

Alberta Asbestos Abatement Manual

October 2012



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Prepared by
Human Services
October 2012





ALBERTA

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Printed copies of the Occupational Health and Safety Code Explanation Guide are available in print from:

Alberta Queen's Printer
5th Floor, Park Plaza
10611 - 98 Avenue NW
Edmonton, AB T5K 2P7
Phone: 780-427-4952 Fax: 780-452-0668
www.qp.alberta.ca

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Scope of this Manual

This manual describes the principles to be followed when selecting the most appropriate techniques for the safe abatement of asbestos-containing materials. The manual also presents basic information on asbestos and asbestos products, health hazards, requirements for worker protection, safe work procedures, inspection criteria, applicable legislation and competency profiles for those persons involved in abatement activities.

Work practices and precautions vary considerably with the type of material being removed, the amount of asbestos it contains, its condition and location. The objective of this manual is to present best practices in asbestos abatement that are to be followed in Alberta.

Occupational Health and Safety officers from Human Services use this manual as a guide when reviewing abatement work practices and employer codes of practice. Practices are assessed against those presented in the manual to determine if they meet the intent of the province's occupational health and safety legislation. Alternate practices are acceptable if they provide workers with a level of safety equal to or greater than those practices presented in this manual.

Glossary of terms

Abatement — procedures to encapsulate, enclose or remove asbestos-containing material.

Aggressive Sampling — air sampling that takes place while air is physically circulated to produce a “worst case” situation. This type of sampling takes place after final clean-up.

AIHA — American Industrial Hygiene Association.

Air-line Respirator — a supplied air respirator through which breathable air is delivered to the worker via an air line. Air is supplied from a compressor or compressed air cylinder.

Airlock — a device allowing movement of persons from one room to another while permitting minimal air movement between those rooms. Curtained doorways are typically constructed by placing two overlapping sheets of plastic over an existing or temporarily framed doorway, securing each sheet along the top of the doorway, securing the vertical edge of one sheet along one vertical side of the doorway and securing the vertical edge of the other sheet along the opposite side of the doorway. The door flaps must be constructed to allow make-up air to flow into the containment area. Two curtained doorways spaced a distance apart form an airlock.

Air Monitoring — the process of measuring airborne fibre levels in a specified area over a period of time. This involves drawing a known volume of air through a filtered cassette with an effective pore size, counting the fibres that collect on the filter and expressing the result as fibres per cubic centimeter (f/cc).

Air Purifying Respirator — a respirator that filters air inhaled by the respirator wearer. Air is exhaled through a valve in the bottom of the respirator.

Amended Water — water that is used during asbestos removal to reduce airborne fibre generation. This water has a non-ionic surfactant added to it which allows for more thorough wetting of asbestos fibres by reducing the water’s surface tension.

Asbestos — a generic name given to a number of naturally occurring hydrated mineral silicates. These silicates are incombustible, separate into fibres and have a unique crystalline structure.

Asbestosis — a fatal lung disease caused by the inhalation of high concentrations of asbestos fibres, leading to a build-up of scar tissue around the fibres. It is a chronic lung disease with symptoms that include coughing, weight loss and difficulty in breathing.

Asbestos Waste — discarded materials from which there is a reasonable chance that asbestos might be released and become airborne, and includes disposable protective clothing that has been used in a restricted area.

Aspect Ratio — the ratio of the length of a fibre compared to its width.

Atmosphere Immediately Dangerous to Life or Health — an atmosphere that poses an immediate threat to life, immediate or irreversible adverse effects on health, or acute eye exposure that would prevent escape.

Bulk Sample — a representative sample taken of any material that is suspected of containing asbestos.

Clean Room — the uncontaminated area of a decontamination facility in which workers change into their disposable clothing and back into their street clothes. It is adjacent to the shower room and opens to the outside of the decontamination facility.

Contaminated Item — any object that has been exposed to airborne asbestos fibres without being sealed off, isolated or cleaned.

Decontamination Facility — an area constructed to prevent the spread of asbestos fibres beyond the work area. It is a series of rooms consisting of a dirty room, shower room, equipment transfer area and clean room. Decontamination facilities may be constructed for personnel leaving the work area or wastes that must be removed from the work area.

Dirty Room — a room adjacent to the containment area where workers dispose of waste or remove personal equipment before entering the shower room.

DOP Testing — testing of equipment fitted with HEPA filters such as vacuum cleaners and negative pressure units after filter installation has been completed. An aerosol of Dioctyl Phthalate (DOP) is introduced on the upstream side of the HEPA unit and if aerosol particles are detected on the downstream side, the unit is shut down and inspected and/or repaired. The particles generated are 0.3 micrometres in diameter or larger. The test is used to determine whether there are imperfections in the filter or in the seal between the filter and the cabinet frame. Where signs of leakage in excess of 0.03 per cent are detected with a photometer, the filter must be repaired or changed and equipment retested.

Emery 3004 — a compound (a poly-alpha olefin) that may be substituted for DOP in HEPA filter testing.

Encapsulation — the process of coating asbestos-containing materials to control the release of asbestos fibres into the ambient air. A sealant is applied that hardens the material (penetrant sealant) and/or provides a protective cover (bridging sealant).

Enclosure — procedures taken or a structure built to completely seal asbestos-containing materials behind airtight, impermeable, permanent barriers.

Equipment and Waste Transfer Section — allows for the removal of asbestos waste material and contaminated equipment. This section can include a dirty room, a holding room and a transfer room. The section can be part of the decontamination facility.

Exposed Worker — a worker who may reasonably be expected to work in a restricted area during at least 30 work days in a 12-month period.

Filter Cassette — an apparatus used to collect air samples for airborne fibre counting, consisting of a 25 mm diameter filter and a 0.45 to 1.2 micrometer cellulose ester membrane that traps the fibres.

Fogging — a procedure used to minimize airborne fibre concentrations in the containment area by using a low pressure atomizing spray.

Friable Material — material that can be crumbled by hand. The more friable the material, the greater the potential hazard due to fibre release.

Glove Bag — a clear polyethylene plastic bag with attached long-sleeve gloves. It is designed to permit the removal of insulation on pipes and pipe fittings.

Heat Cramps — a heat stress condition that causes painful involuntary spasms of heavily used muscles, most commonly of the abdomen and extremities. This form of heat illness is probably the result of an imbalance in the body's fluid level and electrolyte concentrations. Heat cramps can be prevented by drinking copious amounts of water and increasing daily salt intake through the foods eaten.

Heat Exhaustion — a heat stress condition resulting from dehydration and inadequate fluid intake that compromises blood circulation and is usually accompanied by fatigue, nausea, headache, giddiness, clammy skin and pale appearance.

Heat Stress — any of the disorders associated with exposure to excessive heat.

Heat Stroke — caused by the loss of the body's ability to cool itself through sweating. It is the most serious of the heat stress disorders and requires immediate medical attention. Some of the symptoms are hot dry skin, dizziness, nausea, severe headache, confusion, delirium, loss of consciousness, convulsion and coma.

HEPA Filter — a High Efficiency Particulate Air Filter. HEPA filters are used in both respirators and air handling equipment. The filters have a minimum particulate removal efficiency of 99.97 per cent for thermally generated mono-dispersed DOP aerosol particles with a diameter of 0.3 micrometers and a maximum pressure drop of 1.0 inch water gauge when clean and operating at their rated airflow capacity.

Homogeneous — evenly mixed and similar in appearance and texture throughout.

Negative Air Pressure System — reduced air pressure within the work area compared to the ambient air pressure, produced through the use of negative air units. Reduced pressure in the work area prevents leakage of contaminated air out of the work area. Airborne fibres will tend to be trapped by the HEPA filter equipped filtration system instead.

Negative and Positive Pressure Fit Check — a method of testing a respirator's facepiece-to-face seal by covering the inhalation or exhalation valves and either breathing in or out to determine the presence and location of leaks.

NIOSH — the National Institute for Occupational Safety and Health. It is the United States-based approval agency for respiratory protective equipment and methods of analyzing air samples.

PF — protection factor as provided by a respirator.

Phase Contrast Microscopy (PCM) — a method used to determine the airborne fibre concentration in sampled air. A segment of the sampling filter is mounted and then analyzed using a phase contrast microscope at 400X to 500X magnification. Any fibres meeting the 3:1 aspect ratio that are greater than five micrometers in length are counted.

Plural Mesothelioma — a disease mainly associated with asbestos. It is an inoperable and fatal form of cancer of the lining of the lungs.

Powered Air Purifying Respirator (PAPR) — a full-face mask into which filtered air is pumped at approximately 100 – 150 litres per minute (four - six cubic feet per minute). The PAPR consists of a full-face mask, a battery pack, an air pump, high efficiency filter and hoses.

Qualitative Fit Test — a method of testing a respirator's facepiece-to-face seal by injecting an agent such as isoamyl acetate, saccharin or Bitrex™ inside a test chamber (enclosure head), or irritant smoke around the facepiece and subjectively determining whether the wearer detects the agent.

Quantitative Fit Test — a method of testing a respirator's facepiece-to-face seal using instrumentation that quantifies the actual protection factor provided by the respirator.

Removal — procedures necessary to strip asbestos-containing materials from designated areas and to then dispose of these materials at an acceptable site.

Respirator — personal protective equipment that protects a worker against the inhalation of airborne contaminants providing it is the correct type of respirator and is worn properly.

Restricted Area — an area of a work site where there is a reasonable chance of the concentration of airborne asbestos exceeding the eight-hour Occupational Exposure Limit.

SCBA (Self Contained Breathing Apparatus) — respirator that provides breathing air from a compressed air cylinder, usually located on the wearer's back.

Shower Room — part of a decontamination facility, this room is situated between the clean room and the dirty room and contains a walk-through shower.

Surfactant — substance added to water to reduce the water's surface tension. The surfactant allows for more thorough wetting of asbestos-containing materials.

Tear Down — the procedure involving final dismantling of the work area and decontamination facility.

Transmission Electron Microscopy (TEM) — an analytical procedure used to determine asbestos fibre concentrations. Compared to phase contrast microscopy, it has more resolving power and can be used to positively identify asbestos fibres.

Chapter 1 Asbestos and Asbestos-Containing Materials

1.1 Introduction

Asbestos is the common name given to a group of naturally occurring mineral silicates that can be separated into flexible fibres. The name asbestos comes from the Greek word meaning “unquenchable or indestructible.” There are two main mineralogical classifications of asbestos — serpentines and amphiboles — based on the rock types which form the asbestos. Each classification is further sub-divided as follows:

Serpentine Asbestos

- Chrysotile

Amphibole Asbestos

- Amosite
- Crocidolite
- Fibrous Tremolite
- Fibrous Anthophyllite
- Fibrous Actinolite

The serpentine family consists of only chrysotile or “white” asbestos. It is a hydrated magnesium silicate having long wavy fibres that are white or off-white.

Within the amphibole family, only amosite and crocidolite have had significant commercial use. Amosite is often called “brown” asbestos and has much straighter and shorter fibres than chrysotile. Crocidolite is referred to as “blue” asbestos and has long straight fibres much like amosite.

Asbestos is found in veins in the host rock and is produced in a commercially useful form by open pit mining and successive stages of crushing and aspiration of the ore. The fibres are then sealed in plastic bags for use in the manufacture of products containing asbestos. The Chrysotile form accounts for approximately 90 per cent of current world consumption.

1.2 Uses of asbestos

The main properties that make asbestos useful are its incombustibility, strength and flexibility when separated into fibres. It is also effective as a reinforcing or binding agent when combined with cement or plastic.

Many products which at one time contained asbestos are either no longer in use or have been replaced. The uses for asbestos ranged from products in which the fibres were well bound to friable products in which the fibres could easily become airborne. The construction industry was the main user of asbestos products. Sprayed insulation, stucco and joint cements manufactured in Canada and the United States no longer contain asbestos in an unbound form.

