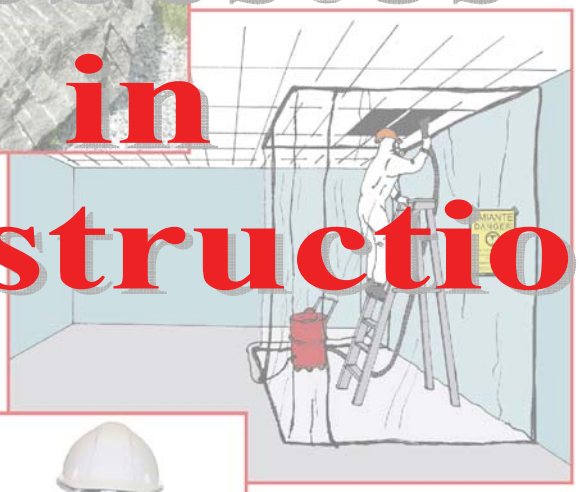
Association paritaire pour la santé et la sécurité du travail
du secteur de la construction – ASP Construction
JWK Pacifique Education Group

Asbestos in Construction



COURSEPACK
FOR
CONSTRUCTION PERSONNEL

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MONTREAL QUEBEC CANADA

2008

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Introduction

This comprehensive material on asbestos awareness and its removal is based on the publication, entitled *Safe Removal of Asbestos,* published by *Association paritaire pour la santé et la sécurité du travail du secteur de la construction*, a Quebec association responsible for training, information, research and counselling services to employers regarding health and safety on construction site issues.

With this extended version the author intends to shed light on the danger and health hazards that the presence of asbestos represents.

When compiling this coursepack the objectives were to sensitize, and inform students about the risks associated with work that is liable to produce asbestos dust emissions, to inform students of the right preventive measures to take for work that is liable to produce asbestos dust emissions, and to inform them about the proper and safe methods for asbestos removal work that is liable to produce asbestos dust emissions.

The first part of this material, *Asbestos Awareness,* provides a complete picture of the origin, the types, the history, the application, and the health effects on humans of this "undestroyable" material and the unique characteristics that made asbestos so popular and widely used – mostly in construction - throughout history.

The second part, *Asbestos Removal,* provides the students with a step-by-step guide for the safe removal of this highly toxic and widely present mineral composite that claims the lives of thousands of workers, construction personnel and family members every year.

Asbestos was extensively used in public buildings, schools, hospitals and homes built between the 1920s and 1980s. Since these buildings' mass demolition, renovation and remodelling has been gradually going on since the 1950s, tens of thousands of construction workers of all trades, managers, inspectors and family members have been exposed to the high level of toxicity of this once revered material.

The latency period of this carcinogen, which may cause cancer by altering cellular metabolism or damaging DNA directly in cells of the lungs or in other vital organs, is fifteen to sixty years. Consequently, those who were exposed to asbestos dust, or used asbestos containing materials (ACMs), in the course of renovation, remodelling, demolition, etc. in the second half of the twentieth century, will very likely develop symptoms of lung cancer in our lifetime. We can expect this trend to peak in the coming years, resulting in an increased number of 'exposures to asbestos' related deaths in the coming years. This trend must be stopped, and it can be stopped by raising awareness for the future generation of construction personnel.

JWK

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Foreword

Asbestos is the best insulator and one of the toughest minerals the world has ever known. Despite all its engineering praise and glory throughout history, it also turned out to be, only recently though, the deadliest material.

Its extraordinary properties have been recognized by ancient civilizations, and because of its unique characteristics, this fibrous mineral was widely used in manufacturing thousands of commercial, mostly construction related, products over the centuries. In the building industry asbestos was frequently used as fireproofing, heat insulation and in the construction sector as a strengthening agent.

Asbestos is a generic name given to a group of naturally occurring minerals that possess high tensile strength, resistance to chemicals, physical and thermal degradation.

However, these very same properties that give asbestos performance capabilities that are difficult to match are responsible for millions of premature deaths (mostly due to lung cancer) of people who came in contact with this mineral while mining, processing or working with it, most of the time unaware of its toxicity.
Today, when the number of deaths, due to exposure to asbestos in the second part of the last century, is increasing exponentially asbestos is considered the silent killer in the construction industry.

For some sixty years until the 1980s amosite and crocidolite, the two most vicious types of asbestos were extensively used in all types of buildings, from the foundation to the roof, and everywhere in between. In the mid-1980s, having identified the health risks involved when asbestos fibres separate from the matrix and are allowed to become airborne, all types of asbestos in the amphibole group, including amosite and crocidolite, were banned in the developed world. Consequently, properties erected since the mid-eighties are unlikely to have asbestos anywhere within the building.
Properties built in the last decade of the twentieth century are extremely unlikely to contain asbestos or ACMs, so they represent no danger whatsoever either to the occupants or to the renovation and maintenance personnel.

Mr. Joseph William Kristof, a published author, is considered an authority on health and safety in the construction of engineering projects. He teaches related courses at colleges and universities in the Montreal area. He earned his degrees in different engineering disciplines at reputable universities. He has over 20 years of experience working in the construction sector. He was the founder and publisher of a book review magazine and a construction related trilingual newspaper entitled *Construction Aujourd'hui.*

This book covers everything that you will need to know about this material, such as its nature, its impact on the environment and human health, methods of its removal, risks involved in dealing with it, handling of its waste, legal requirements in dealing with it and recommended tools used in its handling.

This carefully compiled coursepack is a must-read for all personnel in the construction sector, from labourers to developers, as well as for everyone who is interested in renovating or refurbishing older buildings.

Hani Keira, Ph.D., P. Eng.
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What is Asbestos

The term *asbestos* applies to a group of highly fibrous silicate minerals - found in certain types of rock formations - with separable, long and thin fibres. The term *fibre* applies to all inorganic and organic materials that have a length to diameter ratio greater than 3.
Due to its extraordinary mechanical and thermal properties asbestos has been considered a miracle material, and has been used in more than 3,000 different construction materials and manufactured products.

Naturally occurring rocks with asbestos content Photo: JWK Pacifique Images

Fibrous asbestos

Asbestos City, Quebec, Canada
Photo : JWK Pacifique Images

Jeffrey Mine
Collection : Musée minéralogique d'Asbestos
Photo : JWK Pacifique Images

The largest open pit asbestos mine in the world
Cantons-de-l'Est, Quebec, Canada
cc. www.cantonsdelest-guidetouristique.com

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Types of Asbestos

There are two general types of asbestos with several subdivisions:

a/ Serpentite

- Chrysotile (MgSiO) – also called white asbestos, originates from Canada. It is curly, less sharp, white to grey fibre that is difficult to separate into individual fibres.

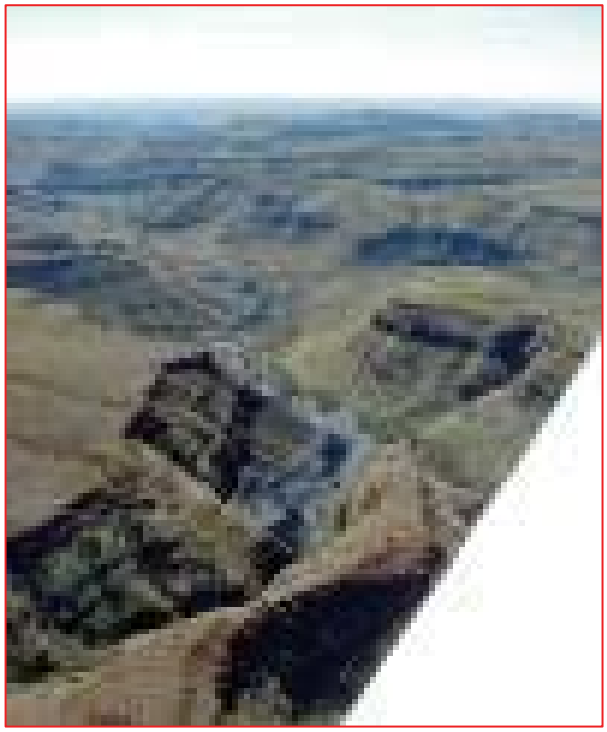
b/ Amphibole

- Amosite (FeMgSiO) – also known as grey asbestos, originates from Africa, which consists of colourless, grey and brown straight fibres.
- Crocidolite (NaFeSiO) – also called blue asbestos, comes from Africa and Australia, and it is similar to amosite but blue in colour.
- Tremolite

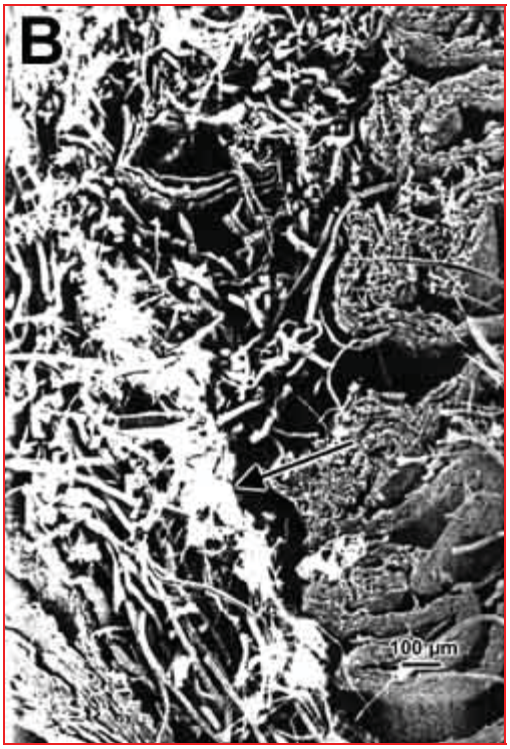
The two most dangerous – carcinogens - types are the amosite and crocidolite subgroups. These two asbestos types have been most commonly used in building products.

Serpentinized peridotite asbestos
Photo: JWK Pacifique Images

Tremolite asbestos



Blue asbestos mine
Wittenoom, Australia



Crocidolite fibres

Historical Background

The word *asbestos* is derived from Greek meaning “unquenchable,” or “impossible to destroy,” and has been in use for over 6000 years. During its early period the Greeks wove it into oil lamp wicks and funeral shrouds.

Historical records show that asbestos cloth was used by ancient Egyptian pharaohs. During the Middle Ages, Charlemagne, a Roman emperor, used to impress his guests after a banquet by throwing the tablecloth into the fire to clean it. He would leave it in the fire for a while to burn off all of the food scraps, then snatch it from the flames to show that it was as good as new. This appeared to be magic, but the secret was just that the tablecloth was made of asbestos cloth. The ancient Romans knew of asbestos's properties and used it in woven form for clothing, bedding and even burial shrouds. They reported, through Pliny the Elder and others, certain diseases and a great number of deaths suffered by slaves who spent their short lives wearing asbestos cloth.

About the same time, as Finnish archeological evidence shows, it was used to give clay pots added strength. By 1000 AD asbestos was widely used for cremation cloths, mats and temple lamp wicks in the Mediterranean area. In the early 1700s the first asbestos paper and boards were made in Italy.

In the mid-nineteenth century firefighters wore helmets and jackets made of asbestos in France. It was also used to manufacture insulation and packaging materials.

The 1870s mark the advent of the asbestos industry with the opening of large asbestos companies in England, Scotland and Germany.

The first asbestos pipes and corrugated sheeting were manufactured in the first quarter of the twentieth century in England, Germany and in Canada, where large deposits of chrysotile (white asbestos) were exploited.

It was only in 1897 that doctors and scientists established a correlation between asbestos and bronchial problems.

The first regulation governing asbestos use was passed in 1931 in the United Kingdom.

Hollywood also picked up the “unquenchable” characteristics of asbestos. In the 1939 film “The Wizard of Oz,” the wicked witch of the west’s broom was made of asbestos.

During WWII parachutes and fireproof suits were made of this durable material and it was widely used to insulate piping, boiler rooms and other areas of high heat in Navy shipyards.

During the building and repair of ships at the Puget Sound Naval Shipyard, both civilian and military employees were often exposed to high levels of asbestos fibres.

