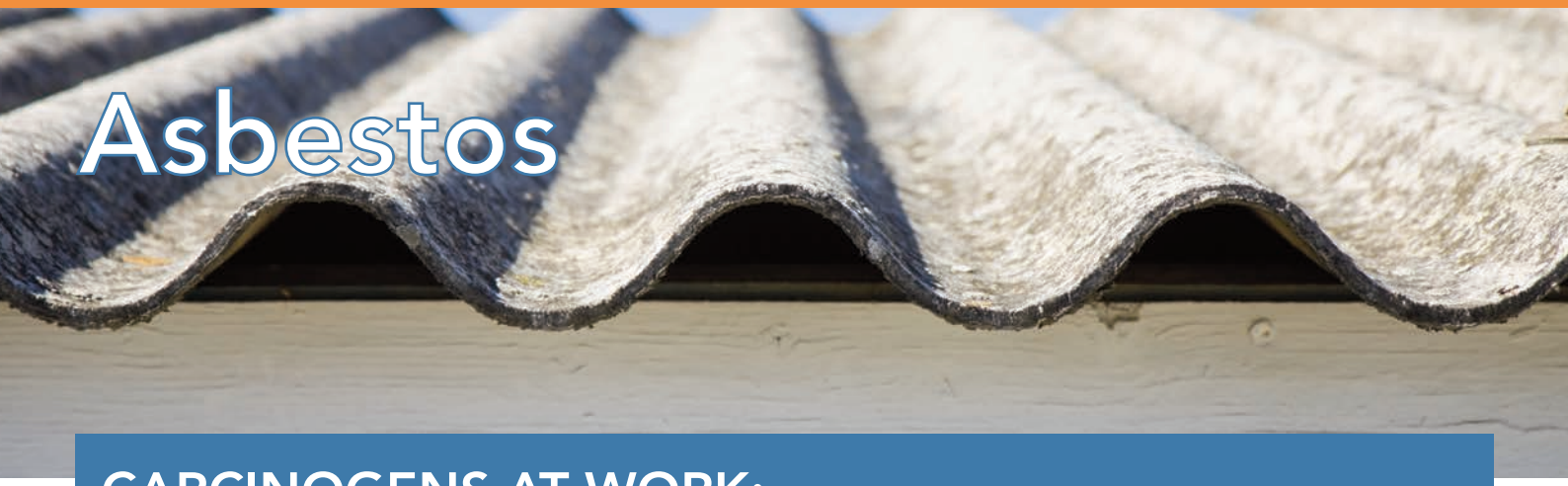
GOBIERNO DE ESPAÑA
MINISTERIO DE TRABAJO Y ECONOMÍA SOCIAL
insst Instituto Nacional de Seguridad y Salud en el Trabajo



Asbestos

CARCINOGENS AT WORK: Know to Prevent

Information about the substance and where it can be found

"Asbestos" is the generic term for a group of hydrated silicate minerals with a fibrous, crystalline structure and a variable chemical composition.

Silicates can be classified into different groups depending on the composition and spatial organization of their molecules. For example, the amphibole group is characterised by short, straight fibres, or the serpentine group has long and curved fibres. Thus, based on this characterisation and chemical composition, the varieties of asbestos regulated for the purposes of applying Royal Decree 396/2006, of 31 March, which sets out the minimum health and safety provisions applicable to work involving risk due to exposure to asbestos, are as follows:

Table 1
Varieties of asbestos regulated by Royal Decree 396/2006 and their analogous non-fibrous minerals

VARIETY OF ASBESTOS			CAS n°	Analogous minerals (non-fibrous)
Mineralogical group	Name	Chemical formula		
Serpentines	Chrysotile	$Mg_6(Si_4O_{10})(OH)_8$	12001-29-5	Lizardite, Antigorite
Amphiboles	Crocidolite	$Na_2Fe_3^{2+}Fe_2^{3+}(Si_8O_{22})(OH)_2$	12001-28-4	Riebeckite
	Amosite (Grunerite)	$(Fe^{2+}, Mg)_7(Si_8O_{22})(OH)_2$	12172-73-5	Grunerite
	Anthophyllite asbestos	$(Mg, Fe^{2+})_7(Si_8O_{22})(OH,F)_2$	77536-67-5	Anthophyllite (Cummingtnite)
	Actinolite asbestos	$Ca_2(Fe^{2+},Mg)_5(Si_8O_{22})(OH)_2$	77536-66-4	Actinolite
	Tremolite asbestos	$Ca_2Mg_5(Si_8O_{22})(OH)_2$	77536-68-6	Tremolite

Asbestos can be found in nature almost everywhere in the world, and is extracted in opencast mines. The most important deposits are located in the USA, Canada, South Africa, China and Russia.

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Asbestos-containing material (ACM) is defined as material containing asbestos that has been intentionally added in making it, the best-known ACM being asbestos cement.

After extraction, it is processed into the end product of commercial interest. Thus, by mixing asbestos fibres (one or more varieties) with other materials (matrix) in different proportions, a wide variety of low-cost products have been obtained that have very useful properties in industry and, particularly, in construction, which is why it was widely used during the 20th century.

