



ASBESTOS:

CONTROLS FOR CONSTRUCTION, RENOVATION, AND DEMOLITION

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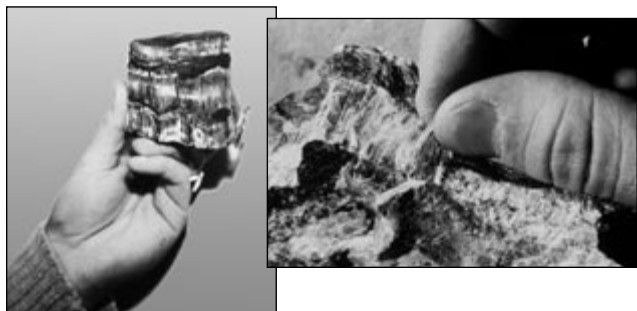
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1 INTRODUCTION

“Asbestos” refers to a group of naturally occurring minerals once used widely in the construction industry.



Its strength, insulation properties, ability to withstand high temperatures, and resistance to many chemicals made asbestos useful in hundreds of applications in the construction industry.

1.1 Types of asbestos

There are two general categories of asbestos: *serpentine* (long and flexible fibres) and *amphibole* (brittle and sharp fibres). There are six types of asbestos generally recognized:

- chrysotile (*serpentine*)
 - crocidolite
 - amosite
 - actinolite
 - anthophyllite
 - tremolite
- } *amphibole*

Chrysotile asbestos is characterized by long wavy fibres that are white or off-white. Amosite is often called “brown” asbestos and has much straighter, shorter and sharper fibres than chrysotile. Crocidolite is referred to as “blue” asbestos and has long straight fibres much like amosite.

Chrysotile is by far the most common type of asbestos found in Ontario. Within the amphibole family, only amosite and crocidolite have had significant commercial use.

Some studies show that fibres such as amosite and crocidolite (amphiboles) stay in the lungs longer than chrysotile fibres (serpentine). This tendency may account for the greater toxicity (harmfulness) of amphibole fibres.

1.2 History

Major use of asbestos products in construction began in the 1930s and escalated during the post-war building boom. During the 1950s and up to 1970 approximately 30 to 80 thousand tons were used annually in Canada.

In the early 1970s, the use of such products in Canada declined sharply because of increasing concern over the health effects of asbestos. In the mid-1970s specific prohibition and the availability of safer substitutes put an end to the use of many asbestos products. But the early widespread use of asbestos has left a potentially dangerous legacy. The thousands of tons of asbestos installed over the past eighty years can pose serious risk to workers in the renovation, maintenance, repair, and demolition sectors of the construction industry.

2 HEALTH EFFECTS OF ASBESTOS

Asbestos fibres don’t break in half across their diameter (width), but rather split into thinner and thinner needle-like fibres along their length.



An asbestos fibre can remain airborne for a long time and can easily become airborne again after it has settled if there is any air movement.

Asbestos fibres usually need to be less than 3 micrometres in diameter before they can be inhaled deep into the lungs. (A micrometre is one millionth of a metre, which is one thousandth of a millimetre, and its abbreviation is μm .) The fibres can remain in the lungs for many years—even decades.

The average diameter of an airborne asbestos fibre ranges from 0.11 to 0.24 μm , depending on the type of asbestos and are invisible to the eye. You can see fibres that are greater than 100 μm in diameter.

Human hair is approximately 100 μm in diameter—more than 300 times thicker than asbestos fibre.

Inhalation of the airborne asbestos fibres that you cannot see is what causes asbestos-related diseases.

Inhaling asbestos fibres has been shown to cause the following diseases:

- Mesothelioma
- Lung cancer
- Asbestosis
- Other illnesses.

A person exposed to asbestos may feel no ill effects at the time of exposure. The time period between exposure to asbestos fibres and the

development of disease can range from 15 to 55 years. This is known as the **latency period**. The asbestos-related diseases workers get today are the result of exposures during the 1960s, 1970s, and 1980s.

Mesothelioma is a rare and fatal cancer of the lining of the chest and/or abdomen. While this disease is seldom observed in the general population, it appears frequently in workers exposed to asbestos.

Because of past exposures, mesothelioma is the #1 cause of occupation-related death in construction.

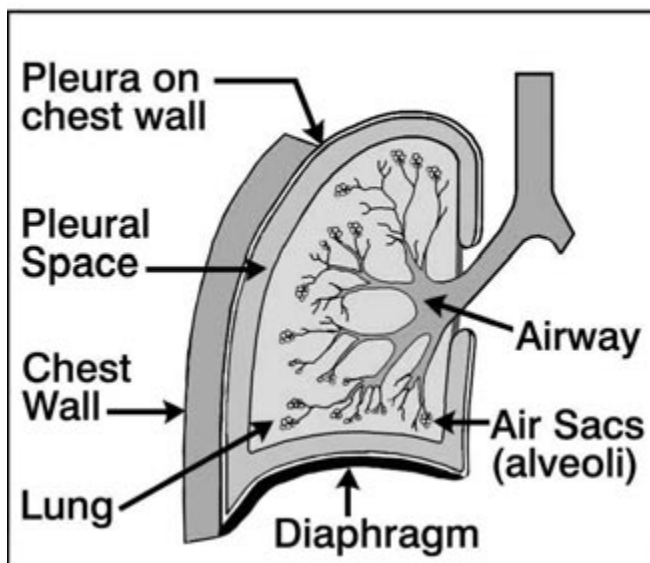
Lung cancer appears quite frequently in people exposed to asbestos dust. While science and medicine have not yet been able to explain precisely why or how asbestos causes lung cancer, it is clear that exposure to asbestos dust can increase the risk of this disease. Studies have shown that the risk to asbestos workers is roughly five times greater than for people who are not exposed to asbestos.

Cigarette smoking, another cause of lung cancer, multiplies the risk. Cigarette smoking and asbestos combine to produce a synergistic effect. Research has shown that the risk of developing lung cancer was fifty times higher for asbestos workers who smoked than for workers who neither smoked nor worked with asbestos.

Asbestosis is a disease of the lungs caused by scar tissue forming around very small asbestos fibres deposited deep in the lungs. As the amount of scar tissue increases, the ability of lungs to expand and contract decreases, causing shortness of breath and a heavier workload on the heart. Ultimately, asbestosis can be fatal.

Other illnesses – There is some evidence of an increased risk of cancers of the gastrointestinal tract and larynx. However, the link between asbestos exposure and the development of these illnesses is not as clear as with lung cancer or mesothelioma.

Normal Lung Anatomy



The diseases described above do not respond well to current medical treatment and, as a result, are often fatal.

Asbestos may cause skin irritation and a wart-like condition which can be prevented by wearing normal clothing. Asbestos does not cause skin cancer.

Significant exposure to asbestos puts you at risk for developing pleural plaques (scarring of the pleura—the lining of the lung). Pleural plaques are an indicator of previous exposure to asbestos and can make breathing difficult. Some researchers believe that there is evidence that workers with pleural plaques are at risk of developing other asbestos-related diseases such as lung cancer or mesothelioma. If you develop pleural plaques you should inform your physician about your exposure to asbestos.

2.1 Disease statistics

From 1997 to 2006, Ontario’s Workplace Safety and Insurance Board (WSIB) approved 300 occupational disease fatality claims – the vast majority of them (approximately 85%) due to asbestos exposure. Trades at particular risk include plumbers/pipe fitters, insulators, labourers, and electricians.

2.2 Pre-employment medical examination

Before starting as an asbestos worker, it is recommended that the prospective worker go through a pre-employment medical examination. The examination is to see if the worker has a pre-existing respiratory disease (such as asthma or evidence of impaired lung function) that may prevent the worker from using respiratory protection.

3 LOCATIONS OF ASBESTOS

Two classes of asbestos products were widely used. The first includes materials easily crumbled or loose in composition such as spray-fireproofing. These are referred to as “friable.” The second type includes

materials that are much more durable because they are held together by a binder such as cement, vinyl, or asphalt. These products are termed “non-friable.”

FRIABLE means easily crumbled into dust

NON-FRIABLE means difficult to crumble into dust.

3.1 Typical locations – friable materials

3.1.1 Sprayed-on fireproofing

This material was widely used to fireproof steel structures. It can be found on beams, columns, trusses, joists, and steel pan floors. Sprayed material was also used as a decorative finish and as acoustical insulation on ceilings. The material can be loose, fluffy, and lumpy in texture or, if more gypsum or cement was used, it may be quite hard and durable.



Sprayed-on fireproofing

3.1.2 Pipe and boiler insulation

Much of the insulation on older heating systems and industrial processes was asbestos. Some types were pre-formed blocks or sections while others (commonly called “air cell” insulation) were corrugated and resemble cardboard. Often these materials are covered by painted canvas or sheet material.

Site-mixed asbestos cement was often used to insulate valves and elbows on piping and on the rounded ends of boilers and pressure vessels.



Boiler



Pipe and boiler insulation



Air cell insulation

3.1.3 Loose fill insulation

This application was relatively rare and usually limited to tank insulation where the asbestos is held in place by light gauge wire mesh and then covered with sheet metal.



Loose fill insulation

3.1.4 Vermiculite

Vermiculite is a mineral. It has been used in insulation and many commercial and consumer products for well over 50 years. Vermiculite itself is not asbestos and has not been shown to pose a health problem. Vermiculite, however, can be contaminated with asbestos since mineral deposits of the two substances can occur together underground. For example,

vermiculite ore from the Libby Mine in Montana from the 1920s to 1990 was contaminated with asbestos. Insulation made from this vermiculite was sold in Canada during that time under various trade names such as “Zonolite.”



Vermiculite

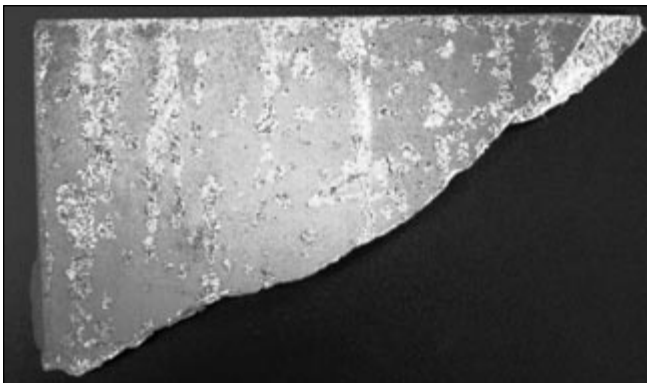
Not all vermiculite contains asbestos fibres. It is recommended that buildings with vermiculite-based insulation be tested to determine if asbestos is present. If you don't test the material, assume that it contains some asbestos.

3.2 Typical locations – non-friable materials

Note: Certain conditions (such as chemical exposure, thermal degradation, and water damage) may cause non-friable asbestos-containing material to deteriorate and become friable.

3.2.1 Asbestos cement products

This type of material contains cement to bind the asbestos fibres together and was used in pipe form for sewers and water supply. In sheet form it was used for roofing and siding, as well as some types of firewall construction—for example, behind stoves and fireplaces and in high-rise construction.



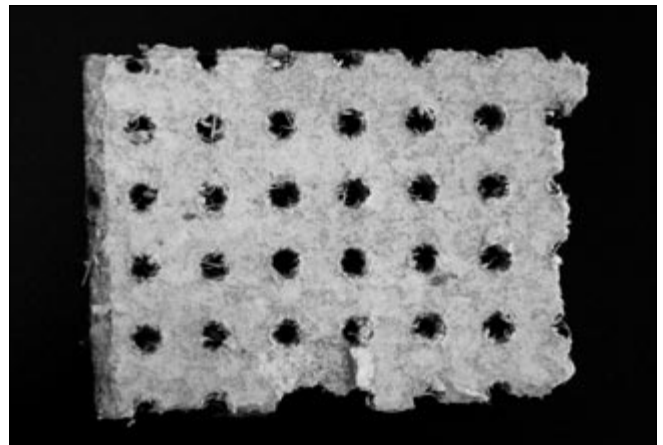
Asbestos concrete

3.2.2 Acoustical plaster

Acoustical plaster may be friable – it depends on the exact mixture. This material was mixed on site and applied like conventional plaster. It was used in schools, auditoriums, hospitals, and commercial buildings where acoustical properties were required.

3.2.3 Acoustical tiles

Some of the older acoustical tiles may contain significant amounts of asbestos. Some tiles were stapled or glued in place whereas others were suspended on T-bar. Some tiles can be considered friable because they can be crumbled by hand pressure. They are generally considered to be non-friable, however, since they are usually intact when they're handled.



Acoustical tile

3.2.4 Vinyl asbestos products

These products were widely used in flooring as both tiles and sheets. The vinyl served to lock in the asbestos fibres.



Vinyl asbestos flooring

3.2.5 Roofing felts/shingles

Some roofing felts used in built-up asphalt or pitch roofing contained asbestos. Asphalt or pitch was used to saturate the felts and bind the fibres in place.

3.2.6 Asphalt/asbestos limpet spray

This black tarry mixture was sprayed onto tanks and other equipment primarily in petrochemical plants and heavy industry. The application was very similar to sprayed-on fireproofing except that

asphalt was used as the binder. In some applications a surface coat of asphalt was used to cover asbestos insulation on tanks, hoppers, and other storage or process equipment.

Asbestos was added to asphalt and used for road construction.

3.2.7 Drywall joint-filling compound

Early drywall joint-filling compounds contained significant amounts of asbestos fibre. This particular use was specifically prohibited in 1980 by the *Hazardous Products Act*. Still, it may be found in buildings constructed several years afterwards.



Drywall joint-filling compound

3.2.8 Coatings and mastics

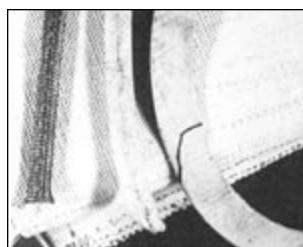
Since asbestos was relatively inexpensive and withstood weathering, it was widely used as a filler in many coatings and mastic products such as roofing cement, caulking materials, and flooring adhesives.

3.2.9 Gaskets and packings

Several different types of gasket material contained asbestos. One common type was a rubber/vinyl/asbestos mixture which could be cut to size or came in standard sizes and patterns. Woven or pressed asbestos material was also widely used on doors and other openings on boilers, furnaces, and kilns (see image a). A third type consisted of a metal outer ring and an asbestos inner ring (see image b) and was used on high pressure steam lines and similar processes (see image c). A fourth type was often used as packing for pumps and valves (see image d).

3.2.10 Refractory brick

High temperature refractory brick and mortar containing asbestos material were previously



a



b



c



d

Gaskets and packings

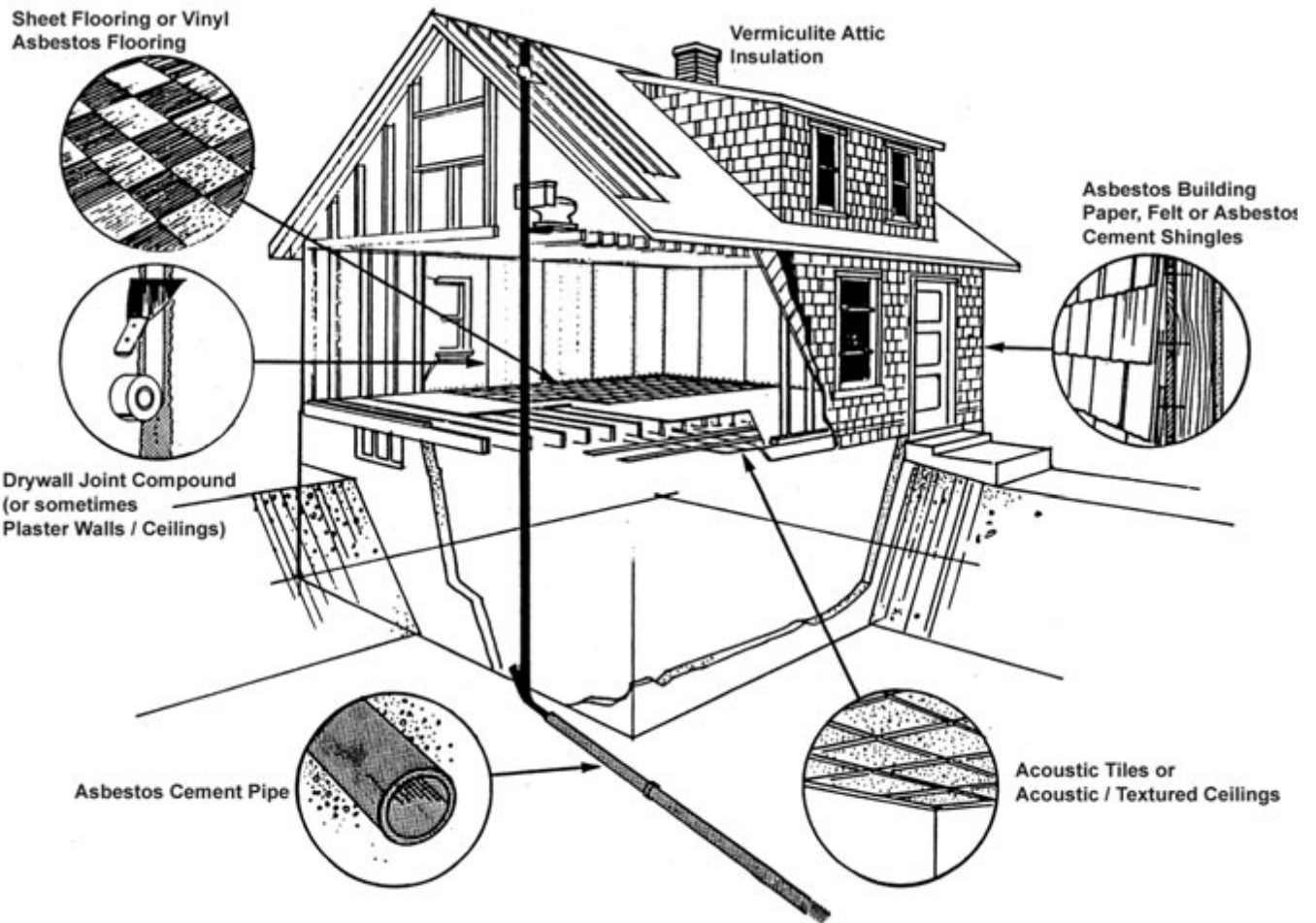
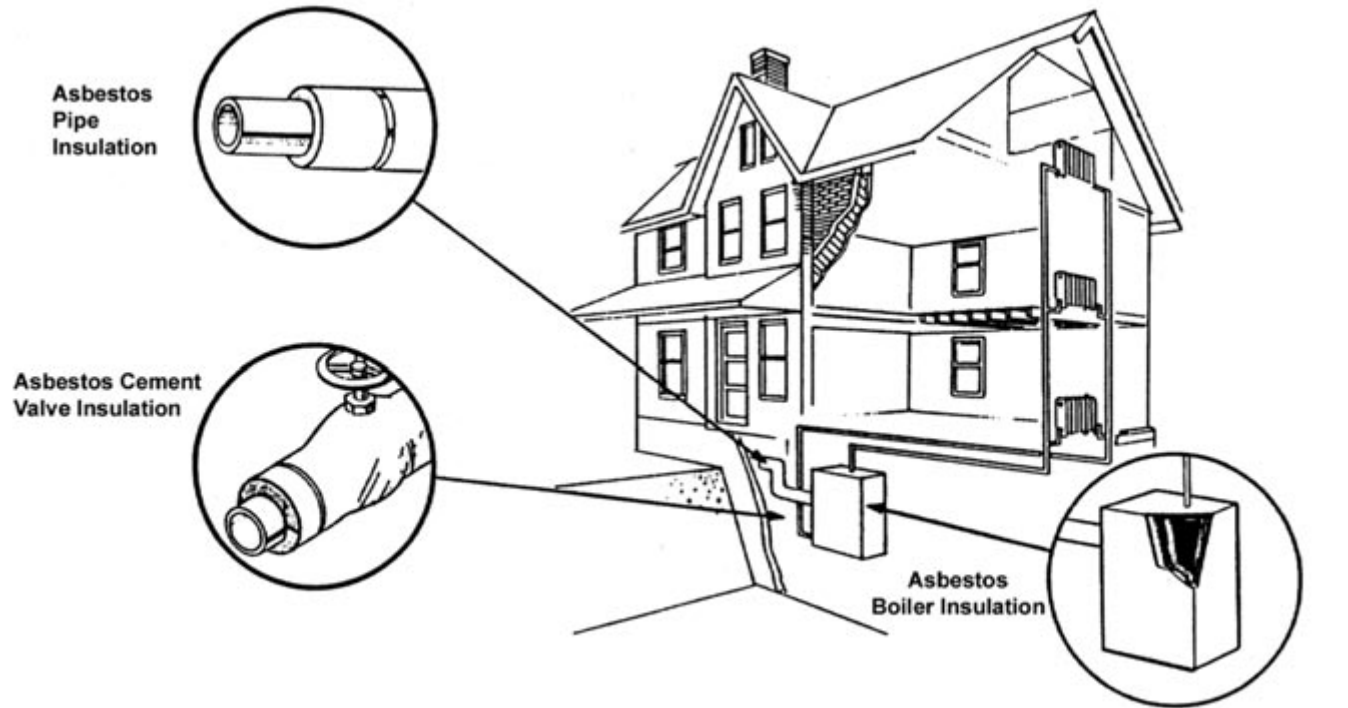
used in the construction of structures required to withstand high temperatures such as in boiler rooms and furnace rooms.