As a matter of fact, in 2001, the shipyard’s blue collar union filed a large grievance against the yard, alleging that “thousands of workers were denied extra pay for exposure to potentially harmful levels of cancer-causing asbestos”.

Puget Sound Naval Shipyard, Washington

Post-war reconstruction heavily relied on asbestos, and its usage reached an all-time high in 1973.

Since the 1970s most industrialized nations banned the usage of certain types of asbestos in the construction industry, and the manufacture of products containing asbestos (ACMs).

Note: ACM – *asbestos containing material* is defined as material containing more than 0.1% asbestos.

Unusual Properties of Asbestos

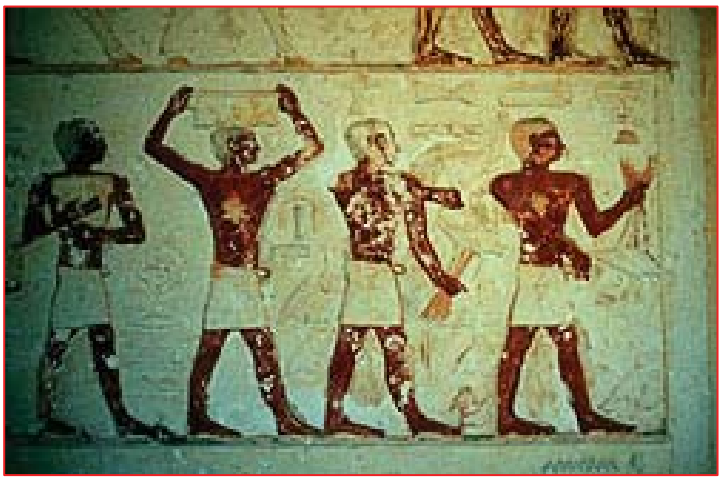
Millenniums ago ancient people already recognized the excellent and unusual properties of asbestos. Historically, asbestos has been used in diverse types of projects, such as in fabrics, shrouds, lamp wicks, etc.

The unusual properties that made this fibrous mineral so valued over centuries are:

- Asbestos fibre is virtually indestructible;
- It resists high temperatures, chemical attack and wear;
- It is a poor conductor, it insulates well against heat and electricity;
- It is probably the best insulator known to man;
- It resists corrosion;
- It is stable in the environment;
- It does not evaporate into air, or dissolve in water;
- It is not broken down over time;
- Since asbestos crystals are long, flexible and silky fibres, they can be woven, spun or braided.

The combination of these properties gives asbestos performance capabilities that are difficult to match.

Due to these characteristics it is estimated that over 3,000 different types of commercial products, mostly construction related, contain some amount of asbestos.



Slaves wore garments made of asbestos
cc. N0VA. PBS

CXG-51 Flexible Graphite sheet
cc. gasket.chinese-suppliers.com

Diverse Uses of Asbestos

Due to its characteristics, asbestos was one of the world's most valuable resources for thousands of years.

Due to its versatility, strength and durability, this fibrous material, asbestos, and its combinations became highly popular commercial products for builders and manufacturers from the early 1900s to the 1970s, when they were banned in most industrialized countries. So for half a century, until the 1970s, asbestos was used in office buildings, public and private buildings, as well as in schools. Some asbestos-containing materials, however, were still being installed into the late 1980s.
Asbestos has also been widely used in transportation and electrical appliances, frequently mixed with, and encased in, other materials.

It is the construction sector in which asbestos – mostly amosite and crocidolite, the two most vicious types - have been used most frequently. Workers or homeowners involved in demolition work, maintenance, repair, or remodelling of buildings may very well face these toxic combinations.

This fibrous, toxic material has been used and can be found in:

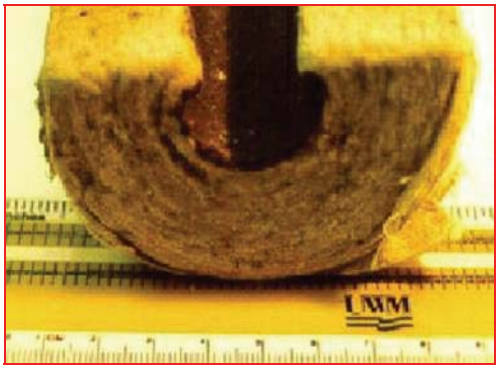
- Insulation – found in and around pipes, asbestos gaskets, air ducts, boilers, thermal paper products, electrical wiring; Fireproofing products – fire blankets, curtains, doors;
- Acoustical products – acoustic tiling, acoustical plaster;
- Sprayed textured paint and coatings;
- As strengthening agent in concrete and mortar;
- Cement boards;
- Patching and taping compounds – putty, caulk, adhesive, joint compounds;
- Tiles, wallboard, siding;
- Roofing materials, such as shingles, asbestos tiling, asphalt;
- Vinyl floor tiles, ceiling tiles, flooring backing;

- Textile and cloth products – blankets, pyjamas, oven mitts, aprons, gloves;
- Vermiculite – used in a variety of horticulture products, brake pads;
- Laboratory hoods and table tops;
- Some talc-containing crayons;
- It is braided into ropes;
- Cigarette filters.

The original version of the Kent Micronite cigarette filter used crocidolite, the most toxic type of asbestos, from 1952 until at least mid-1956. Cigarettes from intact, unopened packs of the brand from this period were examined. One filter contained approximately 10 mg of crocidolite. Crocidolite structures were found in the mainstream smoke from the first two puffs of each cigarette smoked. At the observed rates of asbestos release, a person smoking a pack of these cigarettes each day would take in more than 131 million crocidolite structures longer than 5 microns in 1 year. These observations suggest that people who smoked the original version of this cigarette during the 1950s were substantially exposed to crocidolite.
(WE Longo, MW Rigler and J Slade, Materials Analytical Services, Inc., Norcross, Georgia 30092, USA., Cancer Research, Vol 55, Issue 11 2232-2235, Copyright © 1995 by American Association for Cancer Research)

Kent, the first cigarette with smoke filter
First filter in 1952 contained Crocidolite asbestos
cc. 1998 | chickenhead productions

Face view of mouthpiece end of filter Arrows
Crocidolite asbestos
cc. W. E. Longo, M. W. Rigler, J. Slade



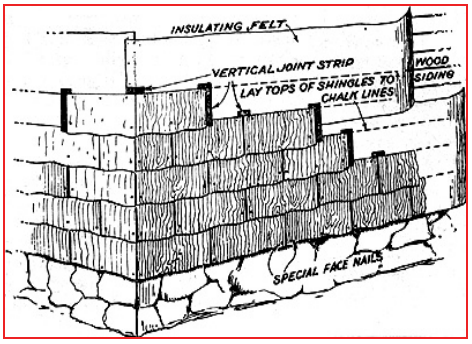
Thermal glove - Pipe Insulation
cc. www.amiadini.com

Asbestos cement sheeting
cc. JWK Pacifique Images

Yarns

Asbestos gaskets

Musée mineralogique d'Asbestos, Asbestos City, Quebec, Canada
Photo: JWK Pacifique Images



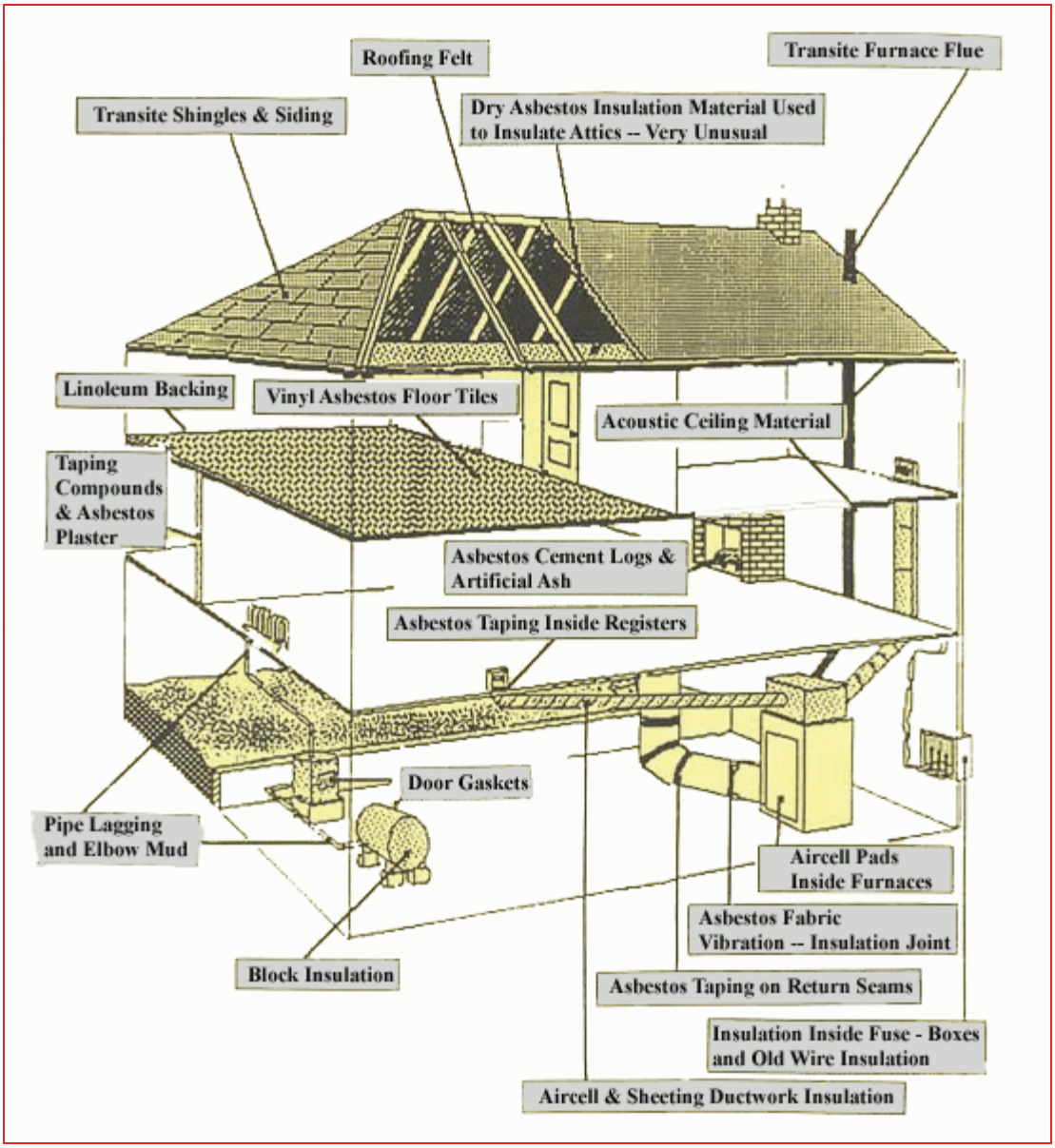
Asbestos-cement siding installation
McCawley, 1940, cc. Amy lamb Woods, 2000

Asbestos material in roofing
cc. Joseph Jenkins, Inc

Summary of Building Materials Which May Contain Asbestos

Product	% of Asbestos	Dates of Use	Binder	Friable/ NonFriable
Walls and Ceilings				
Sprayed coating	1 - 95	1935-1978	Portland cement, sodium silicate, organic binders	Friable
Troweled coating	1-95	1936-1978	Portland cement, sodium silicate	Friable
Asbestos-cement sheet	20-50	1930-present	Portland cement	NonFriable
Spackle	3-5	1930-1978	Starch, casein, synthetic resins	Friable
Joint compounds	3-5	1945-1977	Asphalt	Friable
Textured paints	4-15	?-1978		Friable
Millboard, rollboard	80-85	1925-?	Starch, lime, clay	Friable
Vinyl wallpaper	6-8	?		NonFriable
Insulation board	30	?	Silicates	Friable
Floors				
Vinyl-asbestos tile	21	1950-1980	Poly(vinyl) chloride	NonFriable
Asphalt-asbestos tile	26-33	1920-1980	Asphalt	NonFriable
Resilient sheet flooring	30	1950-1980?	Dry oils	NonFriable
Mastic adhesives	5-25	1945-1980?	Asphalt	Friable
Roofing and Siding				
Roofing felts	10-15	1910-present	Asphalt	NonFriable
Roof felt shingles	1	1971-1974	Asphalt	Friable
Roofing shingles	20-32	?-present	Portland cement	NonFriable
Roofing Tiles	20-30	1930-present	Portland cement	NonFriable
Siding shingles	12-14	?-present	Portland cement	NonFriable
Clapboards	12-15	1944-1945	Portland cement	NonFriable
Pipes and Boilers				
Cement pipe and fittings	20-?	1935-present	Portland cement	NonFriable
Block insulation	6-15	1890-1978	Magnesium carbonate, calcium silicate	Friable
Preformed pipe wrap	50	1926-1975	Magnesium carbonate, calcium silicate	Friable
Corrugated asbestos paper	90 35-70	1935-1980 1910-1980	Sodium silicate, starch	Friable
Paper tape	80	1901-1980?	Polymers, starches, silicates	Friable
Putty (muddling)	20-100	1900-1973	Clay	Friable

Source: US EPA - Western Analytical Laboratory



Common construction materials containing asbestos
The original of this graphic is by UC Berkeley Extension, Pacific Information Center
Source: Western Analytical Laboratory, 12734 Branford St., #19, Arleta, CA 91331

Based on the method of application of asbestos fibres, we differentiate the following two groups:

1. FRIABLE SUBSTANCES

   - Sprayed on as fire protection (columns, beams, etc.);
   - Sprayed on as decorative finish;
   - Sprayed on as acoustic insulation;
   - Pipe and boiler insulation.

