposure should be provided for occupational hygienists and for other occupational safety and health workers.

11.3.4. Occupational physicians and other occupational health personnel should have specialised training in the health effects associated with asbestos dust exposure, chest radiography, the technical aspects of carrying out and interpreting pulmonary function tests and the principles of screening.

B. Control of asbestos exposure in specific activities

The list of acceptable measures, as detailed below, is not necessarily exhaustive. Only fully acceptable measures may be taken.

12. Mining and milling

12.1. Opencast mining

12.1.1. Dust generated by drilling operations should be controlled by extraction equipment mounted on the drills.

12.1.2. Dust emissions from blasting should be minimised by the use, wherever practicable, of multiple small blasts rather than one large blast.

12.1.3. Roadways should be regularly wetted in order to reduce to a minimum the creation of asbestos dust.

12.2. Underground mining

12.2.1. Mining should be carried out only when an adequate water supply is available.

12.2.2. Underground workplaces should be kept wet continuously during work shifts.

12.2.3. The floor of every main travelling road underground should be kept wet.

12.2.4. Hanging and foot walls should be regularly washed down to prevent the accumulation of dust.

12.2.5. Ore discharged into bins or ore passes and at conveyor transfer points should be wetted.

12.2.6. After blasting, workings should be entered only after time has been allowed for dust, smoke and fumes to be cleared by ventilation.

12.2.7. The rock walls and broken ore should be properly wetted before the area is entered.

12.2.8. All underground dead ends should be effectively ventilated.

12.3. Crushing and screening

12.3.1. Control of dust during ore crushing and screening should be by exhaust ventilation to a cyclone and baghouse.

12.3.2. Where new plant is installed, the higher efficiency of bag extraction is to be preferred.

12.3.3. Owing to their higher potential for dust generation, vibrating screens should be in leak-proof enclosures, with nylon or other suitable flexible connections to the feed chutes.

12.4. Chutes

12.4.1. Chutes which feed belts either from other belts or from other equipment should always be enclosed.

12.4.2. Chutes should feed axially where practicable.

12.4.3. (1) Because long vertical drops cause puffing of dust, they should be avoided.

(2) Chutes should be run at angles to reduce the velocity of the material fed to the conveyor.

12.4.4. Chute design should enable sufficient quantities to be carried without plugging; chutes should therefore be adequate in cross-section and should run at angles which minimise liability to blockage.

12.4.5. (1) The chute enclosures should be leak-proof and yet allow ready access.

(2) Access doors should be leak-proof.

12.4.6. Where ore-containing rocks are being conveyed and bolted steel plate is used, the unions should be fitted with gaskets.

12.4.7. Where fibre only is conveyed, seams may be welded but should be leak-proof.

12.5. Conveyors

12.5.1. All conveyors should be totally enclosed.

12.5.2. Belt width and speed should be adequate to carry the material within the rubber skirting at each side, so that material is not forced out of the conveyor.

12.5.3. The return belt should in all cases be cleaned by scrapers or rotating brushes.

12.5.4. Where practicable, the return belt should also be enclosed.

12.5.5. Dust exhaust connections should be installed at intervals along belt conveyor enclosures.

12.5.6. Exhaust connections should be sited particularly at chute feeding points and conveyor junction points, since air pressure is generated there by movement of material.

12.5.7. They should also be sited at the exits from the conveyor enclosure, where dust would otherwise be pumped into the mill.

12.5.8. Dust connections should normally be attached to the conveyor enclosures by means of a settling box to reduce the exhaust velocity and to minimise the extraction of materials.

12.5.9. The exhausted air should be passed to a baghouse, possibly preceded by a cyclone separator or an electrostatic precipitator.

12.5.10. The air used in aspiration and pneumatic conveying of fibre, after passing through cyclone collectors, should also pass to the main baghouse.

12.5.11. Final emissions to atmosphere should be within the prescribed control limits for the general atmosphere.

12.6. Packing

12.6.1. Separation, grading and mixing should be carried out without manual intervention as part of the totally enclosed milling operation.

12.6.2. The finished fibre should also be weighed, compressed and packed automatically.

12.6.3. These processes should take place in enclosed booths with adequate dust exhaust ventilation.

12.6.4. Fibre should be packed in impermeable bags.

12.6.5. Filled bags should be assembled in unit loads which should be securely fastened for mechanical handling.

12.6.6. Unit loads should, where practicable, be further enclosed in a cover of impermeable material.

12.7. Tailings

12.7.1. For the disposal of tailings, wider conveyor belts operating at slower speeds should be used in preference to high-speed belts.

12.7.2. Conveyors should operate close to the dump to minimise windborne dust. This may be facilitated by the use of swing conveyors.

12.7.3. High-speed conveyor-flingers should not be used.

12.7.4. Where practicable, tailings should be wetted at or before the point of deposit.

12.7.5. Baghouse dust should be adequately damped before it is deposited with the tailings.

13. Asbestos cement

13.1. Fibre preparation

13.1.1. Where asbestos fibre is supplied in paper or plastic bags, the bags should be opened and emptied automatically whenever practicable.

13.1.2. If the bags are opened by hand, this should be carried out in the enclosed booth of a dust extraction system under negative pressure.

13.1.3. The bags should be placed as close as possible to the hopper or feed chamber.

13.1.4. The contents of the bag should be discharged without the bag being shaken.

13.1.5. Empty bags should be disposed of immediately within the same dust extraction system to prevent the release of asbestos dust to the atmosphere.

13.1.6. Where the booth enclosure and exhaust ventilation are insufficient to prevent the release of asbestos dust to the air of the workplace, the workers present should wear respiratory protective equipment.

13.1.7. The delivery of the fibre to the storage chamber and any subsequent weighing and mixing with other materials should be carried out under enclosed conditions with automatic control.

13.1.8. Exhaust ventilation with negative pressure should be maintained within the enclosure to prevent leakage of asbestos dust.

13.2. Handling finished products

13.2.1. At the final stage of manufacturing, or wherever asbestos-cement products are being handled in large quantities, mechanical handling equipment should be used when practicable.

13.2.2. (1) Individual boards, sheets or other products, when moved manually, should be placed with care on the stack or other resting site.

(2) Dropping and dragging of finished products should be avoided.

13.2.3. (1) All storage of asbestos-cement products on site should be within a designated area.

(2) The designated area should be maintained in a clean condition.

13.3. Finishing operations within the factory

13.3.1. (1) All power-sawing, drilling, sanding or milling machines should be fitted with efficient dust extraction equipment.

(2) Low-volume, high-velocity air systems are usually the most suitable for this purpose.

(3) It is recommended that slow-running tools with hard metal teeth be used.

13.3.2. The equipment should be designed to remove loose dust and swarf from the cut edges.

13.3.3. Where appropriate, boards should be treated with a sealing solution for the suppression of dust on surfaces and edges.

13.3.4. Boards should be cut singly where practicable.

13.3.5. The surfaces of all dry sheets which require finishing should be vacuum-cleaned before stacking, where there is a risk of airborne asbestos.

13.3.6. (1) Dust and swarf should be removed from the workplace by vacuum cleaning.

(2) Where this is not practicable, the material should be thoroughly wetted before removal.

13.3.7. Where maintenance work is carried out within enclosures, on dust filters or in other situations of higher dust exposure, protective clothing and respiratory equipment should be provided and worn.

13.3.8. (1) The provision of personal protective equipment should be accompanied by training in its use.

(2) Changing rooms, storage lockers and laundering should also be provided in accordance with this code of practice.

13.4. Work on site

13.4.1. Asbestos-cement products should, where practicable, be delivered to the site ready for use and should not need further processing which may generate dust.

13.4.2. Hand tools or slow-running tools producing coarse dust or chips should be used where practicable rather than high-speed machines or those which cut by abrading the material.