All varieties of asbestos have similar physical-chemical properties, the most important of which are the following:

- Abrasion and friction resistance.
- Resistance to high temperatures, which makes it suitable for thermal insulation.
- Non-combustible, non-flammable and prevents the spread of fire.
- High chemical resistance, resistant to erosion, impregnation or corrosion caused by acids, bases or chemical solvents.
- Non-biodegradable, resistant to the action of biotic agents, fungi, pests, pathogens or other organisms.
- Low thermal, electrical and acoustic conductivity.
- Easily weaved (mainly chrysotile).
- Ability to mix with other materials (matrix) to form asbestos containing materials (ACM).

Because of these excellent properties, asbestos began to be used commercially in the late 19th century, and became widely used in many industries after the Second World War. It has been used, for example, in the construction industry as a cement reinforcement, a thermal insulator and an acoustic insulator, in the textile industry, in the shipbuilding industry as a boiler and pipe insulator, in the railway or automotive industry in vehicle brake shoes and clutch discs, in paints and coatings, also as a spark arrester and in electrical panels, etc. (ATSDR).

Chrysotile is the most common variety of asbestos and the most widely used in construction (Mateo et al. 2013). It is estimated that its use accounted for more than 90% of imported asbestos, followed by crocidolite and amosite.

Chrysotile (top) and amosite (bottom) fibres.

Table 2 describes the different types of ACMs, their main uses and main applications:

Table 2
Types of asbestos-containing materials, uses and applications. Non-exhaustive list

TYPE OF ACM	USES AND APPLICATIONS
Loose fill asbestos fibres (Bulk asbestos or asbestos dust)	Interior insulation of fire doors. Filler for ceilings and false ceilings.
	Coatings on machinery.
	Ceiling and wall cladding.
Spraying and mortars	Thermo-acoustic coatings for metal structures and buildings. Inner side of some roofs.
Laggings and packagings	Thermal insulation of air-conditioning systems in buildings (pipes and boilers) and in industrial facilities and machinery.
Cords and yarns	Heat and fire-resistant gaskets and sealants, thermal insulation of installations subjected to high temperatures and braided tubes for electrical cables.
Textiles	Thermal protective clothing (gloves, aprons, overalls, etc.) for workers in activities with very high working temperatures. Flame retardant textiles in theatres, cinemas or auditoriums.
Asbestos insulating board (AIB)	Insulating panels for fire protection, thermal and acoustic insulation, used in general construction. Fire-resistant (RF) cladding plates on structures, equipment or elements requiring point heat protection.
Paper and cardboard-asbestos	Wall cladding (internal and external), fire resistant, and pipe insulation. Electrical and thermal insulation of electrical equipment. Filler in gaps and joints.
Friction elements	Braking elements for equipment, machinery or transport systems (vehicles, trains, etc.), as well as for protection against corrosion.
Asbestos-vinyl. Thermoplastic tiles. Reinforced plastics.	Wall and floor cladding in buildings, industrial floors and surfaces with resistance-to-friction, wear and chemical degradation requirements.
Adhesives, sealants and putties	In waterproofing, expansion joints and watertightness seals in general.
Bitumens and asphalts	In waterproofing flat roofs and roof terraces. Also, as inner linings of gutters and cladding on metal and in the last wearing course of road surfaces due to its wear resistance.
Paints and varnishes	Wear-resistant coatings in high traffic areas, in road marking paints on paved surfaces.
Asbestos cement	In buildings with different purposes (housing, public or private buildings to provide services, industrial or livestock buildings, etc.). On roofs and façades, pipes and gutters, tanks, flues or chimneys, fixed louvres of blinds, garden furniture, decorative elements in friezes, railings, balustrades, etc.

In 2002, after the entry into force of the Order of 7 December 2001, the use, production and marketing of asbestos fibres and products containing these fibres was completely banned in Spain.

However, the use of ACMs installed or in service before this order came into force remains permitted until their disposal or they reach the end of their useful life. However, the use of ACMs installed or in service before this order came into force remains permitted until their disposal or they reach the end of their useful life. In the field of prevention, the end of the useful life of an ACM must be deemed to have been reached when it is likely to be harmful to health because of the likelihood of its releasing asbestos fibres into the environment, either because of its state of deterioration or because of other factors that may induce the release of fibres such as the risk of breakage, impact, vibration, etc., due to its location.

The European Parliament deems asbestos-containing materials to typically have a life cycle of between 30 and 50 years from the product's manufacture (European Parliament resolution of 14 March 2013 on asbestos-related health risks in the workplace and the prospects for removing all existing asbestos (2012/2065(INI))).

Furthermore, Royal Decree 396/2006 prohibits activities that expose workers to asbestos fibres in asbestos removal, the manufacture and processing of asbestos products and the manufacture and processing of products containing deliberately-added asbestos, with the exception of the treatment and disposal of products resulting from demolition and asbestos removal.

Therefore, the possibility of finding asbestos in Spain is currently limited to already installed ACMs that are part of, for example, structures or facilities in buildings, equipment or units such as ships, trains or vehicles, or the management of asbestos-containing waste.

At European Union level, the **Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)**, sets out in its Annex XVII on "Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and ar ticles", besides the prohibition of the manufacture, placing on the market and use of asbestos fibres and of arti cles and mixtures these fibres added containing intentionally, that *"the use of articles containing asbestos fibres which were already installed and/or in service before 1 January 2005 shall continue to be permitted until they are disposed of or reach the end of their service life. However, Member States may, for reasons of protection of human health, restrict, prohibit or make subject to specific conditions, the use of such articles before they are disposed of or reach the end of their service life."*

Health effects

Products containing asbestos do not present a health risk if the asbestos fibres are strongly retained in their matrix, but when ACMs are broken down, grinded or degraded they are likely to release fibres into the environment.