2. NON-FRIABLE SUBSTANCES

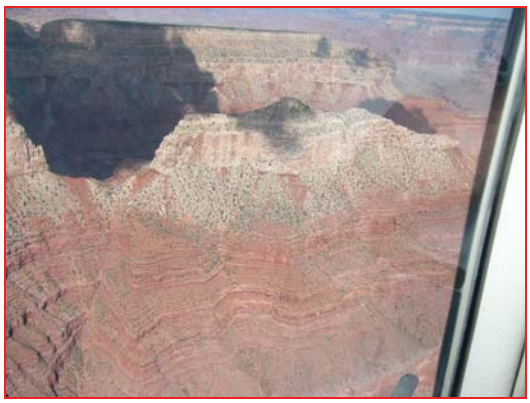
   - Asbestos-cement products;
   - Acoustic tiles;
   - Vinyl tiles;
   - Asbestos-asphalt roof shingles;
   - Filling for gyprock paneling;
   - Gaskets and seals.

Note: A material is *friable* if it can be easily reduced (i.e. by rubbing) to powder or to tiny particles.

Occurrence of Asbestos in the Environment

6. 1 General environment

Regardless of location, the general public is exposed to asbestos contamination both outdoors and indoors to a certain degree. The natural erosion of the soil and rocks on the earth's crust represents a potential source of contamination in the environment.
Detectable concentrations of asbestos fibres have been found in the rural environment, even in the most remote rural settings.
In urban areas, asbestos concentration in the ambient air may be elevated due to different sources of diffusion, mostly from vehicle brake pads and clutches facing wear.
Areas with industries manufacturing asbestos-base products, such as attic insulation products, roofing shingles, floor tiles, wall boards, acoustical plaster, fire resistant fabrics, etc., and in mining towns, such as Libby, Montana where asbestos dust filled the air, the levels of toxic concentration can be elevated to a dangerous level.



Asbestos Valley, Arizona
cc. JWK Pacifique Images

Asbestos Canyon (Grand Canyon, Arizona).
cc. JWK Pacifique Images

6. 2 Workplace environment

Obviously, the highest level of asbestos concentration can be found in asbestos mines and mills where workers spend their shifts in asbestos dust-filled air. The level of toxicity may also be dangerously high, due to the presence of friable asbestos materials such as sprayed asbestos in shipyards, on construction sites, in public buildings undergoing maintenance, in cases of remodelling older residential buildings, as well as in processing plants.

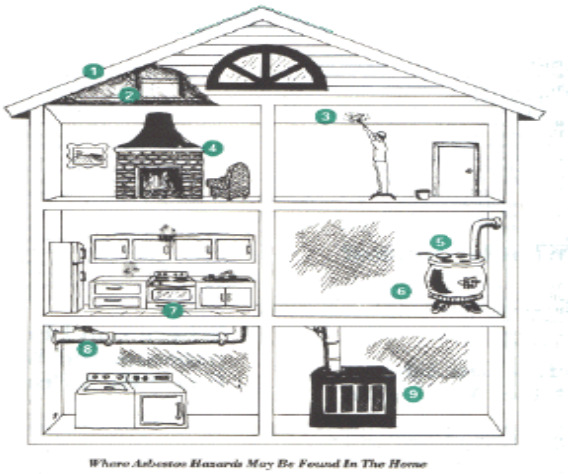
Open-pit asbestos mines.
cc. JWK Pacifique Images

6. 3 Home environment

Materials in residential buildings which may contain asbestos are roofing shingles, exterior siding, pipe and boiler insulation, attic insulation and many others. As long as they are not damaged or disturbed they don't pose any significant danger.

Places where Asbestos Containing Material (ACM – defined as material containing more than 1% asbestos) may be found in the home environment are the following:

1. Roof coverings
2. Attic Insulation (see above)
3. Joint compounds and acoustical plasters
4. Fireplace insulation
5. Wood-burning stoves
6. Wall/floor coverings
7. Oven insulation
8. Pipe insulation
9. Boiler insulation



Source: Closer Look Inspection, O&M Plan, Ohio

Often without realizing it, homeowners and maintenance personnel put themselves at risk by disturbing asbestos captaining materials (ACM).

This may happen when:

- Disturbing loose-fill vermiculite insulation;
- Removing deteriorating roof shingles and sidings containing asbestos;
- Ripping away old asbestos insulation from around a hot water tank;
- Sanding or scraping vinyl asbestos floor tiles;
- Breaking apart acoustical ceilings tiles containing asbestos;
- Sanding plaster containing asbestos, or sanding or disturbing acoustical plaster that gives ceilings and walls a soft, textured look;
- Sanding or scraping older water-based asbestos coatings such as roofing compounds, Spackling, sealants, paint, putty, caulking or drywall.

NOTES

The Labour Force Exposed to Asbestos

We are all exposed to low levels of asbestos in our environment. These ambient – or typical – air concentrations of asbestos fibres are 0.00001 to 0.0001 fibres per ml. Higher concentrated levels of exposure than this are known to cause life-threatening health effects.

When asbestos containing materials are solidly embedded, contained or undisturbed, exposure risk is minimal. However if any material containing asbestos is disturbed, broken or damaged, it will release fibres into the air. If proper respiration protection is not in place, this airborne asbestos dust will find its way into the lungs of exposed persons through their respiratory systems.

A large number of workers, mostly in the construction sector, do-it-yourself home renovators, and people in many other industries are exposed to a dangerously high level of asbestos contamination. Individuals who have worked, or are working in fields listed below should consult a medical doctor specializing in asbestos-related lung disease.
All those who were involved in the tragic events of the World Trade Center on September 11, 2001, were exposed to a certain level of asbestos contamination. The asbestos fibres detected in the samples taken in the WTC sites were chrysotile asbestos.

Some of the work environments and occupations exposed to asbestos:

7. 1 Work environment

- Asbestos product manufacturing (insulation, roofing, building materials);
- Automotive repair (brakes and clutches);
- Constructions sites;
- Maritime operations;
- Mining operations;
- Offshore rust removals;
- Oil refineries;
- Power plants;

- Railroads;
- Sand or abrasive manufacturers;
- Shipyards, shipbuilders;
- Steel mills.

7. 2 Occupations

- Asbestos removal workers;
- Workers at exfoliation facilities where vermiculite ore from Libby, Montana, was processed;
- Demolition workers;
- Workers at asbestos product manufacturing plants;
- Auto mechanics;
- Individuals who restore old cars – even as a hobby;
- Boilermakers;
- Bricklayers;
- Builders;
- Building inspectors;
- Construction managers;
- Carpenters;
- Drywallers;
- Electricians;
- Floor covering manufacturers and installers;
- Furnace workers;
- Glazers;
- Grinders;
- Hod carriers;
- Insulators;
- Iron workers;
- Laborers;
- Longshoreman;
- Maintenance workers;
- Merchant marines;
- Millwrights;
- Operating engineers;
- Painters;
- Plasterers;
- Plumbers;
- Roofers;
- Family members of all of the above!

Be aware of the dangers that asbestos in older car components present
cc. JWK Pacifique Images

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cc. www.ualocal112. org

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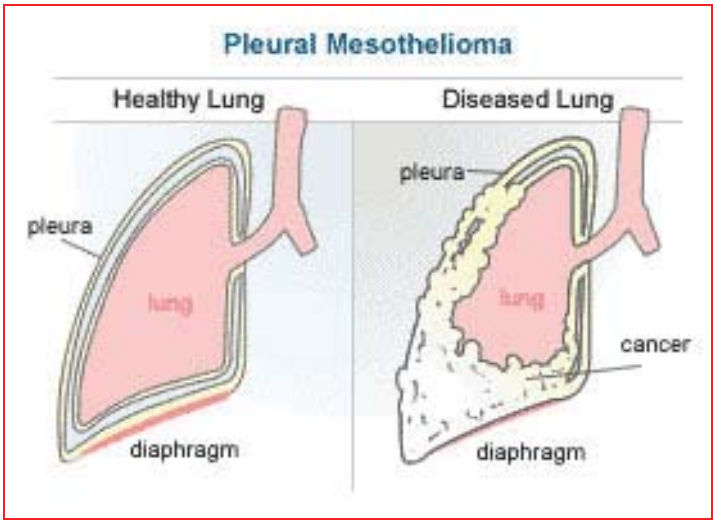
Effects of Asbestos on Human Health

The presence of asbestos in the workplace, home or in the general environment can contaminate the soil, water and food. The major entry point of this health threatening contaminant into the body is the respiratory system. When asbestos containing material (ACM) is manipulated, or disturbed in any way it releases fibres to the ambient air where they are suspended and can float for days. These carcinogenic fibres can also stick to clothes and be taken to non-contaminated areas, like homes.
If these fibres find their way – by inhalation bypassing the natural filtration system, such as nose hairs, vibrating cilia, mucus – into the human body, they lodge in the lung's most vulnerable areas, causing scarring that can ultimately lead to impaired lung function (asbestosis – non-malignant lung condition), mesothelioma, a type of lung cancer exclusively associated with asbestos exposure, or lung (lung cavity) cancer.

The durability and tensile strength of the asbestos fibres are why asbestos was so widely used as a fire retardant, and as a construction component. However, these very same properties allow asbestos fibres to stay embedded in lung tissues for many years without being destroyed by the body's immune system.
The latency period is 15-40 (in some cases 60) years from time of exposure.
Before being observed clinically, 25% of the lung's tissues show irreversible damage.



When asbestos fibre is inhaled.
source: www.mesopharmacy.com

A correlation between asbestos exposure and lung cancer was suspected in the nineteenth century. The risks became more evident in the late 1960s, when workers who had been heavily exposed 20 to 30 years earlier showed increased incidence of lung diseases. Occupational exposure is now strictly regulated by provincial and state governments in the industrialized world.

8. 1 Asbestos exposure and lung diseases

Diseases from asbestos exposure take a long time to develop. Most cases of lung cancer or asbestosis in asbestos workers occur 15 to 40 (in some cases even 60) years after initial exposure.

Changes in the lining of the lungs (pleura) such as thickening, plaques, calcification, and fluid around the lungs (pleural effusion) may be early signs of lung disease.

The following factors – among others – determine how exposure to asbestos affects an individual:

- Exposure concentration;
- Exposure duration;
- Exposure frequency;
- Chemical makeup of asbestos fibre;
- Size and shape of the fibre.
- General state of health of individuals;
- Lifestyle. Smoking cigarettes exponentially increases the risk of developing lung cancer.