3.3 Summary: Typical locations

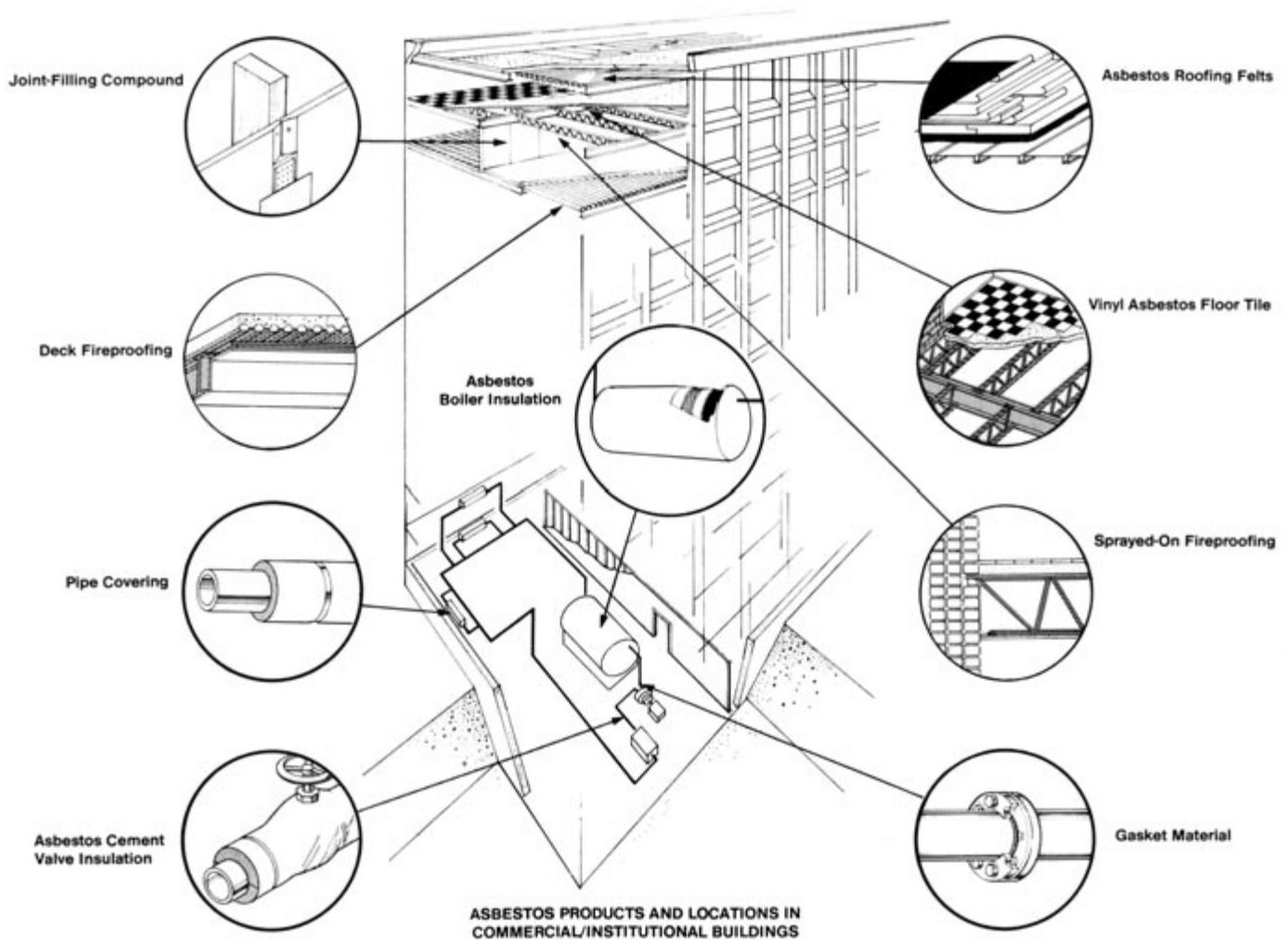
Table 1 summarizes where asbestos products have been generally used. The images on the following pages indicate typical locations of asbestos materials in various types of construction.

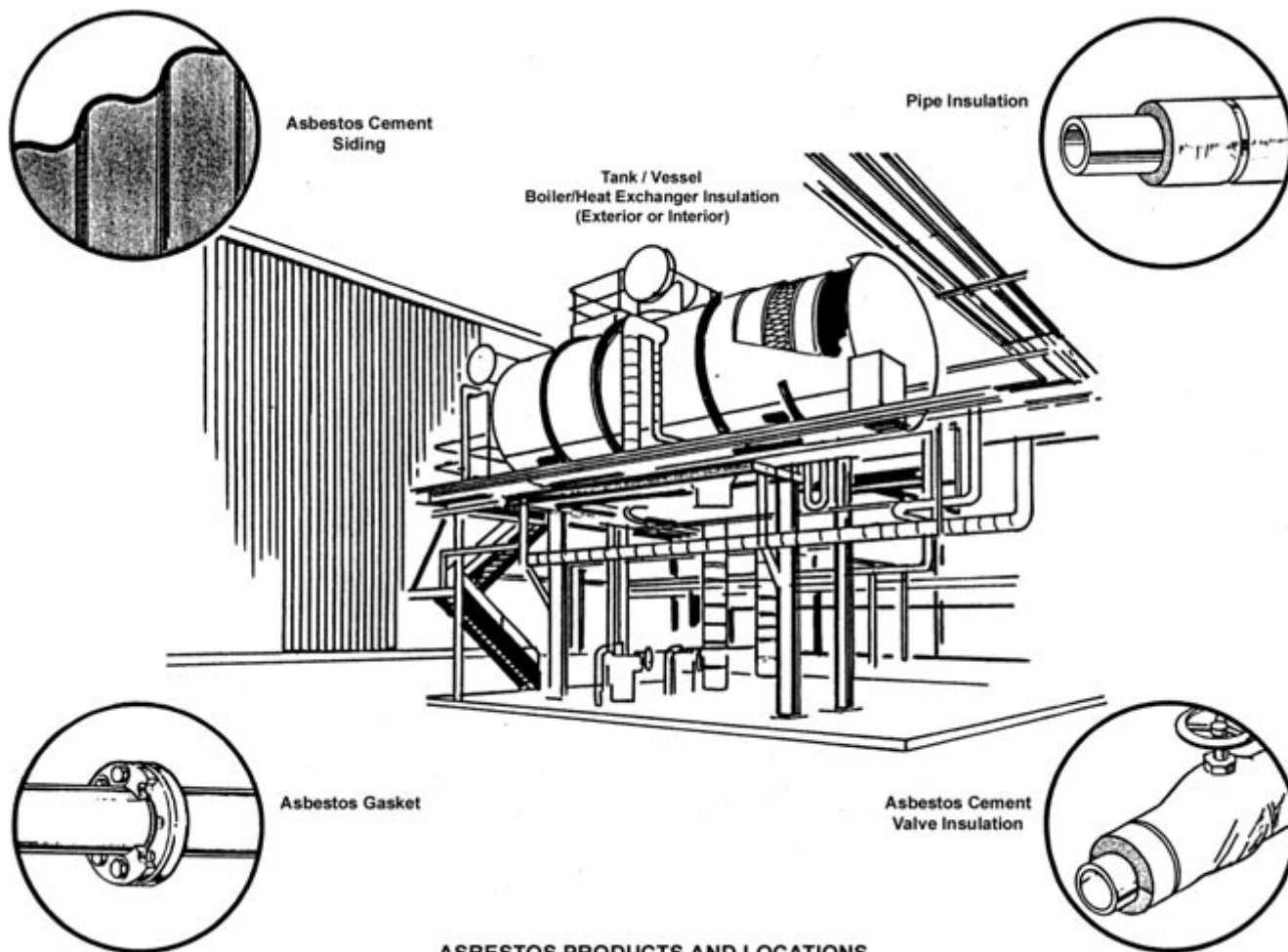
TABLE 1 — ASBESTOS PRODUCTS IN CONSTRUCTION			
Product	Residential	Commercial/Institutional	Industrial
Sprayed-On Fireproofing		XX*	
Pipe and Boiler Insulation	X	X	XX
Loose Fill Insulation	X		X
Vermiculite Insulation	X		
Asbestos Cement Products	X	X	X
Acoustical Plaster	X	X	
Acoustical Tiles	X	XX	
Vinyl Asbestos Tiles	X	X	
Gaskets		X	XX
Roofing Felts	X	X	X
Asphalt/Asbestos Limpet Spray			X
Drywall Joint-Filling Compound	X	X	
Coatings and Mastics	X	X	X

*Extensive use



Asbestos Products in Residential Buildings





ASBESTOS PRODUCTS AND LOCATIONS IN INDUSTRY

4 IDENTIFYING ASBESTOS-CONTAINING MATERIAL (ACM)

Although the only true method of identifying asbestos is by microscopic analysis of samples, several rules of thumb indicate whether it's likely that asbestos is present.

4.1 The age of the building or equipment

Asbestos pipe and boiler insulation was used extensively in all sectors of the industry until the 1970s, when substitutes such as fiberglass, mineral wool, rock wool, and refractory ceramic fibre became more economical and less hazardous. Buildings and installations dating from before that period may contain asbestos in different forms.

Since the late 1970s, many owners of processes have upgraded their insulation. The original asbestos insulation may have been covered by some other material (e.g., fiberglass or refractory ceramic fibre) and a surface inspection may not reveal any underlying asbestos.

In the case of fireproofing, 1974 marks the last major use of asbestos for this application.

4.2 The type of construction

Structural steel frame buildings require fireproofing to protect the integrity of the structure until occupants can be evacuated. This resulted in widespread use of sprayed-on or trowelled-on fireproof coatings, most of which contained chrysotile asbestos.

Reinforced concrete structures do not normally require additional fireproofing since the concrete protects the reinforcing steel which provides the critical structural support. However, composite steel pan/concrete floor construction was often fireproofed with asbestos.

In low-rise residential construction, the use of friable asbestos material is usually limited to pipe and boiler insulation as described above.

4.3 The nature of the equipment

Asbestos insulation materials were used on equipment exposed to extreme conditions such as high temperatures and corrosive environments. As a result, asbestos can be anticipated on high pressure steam lines, "hot" process piping, and refractory linings in furnaces and kilns.

Asbestos cement sheeting was often used in industrial settings for roofing, siding, and splash protection from corrosive material.

4.4 The appearance of the material

While mineral wool, calcium silicate, and asbestos are quite similar in appearance, other materials such as fiberglass are noticeably different. This fact can be used to eliminate certain materials from consideration and analysis.

In the case of pipe insulation, the corrugated type of material commonly called "air-cell" insulation was almost exclusively made with a significant amount of asbestos.

The factors in Sections 4.1 and 4.4 (above), along with a review of original plans and specifications, can be used by the client or the client's representative in conducting an inspection and preparing the required report. Any suspect materials which cannot be determined to be asbestos or are not treated as asbestos-containing material (ACM) must be sampled and microscopically analyzed (U.S. EPA Test method EPA/600/R-93/116) to determine:

- whether the material is ACM
- the type of asbestos
- the percentage of asbestos present.

5 OVERVIEW OF THE NON-ASBESTOS LEGISLATION AND POLICIES THAT APPLY TO ASBESTOS WORK IN ONTARIO

5.1 Occupational Health and Safety Act (OHSA)

The *Occupational Health and Safety Act*

1. sets out the rights and duties of all parties in the workplace. Its main purpose is to protect workers against health and safety hazards on the job.
2. establishes procedures for dealing with workplace hazards, and it provides for enforcement of the law where compliance has not been achieved voluntarily through the internal responsibility system.

5.1.1 Specific non-asbestos regulations made under the OHSA

5.1.1.1 Construction Regulation (Ontario Regulation 213/91)

Asbestos removal falls under the Construction Regulation which regulates health and safety issues such as:

- housekeeping
- electrical hazards
- fire safety
- ladders
- scaffolds and work platforms
- elevating work platforms
- confined spaces
- demolition.

5.1.1.2 WHMIS (Workplace Hazardous Materials Information System)

WHMIS applies to all work sites where controlled products are used. Under the WHMIS regulation, employers must:

- provide material safety data sheets (MSDSs) for the products,
- ensure that controlled products have WHMIS labels applied to the containers,
- ensure that workers receive WHMIS training.

5.1.1.3 Critical Injury Definition Regulation (Regulation 834)

For the purposes of the *Occupational Health and Safety Act* and the regulations, “critically injured” means an injury of a serious nature that,

- places life in jeopardy;
- produces unconsciousness;
- results in substantial loss of blood;
- involves the fracture of a leg or arm but not a finger or toe;
- involves the amputation of a leg, arm, hand or foot but not a finger or toe;
- consists of burns to a major portion of the body; or
- causes the loss of sight in an eye.

All critical injuries must be reported to the Ministry of Labour (MOL) for further investigation.

5.2 Workplace Safety and Insurance Act

Through the *Workplace Safety and Insurance Act*, the Workplace Safety and Insurance Board (WSIB) oversees the compensation of those injured or made ill due to work-related causes. The WSIB provides disability benefits, monitors the quality of health care, and assists in early, safe return to work for workers who were injured on the job or who developed an occupational disease.

The *Workplace Safety and Insurance Act* also outlines first aid requirements for companies.

5.3 Environmental Protection Act

The disposal of asbestos is strictly regulated by the *Environmental Protection Act*. Asbestos waste must be disposed of at a landfill specifically approved and equipped to handle asbestos waste.

5.4 Transportation of Dangerous Goods Act

The transportation of asbestos-containing waste from the site of the asbestos abatement project to the landfill is regulated by the Transport of Dangerous Goods (TDG) Regulation and requires that

- any person transporting or handling dangerous goods has a TDG certificate
- the contractor transporting asbestos waste must have correct
 - TDG placarding on vehicles
 - manifest
- friable asbestos waste is transported only in vehicles equipped with emergency spill clean-up equipment.

5.5 Company policies

Companies may establish additional safe work practices and procedures (policies) that go beyond the requirement set out in the OHS Act and its regulations. Company supervisors are responsible for ensuring compliance and enforcement of these work practices and procedures.

6 OVERVIEW OF THE ASBESTOS LEGISLATION THAT APPLIES TO ASBESTOS WORK IN ONTARIO

Ontario Regulation 278/05 (*Designated Substance—Asbestos on Construction Projects and in Buildings and Repair Operations*) under the *Occupational Health and Safety Act* (OHS Act) outlines safe work measures and procedures and respiratory protection for workers who may encounter asbestos-containing material (ACM) in the course of their work.

ACM (asbestos-containing material) is defined as material containing 0.5% or more asbestos.

6.1 Application

The regulation applies to all work on ACM, or work which is likely to disturb ACM, with the major exception being residential buildings containing four dwelling units or less, where one of the units is occupied by the owner or the owner’s family. However, Section 30 of the *Occupational Health and Safety Act* states that homeowners are required to inform contractors about the presence of asbestos in their homes so that they can protect workers.

6.2 Restriction of sprayed material and thermal insulation

Spraying material containing more than 0.1% asbestos or the use of thermal insulation containing more than 0.1% asbestos is prohibited.

6.3 Classification of Type 1, Type 2, and Type 3 operations

The Ministry of Labour uses the following five factors to categorize the asbestos-related activity into one of three types: Type 1, Type 2, or Type 3. Think of Types 1, 2, and 3 as describing low-, medium-, and high-risk work.

1) Nature of material

FRIABLE versus NON-FRIABLE

Friable means easy-to-crumble with hand pressure into dust.

Non-friable means difficult-to-crumble with hand pressure into dust.

- Friable products such as fireproofing and thermal insulation can release fibres very easily, whereas non-friable products will generally release fibres only when they are
 - cut

- ❑ shaped
- ❑ otherwise worked with power tools
- ❑ deliberately crumbled or pulverized.
- Compared to chrysotile, amphiboles such as amosite are not as easily controlled by water and thus tend to generate more dust during removal.
- Some studies show that amphibole fibres (crocidolite, amosite, tremolite) stay in the lungs longer than serpentine (chrysotile) fibres. This tendency may account for the greater toxicity (harmfulness) of amphibole fibres.

2) Nature of activity

This can greatly affect the degree of hazard. For example, cutting asbestos cement products with a power tool creates much more dust than scribing and breaking.

3) Application of water

Using water to prevent the creation and spread of dust is a practical control in many cases. It is not practical, however, in areas where wetting would create a hazard or cause damage. In such circumstances, dry removal is allowed.

4) Size of the project or duration of exposure

Asbestos diseases are dose-related: the greater the exposure in duration and/or intensity, the greater the risk. Short exposures to any given amount of asbestos will usually be less significant than longer exposures.

5) Risk to bystanders

The hazards of exposure must be considered for both workers and other people not directly involved in the asbestos project. For instance, handling asbestos outdoors or pre-demolition does not pose the same risk to bystanders as handling it in an occupied building where the dust may recirculate.

The classification and control procedures for carrying out Type 1, 2, and 3 operations are outlined in Sections 9, 10, and 11 of this manual.

6.4 Demolition, alteration, and repair—Owner’s report

For any demolition, alteration, or repair projects the owner must complete a **report** indicating whether any material *that is likely to be handled, dealt with, disturbed, or removed* is

- friable or non-friable asbestos-containing material (ACM), or
- to be treated as ACM, and, in the case of sprayed-on friable material, treated as though it contained a type of asbestos other than chrysotile.

The report (including drawings, plans, and specifications as appropriate) must show the location of the ACM and must be provided to all contractors bidding on the job and must be reviewed before contract arrangements are finalized.

6.5 Training and certification requirements

6.5.1 General asbestos awareness training requirement

Anybody who works in a Type 1, Type 2, or Type 3 asbestos operation must be trained by a competent person on the following:

- the hazards of asbestos exposure
- the purpose, inspection, maintenance, use, fitting, cleaning, disinfecting, and limitations of respirators
- personal hygiene and correct procedures for work with asbestos
- how to use, clean, and dispose of protective clothing.

This requirement includes workers such as electricians, plumbers and pipe fitters, gas fitters,

painters, drywallers, demolition workers, heating and ventilation workers, and computer installers performing work in the area of a Type 1, Type 2, or Type 3 operation, but not involved in an actual removal operation.