The danger of asbestos lies in inhaling fibres that can be released from asbestos-containing materials.

The fibres have dimensions of the size of the respirable fraction, with a length > 5 µm, a diameter < 3 µm and a length to diameter ratio > 3, and they can therefore remain in suspension in the air and be inhaled, being deposited in the respiratory tract and causing adverse health effects, for example, inflammatory, fibrotic and carcinogenic action. The processes of inflammation, fibrosis and carcinogenesis appear to be interrelated (Sanidad, M. d., 2013).

Asbestos exhibits what is known as the **asbestiform property**. Because it is made up of bundles of fibres, it can divide longitudinally and create new fibrils, which are finer than the first. Thus, fibres of different sizes can become suspended in the air and can penetrate and cause damage at different levels of the respiratory tract. When asbestos fibres are inhaled and enter the respiratory tract, they can be retained by the mucociliary system and eliminated by mucociliary clearance. Those not eliminated by this mechanism pass into the alveoli, where they may be phagocytosed by macrophages, eliminated via the lymphatic pathway, or they may be deposited and accumulate, causing fibrosing or oncogenic effects (Abu-Shams et al., 2005).

The ability of asbestos fibres to cause pathology appears to depend on their aerodynamic diameter, their length and the length of time they remain in the tissues. Larger-diameter fibres are deposited in the nose, trachea and bronchi and are eliminated by the mucociliary system through the mucociliary clearance mechanism. Those with smaller diameters can reach the respiratory bronchioles. In terms of fibre length, long fibres that reach the alveoli are deemed to have higher pathogenicity due to lower clearance, while shorter fibres, shorter than 5 µm, have lower biological activity. Besides fibre dimensions, other properties seem to influence the pathogenic capacity. Because of their configuration, the long, coiled chrysotile fibres are more easily retained in the proximal bronchi by the mucociliary system, while the short, stiff amphibole fibres reach the bronchioloalveolar spaces (Abu-Shams et al., 2005).

Regulatory references:

Asbestos was classified as a carcinogen (Carc. 1A) in the European Union in Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures (CLP Regulation).

Besides the specific regulations for work with asbestos, the provisions of Royal Decree 665/1997 of 12 May 1997 on the protection of workers from the risks related to exposure to carcinogens at work shall also apply.

The IARC (iarc.who.int) is an autonomous agency of the World Health Organization of the United Nations. It seeks to promote international collaboration in cancer research. It runs studies that are widely recognised for their quality and independence.

In any case, asbestos fibres are biopersistent, causing greater damage the longer they remain in the tissues (Brody, A. R., 2018). In general, chrysotile has a half-life of months, whereas amphiboles can remain in the lung for decades (Hueto, J. et al., 2005).

The elimination of fibres (retained in the mucous film of the airways or in cells that have absorbed them in non-ciliated areas) through faeces or urine is rapid, from minutes to about twelve hours, and its effectiveness reaches 98% (Hueto, J. et al., 2005).

The International Agency for Research on Cancer (IARC) recognises asbestos in all its varieties as a carcinogen (group 1), since there is sufficient evidence that exposure to asbestos fibres can cause at least the following diseases:

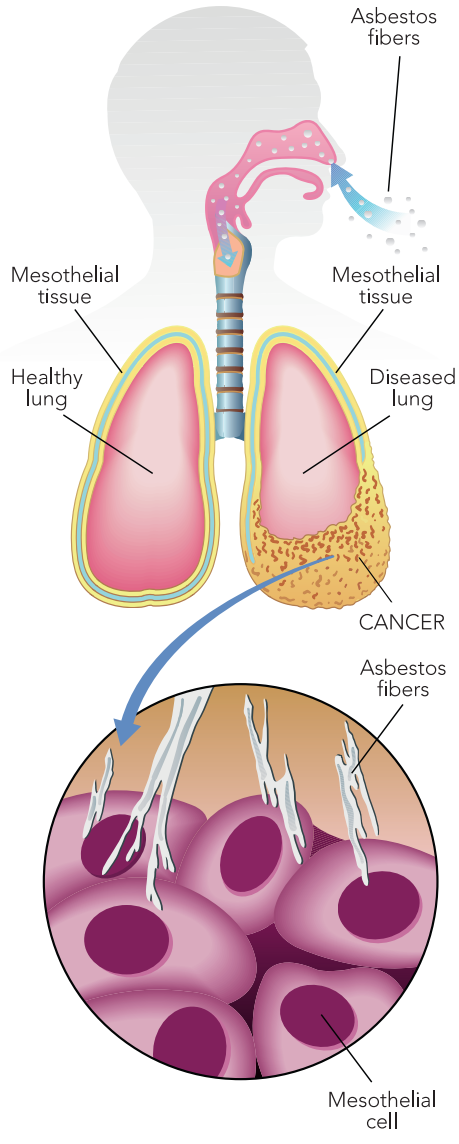
- Asbestosis or pulmonary fibrosis.
- Mesothelioma.
- Benign pleural diseases.
- Skin cancer.
- Laryngeal cancer.
- Ovarian cancer.