8. 2 Asbestosis

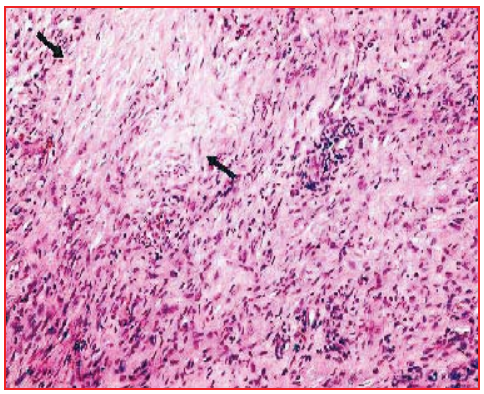
When asbestos fibres are inhaled and are not expelled by the body's natural filtering systems they get embedded in the lung tissues and they remain there throughout life. Once they accumulate, they cause scarring and inflammation of the lung tissues. The final result is asbestosis.
Asbestosis is a progressive, long-term, non-malignant lung condition, characterized by pulmonary fibrosis (the formation of scar-like tissues). The development and progression of asbestosis varies from individual to individual. It is often slow with few changes over the years and many cases do not advance after diagnosis. The most common symptoms are shortness of breath, persistent and productive cough (mucus), chest tightness, chest pain, loss of appetite and dry crackling sounds in the lungs while inhaling.

8. 3 Mesothelioma

Mesothelioma is a cancer of the outer covering of pleura (lungs) and peritoneal cells (lining of the lung and abdominal cavity). The symptoms are chest, as well as shoulder, pain and often, dry cough. Patients also experience weight loss, weakness and fever as the tumour grows bigger. The latency period varies between 10 and 40 years.

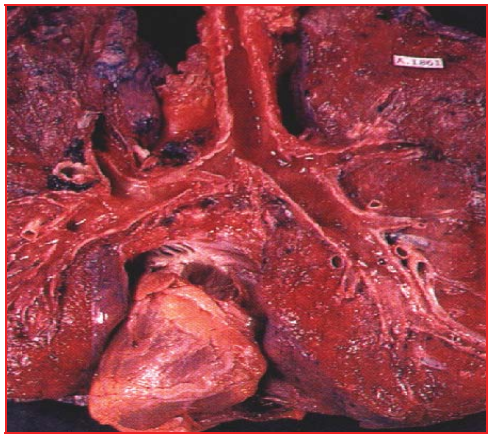
8. 4 Lung cancer

Lung cancer is a malignant tumour that invades and obstructs the lung's air passages. Cigarette smoking greatly increases (up to 50 times) the likelihood of a person developing lung cancer as the result of asbestos exposure.
In the early stages lung cancer usually does not cause symptoms, but when they do occur, the cancer is often advanced.
The most common symptoms of lung cancer are coughing, wheezing, unexplained weight loss, coughing up blood and laboured breathing. Other symptoms are shortness of breath, persistent chest pain, hoarseness, and anaemia.



Mesothelioma cancer in the lung
cc. www.mesothelioma-asbestos-lung-cancer.com/ inf...

Lung cancer
cc. www.atsdr.cdc.gov



Healthy lung

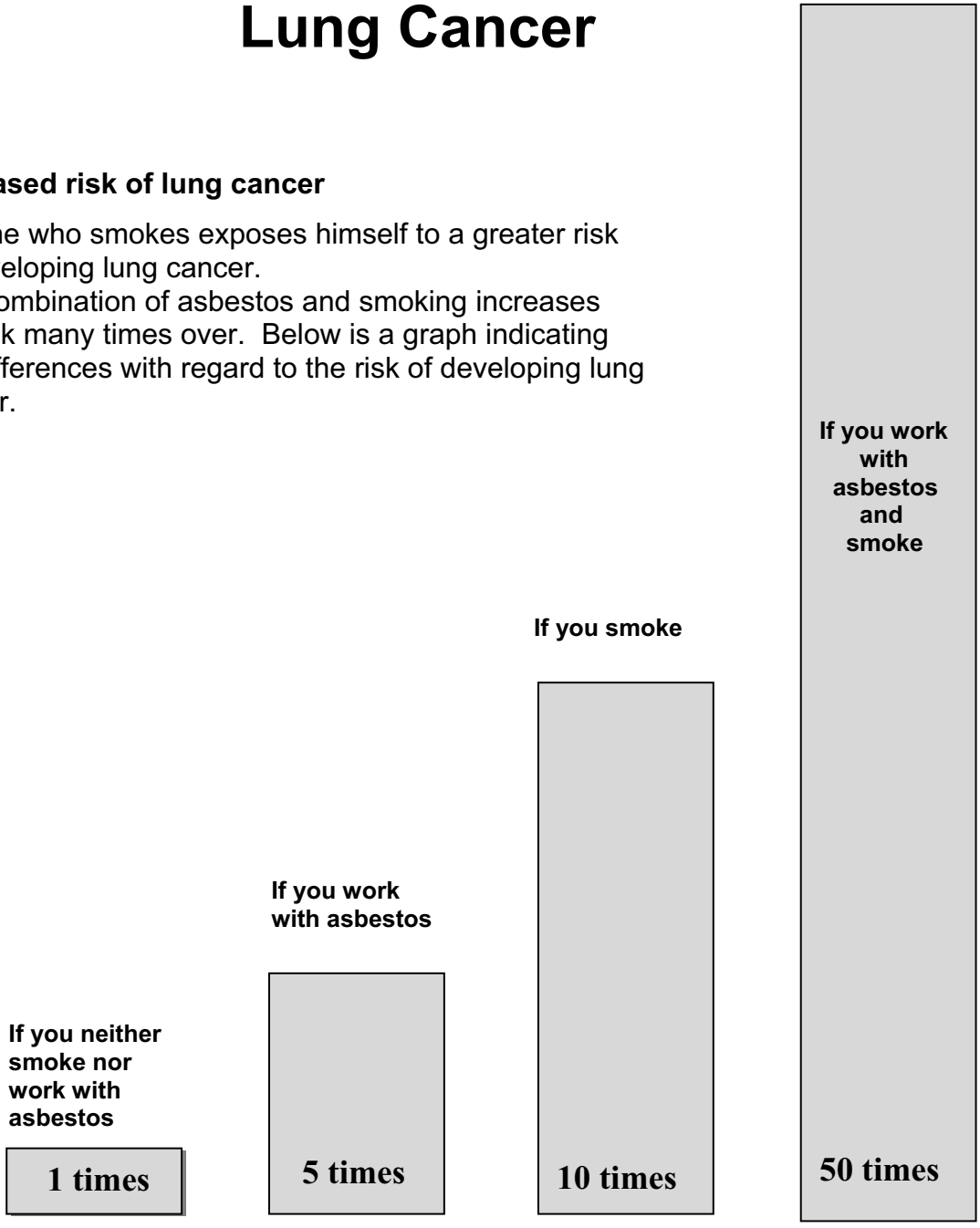
cc.www.cancer-info.com

Lung with cancer

Smoking + Working with Asbestos = Increased Risk of Lung Cancer

Increased risk of lung cancer

Anyone who smokes exposes himself to a greater risk of developing lung cancer.
The combination of asbestos and smoking increases the risk many times over. Below is a graph indicating the differences with regard to the risk of developing lung cancer.

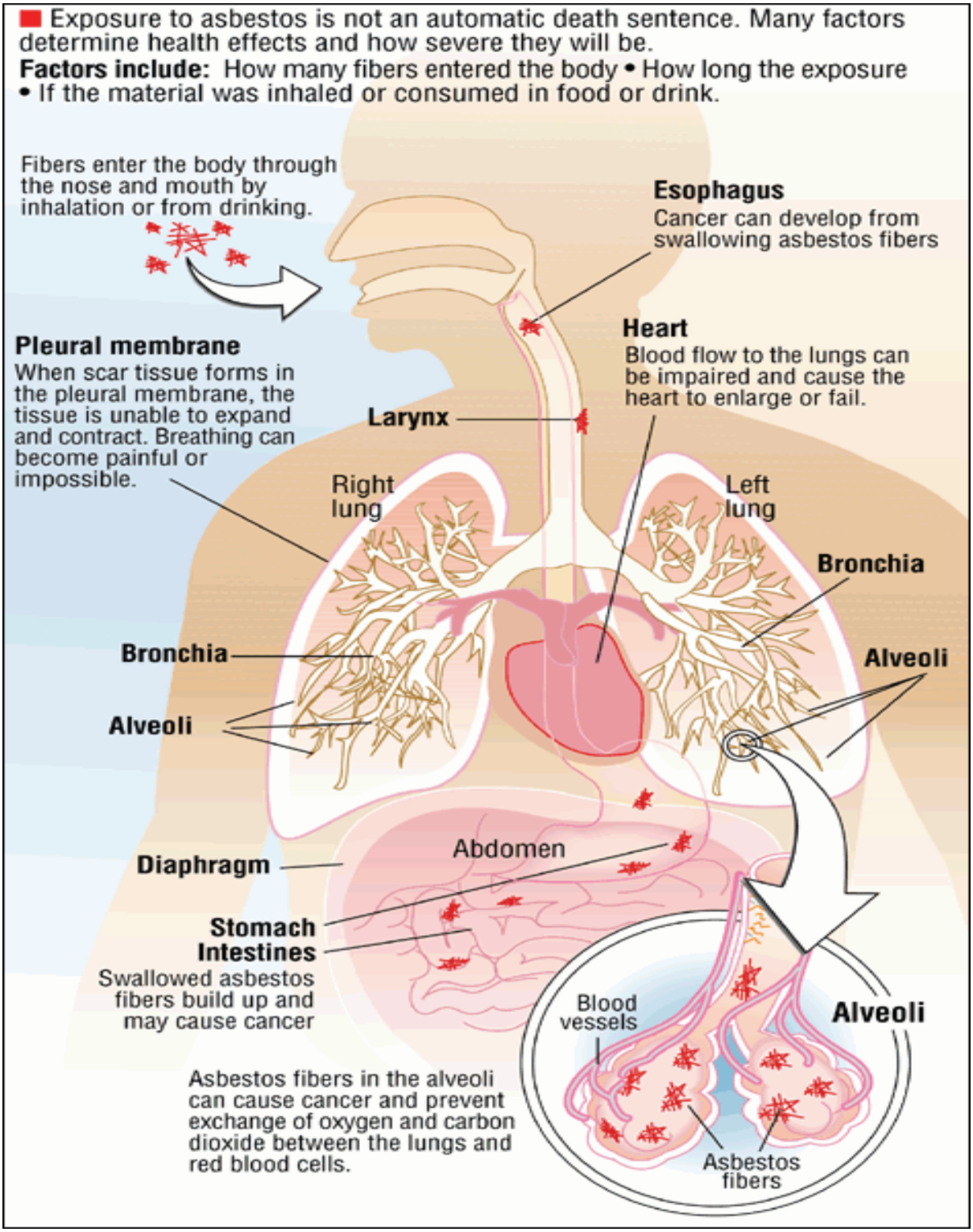


8. 5 Asbestos exposure and cancer in other body parts

Some epidemiologic studies have established correlations between exposure to asbestos and cancers at other sites in the human body. However most of these studies do not clearly or consistently show a strong link and so the debate continues.
Keeping in mind that the evidence is unclear, and research in this area is inconclusive, some scientists suggest links between exposure to asbestos and the following cancers:

- gastrointestinal (esophagus and stomach) and colorectal (colon and rectum);
- bladder;
- reproductive;
- hematopoietic;
- larynx.
- kidney;
- brain;
- urinary;
- lymphatic;

Some studies link asbestos to larynx cancer.
cc. ctv.ca



cc. Ohio Asbestos Information Center

NOTES

Identifying and Measuring Asbestos

Before old buildings are demolished or refurbished it is pivotal that a systematic investigation is carried out in order to find out if they contain any asbestos containing materials (ACM). If asbestos is present, the first step is to identify the type of asbestos and its abundance.

No work can start until the results of the analysis are available and appropriate precautions (low-, moderate-, high-risk work legislation) are taken to protect the health of workers and others involved, such as management, family, inspectors, etc.