Workers performing Type 3 operations and supervisors in these operations must also be certified to do so, as described below.

6.5.2 Certification requirements for Type 3 operations

As of November 1, 2007, **workers** and **supervisors** must be certified before they can do Type-3 asbestos work or supervise Type-3 work. Certification is not required for

- workers in Type 1 or Type 2 operations
- workers entering Type 1, 2, or 3 work areas to perform work not related to the asbestos removal operation.

The workers that do not require certification are, however, required to have asbestos awareness training.

There are two asbestos abatement certification programs: one for workers (*Asbestos Abatement Worker*) and one for supervisors (*Asbestos Abatement Supervisor*). Before becoming a certified asbestos abatement supervisor you must

- be certified as an asbestos abatement worker
- have taken a 16-hour training course on being a supervisor in construction
- take the *Asbestos Abatement Supervisor* program and pass the test.

Workers and supervisors must have their original certification cards available at the work site when they are working. Ministry of Labour Inspectors may ask a worker to produce their original card plus appropriate identification.

6.5.2.1 Steps to get certified

1. One of the following groups must register you for an in-school training program approved by the Ministry of Training, Colleges, and Universities (MTCU):
 - employers engaged in Type 3 asbestos work
 - joint local union/employer training committees.

Note: The employer must apply to the MTCU for “signing authority” before it can enroll you in an approved training program.
2. Take the training that you need.
3. Once you have completed the in-school part, you are eligible to write the asbestos abatement worker or supervisor test. Each test is administered by the MTCU (not the training provider) and consists of 40 multiple-choice questions.
4. If you pass the test, the “signing authority” (the employer) sends the required paperwork to the MTCU. This confirms that you have successfully completed the in-school training program and have passed the test. The MTCU will then issue you a Certificate of Completion.

6.5.2.2 Exemption from exams

Until November 1, 2008, experienced Type 3 workers and supervisors can take the tests without having to take the in-school training programs. If you fail the test, however, you will be required to take an in-school training program approved by the MTCU.

Experienced workers and supervisors from outside Ontario can take the tests without having to take the in-school training. If they fail the test, however, they will be required to take an in-school training program approved by the MTCU.

You are considered experienced if you have at least 1,000 hours of experience performing Type 3 work before November 1, 2007. You must prove this with an Asbestos Work Report Form 1 (or equivalent document for those from outside Ontario) or a letter on official company letterhead.

6.6 Notifying the Ministry of Labour (MOL)

6.6.1 Informing the Ministry of Labour of Type 3 operations and Type 2 glove-bag operations

You must notify the Ministry of Labour (MOL), orally and in writing, before beginning a Type 3 operation, or before beginning a Type 2 operation in which one square metre or more of insulation

is to be removed using a glove bag. The written notice must include

- the name and address of the person giving the notice
- the name and address of the owner of the place where the work will be done
- the exact address and location where the work will be done
- a description of the work that will be done
- the starting date and expected duration of the work
- the name and address of the supervisor in charge of the work.

TORONTO-BASED ENERGY COMPANY FINED FOR HEALTH AND SAFETY VIOLATIONS

SARNIA, Ont. - A Toronto-based energy company that operates an ethanol refinery in Sarnia, was fined \$125,000 for two violations of the *Occupational Health and Safety Act*, and a London, Ont.-based insulation contractor, was fined \$50,000 for one violation, both on May 14, 2007, in connection with asbestos infractions.

Between March 9 and 12, 2005, workers removed insulation and other materials from heat exchangers and from a “stripper change drum” (large chemical vessel). On the morning of March 11, 2005, a concern was raised that material on the stripper change drum contained asbestos. The constructor of the insulation-removal project sent the materials for testing to a facility in London and received confirmation at 4 p.m. from that facility that the materials contained asbestos. The energy company failed to notify the Ministry of Labour of the asbestos, both orally and by submitting a required written report in a timely fashion. Both the energy company and the insulation contractor, which employed the workers who were removing the materials, also failed to ensure workers wore appropriate personal protective equipment when removing the materials both after the suspected asbestos was discovered and after it was confirmed.

The energy company pleaded guilty, as a constructor, to:

1. failing to ensure friable material discovered during the work, that was not referred to in a previously-prepared asbestos report, was reported to the Ministry of Labour, both orally and in a written report, as required by Section 7(6) of the Regulations for Asbestos on Construction Projects and in Buildings and Repair Operations. This was contrary to Section 23(1) of the act; and
2. failing to ensure workers were provided with protective equipment that included a supplied-air, positive-pressure full-face-piece respirator for a Type 3 asbestos removal, as required by Section 14(5)(viii) of the Regulations for Asbestos on Construction Projects and in Buildings and Repair Operations. This was contrary to Section 23(1)(b) of the act.

The Justice of the Peace fined the company \$25,000 on the first count and \$100,000 on the second count.

6.6.2 Discovery of material that may be asbestos

If during work, suspicious material that was not referred to in the asbestos report (see Section 6.4) is discovered, then the constructor must immediately report the discovery to the Ministry of Labour, both orally and in a written report. The owner, contractors and the joint health and safety committee must also be informed both orally and in writing by the constructor.

No work is allowed until the material is tested for the presence of asbestos unless the material is treated as ACM and, in the case of sprayed-on friable material, as though it contained a type of asbestos other than chrysotile.

6.7 Enclosures

Where there is a significant risk of contamination (certain Type 2 and Type 3 operations) there is a requirement to enclose the work area. The purpose of the enclosure is to contain ACM within the enclosure, thus preventing exposure of people outside of the containment area. Additionally, by enclosing the work area you prevent unauthorized access to the work area.

For indoor Type 3 operations the enclosure must be kept under negative pressure (0.02 inches of water).

For more information about enclosures, see Sections 10.2, 11.4, and 11.5 in this manual.

6.8 Clearance air sampling

For certain Type 3 operations, once asbestos removal has been completed a visual inspection and clearance air testing must be performed (see Sections 11.8, 11.10, and Appendix C in this manual for more details).

6.9 Asbestos work report

The employer must complete and submit to the Ministry of Labour an asbestos work report form (available from the Ministry of Labour) for each

person working in a Type 2 or Type 3 operation. The employer must do this at least once a year and immediately on termination of a worker's employment.

6.10 Asbestos work registry

The Ministry of Labour maintains an Asbestos Workers Register based on asbestos work report forms. Workers listed in the Register may be asked by the Ministry's Provincial Physician or their own physicians to voluntarily have a medical examination to determine if they are suffering from a condition resulting from asbestos exposure.

6.11 Use of equivalent measure or procedure

If you wish to use other equivalent methods or procedures than those required by Ontario Regulation 278/05, you must submit a proposal in writing to the joint health and safety committee or the health and safety representative. The equivalent method must provide protection equal to the protection provided in the regulation. Workers must be trained on the equivalent measure or procedure.

Poor work practices

Poor work practices such as not wetting ACM, or dry sweeping of waste ACM, can lead to high fibre levels. By not following proper work practices you will not only endanger yourselves but also your family, co-workers, and building occupants.

6.12 Enforcement of OHSA and its regulations

The Ministry of Labour Inspectors are responsible for enforcing the provisions of the OHSA and the regulations made under it.

6.12.1 Powers of the Ministry of Labour Inspector

An inspector can visit a site at any time and exercise fairly broad powers to inspect, test, look at documents/records, take photographs, ask questions, and give orders. If the inspector approaches a worker or supervisor directly, the worker must answer questions and cooperate. The supervisor must be informed of any orders given or recommendations made.

7 NON-ASBESTOS HAZARDS ASSOCIATED WITH ASBESTOS OPERATIONS

7.1 Electrical hazards

Due to the presence of water used in asbestos abatement procedures, one of the most dangerous hazards is contact with electricity. The employer must develop and implement specific safety procedures for preventing electric shock and burn.

Sometimes, work on energized equipment is unavoidable, such as when transformers or control boxes must remain energized during the abatement project. In such circumstances, dry removal is allowed provided that the appropriated precautions are taken.

7.1.1 Electrical power distribution

- Ensure all electrical panels, exposed electrical conductors, or equipment (such as transformers, switches, capacitors) are locked out and tagged before any work begins. All wiring should be treated as energized unless tested and proven to be de-energized.
- If power cannot be disconnected, all exposed electrical equipment must be covered to prevent moisture from entering into the equipment.
- Electrical power connections to permanent fixtures must be disconnected but temporary connections may be made for lighting

purposes or the operation of tools or equipment.

- Every precaution must be taken to avoid electrical shock. Use ground fault circuit protection.
- Ensure that all permanent circuits are provided with a grounding system. This can be determined with a portable ground tester.
- Ensure that electrical outlets are tightly sealed and taped to avoid water spray.
- Determine what equipment must remain energized during the abatement process.
- Insulate or guard energized equipment and wiring from employee contact and other conductive objects.
- Avoid damaging permanent building wiring during the work.

7.1.2 Temporary power distribution systems

- All temporary circuits provided by the abatement contractor must be provided with a grounding system and protected by ground fault circuit interrupters (GFCIs).
- Avoid stringing temporary wiring across floors and through door openings.
- Elevated wiring should not be fastened with staples, nails, or wire.
- Use care not to damage the wiring insulation during installation or abatement work.
- Temporary lights are to be installed according to the Ontario Electrical Code. You must use inline or circuit breaker/receptacle type GFCIs at all times.

GFCI – A Ground Fault Circuit Interrupter provides additional protection from shocks by shutting off the current to equipment when the GFCI senses an electrical fault.

7.1.3 Electrical cords and tools

- Provide heavy-duty extension cords with a ground conductor.
- Ensure that cords are not damaged, contain no splices, and that grounding pins on the male plugs are intact.
- Position extension cords to eliminate tripping hazards and to protect them from being damaged by moving scaffolds.
- Provide electrical tools which are either grounded or double-insulated.
- Use shatterproof, guarded bulbs and heavy duty wiring for temporary lighting.
- Where plugs enter receptacles, ensure that the connection is protected and secured in place.
- Provide mechanical protection to protect all temporary power cords.
- Before using them, inspect all power tools for damaged components and power cord connections.

7.2 Slips, trips, and falls

Using water to control the spread of asbestos fibres can make polyethylene sheeting very slippery. Rubber boots with non-skid soles are recommended. Post signs in conspicuous locations warning workers of the slip hazard.

Poor lighting makes it difficult to see and can lead to trips and falls. Lighting needs to be sufficiently bright to minimize shadow and to illuminate objects on the work surface.

Poor housekeeping is a cause of trips and falls. ACM or other rubbish—such as ceiling tile, t-bar, metal hangers, wood, nails and screws, and drywall—should be bagged as often as necessary to keep the work area free of slipping and tripping hazards.

Electrical cords, vacuum hoses, and water hoses should be organized and moved away from where workers could trip over them.

Wherever there is a danger of falling from a height, you must install guardrails or use appropriate fall protection equipment. Workers must receive fall protection training in accordance with the Construction Regulation.

Unguarded openings in the work area must be adequately protected by installing a secure temporary cover or by guardrails with toe boards. Covers must be capable of supporting all vertical loads imposed upon them. A large conspicuous sign should warn people about the opening.

Running and horseplay in work areas is prohibited.

7.3 Ladders and scaffolds

Asbestos abatement work often requires working at heights, leading to the use of ladders and scaffolds. Improper use or inadequate maintenance of this equipment can cause injury.

- Inspect ladders regularly for damage. Repair or replace them when damaged.
- Workers must be instructed on how to use ladders correctly.
- Maintain 3-point contact.
- Ladders must not be used as a work platform or walk board.
- Stepladders should be used only when they are completely open.
- If extension ladders are used, the base location should be 1 m away from the point below the upper contact point for every 3 or 4 m of elevation. (One metre out for every three or four metres up.)

Many projects require the use of scaffolds. Correct set-up, regular inspection, and basic maintenance are essential. If a scaffold is rented, the contractor should inspect all components before accepting them. Scaffolding must be erected and dismantled properly. To reduce the risk of a mobile scaffold tipping over, the height must not exceed three times the smallest dimension of its base.

The wheels of the scaffold must operate properly. The scaffold platforms must be fully planked or “decked.” Guardrails should always be installed on scaffolds to prevent falls. Toe boards should be installed to prevent tools and other objects from dropping on workers below. The scaffold must not be overloaded. The rolling scaffold must not be moved with workers on it unless the workers are each tied off to a separate fixed anchor.

7.4 Heat stress

Heat-related disorders are common in asbestos abatement work. Heat stress takes place when your body’s cooling system is overwhelmed and your temperature starts to increase. Heat stress can be a hazard when working around boilers, hot pipe, tanks or furnaces, or structures heated by the sun.

Heat stress can occur when heat combines with other factors such as

- protective clothing that restricts the evaporation of sweat
- hard physical work
- high humidity
- dehydration (loss of fluids)
- certain medical conditions
- lack of acclimatization:
 - ❑ When exposed to heat for a number of consecutive days, the body will adapt and become more efficient in dealing with heat. This is called acclimatization.
 - ❑ Acclimatization usually takes six to seven days but may be lost in as little as three days away from work. People returning to work after a holiday or a long weekend must understand this — and so should their supervisors.

Heat stress can lead to illness or even death.

- **Heat cramps:** painful muscle cramps.
- **Heat exhaustion:** high body temperature; weakness or feeling faint; headache, confusion or irrational behaviour; nausea or vomiting.
- **Heat stroke:** no sweating (hot, dry skin), high body temperature, confusion, or convulsions. Get immediate medical help.

Controls for heat stress hazards:

- Provide cool drinking water near workers and remind them to drink a cup every 1/2 hour.
- Increase the frequency and length of rest breaks.
- Cool break areas should be provided if possible.
- Caution workers about working in direct sunlight.
- Train workers to recognize the signs and symptoms of heat stress. Start a “buddy system” because it’s unlikely that people will notice their own symptoms.
- Allow workers time to get acclimatized.

Note: Employers have a duty under Section 25 (2) (h) of the *Occupational Health and Safety Act* to take every precaution reasonable in the circumstances to protect the worker. This includes developing policies and procedures for hot environments. For more information, see the chapter on Heat Stress in IHSAs’ *Construction Health and Safety Manual*.

7.5 Cold stress

Exposure to the cold can be an important consideration for workers if work must be done outdoors in the winter or indoors if a building’s heating system must be shut down. Exposure to the cold can cause frostbite or hypothermia. For work performed continuously in the cold, allow rest and warm-up breaks. Heated shelters such as

trailers should be available nearby. For more information, see the chapter on Cold Stress in IHSA's *Construction Health and Safety Manual*.

7.6 Mechanical hazards

A work site hazard assessment should be conducted to identify mechanical hazards that can cause injury. Injury can occur when a worker's body comes in-between a component of a moving object and a stationary object. Any mechanically-operated part of a machine to which a worker has access must be guarded or fenced so that it will not endanger a worker. Guards prevent contact between the worker and that part of the machine which may present a hazard.

Workers must wear properly fitting hand, arm, leg, or body protective equipment, appropriate to the work being done and the hazards involved.

Hard hats, eye protection, and safety boots, as appropriate, must be worn at all times when there is potential for workers to be exposed to falling objects, debris entering the eyes, or materials falling on feet.

7.7 Explosive atmospheres

Before spraying highly flammable liquids such as spray glue, eliminate sources of ignition such as static electricity, unprotected electrical equipment, cigarettes, and open flames.

7.8 Atmospheric hazards

Chemicals used during asbestos abatement such as spray glue, lock down sealants, and propane may build up and lead to adverse health effects. Ensure that the material safety data sheets (MSDSs) are available at the workplace, and provide information about protective measures to be followed.

7.9 Carbon monoxide

Carbon monoxide (CO) has no odour or taste and is clear and colourless.

CO poisoning can be very subtle and may cause drowsiness and collapse followed by death.

The major sources of CO include the internal combustion engines powering saws, scissor lifts, generators, compressors, and forklift trucks. Another source of CO can be the internal combustion engine powering the compressor which supplies air to your respiratory protective equipment.

Adequate ventilation is absolutely essential when you cannot avoid using combustion engines indoors or in confined spaces.



Combustion engines produce carbon monoxide

7.10 Noise

Power tools or compressors can generate high levels of noise. Workers exposed to high noise levels must be given adequate hearing protection and trained on how to use it.

8 IDENTIFY EMERGENCY RESPONSE PROCEDURES

Potential emergency situations that can be encountered in an asbestos Type 3 operation include

- fire and smoke
- hazardous material release (e.g., spills, gas, liquids, vapour)
- an electrical failure resulting in a loss of negative air pressure
- respirator failure
- a critical injury that requires immediate attention.

An emergency plan must be in place for each individual jobsite and workers must be informed of the procedures to follow. Workers must be trained on how to respond in the event of an emergency.

There must be a means of communication between workers inside the enclosure and persons outside the enclosure (e.g., two-way radios, cell phones, etc.) The method of communication must be determined by the employer and set out in the emergency plan. Before any Type-3 work begins, workers must know the location of emergency equipment including fire extinguishers, first aid kits, spill kits, and jobsite fire alarms. They must also know the emergency exit routes (clearly marked), where to find the map to the nearest hospital, the emergency phone numbers, and the material safety data sheets. Workers must also know who the health and safety representative and first aid attendants are.



Emergency exit

A serious injury or life-threatening hazard is a more immediate health concern than short-term asbestos exposure. Therefore standard protective measures may be temporarily suspended if they would result in an immediate threat to life. If performing CPR, the respirator should be removed

from an ill or injured worker since breathing through a respirator can place extra stress on the heart.

The ill or injured worker should be removed from the contaminated area to the clean room unless the worker has sustained a head, neck, or back injury. Moving the worker minimizes exposing emergency response personnel and their equipment to asbestos. Non-injured workers responding to the ill or injured worker must decide if there is time to decontaminate the worker. When first aid, ambulance, or emergency personnel have to enter the contaminated area they must be

- warned of the hazard
- provided with appropriate personal protective equipment
- told how to use the protective equipment
- told about the limitations of the protective equipment.

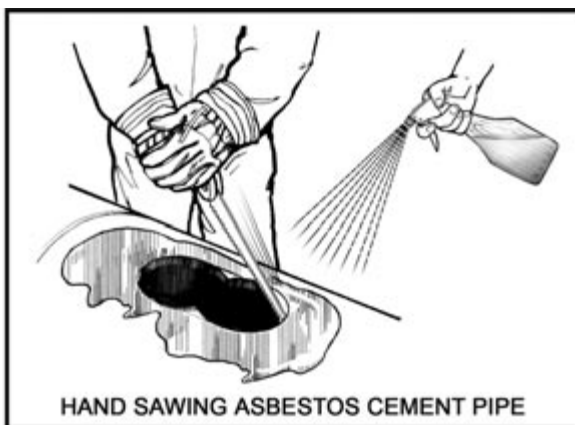


9 TYPE 1 ASBESTOS OPERATIONS

9.1 What are Type 1 operations?

Type 1 operations include the following:

1. Installing or removing less than 7.5 square metres of ceiling tile containing asbestos (81 square feet, or ten 4-foot x 2-foot ceiling tiles) without it being broken, cut, drilled, abraded, ground, sanded, or vibrated.
2. Installing or removing non-friable asbestos-containing material, other than ceiling tiles, without it being broken, cut, drilled, abraded, ground, sanded, or vibrated.
3. Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non-friable asbestos-containing material if a) you wet the material, **and** b) you use only non-powered hand-held tools.



4. Removing less than one square metre of drywall where asbestos joint-filling compound was used.

DRYWALL JOINT-FILLING COMPOUND

Early drywall joint-filling compounds contained significant amounts of asbestos fibre. This particular use was specifically prohibited in 1980. Still, it may be found in buildings constructed several years afterwards.