Building materials containing asbestos in a bound form are typically found in the following locations and products:

Building exteriors

- asbestos cement siding panels – flat, corrugated, shingles or accent panels
- asbestos cement soffits – flat or perforated panels
- asbestos cement roof panels – corrugated
- roofing felts and mastics
- building overhangs – thermal spray
- stucco
- brick and block mortar
- loose fill insulation in exterior wall cavities (vermiculite)

Flooring

- vinyl asbestos tiles (VAT)
- sheet vinyl flooring (asbestos paper backing)
- floor leveling compound

Ceilings

- t-bar ceiling tile
- asbestos cement ceiling tile
- acoustic and stippled finishes
- plaster or drywall jointing materials

Walls

- plaster or drywall jointing materials
- stippled finishes
- thermal spray
- asbestos cement panels

Service areas

- insulation in boiler rooms — boilers, vessels, pipes, ducts, incinerators, floors, ceilings, walls
- fan rooms — insulation on pipes, ducts, chillers, floors, ceilings, walls
- machine rooms — insulation on pipes, ducts, floors, ceilings, walls
- crawl spaces — insulation on pipes, ducts
- wall cavities, insulation above ceiling spaces — pipe and duct chases, pipes, ducts

Structural

- fireproofing spray on beams, decks, joists, columns and other structural members

Pipes (insulation on either exposed or concealed pipes)

- steam and hot water heating supply and return lines
- domestic water supply and drain lines
- chilled water lines
- rain water and sanitary lines — asbestos cement or bell and spigot cast iron, insulated or bare pipe
- gaskets in flanged pipe joints

Miscellaneous

- incandescent light fixture backing
- wire insulation
- fume hoods — internal linings and exhaust ducts
- lab counters
- elevator brake shoes
- heating cabinet panels (asbestos cement)
- fire dampers and fire stop flaps
- diffuser backplaster
- emergency generators — thermal insulation and exhaust manifolds
- firestopping
- theatre curtains
- welding blankets and screens
- incinerators — internal insulation
- cooling towers — panels and fill
- duct tape
- duct expansion/vibration isolation joints

Building products containing asbestos in an unbound or loosely bound form include:

- insulating cements
- sprayed insulation — fire resistant, acoustic, thermal, condensation control
- insulation block — magnesia or calcium silicate
- textiles — not saturated, for lagging, curtains or clothing

- vermiculite insulation (may contain tremolite asbestos as a contaminant) – produced from the Libby, Montana mine by W.R. Grace and Company and known by the brand name “Zonolite”.

The list of products containing asbestos which are used in applications other than construction include:

- bound-fibre products
- brake linings, brake blocks, clutch facings
- gaskets, packings
- plastics
- textiles and catalyst supports
- non-bound fibre products such as millboards and papers
- some electrical insulation and filters or filter aids

Non-friable products which may contain asbestos pose little danger of releasing airborne fibres unless they are cut, broken, sawn, ground, sanded or are in deteriorating condition.

1.3 Friable sprayed products used in buildings

One product that is usually friable and a major cause of concern in buildings is asbestos-containing sprayed-on acoustic or thermal insulation. A good measure of a product’s potential hazard is its friability. A very friable material easily crumbles with hand pressure; a less friable material cannot be crushed with hand pressure. The more friable the material, the more likely it is to release fibres into the air.

Asbestos was introduced into North America for acoustical and decorative use in hotels and restaurants. In 1950, the U.S.- based Underwriters’ Laboratory gave approval for the use of asbestos as a fibrous spray for fireproofing. It was widely used for the fireproofing of structural steel, components of high-rise office and public buildings, and in auditoriums, hallways and classrooms of school buildings. The use of asbestos-containing spray products was widespread until approximately 1972, although the use of several acoustic products containing asbestos continued after this date.

As a general rule, this asbestos-containing sprayed-on insulation contained chrysotile, amosite or amosite/chrysotile combinations. The use of crocidolite in sprayed applications was small, largely due to cost, geographical location and availability. The concentration of asbestos can vary greatly within one installation due to the method of application.

The formulation of sprayed-on insulation depends to some extent on the method of application. There were two main methods of application — the wet method and the dry method. The extent of the problems associated with the insulation at a particular site is determined by the method of its application and the skill of the person applying the product.

Wet method

With the wet method, asbestos (generally five to 30 per cent by weight of the total formulation), mineral wool and/or fiberglass were mixed with Portland cement or gypsum as cementitious binders in a slurry. This material tended to be more dense and therefore less likely to crumble than similar materials applied dry. With the slurry-cementitious product, maximum application thickness was usually 20 to 25 mm ($\frac{3}{4}$ to one in), with most applications being six to 13 mm thick ($\frac{1}{4}$ to $\frac{1}{2}$ in). The surface was often trowelled following spray application producing a dense, hard surface. Most acoustic or texture sprays were applied by the wet method.

Dry method

The dry method used a dry blend of asbestos fibres (anywhere from five to 90 per cent of the total weight) and mineral wool or fiberglass, some Portland cement or gypsum, water soluble resins, starches and possibly other additives. These materials were blended in a hopper on site and then forced through a hose to the application surface. As the dry blended asbestos-containing material left the nozzle, it passed through a ring of water jets which converged several centimetres from the end of the nozzle. This wetted the dry blended material and activated the water-soluble binders, producing a wet fibrous mix that easily adhered to the application surface. It was usually applied in a layer 13 to 63 mm thick ($\frac{1}{2}$ to 2 $\frac{1}{2}$ inches).

Products and condition

The trade names of some sprayed on insulation products which contained asbestos include:

Wet-applied (cementitious)

- Kilnoise Plaster
- Cafco — Soundshield
- Monokote — MK III
- Audicote
- Sabenite

Dry-applied (fibrous)

- Asbestos-spray
- Limpet
- Spraycraft
- Cafco — Type D
- Cafco — Type I
- Cafco — Heat Shield
- Cafco — Blaze Shield
- Spraydon Type J

These materials were used in applications ranging from fully exposed in factories, partially hidden for architectural effect, or fully enclosed behind suspended ceilings. The materials may be found on beams, beams and columns, or beams and decks. The material may be in good condition or may be flaking badly. It may have a hard or solid surface but be very soft beneath the skin. The materials may have become damaged by maintenance or renovation activities or water. The applications may range in thickness from almost no measurable thickness to 75 mm (three in). The materials may be extremely well coated with a layer of dirt behind a suspended ceiling or be completely open in a room and susceptible to damage by direct contact.

1.4 Pipe or boiler insulation

Asbestos-containing materials have been used extensively in thermal mechanical insulation because of their excellent insulating properties. Trade names of pre-formed products used in pipe insulation that may contain asbestos include:

- John Manville (JM) and Newalls 85 per cent magnesia block or pipe covering and cements
- JM Suprex blocks (diatomaceous silica)
- JM Thermobestos block (calcium silicate)
- JM Marinite (diatomaceous silica and binders)
- JM Asbestocell
- JM and Atlas Spongfelt pipe covering
- JM Thermo-wrap, Thermo-tape
- JM Asbestos-sponge
- JM Fibrofil (diatomaceous earth)
- Atlasite pipe covering and sheet block (almost pure amosite, some inorganic binders)
- JM Newtherm
- Newalls Newtempheit pipe covering and blocks and cement (diatomaceous silica and long-strand asbestos)
- Atlas Aircell pipe and tank covering sheets and blocks

- Atlas Finecell pipe and tank covering sheets and blocks
- Rope lagging from JM, Atlas and others
- Owens Corning Kaylo

Asbestos material that can be formed in place was frequently used to complete irregular sections around valves, elbows and fittings or to provide additional strength over fiberglass insulation on pipes or ducts. This material is frequently called asbestos-cement, asbestos insulating cement or blue mud. It may be used with other asbestos-containing insulations or is frequently found combined with fiberglass pipe insulation on straight runs of piping. Trade or product names of typical materials include:

- JM 302 and 352 insulating cements
- Atlas 650, 660, 250, 28, 18
- Cold water paste from a variety of manufacturers

This wide range of asbestos-containing products and the variety of their appearances means it is impossible to confirm by eye, or from building plans, if a product contains asbestos. The only way to be sure is to have the product properly analyzed in a laboratory.

1.5 Assessing health and exposure risk

Asbestos must be inhaled to cause disease. Intact and undisturbed asbestos presents no direct health hazard but does present a potential exposure hazard should fibres be released and inhaled. As a result, there is some risk associated with all asbestos installations.

The health risk is considered minimal for asbestos materials in good condition in an inaccessible location and protected from damage. Where damage can be controlled or prevented, managing the exposure risk is often the most cost-effective control measure. Where damage or disturbance cannot be controlled, or where deterioration is due to uncontrolled natural causes, management of the exposure risk is very difficult.

The use of air monitoring of occupied areas is not considered an acceptable method to determine whether or not asbestos-containing materials must be removed, enclosed, encapsulated or may be left as is (with a management system). Air monitoring alone is insufficient to determine the potential health and exposure risk since asbestos fibres cannot usually be detected above background levels unless the material is disturbed in some way. Additional criteria are needed to determine the risk of exposure or the need for removal.

Examples of materials that cannot be effectively managed include:

- (a) materials in air handling systems where air movement can break down or erode the material;
- (b) materials that are damaged by water or vibration;
- (c) materials that are easily accessible to the general public and may be damaged by accident or through vandalism; and
- (d) friable materials in proximity to maintenance activities.

1.6 Exposure Assessment Algorithm

There are eight major factors which assist in evaluating the condition of a particular asbestos installation. Assessment and determination of health risk should be conducted by competent personnel, trained in the evaluation of potential asbestos exposure risk.

(1) Condition of Material

The condition of the asbestos-containing materials may indicate how easily fibres can cause contamination by being released into the area. An assessment of the condition considers the quality of the installation, adhesion of the material to the underlying substrate, deterioration, vandalism and/or damage.

(2) Water Damage

Water can dislodge, delaminate and disturb friable asbestos-containing materials that are otherwise in good condition. Water can carry fibres as a slurry to other areas where evaporation leaves a collection of fibres that can be released into the air.

(3) Exposed Surface Area

The exposed surface area of friable material affects potential fibre fallout levels and the possibility for contact and damage. Visible friable material is considered to be exposed.

Maintenance personnel frequently access the space above suspended ceilings to service or maintain electrical or communications equipment, or adjust the ventilation system. In most cases, this space is considered an exposed surface. Areas with louvres, grids or other open ceiling systems should be considered exposed.

(4) Accessibility

Accessibility is one of the most important indicators of exposure potential. If the asbestos-containing material can be reached, it is accessible and subject to accidental or intentional contact and damage. Friable material is considered accessible if it is close to heating, ventilation, lighting and plumbing systems requiring maintenance or repair.

In schools, the behaviour of the student population should be considered in evaluating accessibility. Damage is the most obvious factor. For example, students involved in sport activities may accidentally damage material on the walls and ceiling of a gymnasium. Material that is easily accessible is also subject to damage by vandalism.

(5) Activity and Movement

This factor combines the effects of general causes that may result in contact with, or damage to, friable material. These causes include air movement, maintenance activities, vibration (from machinery or other sources) and activity levels of students or building workers. This factor is also an indication of the potential for future exposure.

(6) Air Distribution System

According to the OHS Code, asbestos materials may not be located in supply or return air plenums in a form in which or location where asbestos fibres could enter the air supply or return air systems. Action is required by building owners if asbestos-containing materials are found in these areas.