There are six types of asbestos – *plus their mixtures* --, as mentioned in earlier chapters, but the most common types of asbestos encountered are:

- Chrysotile – or white asbestos;
- Amosite –or brown or gray asbestos;
- Crocidolite – or blue asbestos.

Visual inspection is only a rough guide, as fading and color changes may occur with age and exposure to high temperatures. Therefore, in order to unmistakably identify and analyze the presence of asbestos, combined use of sophisticated detection methods, analyses and techniques have to be implemented.

The most important assessment that will take place regarding asbestos containing materials is how many asbestos fibres they release into the air.
For the purpose of determining (counting) asbestos fibres in a specimen, regulatory agencies commonly count as fibres those particles of asbestos minerals at least 5 micrometers in length and with length: width ratios of 3:1. For other purposes, such as detecting fibres in bulk building materials, asbestos particles with length: width ratios of 5:1 are counted. Concentrations of asbestos fibres in ambient (typical) air are 0.00001 to 0.0001 fibres per millilitre. The recently established exposure limit for U.S. workplaces is 0.1 fibre/ mL.
The most common methods of identifying the type of asbestos present are:

- The Polarized Light Microscopy;
- X-ray Diffraction;
- Membrane Filter Method – for monitoring the amount of airborne asbestos.

Other methods for detecting asbestos

9.1 In air

- Phase Contrast Microscopy. Alone, this method cannot tell the difference between asbestos and non-asbestos fibres, but air samples which produce positive results requires further tests;
- Transmission Electron Microscopy. This powerful electron beam microscope can distinguish asbestos from other fibres collected by the Phase Contrast Microscopy;

cc. www.cst.cmich.edu/ centers/

Meiji Techno Asbestos Microscope
cc. www.meijitechno.com/images/ML6530.jpg

- Scanning Electron Microscopy. SEM can scan a specimen and compare it to identified images of asbestos in order to confirm what the specimen is.

9.2 In soil

- Polarized Light Microscopy. PLM can be used to confirm if the specimen is asbestos, using polarized light. It is the most commonly used technique, providing fast results, as well being the most economical;
- Transmission Electron Microscopy;
- Scanning Electron Microscopy.

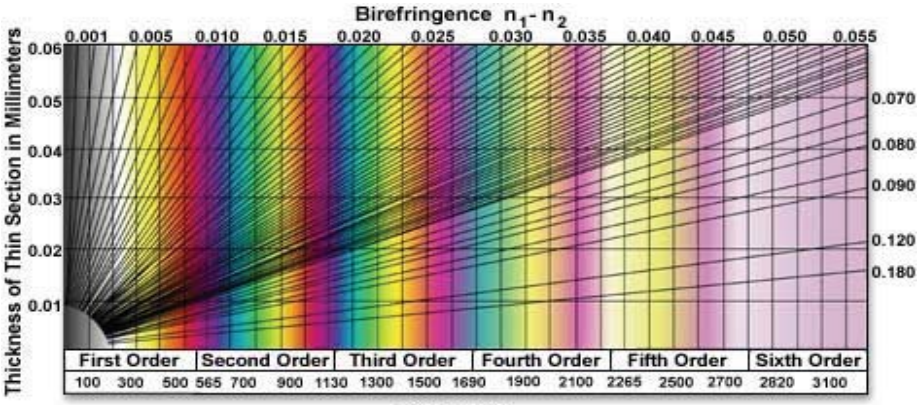


Figure 4

Source: Michel Levysmall
cc. http://asbestos.cybersplat.co.uk/asbestosdetecting.html

At different viewing angles asbestos has the property of double refractive coloured stones in which varying colours can be visible. The diagram above is used by experts in order to decide whether the material is asbestos or not.

9.3 In water

The EPA has proposed a concentration limit of 7 million fibres per litre of drinking water for long fibres (lengths greater than or equal to 5 µm). Treatment methods approved by EPA for removing asbestos: Coagulation/Filtration, Direct and Diatomite Filtration, Corrosion Control.

NOTES

Chapter Ten

Asbestos Removal

10.1 Overview of the work procedure

a/ Report the proposed asbestos removal site opening to the CSST. Appoint the *Competent Person* (may be the contractor himself).
b/ A systematic investigation is to be carried out to identify the type of asbestos present on the site.
c/ Make sure all personnel receive adequate training regarding asbestos removal.
d/ Before starting the work, an updating information course is to be held with all involved personnel, emphasizing the safety and health risks that are involved with exposure to asbestos.
e/ Clearly establish the asbestos work area, and isolate it from all other areas.
f/ Make sure all equipment, tools, general and personal safety equipment as well as disposable containers are provided.
g/ Make sure that the workers' showers and changing rooms are adjacent to the worksite, or that an enclosed corridor leads to the worksite.
h/ Upon completion of the work, carry out a thorough cleaning of the area using a vacuum cleaner fitted with the appropriate filter.
i/ Make arrangements for an approved and safe disposal site for the waste asbestos debris.
j/ The work area can only be reopened for general use after thoroughly checking that the asbestos dust levels in the ambient air are acceptable.

10.2 Training program

Apart from the step-by-step activities involving the procedures of asbestos removal, the following general information must be made available to the participants of the training program:

a/ Legislation concerning working with asbestos.

b/ The health effects associated with asbestos exposure.
c/ The relationship between smoking and asbestos in developing lung cancer.
d/ The methods of recognizing asbestos, including the requirement to presume that certain building materials contain asbestos.
e/ The nature of operations that could result in exposure to asbestos, the importance of controls to minimize exposure including engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, waste disposal, etc.
f/ The purpose, proper use, fit tests instructions and limitations of respirators.
g/ Medical surveillance program requirements.
h/ Names, addresses and phone numbers of public health organizations for further information.
i/ Requirements for posting signs and affixing labels.

10.3 Competent person (CP)

The competent person (CP) is the person who has all necessary qualifications and authority to ensure workers' safety and health.
On all worksites where employees are engaged in asbestos work, the competent person will perform and supervise the following duties:

a/ Set up the regulated work area, enclosure, or other containment.
b/ Conduct frequent and regular inspections of the job site, materials and equipment.
c/ Ensure (by on-site inspection) the integrity of the enclosure or containment.
d/ Set up procedures to control entry to and exit from the enclosed area.
e/ Supervise all employee exposure monitoring.
f/ Ensure that employees working within the enclosure and/or using glove bags wear respirators and protective clothing.
g/ Ensure (by on-site inspection) that employees set up, use and remove engineering controls, and use work practices and personal protective equipment that is in compliance with all requirements.
h/ Ensure that all employees use the hygiene facilities and observe proper decontamination procedures.
i/ iEnsure that all notification requirements are met.

10.4 Regulated area

Enclosure of the Regulated area

- All openings of the *regulated area* (or work area) including doors, windows and vents should be sealed to prevent the escape of asbestos dust to places outside the regulated area;
- People not involved in the asbestos work have to be kept away at least 5 metres from the regulated area;

- Care should be taken to ensure that dust cannot escape at points where pipes and ducts pass through partitions;
- Where it is not possible to make use of existing partitions and walls, use impervious sheeting to form or complete the enclosure;
- Notices should be posted at each entrance of the regulated area to warn personnel that entry without appropriate personal protective equipment is prohibited;
- The work area has to be adjacent (with air tight connection) to the decontamination area that includes:
  a/ work clothes discarding room;
  b/ shower room with individual stalls;
  c/ street changing room.

10.5 Warning signs and labelling

a/ Warning signs

Warning signs printed in bold letters on a contrasting background as below:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING MANDATORY

are to be posted all around the Regulated Area.
Where feasible, installed asbestos products shall contain a visible label.

b/ Labels

Labels printed in bold letters on a contrasting background as below:

DANGER
CONTAINS ASBESTOS FIBRES
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
DO NOT BREATHE FIBRES

shall be fastened to all products containing asbestos and to all containers containing asbestos, including waste containers.

c/ The requirement to label products DO NOT apply where:

- Asbestos fibres have been modified by a bonding agent, coating, binder, or other material that prevents release of airborne concentrations of asbestos fibres in excess of the PELs.
- Asbestos is present in a product in concentration less than 0.1 percent.

10.6 Regulation

There are three levels of asbestos removal work:

- Low-risk work;
- Moderate-risk work;
- High-risk work.

10.6.1 Low-risk work

10.6.1.1 Description of low-risk work

- Installation or removal of manufactured articles containing asbestos, providing that they are and will remain in non-friable condition:
  - vinyl tiles;
  - acoustic tiles;
  - gaskets;
  - seals;
  - asbestos cement products, etc.
- Sawing, cutting, shaping or drilling of these products with a hand tool, or power tool fitted with a dust-collection device or cut point ventilation equipped with a high-efficiency filter;

Nilfisk GM-811 Vacuum

Goodway's
HEPA Vacuum

- Removal of drywall installed with asbestos joint-filling compounds.

10.6.1.2 Personal protective equipment for low-risk work

1. Basic equipment:
   - Protective footwear;
   - Safety helmet;
   - Protective glasses with side panels.
   - Gloves;
   - Cover all (Tyvek);



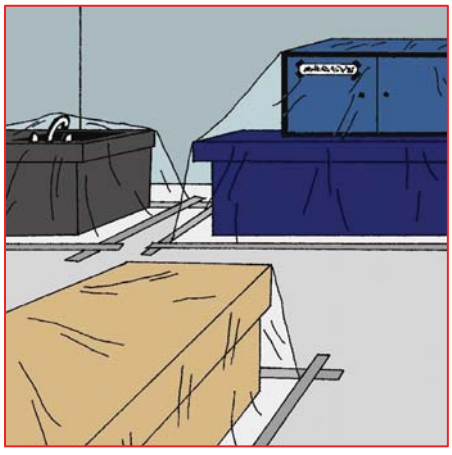

2. Type 100 or HEPA respirator similar to the one below.

Note: HEPA = - high-efficiency particulate air
- high-efficiency particulate arresting

Moldex Half Face Respirator (Reusable)

10.6.1.3 Measures to be taken while low-risk work is performed

1. Demarcate the work area;
2. Remove or cover furniture in the work area:



3. Never use compressed air in the work area;
4. Never smoke, eat, drink or chew any substance in the work area;
5. Make sure that asbestos debris is gathered up SAFELY:
   - vacuum cleaner equipped with high-efficiency filter;
   - wetting debris before removing it.

www.biztee.com/upload/catalogue/ www.cdc.gov/elcosh/docs /vacuum.

6. Handling asbestos debris
   - Remove asbestos debris on a regular basis during and at the end of the work;
   - Place the debris in airtight containers;
   - Attach a label to the asbestos debris containers as bellow:

Material containing asbestos
Toxic when inhaled
Keep container tightly closed
Avoid breathing the dust

- Clean the surface of debris containers thoroughly;
- Deposit each bag of debris into a second bag or into a barrel;
- Close debris containers tightly;
- Deposit debris containers into a bin or storage place;

Attention: Do Not Throw

- Send the debris containers to a burying site;
- Transport manifest (Identify material being transported);
- Outdoor work: prevent the dispersal of debris by using airtight film or some other means (wetting the material);
- Clean reusable drop sheets with a vacuum cleaner equipped with HEPA filter;
- Wet disposable drop sheets and place them in an airtight container;
- Clean the work area and surroundings using a vacuum cleaner with HEPA filter, or damp wipe surfaces;
- Clean respirators.

10.6.2 Moderate-risk work

10.6.2.1 Description of moderate-risk work

- Removal of false ceilings to access a work area where friable materials containing asbestos are found;
- The manual enclosure of friable materials containing asbestos, except if there is the spray application of a sealant (high risk);
- Removal of friable materials containing asbestos where the work area is sealed off from the worker's breathing area (glove bags);
- Handling or removal of small quantities of friable materials containing asbestos (all types) having a volume of debris not exceeding .03 cubic meter (1 cubic ft).