If these operations are done properly, it is unlikely that exposure will exceed acceptable limits. This is

why the use of respirators is optional for Type 1 work.

9.2 Controls for Type 1 operations

1. Eating, drinking, smoking, and chewing gum are prohibited.
2. If a worker requests a respirator and protective clothing for Type 1 operations, the employer must provide them. The respirators must be the proper type (see respirator chart, Appendix A) with filters suitable for asbestos. Once workers request respirators, they must wear them. Protective clothing must be impervious to asbestos fibres. Once workers request protective clothing, they must wear it.

Refer to Section 11.3 of this manual for more information on the use, care, and disposal of respirators and protective equipment.

Protective clothing is used for two reasons:

- to prevent transfer of dust and waste into clean areas
- to guard unprotected workers, their families, and the public from secondary exposures to asbestos.

Members of asbestos workers' families have developed illnesses from the dust brought home in work clothes. (See article on the next page.)

3. Before beginning work, visible dust must be removed by wiping with a damp cloth or by vacuuming with a special HEPA*-filtered vacuum.

* HEPA (High Efficiency Particulate Aerosol) vacuums are specially designed to trap very small particles. They catch at least 99.97% of all particles 0.3 microns or larger. See "HEPA Filters," Appendix I.

Continued after the article on the next page.

SUFFERING FROM A FATHER'S JOB

MARTIN MITTELSTAEDT

GLOBE AND MAIL, April 2006

[What follows is a partial excerpt from the article.]

CAMPBELLFORD, ONT. — The expression “like father, like son,” has tragic poignancy for Tom O’Donnell.

His father died nine years ago at age 76 from lung cancer caused by asbestos.

The cause of death was not entirely surprising. He had worked for nearly 25 years at a now defunct Johns-Manville plant in eastern Toronto that was called a “world-class occupational health disaster” by a 1980s royal commission investigating the plant’s use of asbestos.

Now the son, who is only 48, is dying of mesothelioma, a painful cancer whose only known cause is contact with asbestos.

Mr. O’Donnell’s diagnosis might seem unusual, given that he never worked with the substance. But he is not the only one in his family to have been afflicted since his father died. An older sister and older brother succumbed to the same cancer, which affects the lining of the chest wall, in their 50s.

Medical authorities suspect Mr. O’Donnell and his siblings are victims of a seemingly innocuous asbestos exposure: traces of asbestos dust carried unknowingly home on their father’s work clothes.

Those traces, a testament to the killing power of the mineral, provided enough of a dose to place his children in mortal peril decades later.

Mr. O’Donnell said his father was a loving man for whom “the kids came first” and he remembers him with fondness as “such a nice guy all around. There is not a bad thing you could say about that guy.”

His father had no inkling that the asbestos he worked with was hazardous, and that unknowingly he had started a nightmare for his six children.

“He’s up there,” Mr. O’Donnell said, referring to heaven, “thinking all this work he did and raising the kids and we’re dying because of what was on his clothes.”

Cases such as Mr. O’Donnell’s, once thought to be extremely rare, are starting to crop up more frequently in Canada. There are enough cases that they have been given the formal name of “bystanders,” people who never worked with asbestos yet are at risk of its illnesses.

They are falling ill now because they were exposed during the 1960s and 1970s — the peak years in Canada of asbestos use — as children and spouses of asbestos workers. Because certain cancers have a decades-long latency period, the bystanders are only now starting to be seen in significant numbers.

The bystander cases hold a special cruelty. Many of those exposed to asbestos as children are dying young, robbed of far more years than were their fathers, who were exposed as adults and had a crack at reaching old age because of the latency period.



Vacuum with HEPA filter

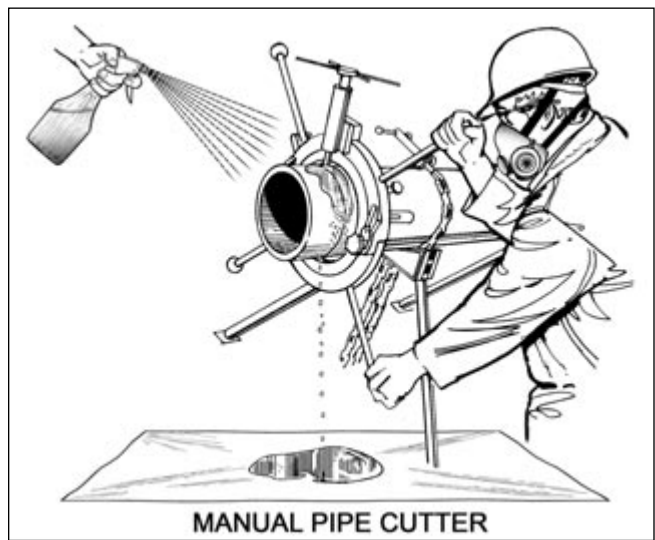
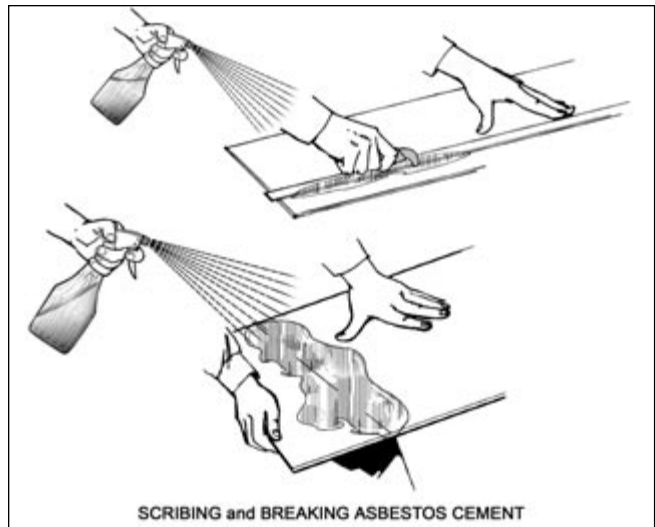
4. Never use compressed air to clean asbestos dust off surfaces. This just blows the fibres into the air.
5. When you wish to cut, shape, or drill the non-friable materials as mentioned in Section 9.1 number 3, you must wet the work (water plus wetting agent—see box below) and use only hand tools such as nibblers, rasps, files, shears, knives, hand drills, or hand saws. Using hand tools may create some dust, but wetting the material will prevent the dust particles from becoming airborne.

WETTING AGENT

Water alone is not sufficient to control dust and fibres. You must add a “wetting agent” to reduce the water’s surface tension. This increases the water’s ability to penetrate material and get into nooks and crannies. To make this “amended water,” you can use ordinary dishwashing detergent: 1 cup detergent for every 20 litres of water.

The US Environmental Protection Agency (EPA), in its *Guidance for Controlling Asbestos-Containing Materials in Buildings*, EPA-560/5-85-024 (Purple Book), recommends the use of a 50:50 mixture of polyoxyethylene ester and polyoxyethylene ether.

6. You must use a dropsheet (typically 6-mil polyethylene) below the work area to help control dust.



7. All asbestos dust and waste must be cleaned up regularly and frequently (before it dries out) using a HEPA vacuum or by damp-mopping or wet-sweeping.
8. Before leaving the work area, workers must damp-wipe or HEPA-vacuum their protective clothing to remove any surface contamination. Workers must damp-wipe their respirators before taking them off.
9. Asbestos waste and disposable coveralls must be placed in dust-tight containers and labeled with warning signs (see Sections 11.7, 11.12, and 12 for more information on clean-up and disposal).
10. You must never reuse dropsheets. After the work is done, dropsheets must be wetted or

damp-wiped and then folded so that any residual dust or scrap is contained inside the folds. Dispose of dropsheets as asbestos waste.

11. Barriers and portable enclosures that are rigid and will be reused must be cleaned by damp-wiping or HEPA-vacuuuming. Barriers and enclosures that are not rigid or cannot be cleaned must not be reused.
12. Containers must be cleaned by damp wiping or HEPA-vacuuuming before being removed from the work area.
13. You must dispose of waste at a landfill site that will accept asbestos (see Sections 11.12 and 12).
14. A washbasin, soap, water, and towels—or a similarly-equipped clean-up facility—must be provided for workers so that they can wash their hands and faces upon leaving the work area. Workers must also wash before eating, drinking, smoking, or any such activities. This will help reduce secondary exposure to asbestos.

10 TYPE 2 OPERATIONS

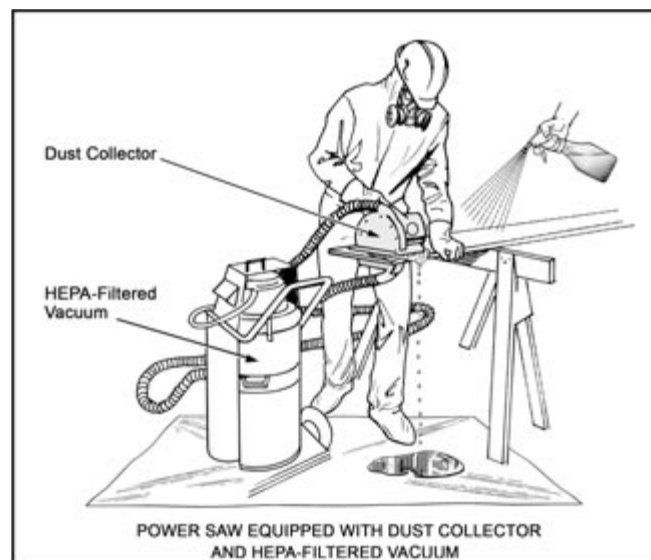
10.1 What are Type 2 operations?

Exposure to asbestos is likely in Type 2 operations. You need controls to protect workers and others nearby. Type 2 operations include the following:

1. Removing all or part of a false ceiling in buildings containing sprayed asbestos fireproofing if it is likely that asbestos fibres are resting on top of the ceiling. This is likely when fireproofing is deteriorating or damaged.
2. Removing or disturbing less than 1 square metre of friable asbestos materials—for example, repairing an insulated pipe joint or

removing some fireproofing to fasten a new pipe hanger.

3. Enclosing friable asbestos insulation to prevent further damage or deterioration.
4. Applying tape, sealant, or other covering (by means other than spraying) to pipe or boiler insulation.
5. Installing or removing more than 7.5 square metres of ceiling tile containing asbestos, without it being broken, cut, drilled, abraded, ground, sanded, or vibrated.
6. Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non-friable asbestos-containing material if the material is not wetted and the work is done only with non-powered hand-held tools.
7. Removing one square metre or more of drywall where the joint-filling compound contains asbestos.
8. Working on non-friable asbestos with power tools that are attached to dust collecting devices equipped with HEPA filters. If you need to power-grind or machine the asbestos product and your tools are not equipped with HEPA-filtered dust collectors, refer to Section 11.15.



To prevent electric shock, any power tools used around water must be equipped with a ground fault circuit interrupter (GFCI) and be maintained properly. GFCIs constantly monitor for any current leaking to ground. If leaking current is detected, the GFCI immediately switches off power to that circuit to prevent a lethal dose of electricity.

9. Using a glove bag to remove asbestos-containing insulation.
10. Cleaning or removing filters used in air-handling equipment in a building with sprayed asbestos fireproofing.
11. Any other operation that is not Type 1 or Type 3, but one that may cause exposure to asbestos.

10.2 Controls for Type 2 operations

1. Workers involved in Type 2 operations must wear a NIOSH-approved respirator as identified in the respirator chart, Appendix A. The employer must provide workers with training on the individual respirators they will be using. The training must cover

- selection of respirator
- fitting
- inspection
- use
- care and maintenance
- cleaning and disinfecting
- limitations of the respirator.

The equipment must be maintained according to the employer's written procedures and must be consistent with the manufacturer's instructions. The manufacturer can provide cleaning and disinfecting products which will not damage the respirators. Any damaged or worn parts must be replaced before a worker uses the equipment.

Wherever possible, the respirators should be assigned to individual workers for their exclusive use. Otherwise, the respirators must be properly cleaned and disinfected before being used by someone else.

Refer to Section 11.3 of this manual for more information on the use, care, and disposal of respirators and protective equipment.

2. Workers must wear protective clothing impervious to asbestos with tight-fitting cuffs at the wrists, ankles, and neck, as well as a hood or head cover. This usually means one-piece disposable coveralls—ones which are easy to clean of surface contamination



Protective clothing



Laceless, pull-on rubber boots

before you throw them away. Torn or damaged clothing must be repaired or replaced. We recommend you use laceless, pull-on rubber boots. They can be washed off later or disposed of as contaminated waste.

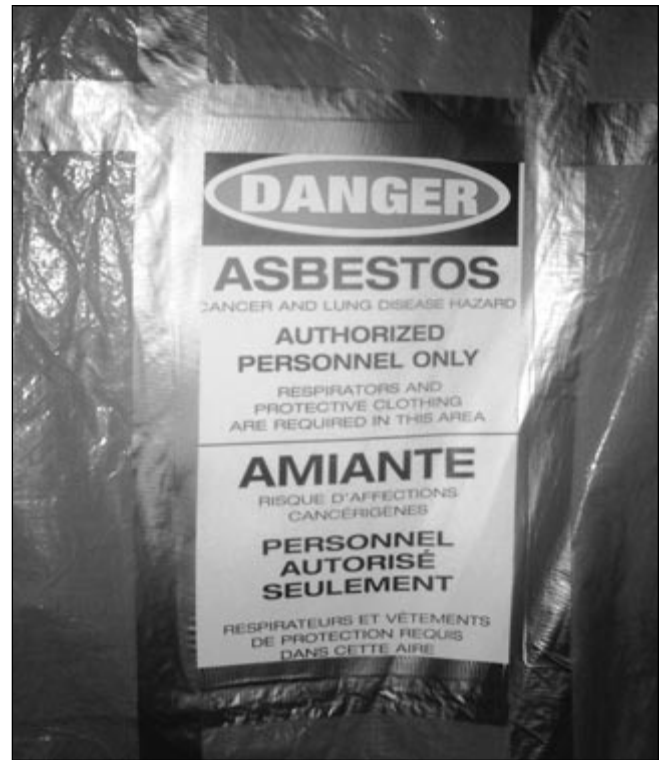
Refer to Section 11.3 of this manual for more information on the use, care, and disposal of protective equipment.

Protective clothing is required for two reasons:

- a) to prevent transfer of dust and waste into clean areas
- b) to guard unprotected workers, their families, and the public from secondary

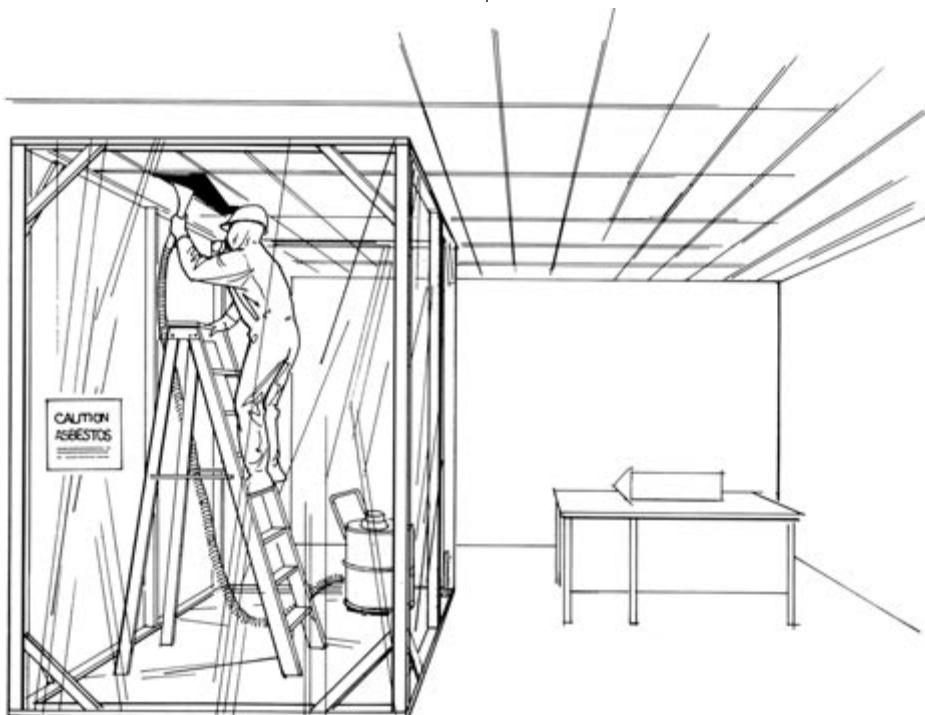
exposures to asbestos. Members of asbestos workers' families have developed illnesses from the dust brought home in work clothes. (See article in Section 9.2.)

3. Only those workers wearing the required respirators and protective clothing are permitted in the work area.
4. You must never eat, drink, smoke, or chew gum in the work area.
5. Never use compressed air to remove asbestos dust from a surface.
6. You must wet asbestos-containing material before you remove it to lessen the chance of creating dust—unless wetting would cause a hazard or damage.
7. You must add a wetting agent to the water. See Section 9.2 number 5.
8. Any dust on exposed surfaces must be cleaned by damp-wiping or HEPA vacuuming before starting work which may disturb the dust.



Warning sign

9. Warning signs are required for all Type 2 activities.
10. For ceiling removal (to gain access to a work area) and for removal of less than 1 square



TYPE 2 ENCLOSURE FOR CEILING WORK

metre of friable asbestos-containing material indoors, an enclosure must be erected around the area to prevent the spread of asbestos dust. If your enclosure is opaque, it must have a transparent window to allow observation of the work. The ventilation system must be disabled and sealed off if the inlets or exhausts are within the enclosed area. For other Type 2 operations, 6-mil polyethylene dropsheets should be adequate.

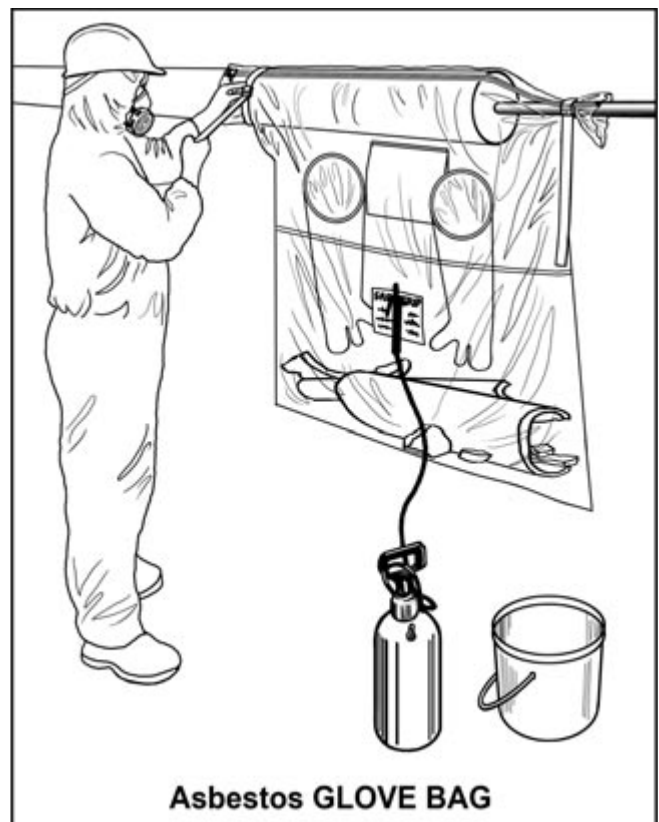
11. You must put waste asbestos, disposable clothing, the enclosure and barrier materials (such as polyethylene sheeting), and any other contaminated items into dust-tight containers labeled with warning signs. The containers must be damp-wiped or HEPA-vacuumed to remove any surface contamination before you take the containers out of the work area. Refer to Sections 11.7, 11.12, and 12 in this manual for information on clean-up and waste disposal.
12. Any dust or waste must be cleaned up by damp-wiping or HEPA-vacuuming before it can dry out and pose a hazard. You must never reuse dropsheets. Dropsheets and enclosures must be decontaminated and wetted before disposal.
13. After the work is completed, barriers and portable enclosures that are rigid and that will be reused must be cleaned by damp wiping or HEPA-vacuuming. Barriers and portable enclosures must not be reused unless they are rigid and can be cleaned.
14. Before leaving the work area, workers must damp-wipe or HEPA-vacuum their protective clothing to remove any surface contamination. Workers must damp-wipe their respirators before taking them off.
15. A washbasin, water, soap, and towels must be provided for workers to wash their

hands and faces before leaving the work area. Workers must also wash before eating, drinking, smoking, or any such activities.