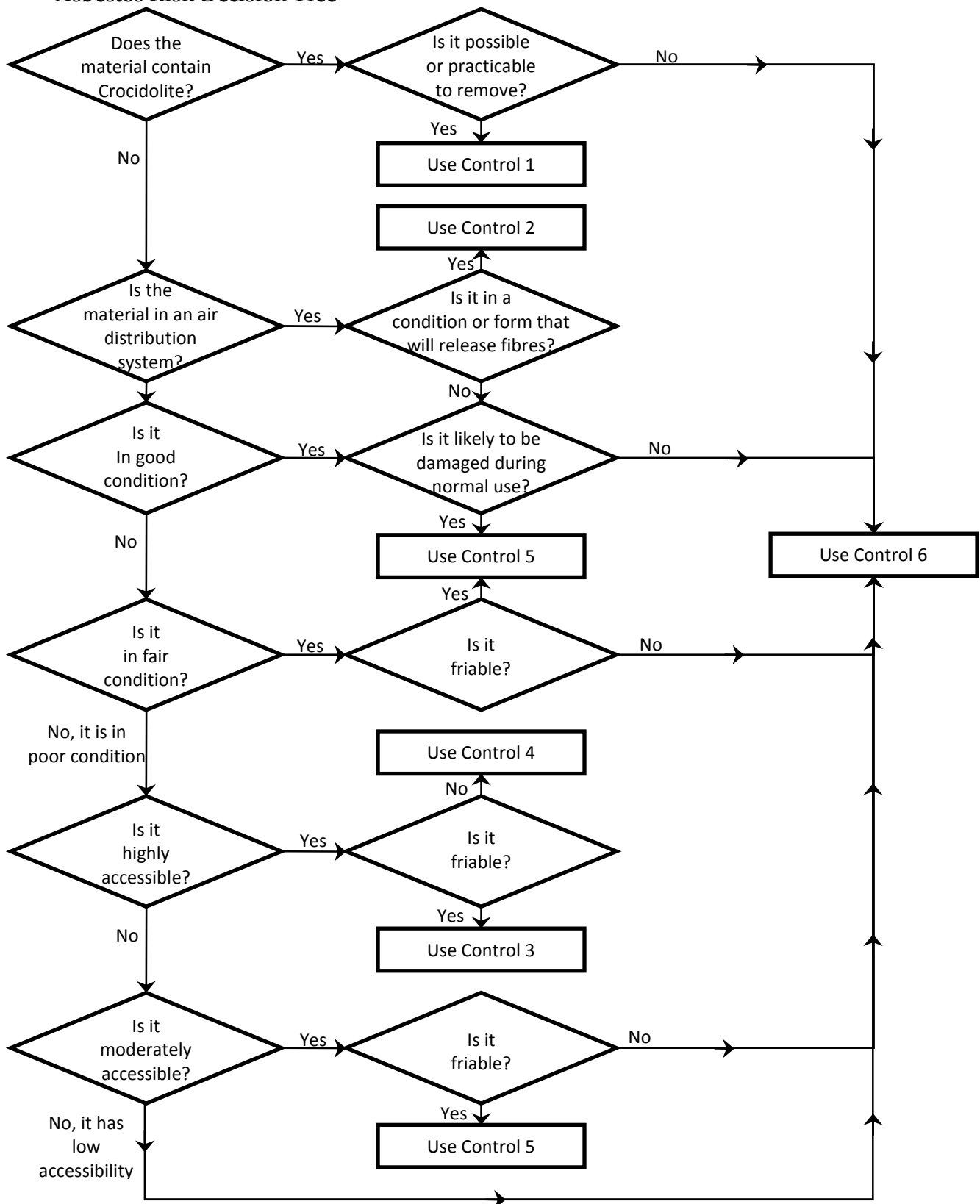
(7) Friability

The easier the material can be crumbled, the more friable the material and the greater the potential for asbestos fibre release and contamination. Sprayed asbestos material is generally more friable than most trowelled materials or mechanically installed insulation.

(8) Asbestos Content

To calculate total asbestos content, the percentage content for each type of asbestos present in a given sample should be summed. While all asbestos-containing materials present an exposure potential, those with a high percentage of asbestos content can release more fibres.

Asbestos Risk Decision Tree



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Asbestos Risk Decision Tree Legend

Good Condition

- No significant signs of damage, deterioration or delamination.

Fair Condition

- Mild to moderate damage deterioration or delamination.

Poor Condition

- Severely damaged, deteriorated or delaminated.

High Accessibility

- Can be touched or contacted through activities (routine or accidental) by all building users.

Moderate Accessibility

- Accessible in low activity areas or beyond the reach of most occupants (with the exception of maintenance staff).

Low Accessibility

- Enclosed or concealed; requires the removal of a building component, including lay in ceilings and access panels into solid ceiling systems. Includes rarely entered crawl spaces, attic spaces, etc.

Control 1

- Immediate removal of material is required as per Section 32 of the OHS Code.

Control 2

- Immediately prevent the asbestos fibres from entering the air distribution system through changes to the system, removal, clean up and/or repair as per Section 33 of the OHS Code, and if not ultimately removed, implement an Asbestos Management Plan (Control 6).

Control 3

- Immediately restrict access to the area and prevent air movement. Remove or clean up and/or repair. If not ultimately removed, implement an Asbestos Management Plan (Control 6).

Control 4

- Immediately restrict access to the area. Remove or clean up and/or repair. If not ultimately removed, implement an Asbestos Management Plan (Control 6).

Control 5

- Schedule removal or clean up and/or repair in a reasonable time frame and if not ultimately removed, implement an Asbestos Management Plan (Control 6).

Control 6

- Implement an Asbestos Management Plan. The Plan should be in writing and include the following:
 - (a) inventory of asbestos-containing materials in the building;
 - (b) inspection frequency and procedures;

- (c) training requirements for maintenance staff and others who may come into contact with the materials or work in proximity to the materials;
- (d) procedures to follow in the event of damage or other emergency situations;
- (e) procedures to follow should the condition of the materials change or work routines be altered;
- (f) notification procedures for occupants and others in the building;
- (g) labeling of asbestos-containing materials; and
- (h) a plan for ultimate removal of asbestos.

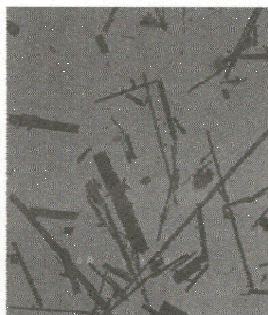
Chapter 2 Health Effects Associated With Exposure to Asbestos

2.1 Physical characteristics of asbestos

Asbestos fibres, unlike man-made fibres such as fiberglass, can be split into thinner and thinner fibres parallel to their length. At their finest, the fibres can hardly be seen by the best optical microscope. The average diameter of an airborne asbestos fibre ranges from 0.11 to 0.24 micrometres, depending on the type of asbestos. By comparison, a human hair is approximately 75 micrometres in diameter (more than 300 times thicker) and a glass fibre ranges between three to 15 micrometres in diameter. Seen under a microscope, chrysotile asbestos has a very curly nature, similar to a wavy string or thread. Amosite and crocidolite forms of asbestos are very straight and rod-like, reflecting their solid structure.



Chrysotile (Serpentine)



Amosite (Amphibole)



Crocidolite (Amphibole)

These fine fibres tend to settle very slowly in air. The aerodynamics of settling are determined by the mass, form (particularly the diameter) and orientation of the fibre. If any air turbulence is present, the fibre may not settle out or can easily re-enter the air stream after it has settled.

2.2 Entering the lungs

Asbestos-related diseases are caused by asbestos fibres that are inhaled and settle in the lungs. Once embedded in lung tissue, the fibres may remain within the body for extended periods. Amphiboles, because of their physical properties, remain embedded for a very long time.

How far asbestos fibres penetrate into lung tissue depends on their length, diameter and shape. Longer fibres are screened more effectively by the nasal hairs. Inside the upper respiratory tract, fibres are deposited either by simple gravity or through impact at points where the air stream changes direction. The size of the deposits depend on both fibre diameter and fibre length.

2.3 Health effects from occupational exposure

The hazardous effects of asbestos were recognized as early as the first century A.D., when Pliny the Elder, the Roman naturalist, and Strabo, the Greek geographer, wrote of a sickness of the lungs of slaves involved in weaving asbestos cloth. Asbestosis was first identified in 1930, but the cancer-producing potential of asbestos was not established until 1949. That year a report described higher than normal percentages of lung cancer among individuals dying from asbestosis. It was not until 1960, with the publication of a series of cases in South Africa, that the association between malignant plural mesothelioma (a cancer of the lining of the lungs) and asbestos exposure was generally recognized.

2.3.1 Asbestosis

Asbestosis is a condition associated with exposure to high concentrations of airborne asbestos. It is an irreversible, fatal disease. The lungs build up scar tissue around the fibres in an attempt to remove them. This causes lung tissues to stiffen and leads to symptoms of coughing, difficulty in breathing, weight loss and eventually death. The disease is similar to silicosis and “black lung”, diseases associated with work in mines.

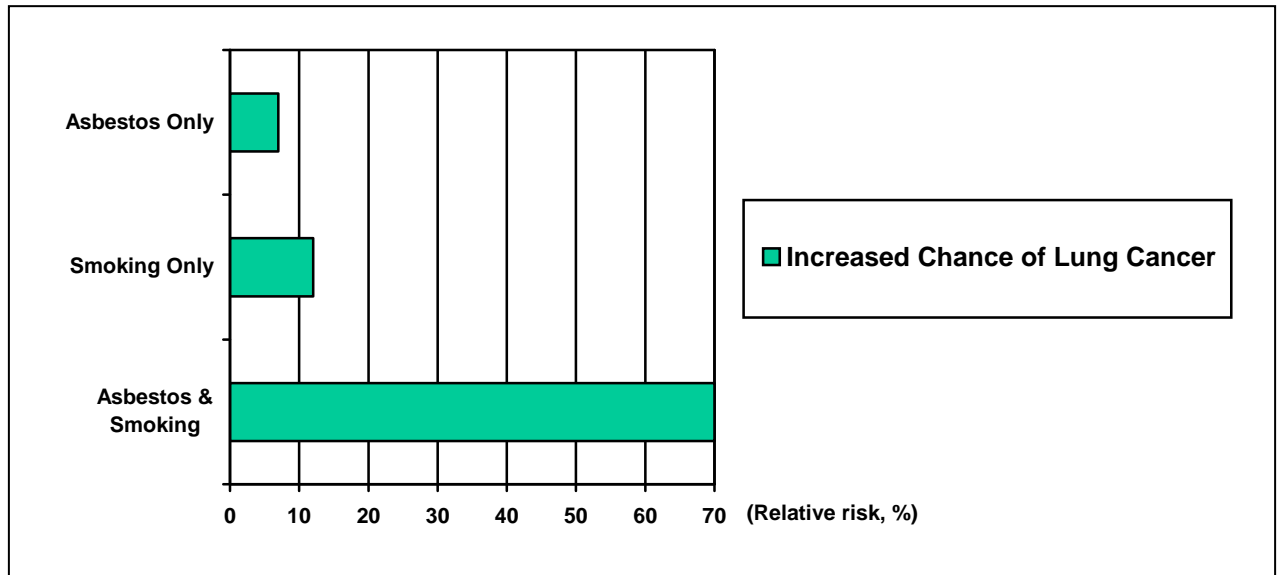
Once established, asbestosis is an untreatable condition. While elimination of further exposure to asbestos will not stop or reverse the disease, it will help to slow down the rate at which the disease progresses. Early symptoms of the disease — shortness of breath, often accompanied by a dry cough — usually develop 10 to 20 years after initial exposure.

2.3.2 Lung Cancer

Lung cancer takes approximately 15 to 25 years to develop, depending on the frequency and duration of exposure. Exposure to asbestos fibres for four to six months may be sufficient to cause lung cancer.

The combination of smoking and occupational asbestos exposure is extremely hazardous. Dr. Irving J. Selikoff, a medical leader in the study of asbestos-related disease, produced the figures shown in Figure 1.

Figure 1 Risk of lung cancer caused by the combination of smoking and asbestos exposure



2.3.3 Pleural and Peritoneal Mesothelioma

Malignant mesothelioma is a rare type of cancer affecting seven to eight persons per million population. Research has shown that exposure to asbestos increases the risk of mesothelioma of the pleura, the membranes that line the lungs, and of the peritoneum, a membrane which lines the abdomen.

Malignant mesothelioma has no effective treatment and is always fatal. One half of all patients die during the first year following diagnosis; few patients survive longer than two years.

Development of the disease does not appear to be related to the amount of asbestos inhaled. Some susceptible individuals develop the disease following exposure in non-occupational settings. Development of the disease has been found to occur in individuals exposed to asbestos for as little as two months, and for as long as 50 years. The latency period between exposure to asbestos and the onset of terminal illness ranges from 15 to 55 years, with a mean of 40 years for both long- and short-term exposures.

2.3.4 Other cancers related to asbestos exposure

Other cancers related to asbestos exposure include cancer of the larynx, trachea, stomach, colon and rectum. While these types of cancer are much rarer than asbestos-induced lung cancer, their true incidence is unknown. However, autopsies do show the presence of asbestos in the cancerous tissues.

Chapter 3 Legislation

3.1 History of prohibitions on asbestos use in Canada and Alberta asbestos legislation

Overall, asbestos has not been banned for use in Canada. However, there are restrictions on the use or sale of certain products, both under federal legislation and under Alberta legislation.