13.4.3. When high-speed power tools are used, they should be fitted with efficient dust extraction equipment designed for the purpose.

13.4.4. Abrasive or masonry discs should not be used for cutting asbestos material.

13.4.5. (1) Sheets to be fixed in an overhead position should be drilled, trimmed or rasped before they are in place.

(2) Where it is necessary to work on sheets in an overhead position, a respirator should be worn.

13.4.6. (1) Workplaces should be kept clean from cutting dust by the use of portable vacuum-cleaning equipment.

(2) Where this is not practicable, floors should be thoroughly wetted before sweeping.

13.5. Waste disposal

13.5.1. Broken pieces and off cuts of asbestos-cement material should be collected and disposed of in a manner which does not generate dust.

13.5.2. Loose swarf and dust collected from fabrication processes should be wetted, where practicable, and placed in sealed impermeable bags or dealt with in another approved manner in accordance with national regulations.

14. Textiles

14.1. Fibre preparation

14.1.1. Where asbestos fibre is supplied in paper or plastic bags, the bags should be opened and emptied either automatically or in an enclosed booth connected to a dust extraction system.

14.1.2. In either case there should be provision for the collection and disposal of empty bags within the same dust extraction system to prevent the escape of dust into the workplace.

14.1.3. The delivery of fibre from the hopper to the machine employed for opening and for the elimination of non-fibrous material should be fully enclosed and provided with a hood.

14.1.4. The fibre should be fed into the machine mechanically and discharged, within enclosed conditions under negative pressure, into the storage chamber.

14.1.5. (1) Where blending is required with other grades of asbestos fibre or with cotton or man-made fibres, input and output should be automatically controlled, the blending itself taking place within an enclosed chamber.

(2) Blending should not be carried out by hand-mixing or in open spaces.

14.2. Carding

14.2.1. Where practicable, direct mechanical or pneumatic feed from the blending operation to the card input should be used. Alternatively the fibre should be transported in a dust-proof container.

14.2.2. Where a container is used, it should be discharged into the card in a way which minimises the escape of dust. This may be achieved by joining the container outlet with the entry aperture of the hopper.

14.2.3. The card or group of cards between the fibre hopper and condenser should be interlocked with the working of the machine.

14.2.4. (1) Wherever possible, dust should be collected and should not be allowed to escape into the card enclosure or into the general atmosphere.

(2) Negative pressure should be maintained within the enclosure by means of the exhaust ventilation system.

14.2.5. Where entry into the enclosure is required while the machines are running, appropriate respiratory protection should be worn.

14.2.6. Specific dust extraction points should be located close to the working surface of the card, particularly where pressure points are created by the carding action.

14.2.7. Where laps and rope lagging are being produced, the delivery conveyor from the doffer cylinder should deliver the material for subsequent processing and packing within an enclosed and ventilated chamber.

14.2.8. (1) Where rovings are being produced, operators engaged in removing them from the card should be protected by ventilation which directs the air away from them and into the card enclosure.

(2) Such ventilation should be in addition to the negative pressure within the enclosure.

14.2.9. Rovings should be transferred to the spinning section in a way which minimises dust generation.

14.2.10. Where it is necessary to remove dry waste from the roving package, this operation should be carried out under a ventilated hood.

14.2.11. Hand stripping of cards should not be permitted.

14.2.12. (1) Cards should be stripped by the use of a revolving cylindrical brush mounted on a traversing mechanism in turn mounted onto the cylinder by means of the grinding brackets.

(2) The brush should be connected to the dust extraction system, which should be of the low-volume, high-velocity type.

14.2.13. Small card rolls should be cleaned and ground on frames fitted with an enclosed hood provided with dust extraction.

14.3. Spinning, doubling and winding

14.3.1. Where practicable, the primary control of dust should be by wetting. This may be accomplished either:

(a) by wetting packages for the machine feed; or

(b) by applying moisture to the roving ends by passing them through water as they are fed to the spinner.

14.3.2. Dust extraction should also be employed for additional control.

14.3.3. Automatic stop spindles or other means should be used and dry waste should be removed by vacuum to minimise the generation of dust from broken or loose ends.

14.3.4. Where pot spinning frames are employed, the pot should be maintained under negative pressure.

14.3.5. Where flyer frames are used, low speeds and good maintenance should be observed in addition to wetting and dust extraction.

14.3.6. Dust control of doubling operations should also be achieved by wetting packages for the machine feed or by applying moisture to yarn ends, together with dust extraction, the use of automatic stop spindles and the removal of dry waste by vacuum.

14.3.7. Cops should be wound wet by applying moisture to the yarn.

14.3.8. (1) Traverse winding and cheese winding equipment should be enclosed and fitted with a means of dust extraction.

(2) Where practicable, dust control in this operation should be made easier by the use of a temporary enclosure, such as overlapping transparent plastic

strips which cover the working entrance of the enclosure, thereby minimising the volume of air to be extracted while maintaining easy operator access and vision.

14.4. Weaving

14.4.1. Where practicable, dust should be controlled by both moisture and dust extraction.

14.4.2. In warp beaming, heavy humidification by means of spray nozzles should be used, with wet feed packages as an addition or an alternative.

14.4.3. (1) In creel warping, wet packages should be used where practicable.

(2) Where this process has to be carried out with dry materials, the creel should be partially enclosed by curtains.

(3) Local exhaust ventilation of the reed and winding point on the beam should be installed.

14.4.4. (1) In fabric weaving, wet packages, spray nozzles or wet rolls should be used wherever practicable.

(2) Dust extraction should also be employed.

14.4.5. (1) Dust control in finishing processes, such as inspection, calendering and drying, may be helped by the application of a dust-suppressant treatment or finish to the material.

(2) Violent manual or mechanical handling should be avoided.

(3) Woven materials should be cut, not torn.

(4) Dust extraction and, where practicable, water sprays should also be employed.

14.5. Braiding and plaiting

14.5.1. Wherever practicable, moisture or dust-suppressant treatment should be applied.

14.5.2. (1) Where this is not possible, the equipment should be enclosed.

(2) A portion of the enclosure should be of transparent plastic to allow the operator to see the process.

14.6. Packaging

14.6.1. Rolls of cloth and coils of tape should be packaged by the low-speed application of plastic wrapping.

14.6.2. Yarns, rope and rovings may be packed in cartons. These should be dust-proof with tape seals.

14.6.3. Where practicable, shrink-wrapping should be employed to give total encapsulation of individual units such as fabric or spools of yarn.

14.7. Fabrication using asbestos cloth

14.7.1. Where practicable, only cloth which has been specially treated to reduce dust emission should be used.

14.7.2. Handling of cloth and cut pieces should be reduced to a minimum.

14.7.3. When not in use, all rolls of cloth should be stored in impermeable wrapping and partly used rolls should be replaced in their wrapping.

14.7.4. After being unwrapped for use, the rolls should have a mandrel inserted through their centre to facilitate handling.

14.7.5. (1) On the cutting table the mandrel should be mounted on brackets at the end, clear of the table surface, and the cloth should be unrolled from the top of the roll.

(2) Cloth should not be pulled from a free-standing roll across the surface of the table.

14.7.6. Backed cloth should be unrolled with the asbestos face downwards.

14.7.7. Working surfaces on which cloth is handled, cut or sewn should be smooth to minimise abrasion.

14.7.8. Asbestos cloth should be cut with shears, a guillotine or a mechanical cutter. It should not be torn or frayed.

14.7.9. If rotary cutters are used, they should be fitted with dust extraction equipment.

14.7.10. When cutting or sewing untreated cloth, the top surface should be well damped.

14.7.11. Off cuts retained for later use should be stored in closed containers.

14.7.12. Finished products should be sealed in impermeable wrapping before dispatch.

14.8. Mattress making

14.8.1. After marking out the mattress pattern, the cloth should be thoroughly damped in the areas to be cut.

14.8.2. Electrically operated rotary knives fitted with dust extraction equipment should be used where practicable.

14.8.3. Both cloth and yarn should be damped before stitching.

14.8.4. Stitched mattress covers should be housed in suitable closed receptacles during transfer to the filling area.

14.8.5. Asbestos fibre used for mattress filling should be dispensed within enclosures under exhaust ventilation.

14.8.6. (1) Workers employed in filling mattresses with asbestos fibre should be equipped with protective clothing and respiratory equipment unless dust measurements indicate that the enclosure and extraction control the dust adequately.