10.3 Glove-Bag Operations

All the procedures that apply to Type 2 operations also apply to glove bag operations. In addition, you must do the following.

1. Separate the work area from the rest of the workplace by walls, barricades, fencing, or other suitable means.
2. Disable the mechanical ventilation system serving the work area and seal all openings or voids, including ventilation ducts and windows to and from the work area.
3. Place polyethylene dropsheets below the work area.
4. The glove bag must be strong and large enough to hold the material you're removing.



5. You must not use a glove bag if you can't make a proper seal because of the condition of the insulation, the temperature of the surface, or the type of jacketing.
6. Check the glove bag for damage or defects.
7. Be careful not to puncture the glove bag.
8. When you've finished removing the asbestos,
 - damp-wipe and HEPA-vacuum the tools
 - wet down the inside walls of the glove bag
 - thoroughly wet the material inside the glove bag
 - wipe down the pipe (or whatever the asbestos was removed from) and seal it with a suitable encapsulant
 - evacuate air from the bag using a HEPA-vacuum and place the glove bag, with the waste inside, in a suitable dust-tight container
 - clean up the work area by damp-wiping or HEPA-vacuuming.

11 TYPE 3 OPERATIONS

11.1 What are Type 3 operations?

Type 3 operations include the following:

1. Removing or disturbing more than 1 square metre of friable asbestos-containing material.
2. Spraying a sealant onto friable asbestos material.
3. Cleaning or removing air-handling equipment in buildings with sprayed asbestos fireproofing.
4. Repair, alteration, or demolition of kilns, metallurgical furnaces, and other installations with asbestos refractory materials.

5. Disturbing non-friable asbestos material in any way with power tools not attached to dust collectors equipped with HEPA vacuums.
6. Repair, alteration, or demolition of buildings which are or were used to manufacture asbestos products unless the asbestos was cleaned up and removed before March 16, 1986.

11.2 Controls for Type 3 operations

Type 3 operations require the most precautions because they can release substantial amounts of asbestos dust. Controls for Type 3 operations include requirements for

- worker protection including protective clothing, respiratory protection, and decontamination facilities
- site preparation including enclosure and isolation of the work area and negative air units
- removal, clean-up, and disposal of waste including dust-suppression techniques.

The following sections provide details.

11.3 Worker protection

11.3.1 Protective Clothing

Protective clothing is required for two reasons:

- a) to prevent transfer of dust and waste into clean areas
- b) to guard unprotected workers, their families, and the public from secondary exposures to asbestos.

Members of asbestos workers' families have developed illnesses from the dust brought home in work clothes. (See article in Section 9.2.)

Continued on the next page.

Protective clothing must:

- fit the worker
- not readily retain asbestos dust or allow it to penetrate. Although it is not a regulatory requirement, we recommend one-piece disposable coveralls with hood for Type 3 operations.
- have tight-fitting cuffs at the wrists and ankles and on the hoods of overalls
- cover the head and feet. Although it is not a regulatory requirement, we recommend laceless rubber boots because they are easy to clean when leaving the work area. Footwear with laces will trap asbestos fibres between the laces and should not be used.
- be immediately repaired or replaced if torn.

Head coverings should be close-fitting and cover the parts of the head and neck not covered by the respirator. The head straps of respiratory protective equipment should be worn under the head covering.

Street clothes must not be worn under coveralls.

Any protective clothing (including rubber boots, reusable coveralls, and disposable coveralls) exposed to the work area must be cleaned either by damp-wiping or HEPA-vacuuming before leaving the work area. If contaminated reusable coveralls are to be laundered, they should first be placed in dust-tight bags which are soluble in hot water and can be loaded, unopened, into a washing machine. These inner bags should then be placed inside a second bag which is sealed and labeled prior to being sent to laundry facilities that specialize in cleaning asbestos-contaminated clothing.

Disposable coveralls that will not be reused must be disposed of as described in Section 11.7.

IT CAN GET HOT IN THERE!

Protective clothing can contribute to a worker's heat stress, especially in summer. See the chapter on Heat Stress in IHSA's *Construction Health and Safety Manual*.

11.3.2 Respiratory Protection

The primary means of exposure to asbestos fibres is inhalation. Despite the use of other control measures such as wet removal, workers involved in Type 3 operations will still encounter airborne asbestos. For this reason, respirators are an important control method.

The respirator requirements for Type 3 operations vary according to:

- the size of the operation
- whether the ACM is friable or non-friable
- the type of asbestos present (chrysotile, or asbestos other than chrysotile)
- whether the ACM is wet or dry
- whether power tools or non-power tools are used for the removal
- whether the power tool is attached to a dust-collecting device equipped with a HEPA filter or not.

The types of respirators required for various Type 3 operations are identified in Ontario Regulation 278/05, Table 2. IHSA has summarized this table in the form of charts (see Appendices A and B).

The employer must develop written procedures on the selection, use, and care of respirators. The employer must give a copy of the procedures to each worker required to wear a respirator, and review the contents with them.

Wherever possible, the respirators should be assigned to individual workers for their exclusive use. Otherwise the respirators must be properly sanitized before being used by someone else.

Workers cannot be assigned to an asbestos work operation unless they are physically able to perform the operation while wearing the respirator (See Appendix E — “Health Surveillance Guidelines” — of CSA Standard CSA-Z94.4-02.)

The employer must provide workers with training on the individual respirators they will be using.

The training must cover

- proper fit
- inspection and maintenance
- cleaning and disinfecting
- limitations of the respirator.

11.3.3 Types of respirators

There are two main categories of respirators used to protect workers in an asbestos Type-3 environment:

- air- (atmosphere-) supplying respirators (respirators that are attached to a supply of new, clean air)
- air-purifying respirators (respirators that clean the air around you before you breathe it in).

11.3.3.1 Air-supplying respirators

Air-supplying respirators provide clean air through a hose called an airline, which is attached to a freestanding tank of compressed air, an air compressor, or an ambient air blower.

11.3.3.1.1 Modes of operation

Air-supplying respirators can operate in the following modes:

- “negative pressure” or “demand”
- “continuous-flow”
- “positive pressure” or “pressure-demand.”

11.3.3.1.1.1 Negative-pressure (demand) mode

Air is delivered only when the wearer inhales. Because contaminated air may leak inward around the facepiece if the breather inhales strongly, these devices have limited use in high- exposure conditions.

11.3.3.1.1.2 Continuous-flow mode

As the name implies, these devices deliver a constant flow of air to the wearer. Inward leakage of contaminated air is still possible if the breather inhales more air than the device can supply. Minimum flow rates must be maintained to minimize inward leakage. Continuous-flow mode offers better protection than the negative pressure (demand) mode.



Air-supplying respirator

11.3.3.1.1.3 Positive-pressure or pressure-demand mode

Since the previous modes may permit inward leakage, a system was developed which maintains a positive pressure inside the facepiece at all times, and also supplies more air as demanded. This class of device is used for high-exposure conditions and offers the best protection of the three modes.

11.3.3.2 Air-purifying respirators

Air-purifying respirators used for protection during a Type-3 asbestos operation must be equipped with N-100, R-100, or P-100 (HEPA) filters.

The “100” (actually 99.97%) refers to the efficiency of the filters.

Oil has been found to ruin the filtering ability of some filter material. Therefore, to ensure that a suitable filter is being used, particulate filters have an N, R, or P designation:

N – Not resistant to oil – must not be used at all in an environment where solvent or oil is present.

R – Resistant to oil - can be used for a single shift in an environment where solvent or oil is present.

P – Oil-**P**roof – can be used for an extended period of time in an environment where solvent or oil is present.

Air-purifying respirators can be powered or non-powered.

11.3.3.2.1 Non-powered air-purifying respirators

Air is drawn through the filter by the wearer breathing in. Non-powered respirators depend entirely on the wearer breathing in (inhaling) and breathing out (exhaling) to deliver an adequate supply of purified breathing air.

For asbestos Type 3 removals, **only full-facepiece** respirators are allowed when using a non-powered air-purifying respirator.



Full-facepiece non-powered air-purifying respirator

11.3.3.2 Powered air-purifying respirators (PAPR)

These respirators use a battery-powered blower to continuously draw air through HEPA filters and into the tight-fitting facepiece (full or half facepiece)



Powered air-purifying respirator

11.3.4 Proper fit

The performance of a respirator with a tight-fitting facepiece depends on good contact between the wearer's skin and the respirator. A good face seal can only be achieved if the wearer is clean-shaven in the region of the seal and the facepiece is of the correct size and shape to fit the wearer's face. Eyeglasses cannot be worn with a full-facepiece

respirator as the side arms will break the seal. An alternative such as eyeglass inserts in the respirator facepiece or contact lenses (check with your employer to see if the use of contact lenses is allowed) should be considered for those who require prescription glasses.

Employers should ensure that the selected facepiece is the right size (small, medium, large) and can correctly fit each wearer.

11.3.4.1 Fit testing

For a tight-fitting facepiece the **initial selection** should include fit-testing to ensure the wearer has the correct device. The test will assess the fit by determining the degree of face-seal leakage using a test agent while the user is wearing the respirator (see Appendix G for more details).

You need to fit test again when

- changing to a different model of respirator
- changing to a different-sized facepiece
- there have been significant changes to the facial characteristics of the individual wearer (e.g., as a result of significant weight gain or weight loss, or a dental procedure).

Fit testing and seal checking are different.

Fit testing (described above) detects if the respirator fits the wearer correctly in the first place. A user **seal check** (described below) is when the user makes sure the straps are correctly adjusted and the respirator is properly seated on the face *before each use*.

11.3.4.2 Seal checking

Before each use, the wearer should conduct a seal check. The manufacturer's instructions will give information on simple seal checks, such as those involving blocking the filters and inhaling to create suction inside the mask (negative seal

check), or blocking the exhalation valve and exhaling (positive seal check) so that any leakage can be detected. (See the following images and Appendix F for more details.)



Negative seal check



Positive seal check

11.3.5 Inspection and maintenance

The equipment must be maintained and inspected according to the employer's written procedures which must be consistent with the manufacturer's instructions.



Clean your respirator with a neutral detergent

A respirator should be checked by the wearer before and after it is used to make sure that it is in good working order (see Appendix D for more details). Any damaged or worn parts must be replaced before a worker uses the equipment.

11.3.6 Cleaning and sanitizing

Respirators must be cleaned *after* each use according to the manufacturer's instructions. If shared by different workers, respirators must be properly sanitized before they can be used by another person.

The manufacturer can provide cleaning and sanitizing products which will not damage the respirators.

Strong detergents, hot water, or household cleaners or solvents must not be used because they may cause the rubber parts to deteriorate. Use a neutral detergent.

The respirator should be thoroughly cleaned and rinsed with warm water to avoid skin irritation (for more details see Appendix E). After rinsing, respirators should be hung up to dry.



After rinsing it, hang your respirator up to dry

11.3.7 Storage

Respirators should be stored in a clean location (away from sunlight, chemicals, excessive heat or cold, and excessive moisture), preferably in a plastic bag in a locker. Respirators must not be left in a car or out where they can gather dust and dirt or be damaged.

11.3.8 Limitations of respirators

11.3.8.1 Some major limitations of air-purifying respirators

- They are not suitable for confined spaces, or atmospheres with less than 19.5% oxygen.
- They are not suitable for gases or vapours unless equipped with proper cartridges.
- As the filter becomes clogged with dust, air flow resistance increases and the filters will have to be changed.
- Proper fit is essential for protection — workers must be clean shaven.

11.3.8.2 Some major limitations of powered air-purifying respirators (PAPR)

- Requires the battery power pack to be recharged frequently.
- The power pack can fail during use requiring the worker to immediately leave the asbestos work area.
- Proper functioning requires a minimum rate of air flow into the respirator mask. Consult the manufacturer's specific instructions concerning the required flow rate and how this should be checked.

11.3.8.3 Some major limitations of supplied-air respirators

- When using supplied-air respirators, the air must be tested to ensure that it meets the requirements set out in the Canadian Standards Association's *Compressed Breathing Air* (CSA Z180.1-00). This standard limits the amount of carbon monoxide, oil mist, water vapour, and other contaminants permissible in such systems.
- Oil-lubricated compressors can produce carbon monoxide. A continuous carbon monoxide monitor equipped with an alarm must be provided.



Carbon monoxide monitor

11.4 Site preparation—indoor projects

Indoor Type-3 operations require strict controls to prevent asbestos dust from contaminating other areas. The work area must be completely enclosed and isolated from the rest of the location in order to

- prevent and contain the spread of asbestos dust
- prevent other people in the rest of the building from being exposed to asbestos
- restrict access of unauthorized personnel.

Requirements for site preparation:

1. Polyethylene sheeting or other suitable material that is impervious to asbestos, held in place with appropriate tape and adhesive, is normally used to build the enclosure. Typically, 6-mil polyethylene is used on the walls and heavier polyethylene is used on the floor (it must withstand foot traffic).

When existing walls aren't appropriate for the enclosure, it may be necessary to erect temporary walls to which the plastic barrier can be attached.

All joints must overlap and be taped to ensure the area is completely sealed off. Regulation 278/05 requires you to have one



Polyethylene sheeting



Temporary walls



Transparent observation window

or more transparent observational windows when you're using opaque, Type-3 enclosures for operations where non-friable asbestos is disturbed in any way with power tools not attached to dust collectors equipped with HEPA vacuums. However, IHSA recommends that all Type 3 enclosures have a transparent window if the enclosure is opaque. Collectively, the windows should allow as much of the work area as possible to be viewed from outside the enclosure. Keep the windows clean and unobstructed.

2. During the construction of the enclosure, asbestos materials should not be disturbed until the enclosure is complete and negative air is in place. In situations where asbestos debris or dust is lying on any surface of the work area and will be disturbed during the construction of the enclosure then the area must be precleaned using a damp cloth, or by using a vacuum equipped with a HEPA filter, before the enclosure is built. Suitable personal protective equipment, including respirators, should be worn during precleaning and during all work which disturbs or could disturb asbestos during the building of enclosures.

Wet wiping procedures

- Wet wipe with clean water and paper towels to remove any residue.
- Dispose of paper towels as asbestos waste.

HEPA vacuum procedures

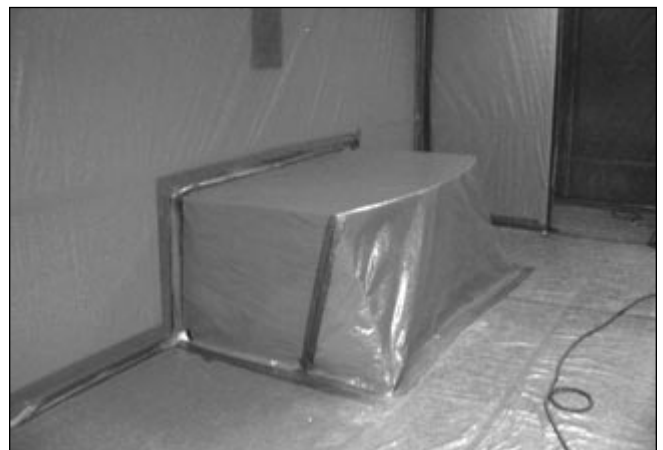
- vacuum the contaminated area in parallel passes with each pass overlapping the previous one.
- Vacuum the area a second time, in the same manner, in passes at right angles to the first passes.

Never use compressed air to clean asbestos dust off surfaces – it is prohibited. It just blows the fibres into the air.

3. The ventilation system serving the work area must be shut down and sealed off.
4. Any furnishings that can be removed must be damp-wiped or HEPA-vacuumed if dusty and taken out of the enclosure before other work begins. Items which cannot be moved must be cleaned and sealed with polyethylene sheeting.



Sealing the ventilation system



Covered and sealed furniture



Sealed pipe

5. If scaffolding is used during the asbestos removal operation the open ends of the scaffold tubing must be sealed.
6. Any openings such as stairways, doors (including elevator doors), windows, and

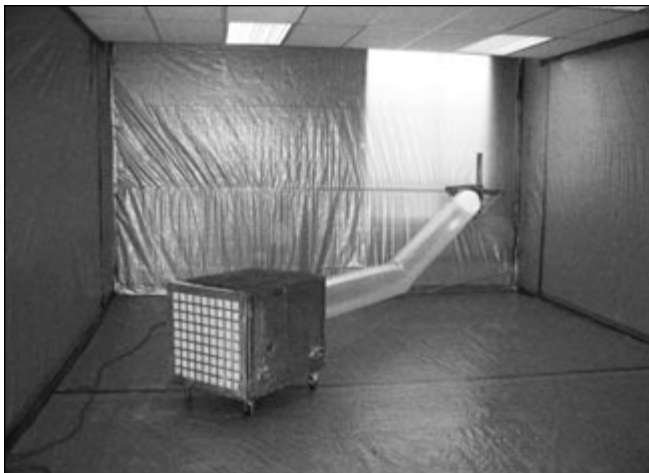
pipe/conduit penetrations must also be sealed off.

7. If asbestos is being removed from an entire floor, the elevators must be prevented from stopping at that floor.
8. With two exceptions (see box below), all Type 3 operations require a negative pressure of 0.02 inches of water inside the enclosure relative to the area outside the enclosure. You can do this by
 - running negative air units equipped with HEPA filters inside the enclosure and venting them outside, **and**
 - making sure that the enclosure is sealed from the surrounding area. The better the area is sealed, the easier it will be to maintain negative air pressure.

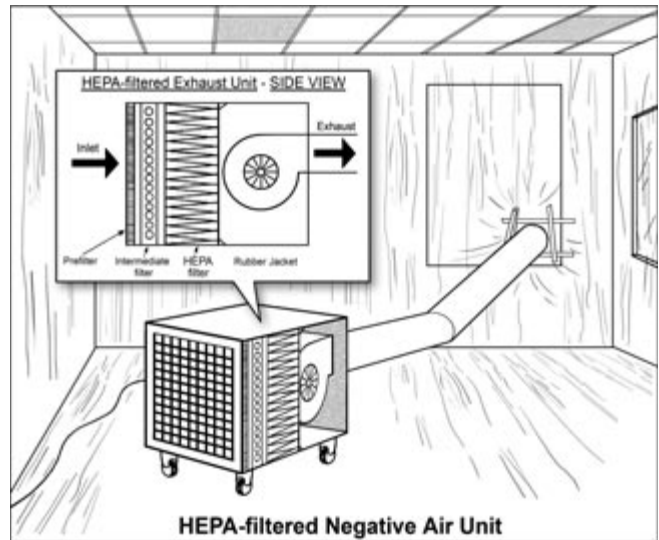
Type 3 operations require a negative pressure of 0.02 inches of water inside the enclosure relative to the area outside the enclosure, *unless*

- the building will be entirely demolished following the asbestos removal work
- the asbestos removal is done outdoors.

Air always moves from positive pressure to negative pressure. By maintaining negative air pressure, air will always move from the



HEPA-filtered negative air unit



non-contaminated or “clean” area into the enclosure, instead of the other way. Without negative air pressure, dust could get out of the enclosure through cracks, tears, ducting, or even through the door to the enclosure.