3.1.1 *Hazardous Products Act*

This is a piece of federal legislation that regulates the sale and use of some asbestos products in Canada. Historically, the *HPA* listed a number of asbestos products that were “prohibited products” (could not be sold or imported for sale into Canada):

- Textile fibre asbestos designed to be worn by a person other than those for protection against fire or heat hazards and are constructed in a way that ensures that asbestos fibres will not become separated from the product when used as intended (date issued July 17, 1973).
- Products containing asbestos which are used by children for learning or play in which asbestos may become separated from the product (date issued June 1, 1976).
- Products for use in modeling or sculpture (date issued June 1, 1976).
- Drywall joint cements, compounds or spackling or patching compounds used in construction, repairs or renovations (date issued April 24, 1980).
- Asbestos products used to simulate ashes or embers (date issued April 24, 1980).
- Goods containing asbestos that are packaged as consumer products (date issued May 5, 1988).
- Spray applied asbestos products (date issued August 24, 1989).
- Products containing crocidolite (date issued October 5, 1992).

In 2007 the requirements that applied to asbestos products were revised and moved into the Asbestos Products Regulations. The *HPA* and Asbestos Products Regulations were amended again in 2011. The Regulation prohibits the importation, advertising or sale of:

- Asbestos products for use in modeling or sculpture.
- Asbestos products used to simulate ashes or embers.
- A product that is composed entirely of asbestos.

The following products, which may not contain crocidolite, may be used:

- A textile product worn on the person: May be used if it provides protection from fire or heat hazards and the person who uses the product in a reasonably foreseeable manner cannot come into contact with airborne asbestos fibres from the product.
- A product that is used by a child in learning or play: May be used if asbestos cannot become separated from the product.
- Drywall joint cement or compound, or spackling or patching compound that is used in construction, repair or renovation: May be used if asbestos cannot become separated from the product during its post-manufacture preparation, application or removal.
- Spray-applied products: May be used if the asbestos is encapsulated by a binder during spraying and the materials that result from spraying are not friable after drying.

With respect to crocidolite, the following products may be imported, sold or advertised as long as the product is not composed entirely of crocidolite, the person who uses the product in a reasonably foreseeable manner cannot come into contact with airborne asbestos during use and a warning label is applied to the product or its container that includes specified information:

1. Asbestos cement pipes.
2. Torque converters.
3. Diaphragms for chloralkali production.
4. Acid and temperature resistant seals, gasket, gland packings and flexible couplings.
5. A product that contains one or more of the above items.

A product that is composed entirely of crocidolite may be imported for the purposes of manufacturing items 3 or 4 as long as the manufacturer follows certain conditions.

3.1.2 Alberta Building Code

The Alberta Building Code is the provincial legislation that has specific prohibitions on the types of asbestos products that can be used in buildings. The Code also has provisions regarding when asbestos containing building products had to be removed or otherwise managed in buildings being demolished or renovated. These provisions have been transferred to the *Occupational Health and Safety Code*.

The dates when the Alberta Building Code provisions came into effect are as follows:

- March 1977 **Alberta Heating, Ventilating and Air Conditioning Regulations**
Supply and return air may not pass over surfaces containing asbestos except for the surfaces of fire stops. This provision was incorporated into the 1978 Alberta Heating, Ventilation and Air Conditioning Code.
- May 1981 **Alberta Building Code**
No product that has a potential for releasing asbestos fibres in a building may be installed apart from asbestos cement board and asbestos cement pipe (as long as the latter two were not used in a supply or return air system).
- June 1985 **Alberta Building Code**
Asbestos may not be used in air distribution systems or equipment in a form or location where asbestos fibres could enter the air supply or return systems.
- February 1987 **Standata 85-DR-009**
Alberta became a signatory to an International Labour Organization convention banning the spray application of asbestos products and products containing crocidolite.
- September 1991 **Alberta Building Code**
- A condition where there is a potential for asbestos fibres to be released in a building may be declared by the Director to be an unsafe condition.
 - The use of materials containing crocidolite is prohibited.
 - Spray application of asbestos products is prohibited.
 - In buildings being altered or renovated, any materials having the potential for releasing asbestos fibres in the area of alteration or renovation must be encapsulated, enclosed or removed.
 - In buildings to be demolished, materials having the potential for releasing asbestos fibres must first be removed.

3.1.3 Health and safety legislation for asbestos

1966

Regulations Respecting the Protection of Persons with Fibrosis of the Lungs (AR 186/66)

- Passed under the *Public Health Act*
- Amended AR 572/57 by inserting Division 25
- Health assessment requirements for anyone who may be exposed to a substance that causes fibrosis.

1971

Fibrosis of the Lungs (AR 375/71)

- Passed under the *Public Health Act*
- Health assessment requirements for anyone who may be exposed to a substance that causes fibrosis.
- Amended by AR 9/82 (some requirements related to silica added)
- Repealed by AR 243/83

1976

Occupational Health and Safety Act (Chapter 40, RSA 1976)

General Accident Prevention Regulation (AR 267/76)

- Passed under the *Occupational Health and Safety Act*
- Requirements for ventilation systems to ensure that exposure kept below the ACGIH TLVs.

1980

Occupational Health and Safety Act (Chapter 0-2, RSA 1980)

1982

Asbestos Regulation (AR 7/82)

- Passed under the *Occupational Health and Safety Act*
- Contained the health assessment requirements that had been in the fibrosis regulations.

Chemical Hazards Regulation (AR 8/82)

- Passed under the *Occupational Health and Safety Act*
- Contained OEL for asbestos fibres (2 f/cc for chrysotile, 0.2 f/cc for other forms of asbestos)

1988*Chemical Hazards Regulation* (AR 393/88)

- Contained revised OEL for asbestos fibres (0.5 f/cc for chrysotile, 0.2 f/cc for other forms of asbestos)
- Amended by AR 17/89 to add Schedule 2 (asbestos included in Schedule)

1992*Chemical Hazards Regulation* amended by AR 303/92

- Asbestos added to Part 3 of the Regulation
- Asbestos Regulation repealed.

1997*Chemical Hazards Regulation* amended by AR 169/97

- Amendments to Section 41
- Section 42 (worker registry) repealed.

2000*Occupational Health and Safety Act* (Chapter 0-2, RSA 2000)**2003***Occupational Health and Safety Regulation*

- Definitions for asbestos and restricted area and requirements for notifiable diseases.

2004*Occupational Health and Safety Code*

- Building code requirement moved to the OHS Code
- Revised OEL for asbestos, 0.1 f/cc for all forms

3.2 Occupational Health and Safety (OHS) Act

The *Occupational Health and Safety Act* is the Alberta law intended to protect the health and safety of workers on the job. Human Services (HS) is the government department responsible for administering the *Act*. HS does this by:

- consulting with employers and workers on the development of safe and healthy work practices and programs;
- conducting workplace inspections;
- investigating serious work-related incidents and injuries; and
- responding to concerns about health and safety conditions at Alberta work sites.

According to Section 2 of the *Act*, employers, workers, suppliers and contractors have the following responsibilities:

Employers

- ensure the health and safety of their workers and other workers present at the work site
- ensure that workers working for them are aware of their responsibilities and duties under the *Act* and regulations

Workers

- take reasonable care to protect their safety and the safety of other workers present at the work site
- cooperate with their employer to protect the health and safety of themselves and others at the work site

Suppliers

- ensure that the tools, appliances or equipment they supply are in safe operating condition
- ensure that any tool, appliance or equipment they supply complies with the *Act* and regulations

Contractors

- where a contractor directs the activities of an employer involved in work at a work site, the contractor must ensure that the employer complies with the *Act* and regulations at that work site

3.2.1 Occupational Health and Safety (OHS) Regulation

The *OHS Regulation* contains the definition for asbestos and a restricted area. A “restricted area” is an area of the work site where there is a reasonable chance that the airborne concentration of asbestos may exceed the Occupational Exposure Limit (OEL) for asbestos specified in the *Occupational Health and Safety (OHS) Code*.

Specific requirements in the *OHS Regulation* that apply to asbestos

- Asbestosis, mesothelioma and three forms of asbestos induced cancer are notifiable diseases. Where a worker is diagnosed with one of these diseases, their physician must notify the Director of Medical Services.
- Documentation required by the *OHS Regulation* or OHS Code, such as a code of practice for asbestos, must be in writing.

There are also general provisions that apply to all work sites:

- Equipment used at a work site must be properly maintained and used for the function it was intended. The employer must ensure that workers use or wear equipment required by the legislation.
- Workers must be competent: i.e. adequately qualified, suitably trained and with sufficient experience to safely perform work without supervision or with only a minimal degree of supervision, or under the direct supervision of a competent worker.
- The employer must ensure that workers be familiar with work procedures and be competent in the application, use, maintenance and limitations of equipment or protective equipment.
- Workers must report to the employer all equipment that is in a condition that may compromise the health and safety of workers using or transporting it, that is not functioning properly, is not strong enough for its purpose or has an obvious defect.
- Employers must provide workers with adequate training in the safe operation of equipment they use and workers must participate in the training and use the safe work procedures.
- If a worker may be exposed to a harmful substance at a work site, the employer must develop procedures to minimize the worker's exposure to that substance, provide training to workers on the procedures, and ensure workers follow the procedures. Workers must participate in the training and use of the procedures.

3.2.2 Occupational Health and Safety (OHS) Code

Part 4 of the OHS Code, Chemical Hazards, Biological Hazards and Harmful Substances, sets limits for exposure to chemicals, including asbestos. The portions of the OHS Code dealing specifically with asbestos identify the general duties of employers, requirements for health assessments, training and project notification. There are also other parts of the OHS Code that will also apply to abatement projects, depending on the work procedures and specific work site hazards.

Definitions

Definitions that deal specifically with asbestos include the following:

“asbestos waste” means material that is discarded because there is a reasonable chance that asbestos might be released from it and become airborne, including protective clothing that is contaminated with asbestos.

“exposed worker” means a worker who may reasonably be expected to work in a restricted area at least 30 work days in a 12-month period.

“restricted area” means an area of the work site where there is a reasonable chance that the airborne concentration of asbestos exceeds the Occupational Exposure Limit (OEL) under an adopted code (from the OHS Regulation, Section 1).

Employer’s general duties

Part 4 of the OHS Code requires employers dealing with asbestos to take appropriate steps to:

- (a) minimize the release of asbestos into the air, keeping work exposure as low as reasonably achievable/practicable, but never exceeding the OEL;
- (b) keep the work site clear of unnecessary accumulations of asbestos waste and materials containing asbestos;
- (c) ensure that decontamination of workers and materials does not result in release of airborne fibres;
- (d) label all asbestos waste as **“Carcinogenic — Do not inhale dust”**;
- (e) ensure that containers used to dispose of asbestos are sealed and impervious to asbestos;
- (f) provide a means to prevent workers’ street clothes from being contaminated;
- (g) ensure that only authorized persons enter a restricted area;
- (h) post signs around restricted areas warning of the hazards and keep the signs posted until the area is no longer restricted;
- (i) provide workers with, and ensure they wear, appropriate protective clothing and respirators; and
- (j) make sure that workers decontaminate themselves before leaving a restricted area.

Maximum allowable asbestos exposure levels

The occupational exposure limit for all forms of asbestos is 0.1 f/cc based on eight-hours of exposure. If workers may be working for more than eight hours, the exposure limit must be adjusted using the equation in section 18(1) of the OHS Code or by a method that uses recognized scientific principles and is approved by a Director of Occupational Hygiene.

For more information

 <http://humanservices.alberta.ca/documents/WHS-PUB-CH055.pdf>

The Effects of Unusual Work Schedules and Concurrent Exposures on Occupational Exposure Limits (OELs)

Monitoring for Airborne Concentrations of Asbestos Fibres

The legal requirements for monitoring on asbestos abatement projects are set out in the OHS Code, Sections 16, 20, 21 and 22. Under Section 16, an employer must comply with the OEL for asbestos (0.1 f/cc). Section 20 specifies the air monitoring methods to be used when collecting samples for the purposes of complying with the OEL. If a worker may be exposed to a harmful substance at a work site, Section 21 of the OHS Code obligates an employer to identify the health hazards associated with exposure and assess the worker's exposure. In other words, if a worker may potentially be exposed to asbestos at the work site when an asbestos containing material is disturbed (whether or not the employer knows that the OEL is being complied with), the employer must conduct monitoring to determine what the worker is exposed to. If a worker may be exposed in excess of the OEL, section 22 of the OHS Code requires the employer to take additional specific actions, in addition to conducting air monitoring. While the OHS Code does not specify how often monitoring must be done, generally some monitoring is needed for every asbestos abatement project, particularly for high risk projects (projects that are "restricted areas").