(2) A transparent window in the exhaust hood will facilitate handling the fibre from outside the enclosure.

14.9. Insulation cladding

14.9.1. When asbestos cloth is used for insulation on site, special care should be taken to ensure that the procedures concerning handling of materials and collection of waste are followed.

14.9.2. Dust suppression by thorough damping before cutting and stitching should be employed wherever practicable.

14.9.3. When asbestos cloth is used extensively for lagging, protective clothing and respiratory equipment should be worn.

14.10. Rope lagging

14.10.1. Asbestos rope lagging which has been treated to reduce asbestos dust emission should be used whenever practicable.

14.10.2. (1) Rope lagging should be supplied, transported and stored in impermeable wrapping.

(2) Damaged bags should be repaired with adhesive tape or should be put inside new bags.

14.10.3. (1) Handling of rope lagging should be minimised where possible by planning in advance the number and length of pieces required for the work in hand.

(2) When lengths have been cut from a coil, the rope ends should be resealed.

14.10.4. Partly used coils should be put back into bags and the bags should be securely sealed between working periods.

14.10.5. When cutting and pipe-wrapping, the laggers should wear protective clothing and respiratory equipment.

14.10.6. When extensive rope-lagging is being carried out, the work area should be separated from other areas, or the work should be carried out at times when workers without respiratory protection are absent.

14.11. Waste

14.11.1. Waste material should not be allowed to accumulate. It should be placed in identified impermeable bags.

14.11.2. Controlled wetting of waste should also be employed where practicable to reduce asbestos dust emission during bag sealing or in the case of bag rupture.

14.11.3. Bags should be sealed before removal from the workplace for disposal.

14.11.4. Workplaces should be kept clean by the regular use of suitable vacuum equipment.

15. Encapsulation or removal of friable thermal and acoustic insulation

15.1. Identification

15.1.1. Before the repair or replacement of thermal or acoustic insulation thought to contain asbestos is planned, the presence and type of asbestos should be positively identified.

15.2. Indications for removal

15.2.1. Asbestos insulation should be removed:

(a) when it is breaking away from the base; or

(b) when the insulation is likely to be abraded or otherwise damaged; or

(c) when the surface is very friable; or

(d) when the resultant concentration of airborne asbestos dust is above the exposure limit.

15.3. Enclosure of the work area

15.3.1. Where dust is liable to escape from the work areas, all external openings from the work area, including windows and doors, should be adequately sealed with adhesive tape or isolated by sealed plastic sheeting to prevent the escape of asbestos dust.

15.3.2. Where the work area forms only part of the building, it should be enclosed or isolated by impervious plastic sheeting which is of adequate strength and firmly supported.

15.3.3. Care should be taken to ensure that asbestos dust cannot escape at points where pipes and conduits pass out of the working area.

15.3.4. (1) To prevent asbestos dust leakage, ventilation which maintains the whole work area under negative pressure should be provided.

(2) The extracted air should pass through an appropriate filtration mechanism before being exhausted to atmosphere.

15.3.5. Exit/entry airlocks should be constructed at points of access to the work enclosure.

15.3.6. All entry points should carry prominently displayed warning notices which forbid entry to anyone not wearing suitable protective equipment.

15.3.7. At the end of each work period, the air extraction equipment should remain in operation for at least 15 minutes after stripping has ceased.

15.4. Monitoring of dust and enclosure efficiency

15.4.1. Before stripping is begun, a smoke generator should be used within the enclosure to test the efficiency of the enclosure.

15.4.2. (1) A visual inspection of the enclosure should be carried out at the beginning of each work period.

(2) Enclosure efficiency should be confirmed at longer intervals by further smoke testing.

15.4.3. Any defect found on inspection or testing should be remedied immediately.

15.4.4. (1) Air monitoring for respirable asbestos fibre should be carried out just outside the work area.

(2) A first count should be taken before starting work to provide a baseline and then a count should be taken between one and two hours after starting the asbestos stripping to test the efficiency of the enclosure.

15.4.5. (1) Where visual examination of the enclosure indicates, or where any one fibre count taken outside the working area is found to exceed permitted exposure limits, stripping work should at once be stopped until any defect in the enclosure has been remedied.

(2) A further air sample should then be taken after the same interval following the resumption of work.

15.4.6. Further asbestos dust monitoring should be carried out at intervals as work proceeds and after each move of the enclosure when this occupies only part of the total area to be stripped.

15.5. Hygiene

15.5.1. Provision should be made for decontamination which should include:

(a) protective clothing as provided for in section 6.2 of the code;

(b) shower facilities;

(c) storage for clean and contaminated clothing;

(d) provision for the collection and cleaning or disposal of contaminated clothing.

15.5.2. The decontamination unit should be sited immediately adjacent to the work site or as close as is reasonably practicable.

15.5.3. The decontamination unit should consist of a contaminated area, a shower area and a clean area.

15.5.4. The contaminated area should have provision for:

(a) the vacuum dusting or hosing down of contaminated clothing and footwear;

(b) the storage of contaminated clothing and footwear;

(c) exhaust ventilation creating negative pressure.

15.5.5. The shower area should be heated (except where inappropriate) and should provide an adequate supply of warm water.

15.5.6. The clean area should have provision for:

(a) the storage of clean clothing;

(b) ventilation under positive pressure.

15.5.7. Where the decontamination unit is at a distance from the work site and where walking between the two necessitates passing through a closed clean area, a further overall should be provided.

15.5.8. Neither food nor tobacco should be taken within the work site.

15.6. Respiratory protection

15.6.1. All persons entering the work site should wear approved respirators.

15.6.2. Workers engaged in stripping by dry methods should, where practicable, use positive pressure respirators operated in the continuous flow mode.

15.6.3. Positive pressure respirators should also be used by any worker whose beard prevents an effective seal between face and mask.

15.7. Supervision

15.7.1. All workers should receive careful instruction in the maintenance of workplace cleanliness and personal hygiene and in the importance of adherence to decontamination procedure.

15.7.2. A competent supervisor should be designated who will be responsible for ensuring:

(a) that all dust control procedures are adhered to; and

(b) that air samples are taken as necessary to ensure that airborne asbestos fibre levels outside the work site are below the prescribed exposure limits.

15.8. Work site preparation

15.8.1. Before starting work, suitable barriers and "no access" warning notices should be set up at a distance from the work site.

15.8.2. Within the work site, movable equipment should be cleaned with vacuum equipment to prevent the transfer of loose asbestos and such equipment should then be moved outside the area.

15.8.3. Fixed plant should be vacuum cleaned and covered, as far as is practicable, with impermeable sheeting sealed with tape.

15.8.4. Floors and walkways should be covered with impermeable sheeting sealed with tape to facilitate collection of loose asbestos and final cleaning.

15.9. Encapsulation

15.9.1. Total enclosure and sealing of the work site should be carried out:

(a) where the surface is liable to cause airborne dust when the sealant is applied;

(b) where the surface has to be broken, e.g. to remove loose surface debris or to provide anchorage for new cladding.

15.9.2. The surfaces to be sealed should be cleaned with a vacuum cleaner fitted with a high-efficiency filter to remove all debris and dust particles so that good adhesion of the coating to be applied can be ensured.

