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HEALTH AND SAFETY AT WORK

The booklets in this series, previously entitled 'Safety, Health and Welfare New Series', are designed to give up-to-date facts and advice about the best practices in health and safety in industrial and other employment. The material is based on the wide experience of HM Factory Inspectors, and much help has been given by representatives of industry and others with special knowledge. Information is given about the provisions of the law where necessary, but there is no intention to provide an interpretation of legal requirements.

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HEALTH, SAFETY DEPT.

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INTRODUCTION

Asbestos is the common name given to a number of inorganic, fibrous, silicate minerals that possess a crystalline structure. ***Chrysotile***, the most abundant of these fibrous silicates and the one most extensively used in industry, belongs to the serpentine group of rock-forming minerals and is mined mainly in Canada, Russia and Rhodesia. The other forms of asbestos belong to the amphibole group. They are ***crocidolite***, commonly known as 'blue asbestos', which is found in South Africa, Western Australia and Bolivia; ***amosite*** which occurs only in South Africa; ***anthophyllite***, the fibrous form of which is found in Finland and Africa; and the fibrous forms of ***tremolite*** (available in Italy) and ***actinolite***, which has been found in South Africa.

Because of certain physical and chemical properties asbestos has come to occupy an increasingly important place in the industries of advanced communities. Grades of chrysotile and crocidolite with relatively long fibres are spun into yarn which is used in asbestos cloth weaving for protective clothing, heat insulation and resin-impregnated pads, in wire braiding and in the production of rope and webbing. Crocidolite can also be made into various textile products where acid-resistant properties are required. All types of asbestos are fire-resistant and the amphibole group has greater acid-resistance. These properties together with its mechanical strength and stability enable it to be integrated very effectively as a filler, binder, or reinforcement with other materials such as cement, rubber and synthetic resins. It can be applied to plant and building structures to provide a high degree of heat and sound insulation. In its various forms it provides the building, engineering, electrical, chemical and other trades with products of great utility such as insulating sprays and mattresses, wall and roof sheeting, pipes, guttering, wall and ceiling boards, brake linings, clutch facings, acid-resisting filter material, lead-acid battery cases, packings, jointing, fireproof curtains and so on. It is not surprising, therefore, that a large increase has taken place in the production and use of asbestos and in the number of workers employed in the industry. The use of crocidolite in the United Kingdom is now very small and confined to certain specialised applications; nevertheless, there are many existing installations where blue asbestos has been employed in the past for insulation purposes and which will therefore at some stage require handling for maintenance or replacement. It can readily be identified by its rich lavender blue colour.

HEALTH HAZARDS

Asbestos, however, is a dusty substance and it is unfortunate that the dust of this very useful mineral can be highly injurious to those who inhale it in sufficient quantities. The danger came to light with somewhat disconcerting suddenness in the second half of the nineteen-twenties when it became apparent that asbestos could cause a specific fibrosis of the lungs which was named 'asbestosis'. A few years later it was suspected that asbestosis might be complicated by the development of lung cancer, a suspicion that was confirmed some twenty years later by the investigations that were conducted during that period. Still more recently a relationship has been demonstrated between exposure to certain types of asbestos and the occurrence of mesothelioma, a cancer of the pleura (the lining of the lungs) or of the peritoneum (the lining of the abdominal cavity). Whereas asbestosis and the lung cancer associated with it have only arisen in workers who have been exposed for years to heavy concentrations of the dust in asbestos factories or in processes in which asbestos is used, mesothelioma has developed in some individuals with short periods of exposure. It is still a rare tumour among the general population but not uncommon among those exposed to asbestos dust. Crocidolite may be more dangerous in this respect than are the other forms of asbestos.

INDUSTRIES

The circumstances in which danger arises from exposure to asbestos dust are thus established. The minerals that come under consideration are those that have industrial significance, namely chrysotile, crocidolite, amosite and anthophyllite, although the last of these has a limited use in this country. The diseases are asbestosis, lung cancer and mesothelioma. The industries are those in which asbestos is processed in the manufacture of a number of products and those in which the products are handled in such a manner that dust is evolved. The great variety of industrial activities, other than those of the asbestos factories themselves, in which asbestos and its products are used, is indicated in the following table abstracted from the Memorandum of the Senior Medical Inspector's Advisory Panel on 'Problems arising from the use of Asbestos'.*

TABLE

(1) Factories in which asbestos and its products are used:

Electricity generating	lagging and de-lagging
Steel	lagging and de-lagging
Heavy engineering	furnace insulation
Loco building, Railway carriage building	heat and sound insulation
Boiler making	heat insulation
Paper	manufacture of filter papers and grinding of rollers
Linoleum, Floor tiles, Rubber, Paints, Plastics, Adhesives, Roofing compounds	used as a filler
Motor assembly	incidental grinding in assembly of brake and clutch parts
Motor vehicle repair	repairs to brake and clutch parts
Building trades	trimming of asbestos cement sheets and insulation boards; asbestos spraying
Scientific	insulation
Light engineering	making of asbestos washers and gaskets
Electrical engineering	insulation systems

(2) Contractors carrying out work involving use of asbestos may be found in:

Dockyards
Shipbuilding
Shiprepairing
Generating stations
Installation of plant in heavy industries e.g. steel
Large building projects—industrial and domestic—
on insulation and repair of heating apparatus e.g. in schools

(3) Other asbestos exposures may occur in:

Certain aircraft maintenance activities
Disposal of asbestos/cement waste which may be used e.g. as hard standing in car parks
Car body undersеals
Asbestos/asphalt mixes for road surfacings

SUBSTITUTES

In the search for safe conditions for a process in which a harmful substance is used, consideration should first be given to the possibility that a safe or less harmful substance may serve the purpose of the process. The physical and chemical properties of asbestos have been of such outstanding value for many technical purposes that alternative materials have not been readily found which would serve a particular purpose as well as asbestos. Sometimes the less harmful chrysotile has been used to replace crocidolite, but the properties of the several minerals falling within the designation of asbestos are not all exactly the same. While the resistance of chrysotile to intense heat is good, that of crocidolite is relatively poor and it tends to fuse at high temperature; on the other hand the resistance of chrysotile to acids is poor while

*"Problems arising from the use of Asbestos", Her Majesty's Stationery Office. Price 3s 9d (4s 1d)

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that of crocidolite is good. Thus one form of asbestos will not necessarily serve as an adequate substitute for another, and the difficulties in finding substitutes among other materials believed to be safe have been considerable. But the problem of providing adequate and effective precautions in some of the circumstances in which asbestos has been regularly used has been even greater, and persistent search and experiment have produced a number of substitutes which users are finding satisfactory for different purposes.