A competent worker must measure the pressure difference between the inside and outside of the enclosure at regular intervals. A digital pressure monometer will measure the differential pressure. Because air pressure can vary within a large enclosure it is recommended that the differential pressure be measured in a variety of locations.

Here are some clues that there is negative air pressure inside the enclosure:



Monometer

- Plastic barriers and sheeting will move inwards toward the work area.
- There will be noticeable air movement through the decontamination units. You can use smoke tubes to see if air moves from the clean room through the shower room and equipment room to the work area. This must be done with the negative air units on.

A competent worker must inspect and maintain the negative air units before each use to make sure that air isn't leaking and that the HEPA filter isn't damaged or defective (See Appendix I and Appendix J for more details on negative air units and HEPA filters). The negative air units must be in proper working order before you can use them. Clean replacement air must be taken from outside the enclosure to replace air being exhausted.

9. Warning signs must be posted outside and at every entrance to the work area.



Warning sign

10. If you plan to use wet removal methods, the electrical power supply in the area should be shut down, isolated, locked, and tagged to prevent electric shock.
11. Any temporary power supply for tools or equipment should have a ground fault circuit interrupter (GFCI).
12. A competent worker must inspect the work area for defects in the enclosure at the beginning and end of each shift. Any defect must be repaired immediately – No work is allowed until the defect is repaired.



Isolated electrical panel

11.5 Entry/decontamination facility

1. You must set up an entry/decontamination facility that keeps airborne asbestos within the “dirty” area and provides a place for workers to decontaminate themselves as well as their tools, materials, and equipment. A typical entry/decontamination facility is shown on the next page.

The facilities will need to have a separate “dirty” changing room for contaminated work clothing, and a separate “clean” changing room for clean or personal clothing. The showers should be located between the two changing rooms so that it is necessary to pass through them when going from one changing facility to the other. The ‘clean’ and ‘dirty’ ends should be fitted with adequate seating and be of sufficient size for changing purposes.

2. The doorways should be fitted with overlapping polyethylene curtains on each side so that they will close behind workers passing through. This “airlock” will help prevent the spread of dust.
3. There must be a temporary shower with hot and cold running water so workers can wash off residual asbestos before they leave the contaminated area.
4. A competent worker must inspect the work area for defects in the decontamination facility at the beginning and end of each

shift. Any defect must be repaired immediately – No work is allowed until the defect is repaired.

11.5.1 Procedures for entry and decontamination

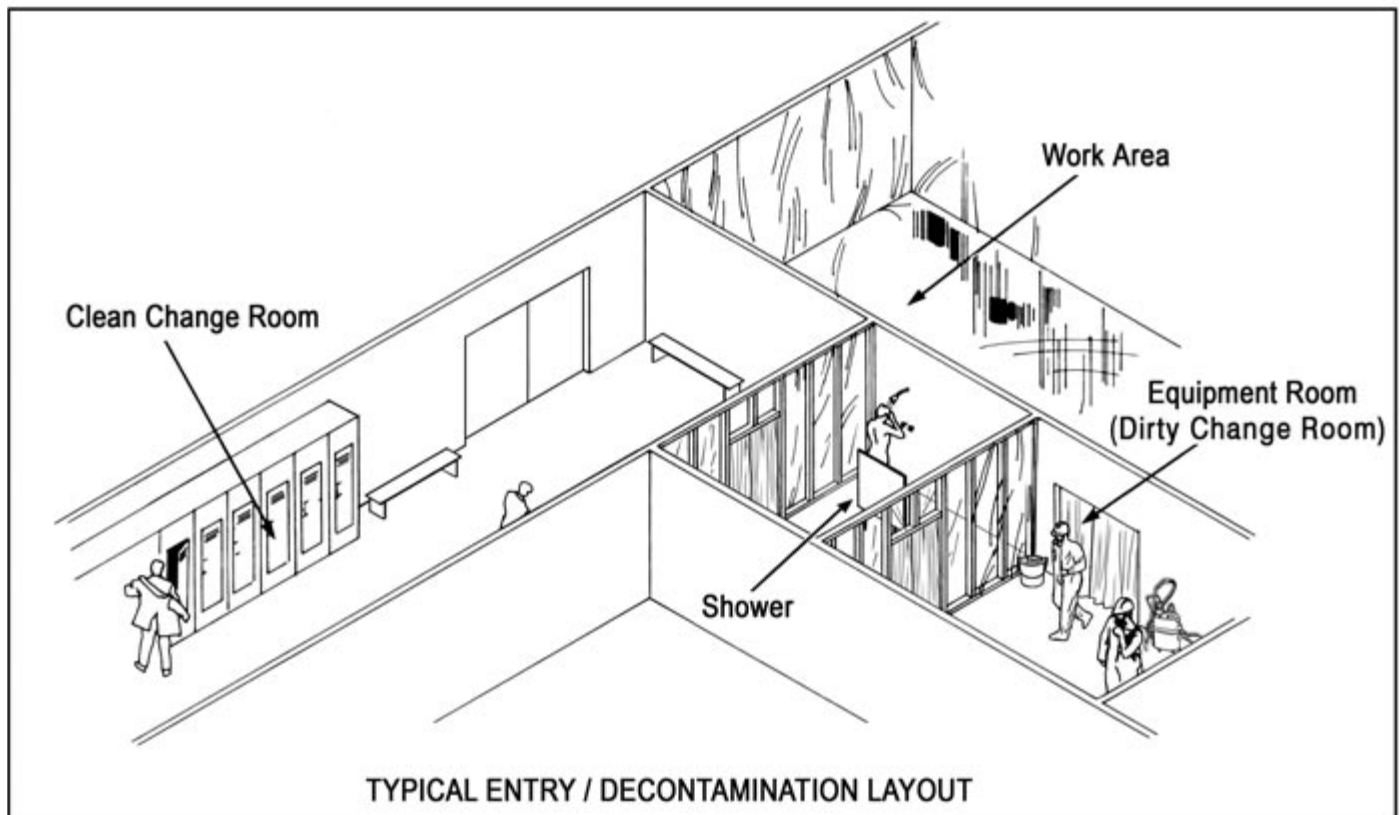
These entry and decontamination procedures must be followed every time workers enter or exit the work area.

11.5.1.1 Entry

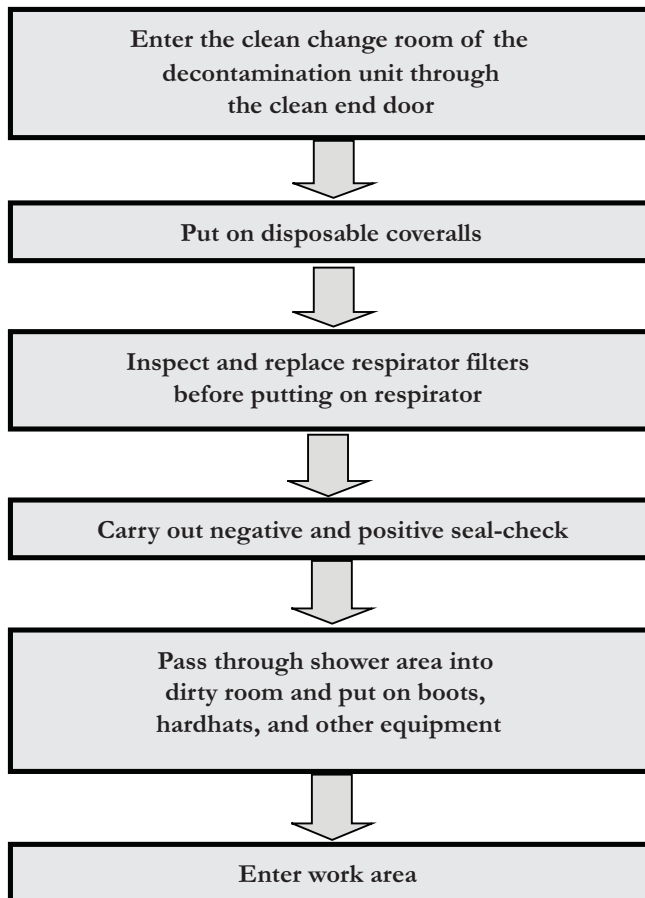
1. Workers enter the clean change room and
 - remove street clothes
 - put on disposable coveralls
 - inspect their respirators
 - replace filters and perform other maintenance (e.g., change power packs on powered air-purifying respirators)
 - put on and seal-check respirators
 - go to the curtained doorway.



2. They enter the shower room and go (without showering) into the equipment room.
3. Here, they put on their boots, hardhats, and other equipment from the previous shift.
4. They enter the dirty work area through the last curtained doorway.



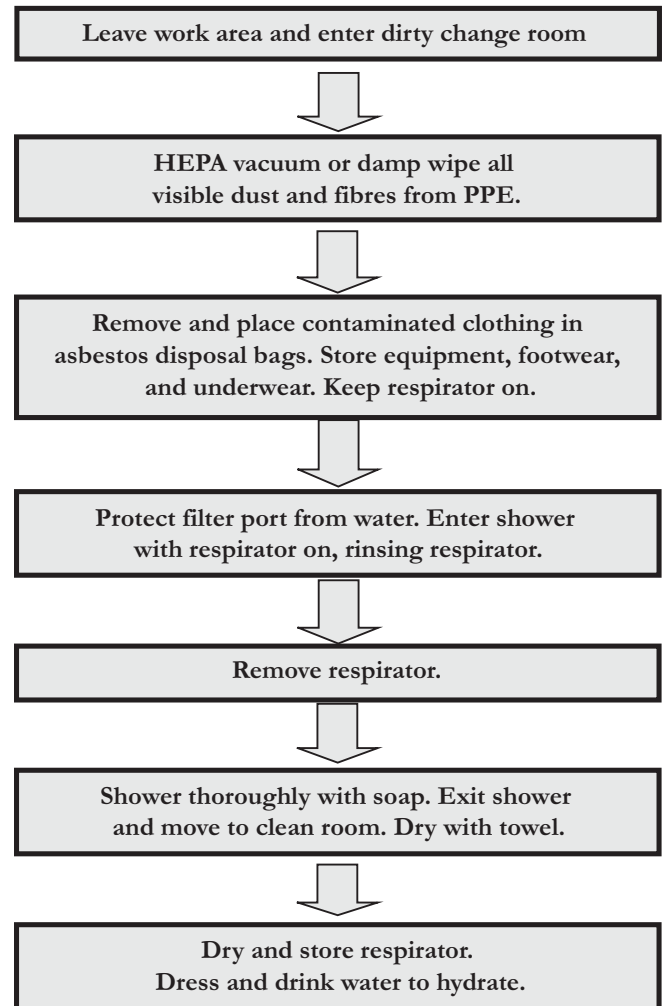
Entering Enclosure



11.5.1.2 Decontamination

- Workers enter the dirty change room and remove any visible dust from their protective clothing by damp-wiping or HEPA vacuuming.
- Workers remove and discard disposable coveralls (see Section 11.7 for disposal information) and store any other personal protective equipment (PPE), tools, and equipment to be reused. They continue to wear their respirators.
- Workers enter the shower area via the curtained doorway and shower with their respirator on, rinsing off the respirator. They then remove the respirator and continue

Leaving Enclosure



showering. With most respirators, the filters, blowers, and battery pack must be kept out of the shower water to prevent damage. Damp-wipe them before taking them off.

- Workers exit to the clean side, and enter the change room via the curtained doorway, and change into their street clothes.

Used towels should be treated as asbestos waste and put into a sealable container.

Any tools or equipment used in the work area should be decontaminated by damp-wiping or HEPA-vacuuming before being taken out of the area.

If necessary, arrangements must be made so that female workers can decontaminate themselves separately from male workers.

11.6 Removal

1. Wherever possible, asbestos-containing material (ACM) should be wetted before removal starts. Unless wetting creates a hazard, it is not recommended to remove ACM when the material is dry. To improve penetration of the water and reduce runoff and dry patches, a “wetting agent” must be added to the water (see Section 9.2). You may need to spray this “amended water” repeatedly to penetrate the ACM and to keep it wet. A portable pressurized vessel such as a pump-up garden sprayer can be used to apply the amended water. Constant water pressure is desirable. High pressure water spray should not be used.
2. Any electric tools and equipment used in wet removal operations must be equipped with ground fault circuit interrupters (GFCIs) to prevent electric shock.

11.7 Clean-up and storage

1. Asbestos waste must be cleaned up frequently and regularly by HEPA-vacuuming, damp-mopping, or wet-sweeping before it dries out. It might be necessary to spray down asbestos debris with amended water to keep it damp after it is removed.
2. Asbestos waste and protective clothing that will not be reused must be placed in a suitable container for disposal. Dropsheets, polyethylene sheets, and enclosure materials must be wetted before they are placed in a suitable container for disposal.
3. A suitable container is
 - dust-tight
 - suitable for the type of waste (e.g., if the waste is sharp, such as floor tiles, the container must be rigid and puncture-proof)

- impervious to asbestos
- properly marked that it contains asbestos waste (see label below).



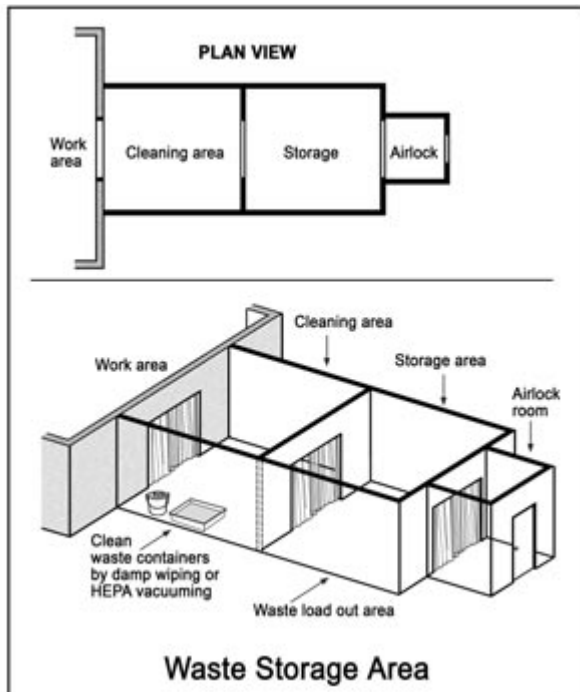
Examples of suitable containers are 6-mil polyethylene bags (always double-bag them) or polyethylene drums.



Double-bagged

4. You must always damp-wipe or HEPA vacuum the surface of the container to remove asbestos dust before taking it out of the work area. Containers must be removed from the workplace frequently and at regular intervals.
5. Before sealing the first 6-mil polyethylene bag, use a HEPA vacuum to suck any excess air out of it. Seal the bag by twisting the top tightly, folding it over, and sealing it with duct tape. Damp-wipe or HEPA-vacuum the outside of the bag before it is moved from the work area to the decontamination area. Once in the decontamination area, place the bag into a second 6-mil polyethylene bag and seal it.

Although not required by regulation it is good practice to remove waste bags from the enclosure via a separate “bag lock,” which is a separate passageway for the waste bags. The bags should be vacuumed all over before being passed into the next compartment of the bag lock where the bags are put into second, outer bags. The bags are then passed to the outside or to an additional storage compartment before being passed to the outside.



6. Don't place waste materials with sharp edges—such as floor, wall, or ceiling tiles—into a bag. These items should be neatly stacked together. Wrap each stack in 2 layers of 6-mil or thicker polyethylene. Then place in a suitable container for asbestos waste.
7. After cleaning up and removing the asbestos waste, the work area must be thoroughly washed down with amended water if it's possible to do so.
8. Once all the asbestos has been removed, tools and equipment—including scaffolding, ladders, etc.—must be thoroughly cleaned by

damp-wiping or HEPA-vacuuming to remove any settled asbestos dust. The negative air units must keep operating during this time.

11.8 Visual inspection

1. A competent worker must conduct a visual inspection to ensure that the enclosure and the work area inside the enclosure are free from visible asbestos-containing material (ACM). A thorough visual inspection consists of verifying that there is no debris or residue from removed ACM and that all visible dust or debris in the work area has been cleaned up. If visible residue, dust, or debris remain, it must be cleaned up using wet wiping and/or HEPA vacuuming before lockdown (gluedown) is applied and clearance sampling is started.
2. The visual inspection should be performed using procedures outlined in the American Society for Testing and Materials (ASTM)'s *Standard Practice for Visual Inspection of Asbestos Abatement Projects* (ASTM E 1368).

11.9 Lockdown/gluedown

Although it is not a regulated requirement, it is a standard industry practice to apply a lock-down sealant throughout the containment area to seal down any invisible dust and fibres undetected during the visual inspection after the removal activities.

- The lockdown sealant needs to be compatible with any materials that will be installed over the sealant such as fireproofing material. (The supervisor must verify this with the manufacturer.)
- The sealant should be applied in accordance with the manufacturer's recommendations.
- There are a variety of lockdown sealants available and the one you choose must be appropriate for the intended use.



Lockdown

For example, if the area requires a certain fire protection rating, the sealant must have that rating.

- Lockdown sealants are available in clear and colour mixtures. They will require different drying times, depending on the manufacturer. Follow the manufacturer's instructions.
- Take care to avoid getting sealant on or in HVAC units, HEPA vacuums, and negative-pressure machines.
- After the first coat, an inspection should be conducted to see if a second coat might be necessary
- If applying two coats, consider using a different colour to ensure complete coverage. You will be able to see the areas where only one coat has been applied.
- Certain lockdown sealants can pose a health risk if used in an enclosed space.

- Review the MSDS for hazards, required personal protective equipment (e.g., respiratory protection requirements), and control measures to use when applying the sealant.
- Follow the manufacturer's instructions.

11.10 Clearance air testing

1. Clearance air testing must be performed upon completion of Type 3 removal or repair operations **except** under any of the following conditions:
 - the operation involves work only on non-friable ACM using a power tool not equipped with a HEPA-filtered vacuum
 - the work is done outdoors
 - the work is done in a building that will be demolished and only the asbestos removal and demolition workers will enter the building.
2. Only a competent worker can conduct clearance air testing after an acceptable visual inspection and after the work area inside the enclosure is dry. For more information, see "Clearance Air Testing," Appendix C. You must keep the barriers, enclosure, decontamination facility, and negative air pressure units operating until the work area inside the enclosure passes the clearance air test (less than 0.01 fibres/cubic centimetre). If the work area does not pass the test, cleaning, decontamination, inspection and lock-down measures inside the enclosure must be repeated before retesting.
3. Within 24 hours after receiving the clearance air testing results, the owner and the employer must post a copy of the results and provide a copy to the joint health and safety committee or the health and safety representative.



Air sampling

11.11 Teardown

1. All polyethylene used for lining and in enclosures must be wetted, disposed of as asbestos waste, and not be reused. Dropsheets must be wetted and then folded so that any residual dust or scrap is contained inside the folds. Dispose of dropsheets as asbestos waste.
2. After the work is completed, barriers and portable enclosures that are rigid and that will be reused must be cleaned by damp-wiping or HEPA-vacuuming. Barriers and portable enclosures must not be reused unless they are rigid and can be cleaned.
3. After the work area has passed both the visual inspection and air-clearance test, you can shut down the negative air filtration units. The negative-air system must be completely decontaminated. All pre-filters must be removed and disposed of as asbestos

waste. Seal the inlet and outlet with 2 layers of 6-mil polyethylene.

4. Teardown should be done as a Type 2 operation and workers must be adequately protected.

11.12 Disposal of asbestos-containing material

Regulation 347 under Ontario's *Environmental Protection Act* covers the off-site handling and disposal of asbestos waste. The regulation describes types of containers, labelling, and disposal procedures. There are also regulations concerning the transportation of dangerous goods, enforced by either the Ontario Ministry of Transportation or Transport Canada.

Some municipalities may not accept asbestos waste at their landfills. Check with your local authorities or the Ministry of Environment to find the nearest disposal site.