Moreover, IARC has observed positive associations between exposure to asbestos fibres and cancer of the pharynx, colorectal cancer and stomach cancer.

Asbestosis or pulmonary fibrosis is an alveolar inflammatory process caused by the inhalation of asbestos fibres, either because there has been prolonged contact over time or very intense contact over a short period of time.

Malignant mesothelioma is a rare type of cancer in the general population. Because its root cause is exposure to asbestos, the incidence rate of asbestos cancer in a country is a good indicator of the population's asbestos exposure (Furuya, S. et al., 2018). It is associated with long-term exposure especially of amphiboles, although it can also be caused by short exposures. It can involve the pleura, peritoneum or pericardium, with pleural cancer being the most common (Brims, F, 2021).

Pleural Mesothelioma



Lung cancer can occur with low exposures to asbestos. Its incidence is governed by an almost linear dose-response relationship, with no clearly-defined threshold (Klebe, S. et al., 2020).

Laryngeal cancer is a tumour that forms in the tissues of the part of the throat that contains the vocal cords.

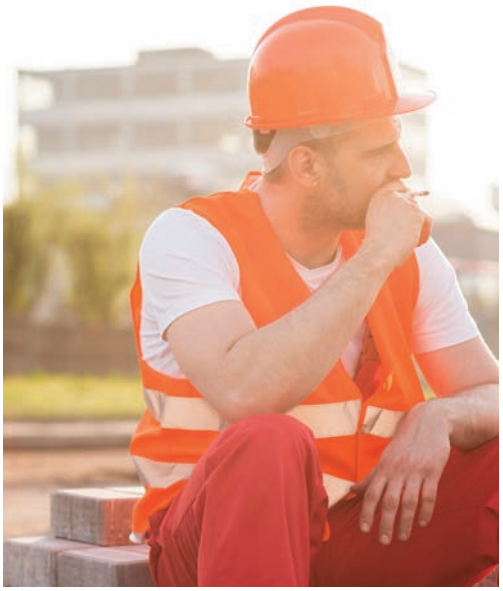
These diseases are characterised by long latency periods, ranging from 10 to 15 years in the case of pleural plaques and 20-30 years for mesothelioma, and many years may pass between exposure to asbestos and the onset of the disease, although with certain exposures the effects may begin much earlier.

Both the intensity and duration of exposure are relevant to the risk of disease (Cvitanovic, S, et al., 2003), that is, the greater the amount of asbestos accumulated over the years, the greater the likelihood of developing one of the associated diseases. However, these factors appear to be significant in asbestosis, albeit of varying influence elsewhere. In the case of cancers, a stochastic presentation is observed that is less dependent on the intensity or the prolonged and continuous time of exposure (Vicente Pardo, J. M., 2014).

The body's response to asbestos exposure may be influenced by other factors or habits such as diet or smoking. Research has shown the negative synergistic effect of smoking and asbestos exposure. That is, asbestos-exposed workers who are smokers have a higher risk of developing lung cancer than if the individual risks of asbestos exposure were added to the risks of smoking (Suárez, D, et al., 2019). The risk of lung cancer is higher in exposed workers if they also smoke. Exposure to asbestos increases the risk of lung cancer fivefold in non-smokers and 55-60 times in smokers (Vicente Pardo, J. M., 2014).

Royal Decree 1299/2006 of 10 November 2006, approving the table of occupational diseases in the Social Security system and setting out criteria for reporting and registering them, includes occupational diseases caused by asbestos (asbestosis, fibrosing affections of the pleura and pericardium with respiratory or cardiac restriction caused by asbestos, malignant neoplasm of the bronchus and pleura, mesothelioma and laryngeal cancer) in group 4 and group 6 of the table in Appendix I.

Cancers resulting from asbestos exposure represent at least half of the deaths attributable to recognised occupational cancers in the world, accounting for three quarters of the recognised occupational cancers in Europe (GBD 2016, 2020).



The risk of developing cancer increases with tobacco use and there is a synergistic effect. Exposure to asbestos increases the risk of lung cancer fivefold in non-smokers, and 55-60 times in smokers.

Where the exposure can take place

Disintegrated ACM

Exposure to asbestos can occur when asbestos fibres are suspended in the air and can be inhaled. Due to their small size, these fibres can remain in suspension for a long time, or adhere to clothing or any kind of surface, thus increasing the likelihood of being inhaled. Since they are microscopic and the fibres are not perceived by the senses, the risk from exposure to asbestos fibres may go unnoticed.

In terms of prevention, the most relevant characteristic of ACMs that will greatly influence exposure is friability, which is defined as the ability of an ACM to release the fibres it contains and which increases as the ACM breaks down, deteriorates or ages. Depending on friability, ACMs are classified as follows:

- **Friable material:** can be broken up or reduced to powder by hand action alone. Examples of friable ACM include sprayed coatings and mortar, fugitive heaters, textiles, paper and paperboard or prefabricated boards.
- **Non-friable material:** is material that needs mechanical tools to be crumbled or reduced to dust, for example, asbestos cement (fibre cement), asphalt roofing felt, thermoplastic tiles or reinforced plastics.