Asbestos is very effective as a heat-insulating lagging for boilers, steam pipes and such plant in which high temperatures are developed and heat loss must be avoided. Originally the asbestos was applied as a paste, a technique now largely superseded by the use of pre-formed sections. With both methods of application dust is formed, but an even more serious cause for concern is associated with these lagging operations. Before old lagging can be repaired or renewed it must first be removed and this is generally an extremely dusty process. It is not surprising, therefore, that more cases of asbestosis are diagnosed in workers in the insulating section of the industry than in any other. The effective removal of asbestos dust from these lagging operations is difficult.

Here the use of substitutes which we believe to be safe is particularly desirable, and a number of non-asbestos heat insulating materials are now well established. A system of colour coding is being recommended by the British Standards Institution for all pre-formed thermal insulation materials under which asbestos materials would be uncoloured. The development of an even wider range of asbestos-free products for heat insulation is being actively investigated though difficulties have been encountered in providing for the higher temperature ranges. Nevertheless, whatever success is achieved in producing effective substitutes, for many years asbestos insulating material already installed will remain in service.

Crocidolite is now mainly used as a reinforcing filler in the pitch compositions used for moulded lead-acid battery boxes where the acid resistance and high tensile strength of the fibres are particularly valuable. Where crocidolite is to be used, the District Inspector of Factories must be informed (see Regulation 6, page 22 in the Appendix). Other fibres cannot be substituted directly for asbestos in these compositions, but manufacturers are avoiding where possible the use of asbestos by making boxes of acid-resisting hard rubber or plastic.

Consideration of alternative materials as fillers for the manufacture of brake linings and other friction materials have been unproductive. In other applications organic synthetic fibres have been substituted for asbestos, and mineral fibres other than asbestos have been used in the manufacture of some fire-resistant boards.

When all the possibilities of substitution have been fully exploited, however, there will still be a very considerable asbestos industry with products in widespread use in industry, and the problem of asbestos dust will continue to demand attention.

ASBESTOS REGULATIONS

When the injurious consequences of exposure to asbestos dust became apparent, the Asbestos Industry Regulations 1931 were introduced, which required the adoption of certain precautions aimed at reducing the exposure of the workers to the dust. It was to be expected that the energetic application of the preventive measures required by the Regulations would ensure a significant reduction in the incidence of asbestosis and while very great improvement has been achieved in those processes to which these Regulations applied the use of asbestos in a great number of processes to which they did not apply has given rise to increasing concern. These processes were principally the application and removal of asbestos insulation and lagging. The Asbestos Regulations 1969* have now been introduced with wider application than the 1931 Regulations and, in addition, with more positive standards of dust control. Technical Data Note 13 (issued by HM Factory Inspectorate) gives an interpretation of levels of asbestos dust or dust containing asbestos which are liable to cause danger to health.

The new Regulations apply to every process involving asbestos or any article composed wholly or partly of asbestos except a process in connection with which asbestos dust cannot be given off. The processes may be those occurring in factories, electrical stations (section 123)†, certain institutions (section 124)†, warehouses other than warehouses of any dock or forming part of any wharf or quay (section 125)†, ships in course of construction or repair (section 126)† and on building operations or works of engineering construction (section 127)†. For the purpose of the Regulations, asbestos is defined as any of the minerals crocidolite, amosite, chrysotile, fibrous anthophyllite or any mixture containing any of these minerals. In the Regulations references to asbestos dust are to be taken as references to dust consisting of or containing asbestos to such an extent as to be liable to cause danger to the health of employed persons, who incidentally need not be persons employed on the actual asbestos processes (Regulation 2[3]). The amount or concentration of asbestos dust which may be regarded as liable to cause danger is based on current information and is thus subject to review as further knowledge becomes available.

For processes involving asbestos the Regulations require the provision of equipment producing an exhaust draught which prevents the entry of asbestos into the air of any workplace (Regulation 7[1]). This ventilating equipment must be kept in use while any work of maintenance or repair is being carried out on the plant in connection with which it has been provided (Regulation 7[2]). However, where exhaust ventilation is impracticable, respiratory protection to achieve the same result can be used instead (Regulation 8[1]). If the process is conducted in such a manner as to be as safe as it would be if the requirement were complied with, the above equipment need not be provided (Regulation 7[1]).*

*Appendix
†Factories Act 1961

DUST SUPPRESSION

Similar safe conditions to those obtained with exhaust draught may be achieved when the asbestos in a process has been effectively wetted so that no dust at all is evolved in the course of the operations. Spray nozzles have been devised that can be inserted in lagging in such a manner that the asbestos layer is thoroughly soaked before it is removed. Certain asbestos compositions for pipe insulation can be effectively wetted within their bag containers before they are applied to the pipes. In certain processes the paper bags containing the asbestos are immersed in water, or steam is admitted to the contents before the bags are discharged into the hoppers of the process plant.

A considerable measure of dust control is achieved in certain textile processes by moistening the asbestos which is being processed. Similar satisfactory conditions may be present during the application of a spray or paste in which asbestos is incorporated in a substance like bitumen. When, however, the medium for a spray or paste is water or any volatile liquid, great care must be taken to ensure that drips or splashes do not in drying create a dust problem on their own. When the paste or spray is applied on site it is advisable to cover the floor in the vicinity with plastic sheeting or similar material. In some processes the use of a wet method is sufficient in itself to ensure safety, but in others it may have to be augmented by a certain measure of exhaust ventilation or by the provision of dust respirators and overalls (Regulation 8).

The above considerations relate to processes from which dust would be evolved unless positive steps (wetting) were taken to prevent it, but there are some asbestos operations which are intrinsically dust free. The punching out of rubberised asbestos gaskets is a process which does not produce dangerous dust because the bonding effect of the rubber prevents the asbestos particles produced by the operations from escaping into the air in the form of dust. Progress has also been made in the development of some dust-suppressed asbestos textile materials which can be used without producing harmful quantities of dust.