10.6.2.2 Protective equipment for moderate-risk work

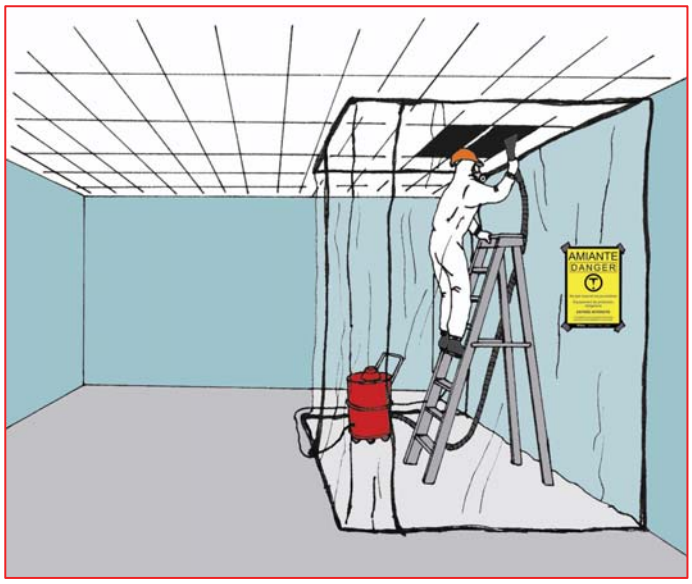
- Basic equipment: helmet, footwear, glasses, gloves;
- A powered air-purifying respirator with a high-efficiency filter or a supplied-air respirator for the following cases:
  - work involving crocidolite or amosite;
  - work not classified as low-risk or high-risk;
- Type 100 reusable respirator for other moderate-risk work;
- Protective clothing, disposable or reusable, used exclusively for this purpose;
- Two layers of disposable protective clothing to be worn over winter work clothes.




Moderate-risk work respirators

10.6.2.3 Measures to be taken while moderate-risk work is performed

- Remove or cover furniture in the work area:
  Remove all friable materials that contain asbestos that have spread into the work area;
- Isolate the work area with an enclosure made of airtight materials in the following cases:
  - manual collection of friable materials containing asbestos;
  - removal of false ceilings inside a building;
- Demarcate the work area if there is no enclosure;



- Protect the ventilation system during work when removing false ceilings in a building;
- Post a danger sign at the entrance to each work area;

Material containing asbestos
Toxic when inhaled
Keep container tightly closed
Avoid breathing the dust
Authorized persons only

- Never use compressed air;
- Never smoke, eat, drink or chew in the work area;
- Wet friable asbestos materials which are likely to be dispersed during work;
- Wetting: use water to which a wetting agent has been added;
- Wait until the materials are well soaked before removing them;
- Remove materials in small sections without tossing or throwing them;
- Make sure all asbestos debris is gathered up.

10.6.2.4 Entering and exiting the moderate-risk work area

1. Put on the protective work clothes;
2. Inspect and put on the respirator, making the necessary adjustments;
3. Put on the hood over the respirator straps;
4. Put on the helmet and safety footwear;
5. Put on the gloves and glasses;

6. Enter the work area and perform the work;
7. At the end of the work: clean the major part of asbestos dust from protective clothing (vacuum cleaner);
8. Remove protective clothing – keep the respirator on;
9. Place disposable protective clothing in a plastic sack;
10. Clean reusable protective clothing with an heavy duty vacuum cleaner HEPA;
11. Clean the respirator and helmet;
12. Wash hands and other exposed parts of the body;
13. Do not remove work clothing or footwear from the work area before cleaning or washing them.

10.6.2.5 Measures to be taken after completion of moderate-risk work

- Clean reusable drop sheets, used to protect the furniture, by means of a vacuum cleaner;
- Wet and then place disposable drop sheets, used to protect furniture, in airtight containers;
- If applicable, clean the work enclosure either by wetting it or by using a vacuum cleaner equipped with a high-efficiency filter;
- Clean the work area and surroundings with a vacuum cleaner equipped with high-efficiency filter or by wetting it;
- Follow the exiting procedure for workers;
- If applicable, dismantle the work enclosure after cleaning the inside part thoroughly.

10.6.3 High-risk work

10.6.3.1 Description of high-risk work

- Handling or removal of friable material containing crocidolite or amosite having a volume of debris greater than .03 cubic meters (1 cubic ft);
- Removal of friable materials containing asbestos, except:
  - If the work area is isolated from the breathing space of the worker (moderate risk);
  - If the volume of debris is less than .03 cubic meters (1 cubic ft) (moderate risk);
- Cleaning or removal of a ventilation system in buildings where the insulation contains sprayed-on asbestos;
- Enclosure of friable material containing asbestos by the spray application of a sealant;
- Repair, alteration or demolition of kilns, boilers or similar devices made entirely or partly of refractory materials containing asbestos;
- Use of a power tool not fitted with a dust-collecting device equipped with a high-efficiency filter.

10.6.3.2 Protective equipment for performing high-risk work

- Basic equipment: helmet, footwear, glasses, gloves;
- Disposable or reusable protective clothing;
- Two layers of disposable protective clothing worn over winter work clothes;
- Powered air-purifying or supplied-air respirator. Use a FULL face mask in the following cases:
  - Removal of asbestos which has not been thoroughly wetted;
  - Crocidolite or amosite in concentrations equal to or greater than 10 fibres/cm^3.

Important: the use of a two-filter respirator is prohibited.

10.6.3.3 Measures to be taken while performing high-risk work

Note: The principal contractor and the employer must supply the workplace with a written list of all work methods, preventative measures and emergency measures.

- Cover ovens, boilers and other structures containing refractory materials if they are not to be moved;
- Remove or cover furniture in the work area;
- Remove friable materials containing asbestos scattered in the work area;
- Post a danger sign at each entrance to the work area;
- Install a decontamination area for the workers;
- Seal off or shut down the ventilation system of the building;
- Isolate the work area by means of an airtight enclosure (for indoor work);

- Install an exhaust ventilation system independent of that of the building;
- Isolate the work area by means of an airtight enclosure (for indoor work);
- Never use compressed air;
- Never smoke, eat, drink or chew gum in the work area;
- Wet friable materials containing asbestos which are likely to be dispersed during the work;
- Wetting; use water to which a wetting agent has been added;
- Wait until materials are well soaked before removing them;
- Remove small sections of material at a time without throwing or tossing them;
- Make sure that asbestos debris is cleaned up;
- Verify the condition of the work enclosure;
- Take a reading of concentration levels during each shift in the work area;
- Construct an area for handling asbestos debris.

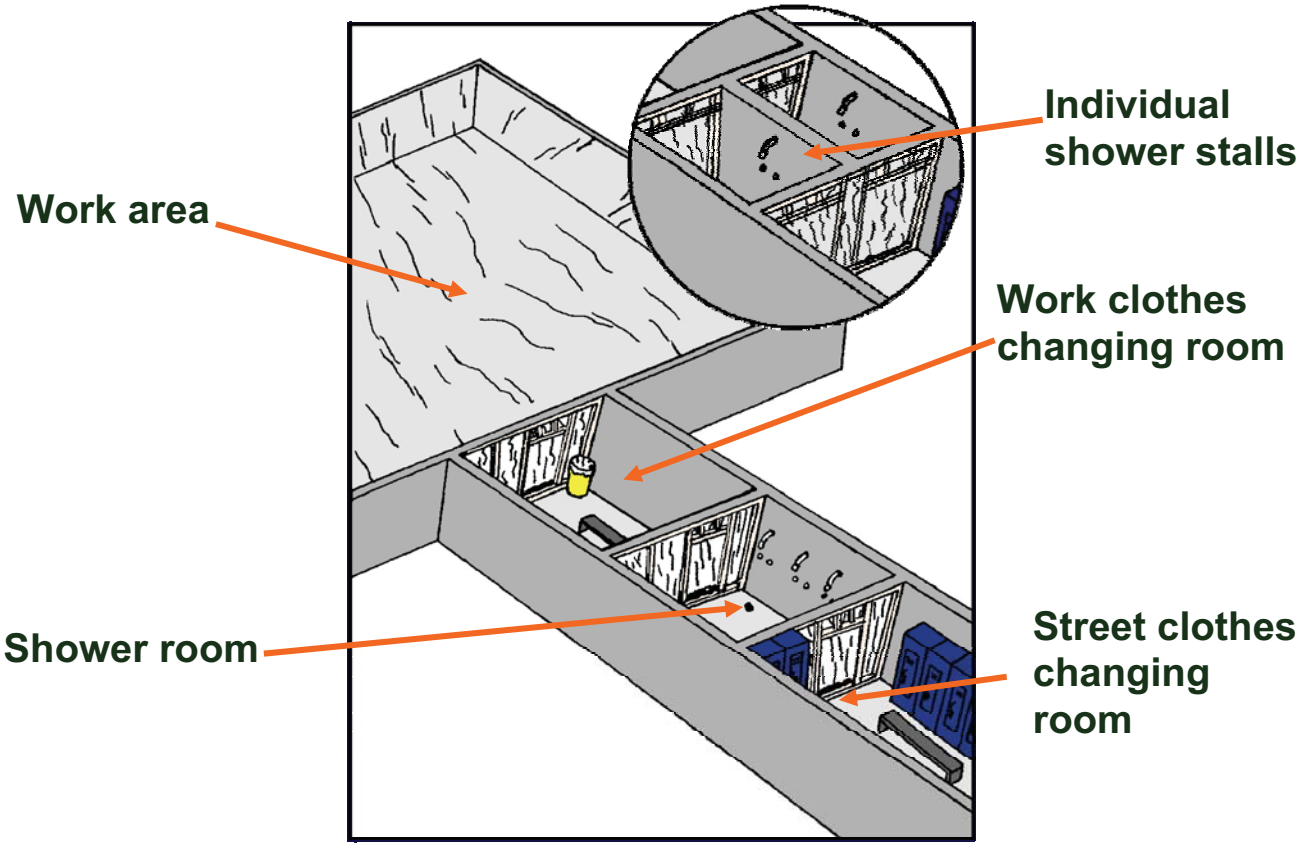
10.6.3.4 Installation of a decontamination area where high-risk work is performed

- Decontamination area contiguous to the work area;
- Work clothes changing room, and street clothes changing room;
- Shower room between the two changing rooms;
- Changing room and shower room located separately;
- Only the street clothes changing room may connect directly to the exterior of the work area;
- Street clothes changing room shall contain at least one locker per worker;
- At least .14 cubic metres (5 cubic ft) of storage space in each locker and at least 600 mm (23.5 in.) in front of each row of lockers.

Note: A decontamination area is not required if the work generates less than .3 cubic metres (10 cubic ft.) of debris.

- Non-standard construction: usually, 2x4 structure and walls of plywood or plastic sheets;
- Benches in changing rooms;
- Containers or receptacles filled with water for contaminated clothes;
- Storage space for respirators;
- Showers;
- Doorways: curtains (sometimes, screens are constructed);

High-risk work Decontamination Area



10.6.3.5 Construction of a work area where high-risk work is performed

- Required for high-risk indoor work;
- Must isolate the work area and the work clothes changing room from the rest of the building;
- Non-standard construction;
- General steps to be taken:
  - Sealing off doorways;
  - Sealing off floors;
  - Sealing off walls;
  - Sealing off electrical equipment;
  - Sealing off lights, etc.
- Outdoor work:
  Mark the passageway that connects the work area and the work clothes changing room with hazard signs.

10.6.3.6 Ventilation system for work enclosure where high-risk work is performed

- Required for all high-risk work:
  - To be installed in the work area if the work is indoors;
  - To be installed in the work clothes changing room if the work is outdoors.

10.6.3.7 Use of the ventilation system

- To decrease concentration of asbestos fibres in the air within the work enclosure;
- To change the air of the work enclosure at regular intervals;
- To prevent fibres suspended in the air from escaping toward the outside of the work enclosure;
- To facilitate cleaning of the work enclosure when the work is completed.