11.13 Outdoor operations

Outdoor operations can be simpler than indoor operations. You can often use large quantities of water to thoroughly soak the material and reduce the amount of airborne dust. There's less risk to bystanders because of this increased wetting and the natural dispersion of asbestos dust in the air.

For these reasons, there are some different requirements for outdoor Type-3 operations:

- No final visual inspection or clearance air test is required after removal.
- An enclosure is required only when removing non-friable asbestos-containing material using power tools without HEPA-filtered vacuums. A transparent window area to allow observation of the entire work area is required if the enclosure material is opaque.
- Full decontamination facilities are required for outdoor Type-3 operations except for

outdoor operations on non-friable asbestos-containing material involving power tools without dust-collecting devices equipped with HEPA filters (only wash-up facilities are required for this exception).

- Dust and waste must not be allowed to fall freely from one work level to another.
- All the other requirements as for indoor Type-3 operations apply.

Weather conditions may influence the performance of work. Heat, cold, or high winds can make working unsafe. Exposure to the cold can be an important consideration for workers if work must be done outdoors in the winter or indoors if a building's heating system must be shut down.

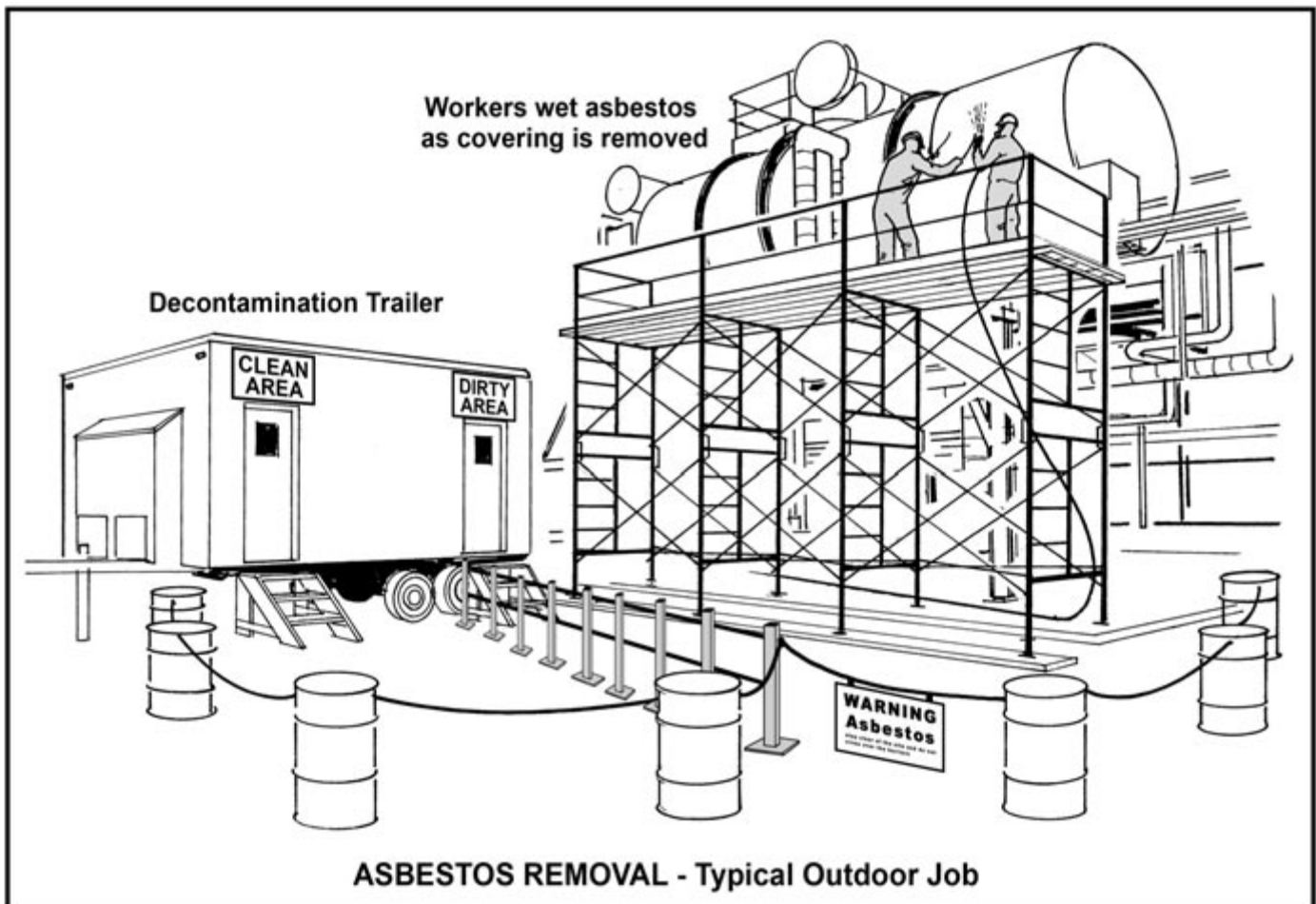
For outdoor operations it will generally not be possible to connect a decontamination facility directly to the work area. In such situations,

portable decontamination units will have to be provided. When leaving the work area, workers should thoroughly vacuum their personal protective equipment and respirators, and wash their footwear, but **DO NOT REMOVE RESPIRATORS**. Workers should immediately put on another set of disposable coveralls (transit coveralls having a different colour from those worn inside the work area) before making their way to the portable decontamination unit. All transit routes should be clearly marked to keep out other workers and members of the public.

11.14 Demolition

Before any building is demolished, all asbestos-containing material (ACM) that may be disturbed during the work has to be removed if possible, including material that is hidden:

- Asbestos can be hidden in shafts, between walls, or above false ceilings.



- You may have to look behind these hidden places to identify suspected ACM. Care must be taken when sampling the material to see if it is ACM.
- All pipes should be traced along their whole length and all the ACM removed.

Demolition involving Type 3 operations is exempt from

- creating and maintaining a negative air pressure of 0.02 inches of water within the enclosed area
- a final visual inspection and clearance air testing.

All the other requirements as for indoor Type-3 operations apply.

No one must enter the building that is to be demolished except for the workers involved in the demolition.

11.15 Disturbing non-friable asbestos with power tools not equipped with HEPA filters

If you use power tools without HEPA-equipped dust-collecting devices, then all Type-3 requirements for indoor projects apply, with three exceptions:

- If the work is outdoors or you're demolishing a building, you do not need to maintain a negative pressure of 0.02 inches of water inside the enclosure.
- You do not need full decontamination facilities. You must, however, decontaminate protective clothing and have facilities for workers to wash their hands and faces.
- You do not need a final visual inspection or clearance air testing.

Power tools should not be used for removing ACM because they generate high levels of airborne dust. If possible, use non-powered tools or power tools with HEPA-equipped dust-collecting devices. Also, use amended water to control the dust.



To prevent electric shock, all power tools used around water must be equipped with a ground fault circuit interrupter (GFCI) and be maintained properly.

12 ASBESTOS WASTE MANAGEMENT

Ontario's *Environmental Protection Act* covers the disposal of asbestos waste and is enforced by the Ministry of Environment.

There are also regulations concerning the transportation of dangerous goods, enforced by Transport Canada.

Some municipalities may not accept asbestos waste at their landfills so check with your local authority or the Ministry of Environment to find the nearest disposal site.

INDIVIDUAL FINED \$45,000 FOR ILLEGAL TRANSPORT OF ASBESTOS WASTE

SARNIA – A person was fined \$45,000 for operating a waste management system without Ministry of the Environment (MOE) approval under the Environmental Protection Act (EPA). In the fall of 2002, the person was awarded a demolition contract requiring the removal and disposal of asbestos waste at a long-term care facility for senior citizens.

The contract clearly set out the requirements for the disposal of the waste in accordance with Ontario Regulation 347 made under the EPA. At the time, the individual bagged some of the asbestos waste and transported it to asbestos waste bins owned by a disposal company in London without notifying that company. In July 2003, the ministry was advised that some asbestos waste from the senior citizen's home had not been handled in accordance with the regulations. An investigation by the ministry's Investigation and Enforcement Branch confirmed that a quantity of asbestos waste was transported without a Certificate of Approval for a waste management system. The individual was charged accordingly.

On June 21, 2005, the individual was convicted on one count under the EPA. For transporting waste without a Certificate of Approval contrary to Section 27(1) (a) of the act, the person received a \$45,000 fine plus victim fine surcharge.

RESPIRATOR CHART FOR ASBESTOS WORK

“ACM” means asbestos-containing material.

Description of work		Required respirator
Type 1 operations		
All Type 1 operations		If worker asks employer to provide a respirator: A
Type 2 operations		
Removing all or part of a false ceiling to obtain access to a work area, if ACM is likely to be lying on the surface of the false ceiling.		B
Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non-friable ACM if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.	Material is not wetted	B
	Material is wetted to control fibres	A
All other Type 2 operations*		A
Type 3 operations		
Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non-friable ACM using power tools, if the tool is not attached to a dust-collecting device equipped with a HEPA filter.	Material is not wetted	C
	Material is wetted to control fibres	B
<ul style="list-style-type: none"> ➤ Removing or disturbing more than one square metre of friable ACM during the repair, alteration, maintenance, or demolition of all or part of a building, aircraft, ship, locomotive, railway car or vehicle, or any machinery or equipment. ➤ Spraying sealant on friable ACM. ➤ Cleaning or removing air-handling equipment, including rigid ducting but not including filters, in a building where sprayed fireproofing is ACM. ➤ Repairing, altering, or demolishing all or part of a kiln, metallurgical furnace, or similar structure that is made in part of refractory ACM. ➤ Repairing, altering, or demolishing all or part of any building in which asbestos is or was used in the manufacture of products, unless the asbestos was cleaned up and removed before 16 March 1986. 	Material is not wetted	D
	Friable ACM other than chrysotile was applied or installed by spraying, and is wetted to control fibres	C
	Friable chrysotile ACM was applied or installed by spraying, and is wetted to control fibres	B
	Friable ACM was not applied or installed by spraying, and is wetted to control fibres	B

* **Warning:** For any **Type 2** operation in which wetting is required but would cause a greater hazard or damage, then dry work is permitted. Dry work, however, usually results in more airborne fibres. IHSA recommends that you select a category B respirator (see below).

KEY TO RESPIRATOR CHART

A	B	C	D
Air-purifying half-mask respirator with N-100, R-100, or P-100 particulate filter. If the worker requests the respirator from the employer, then the worker must wear it.	Choose any of the following: <ul style="list-style-type: none"> ➤ Air-purifying full-facepiece respirator with N-100, R-100, or P-100 particulate filter. ➤ Powered air-purifying respirator with a tight-fitting facepiece (either full or half facepiece) and a high-efficiency filter. ➤ Negative-pressure (demand) supplied-air respirator with a full facepiece. ➤ Continuous-flow supplied-air respirator with a tight-fitting facepiece (full or half facepiece). 	Pressure-demand supplied-air respirator with a half facepiece.	Pressure-demand supplied-air respirator with a full facepiece.

Disposable respirators or dust masks are not recommended for avoiding exposure to asbestos fibres because it's difficult to perform negative-pressure and positive-pressure seal checks.

CHART FOR ASBESTOS OPERATIONS

Use this chart to determine the “Type” of asbestos procedure and required respirator.

How to use the chart

- ▶ Use this chart with IHSA’s data sheet *Asbestos: Controls for Construction, Renovation, and Demolition* (DS037). It will clarify any details. You can order the data sheet from IHSA or download it free from www.ihsa.ca. (You can also download a colour version of this chart).
- ▶ Start in the middle of the chart and work outwards.
- ▶ Your goal is to reach the boxes that will tell you the “Type” of removal (Type 1, 2, or 3) and the respirator you require.
- ▶ The outside circle of the chart tells you what kind of respirator you need. We’ve used A, B, C, and D to represent different kinds of respirators. The respirator table below explains what each of the letters means.
- ▶ For two categories of operations, the chart asks you to determine the size of the material you’re working with. Once you choose the size (area in m²), you have to stay within the colour (shading) of the size until you get to the “Type” ring. For example, if you’re removing ceiling tiles, and the area is greater than 7.5 m², you have to stay within the area of the chart that is coloured the same dark grey as the “Greater than 7.5 m²” cell (**this includes the striped area**) until you get to the “Type” ring. You must not move into the light-grey areas which are for operations of less than 7.5 m².

See the third page of this chart for another example of how to use the chart.

- ▶ **When you know the “Type” of removal, you need to implement the required controls.** The controls for each type of operation are listed in the asbestos regulation (Ontario Regulation 278/05, *Designated Substance—Asbestos on Construction Projects and in Buildings and Repair Operations*). To help you understand the regulation’s requirements, IHSA has produced a guide called *Asbestos: Controls for Construction, Renovation, and Demolition* (DS037). You can order both of these publications from IHSA or download them free from www.ihsa.ca.

LEGEND

ACM means asbestos-containing material.

HEPA or No HEPA refers to whether your tool is attached to a dust-collecting device equipped with a High-Efficiency Particulate Aerosol (HEPA) filter.

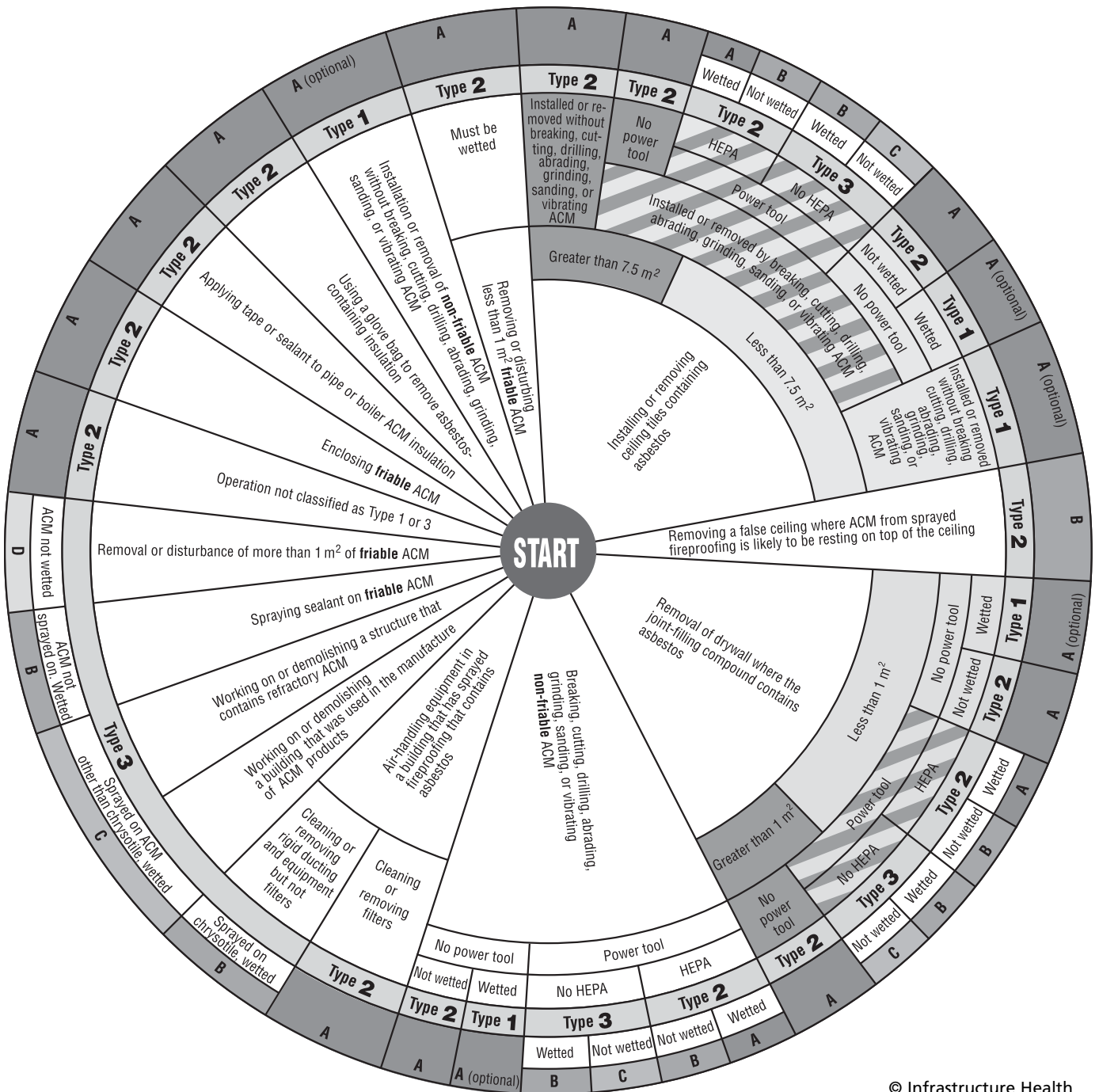
Wetted or not wetted refers to the practice of wetting the asbestos-containing material with “amended water,” (such as a mixture of 1 cup dishwashing detergent for every 20 litres of water).

RESPIRATORS

A*	B	C	D
Air-purifying half-mask respirator with N-100, R-100, or P-100 particulate filter. The worker must wear the respirator if he or she requests it from the employer.	Choose any of the following: <ul style="list-style-type: none"> <input type="checkbox"/> Air-purifying full-facepiece respirator with N-100, R-100, or P-100 particulate filter. <input type="checkbox"/> Powered air-purifying respirator with a tight-fitting facepiece (either full or half facepiece) and a high-efficiency filter. <input type="checkbox"/> Negative-pressure (demand) supplied-air respirator with a full facepiece. <input type="checkbox"/> Continuous-flow supplied-air respirator with a tight-fitting facepiece (full or half facepiece). 	Pressure-demand supplied-air respirator with a half facepiece.	Pressure-demand supplied-air respirator with a full facepiece.

Disposable respirators or dust masks are not recommended for avoiding exposure to asbestos fibres because it’s difficult to perform negative-pressure and positive-pressure seal checks. For more information on seal checks, see Appendix F of IHSA’s *Asbestos: Controls for Construction, Renovation, and Demolition* (DS037), available on www.ihsa.ca.

* For any Type 2 operation in which you will **not** wet the asbestos-containing material, IHSA recommends that you use a category **B** respirator.



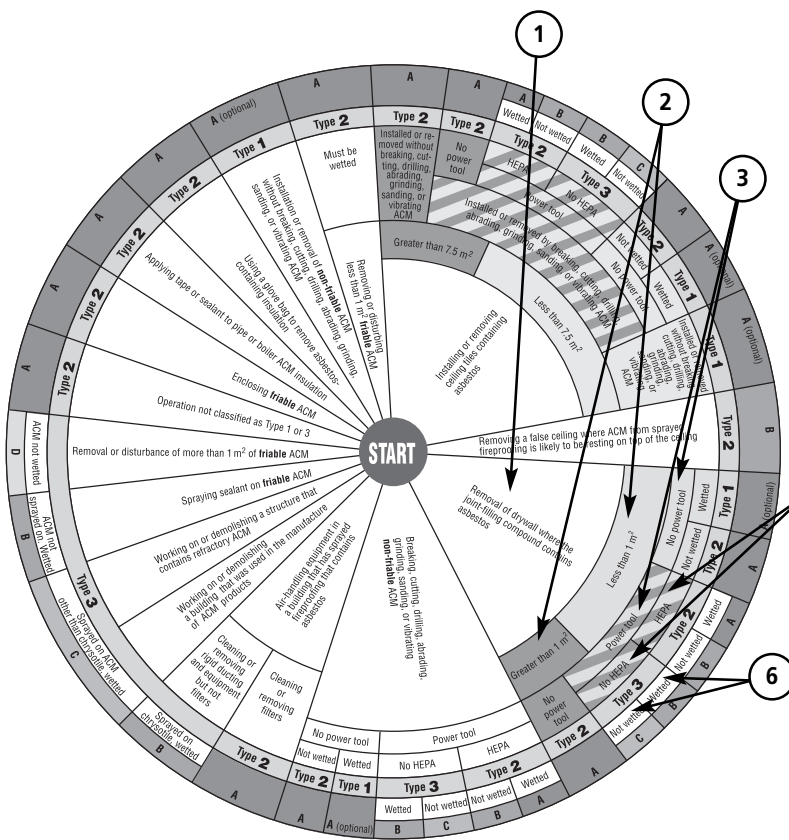
© Infrastructure Health and Safety Association

February 2008, DS037, grayscale

Example of how to use the chart

- Let's say you want to remove drywall where the joint-filling compound contains asbestos. The first thing you do is find the slice of the pie that says this. (To the right and a bit below "START".)
- You then move outward and see what decision you need to make. In this case, you need to decide how much drywall you will be removing (greater than 1 m² or less than 1 m²). Let's say that you will be removing less than 1 m².
Notice that the "colour" of the box is light grey.
- Staying within the light grey colour, move outward and see what decision you need to make. You need to decide if you will use a power tool or not. ("Power tool" is an option despite the dark stripes because the area still contains some light grey.) Let's say you will be using a power tool for the removal.
- The next step asks if your power tool is attached to a dust-collecting device equipped with a HEPA filter. If it doesn't have a HEPA filter, then your project is a **Type 3** asbestos operation.