Worker training

The OHS Code requires that all workers who work with asbestos receive training necessary for them to perform their work safely. The employer must ensure that all workers who may enter a "restricted area" successfully complete an asbestos abatement course of at least two days duration. The course must be approved by Human Services. A list of the training agencies approved to provide the asbestos worker training course and issue Asbestos Worker Cards is available at the Occupational Health and Safety Web site <http://humanservices.alberta.ca/documents/WHS-EP-asbestos-agencies.pdf>.

The approved courses will not ensure that a worker is competent, as defined by the *OHS Regulation*, since competence is a mixture of training and experience. The course will require participants to become aware of the hazards associated with asbestos, as well as health and safety legislation. Practical sessions focus on worker protection, set-up of the work area and safe work practices. Each course concludes with an examination that requires an 80 per cent passing grade. Workers who successfully pass the course will receive an Asbestos Worker Card.

Workers must have their valid certification cards available at the work site when they are working. Occupational Health and Safety Officers may ask a worker to produce their original card plus appropriate identification.

The Asbestos Worker Card remains the property of Human Services can be revoked.

Workers involved in low and moderate risk abatement projects (work sites that are not restricted areas, see Chapter 5 of this manual) are not required to complete a two day asbestos abatement course and need not possess an Asbestos Worker Card. However, training must be provided that is appropriate to the level of worker involvement in the project in accordance with Section 15 of the *OHS Regulation*. The training should, at a minimum, contain the following elements:

- (a) health hazards associated with exposure to asbestos;
- (b) responsibility of workers, employers, contractors and suppliers under the *OHS Act*;
- (c) asbestos requirements in Part 4 of the *OHS Code*;
- (d) safe work procedures related to the work, see Chapter 5 of this manual, as appropriate;
- (e) how to properly wear, use and maintain personal protective equipment that will be used at the work site.

This training may be provided by a training agency or in-house by persons who are knowledgeable in the procedures and hazards associated with asbestos abatement.

For more information



<http://humanservices.alberta.ca/documents/WHSE-EP-asbestos-guidelines.pdf>

Information on the asbestos worker re-certification requirements can be found in Schedule E of the course guideline for the “Occupational Health and Safety for the Asbestos Worker”



<http://humanservices.alberta.ca/documents/WHSE-EP-asbestos-agencies.pdf>

The list of approved training agencies that administer re-certification exams

Worker health assessment

Each worker must undergo a health assessment within 30 days of becoming an exposed worker, and every two years thereafter. At the time the worker becomes an exposed worker, the worker’s employer is responsible for ensuring that the health assessment is done. The assessment must be conducted by a qualified physician and consist of a chest x-ray, including radiologist’s report, a pulmonary function test and worker’s work history.

The cost of medical testing and the time taken to undergo the tests must be borne by the employer. The worker may refuse the test by submitting a written refusal to the employer. Test records must be kept confidential unless the worker has given written permission for access by another person or the records are in a form that do not identify the worker.

For more information



http://humanservices.alberta.ca/documents/WHS-PUB_ch019.pdf

Asbestos at the Work Site – CH019

Code of practice

Asbestos is identified as a designated substance in the OHS Code. If there is more than 10 kg of pure asbestos, or asbestos-containing material that has more than 0.1 per cent asbestos by weight and the amount exceeds 10 kg, the employer must establish a code of practice governing the storage, handling, use and disposal of the asbestos. If there is a possibility that the fibres may be released in an uncontrolled manner, the employer must also establish a code of practice governing procedures to be followed to prevent uncontrolled release and procedures to be followed in the event of a release.

For the purposes of interpretation, a code of practice is not mandatory for materials containing less than one per cent asbestos by weight. This applies to the specific material, not the total waste. However, this does not apply if the material may create a restricted area when it is disturbed (e.g. vermiculite insulation contaminated with asbestos). Also, the employer is still responsible to complete the hazard assessment and identify situations where there is a potential for asbestos fibre release. In these situations, the employer must ensure that work procedures are in place and workers are appropriately trained on these procedures.

Notification of project start-up

Notification must be given to the Occupational Health and Safety province-wide Contact Centre at least 72 hours before workers may be exposed to airborne fibres. This includes the set-up operations that may release fibres such as the removal of barriers or partitions such as false ceilings behind or on which asbestos-containing materials may have accumulated. The OHS Contact Centre telephone number is 1-866-415-8690.

This notification must include the location of the work site, the start and completion dates, and a description of the work to be performed. An Asbestos Project Notification form (Form WHS 3910) must be completed and submitted to Occupational Health and Safety. The form is available by contacting the contact centre or printing the form from

the Occupational Health and Safety's web site. Receipt of the form will be acknowledged with an Asbestos Project Notification Acknowledgement form.

For more information



http://humanservices.alberta.ca/documents/WHs-PUB_whs3910.pdf

Asbestos Project Notification Form

Notification is required for all high, moderate and low risk projects. Projects requiring notification involve operations having the potential to release fibres from asbestos-containing materials. Although Human Services requires notification of all asbestos abatement projects, the Department is flexible regarding the 72-hour notification requirement where it can be demonstrated that there is a need to carry out the work immediately. An example of this type of situation would be the immediate removal of asbestos cladding on a ruptured pipe. Immediate action is justified to prevent damage to the building. However, delays in construction schedules resulting from the discovery of asbestos are not considered sufficient reason to reduce the notification period.

For ongoing routine maintenance work involving low or moderate risk activities, projects may be granted "extended project notification status" as long as workers are adequately trained and follow safe work procedures. Extended notifications may be granted for up to a year, depending on the employer's ability to plan in advance. Extended notifications will only be considered for low or moderate risk work.

Types of projects that do not require notification include:

- (a) inspection of asbestos-containing materials as part of a management plan or asbestos assessment project;
- (b) sampling of asbestos-containing materials or potential asbestos-containing materials as part of an asbestos assessment project. Sampling must be performed by trained personnel in a manner that minimizes disturbance and damage to the asbestos-containing materials;
- (c) removal and replacement of small (less than 30 centimeter diameter) manufactured asbestos products such as gaskets or valve packing;
- (d) short-term work in areas containing non-friable asbestos-containing materials that does not involve disturbing the asbestos-containing materials; and
- (e) transportation of asbestos-containing materials in sealed containers unless the materials are part of an asbestos abatement project.

In the above cases, employers must take precautions to ensure that asbestos fibres are not released. These types of projects must only be carried out by competent workers and in accordance with the requirements of the Part 4 of the OHS Code. Work procedures must be developed and followed to prevent potential asbestos exposure.

Asbestos in buildings

The following uses of asbestos are prohibited in new or existing buildings:

- (a) the use of materials containing crocidolite (blue) asbestos;
- (b) the use of asbestos-containing materials in a supply or return air plenum in a location or form that will allow asbestos fibres to enter the system;
- (c) the installation of a product that has the potential for releasing asbestos fibres in a building. Asbestos cement pipe and asbestos cement board are exceptions as long as they are not installed in a supply or return air plenum; and
- (d) the installation of asbestos by spray application.

In existing buildings where there is a potential for the release of asbestos fibres, an unsafe condition may be declared. In this case, the material must be removed, enclosed or encapsulated.

If an area within a building is being altered or renovated, materials that have the potential for releasing asbestos fibres in that area must be removed, enclosed or encapsulated. In buildings or parts of buildings that are being demolished, materials having the potential for releasing asbestos fibres must first be removed. These requirements are based on the potential for asbestos fibres to be released when the material is disturbed, not on the amount of asbestos in the material.

Historically, materials containing less than one per cent asbestos were not considered “asbestos containing materials” for the purposes of the OHS legislation. However, some materials, such as vermiculite insulation, can release significant amounts of asbestos fibres into the air, even when they contain very low levels of asbestos. Since the requirements in Part 4 of the OHS Code are based on the ability of a material to release asbestos fibres when disturbed, this interpretation was not consistent with the legislation.

The employer must comply with the asbestos requirements when:

- the individual material in question contains more than one per cent asbestos (by weight)
- the material contains less than one per cent asbestos, but it is known that a “restricted area” is likely to occur when it is disturbed (e.g. vermiculite)
- the material contains less than one per cent asbestos and there is a reasonable chance that asbestos fibres may be released when the material is disturbed, either due to the condition of the material or the work procedures that will be used (e.g. removal of friable stipple material, dry removal of wall and ceiling plaster or drywall where the materials contain low levels of asbestos).

Materials identified as containing less than one per cent asbestos such as drywall joint compounds and stipple may not have been uniformly mixed when they were applied and could contain asbestos in concentrations greater than one per cent in sections. When dealing with large quantities of such materials, employers should take non-homogeneous mixtures into consideration.

It is the responsibility of the employer to conduct a hazard assessment and evaluate the likelihood of asbestos fibre release based on the material in question and the work procedures. This assessment must be documented and may need to be supported with air monitoring data. If the material contains less than one per cent asbestos and the likelihood of fibre release is low, the product may be handled as a non-asbestos material.

OHS Code Part 29 - Workplace Hazardous Materials Information System (WHMIS)

This Part of the OHS Code applies to all work sites where controlled products are used, stored or made. The employer must

- provide material safety data sheets for the products,
- ensure that the products have WHMIS labels applied to the containers,
- ensure that workers receive WHMIS training that complies with section 397 of the OHS Code.

Controlled products are defined by federal legislation; i.e. *Hazardous Products Act* and *Controlled Products Regulations*. They are products that fall into one or more of six hazard classes:

- A Compressed Gas
- B Flammable and Combustible Material
- C Oxidizing Material
- D Poisonous and Infectious Material
- E Corrosive Material
- F Dangerously Reactive Material

Some products are covered by other federal legislation so the requirements for material safety data sheets and WHMIS labels do not apply. However the employer must still provide WHMIS training. These are

- explosives within the meaning of the *Explosives Act*;
- cosmetics, devices, drugs or food within the meaning of the *Food and Drug Act*;
- a control product within the meaning of the *Pest Control Product Act*;
- a nuclear substance within the meaning of the *Nuclear Safety and Control Act*;
- a product, material or substance packaged as a consumer product and in quantities normally used by the consuming public.

For more information



http://humanservices.alberta.ca/documents/WHIS-PUB_ch007.pdf

WHMIS – Information for Workers (CH007)

Note this publication is also available in Booklet format



http://humanservices.alberta.ca/documents/WHIS-PUB_ch008.pdf

WHMIS – Information for Employers (CH008)

Note this publication is also available in Booklet format

OHS Code Part 18 – Personal Protective Equipment

Respiratory Protective Equipment

The OHS Code lists the factors an employer must consider when determining the need for respiratory protection. Respiratory protective equipment must be provided and worn by the worker where a risk of over-exposure exists, or where a worker will be working in a restricted area. In selecting the appropriate equipment, the employer must consider:

- (a) the nature of the contaminant(s);
- (b) the concentration of contaminants;
- (c) the duration of worker exposure;
- (d) oxygen concentrations; and
- (e) the need for emergency escape from the work area.

The OHS Code allows air-purifying respirators to be used if the air in the work area is not immediately dangerous to life or health and the oxygen content is 19.5 per cent or more. If not, a supplied air system with an auxiliary source of respirable air (sufficient to allow escape from the work area) or a positive pressure self-contained breathing apparatus (SCBA) fitted with an alarm warning must be worn. Where air purifying respirators are used, the airborne contaminant level may not exceed the product of the protection factor assigned to the respirator multiplied by the OEL for asbestos.

The OHS Code also addresses approval of equipment. All respirators and their constituent components must be approved by the National Institute for Occupational Safety and Health (NIOSH) in the United States. A different equipment testing organization's approval will only be recognized if approved by a Director of Occupational Hygiene.

The quality of air used for supplied-air respiratory protection systems must comply with the CSA Standard for compressed breathing air. As well, no contaminant may be present in a concentration exceeding 10 per cent of the current applicable OEL.

In addition, a proper respirator fit must be obtained by each worker, workers must be clean shaven where the respirator meets the skin of the face (if their efficacy depends on a tight facial seal) and respirators must be stored, cleaned, inspected, serviced and used in accordance with the manufacturer's specifications. The OHS Code also requires that a code of practice for the selection, maintenance and use of respiratory protection be established.

Respirators must be selected and fit-tested in accordance with the CSA Standard Z94.4-02, *Selection, Use and Care of Respirators*.