High-risk work fan filters

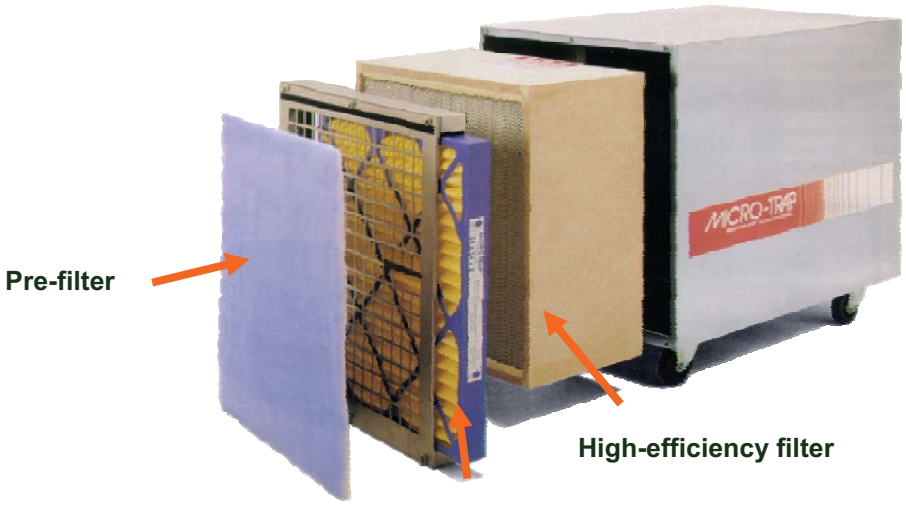
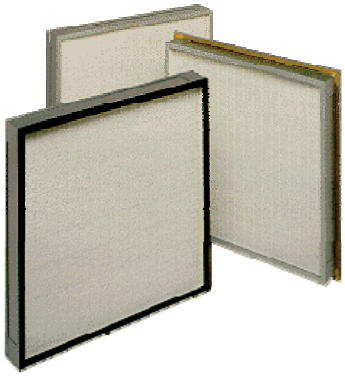


Photo: Micro-Trap Filters

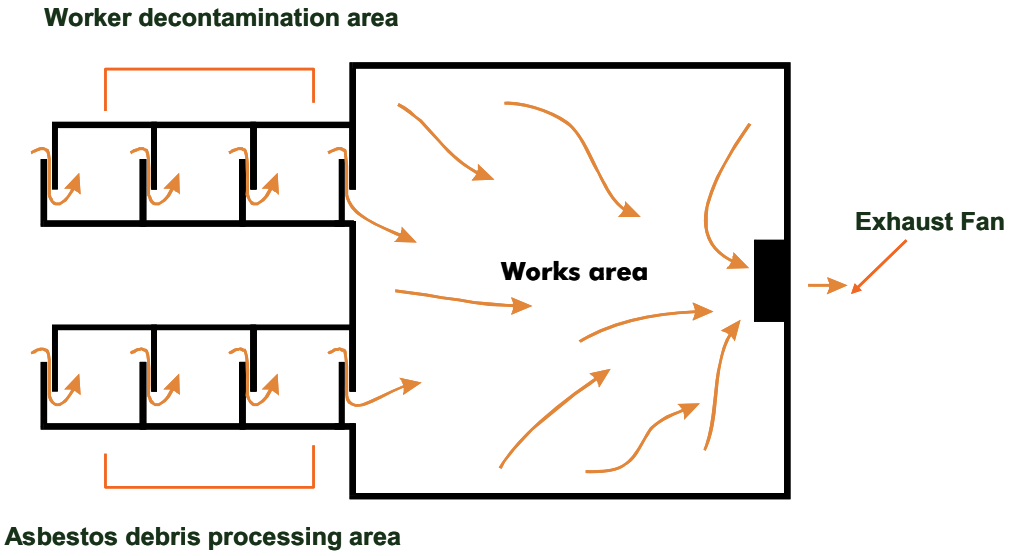
Upright HEPA **Filter**
cc.www.geyservac.com



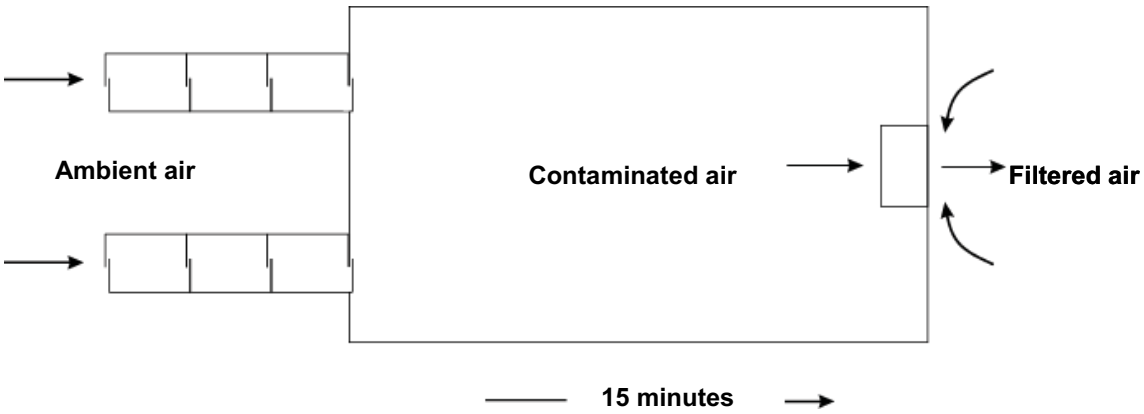
AMAIR® Panel Filters
cc. Tate Engineering Systems, Inc.

10.6.3.8 Air circulation in work enclosure while performing high-risk work

High-Risk Work
Air circulation in a work area



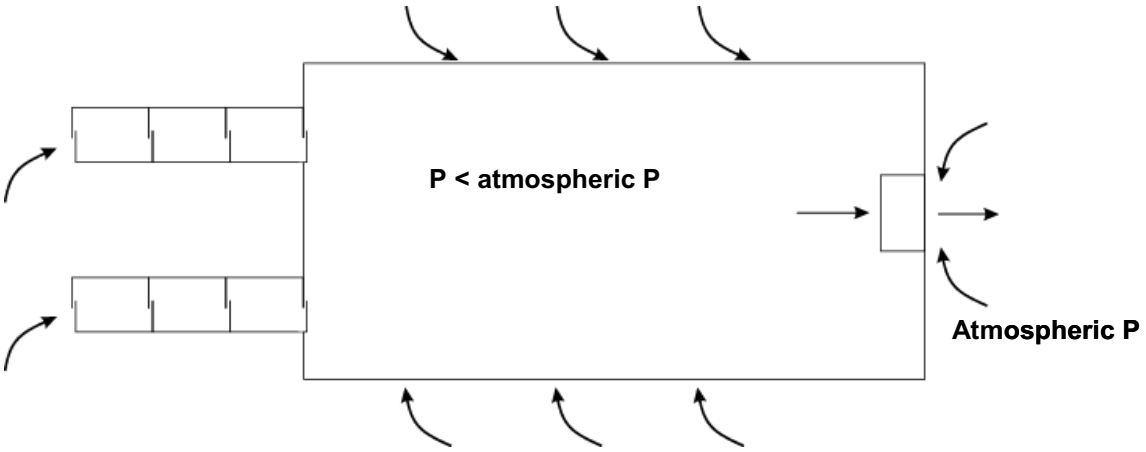
10.6.3.9 Air changes in work enclosure while performing high-risk work



10.6.3.10 Negative pressure in work enclosure while performing high risk work

- Negative pressure of 1 Pa to 4 Pa: pressure inside the enclosure is less than 1 Pa to 4 Pa (.004 to .016 inches of water) in relation to atmospheric pressure.

Precision digital manometer for measuring pressure, negative pressure and differential pressure
cc. MRU-Air



External air seeks to enter the enclosure (regulated area).
Contaminated air does not seek to leave the regulated area.

10.6.3.11 Calculating the required number of exhaust fans where high-risk work is performed

1st Step: Calculate the volume of the work enclosure

Volume = Length x Width x Height

2nd Step: Calculate the required number of exhaust fans

$$\text{Number of fans required} = \frac{\text{Volume of enclosure}}{\text{15 min x capacity of each fan}}$$

Attention:

- Fans never operate at their full capacity;
- Work enclosure is never completely airtight;
- Pressure in the enclosure may change as work progresses (i.e. with the removal of false ceilings).

Sample calculation to determine the number of exhaust fans required

- Work enclosure is 100x60x10
- Available fans have a capacity of 1800 cubic ft./min.

How many fans are necessary to ensure the desired number of air changes per hour?

Volume = 100x60x10 = 60,000 cubic ft

$$\text{Number of fans required} = \frac{\text{Volume of enclosure}}{\text{15 min x capacity of each fan}}$$

$$\text{Number of fans required} = \frac{60{,}000\ ft^3}{15\ min \times 1800\ ft^3 / min / fan} = \mathbf{2.22\ fans}$$

Consequently 3 fans are required.

10.6.3.12 Installation of ventilation system where High-risk work is performed

- Install exhaust fan(s):
  - on the ground or up high (depending on the kind of work);
  - within the work enclosure;
  - as far as possible from the curtain doorway through which workers enter the enclosure;

- Seal the enclosure plastic well around the exhaust pipe;
- Install fan(s) in a way that will require the shortest possible exhaust pipe;
- Follow the manufacturer's installation instructions;
- If applicable, start up the exhaust fans ONE AT A TIME;
- Start the system before work begins;
- Keep the system in operation during work breaks;
- Perform the work beginning at the point farthest from the exhaust fan(s);
- Stop the work if there is a power failure;
- Do not shut off the system before dismantling the enclosure.

10.6.3.13 Maintenance of ventilation system where high-risk work is performed

- If there is a variation in pressure, verify changes that have occurred within the work enclosure and correct the situation as needed;
- Inspect unit filters on a regular basis;
- Follow manufacturer recommendations for replacing filters;
- Place contaminated filters in airtight containers (trash);
- Do not change filters at the end of the project.

Removal of asbestos

cc.CNN

The future: Pipe-hugging asbestos removing robot
cc.CNN

10.7 Procedure for Handling Asbestos Waste

10.7.1 Procedure for handling asbestos waste while performing high-risk work

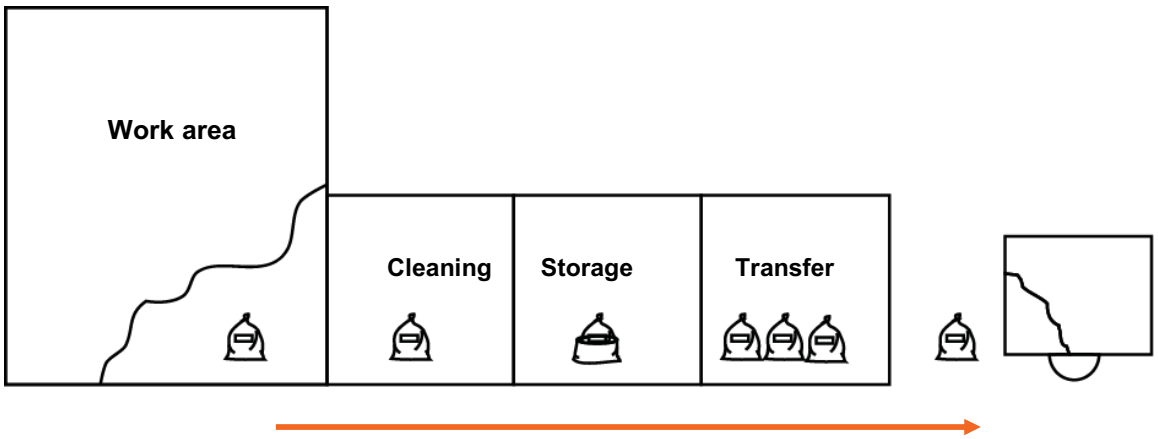
- Label all waste containers;
- Be careful not to overload waste containers;
- Close containers well while still in the work area;
- Remove most of the dust that is on the containers while still within the work area;

Cleaning bags and containers containing asbestos debris
cc. E.Decedis

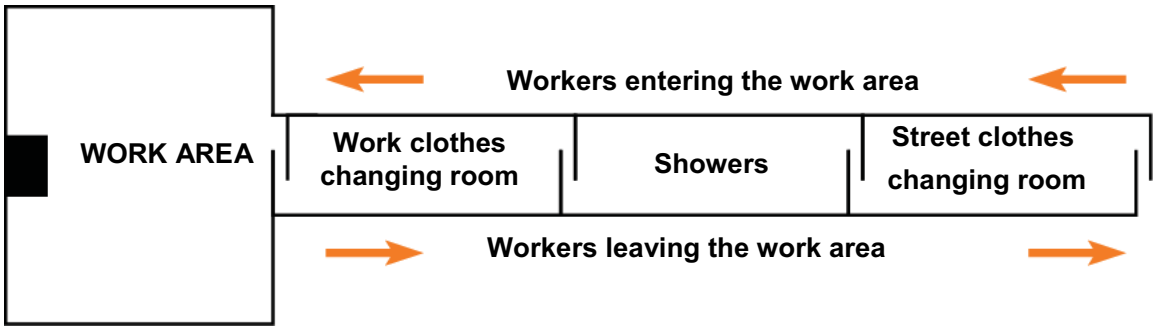
- Transfer containers into the cleaning compartment;
- Clean containers with a damp sponge in the cleaning compartment;
- Transfer containers into the storage compartment;
- Place each bag into a second beg, or into a barrel;
- Transfer the containers into the transfer bag;
- Transfer the containers of waste into a freight container or truck.