15.9.3. All damaged areas should be repaired where necessary to ensure a suitable profile for the encapsulation system.

15.10. Dry stripping

15.10.1. Dry stripping is associated with very high levels of asbestos dust. It should therefore be used only:

(a) where wet methods cannot be used;

(b) where live electrical apparatus might be made dangerous by contact with water;

(c) where hot metal is to be stripped and the use of water may be damaging.

15.10.2. Where dry stripping is employed, as effective a standard of separation as possible should be preserved between the work site and the adjacent areas to prevent the escape of asbestos dust.

15.10.3. All workers within the separated area should be provided with, and should use, suitable respiratory equipment and protective clothing.

15.10.4. Surfaces from which the insulation has been removed should be sealed to prevent the later release of remaining fibres into the air.

15.10.5. As far as is practicable, waste should be removed in small pre-cut sections with as little disturbance as possible in order to minimise the release of airborne asbestos.

15.10.6. Waste should be either placed immediately into suitable wetted containers or removed with the aid of high-power vacuum suction.

15.10.7. Waste containers should be sealed and should be identifiable.

15.11. Wet stripping

15.11.1. Areas in which wet stripping is being carried out should be separated from other work areas.

15.11.2. All workers within the separated area should use suitable respiratory protective equipment and protective clothing.

15.11.3. Electrical equipment in the area should be isolated from the entry of water.

15.11.4. At the end of the work a competent person should ensure that it is safe for the electrical supply to be restored.

15.11.5. Before removal is started, care should be taken that the asbestos material is saturated with water. This may be made easier by the addition of a water-wetting agent.

15.11.6. (1) Where cladding has to be removed, it should first, where practicable, be punctured and the asbestos-containing material within the cladding should be thoroughly wetted.

(2) The cladding should then be removed carefully within the enclosure and all surfaces should be vacuumed or sprayed with water.

15.11.7. The water-saturated material should be removed in small sections and placed immediately in labelled containers which should then be sealed.

15.11.8. Any slurry produced should be contained and not discharged into drains without adequate filtration.

15.11.9. Slurry should not be permitted to dry out on surfaces, but should be completely removed while still wet.

15.11.10. Surfaces from which insulation has been removed should be sealed to prevent the later release of remaining fibres into the air.

15.12. Stripping by high-pressure water jets

15.12.1. This specialised method should be carried out only by trained personnel and all precautions relevant to the operation should be taken. Special safety precautions, including those given in this section of the code, are required.

15.12.2. The safety provisions concerning high-pressure water jetting should be fully observed.

15.12.3. Warning notices marked: "Danger. High-pressure spraying" should be displayed in addition to the other stripping warning notices.

15.12.4. The work area should be isolated as for other stripping techniques.

15.12.5. All electrical equipment should be isolated.

15.12.6. At the end of the work, electrical supply should not be restored until passed as safe by a competent person.

15.12.7. (1) The slurry produced should be collected by pump into suitable containers for disposal.

(2) Such slurry should not be allowed to enter the drainage system.

15.13. Waste disposal

15.13.1. Asbestos waste should be placed in suitable containers immediately on removal.

15.13.2. Waste should not be permitted to remain on floors or other surfaces of the workplace at the end of the working period.

15.13.3. Suitable containers should be impermeable.

15.13.4. When such containers are filled, they should be sealed to prevent the escape of asbestos dust.

15.13.5. The external surface of such containers should be cleaned and then the containers should be removed to an area set aside for such waste.

15.13.6. Either the containers or the separate storage area should be clearly identified as containing asbestos.

15.14. Decontamination procedure

15.14.1. When starting work, workers should:

(a) enter the clean end of the decontamination unit, remove all clothing, store it in the lockers provided and fit on clean, appropriate respiratory equipment;

(b) pass through the shower-room to the contaminated area and put on work clothing (overalls, footwear, gloves, etc., as appropriate);

(c) leave the contaminated area and enter the work site.

15.14.2. At the end of work, workers should:

(a) enter the contaminated area of the decontamination unit, with the use of a vacuum cleaner remove all loose asbestos fibre from their work clothing (overalls, footwear, gloves, etc.) and from their respiratory equipment, remove all clothing and store it in the lockers provided;

(b) pass through the shower-room and shower thoroughly;

(c) pass through to the clean area, dry themselves, dress and leave through the clean area door.

15.14.3. (1) Where the decontamination unit is situated at a distance from the work site and passage through a clean zone is necessary, a two-stage airlock should be provided at the work site.

(2) Both airlocks should be provided with lockers; the contaminated airlock should be provided with vacuum-cleaning equipment.

15.14.4. In the case provided for in paragraph 15.14.3, workers should, when starting work:

(a) proceed as indicated in paragraph 15.14.1 but put on clean overalls (instead of work clothing) in order to cross the clean zone;

(b) enter the first (clean) airlock, remove their overalls and store them in the lockers provided;

(c) pass through to the second (contaminated) airlock, put on work clothing and enter the work site.

15.14.5. In the case provided for in paragraph 15.14.3, workers should, at the end of work:

(a) enter the contaminated airlock, with the use of a vacuum cleaner remove all loose asbestos dust from their work clothing and from their respiratory equipment, remove all work clothing and place it in the lockers provided;

(b) move to the clean section of the airlock and put on their overalls;

(c) return to the decontamination unit, enter the contaminated area of the decontamination unit, remove their overalls and store them in the lockers provided, and then follow the procedure outlined in paragraph 15.14.2 *(b)* and *(c)*.

15.14.6. The decontamination unit and, where this is required, the two-stage airlock should be regularly cleaned and serviced.

16. Friction materials

16.1. Fibre preparation and mixing

16.1.1. (1) Raw fibre should be supplied only in closed containers, such as impermeable paper or plastic bags.

(2) Where practicable, these containers should be opened by automatic means and discharged directly into enclosed mixing systems.

16.1.2. Where bags of fibre have to be opened manually, this operation should be carried out only within a partial enclosure equipped with air extraction ventilation sufficient to control all asbestos dust emissions during bag opening.

16.1.3. Dry mixing operations should be undertaken only in enclosed systems under negative pressure.

16.1.4. Local exhaust ventilation (dust extraction) should be provided at feed points for additives and at discharge openings.

16.1.5. Where wet mix or plasticised materials are used in open systems, waste and dried out residues should be cleared by vacuum-cleaning equipment or by other dustless methods.

16.2. Transfer of mixed compound to moulding and forming

16.2.1. Wherever practicable, totally enclosed systems should be provided for the transfer of compounds from the mixing area to the processing machinery.

16.2.2. Where manual methods of transfer have to be employed, closed containers should be used and arrangements should be made for coupling the containers direct to the processing machinery in a manner which eliminates dust emission.

16.2.3. If tipping or manual transfer of compounds from transit containers to the processing machinery is necessary, suitable dust extraction equipment should be provided to prevent the dispersion of dust into the workplace.

16.3. Pre-forming, forming, curing and moulding machines

16.3.1. Automatic systems for dispensing fibre compounds to press moulding boxes should be used where practicable.

16.3.2. Suitable dust extraction equipment should be fitted to all points of possible asbestos dust emission.

16.3.3. Fettling of moulded components should be carried out only under local exhaust ventilation.

16.3.4. When goods which are being processed are in transit from one machine or section to another, they should be conveyed in closed systems or containers.

16.3.5. High-pressure jet lubrication of moulding plates and tools in curing presses should be designed to minimise over-spray and air movement.

16.4. Finishing operations

16.4.1. Suitable dust extraction equipment should be fitted to all finishing machines which drill, bore, grind, finish or otherwise abrade friction components.

16.4.2. Wet pads or aerosol sprays should, where practicable, be used to remove or suppress dust adhering to components.

16.4.3. Finished components should, where practicable, be dipped or sprayed with a suitable dust suppressant.

16.4.4. Inspection of finished components for quality control purposes should be carried out on tables equipped with a dust extraction system.