TOTAL ENCLOSURE

When every advantage has been taken of the possibilities of substitution and dust control by wet methods there will still remain many processes in which asbestos must be treated in a dry condition, and dust will be evolved in the course of the operations. Dust arising from a process can be prevented from entering the air of a workroom or workplace if the operations are conducted under a system of total, dust-tight enclosure. Such systems have been developed for the handling of very dangerous substances such as those which are radioactive. They take the form of glove-boxes, or enclosures in which the movement of the materials is effected by manipulators controlled from outside the enclosure. The method is expensive, however, and, in its absolute form, unsuited to high-speed mass production; it is thus economically practicable only when the price of the product is high.

Nevertheless certain pan mills in which asbestos is ground are completely enclosed except for the openings in the enclosure through which conveyors pass to feed the unground materials to the mill and to withdraw the milled product. The enclosure is kept under reduced pressure and dust is thus prevented from escaping. This is virtually total enclosure, but some authorities may prefer to include such an arrangement in the next section.

PARTIAL ENCLOSURE WITH EXHAUST DRAUGHT

The economies of asbestos production and the processes that are commonly associated with it do not readily lend themselves to total enclosure, but a similar type of enclosure is suitable for a number of operations to which asbestos is subjected, namely partial enclosure with exhaust draught. This can be a very effective means of preventing the dust caused by an operation from entering the air of a workroom. The nature of the process determines the general design of such an enclosure and the materials used in its construction e.g. steel, wood, glass or plastic; but the common feature of all such enclosures is that the openings in them are specially planned to facilitate the passage of the work and the manipulation that has to be carried on inside them. Subject to these considerations the openings should be as small as possible and suction should be applied to the interior of the enclosure so that air moves inwards through the openings at sufficient speed to prevent an outward movement of dust. This air speed is related to the conditions which the process creates inside the enclosure.

BOOTHS

For the purposes of the work it may be necessary that the whole of one side of a ventilated enclosure should be open. A booth of this type therefore has a relatively large open area through which dust can escape if the design is faulty. The structure should be large enough to contain the dust cloud and deep enough to ensure that the eddies in the back corners caused by the exhaust suction will not spill out at the open face of the booth. If the asbestos process within a booth conforming to this design does not itself give rise to high pressures or turbulent conditions, the escape of dust will be prevented by an exhaust that produces an inward air movement of relatively low speed over the whole of the open face of the booth. On the other hand if turbulence is caused inside the booth by high temperatures or by mechanical movement associated with the process, then higher inward air speeds will be required to counter the outward movement of the dust cloud. What is important is that the air speed should be adequate to control the conditions created by the process.

The correct positioning of the operator in relation to the dust source, therefore, will depend upon the air velocity into the hood, the design of hood and the speed at which the dust is released.

Typical processes to which this form of dust control can be applied are:

charging bags of asbestos fibre to opening and mixing plant

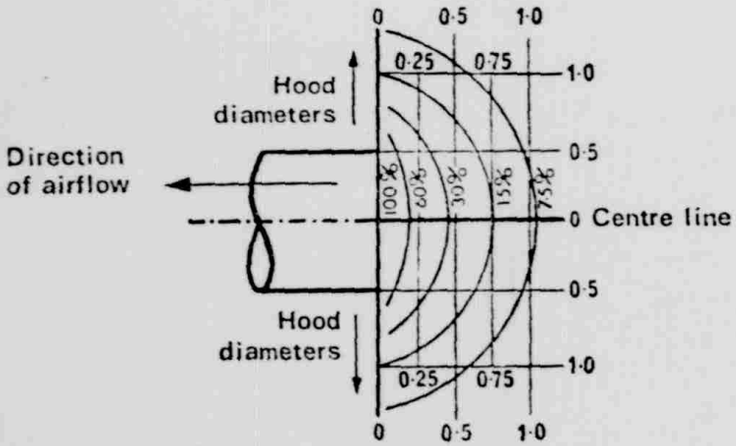
bagging off asbestos fibre and dry mixtures containing asbestos

machining, fettling and sanding operations carried out on asbestos cement and resinated asbestos materials, textile processes involving close handwork e.g. mattress making.

RECEPTOR AND CAPTOR HOODS

When the process cannot be enclosed in the manner described in the preceding paragraphs, hoods, forming part of an exhaust ventilation system, should be fitted as near as possible to the source of the dust. These exhaust systems may be designed to receive and remove the dust-laden air that the process is delivering to them, or they may be designed to deflect dust particles that are moving in a direction imposed on them by the process, and extract them before they pollute the general atmosphere. Exhaust systems associated with receptor hoods must be capable of removing all the air that the process is delivering to the hood, and the fan of a captor system must draw air into the hood at a speed that is capable of changing the direction of the dusty air from the process. The speed of the air which is drawn into the hood falls off rapidly as the distance from the hood increases; the air speed into a circular, square or rectangular hood (but not a slot) at a point in space only one hood-face diameter from the centre of the hood face itself is only one-tenth of the speed at the face. Thus the source of the dust should not be more than one hood diameter away from the hood if the ordinary exhaust system is to be effective. For the high velocities that abrasive wheels may impose on the dust particles extraction systems based on 'low-volume high-velocity' principles have proved effective and should be considered if the methods described in the preceding two sections are impracticable. It should be emphasised, however, that the design of extraction systems for any particular process requires professional expertise and it should therefore be referred to a ventilating engineer of sound professional standing.

(For use on captor guards only)



These methods have been applied with varying success to processes such as the following:

traditional textile processes

machining and sewing of asbestos products

most of the operations already mentioned e.g. machining and mechanical sawing where it was thought that the particular process did not lend itself to a degree of enclosure.

FILTRATION AND DUST-SETTLING PLANT

The purpose of exhaust ventilation is defeated if, for any reason, the extracted dust finds its way back into a workroom. For this reason the dust-laden air should be passed through an air cleaning plant adequate to control the dust. The weekly inspection of this plant (Regulation 7[3]) should include an examination of the condition of all parts of the filtration equipment. The air discharged from the filters will normally be ducted to atmosphere preferably at a height well above head level. In some cases, however, it may be permissible to return filtered air to the workroom if the concentration of asbestos in the effluent air is less than one-tenth of the appropriate Threshold Limit Value or Hygiene Standard, and if safeguards are incorporated in the filtration unit to ensure that a failure in performance is detected and steps are taken to prevent the discharge of dust into the air of the workroom. When settled dust is being removed from the filters care must be taken to avoid spilling it or allowing it to escape in such a manner that it may again become a possible cause of air pollution. It may be necessary to wear protective equipment while performing this operation unless the dust is collected into disposable impervious bags.