Operations or activities in which exposure to asbestos fibres may occur, included in the scope of application of Royal Decree 396/2006, are as follows:

Table 3
Activities in which workers may be exposed to asbestos fibres

Demolition work on buildings where asbestos or materials containing asbestos are present.
Dismantling work on elements, machinery or tools where asbestos or materials containing asbestos are present.
Work and operations for the removal of asbestos or asbestos-containing materials from equipment, units (such as ships, vehicles, trains, etc.), facilities, structures or buildings.
Maintenance and repair work on existing asbestos-containing materials in equipment, units (such as ships, vehicles, trains), facilities, structures or buildings.
Maintenance and repair work involving the risk of asbestos fibres being released due to the existence and proximity of asbestos materials.
Transport, treatment and destruction of waste containing asbestos.
Authorised landfill sites for asbestos waste.
All other activities or operations involving handling of asbestos-containing materials, where there is a risk of asbestos fibres being released into the work environment.

However, exposure may have various origins. We may refer to occupational exposure when it affects the workers themselves who are directly involved in working with asbestos, such as those listed in the table above, or of accidental exposure when, due to work being done with asbestos, it affects people who are not involved in the intervention. Inadvertent exposure may also occur when work done without knowing that ACM is present, and it can affect both workers and third parties.

Therefore, in terms of occupational exposure, workers exposed or likely to be exposed to asbestos fibres or materials containing asbestos are limited to those who perform the activities and operations included in the scope of application of Royal Decree 396/2006 and listed in table 3; rather, several types of workers exposed or likely to be exposed to asbestos fibres or materials containing asbestos may be identified:

- Those who work with asbestos (prolonged and/or regular exposure).
- Those who, in the course of their work, encounter asbestos-containing materials unexpectedly or who work in the vicinity of ACM (unintentional or accidental exposures).
- Those who work where asbestos-containing materials are installed (inadvertent exposures).

Exposure assessment

Work involving exposure to asbestos or materials containing asbestos falls within the scope of application of Royal Decree 396/2006, on the minimum health and safety provisions applicable to work involving the risk of exposure to asbestos and, therefore, the assessment of exposure and the control measures to be applied must take into account the requirements of this regulation, which also puts in place a binding occupational exposure limit value (BOELV), 8-hour OEL, of 0.1 fibres/cm^3.

Thus, before starting any activity involving risk due to exposure to asbestos, this risk must be assessed, to establish a basis for making decisions regarding the preventive measures to be implemented and the working procedures to be adopted.

According to the regulations, for any type of activity that may present a risk due to exposure to asbestos or asbestos-containing materials, the risk assessment must include a measurement of the concentration of asbestos fibres in the air in the workplace and its subsequent comparison with the

Some workers may be accidentally or circumstantially exposed to asbestos fibres because of the likelihood of encountering ACM in the course of their work. They should also be identified and taken into account in the risk assessment.

They may be:

- Heating and ventilation technicians.
- Demolition workers.
- Carpenters.
- Fitters.
- Plumbers.
- Electricians.
- Painters and decorators.
- Plasterers, plasterers, renderers.
- General maintenance workers.
- Installers of alarms and fire protection systems.
- Gas installers.
- Telecommunication systems installers.
- Architects, surveyors.
- etc.

8-hour OEL. Appendix I of Royal Decree 396/2006 sets out the sampling and analysis requirements (fibre counting), which include the requirement that sampling should preferably be performed according to the procedure in the INSST's **MTA/MA-051/A04** method, which describes the equipment and procedure necessary for sampling and counting fibres, or by any other method giving equivalent results. Moreover, the design of the measurement strategy must be such that a representative exposure can be determined for an eight-hour reference period by taking samples representative of workers' potential exposure.

There are various methodologies for performing this exposure assessment, one of the most widely recognised for the quantitative assessment of exposure to chemical agents being that set out in the UNE- EN 689:2019 Standard, not only due to the number of personal measurements to be made to verify the conformity of the results with the occupational exposure limit (OEL) but also to establish frequency and periodicity intervals for subsequent assessments (periodic reassessments).

Risk assessment for asbestos exposure is a complex task due to the characteristics of the method used to measure exposure and the variety of situations in which it may occur in the workplace: it requires professional judgement and experience. Therefore, risk assessments must be performed by personnel qualified to carry out higher level duties with a specialisation in Industrial Hygiene and detailed knowledge of the f sampling and analysis method.

On the other hand, the analysis (fibre counting) can only be done by specialist laboratories whose technical capacity has been formally recognised by the labour authority of the Autonomous Community where the laboratory is located, according to the procedure set out in Appendix II of the Royal Decree.

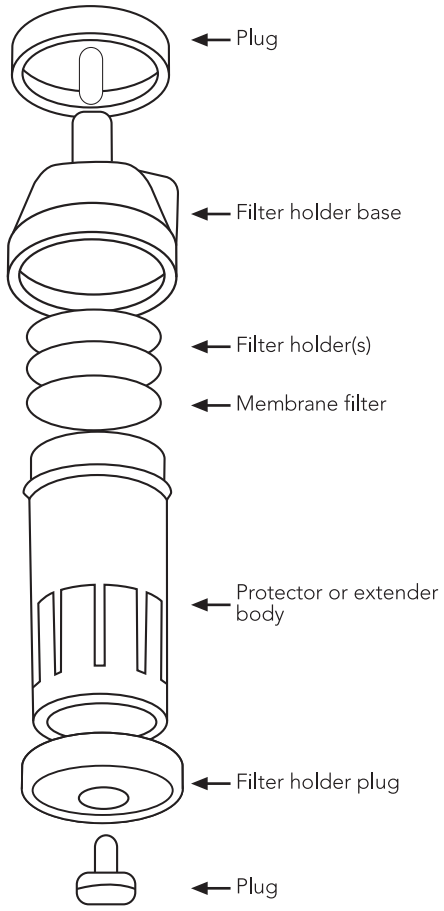
Representativeness of the samples

Whenever a quantitative assessment of inhalation exposure to a hazardous chemical agent is performed, a sampling strategy must be adopted to ensure the representativeness of the data obtained. The standard UNE-EN 689:2019+AC:2019, *Workplace exposure. Measurement of exposure by inhalation of chemical agents.* Strategy for testing compliance with the occupational exposure limit values, provides a possible strategy for comparing daily exposure with the occupational exposure limit values.