16.4.5. Finished components should be shrink-wrapped or otherwise sealed in dust-proof packaging before final dispatch.

16.5. Reclamation of materials

16.5.1. Disintegrators, milling machinery or grinding plant used to reclaim waste material should operate in an enclosed booth under negative pressure ventilation.

16.5.2. Reclaimed material should be transferred back into the process either automatically within an enclosed system or in sealed containers.

16.6. Processing friction materials in factory conditions

16.6.1. Asbestos dust generated by asbestos friction materials delivered in bulk should be removed by vacuum cleaning prior to handling.

16.6.2. Suitable dust extraction equipment should be fitted to every cutting, drilling or grinding machine. The extraction equipment should be of the low-volume, high-velocity type.

16.7. Use of friction materials in workshops

16.7.1. Where practicable, friction materials should be supplied already cut; machined or drilled to requirements.

16.7.2. Where practicable, hand tools or slow-running tools producing coarse dust or chips should be used rather than high-speed machines or those which cut by abrading the material.

16.7.3. Fixed working points or machines should have a suitable dust extraction system installed.

16.7.4. (1) Portable tools should be fitted with an inbuilt dust extraction unit.

(2) Low-volume, high-velocity systems are usually the most appropriate for this purpose.

16.7.5. Where linings, blocks and clutch facings are riveted, dust extraction equipment should be installed.

16.7.6. (1) All exhaust ventilation equipment should be inspected and tested by a competent person at regular intervals not exceeding seven days.

(2) A record of every inspection should be made and retained.

16.8. Servicing of brakes and clutches in garages and workshops

16.8.1. Compressed air or dry brushing should not be used to remove accumulated dust from brake and clutch assemblies when worn friction materials are being removed, except when this is carried out within an extraction box equipped with exhaust ventilation.

16.8.2. (1) Dust should be removed by a vacuum cleaner fitted with a high-efficiency filter.

(2) If such a vacuum cleaner is not available, dust should be removed with a damp cloth or one moistened with light mineral oil.

16.8.3. (1) Where practicable, friction material should be cut to length with shears.

(2) Power saws or abrasive discs should not be used unless exhaust ventilation is in operation.

16.8.4. Where products are machined, dust extraction equipment should be fitted.

16.8.5. (1) Before applying adhesive to bond segments to brake shoes, surface dust should be removed with a damp cloth or one moistened with light mineral oil.

(2) Dust should not be removed by tapping or by compressed air.

16.8.6. (1) Loose swarf and dust should be removed from the workplace by vacuum cleaning.

(2) Where such vacuum cleaning is not practicable, the material should be thoroughly wetted before removal.

16.9. Waste disposal

16.9.1. Loose swarf and dust collected from fabrication processes, and broken and worn linings, should be placed in an impermeable container, such as a plastic bag, and the container should then be sealed.

16.9.2. The sealed bags should be disposed of in accordance with the provisions of this code of practice.

17. Handling of asbestos fibre in ports and container terminals

17.1. Packaging

17.1.1. All asbestos fibre to be handled by waterside or terminal workers should be packed in airtight bags.

17.1.2. The packages should be made up into unit loads securely fastened by banding.

17.1.3. The unit loads should be securely fastened in packages on suitable pallets or straps which can be moved by hoist, fork-lift truck or other mechanical handling equipment without damage.

17.1.4. When standard international containers are used, the shipper should ensure that all projections inside the container are adequately shielded to prevent damage to the packages in transit.

17.2. Handling

17.2.1. Each shipment should be inspected before handling to ascertain if any breakages or spillages of asbestos have occurred in transit.

17.2.2. Hooks or other sharp equipment should not be used on bags or unit loads.

17.2.3. Unit loads should be lifted intact into and out of ships' holds and on and off land transport by hoists, fork-lift trucks or other mechanical handling equipment.

17.2.4. The equipment should be properly engaged in the pallets or other forms of joint packages.

17.2.5. Unstable loads should be stabilised before lifting.

17.2.6. Stowing of loaded pallets should be carried out without damage to the pallets.

17.2.7. Except where the packages of asbestos are carried in sealed containers, suitable vacuum-cleaning equipment of sufficient capacity should be available on site at all times when asbestos is being handled.

17.3. Spillages

17.3.1. Suitable adhesive tape should be available for the repair of damaged loads.

17.3.2. Damaged bags which are not part of unit loads should be repaired with adhesive tape.

17.3.3. Where practicable, unit loads which have been damaged to a minor extent should be sealed with adhesive tape.

17.3.4. Where extensive damage to a unit load has occurred, the load should be broken down and the damaged bags should be repaired and repacked. The pallet should then be restowed.

17.3.5. All spilt material should be cleaned up by the use of vacuum equipment.

17.3.6. Collected waste should be placed in impermeable bags for disposal.

17.3.7. Containers, cargo holds, decks, vehicles and storage areas which may have been contaminated by spillage should be cleaned by vacuum equipment or by some other dustless method.

17.3.8. All workers engaged in the collection and rebagging of loose asbestos resulting from spillage should be provided with protective clothing and appropriate respirators.

17.3.9. (1) Overalls or other protective clothing should be used for one shift only.

(2) Changing facilities should be provided.

17.3.10. Facilities should be available to ensure that protective clothing is suitably cleaned and laundered, and that respirators are properly maintained and serviced.

18. Construction, demolition and alteration work

18.1. Construction work

18.1.1. All material to be used on site and containing asbestos should be labelled in such way as to alert the user to the potential health hazards involved and to the appropriate precautions to be taken.

18.1.2. (1) Where a large amount of work has to be carried out on materials containing asbestos, such work should be done on a portion of the work site set aside for the purpose.

(2) Where practicable, a shed or a separate part of a building should be allocated for such work.

18.1.3. The provisions of this code should be followed for all work on asbestos-cement materials and also on all other products containing asbestos, such as asbestos boards and tiles.

18.1.4. Materials containing asbestos in bonded form, such as caulking compounds and bituminous damp coursing, should, when sanded or otherwise abraded, be subject to appropriate precautions.

18.1.5. At regular intervals, and at the end of each work period, the provisions on waste disposal of this code should be followed.

18.2. Demolition and alteration work

18.2.1. (1) Where it has been previously identified that buildings or fixed or movable structures contain substantial amounts of asbestos-containing insulation materials liable to become airborne, only persons or bodies acceptable to the competent authority in accordance with national practice should carry out their demolition or alteration.

(2) Where it is subsequently discovered that such asbestos-containing materials are present, or where such materials are present only to a limited extent, specialised contractors acceptable to the competent authority in accordance with national practice should undertake that part of the work.

18.2.2. It should be the responsibility of these authorised persons or bodies to identify asbestos-containing insulation or lagging before demolition commences and to ensure the safe removal and disposal of the material in accordance with the provisions of the national regulations.

18.2.3. All sprayed thermal or acoustic insulation, lagging and loose insulation of a fibrous nature should be regarded as containing asbestos until otherwise established.

18.2.4. (1) For positive identification the samples taken to identify the possible presence of asbestos should be analysed in a suitably equipped laboratory.

(2) The result of such material identification should be reported to the competent authority and, where the material has been identified as containing asbestos, the report should detail the proposed removal programme.

18.2.5. The persons or bodies authorised to perform the demolition or alteration work should ensure that the requirements of the competent authority have been fully satisfied before proceeding with demolition or alteration.

18.2.6. (1) All workers engaged in the work of demolition or alteration should be informed of any areas where asbestos-containing insulation remains.

(2) The authorised persons or bodies should ensure that this material is not accidentally disturbed.

18.2.7. All workers engaged in the work of demolition or alteration should be made aware of the health hazards and should be made aware that the work should be performed in accordance with the prescribed safety and health regulations.