PROTECTIVE EQUIPMENT

When the circumstances are such that it is not practicable to comply with the requirements of the Regulations concerning exhaust ventilation, protective

equipment must be provided for the use of each employed person exposed to asbestos dust liable to escape from a process (Regulation 8).* The protective equipment must consist of approved respiratory protective equipment and suitable protective clothing.

RESPIRATORY PROTECTIVE EQUIPMENT

Where it is not practicable to control concentrations of asbestos dust to adequate standards† respiratory protective equipment will be necessary (Regulation 8). This may take the form of an approved dust respirator except in high concentrations when face-piece leakage and other factors may make respirators ineffective. Information concerning these levels is available. In these cases air-line breathing apparatus or pressure-fed respirators should be worn. Information about respiratory protective equipment approved by the Chief Inspector may be obtained from HM Factory Inspectorate. Reference may also be made to British Standards Institution publication BS 2091:1969 'Specification for Respirators for Protection against Harmful Dust and Gases'. It is essential that all such equipment is cleaned (Regulation 8[4])* and maintained (Regulation 8[2])* to an efficient standard.

AIR-LINE BREATHING APPARATUS

The Chief Inspector has approved 'any breathing apparatus which consists of a properly fitting helmet or facepiece with necessary connections by means of which a person using it in a poisonous, asphyxiating or irritant atmosphere breathes ordinary air'. The air may be pressure fed through a hose to the helmet or facepiece from a compressed-air system fitted with suitable control valves and an oil filter. Alternatively air may be pumped through the hose by means of a hand pump, or the wearer may be able to draw the air himself through a comparatively short hose. If one of the last two arrangements is used, great care must be exercised to ensure that the air entering the hose is not contaminated.

POSITIVE-PRESSURE POWERED RESPIRATORS

Approved dust respirators have dust filters attached to the facepiece through which the wearer draws air in breathing and thus inhales air from which the dust has been filtered according to the efficiency of the filter. It is difficult to increase the efficiency of such respirators, however, in view of the leakage between the facepiece and the face of the wearer. This difficulty has been overcome in the positive-pressure, powered, dust respirators in which the air is driven through a filter to the facepiece by means of a battery-powered air blower carried on a belt by the wearer. There is thus a positive pressure which makes breathing easier and which counters any tendency of dust-laden air to leak into the facepiece at the edges in contact with the face. This respirator has many advantages for asbestos workers engaged in process,

*Appendix
†TDN 13

cleaning, repair and maintenance; for occasional work with crocidolite it should be regarded as representing the minimum standard. The pre-filter should be changed at least once per shift and the main filter checked periodically for clogging.

PROTECTIVE CLOTHING

It has been shown that the normal movements of the wearer of a dusty overall can dislodge the dust and disperse it in the air that he himself is breathing. It is manifestly desirable therefore that the material of the overall of the asbestos worker should be one that does not readily hold dust. Asbestos fibres adhere readily to the normal type of overall material, but a material consisting of 60 per cent polyester fibre and 40 per cent cotton has a relatively low tendency to become dusty and materials made wholly from synthetic fibres are even better in this respect. The overalls should be close fitting at the neck, ankles and wrists. The equipment should include a cap of the same material and in certain instances it may be augmented by plastic gloves, rubber boots and a plastic apron.

CHOICE OF PROTECTIVE EQUIPMENT

The nature of the protective equipment that should be provided is determined largely by the conditions of the work. It is only by atmospheric monitoring that a true assessment of relative exposures can be reliably made. When this is done it becomes possible to provide the workers with suitable protective equipment for the type and concentration of dust produced in his particular process or in his vicinity. Choice of respiratory protective equipment is governed principally by the concentrations of asbestos dust to which the operative is exposed as already stated. Further information is given in British Standards Institution publication BS 4275:1968 'Recommendations for the Selection, Use and Maintenance of Respiratory Protective Equipment'. It is expected that where crocidolite-containing insulation has to be exposed, it will not be sufficient to wear an approved ori-nasal respirator. Positive-pressure fed respirators or air-line breathing apparatus together with full protective clothing and associated facilities will be necessary.

CLEANING

Dust lying on floors, ledges and plant surfaces can become a source of air contamination when it is disturbed by draughts or by workroom activity and thus re-enters the atmosphere from which it originally settled. This settled dust can be a serious and persistent cause of harmful concentrations if it is not removed by efficiently directed cleaning. It has long been known that simple sweeping can prove to be an ineffective way of removing a dangerous

industrial dust. It tends to waft the finest and most dangerous particles into the air from which it is deposited on more inaccessible ledges. The problem is not confined to asbestos, and equipment is available which enables cleaning methods to be applied which do not themselves raise dust.

VACUUM CLEANING PLANT

Two forms of vacuum cleaning plant have been designed to cope with industrial conditions. The simplest form consists of a transportable unit mounted on a bogey which is wheeled to the place where it is to be used, the electric motor being connected with the electrical supply as a domestic vacuum cleaner is plugged into a house circuit. The filtered air is returned to the workplace where the cleaner is being used, and it is essential, therefore, that only high efficiency filters are fitted to vacuum cleaners being used for asbestos dust and that they are well maintained (Regulations 10 and 12).*

An arrangement of this type is suitable in situations where asbestos is used only at irregular and infrequent intervals; it could be used in a factory in which plant, that must be treated with asbestos, has from time to time to be installed or repaired. On the other hand when asbestos is regularly used in the processes the vacuum cleaning plant should preferably consist of a central suction, filtration and settling unit from which pipes run to those parts of the building in which vacuum cleaning is necessary. Openings with closure caps are fitted at intervals along these pipes so that the hose of a vacuum cleaning implement may be connected with the suction by inserting its adapter into an appropriate opening.

The requirements concerning cleaning are set out in Part III of the Asbestos Regulations 1969.*

It is clearly desirable to avoid surfaces on which dust may settle. The walls of buildings in which asbestos dust is liable to be present should have smooth inner surfaces and rooms should be constructed in such a manner that there are as few ledges as possible on which dust may lodge. In the case of factories or parts of factories built or taken into use for the purposes of processes described in the Schedule to the Regulations, which are carried on for more than 8 hours in any week after the coming into force of the 1969 Regulations, it will be a legal requirement for the buildings to be so constructed and to incorporate a central vacuum cleaning system as described (see Regulation 13 page 24).