The INSST has validated the MTA/MA-051/A04: method: Determination of asbestos and other fibres in air. Membrane filter method / Phase contrast optical microscopy. (Multi-fibre method) for the sampling and analysis of asbestos fibres in air.

The INSST has also published various documents to clarify the methodology for taking samples of asbestos in air:

- NTP 158: Sampling of asbestos fibres.
- NTP 801: Asbestos: reliability of the results of airborne fibre determinations determination of airborne fibres. - Requirements.
- NTP 1159: Asbestos: Determination of fibres in air. Sampling volume.
- CR-02/2005: Reliable measurement of asbestos fibre concentrations in air. Application of the MTA/MA-051/A04 sampling and analysis method. (Multi-fibre method).



Controlling exposure

According to Royal Decree 396/2006, workers' exposure to asbestos fibres or materials containing asbestos in the workplace must be reduced to a minimum and, in any case, below the 8-hour OEL, by applying general technical prevention measures, organizational measures and individual hygiene and protection measures.

There is no work with asbestos for which minimum preventive measures are not necessary, no matter how low the risk. In other words, not all measures are always necessary, but preventive measures are always necessary. These measures shall be in accordance with the estimated level of risk of the work to be performed, bearing in mind the various alternatives and assessing the additional risks they may introduce.

1. Technical preventive measures:

The measures to be implemented must be those which aim to reduce the emission of fibres, those that reduce their dispersal and those that facilitate the cleaning and decontamination of the work area, in order to reduce exposure to the lowest level that is technically possible.

It should be borne in mind that there is no value below which the concentration of asbestos fibres in air is safe.

Therefore, even if there is a binding OEL (8-hour OEL), all reasonably practicable specific preventive measures must always be taken to reduce the risk to the lowest possible level, and in any case below the 8-hour OEL.

Removal without fragmentation

It is necessary to use work procedures that do not involve breaking or fragmenting the ACMs, removing whole materials in reverse order of assembly wherever possible. For example: as part of the removal procedure for fibre cement boards, if possible, the fastening anchors should be cut and the entire board removed while respecting the overlaps of the boards, with the topmost boards being removed first.

Wet operations

The best option is always to work wet (avoid working dry, unless this is not possible due to electrical hazards). The spraying of water, or another encapsulating agent, during the work by adding the liquid at the cutting, drilling, breaking, etc., points capture and carries away the particles, preventing them from becoming suspended.

Pre-wetting of the materials to be removed must be done by spraying at low pressure to prevent the mechanical action of the water from dispersing the asbestos fibres into the environment. If a wet injection technique is used, the time it takes for the wetting agent to homogeneously penetrate the ACM must be taken into account.

When humectation is used, a system and procedure for cleaning and collection of sludge must be put in place to prevent the asbestos fibres from going into suspension. The waste must be handed over to an authorised waste manager.

Manual techniques

Always use hand tools or low-speed tools that do not produce strong vibrations. Fibre-emitting operations such as abrasion, sanding, machining, cutting, etc., of the ACM and the use of power tools must not be performed since they release more fibres.

Local Exhaust Ventilation

It is an effective measure to prevent the dispersal of fibres once they have been generated, preventing them from becoming suspended by acting directly on the source of the emission. High efficiency particulate filters (at least H13, according to UNE-EN 1822-1:2020 Absolute filters (EPA, HEPA and ULPA) must be used. Part 1: Classification, general principles of testing and marking).

The combination of using hand tools and the use of water can reduce the concentration of asbestos fibres to undetectable levels.

Isolation and confinement of the work area

This consists of sealing and covering with plastic sheeting all doors and windows, heating, ventilation and/or air conditioning ducts, etc., to isolate the work area. It also includes sealing all grooves in floors, walls and ceilings to prevent fibres from becoming trapped in them. The joints are sealed with strong adhesive tape to prevent breakage and to ensure watertightness.

Isolation may consist of a protective cover or bubble (confinement) based on plastic sheeting that prevents fibres from escaping from the working area. A negative pressure can be generated inside (dynamic containment) by using exhaust fans fitted with absolute particulate filters operated continuously until the end of the work and final cleaning, such as to prevent asbestos fibres suspended in the air inside the building from escaping.

Access and egress to and from the work area must be via a decontamination unit.

Glove bag technique

To prevent asbestos fibres from being dispersed, glove bags can be used, which allow work to be done inside them through the glove-shaped openings through which the arms can be inserted and the asbestos handled; they also allow the resulting waste to be directly packaged. These bags, which make it possible for several people to work simultaneously, are placed around the element from which asbestos is to be removed and sealed with adhesive tape. They also have an interior compartment for storing the tools and equipment required for the operation and can be fitted with valves to connect the system for wetting the asbestos material.