For more information



http://humanservices.alberta.ca/documents/WHSPUB_ppe001.pdf

Respiratory Protective Equipment – An Employer's Guide (PPE001)



http://humanservices.alberta.ca/documents/WHSPUB_ppe004.pdf

Guidelines for the Development of a Code of Practice for Respiratory Protective Equipment (PPE004)

CSA has published the following applicable standards:



Selection, Use and Care of Respirators [CSA-Z94.4-02]

Compressed Breathing Air and Systems [Z180.1-00]

Personal protective equipment

To prevent worker contamination and protect against other hazards at the work site, protective equipment and clothing is normally required during asbestos abatement work. The employer must ensure that the equipment itself does not create a hazard to the worker, workers use the required protective equipment and the equipment is in proper working condition. Workers must, in turn, use the equipment appropriately.

Where there is a potential danger of injury to a worker's head, protective headwear must be worn. This equipment must meet the appropriate CSA or American National Standards Institute (ANSI) Standard. Where it is not practical for the worker to wear protective headwear, other means permitted by the OHS Code must be used to protect the worker's head from injury.

Where there is a danger of injury or irritation to a worker's eyes, the employer must ensure that the worker wears suitable eye protection. This equipment must be appropriate to the work being done, the hazard involved and be approved to the appropriate CSA standard.

Foot protection or limb and body protection may also be required where there is a danger of injury to the foot, hands, legs or trunk.

Where there is a danger of falling from a height, appropriate fall protection equipment or methods must be used. The OH Code, Part 9 describes the circumstances under which the equipment or methods must be used.

OHS Code Part 23 – Scaffolds and Temporary Work Platforms

The OHS Code presents requirements for this type of equipment and how it should be erected. Generally, the equipment must be installed by workers who are competent to do so, and the employer must ensure that the equipment is appropriate for the job and loads to be supported.

OHS Code Part 5 – Confined Spaces

Some areas where asbestos must be removed may be confined spaces, presenting additional hazards to workers. A *confined space* is defined as “a restricted space which may become hazardous to a worker entering it because of

- (a) an atmosphere that is or may be injurious by reason of oxygen deficiency or enrichment, flammability, explosivity, or toxicity,
- (b) a condition or changing set of circumstances within the space that presents a potential for injury or illness, or
- (c) the potential or inherent characteristics of an activity which can produce adverse or harmful consequences within the space”.

A *restricted space* is defined as “an enclosed or partially enclosed space, not designed or intended for continuous human occupancy, that has a restricted, limited or impeded means of entry or exit because of its construction”.

Employers must develop procedures to eliminate hazards associated with confined spaces that address ventilation, presence of harmful substances in the air, oxygen deficiency, isolation from other piping and supply lines, protective equipment, rescue procedures and communication. The employer must develop a written code of practice that includes identification of the confined space, worker qualifications and training, isolation, ventilation, tests to be done prior to entry, protective equipment, rescue procedures and equipment, and identification of other hazards that may be present.

For more information



http://humanservices.alberta.ca/documents/WHS-PUB_cs001.pdf

Guideline for Developing a Code of Practice for Confined Space Entry (CS001)

3.3 Alberta Building Code

Alberta Municipal Affairs sets standards to provide a safe environment for building occupants. Part of the Department's mandate includes regulations for the use of building materials containing asbestos. These provisions were transferred into the OHS Code Part 4 – Chemical Hazards, Biological Hazards and Harmful Substances and are now enforced by Alberta Human Services.

The need for a building permit should be discussed with Alberta Municipal Affairs. A building permit is generally required prior to any work being done, including demolition. A Safety Codes Officer will review the plans and specifications submitted and sign-off on the project once the following items have been assessed:

Additions/Renovations

- Where asbestos-containing building components are removed, equivalent replacements such as fire barriers may need to be provided.
- Impact on exits during the abatement project, e.g. a second floor exit may be blocked off while abatement occurs on the floor below.
- Operation of existing fire suppression systems.
- Impact on electrical systems and emergency lighting or alarm systems while the abatement project is in progress.
- Impact on building ventilation systems.

Demolition

- A fire safety plan must be developed for the site.
- A schedule for the asbestos removal project must be provided.
- Preventing the spread of contamination to other buildings must be considered.

In all cases, Alberta Human Services's health and safety legislation must be followed.

Where a building permit is obtained depends on the municipality in which the building is located. For non-accredited municipalities, an Alberta Municipal Affairs Contracted Accredited Agency will issue the permit. Accredited municipalities that issue permits and have taken responsibility for all of the *Alberta Building Code* issue the permit directly. In accredited municipalities that do not issue permits related to asbestos, an Alberta Municipal Affairs Contracted Accredited Agency must be contacted for the permits related only to the asbestos enclosure, removal or encapsulation. Prior to the start of work, the municipality or Alberta Municipal Affairs should be contacted to confirm where the building permit can be obtained.

3.4 Waste transport and disposal

The OHS Code, requires that asbestos waste be stored, transported and disposed of in sealed containers that are impervious to asbestos and asbestos waste.

The disposal of hazardous wastes is under the mandate of Alberta Environment. Alberta Environment has published "*Guidelines for the Disposal of Asbestos Waste*". In the guidelines, asbestos waste is defined as "a waste containing more than one per cent asbestos by weight." An overview of the Transportation of Dangerous Goods Regulation's requirements for the shipment of asbestos waste is also included. Although asbestos waste does not require a manifest, a shipping document must accompany the waste to the landfill. This document must include the following information:

- (a) a document identification number that is legible and indelibly printed;
- (b) the date;
- (c) the name and address of the shipper;
- (d) the shipper's signature;
- (e) the name and address of the receiver (landfill);
- (f) the name of the initial carrier (transporter of the waste); and
- (g) a description of the dangerous goods in the following order:
 - (i) the proper shipping name of the product (asbestos: white for chrysotile, brown for amosite, blue for crocidolite);
 - (ii) the dangerous goods class (9.4);
 - (iii) the Product Identification Number (PIN) [UN 2590 for chrysotile, UN 2212 for all others];
 - (iv) the packing group (III);
 - (v) the number of packages, where applicable, and the total weight or volume of each type of dangerous good;
 - (vi) any special handling instructions;
 - (vii) a 24-hour emergency telephone number where information concerning damaged or defective packages may be obtained; and
 - (viii) an indication of the types and number of placards required.

For more information



<http://environment.gov.ab.ca/info/library/7247.pdf>

Guidelines for the Disposal of Asbestos Waste

Regulations applicable to how the waste is transported require that:

- (a) bags are marked with a shipping name and PIN number;
- (b) the shipment vehicle is placarded;
- (c) the vehicle operator has a valid Certificate of Training issued by the operator's employer (a Transportation of Dangerous Goods training course is usually taken);

- (d) asbestos is transported as directly as possible to the disposal site;
- (e) asbestos is not transported with any other cargo in the same vehicle;
- (f) asbestos is not mixed with other types of waste; and
- (g) asbestos is not transported in a compaction type of waste haulage vehicle.

The external surfaces of every container and of every vehicle or vessel used for the transport of asbestos waste must be free of asbestos waste. Asbestos waste must be properly secured and transported within an enclosed vehicle or covered by a tarpaulin or net if transported in a vehicle which is not enclosed.

Friable asbestos waste should only be transported in vehicles equipped with emergency spill clean-up equipment that includes a shovel, a broom, wetting agent, protective clothing, a supply of six mil thick polyethylene bags, bag closures and approved respiratory protection.

Friable waste that leaks from a container during transport must be collected and double bagged in six mil thick polyethylene bags immediately upon discovery. If possible, punctured and broken containers should also be double bagged in six mil thick polyethylene bags.

No person should allow friable asbestos waste to leave the location at which it is generated unless

- (a) the asbestos is in a rigid, impermeable, sealed container of sufficient strength to accommodate the weight of the waste;
- (b) the waste is double bagged in six mil thick polyethylene bags; or
- (c) the waste is packaged in accordance with a method approved by a Director of Standards and Approvals from Alberta Environment.

Every container referred to in the previous text must be free from punctures, tears or leaks, and must be clearly labelled to indicate the nature of the contents and the presence of a carcinogenic hazard, with a warning that the dust should not be inhaled. The final disposal site of asbestos waste must be a sanitary landfill approved by the local Board of Health or an industrial landfill approved and designated as Class I or II by Alberta Environment.

Where containers of asbestos waste are being unloaded, the unloading must be performed so that no loose friable asbestos waste or punctured, broken or leaking containers are landfilled. Any friable asbestos waste in a container that is punctured, broken or leaking must be double bagged in six mil thick polyethylene bags immediately upon discovery.

Asbestos waste may be deposited only at locations in a landfill site that have been adapted for the purpose of receiving asbestos waste or are otherwise suitable for that

purpose. Before the waste is transported, the landfill site must be contacted for approval to dispose of the waste, to confirm dates and times when it will be received and to determine if there are any special requirements regarding waste delivery and packaging.

Asbestos waste may be deposited at a landfill site only while supervised by the site operator. Where asbestos is deposited, at least 25 cm of cover material other than garbage must be placed immediately over the waste to prevent direct contact with compaction equipment or other equipment operating at the site. The final cover should be at least 125 cm thick and may include garbage.

The surfaces of vehicles and reusable containers that have been in contact with friable asbestos waste must be thoroughly cleaned prior to leaving the disposal site. Only the minimum amount of water necessary to wet the asbestos fibres should be used during cleaning. Any waste produced during vehicle or container cleaning should also be covered immediately.

Every person directly or indirectly involved in the transportation, handling or management of asbestos waste must take all precautions necessary to prevent asbestos fibres from becoming airborne.

Chapter 4 Introduction to Asbestos Abatement Methods

The first step to properly managing asbestos is to conduct a building survey to confirm the location of asbestos-containing materials, the types of asbestos present and the condition of the materials. In situations where a building was constructed prior to 1980, the building survey is an important step prior to the start of any renovation or demolition work. In rare instances, asbestos has been found in buildings constructed after 1980.

If asbestos-containing materials are identified and exposure is occurring or is likely to occur, corrective action must be taken. In deciding which actions provide the most efficient long-term solution, consideration should be given to the present condition of the asbestos-containing materials, the location of these materials, their function and the cost of the proposed method for controlling asbestos exposure.

There are four basic approaches to controlling exposure:

- (1) **Removal** — asbestos-containing materials are completely removed and properly disposed of.
- (2) **Encapsulation** — asbestos-containing materials are coated with a bonding agent called a sealant.
- (3) **Enclosure** — asbestos-containing materials are separated from the building environment by barriers.
- (4) **Management Plan** — the area is inspected periodically for changes in exposure potential and maintenance staff are correctly notified and trained to deal with the asbestos-containing materials. A management plan can be used to deal with asbestos-containing materials that do not pose a risk or for materials remaining after remedial actions have reduced the potential for exposure.

Removal, encapsulation and enclosure are corrective methods and can be used separately or in combination. Removal completely eliminates the source of exposure and therefore offers a permanent solution. Enclosure and encapsulation are containment methods that do not remove the potential source of asbestos exposure. If asbestos-containing materials remain in place (even if enclosure or encapsulation have been implemented), a management plan will be required for the building.

Since asbestos-containing materials remain within a building following enclosure or encapsulation, these approaches should only be considered as temporary control measures. The expected length of time before a building is to be demolished or undergo major structural changes will be a factor in deciding which method to use. If a building is later renovated or demolished, encapsulated and enclosed asbestos-containing materials must be removed and disposed of by acceptable methods.

The following sections present detailed explanations of each of the approaches to controlling exposure.

4.1 Removal

During removal, all asbestos-containing materials are taken off the underlying surface and collected and placed in containers for burial at an approved waste disposal site. This process is the most expensive control method in the short-term and may require interruption of building activities. Removal is a necessary pre-requisite for demolition of a building containing asbestos-containing materials or when planned renovations will disturb the asbestos.

Fireproofing material that has been removed must be replaced to maintain compliance with fire and building codes (except in the case of a building that is to be demolished). If the asbestos-containing materials fulfilled either an insulating or acoustical function, the replacement material should have similar characteristics.

Where asbestos had been used to protect structural members from fire conditions, it is important that precautions be taken to maintain an adequate level of fire safety in the building during the removal process and subsequent application of fire protection materials. A registered architect and/or professional engineer must be retained to assist in the development of plans and specifications for the overall project. Site review during the project should be required by the architect and/or engineer.

Advantages of removal

- Eliminates the source of the asbestos.
- Eliminates the need for an ongoing surveillance program.

Disadvantages of removal

- Usually the most costly and complicated method of controlling exposure.
- Usually the most time consuming method.
- Replacement with substitute material may be necessary.
- Highest potential for worker exposure during removal.