SPECIAL PROBLEMS IN CONSTRUCTION AND SHIPBUILDING

When a process, especially a repetitive process, is carried on in a factory as part of the normal, continuing routine, precautions such as exhaust ventilation can be tailored to the process with a knowledge of the surrounding conditions and the manner in which the operations are to be performed. Such conditions are often impossible in the construction and shiprepairing industries where the working sites may be of a temporary nature and the conditions surrounding the operations may be variable. In these industries asbestos and its products are used for a number of purposes, notably for lagging and spraying and in the form of tiles, boarding and partitioning. In this part some consideration is given to the special difficulties associated with these operations.

*Appendix

LAGGING OPERATIONS

The high incidence of asbestosis in the insulating section of the asbestos industry has already been mentioned. It was explained that this was due to the circumstances in which the work had to be done – dusty operations that had to be performed in situations where permanent, specially designed enclosure and exhaust ventilation could not be provided. In particular the dismantling of old lagging could give rise to very large quantities of dust.

For these reasons compensating precautions have to be carefully planned before such work is begun, and, with this purpose in mind, some responsible employers have been able to improvise precautions similar in principle to the permanent installations provided in factories for normal production process.

Thus plastic sheeting is kept available and is used as a floor covering in the vicinity of the work in order to save the floors, chequer plates and gratings from contamination by falling débris. Neighbouring plant is similarly covered to limit the quantity of dust that may settle on it. The sheeting may also be used in the form of a tent round the job to confine the dust and débris and to concentrate the effect of the portable, local, exhaust ventilating equipment on the actual work. This should be kept available by firms engaging in this work. Any one working within this enclosure must wear respiratory protection.

Large pieces of waste lagging should be placed directly into impermeable containers—e.g. polythene bags or strong, impermeable paper bags—into which the débris collected on the sheeting should also be put as each section of the work is completed.

The dust normally associated with delagging operations has been successfully reduced by the use of wetting equipment that has been devised to effect the complete saturation of the lagging to be removed. It consists of a manifold with a number of hoses terminating in injection heads which are inserted in the lagging, and water from perforations in the heads seeps into the asbestos.

When total saturation is not practicable some control of the dust can be achieved by the use of a fine water spray by means of which the surface of the old lagging is first soaked. The spray is then directed on the cutting operation when the lagging is being removed. Spraying in this manner is not as effective as total saturation in controlling the dust, and the arrangements have to be augmented by portable, local exhaust ventilation.

It is not always practicable to adopt these wet methods and consequently there are circumstances in which old lagging must be removed in a dry condition. In particular it has been found difficult to use a wet method on a

ship undergoing repair or refitting: the heavy bags of saturated asbestos may be too cumbersome to carry through restricted openings and up steep flights of steps. Full advantage must therefore be taken of all other precautions. Dust extraction must be as effective as possible and, in the selection of tools for removing the lagging, preference should be given to those producing least dust. It is understood that progress is being made in the development of stripping tools incorporating dust-extraction equipment. When lagging has to be removed in a dry condition the laggers may have to be provided with the highest standard of protective equipment—heavy-duty, impermeable overalls with head coverings and air-line breathing apparatus connected to a supply of clean compressed air. This is particularly important when the old lagging is crocidolite or 'blue asbestos'.

In addition to the laggers other workers in the vicinity of lagging operations and exposed to the dust should wear protective equipment. The area over which this precaution is needed should be roped off and signposted. If possible lagging and delagging operations should be carried out at times when other workers are not in the vicinity.

When each stage of the work has been completed the floors, walls, fixtures and plant in the area should be thoroughly cleaned by a wet method or by a vacuum cleaner or by both. Where this is not practicable, the Regulations allow cleaning by other methods but in these cases protective equipment must be worn (Regulation 11).*

As substitutes displace asbestos in this process the risk will diminish, but for many years old asbestos lagging will have to be stripped—sometimes in its most dangerous form, crocidolite—and precautions will have to be scrupulously observed. Where old lagging containing crocidolite (blue asbestos) is being stripped, the District Inspector of Factories must be informed (see Regulation 6).*

ASBESTOS SPRAYING

In the construction industry asbestos is applied by spraying techniques to open steel work, walls and ceilings for the purposes of fire protection, thermal insulation, acoustic damping, condensation prevention and corrosion inhibition. The material employed for the process is usually a powder consisting of a cement and asbestos mixture, but sometimes the mixture consists of adhesive resin and cement. These preparations are incorporated with water in various types of pre-mixing machines and spray-guns and are thus applied to the surfaces in the form of an aqueous spray.

The nature of the spraying process and the circumstances in which it must be performed conduce to a serious contamination of the environment and very positive steps must be taken to reduce it. This contamination may be caused by overspray when surplus material falls to the floor in quite substantial quantities, or the air in the vicinity of the spray may be directly contaminated by a haze or mist which contains minute asbestos particles. The atmospheric contamination arising from this cause can be greatly reduced by using a pre-damping technique which moistens the asbestos fibre before it is fed to the gun. The reductions in dust concentrations achieved by this method are dramatic; the radius over which workers are exposed is considerably reduced and fewer workers need personal protective equipment.

The dry asbestos mixtures may be spilt or wafted by wind as they are being charged into the pre-treatment plant on the open site; similar conditions may be created by the discharge of material from the hoppers during spraying operations; and the lighter material may become airborne when building débris is being swept up if the spraying operation has been carried out before waste from other operations has been removed and the asbestos waste has thus intermingled with the earlier deposits. These conditions are aggravated when the work has to be done in tall, open buildings subject to winds and draughts which blow loose asbestos over the working area and into other areas that have been regarded as safe.

In these conditions it is difficult to combat contamination and the efforts made to overcome the difficulties must be correspondingly vigorous. Waste from the spraying process must not be swept up in a dry condition by an ordinary brush. Either it must be prevented from drying out (if necessary, by means of a water spray) until it is swept up, or vacuum cleaners should be used. As in lagging operations plastic sheeting can serve a very useful purpose in reducing contamination. It can be used to protect the floor from spillages, drips and other deposits and it can be used in the form of curtains to confine the spray and dust to the area where spraying is being done and to reduce the effect of the wind in the vicinity of the work. Approved dust respirators or breathing apparatus and a high standard of protective clothing should be provided and worn. When necessary, strenuous efforts should be made by education, supervision and discipline to persuade those engaged in spraying to observe these precautions.