They are especially useful for pipe work.

Measures to facilitate cleaning and decontamination of the working area

Before work commences, the area must be prepared by removing mobile elements and isolating or protecting those that cannot be moved. The floor must also be covered with plastic material to make it easier to remove waste.

Waste management

Asbestos-containing waste is hazardous waste. Waste must be collected as it is produced, as soon as possible and segregated from other non-asbestos-containing waste, unpackaged waste must never be allowed to accumulate. They must be collected and transported away from the place of work as soon as possible and the waste collected, transported and treated by a waste manager authorised by the relevant autonomous community. Where possible, the entire ACM (for example, whole plates or pipes) should be wrapped without breakage for disposal as waste.

They must be identified with the regulatory label, in accordance with the REACH Regulation, such that it can be strongly affixed to the packaging or printed directly on the packaging.

Both Law 7/2022 of 8 April on waste and contaminated soils for a circular economy and Royal Decree 553/2020 of 2 June regulating the shipment of waste within the territory of the State are applicable to them.

All disposable materials (tools, accessories or personal protective equipment, etc.) used or generated during the handling of ACMs must be assumed to be asbestos-containing waste and treated as such.

The work area shall be cleaned by wet cleaning (using wetting and/or encapsulating agents, if necessary) and/or dry cleaning, using a hoover with high efficiency particulate filters (class H13 or higher). The work cycle shall be repeated as many times as necessary until no visible dust remains, allowing time between cleaning cycles for asbestos fibres in suspension to settle and be removed in the next cleaning cycle. Equipment and tools which may contain asbestos fibres must also be cleaned.

Blowing, projection or sudden manoeuvres that cause movements and disturbances that could lead to the dispersal of fibres in the air must be avoided, as must conventional sweeping and vacuuming.

2. Organisational measures

The number of workers exposed or likely to be exposed to asbestos fibres or materials containing asbestos must be kept to a strict minimum.

Workplaces must be demarcated and, both at the entrance and at the perimeter of the work area, clear and visible signs must be posted warning of the possibility that ambient concentrations of asbestos may exceed the limit value, indicating the mandatory use of PPE, limiting access to persons directly involved in the work and expressly indicating the prohibition of eating, drinking and smoking.

Workers may not work overtime or work under an incentive system when their work activity requires physical strain, forced postures or is performed in hot environments.

Safe working procedures and action protocols must be put in place for accidental exposures where the limit value is accidentally exceeded.

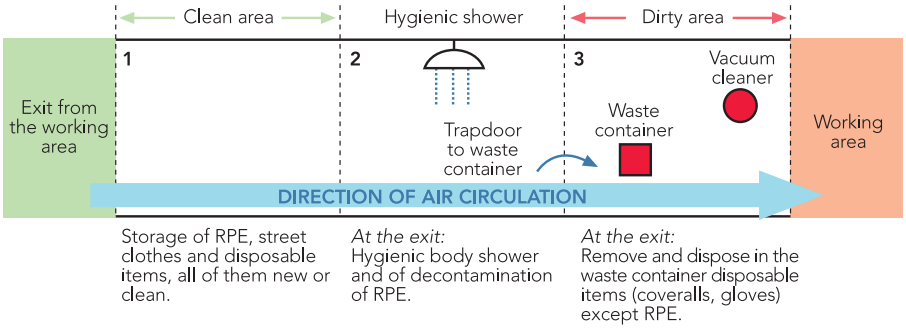
3. Hygiene and personal protection measures

They are intended to prevent asbestos fibres from adhering to the worker's clothing or skin and subsequently being released outside the work area, with the consequent risk of being inhaled by both the worker and others. Preventive measures that can be taken include the following:

- Make available to workers at risk of exposure to asbestos for personal hygiene, at least during the working day, ten minutes before lunch and another ten minutes before leaving work.

- Have facilities or places for separate storage of work clothes and street clothes as well as a place for proper storage of protective equipment.
- Have sanitary and personal decontamination facilities appropriate to the type of work being done. In most cases, the sanitary facilities must consist of the decontamination unit, a compartmentalised space that ensures separation and isolation between the contaminated area (dirty area) and the asbestos-free area (clean area) through the hygienic shower. The decontamination unit, which must have 3 or 5 modules depending on the risk level of the work, must be the only permitted point of access to or egress from the work area. It must be installed before work commences and must not be dismantled until the work is completed and it is certain that there are no hazards in the workplace. It must be cleaned daily after decontamination and cleaning of workers.

Personal decontamination protocols must be put in place as well as for the decontamination of equipment and installations.



4. Personal protective equipment (PPE)

As a general rule in prevention, PPE must be used as a last resort, only when all priority prevention measures have been implemented and are not sufficient. However, in the case of asbestos, whose main entry route is inhalation, the employer must provide the worker with appropriate respiratory tract PPE and, even if the 8-hour OEL is not exceeded, the employer shall make such equipment available to those persons who expressly request it. For activities where the possibility of exceeding the 8-hour OEL for asbestos fibres is expected, for example, demolition or asbestos removal, use of personal protective equipment for the respiratory tract is mandatory.