- Now that you know the "Type" of your operation, you need to learn your legal requirements and the controls you must use. Refer to the documents listed on the page opposite the chart (under "When you know the "Type" of removal").
- To determine what respirator you require, move one step further in the circular chart, and decide whether you will wet the material with "amended water" (see the page opposite the chart). If you're performing a dry removal, the **respirator type will be C**.
- Look at the respirator table on the page opposite the circular chart, and see what respirator "C" represents. It is a **pressure-demand supplied-air respirator equipped with a half facepiece**. This is the kind of respirator you need.



RESPIRATORS

A*	B	C	D
Air-purifying half-mask respirator with N-100, R-100, or P-100 particulate filter. The worker must wear the respirator if he or she requests it from the employer.	Choose any of the following: <input type="checkbox"/> Air-purifying full-facepiece respirator with N-100, R-100, or P-100 particulate filter. <input type="checkbox"/> Powered air-purifying respirator with a tight-fitting facepiece (either full or half facepiece) and a high-efficiency filter. <input type="checkbox"/> Negative-pressure (demand) supplied-air respirator with a full facepiece. <input type="checkbox"/> Continuous-flow supplied-air respirator with a tight-fitting facepiece (full or half facepiece).	Pressure-demand supplied-air respirator with a half facepiece.	Pressure-demand supplied-air respirator with a full facepiece.

Disposable respirators or dust masks are not recommended for avoiding exposure to asbestos fibres because it's difficult to perform negative-pressure and positive-pressure seal checks. For more information on seal checks, see Appendix F of IHSAs *Asbestos: Controls for Construction, Renovation, and Demolition* (DS057), available on www.ihsa.ca

* For any Type 2 operation in which you will **not** wet the asbestos-containing material, IHSAs recommends that you use a category B respirator.

APPENDIX C

CLEARANCE AIR TESTING

The asbestos regulation for construction (Ontario Reg. 278/05) requires clearance air testing upon completion of Type-3 removal or repair operations. (There are some exceptions to this rule. See the regulation for details.)

Clearance air testing involves collecting air samples from inside the work area and analyzing them. This will determine if the clean-up and decontamination measures have eliminated the asbestos dust hazard. Clearance air testing is done only after the work area has passed the visual inspection, the area inside enclosure is dry, and “lockdown/gluedown” has been applied.

Clearance air testing reference: M.1.5, Appendix M of Guidance for Controlling Asbestos-Containing Materials in Buildings, publication number EPA 560/5-85-024, 1995, by the U.S. Environmental Protection Agency.

Barriers, enclosures, decontamination facilities, and negative air units **must be maintained** until the work area inside the enclosure passes the clearance air test.

Only a competent worker can perform clearance sampling.

Before and during sampling, “forced” air using leaf blowers or similar equipment is used to disturb settled dust from all surfaces in the work area, including enclosure surfaces. This disturbance displaces any settled dust to ensure “worst case” air concentrations of asbestos dust. Airborne dust is then sampled using an air pump which draws air through a filter. Samples are sent to an accredited laboratory for analysis. Laboratory turn-around times are anywhere from 24 to 72 hours.

There are two methods of analysis:

- Phase Contrast Microscopy (PCM). A technician uses an optical microscope.
- Transmission Electron Microscopy (TEM). A technician uses an electron microscope.

Phase Contrast Microscopy generally costs less, but it can be less accurate than Transmission Electron Microscopy. In Phase Contrast Microscopy, all fibres including non-asbestos fibres are counted, while in Transmission Electron Microscopy, only asbestos fibres are counted. Also, the number of samples required for analysis is different.

There are 3 clearance test analysis options:

1. Clearance test using PCM analysis alone
2. Clearance test using TEM analysis after the clearance test fails using PCM analysis.
3. Clearance test using TEM alone.

The clearance test passes if

- using PCM alone; all samples are less than 0.01 fibres per cubic centimeter in concentration
- using TEM after the clearance test using PCM analysis fails, all samples are less than 0.01 fibres per cubic centimeter in concentration. (The 0.01 refers to **all fibres** for PCM, and **asbestos fibres** for TEM.)
- using TEM alone, the average asbestos fibre concentration level inside the enclosure is statistically the same or less than the average asbestos fibre concentration outside the enclosure.

Consequences of failure of clearance test: If the work area does not pass the test, cleaning, decontamination, inspection, and lock-down measures inside the enclosure must be repeated before retesting. This adds to the cost and duration of project. It’s crucial that the project owner or

general contractor ensures that the asbestos work is done properly and that the clearance sampling is done only by a competent worker.

Clearance air testing is not required for

- Type 1 operations
- Type 2 operations
- Type 3 operations when
 - the operation involves work only on non-friable ACM using a power tool not equipped with a HEPA-filtered vacuum
 - the work is done outdoors, or
 - the work is done in a building that will be demolished and only the asbestos-removal and demolition workers will enter the building.

APPENDIX D

INSPECTING RESPIRATORS

Before each use, respirators must be inspected to make sure that they are in good working order.

The pre-use inspection should include checking

1. the facepiece and face-seal area for cracks, tears, dirt, or warping
2. the inhalation valves for warping, cracking, or tearing
3. the head straps for cracks — ensure that they have good elasticity
4. all plastic parts for signs of cracking — ensure that filter gaskets or seal areas are in good condition
5. the exhalation valve and valve seat for signs of dirt, warping, cracking, or tearing
6. the viewing area of the full facepiece for any damage that might restrict vision
7. the type and condition of the filter
8. the battery charge/condition and the airflow rate for powered air-purifying respirators (PAPR).
9. the regulators, alarms, and other warning systems.

A respirator with any damaged or deteriorated components must be repaired or discarded.

APPENDIX E

CLEANING AND STORAGE OF RESPIRATORS

Respiratory protective equipment should be cleaned after each use. It must be disinfected whenever the equipment is transferred from one person to another. Maintenance and cleaning procedures need to be appropriate for the type of respiratory protective equipment being used. Follow the manufacturer's instructions.

The following is based on Appendix F (Guidelines for cleaning, disinfecting and storing of respirators) of CSA Z94.4-02:

1. Remove cartridges and filters.
2. Rinse respirator in warm water.
3. Immerse facepiece (excluding filters and cartridges) in warm water (50° C) with a mild detergent.
4. Clean with soft brush or sponge. Do not use cleaners containing solvents, because they will damage the respirator components.
5. Rinse in fresh, warm water.
6. If the respirator is shared, disinfect the facepiece by soaking in a solution of quaternary ammonia disinfectant or sodium hypochlorite (30 ml of household bleach in 7.5 litres of water).
7. Rinse in fresh, warm water, and air dry.
8. The cleaned respirator must be stored in a clean area away from dust, chemicals, sunlight, heat, extreme cold, and excessive moisture.

APPENDIX F

PUTTING ON AND SEAL CHECKING RESPIRATORS

Putting on the respirator

1. Fully loosen all head straps. Pull hair back with one hand. Bring facepiece up to face with other hand.
2. While holding the facepiece in place, pull the straps over your head.
3. Tighten the straps starting from the bottom and going to the top.

Seal checking

Respirators must be seal checked (negative **and** positive) before each use.

Negative pressure test

- Wearer puts on respirator and adjusts it appropriately.
- Inlets to the filters are blocked with hands or covers.
- Wearer inhales gently and holds for 5 seconds.
- Mask should collapse slightly and not permit air into the facepiece.



Negative-pressure seal check

- If a leak is detected, readjust the mask and repeat the test.

Positive pressure test

- Perform only once wearer is satisfied with negative pressure test.
- Cover or block exhaust port of respirator.
- Wearer exhales gently for 5-10 seconds.
- Mask should expand outward slightly
- If a leak is detected, inspect and/or readjust mask and repeat the test.



Positive-pressure seal check

If you cannot achieve a proper seal, do not enter the work area. See your supervisor.

APPENDIX G

FIT TESTING RESPIRATORS

Fit testing is required

- for each user when they use a new type or model of respirator
- to ensure user can achieve an acceptable seal.

Accurate records should be kept of who performed the fit test, when it was performed, on whom it was performed, the method of fit testing performed, and the results of the fit test.

There are two methods of fit testing: qualitative and quantitative. Fit testing should be performed according to CSA standard Z94.4-02.

Qualitative

In qualitative fit testing, the worker wears the respirator. A chemical agent which can normally be noticed by smell, taste, or the irritation that it causes, is introduced to determine if a proper fit has been achieved. A negative result (the worker does not smell, taste, or become irritated) indicates a good fit, while a positive result (the worker smells, tastes, or is irritated) indicates a poor fit.

Qualitative fit testing is uncomplicated, fast, and can be done in the field. The drawback is that it depends on the wearer's subjective response to the testing agent.

When testing half masks, irritant smoke or other substances can irritate the eyes. Wearers should close their eyes during the test.

Quantitative

Quantitative fit testing is a procedure in which a test substance (aerosol, vapour, or smoke) is released outside the respirator. A probe and specialized equipment measure the concentration of the test substance both outside and inside the

respirator. The test passes if the concentration inside the respirator passes a fit factor (based on an assigned NIOSH rating).

Quantitative fit testing does not depend on the wearer's subjective response, but it is expensive, and it requires a competent person to conduct the test. Quantitative fit test equipment must be maintained, calibrated, and used according to the manufacturer's instructions.

APPENDIX H

RESPIRATOR POLICY

Each company is required to have a written respirator policy and a program for implementing that policy.

The CSA Z94.4-02 standard outlines the content requirements for a respiratory program which includes:

- Roles and responsibilities
- Hazard assessment
- Selection of the appropriate respirator
- Respirator fit testing
- Training
- Use of respirators
- Cleaning, inspection, maintenance, and storage of respirators
- Health surveillance of respirator users
- Program evaluation
- Record-keeping.

A qualified person should administer and oversee the respiratory protection program.

APPENDIX I

HEPA FILTERS

HEPA stands for High-Efficiency Particulate Aerosol, and refers to filters used in a variety of industries and workplaces.

In construction, there are two main uses for HEPA filters:

1. industrial HEPA vacuum cleaners
2. negative air filtration units.

Vacuum cleaners with HEPA filters trap toxic particles such as asbestos and keep them from returning to the air where people can inhale them.

Negative air filtration maintains air pressure inside an enclosure at a lower level than outside. The filtration unit draws contaminated air from within the enclosure through a HEPA filter and blows the air outside.

To qualify as a HEPA filter, the filter must be certified by the Institute of Environmental Sciences and Technology to ensure that it can capture 99.97% of particles greater than or equal to 0.3 microns in diameter. A filter passing the certification test is given a number and the test results are recorded on the label. So read the label carefully.

Efficiency

By definition, a HEPA filter is able to remove a minimum 99.97% of all particles 0.3 microns in diameter or larger. A human hair, by comparison, is about 100 microns in diameter.

Ordinary filters cannot trap such microscopic particles. Instead, the particles are blown back into the air where workers can inhale them. HEPA filters prevent this from happening.

HEPA vacuums and negative air units have pre-filters to remove large particles before they can reach the HEPA filter itself. Without pre-filters, costly HEPA filters would have to be replaced much more often.

Guidelines

To ensure that HEPA filters are working efficiently, take the following steps.

- Read and follow the manufacturer’s instruction manual.
- Filters are contaminated with toxic substances. When inspecting or replacing filters, do it in a safe, well-controlled place and wear personal protective clothing and equipment. Personal protective equipment will vary according to the hazard but may include an N-100, R-100, or P-100 NIOSH-approved air-purifying respirator, dust-resistant safety goggles, disposable coveralls, and impervious gloves.
- When renting HEPA vacuums or negative air units with HEPA filters, make sure the filters are real HEPA filters and not “HEPA-like” filters.
- Test HEPA filters by means of a Dispersed Oil Particulate (DOP) test when the filters are first installed to see if they’re mounted correctly. The purpose is to ensure that air flows through the filter and doesn’t leak around the seals of the filter housing.

We recommend that after the test is complete, you put a sticker on the unit stating when the test was completed and the result. After the work is finished and before the next use, perform a new test and place a new sticker on the unit.
- Make sure the filter is not installed backwards, is properly seated in its housing, and is tightly secured.
- Inspect the filter housing for signs of dust indicating that dust is bypassing the filter. A HEPA filter is useless if the housing leaks.
- Dust in the exhaust airflow means the HEPA filter has ruptured or failed and must be replaced.
- If the fan is not drawing the amount of air required to keep the area under negative

As the HEPA filter becomes coated with more and more particles, the air flow through the vacuum or negative air unit will decrease. Change the filter.

pressure, the unit filters may have become loaded or clogged with dust. This can be confirmed by measuring the pressure change across the filters (most units have either a differential pressure gauge or a “change filter” indicator). If the filter is clogged, the pre-filter should be changed first. If the pressure change does not decrease, the intermediate filter should be changed. If changing both the pre-filter and the intermediate filter does not solve the problem, the HEPA filter may need to be changed.

- When changing the HEPA filter, make sure the fan is off. Always use the manufacturer’s recommended replacement filter. Other filters may not fit and therefore they may leak.
- After the filter has been replaced, arrange for a Dispersed Oil Particulate (DOP) test to ensure that
 - the new filter’s integrity is good
 - air flows through the filter
 - air doesn’t leak around the seals of the filter housing.

A new test certificate sticker should be placed on the unit.
- All used filters must be placed in sealable plastic bags, labeled, and disposed of as asbestos waste.
- Pre-filters and HEPA filters cannot be cleaned. They must be replaced with new filters approved by the manufacturer.
- Don’t use compressed air to clean old filters or bang old filters to remove accumulated dust.

- Don’t punch holes in HEPA filters or pre-filters when they get clogged.
- Follow the manufacturer’s instructions on when and how to change the filter.
- To replace old filters, use only new filters approved by the manufacturer.
- Don’t use another manufacturer’s filter or alter it to fit your vacuum or air filtration unit.
- Dispose of old filters as contaminated waste.

See Appendix J for information on “Negative Air Units and HEPA Filters: Troubleshooting.”

APPENDIX J

NEGATIVE AIR UNITS AND HEPA FILTERS: TROUBLESHOOTING

How do I know if the HEPA filter is leaking dust?

- There are two specific purposes for testing the HEPA filters:
 1. to check the filter, and
 2. to ensure that air flows through the filter and doesn't leak around the seals or the filter housing.
- Before each use it is the supervisor's responsibility to have the negative air unit's HEPA filter tested.
- Testing must be done by means of a DOP (Dispersed Oil Particulate) test. During a DOP test, a competent worker will introduce small amounts of aerosol or "smoke" upstream of the HEPA filter. While the aerosol or "smoke" is being pulled through the unit, the competent worker doing the testing will then use a meter to check for particles downstream of the HEPA filter to determine if any aerosol or "smoke" has passed through or around the filter.
- After the test is complete, the tester will place a sticker on the unit stating when the test was completed, the serial number of the unit, and whether the result was a pass or fail.
- The test certificate is only valid for that specific "job" or "setup." Once the work has been completed and before the next use, your supervisor must arrange for a new test.

Take extra care when handling a negative air unit.

- Any jarring movement to the unit or even the slightest damage to the unit can cause the seal to fail or even the HEPA filter to break.

- If you notice any damage to the unit, or if you know that the unit has been hit or jarred, you should notify your supervisor immediately.

How do I know when there is a problem and what do I check for?

- It is a requirement to maintain the enclosure pressure at 0.02 inches of water negative to the surrounding area. If the air pressure in the enclosure goes below 0.02 inches of water, immediate action is required.
 - The first thing you need to do is check if the negative air unit is still running.
 - If the unit is running then there could be an opening in the enclosure somewhere. Even a small opening can cause a substantial drop in the negative air pressure.
 - If you have checked the enclosure and everything is okay then the problem could be that the negative air unit's filters have



HEPA test sticker

become clogged with dust which restricts the air flow through the unit. If this is the case the first thing you can do is vacuum some of the dust off of the pre-filter. You may be able to remove enough dust to substantially increase the air flow through the unit. If this doesn't work, the negative air unit's filters need to be changed.

How do I change the filters?

- When the fan is not drawing the amount of air required to keep the containment area under negative pressure, the unit filters may have become loaded or clogged with dust.
- This can be confirmed by measuring the pressure difference across the filters. Most units have either a differential pressure gauge or a "change filter" indicator as part of the unit.
- If the filters have become clogged, the pre-filter should be changed first.
- All filters must be changed within the Type-3 enclosure and in accordance with the manufacturer's instructions.
- If changing the pre-filter does not increase the air flow then the intermediate filter should be changed as well.
- If changing both the pre-filter and intermediate filter does not solve the problem, the HEPA filter may require changing.
 - When changing the HEPA filter, make sure the fan is off.
 - Always use the manufacturer's recommended replacement HEPA filter. Other filters may not fit and therefore they may leak.
 - After the filter has been replaced, arrange for a DOP (Dispersed Oil Particulate) test to ensure the new filter integrity is good and that air flows through the filter and

doesn't leak around the seals or the filter housing.

- All used filters must be placed in sealable plastic bags, labeled, and disposed of as asbestos waste.

Where do I position the negative air unit and the exhaust?

- When preparing for a Type 3 removal the location of the negative air unit and the location of the unit's exhaust duct are important.
- Try to position the negative air unit away from the demolition or in a location that will have the least amount of airborne dust.
- Lower dust levels will minimize the likelihood of having to replace the filters which means
 - the unit will operate for longer durations
 - the unit will operate more efficiently
 - there will be less change in pressure within the enclosure
- Whenever possible, the exhaust or discharge duct should be placed so that it discharges outside.
- Never have the exhaust duct discharge to the building's return air system. If the unit's HEPA filter fails, asbestos fibers could be spread throughout the building.
- Negative air pressure within the enclosure must be established before any work is performed.
- Negative air pressure must be maintained at all times during Type-3 removal.

What will happen if there is a power failure?

- In the event of a power failure, the negative air unit will stop running. This means that the enclosure will no longer be under negative air pressure.

- If this happens, do the following:
 - ❑ Stop working immediately.
 - ❑ Leave the work area through the designated exit.
 - ❑ After you leave the enclosure seal the entrance way, exits or any other opening in the enclosure with plastic and tape.
 - ❑ Do not open the door to the enclosure. Remember, without negative air pressure, dust could get out of the enclosure and contaminate adjacent areas with asbestos.

Leave the negative air unit in the on position even though it is not running. When the power is reestablished, the enclosure will again be under negative pressure without anyone having to open a door.



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