Comments

- Removal is mandatory prior to demolition or major renovations.
- Removal is significantly cheaper if combined with renovation or demolition activities.

4.2 Encapsulation

During encapsulation, asbestos-containing materials are coated with a bonding agent called a sealant. Sealants penetrate and harden the material (penetrants) and/or cover the surface of the material with a protective coating (bridging sealants).

Sealants are applied over the surface of the material using airless spray equipment at a low pressure setting. Airless equipment reduces the force of the stream of sealant spray and its impact on the friable asbestos material surface, thus reducing the potential for fibre release during application. Where a sealant is applied, the person doing so must ensure that it penetrates through the material to the underlying support such as piping. Otherwise, the potential for delamination of the asbestos-containing material due to the additional weight of sealant is increased. In some cases, a test application may be recommended to ensure sufficient penetration of the sealant into the material.

Bridging sealants must form a tough skin that can withstand moderate impact, be flexible and flame retardant, resist deterioration over time, and is non-toxic.

Encapsulation should be limited to areas where the asbestos-containing material will not be subject to further damage by contact. Encapsulation should also be limited to material that is capable of supporting the additional weight of the sealant. In addition, the fire rating of the material must be considered before applying a sealant. Encapsulated material needs to be routinely inspected for deterioration or damage. Although the method may be less costly than removal in the short term, the long term cost will be greater due to increased management of the material and removal will eventually be required.

Advantages of encapsulation

- Can be a more rapid and economical method of controlling exposure.
- Reduces the potential of fibre release.

Disadvantages of encapsulation

- The asbestos source remains.
- If material is damaged or deteriorating, the additional weight of the sealant may cause delamination.
- A management system is required. Precautions are necessary to prevent damage during maintenance or removal.

- Continuing inspection is required to check for damage to encapsulated surfaces.
- Maintenance of damaged or deteriorating encapsulated surfaces is required.
- Encapsulated material may be more difficult to remove later.

Comments

- Encapsulation is only a temporary measure — the encapsulated asbestos will eventually require removal.
- Encapsulation must be performed using high risk work procedures.
- Encapsulation is difficult to do where access to the asbestos material is awkward.

4.3 Enclosure

Enclosure requires that a physical barrier be placed between asbestos-containing materials and the building environment. A drywall covering is normally an acceptable enclosure. A suspended ceiling is too easily entered and does not provide a reliable barrier. If a suspended ceiling must be saved, the tiles should be labelled to indicate that asbestos is present behind the tiles and will be disturbed if a tile is removed.

Since the asbestos has not been removed, fibres will continue to be released and will accumulate behind the barrier. If the enclosure is damaged or entered for maintenance, this accumulation may be released into the building environment. Although the abatement method may be less costly than removal in the short term, the long term cost will be greater due to increased management of the material and removal will eventually be required.

Advantages of enclosure

- May be a rapid, economical, uncomplicated method of controlling exposure.

Disadvantages of enclosure

- The asbestos source remains.
- Fibre fallout may continue behind the enclosure.
- May be costly if the enclosure disturbs the function of other systems e.g. enclosure may require lighting changes.
- A management system is required. Precautions are necessary for entry into the enclosure when performing maintenance or renovation activities.
- Continuing inspection is required to check for damage to the enclosure system.

Comments

- Enclosure is a very cost effective method of repairing damage to mechanical systems.
- Enclosure is a temporary measure only — asbestos-containing materials will eventually require removal.
- Depending on the location and condition of the asbestos, enclosure must be performed using moderate or high risk work procedures.

4.4 Management plan

When asbestos-containing materials remain in place, a management plan must be implemented. The plan should be in writing and address the following:

- (a) inventory of asbestos-containing materials in the building;
- (b) inspection frequency and procedures;
- (c) training requirements for maintenance staff and others who may come into contact with the materials or work in proximity to the materials;
- (d) procedures to follow in the event of damage or other emergency situations;
- (e) procedures to follow should the condition of the materials change or work routines be altered;
- (f) notification procedures for occupants and others in the building; and
- (g) labelling of asbestos-containing materials.

The cost of a management plan can vary greatly, but may result in a cost savings if work can be deferred to a later renovation or demolition.

Encapsulation, enclosure and management plans allow asbestos-containing materials to remain within the building. It is important to recognize that the risk of hazardous asbestos exposure may increase as a result of changing conditions in the building. For example, materials can be damaged by maintenance, repairs or renovation activities, causing further fibre release. Consequently, a management plan should be implemented to ensure that asbestos is not released as a result of these activities. All persons involved in such activities must be informed that asbestos-containing materials are present and be trained in work procedures to prevent damaging them.

Advantages of a management plan

- Initial cost lowest and minimum disruption to building operation.

Disadvantages of a management plan

- The asbestos source remains.
- The potential for exposure may increase over time.

- Precautions are necessary to prevent damage during maintenance or renovation activities.
- Continuing inspection and re-evaluation are necessary.

Comments

- A management plan may be very difficult and costly to implement and enforce.
- This is a temporary measure as removal of the material will eventually be required.

Chapter 5 Asbestos Abatement Procedures

5.1 Introduction

Asbestos abatement procedures vary depending on the type, amount and location of the asbestos. In general, the procedures can be divided into three categories — low risk, moderate risk and high risk — according to their potential for generating airborne asbestos fibres.

All procedures follow the same four principles:

- (1) isolate the work area;
- (2) protect workers;
- (3) minimize the release of asbestos fibres; and
- (4) ensure adequate clean-up and decontamination.

This chapter presents procedures for low, moderate and high risk abatement activities. The information provided should only be used as a guide since actual risk levels may vary and, depending on work conditions, the project risk level can change. Site or work conditions may require modification of procedures. In these cases, alternate work procedures must provide “equal or greater” protection to workers. Despite the examples provided in this section, in any work area that may become a “restricted area”, high risk procedures must be followed.

5.2 Low risk abatement activities

5.2.1 Description of projects

Operations classified as “low risk” have a minimal risk of releasing asbestos fibres into the air. The precautions to adequately protect workers are relatively simple to follow. Low risk activities include:

- Installing or removing non-friable products (that are in good condition) manufactured from asbestos-containing materials without cutting, breaking, sanding or vibrating the materials. This includes handling products such as gaskets (30 cm diameter and greater), vinyl asbestos floor tile, asbestos cement products, millboard (transite) and asbestos cement piping.
- Work done in proximity to friable asbestos that does not require contacting the asbestos.

- Using non-powered hand tools designed to cut, drill or abrade a non-friable manufactured product containing asbestos, as long as water is used to control fibre release and waste products are controlled.
- The transportation or handling of asbestos-containing materials in sealed containers.

5.2.2 Equipment

Required equipment should include the following:

- (a) vacuum cleaner fitted with a HEPA filter;
- (b) polyethylene drop sheets having a minimum six mil thickness;
- (c) six mil thick labelled asbestos disposal bags;
- (d) spray bottle or hand pump garden sprayer to wet asbestos;
- (e) barriers and warning signs;
- (f) hand powered tools for abatement work;
- (g) mops and/or rags and water for clean-up;
- (h) fire extinguisher; and
- (i) appropriate first aid kit.

5.2.3 Personal protective equipment

Workers who may be exposed to asbestos fibres should wear:

- (a) a NIOSH-approved half mask air purifying respirator equipped with a P100 (oil Proof), R100 (Resistant to oil) or N100 (Not resistant to oil) particulate filter;
- (b) disposable coveralls over work clothing to prevent contamination of the worker's clothing; and
- (c) personal protective equipment appropriate to the other hazards present at the work site.

5.2.4 Pre-job planning

- (1) Establish the work procedures to be followed and assemble the equipment required to perform the job.
- (2) Submit a completed Asbestos Project Notification Form (see Figure 2) to Occupational Health and Safety 72 hours before workers may be exposed to airborne fibres, including set-up operations that may release fibres.
- (3) Ensure workers are adequately trained in the hazards and proper methods of working with asbestos.

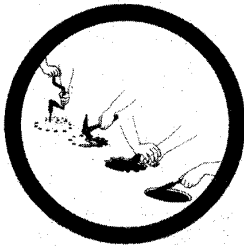
- (4) Procedures to deal with emergencies such as fire or injury must be developed and in place prior to work starting.

5.2.5 Site preparation

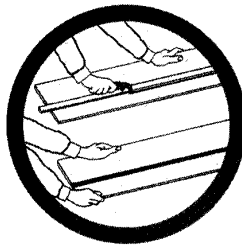
Barriers and warning signs should be positioned in areas where access needs to be restricted until the work is completed.

5.2.6 Work procedures

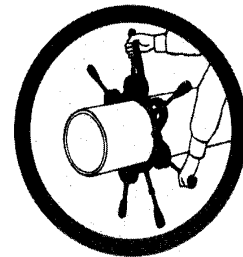
- (1) Dry removal of asbestos-containing material is not permitted. Localized wetting of the material must be done to minimize fibre release.
- (2) Remove all visible dust on work surfaces with a damp cloth or a vacuum cleaner fitted with a HEPA filter.
- (3) Where necessary, use plastic drop sheets or similar materials to prevent the spread of asbestos dust to other work areas.
- (4) When hand tools are used to cut, shape or drill a non-friable manufactured product containing asbestos, the product should be wetted whenever possible to minimize the release of airborne fibres. If the material cannot be wetted, the work must be classified as moderate risk and moderate risk abatement procedures followed.



Use of hand tools to remove wall boarding containing asbestos



Cutting asbestos-containing wall board by hand.



Cutting asbestos-containing pipe by hand.

- (5) No person may eat, drink, smoke, or chew gum or tobacco at the work site except in a designated clean area. Workers must remove protective equipment and clothing and clean their hands and faces prior to any of these activities.

5.2.7 Decontamination

- (1) During and immediately upon completing the work:
 - (a) clean up dust and waste by vacuuming with a vacuum cleaner fitted with a HEPA filter, by wet sweeping or by damp mopping; and
 - (b) drop sheets must be wetted, folded in on themselves to contain dust, properly bagged and disposed of as asbestos waste.
- (2) Compressed air must not be used to clean up or remove dust from work surfaces or clothing. Cleaning must be done with a vacuum cleaner fitted with a HEPA filter, by wet sweeping or by damp mopping.
- (3) Non-disposable coveralls or other clothing contaminated with asbestos must be laundered following proper procedures. Footwear should be properly decontaminated.

5.2.8 Disposal

Asbestos waste, including contaminated disposable clothing, must be placed in sealable containers that are labelled as containing asbestos waste. Containers of asbestos waste must be sealed and external surfaces cleaned by wiping with a damp cloth that is also to be disposed of as asbestos waste, or by using a vacuum cleaner fitted with a HEPA filter. The cleaned containers must then be removed from the work area.



Waste bags should be properly labelled

5.2.9 Air monitoring

Air monitoring is useful in determining typical exposure levels during the performance of abatement activities. Air monitoring results should be below 0.01 fibres per cubic centimeter during all phases of the work. Once air monitoring has confirmed this, further air monitoring may not be required. In the case of low risk projects, a baseline measurement should be taken.

5.2.10 Site inspection

Upon completion of the work, the work area must be visually inspected to ensure that all visible asbestos-containing debris has been properly cleaned up.

5.3 Moderate risk abatement activities

5.3.1 Description of projects

Activities where there is a moderate risk of exposure to airborne asbestos fibres include:

- Using non-powered hand tools to cut, shape, drill or remove a non-friable manufactured product containing asbestos if water is not used to control fibre release.
- Using a mechanical or electrically powered tool, fitted with a HEPA filter dust collector, to cut, shape or grind non-friable manufactured products containing asbestos.
- Removing all or part of a false ceiling to gain access to a work area and where friable asbestos-containing materials are, or are likely to be, lying on the surface of the false ceiling.
- Removing, encapsulating, enclosing or disturbing minor areas (less than 0.09 m² or 1 ft²) of friable asbestos-containing material during the repair, alteration, maintenance, demolition or dismantling of a building, structure, machine, tool or equipment, or parts of it.
- Performing glovebag operations (see Section 5.5.8 for detailed information).
- Dry buffing and stripping of vinyl asbestos tile.
- Renovation or hand demolition involving drywall joint compound, block mortar, stucco, or brick mortar products containing asbestos.
- Removal of 9.3 m² (100 ft²) or less of contiguous ceiling tile containing asbestos or sheet vinyl flooring/vinyl floor tiles having an asbestos backing.
- Dry removal of non-friable asbestos material where the material may be cut, broken, or otherwise damaged during removal.