Arrangements should be made as far as possible to spray asbestos at times when other workers are not in the vicinity; if this is not possible the other workers must be provided with protective equipment. The contractor who has undertaken the work of asbestos spraying is responsible for providing this protective equipment for all the workers exposed to the danger whether they are employed by himself or by other contractors (Regulation 5[2]).*

The dry asbestos powder for the process should be taken to the site and the asbestos débris should be removed from the site in strong impermeable bags which must be sealed.

FITTING OF ASBESTOS PRODUCTS IN BUILDING AND SHIPBUILDING WORK

A considerable number of asbestos products such as asbestos-cement sheet, asbestos wood, asbestos wallboard, asbestos tiles and asbestos-cement pipes are used in the building and shipbuilding trades. In fitting them into position these products often have to be cut, shaped, drilled and ground on the site, and precautionary devices have to be adapted to the circumstances of the situation. Some contractors who have experience of such work keep portable plant available that is capable of being adjusted to a variety of conditions.

*Appendix

*Appendix

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A large amount of work that is associated with fitting sheet, tiles or preformed sections into position consists of hand-sawing, drilling and shaping which produce dust in concentrations which may not be excessive if the duration of exposure is only brief. The use of power-driven saws, however, and high-speed, portable abrasive tools can cause clouds of dust and is thus associated with a greater risk.

Every opportunity should, therefore, be taken to segregate this work from other operations in progress on the site or on the ship, and to arrange for the provision of exhaust ventilation for dusty operations. An excellent arrangement which is sometimes adopted is to provide a shed that is reserved exclusively for this work. Plant that gives rise to dust, like circular saws and grinding machines, is provided with effective exhaust, and only those workers who are handling the asbestos products are present while these products are being machined.

Workers who are exposed to harmful concentrations of asbestos dust, whether they are handling asbestos products or not, must be provided with approved respiratory protection and protective clothing.

The place where work on the asbestos products is taking place must be kept clean, the dust being removed by a wet method or by a vacuum cleaner when facilities are available for its use. Where this is not practicable the use of other methods is provided for by Regulation 11.* The dust and other débris should be removed from the site or from the ship in sealed impermeable bags or in other suitable containers.

Finally, in this booklet reference has been made to the use of substitute materials. This is in line with the general policy of HM Factory Inspectorate in dealing with any hazardous process.

Many uses of asbestos can be adequately controlled or in themselves offer little risk but where there is real risk and control is difficult, all concerned should consider safer substitute materials.

FURTHER INFORMATION

Further information, providing detailed precautions to be taken in particular circumstances may be obtained from the Asbestosis Research Council, Secretary, Dr. S. Holmes, PO Box 40, Rochdale, Lancs, or The Secretary, Environmental Control Committee of the Asbestosis Research Council, 114 Park Street, London W1Y 4AB.

Information on sampling methods and analytical techniques may be obtained from Industrial Hygiene Section, HM Factory Inspectorate, Baynards House, Chepstow Place, London W2, alternatively reference may be made to Technical Note 1, 'The Measurement of Airborne Asbestos Dust by the Membrane Filter Method', issued by the Asbestosis Research Council, or 'Hygiene Standards for Chrysotile Asbestos Dust' reprinted from Annals of Occupational Hygiene, Vol. 11, pp. 47–69, Pergamon Press, 1968, London.

Information on levels of asbestos dust liable to constitute danger to health and on sampling techniques is contained in TDN 13 available from HM Factory Inspectorate.

*Appendix

APPENDIX

The Asbestos Regulations 1969

Made - - - - 13*th May* 1969
Laid before Parliament 22*nd May* 1969
Coming into Operation 14*th May* 1970

ARRANGEMENT OF REGULATIONS

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REGULATIONS

The Secretary of State—

(*a*) by virtue of her powers under sections 62, 76 and 180(6) and (7) of the Factories Act 1961(a) and of all other powers enabling her in that behalf; and

(*b*) after publishing, pursuant to Schedule 4 to the said Act of 1961, notice of the proposal to make the Regulations and not having received any objection to the draft in regard to which she is required by the said Schedule to direct an inquiry to be held,

hereby makes the following special Regulations:—

PART I

APPLICATION, INTERPRETATION AND GENERAL

Citation, commencement and revocation

1.—(1) These Regulations may be cited as the Asbestos Regulations 1969 and shall come into operation on 14th May 1970.

(2) The Asbestos Industry Regulations 1931(b) are hereby revoked.

(3) The Shipbuilding and Ship-repairing Regulations 1960(c) shall have effect as if the following provisions were omitted—

(*a*) in Regulation 3(2), the definition of the word "asbestos";
(*b*) in Regulation 76(1), sub-paragraphs (*a*) to (*d*); and
(*c*) in Regulation 77, paragraphs (*a*) to (*d*).

(a) 1961 c. 34. (b) S.R. & O. 1931/1140 (Rev. VII, p. 181; 1931, p. 410).
(c) S.I. 1960/1932 (1960 II, p. 1427).

Interpretation

2. (1) The Interpretation Act 1889(d) shall apply to the interpretation of these Regulations as it applies to the interpretation of an Act of Parliament, and as if these Regulations and the Regulations hereby revoked were Acts of Parliament.

(2) In these Regulations, unless the context otherwise requires, the following expressions have the meanings hereby assigned to them respectively, that is to say

"approved" means approved for the time being by certificate of the Chief Inspector;

"asbestos" means any of the following minerals, that is to say, crocidolite, amosite, chrysotile, fibrous anthophyllite and any mixture containing any of the said minerals;

"factory" includes any premises and place to which these Regulations apply;

"protective clothing" means overall and headgear, which (in either case) will when worn exclude asbestos dust;

"the principal Act" means the Factories Act 1961 as amended by or under any other Act.

(3) References in these Regulations to asbestos dust shall be taken to be references to dust consisting of or containing asbestos to such an extent as is liable to cause danger to the health of employed persons.

Application of Regulations

3.—(1) These Regulations shall apply to the following premises and places in which any process to which these Regulations apply is carried on, that is to say, factories and all premises and places to which the provisions of Part IV of the principal Act with respect to special regulations for safety and health are applied by the following provisions of that Act, namely, section 123 (which relates to electrical stations), section 124 (which relates to institutions), so much of section 125 as relates to warehouses other than warehouses within any dock or forming part of any wharf or quay, section 126 (which relates to ships) and section 127 (which relates to building operations and works of engineering construction).

(2) These Regulations apply to every process involving asbestos or any article composed wholly or partly of asbestos, except a process in connection with which asbestos dust cannot be given off.