Attention: Do not throw them!

10.7.2 Waste handling area where high-risk work is performed



10.7.3 Procedure for entering and exiting the work area while performing high risk work



10.7.4 Before entering the work area

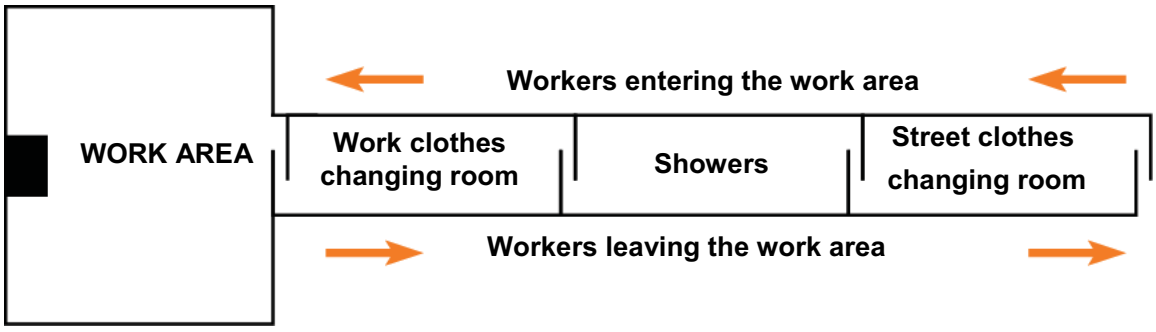
- Remove street clothes;
- Slip on protective clothing;
- Inspect and put on respirator and make adjustments;
- Put on safety helmet;
- Walk through the shower room.

10.7.5 Work clothes changing room

- Put on reusable equipment (boots and gloves);
- Enter work area;
- Perform the work with all safety measures in mind.

10.7.6 Leaving work area

- Clean off the major part of the dust in the work area;



10.7.7 Work clothes changing room

- Remove protective clothing; keep the helmet and respirator on;
- Place disposable clothing in bags and reusable clothing in water;
- Wash or clean reusable equipment before storing.

10.7.8 Shower room

- Go under the shower with helmet and respirator on and wash them;
- Wash body and hair.

10.7.9 Street clothes changing room

- Place used towel in receptacle;
- Put on street clothes again;
- Store respirator and filter as required.

10.8 Maintenance of clothing while performing high-risk work

- Reusable clothing is to be washed before being reused;
- Work clothes and protective footwear are to be washed before taking them out of the work area;
- Winter work clothes:
  - to be cleaned with a vacuum cleaner (high-efficiency filter);
  - to be placed in an airtight bag;
  - to be dry cleaned and waterproofed;
- Clean or throw out materials used to protect the work area;
- Clean the work area and surrounding areas;
- Dismantle airtight enclosure only when the concentration of asbestos fibres in the work area reaches a level lower than .01 fibres/cm^3 of air.

10.9 Measures to be taken upon completion of high-risk work

- Thoroughly clean the entire work area and decontamination area (wetting, vacuum cleaner, etc);
- Perform a detailed visual examination of the work area and decontamination area;
- Clean again, if necessary;
- Clean and remove work equipment;
- Absolutely shut off the ventilation system before the next procedure;
- Apply a sealing product;
- Wait 12 to 24 hours: take a reading of the concentration level;
- Dismantle the enclosure if the concentration figures are satisfactory.

Summary of Legal Requirements

Safety Code for the Construction Industry (Section 3.23)

11.1 Work liable to produce asbestos dust emissions

Summary of legal obligations	Low-risk work	Moderate-risk work	High-risk work
Generalities			
• **Determine type of asbestos**	x	x	x
• **Post notice for opening and closing of site**	x	x	x
• **Train workers**	x	x	x
• **Identify procedures, risk and prevention methods**			x

X = Obligatory
* = Obligatory only in certain cases
** = Not obligatory if the volume of debris is less than .3 m^3 (10 $ft.^3$)

Summary of legal obligations	Low-risk work	Moderate-risk work	High-risk work
Personal Protective Equipment			
• **Safety footwear**	x	x	x
• **Safety helmet**	x	x	x
• **Safety glasses**	x	x	x
• **Gloves**	x	x	x
• **Respirators**	x	x	x
• **Protective clothing**		x	x

X = Obligatory
* = Obligatory only in certain cases

** = Not obligatory if the volume of debris is less than .3 m^3 (10 $ft.^3$

Summary of legal obligations	Low-risk work	Moderate-risk work	High-risk work
Preparation for the work			
• **Remove furniture**	x	x	x
• **Remove asbestos material dispersed throughout the work area**		x	x
• **Isolate/mark off work area**		x	x
• **Post danger signs**		x*	x
• **Protect ventilation system of the building**			x**
• **Install a decontamination area**			x
• **Install an airtight enclosure**			x
• **Install an exhaust ventilation system**			

X = Obligatory
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** = Not obligatory if the volume of debris is less than .3 m^3 (10 $ft.^3$)

Summary of legal obligations	Low-risk work	Moderate-risk work	High-risk work
Execution of the work			
• **Do not smoke, eat, drink or chew gum**	x	x	x
• **Wet the materials**		x	x
• **Remove asbestos residue**	x	x	x
• **Affix label to waste containers**	x	x	x
• **Verify the condition of the enclosure**			x
• **Take reading of concentration**		x	x
• **Follow decontamination procedure for workers**		x	x

X = Obligatory
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Summary of legal obligations	Low-risk work	Moderate-risk work	High-risk work
Upon completion of work			
• **Clean work area**	x	x	x
• **Verify the concentration level before dismantling the enclosure**			x

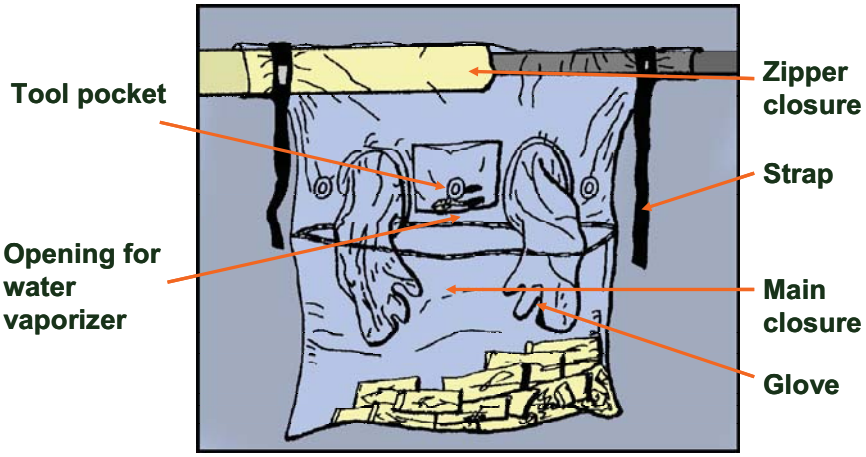
X = Obligatory
* = Obligatory only in certain cases
** = Not obligatory if the volume of debris is less than .3 m^3 (10 $ft.^3$)

The Use of Glove Bags

Note: **If the asbestos is the CHRYSOTILE type, the use of glove bags is considered MODERATE-RISK work, regardless of the quantity of debris generated by the work.**

12.1 Definition of a glove bag

An impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled. For indoor use the bag is not recommended to be larger than 60x60 inches.



12.2 Restrictions for the use of glove bags

- If the insulation is heavily damaged;
- If the temperature of the pipes is lower or higher than the limit temperatures recommended by the manufacturer.

www.fernald.gov

Use and Maintenance of Respirators

13.1 Selection of respirators

- The filtering respirator that protects against particles is a half mask equipped with one of several types of particle filters;
- The APF rating (Assigned Purification Factor) of this respirator is 10;
- APF increases to 50 when the respirator is motorized (half mask), and to 100 when it is a non-motorized full mask;
- The motorized air-purifying respirator or the supplied-air respirator with full mask, hood or helmet which has an APF rating of 1000.

13.2 Protection of workers

13.2.1 Use of respirators

- Medical examination recommended;
- Beards, long mustaches and long sideburns are usually forbidden by employers;
- Glasses: pay attention to sidepieces;
- Facial characteristics: ensure air-tightness;
- Use of one respirator for each worker. Otherwise make sure they are disinfected;
- Approval of respirators by NIOSH (National Institute for Occupational Safety and Health).

13.2.2 Inspection of respirators

A thorough inspection is to be carried out on a daily basis on:

- Face piece;
- Adjustable straps;
- Inhalation and exhalation valves;
- Filters;
- Batteries.

13.2.3 Fit tests

- Negative pressure seal check;
- Positive pressure seal check;

13.2.4 Negative pressure seal check

Air-tightness of the mask is verified in the following way:

- Put on the respirator and adjust the straps so that they feel tight but not uncomfortable;
- Cover the openings of the cartridges with your hands;
- Inhale lightly to create a vacuum;
- Hold your breath for five seconds or follow the manufacturer's instructions;

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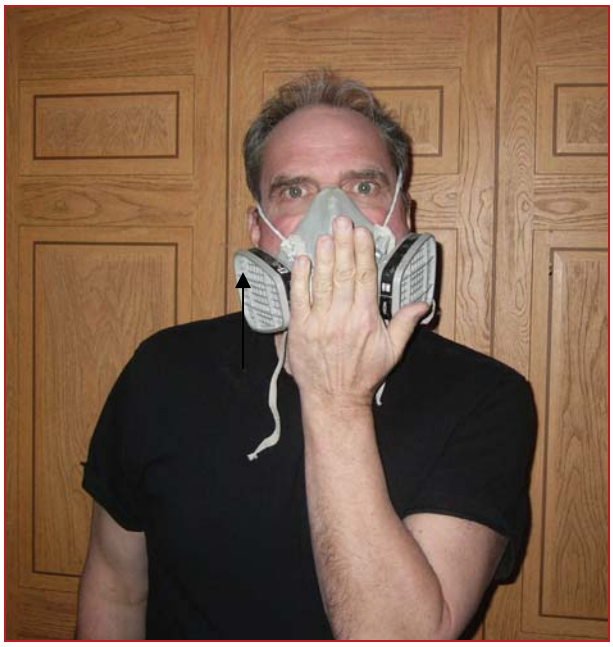
- If it is airtight, the mask will collapse slightly;
- If this is not the case, the mask should be readjusted, and the test redone. It is also possible that the mask is not the right size, or that the style of respirator is not appropriate.

13.2.5 Positive pressure seal check

Air-tightness of the mask is verified in the following way:

- Cover the opening of the exhalation;



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- Exhale gently into the mask;
- Hold for five seconds or follow the manufacturer's instructions;
- If it is airtight, the mask will bulge slightly. If it is not airtight, the mask should be readjusted and the test redone.

NOTES

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