Appendices

A. Exposure limits in various countries
(as at October 1983)

Country	Regulations	Limit values (f = fibre)
Australia	National Health and Medical Research Council	Amosite 1.0 f/ml Chrysotile 1.0 f/ml Crocidolite 0.1 f/ml
Austria	July 1980	1,250 particles/cm³ (dust containing < 2.5% asbestos) 600 particles/cm³ (dust containing 2.5-15% asbestos) 300 particles/cm³ (dust containing 15-50% asbestos) 150 particles/cm³ (dust containing > 50% asbestos)
Belgium	January 1980	Amosite 2.0 f/ml Chrysotile 2.0 f/ml Crocidolite 0.2 f/ml
Canada	Special regulation in each province[1]	In 1982 the Province of Ontario adopted: Amosite 0.5 f/ml Chrysotile 1.0 f/ml Crocidolite 0.2 f/ml
Cyprus	Amendment 1981, No. 1705	All types of asbestos 2.0 f/ml
Czechoslovakia		
	Ministry of Health, Czechoslovak Socialist Republic, Guide-lines No. 46, 11 May 1978	Dust containing asbestos: *(a)* below 10%: 4 mg/m³ *(b)* over 10%: 2 mg/m³
Denmark		Crocidolite 0.1 f/ml All other types of asbestos 1.0 f/ml
Finland	23 September 1976	All types of asbestos 2.0 f/ml
France	Decree No. 77-949, 17 September 1977	All types of asbestos 2.0 f/ml
Federal Republic of Germany		
	1 July 1982	All types of asbestos 1.0 f/ml
India	Model Rule 123-A under section 112 of the Factories Act	Amosite 0.5 f/ml Chrysotile 2.0 f/ml Crocidolite 0.2 f/ml Other forms 2.0 f/ml
Indonesia[2]		Amosite 1.0 f/ml Chrysotile 1.0 f/ml All other types of asbestos 4.0 f/ml
Ireland	1972, 1975	Amosite 2.0 f/ml Chrysotile 2.0 f/ml Crocidolite 0.2 f/ml

[1] Other provinces including Quebec still have a time-weighted average (TWA) of "less or equal" to 2.0 f/ml for asbestos in general.

[2] Crocidolite given no standard but understood to be banned.

Country	Regulations	Limit values (f = fibre)
Israel	January 1980, March 1982	All types of asbestos 1.0 f/ml
Italy		All types of asbestos 2.0 f/ml
Japan	Japan Industrial Health Society, 1981	Crocidolite 0.2 f/ml All other types of asbestos 2.0 f/ml
Netherlands	October 1983	Chrysotile 2.0 f/ml Crocidolite forbidden
New Zealand	24 August 1981	Actinolite, Amosite, Anthophyllite, Chrysotile, Tremolite: *(a)* 1.0 f/ml for any 4 hours' exposure *(b)* 6.0 f/ml for any 10 minutes' exposure Crocidolite: 0.2 f/ml over any 10 minutes' exposure
Nigeria	Draft Code of Practice	All types of asbestos 2.0 f/ml
Norway	May 1983	Amosite 0.5 f/ml Tremolite 0.5 f/ml Crocidolite 0.2 f/ml All other types of asbestos 2.0 f/ml
Spain	August 1982	All types of asbestos 2.0 f/ml
Sweden		All types of asbestos (except crocidolite) 1.0 f/ml
Thailand	30 May 1977	All types of asbestos 5.0 f/ml
United Kingdom	1 January 1984	As from 1 August 1984: Amosite 0.2 f/ml Chrysotile 0.5 f/ml Crocidolite 0.2 f/ml
United States[3]	1 July 1976, OSHA	All types of asbestos 2.0 f/ml (currently under revision)
USSR	GOST, 12-1-005-76	Dust containing over 10% asbestos: 2 mg/m³ Asbestos cement: 6 mg/m³ Asbestos bakelite: 8 mg/m³
Zambia[4]	1 January 1984	Amosite 0.2 f/ml Chrysotile 0.5 f/ml [Crocidolite 0.2 f/ml] All other types of asbestos 1.0 f/ml

[3] Threshold limit values (TLVs) recommended by ACGIH (American Conference of Governmental Industrial Hygienists), 1982: Amosite 0.5 f/ml, Chrysotile 2.0 f/ml, Crocidolite 0.2 f/ml, all other forms of asbestos 2.0 f/ml.

[4] Crocidolite is not imported into Zambia.

B. Principles of the membrane filter method for the determination of airborne asbestos fibre concentrations by light microscopy

1. A sample is collected by drawing a measured quantity of air through a membrane filter by means of a battery-powered sampling pump. The filter is later transformed from an opaque membrane into a transparent optically homogeneous specimen. The fibres are then sized and counted using a phase contrast microscope. The result is expressed as fibres per millilitre of air, calculated from the number of fibres on the filter and the measured volume of air sampled.

2. Personal samples are taken within the worker's breathing zone, i.e. within. a hemisphere of 300 mm (12 in) radius extending in front of the face and measured from a line bisecting the ears.

3. An open-faced filter holder fitted with a cylindrical cowl is fastened to the jacket lapel of the worker with the cowl pointing downwards.

4. Static samples are taken at fixed locations.

5. Membrane filters (mixed esters of cellulose or cellulose nitrate) of 1.2 μm pore size with printed grids and a diameter of 25 mm (1 in) should be used.

6. A portable battery-operated pump – carried on the worker's belt or in a pocket for personal sampling – must be used. The flow rate should be adjusted to 1 l/min ± 5 per cent, i.e. approximately 4 cm/s face velocity. The difference of the flow rates before and after sampling should not be greater than 10 per cent.

7. The minimum filter loading should exceed 50 fibres/mm² (i.e. approximately 40 fibres/100 Walton-Beckett graticule areas).

8. The maximum filter loading should normally not exceed 5 fibres/graticule area (average value for all counted fields), but should never exceed 10 fibres/graticule area.

9. Sampling time should be measured accurately.

10. It is preferable to mount the total filter on a microscope slide using the acetone-glycerol triacetate (acetone-triacetin) method.

11. A binocular microscope in phase-contrast should be used for counting and should be assessed by means of detection limit test slides. As reference method, the United Kingdom Health and Safety Executive Test Slide[1] should be used and Block 5 should be achieved.

12. The microscope should have the following features:

(a) Koehler illumination;

(b) Abbé or achromatic phase-contrast condenser incorporated into a substage unit;

(c) built-in mechanical specimen stage fitted with slide clamps and x-y displacement;

(d) rotating nose-piece fitted with 10 × and 40 × parafocal phase-contrast achromatic objectives. The 40 × objective must have a numerical aperture (NA) of 0.65, achromatic. The phase ring absorption should be in the range 65-85 per cent. Either positive or negative phase-contrast is suitable;

[1] Health and Safety Executive (United Kingdom) and National Physical Laboratory (United Kingdom): HSE/NPL test slide (mark II) for the determination of detection limit when using phase-contrast microscopy.

(e) binocular eyepieces of the compensating type giving a total magnification of between 450 × and 500 × , preferably 500 × . At least one eyepiece must permit the insertion of a graticule and be of the focusing type;

(f) a Walton-Beckett circular eyepiece graticule with an actual diameter – when using the 40 × phase objective and an appropriate eyepiece – of 100 µm ±2 µm checked against a stage micrometer.

13. Counting and sizing fibres:

(a) a countable fibre is any object having a diameter less than 3 µm and a length greater than 5 µm and a length to diameter ratio greater than 3 : 1, and which does not appear to touch any particle with a diameter greater than 3 µm;

(b) a countable fibre with both ends within the graticule area shall count as one fibre; a fibre with only one end within the area shall count as half a fibre;

(c) graticule areas for counting shall be chosen at random within the exposed area of the filter;

(d) 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 (a split fibre) is regarded as a single countable fibre if it meets the definition in 13 *(a)*, the diameter being measured across the undivided part, not the split part;

(e) in any other agglomerate in which fibres touch or cross one another (a bundle), these fibres shall be counted individually if they can be distinguished sufficiently to determine that they meet the definition in 13 *(a)*. If no individual fibres meeting the definition can be distinguished, the bundle is a countable fibre if the bundle as a whole meets the definition in 13 *(a)* ;

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

(g) at least 100 fibres shall be counted with a minimum of 20 graticule areas examined; no more than 100 graticule areas need to be examined.