(3) The provisions of these Regulations are in substitution for the provisions of so much of section 1(2) of the principal Act as relates to the cleaning of parts of factories, being parts in which any process to which these Regulations apply is carried on or into which any asbestos dust from any such process carried on in the factory is liable to escape, and of so much of section 63(1) of that Act as relates to the measures to be taken against asbestos dust, but save as aforesaid are in addition to and not in substitution for or in diminution of other requirements imposed by or under the principal Act.

(d) 1889 c. 63.

Certificates of exemption

4. The Chief Inspector may (subject to such conditions, if any, as may be specified therein) by certificate in writing (which he may in his discretion revoke at any time) exempt from all or any of the requirements of these Regulations

(*a*) any factory or part of any factory; or

(*b*) any class or description of factories or of parts thereof; or

(*c*) any machine, plant, apparatus or process or any class or description of machines, plant, apparatus or processes; or

(*d*) the employment of any person or class or description of persons,

if he is satisfied that the requirements in respect of which the exemption is granted are not necessary for the protection of persons employed or are impracticable.

Obligations under Regulations

5.—(1) Except in the case of any place where building operations or works of engineering construction are carried on it shall be the duty—

(*a*) of every employer (whether or not an occupier) who is undertaking in a factory any process to which these Regulations apply to comply with the requirements of these Regulations in relation to any person employed by him, any plant or material under his control, and any part of the factory in which he is carrying on the process or into which asbestos dust in connection with that process is liable to escape;

(*b*) of every occupier of any factory (whether or not such an employer as aforesaid) where any such process is being carried on to comply with the requirements of Regulations 8, 18 and 19 in relation to any person employed in the factory (other than any person employed by an employer who is undertaking in the factory any process to which these Regulations apply) and with the requirements of Part III of these Regulations; and

(*c*) of every person who is undertaking in a factory any process to which these Regulations apply and who employs no other person in the carrying on of that process to comply, for the protection of employed persons working there, with the requirements of these Regulations (other than Regulations 8, 14 and 18 to 20) with which he would have to comply if he were the employer of a person doing there the work which he does himself.

(2) In the case of places where building operations or works of engineering construction are carried on it shall be the duty of every contractor and of every employer who is undertaking any process to which these Regulations apply to comply with the requirements of these Regulations in relation to any person employed by him and any person employed there who is liable to be exposed to asbestos dust in connection with any process carried on by the contractor or employer (as the case may be), and in relation to any plant or material under his control and any part of the site where he is carrying on the process or where asbestos dust in connection with that process is liable to escape.

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(3) It shall be the duty of every person employed to comply with the requirements of such of these Regulations as relate to the performance of or refraining from an act by him.

Notifications

6.—(1) Where at the date of the coming into operation of these Regulations a person is undertaking in a factory any process involving crocidolite (including the removal from any surface of lagging consisting of or containing crocidolite), he shall within 28 days of that date give written notice to the inspector for the district that he is undertaking such a process and of the address of the factory at which he is doing so.

(2) Before a person first begins after the coming into operation of these Regulations to undertake in a factory any such process as aforesaid, he shall give not less than 28 days written notice to the inspector for the district, or such shorter notice as the inspector may agree to accept, of the date on which and of the address of the factory at which he will begin to do so.

Part II

Exhaust Ventilation and Protective Equipment

Exhaust ventilation

7.—(1) Subject to the provisions of the next following Regulation, no process to which these Regulations apply shall be carried on in any factory unless equipment is provided, maintained and used which produces an exhaust draught which prevents the entry into the air of any workplace of asbestos dust:

Provided that the foregoing requirements of this Regulation shall not apply where any such process is carried on in such a manner as to be as safe as it would be if the said requirements were complied with.

(2) Exhaust ventilation equipment provided in accordance with this Regulation shall while any work of maintenance or repair to the machinery, apparatus or other plant or equipment in connection with which it is provided is being carried on, be kept in use so as to produce an exhaust draught which prevents the entry into the air of any workplace of asbestos dust.

(3) Exhaust ventilation equipment provided in accordance with this Regulation shall be inspected at least once in every seven days and shall be thoroughly examined and tested by a competent person at least once in every period of fourteen months, and a report of the results of every such examination and test containing approved particulars and signed by the person making or responsible for the carrying out of the examination and test shall be made within fourteen days after the examination and test.

(4) Every such report as aforesaid shall be attached to the general register and be preserved and kept available for inspection by any inspector for a period of two years after it is made.

Protective equipment

8.—(1) Where in any factory the requirements of paragraph (1) or (2) of the last foregoing Regulation apply, but it is impracticable to comply with those requirements, there shall be provided for the use of each person employed in any part of the factory, being a part into which asbestos dust from a process to which these Regulations apply is liable to escape—

(*a*) approved respiratory protective equipment; and

(*b*) protective clothing.

(2) All respiratory protective equipment and protective clothing provided in pursuance of the foregoing paragraph of this Regulation shall be maintained.

(3) All respiratory protective equipment and protective clothing so provided shall be used by the persons for whom they are provided while employed in any such part of the factory as aforesaid.

(4) No respiratory protective equipment so provided which has been worn by a person shall be provided for the use of another person unless it has been thoroughly cleaned and disinfected since last being worn.

(5) No person shall be employed to perform any work for which respiratory protective equipment is provided in pursuance of this Regulation unless he has been fully instructed in the proper use of that equipment.

Part III

Cleanliness of Premises and Plant

Duty to keep clean

9. All machinery, apparatus, work benches and other plant and equipment used in any factory for the purposes of any process to which these Regulations apply, all external surfaces of exhaust ventilation equipment provided in pursuance of these Regulations and all floors, inside walls, ceilings, ledges and other internal surfaces of any part of a building or of any ship, being a part in which any process to which these Regulations apply is carried on or into which asbestos dust from any such process carried on in the factory is liable to escape, shall, so far as is practicable, be kept in a clean state and free from asbestos waste and dust in accordance with the provisions of this Part of these Regulations.

Cleaning by dustless method

10. The cleaning required by the last foregoing Regulation shall, so far as is practicable, be carried out—

(*a*) by means of vacuum cleaning equipment so designed and constructed and so used; or

(*b*) by some other suitable method such,

that asbestos dust neither escapes nor is discharged into the air of any workplace.

Cleaning where cleaning by dustless method is impracticable

11. (1) In so far as it is impracticable to carry out the cleaning required by Regulation 9 in accordance with the provisions of the last foregoing Regulation, such cleaning shall be carried out in accordance with the provisions of this Regulation.