However, although their use will be determined by the outcome of the relevant risk assessment, **it is recommended that it always be used** (even when the limit value is not expected to be exceeded) since no exposure

Regulatory references concerning PPE

- Legal provision on design and manufacture:
  - Regulation (EU) 2016/425
  - (Royal Decree 773/1997)
- Harmonised technical standards with applicable requirements:
  - Full masks: UNE-EN 136:1998
  - Half masks: UNE-EN 140:1999
  - Particulate filters: UNE-EN 143:2021
  - Filtering equipment for assisted ventilation: UNE-EN 12941, UNE- EN 12942
  - Self-contained breathing apparatus: UNE-EN 137:2007, UNE-EN 14435:2004
  - RPE with fresh air hose: UNE-EN 138:1995
  - Protective clothing: UNE-EN ISO 13982, UNE-EN ISO 13688, UNE-EN 14325:2018
  - Protective gloves: UNE-EN 374
- Related technical standards:
  - Recommendations for selection, use and maintenance: UNE-EN 529:2006

More information at:

https://www.insst.es/materias/equipos/epi

to asbestos fibres can be considered safe, nor is it possible to guarantee that unintended accidental exposures will not occur.

The worker makes not use respiratory protective equipment for more than 4 hours per day.

The choice of the most appropriate RPE will depend on the level of protection required and the type and duration of the work. It is advisable to take into account the expected ambient concentration of asbestos fibres; thus, FFP3 masks, which may be suitable for lower risk work covered by article 3.2, are the minimum recommended respiratory protection, and as the expected ambient concentration increases, the level of RPE protection (half mask or full mask with P3 filter, TH3 or TM3 powered filtering equipment or air supply equipment) must be increased. Moreover, the anatomy of the workers who will be using it must be taken into account and it is highly recommended that a fit test be carried out on each person.

Protective clothing must be chemical protective clothing offering full body protection against airborne solid particles (type 5 clothing), with an integrated hood and made of materials offering mechanical resistance to tearing.

Protective clothing must be smooth and have antistatic properties so that asbestos fibres in the environment are not attracted or deposited on the surface of the suit. The cuffs of the suit must allow for adjustment.

Use of shoe covers is recommended, especially for frequent exposures. It is recommended that they have non-slip soles.

The gloves must offer sufficient mechanical tear strength to prevent accidental exposure to asbestos fibres due to breakage.

PPE may be either single-use PPE, in which case it will be treated as asbestos waste, or reusable PPE, which must be decontaminated after completion of the work.

Health surveillance

Occupational diseases due to asbestos exposure have a slow onset and development and a late clinical onset (Vicente Pardo, J. M., 2014). Hence the importance of following specific health surveillance.

The Specific Health Surveillance Protocol for Asbestos put in place by the Ministry of Health is a guide for the specific health surveillance of workers exposed to asbestos. This protocol sets out, among other specifications, the criteria for determining the frequency with which medical examinations must be performed.

This protocol applies to workers in operations and activities where they are exposed or are likely to be exposed to asbestos fibres or materials containing asbestos. However, due to these long latency periods, Royal Decree 396/2006 establishes the right of workers who have been exposed to these agents to prolong health surveillance beyond the end of the exposure or employment relationship.

Where the cessation of exposure is due to the termination of the employment relationship, post-occupational health surveillance shall be performed through the national health system. However, where the cessation of exposure is due, for example, to a change of job, it will continue to be the responsibility of the employer.

The Specific Health Surveillance Protocol for Asbestos put in place by the Ministry of Health is a guide for the specific health surveillance of workers exposed to asbestos.

Prerequisites for working with asbestos

Who can work with asbestos?

Companies that are going to perform activities or operations that involve a risk of exposure of workers to asbestos fibres or materials containing asbestos must be registered in the Register of Companies at Risk of Asbestos (RERA), with the exception forest out in article 3.2 of the Royal Decree for sporadic exposure of workers, of low intensity and with results of the risk assessment that clearly indicate that the 8-hour OEL is not exceeded, when it is one of the activities listed in sections a), b), c) or d) of the aforementioned article 3.2.

Registration in the RERA shall be done with the labour authority of the autonomous community where the company's main premises are located, and it entitles the company to perform work throughout Spain. Any modification of the data or deregistration as a RERA-registered company must also be reported.

Work plan

A work plan must be drawn up before beginning any work involving the risk of exposure to asbestos. This is the document which describes in detail the work to be done, the methodology to be followed and the prevention and protection measures necessary to guarantee the health and safety of both the workers who are to perform these operations and other persons who may be affected. The content of the work plan shall comply with Royal Decree 396/2006 and workers' representatives shall be consulted when preparing it.

The employer of the company performing the work is responsible for drawing up and implementing the work plan. It must be based on the prior risk assessment and it is therefore recommended that it be performed by a senior technician in occupational risk prevention specialising in Industrial Hygiene.

The work plan must be submitted to the labour authority for approval. In the case of specific work plans, the labour authority shall be the Autonomous Community where the work is to be done and, in the case of single general plans, the labour authority will be that of the Autonomous Community where the company's main facilities are located.

Other preventive measures

In work involving risk due to exposure to asbestos fibre in the working environment, another series of preventive measures set out in Royal Decree 396/2006 must be complied with, such as the following:

- Data recording and document filing (article 18). On completion of the work covered by the plan, Appendix IV is required to be sent to the labour authority. Appendix V must be sent to the health authority.
- Consulting, informing and training workers (articles 13, 14 and 15).

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