14. The mean number of fibres per graticule is calculated by dividing the number of fibres counted by the number of graticule areas examined.

15. The contribution to the count due to contamination shall be kept below 3 fibres/100 graticule areas or 10 per cent of the actual sample fibre count/100 graticule areas and shall be assessed using blank – unused – filters.

16. Concentration in air in fibres per millilitre equals:

$$C = \frac{\text{effective filter area (mm}^2\text{)} \times \text{mean number of fibres per graticule area}}{\text{graticule area (mm}^2\text{)} \times \text{volume of air collected (ml)}}$$

17. All calculated values less than 0.1 f/ml should be reported only as "less than 0.1 f/ml". All higher values should be rounded off to the first decimal place.

For practical purposes, it is recommended to consider further details which may be obtained from: *Asbestos International Association: Reference method for the determination of airborne asbestos fibre concentrations at workplaces by light microscopy (Membrane filter method)*, AIA health and safety publication, Recommended technical method No. 1 (RTM1), (January 1982), available from 68 Gloucester Place, London W1H 3HL, United Kingdom.

C. Principles of gravimetric methods of measuring airborne dust containing asbestos at the workplace

1. General

1.1. Airborne dust concentrations should be measured in the vicinity of various items of equipment.

1.2. Airborne dust concentration measurements must be effected in the breathing zone, account being taken of the main technical processes which could produce such asbestos-containing dust. In making such measurements, samples are to be taken at a height of 1.5 m (5 ft) from the floor or the ground.

1.3. Airborne dust samples are taken by drawing air through an analysis filter. Two samples are simultaneously taken at each point of measurement. The filters should be placed vertically or slightly inclined.

1.4. Where a team of workers is employed in an area where airborne dust concentrations are being monitored, a sufficient number of samples must be taken to enable an accurate determination of the airborne dust to be made, i.e. at least five samples.

1.5. Measurements of airborne dust concentrations should be accompanied by measurements of environmental temperature, relative humidity and air flow rate. Five sets of measurements should be taken in a working day.

1.6. When airborne concentrations of dust at workplaces are monitored periodically, one sample may be taken at each workplace in order to determine the overall maximum concentration. In such cases, the sampling period should not exceed 30 minutes.

1.7. Where air flow rates are in excess of 3 m/s, as may occur when monitoring airborne dust concentrations in factories, quarries, etc., special nozzles should be used to ensure equal air velocities and rates of aspiration. Deviations should not exceed ± 20 per cent.

1.8. Measurements shall be considered to be correct if the difference in airborne dust concentrations between two samples taken at the same time and the difference between the average characteristics of any two samples taken during a given working day do not exceed 25 per cent. Should the variation be greater, additional measurements shall be taken in order to determine the reasons for such variations.

2. Materials and equipment for measuring airborne dust concentration

2.1. In gravimetric monitoring of airborne dust, synthetic or glass fibre filters are used. Membrane and ash-free paper filters may also be used. Preferably, filters with a moisture content not in excess of 0.5 per cent should be used. Analysis filters should retain at least 95 per cent of the dust. The margin of error in measurements of the air volume sampled should not exceed ± 10 per cent.

2.2. The instruments used for monitoring should enable concentrations of airborne dust to be determined with a precision of 0.3 of the permitted concentration, sampling time not being limited.

2.3. Instruments used for monitoring airborne dust concentration shall meet the following requirements:

(a) errors in the measurement of dust collected on the analysis filter shall not exceed ± 10 per cent;

(b) errors in measurements of the quantity of air passing through the filter shall not exceed ± 10 per cent;

(c) the total error in the measurement of airborne dust shall not exceed +25 per cent.

2.4. Other instruments used for monitoring shall meet the following requirements:

(a) error in determining temperature shall not exceed ± 0.5° (± 1.06°F);

(b) error in determining relative humidity shall not exceed ± 5 per cent in any sampling time up to five minutes;

(c) error in determining air flow rates shall not exceed ± 0.05 m/s when measured indoors and ± 0.5 m/s when measured out-of-doors.

3. Order in which measurements shall be taken

3.1. The mass of a clean filter should be ascertained and the volume of air passing through the filters should be adjusted to the maximum in accordance with the manufacturers' recommendations.

3.2. Analysis filters should be numbered. The mass of each filter, before and after sampling, should be entered in the laboratory registers. The registers should also show the mass of the airborne dust deposited on the filter.

3.3. Analytical filters, properly weighed, should be kept in smooth paper envelopes or special cassettes.

3.4. Once the filters have been inserted, the aspirator is connected and the rate of air flow for each filter is set. An even rate should be maintained throughout the sampling process. At the same time, temperature, relative humidity and the velocity of the air at the sampling point should be measured. Having completed the sampling, the filter should be folded in half (with the dust deposit inside) and placed in an envelope or a cassette.

3.5. The mass of the airborne dust collected on the filter should not be less than 1.5 mg, if the total weighing error does not exceed ± 0.15 mg and, if the total weighing error is ± 0.05 mg, the mass of the dust collected should be at least 0.7 mg.

3.6. The method of dust sampling should always be so selected as to enable the mass of dust collected to be in excess of the minimum. The sampling time should not exceed 30 minutes and the airborne dust concentration should be 50 per cent of the permitted maximum. Minimum air sampling time should be five minutes.

Comment: Aspirators with an air flow of 20 1/min may be used. When the minimum weight of the dust collected is 1.5 mg, the airborne dust concentration will be $\geq$ 5 mg/m³. When the minimum weight of the dust collected is 0.7 mg, the airborne dust concentration will be $\geq$ 2 mg/m³. The most suitable aspirators are those with an air flow of 50 1/min or more, as these enable airborne dust concentrations to be measured over a wide range with a sampling time of not more than 30 minutes.

4. Calculation of airborne dust concentration

4.1. Airborne dust concentration is calculated using the following formula:

$$C = \frac{(m_1 - m_0)\ 1{,}000}{V} \text{ mg/m}^3$$

where m_0 and m_1 in milligrams represent the mass of the filter before and after sampling, and where V in litres represents the quantity of air sampled.

4.2. Before effecting the analysis, all of the results of the airborne dust concentration monitoring have to be converted to normal conditions, i.e.:

– air temperature 20 °C (68 °F);
– relative humidity 50 per cent; and
– barometric pressure 103 kPa.

4.3. The results obtained from airborne dust concentration measurement shall be analysed to obtain average and maximum values for a given workplace, a given work area and a given operation.

4.4. For measuring the size and number of asbestos fibres the rate of aspiration should be of 1 1/min. The filters shall firstly be mounted using the acetone-glycerol triacetate (acetone-tracetin) method. The fibres shall then be measured using optical microscopy followed by counting.

D. Recommendations concerning medical examinations

1. General

1.1. The recommendations of this appendix are intended as medical guide-lines. Occupational physicians may wish to supplement these provisions to meet local needs and to assist in proper evaluation of individual cases.

1.2. The health personnel responsible for the medical examination of workers shall have free access to their workplaces and to the data on monitoring of the level and duration of exposure to asbestos dust. When necessary, they may require additional measurements of exposure.