(2) Protective clothing and approved respiratory protective equipment shall be provided for and used by every person present in any part of a factory while such cleaning is being carried out in that part otherwise than in accordance with Regulation 10.

(3) No respiratory protective equipment so provided which has been worn by a person shall be provided for the use of another person unless it has been thoroughly cleaned and disinfected since last being worn.

(4) No person shall be employed to perform any work for which respiratory protective equipment is provided in pursuance of this Regulation unless he has been fully instructed in the proper use of that equipment.

(5) Any surface on which asbestos waste or dust is deposited as a result of the carrying out of cleaning in pursuance of this Regulation, not being a surface of the cleaning equipment used, shall be cleaned forthwith.

Vacuum cleaning equipment

12. Vacuum cleaning equipment used for cleaning in accordance with the provisions of this Part of these Regulations shall be maintained and have all external surfaces kept in a clean state and free from asbestos waste and dust.

Requirements as to construction of buildings before first use for certain processes

13. After the date of the coming into operation of these Regulations no process specified in the Schedule to these Regulations shall be carried on in a building by the occupier of the building unless any part of such building where any such process is carried on and has not previously been carried on—

(*a*) is so constructed that all its interior surfaces are smooth and impervious and is so designed and constructed as to have in it as few surfaces as is practicable on which asbestos dust can settle; and

(*b*) has a vacuum cleaning system which has filters and a source of suction located at a fixed central point with pipes throughout the building fitted with suitably placed inlets to which portable cleaning implements can be attached and is a system which is so designed and constructed that asbestos dust cannot escape or be discharged from it into the air of any workplace:

Provided that the requirements of this Regulation shall not apply where a process or processes so specified are carried on in a factory for a total number of hours not exceeding eight in any week.

Cleanliness of accommodation for clothing

14. Where there is provided for the use of employed persons under section 59 (accommodation for clothing) of the principal Act or under any regulations made under that Act accommodation for clothing not worn during working hours, the accommodation so provided shall be such or shall be so situated that asbestos dust is not deposited on any such clothing in the said accommodation.

PART IV

STORAGE AND DISTRIBUTION

Storage

15. All loose asbestos in a factory shall when not in use be kept in suitable closed receptacles which prevent the escape of asbestos dust therefrom, and all asbestos waste in a factory shall, when stored, be kept in such receptacles.

Distribution, etc.

16. No loose asbestos or asbestos waste shall be despatched from or as far as is practicable received into a factory except in suitable closed receptacles which prevent the escape of asbestos dust therefrom or shall be distributed within a factory except in such receptacles or in a totally enclosed system of conveyance.

Marking of receptacles

17. All such receptacles as aforesaid shall, where they contain crocidolite, be clearly and boldly marked with the words "Blue asbestos—do not inhale dust".

PART V

ACCOMMODATION FOR AND CLEANING OF PROTECTIVE EQUIPMENT

Accommodation, etc. for protective clothing and respiratory protective equipment

18.—(1) Suitable accommodation in a conveniently accessible position shall be provided for the use of persons employed when putting on or taking off respiratory protective equipment and protective clothing provided in pursuance of these Regulations and for the storage of such clothing and equipment when it is not in use.

(2) All protective clothing and respiratory protective equipment which has been provided in pursuance of these Regulations for the use of persons employed shall when not required for use be kept in the accommodation for storage provided in pursuance of paragraph (1) of this Regulation, except when it is necessary for it to be removed for cleaning or replacement.

(3) So far as practicable, the same protective clothing shall (until it becomes necessary to replace it) be available for use by a person employed on each occasion on which he requires to wear it in pursuance of these Regulations.

Cleaning of protective clothing

19.—(1) All protective clothing provided in pursuance of these Regulations shall at suitable intervals be cleaned.

(2) The said cleaning shall be carried out within the factory where the clothing is provided:

Provided that this requirement shall not apply in the case of protective clothing which before despatch from the factory for cleaning is properly packed in suitable containers which prevent the escape of asbestos dust therefrom and the containers in which it is packed are clearly and boldly marked with the words "Asbestos contaminated clothing".

PART VI

YOUNG PERSONS

Employment of young persons

20. No young person shall be employed—

(*a*) in any process to which these Regulations apply or in any part of a factory into which asbestos dust from any such process carried on in the factory would otherwise be liable to escape unless the requirements of Regulation 7 are complied with in respect of that process; or

(*b*) in carrying out any cleaning in accordance with Part III of these Regulations otherwise than by means of vacuum cleaning equipment or other suitable method in accordance with the provisions of Regulation 10.

13th May 1969.

Barbara Castle,
First Secretary of State and Secretary
of State for Employment and Productivity.

SCHEDULE

Regulation 13

Processes specified for the purposes of Regulation 13

1. Breaking, crushing, disintegrating, opening and grinding of asbestos, and the mixing of asbestos (including the mixing of asbestos with any other material) or the sieving of asbestos, and all processes involving manipulation of asbestos incidental thereto.

2. All processes in the manufacture of yarn or cloth composed of asbestos or asbestos mixed with any other material, including preparatory and finishing processes.

3. The making of insulation slabs or sections, composed wholly or partly of asbestos, and processes incidental thereto.

4. The making and repairing of insulating mattresses, composed wholly or partly of asbestos, and processes incidental thereto.

5. Any other process in the manufacture of articles composed wholly or partly of asbestos in connection with which asbestos dust is given off.

EXPLANATORY NOTE

(*This Note is not part of the Regulations.*)

These Regulations impose requirements for the safety and welfare of persons employed in factories and in other premises and places to which the Factories Act 1961 applies, where processes are carried on which involve asbestos or any article composed wholly or partly of asbestos and are capable of giving rise to asbestos dust. The Regulations require that the processes be carried on under an exhaust draught or in some other equally safe way, or that protective clothing and respiratory protective equipment be provided for the use of persons employed. The Regulations also impose requirements as to the cleaning of premises and plant, the construction of buildings newly used for the processes, the storage and distribution of asbestos, the accommodation to be provided for protective equipment and the cleaning of protective clothing. The employment of young persons in connection with processes to which the Regulations apply and in cleaning work is prohibited except in specified circumstances. The Regulations also require that notification of processes involving crocidolite be sent to the inspector for the district.

The Asbestos Industry Regulations 1931 and certain provisions concerning asbestos of the Shipbuilding and Ship-repairing Regulations 1960 are revoked.