2. Structure of the medical examination

2.1. The pre-assignment medical examination of workers whose work is likely to involve them in exposure to asbestos dust should include:

(a) a case history which includes the occupational history of the worker with an emphasis on the respiratory system, previous occupational exposures and smoking history;[1]

(b) a general physical examination, with an emphasis on the respiratory system;

(c) a full-sized postero-anterior chest radiograph to be obtained and interpreted using the most recent ILO guide-lines;[2]

(d) spirometry, in order to obtain representative forced vital capacity (FVC) measurements and forced expiratory volume in one second (FEV_1);

(e) additional tests as necessary for diagnostic purposes, particularly in high-risk groups of workers.

2.2. The periodic medical examination for asbestos dust exposure should include:

(a) a brief medical and occupational history including smoking habits;

(b) a physical examination, with an emphasis on the respiratory evaluation;

(c) a full-sized postero-anterior chest radiograph to be obtained and interpreted using the most recent ILO guide-lines;[3]

(d) spirometry to obtain a representative FVC and FEV_1;

(e) additional tests as necessary for diagnostic purposes, particularly in high-risk groups of workers.

2.3. Medical examinations following sickness will depend largely upon the nature of the sickness. Should the sickness be thought possible to be work-related, further documentation is indicated.

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[1] The ILO publication entitled *Respiratory Function Tests in Pneumoconioses*, Occupational Safety and Health Series, No. 6 (Geneva, 1966), pp. 141-144, provides a copy of the MRC (United Kingdom, Medical Research Council) Short Questionnaire on Respiratory Symptoms. This remains a useful questionnaire with which to assess respiratory symptoms, occupational history and smoking history.

[2] *Guidelines for the use of ILO international classification of radiographs of pneumoconioses,* Occupational Safety and Health Series, No. 22 (Revised edition, 1980), (Geneva, Third impression 1983), provides a detailed description of the international classification, standard films, guidance notes on radiographic equipment and technology, and a suggested reading sheet.

[3] See note 2, p. 105.

2.4. Upon the cessation of employment, a full medical evaluation, which would include a review of all medical tests previously obtained, should be performed. A decision should be made whether further follow-up of the health conditions of the worker is advisable, taking into account the duration and level of the past asbestos dust exposure and the health conditions of the worker. If so, the frequency of examinations should also be recommended.

2.5. Workers who have developed possible asbestos-related disease should, if appropriate, be referred to medical specialists for detailed diagnostic evaluation, assessment of the work-relatedness of the disease and assessment of health impairment.

2.6. The competent authority should establish a registry to which all cases of asbestos-related diseases should be reported.

3. Frequency of medical examinations

3.1. The frequency of periodic medical examinations should be established by the competent authority, according to national practice, taking into account the duration and level of asbestos dust exposure and health status. In the absence of established national practice, the competent authority should draw up a medical surveillance programme based on the most recent medical knowledge.

4. Results and interpretation

4.1. The results of all medical examinations and supplementary examinations and tests should be placed in the individual worker's medical file and be held in medical confidence.

4.2. Fitness for any particular job should be certified by a suitable certificate containing no medical data.

4.3. Under certain circumstances, it may be desirable to prescribe appropriate measures or conditions in order to certify the worker's fitness for a particular job.

5. Radiographic evaluation

5.1. Radiographic evaluation of the worker exposed to asbestos dust should be based on the "ILO 1980 International classification of radiographs of the pneumoconioses",[1] or any subsequent revision.

5.2. Additional radiographic examination may be required for diagnosis in individual cases.

6. Pulmonary function evaluation

6.1. For recording FVC and FEV_1, a device which provides a tracing of volume-time or volume-flow during the entire forced expiration is recommended. The tracing should be stored and available for recall.

[1] ibid., p. 1 ff.

6.2. Additional examination of respiratory function may be necessary for appropriate diagnosis, particularly in subjects with evidence of respiratory symptoms or functional impairment on spirometry.

E. Glossary

In this code of practice the following terms have the meaning shown:

adequate or suitable: quantitatively or qualitatively appropriate method used to protect the worker;

asbestosis: a fibrosis (thickening and scarring) of the lung tissue which develops slowly, usually after many years of exposure;

competent authority: minister, official service or any other public authority having the power to issue, approve or implement decrees, orders, regulations or other provisions having the force of law concerning the prevention of airborne asbestos in the working environment;

contamination: the air pollution of the working environment by a harmful substance or agent;

dust: airborne solid particulate matter, the particle size being greater than a fume; dusts are usually produced by the mechanical cutting, abrasion or erosion of a solid; *asbestos dust:* airborne or settled fibrous particles which may become airborne; *total dust:* all types of airborne dust particles which are collected during sampling; *respirable dust:* the fraction of the total inspirable dust which can enter the respiratory tract; *respirable fibres:* any organic or inorganic structure with a geometric diameter less than 3 µm and of which the length is at least three times the diameter;

exposure limit: that concentration in air, commonly expressed in terms of 8 hours/day and 40 hours/week, which is considered acceptable by the competent authority responsible for setting such limits and is considered to minimise or to prevent the hazard to health. The exposure limit does not constitute an absolute dividing line between harmless and harmful concentrations. This term covers the various expressions employed in the national lists such as "maximum allowable concentration", "threshold limit value", "permissible level", "limit value", "average limit value", "permissible limit", "time-weighted average", etc.;

forced expiratory volume in one second (FEV_1): volume of gas which can be exhaled from the lungs in one second by forced expiratory effort starting from a position of full inspiration;

forced vital capacity (FVC): volume of gas which is exhaled during a forced expiration starting from a position of full inspiration and ending at complete expiration;

hazard: probability of impairment of health following exposure to a harmful substance or agent; *occupational hazard:* probability of impairment to health following exposure to a harmful substance or agent in the working environment;

health: state of complete physical, mental and social well-being and not merely an absence of disease or disablement;

lung cancer (cancer of the bronchial tubes): this is a similar type of cancer to that associated with cigarette smoking and there is evidence to suggest that the two factors of asbestos exposure and cigarette smoking are synergistic;

mesothelioma: this is a cancer of the pleura or peritoneum which, while rare in the general population, is much more common among asbestos workers after a latency period of 20 to 40 years or longer. No relationship has been found between mesothelioma and the smoking habit;

monitoring: systematic surveillance of the hazards to which workers are exposed; it may be carried out by measuring certain parameters of the working environment, particularly the concentrations of airborne toxic substances, or by measuring biological parameters; *personal monitoring:* sampling the air and/or carrying out measurements in the worker's breathing zone, whatever his movements during the period of duty, by means of a light and compact portable sampling instrument; *static monitoring:* samples taken at fixed locations;

pleural changes: the development of diffuse thickening of the pleura sometimes associated with impairment of lung function or circumscribed pleural plaques which may become calcified and are unlikely to have adverse health effects in themselves;

screening has been defined as the presumptive identification of unrecognised disease or defect by the application of tests, examinations or other procedures which can be applied rapidly. Screening helps to identify apparently healthy individuals who have a disease or some defect from those who probably do not have it. It may be used selectively for a special purpose (e.g. chest radiography) or for special groups (age, occupation, etc.); *mass screening* means examining or testing a large number at one time or from time to time, or where the tests are undertaken in series over a longer or shorter period of time;

spirometer: instrument for measuring the vital capacity of lungs and its subdivisions;

waste: solid or liquid residue from industrial, commercial, research, or any other activities;

work clothing: the clothing put on by the worker on arriving at the factory and taken off on leaving*; protective clothing:* the additional special clothing required for particular jobs.

Index[1]

[1] Numbers refer to the sections or paragraph of the code and letters refer to the appendices.

Other ILO publications

Three titles in the Occupational Safety and Health series (OSH)

Guidelines for the use of ILO international classification of radiographs of pneumoconioses: Revised edition 1980 (OSH 22)

ISBN 92-2-102463-6 7.50 Swiss francs

This booklet accompanies and is included with: **International classification of radiographs of pneumoconioses:** Set of 22 radiographs 650 Swiss francs

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