5.3.2 Equipment

Required equipment should include the following:

- (a) vacuum cleaner fitted with a HEPA filter;
- (b) polyethylene drop sheets having a minimum six mil thickness;
- (c) six mil thick labelled asbestos disposal bags;
- (d) spray bottles or hand pump garden sprayers to wet asbestos;
- (e) barriers and warning signs;
- (f) appropriate tools;
- (g) mops, rags, brushes, water and other supplies for clean-up;
- (h) fire extinguisher; and
- (i) appropriate first aid kit.

5.3.3 Personal protective equipment

- (1) Workers exposed to asbestos fibres should wear protective clothing that:
 - (a) is made of material such as Tyvek™ that resists penetration by asbestos fibres;
 - (b) covers the body and fits snugly at the neck, wrists, and ankles;
 - (c) covers the head and feet (laceless rubber boots are recommended); and
 - (d) is immediately repaired or replaced if torn.

The wearing of disposable coveralls is recommended. Street clothes should not be worn under disposable coveralls if work is conducted inside a containment.

- (2) A NIOSH-approved respirator equipped with a P100 (oil Proof), R100 (Resistant to oil) or N100 (Not resistant to oil) particulate filter must be worn. Disposable, single use respirators must not be used. The respirator selected must have a sufficient protection factor to provide adequate protection for the fibre levels encountered during the project.
- (3) Personal protective equipment such as safety boots, hard hats, etc. appropriate to the other hazards present at the work site must be used. If other airborne contaminants are also present, respiratory protective equipment appropriate to those hazards is necessary.

5.3.4 Pre-job planning

- (1) Establish the work procedures to be followed and assemble the equipment required to perform the job.
- (2) Submit a completed Asbestos Project Notification Form (see Figure 2) to Occupational Health and Safety 72 hours before workers may be exposed to airborne fibres, including set-up operations that may release fibres.
- (3) Ensure all equipment fitted with HEPA filters has been tested (see Section 5.6.1) before the job commences.
- (4) Ensure workers are adequately trained in the hazards and proper methods of working with asbestos.
- (5) Ensure that building occupants, tradespeople, etc. are notified, in advance, of the location, duration and type of work to be performed.

- (6) Procedures to deal with emergencies such as a fire or injury must be developed and in place prior to work starting. Where a containment is used for moderate risk work, a worker should be stationed outside the containment to respond to emergencies and contact rescue personnel, if required.

5.3.5 Site preparation

- (1) Barriers and warning signs should be posted in areas where access to unauthorized persons needs to be restricted until the work is completed. The signs should read as follows and include the name of a contact person on-site.

**Caution
Asbestos Dust Hazard**

**Avoid Breathing Dust
Wear Protective Equipment**

**Breathing Asbestos Dust May
Cause Cancer**

**Entry is Prohibited
Except to Authorized Persons**

**Eating, Drinking and Smoking
are Prohibited in this Area**

- (2) Clearly mark the boundary of the work area by placing barricades, fencing or similar structures around it.
- (3) Prior to starting any work that is likely to disturb friable asbestos-containing materials, the materials must be cleaned by damp wiping or vacuuming with a vacuum cleaner fitted with a HEPA filter.
- (4) All air handling and ventilation systems that could cause asbestos fibres to be distributed, disturbed or become airborne as a result of the work should be shut down before work begins.
- (5) Lock-out and isolate all electrical and mechanical equipment within the work area.
- (6) Electrical power for abatement work should be supplied through a ground fault circuit interrupter (GFCI).

- (7) If required, a containment should be constructed using six mil thick polyethylene sheeting. The containment should be less than 9.3 m² (100 ft²) in size. A HEPA-filtered exhaust unit should be connected to the containment to provide negative pressure for the duration of the project. If a larger containment is needed, the project may require re-classification as high risk. (See Section 5.4.5 regarding site preparation of larger containments.)
- (8) A worker decontamination room should be attached to the containment.

5.3.6 Work procedures

- (1) Wet material thoroughly before and during the work unless such wetting creates a hazard to workers. Material should be wet but not saturated, as this may cause delamination or disintegration of the material.
- (2) Do not use compressed air to clean up or remove dust or materials from work surfaces or clothing. Techniques which generate excessive fibre levels should be avoided. Clean-up techniques should include vacuuming with a vacuum cleaner fitted with a HEPA filter, wet sweeping or damp mopping.
- (3) Use plastic drop sheets and barriers to prevent the spread of asbestos-containing dust to other work areas.
- (4) Do not allow asbestos waste to accumulate or dry out before final bagging.
- (5) Once abatement work is complete, seal all rough edges or surfaces containing asbestos-containing material at the edges of the work area with an encapsulant.
- (6) If a containment is constructed, apply a slow drying sealant such as glue spray to its surfaces prior to dismantling it. This ensures that non-visible asbestos fibres are bonded to the surfaces of the containment and cannot become airborne.
- (7) If a containment is used, complete a final air test after a minimum drying period of four hours. (See Section 5.3.9. for air monitoring criteria.)

5.3.7 Decontamination

- (1) Immediately upon completing the work:
 - (a) clean up dust and waste by vacuuming with a vacuum cleaner fitted with a HEPA filter, by wet sweeping or by damp mopping; and
 - (b) drop sheets must be wetted, folded in on themselves to contain dust, properly bagged and disposed of as asbestos waste.
- (2) Before leaving the work area:
 - (a) clean protective equipment and clothing before removing it from the work area. Use a vacuum cleaner fitted with a HEPA filter or wipe the equipment and clothing with a damp cloth;
 - (b) leave all disposable protective clothing used during abatement in the work area;
 - (c) place protective clothing, if it will not be laundered and re-used, in a sealable container and dispose of it as asbestos waste. Clothing and protective equipment that is to be reused must be laundered and cleaned using proper procedures; and
 - (d) wash all exposed skin surfaces prior to removing respirators. All persons in the work area must properly decontaminate themselves prior to leaving the work area. This is to be done under all circumstances, including prior to drinking, eating, using a bathroom, etc.

5.3.8 Disposal

- (1) Place asbestos waste into a sealable container labelled as containing asbestos waste.
- (2) Clean the external surfaces of sealed containers of asbestos waste by wiping with a damp cloth that is also to be disposed of as asbestos waste, or by using a vacuum cleaner fitted with a HEPA filter.
- (3) Remove containers from the work area.

5.3.9 Air monitoring

Proper air monitoring requires that samples are taken prior to work starting (baseline or background samples), during abatement activities and upon completion of the job if required. Air monitoring must be performed by competent personnel following the methods specified in the OHS Legislation.

The following criteria should be applied when reviewing results:

- (1) If fibre levels inside the work area exceed the protection factor (see Section 6.1.3) of the respiratory protective equipment being used, work must stop until appropriate respirators are supplied and airborne fibre levels can be controlled.
- (2) If fibre levels measured just outside the barriers exceed 50 per cent of the Occupational Exposure Limit (OEL), work practices must be reviewed. If high levels continue, work must stop until the reasons for the high levels are identified and corrected. If fibre levels outside the work area approach the OEL, work must immediately stop until the reasons for the high levels are identified and corrected. Fibre levels outside the work area must never exceed the OEL. Note that if fibre levels are approaching the OEL, the work area may need to be reclassified as high risk.
- (3) Final air monitoring test results should be less than 0.01 fibres per cubic centimetre. Aggressive sampling techniques should be used for final air sampling if a containment is used (see Section 5.6.2).

5.3.10 Site inspection

A visual inspection of the integrity of the containment, if one is used, must be performed prior to work commencing. If the project continues for more than one shift, the containment should be checked for damage at the time of the shift change and repaired immediately.

Upon completion of the work, the work area must be visually inspected to ensure that all visible asbestos-containing debris has been properly cleaned up and removed.

5.4 High risk abatement activities

5.4.1 Description of Projects

Activities where there is a high risk of exposure to airborne asbestos fibres include:

- Removing, encapsulating or enclosing areas 0.09 m² (1 ft²) in size or greater of friable asbestos-containing materials during the repair, alteration, maintenance, demolition, or dismantling of a building, structure, machine, tool or equipment, or part of it.
- Cleaning, maintaining or removing air-handling equipment in buildings where sprayed fireproof asbestos-containing material has been applied to



Typical high risk abatement project

airways or ventilation ducts.

- Repairing, altering or dismantling a boiler, furnace, kiln or similar device, or part thereof, where asbestos-containing materials have been used or applied.
- Demolishing, dismantling, altering or repairing any building or structure, or part of it, in which insulating material containing asbestos was used or in which asbestos products were manufactured.
- Removal of more than 9.3 m² (100 ft²) of contiguous ceiling tile containing asbestos or sheet vinyl flooring having an asbestos backing.
- Dry removal of friable asbestos-containing material.
- Abatement activities involving any type of project where there is a reasonable chance of the concentration of airborne asbestos exceeding the 8-hour OEL: i.e. a "restricted area".

5.4.2 Equipment

Required equipment should include the following:

- (a) portable HEPA-filtered exhaust units with extra fuses;
- (b) replacement HEPA filters;
- (c) flexible or rigid duct;
- (d) vacuum cleaners fitted with HEPA filters;
- (e) electrical extension cords;
- (f) portable ground fault circuit interrupter (GFCI);
- (g) garden hose;
- (h) hand pump garden sprayer to wet asbestos;
- (i) wetting agent (50 per cent polyoxyethylene ether and 50 per cent polyoxyethylene, or equivalent);
- (j) scrapers, nylon brushes, dust pans, shovels, etc.;
- (k) scaffolds with railings;
- (l) duct tape or an alternative tape with similar or better adhesive qualities;
- (m) polyethylene sheeting having a minimum six mil thickness;
- (n) six mil thick labelled asbestos disposal bags;
- (o) barriers and warning signs;
- (p) mops and/or rags, water and other supplies for clean-up;
- (q) encapsulant for sealing edges;
- (r) manometer, pumps and smoke generator;
- (s) fire extinguisher; and
- (t) appropriate first aid kit.

5.4.3 Personal protective equipment

- (1) Workers exposed to asbestos fibres should wear protective clothing that:
 - (a) is made of material such as Tyvek™ that resists penetration by asbestos fibres;
 - (b) covers the body and fits snugly at the neck, wrists and ankles;
 - (c) covers the head and feet (laceless rubber boots are recommended); and
 - (d) is immediately repaired or replaced if torn.

The wearing of disposable coveralls is recommended. Street clothes must not be worn under disposable coveralls.



Protective equipment required for high risk activities

- (2) If contaminated clothing is to be laundered, it must first be vacuum cleaned, wetted down, placed in plastic bags, sealed and labelled prior to being sent to laundry facilities. Machines and facilities equipped with proper HEPA filters must be used to clean asbestos-contaminated clothing. On-site facilities are preferred. Workers who launder the clothes must be informed of the hazards of asbestos and the precautions required when handling contaminated clothing. Contaminated clothing or towels must not be taken home by workers for laundering.
- (3) During high risk abatement activities, acceptable respiratory protection is a Powered Air Purifying Respirator (PAPR) or better, equipped with a P100 (*Oil proof*), R100 (*Resistant to oil*) or N100 (*Not resistant to oil*) particulate filter. Positive pressure supplied air respirators may be required if wet removal is impossible. In some cases, dual cartridge half and full-face respirators with high efficiency filters are acceptable. The appropriate level of respiratory protection can only be determined by conducting air monitoring tests and calculating the protection factor needed. However, where a level of protection lower than PAPR is chosen for a high-risk operation, the suitability of such equipment must be assessed for the duration of the project. If fibre concentrations increase, workers will need to switch to respiratory protective equipment with a higher protection factor.
Disposable single-use respirators must not be used.
- (4) Half mask air purifying respirators equipped with a P100 (*Oil proof*), R100 (*Resistant to oil*) or N100 (*Not resistant to oil*) particulate filter can be used for the set-up and dismantling phases of the removal project.
- (5) Protective clothing and respiratory protective equipment must be provided for authorized visitors.

- (6) Workers must use body protection and safety equipment appropriate to other hazards present at the work site.

5.4.4 Pre-job planning

- (1) Establish the work procedures to be followed and assemble the equipment required to perform the job.
- (2) Submit a completed Asbestos Project Notification Form (see Figure 2) to Occupational Health and Safety 72 hours before workers may be exposed to airborne fibres, including set-up operations that may release fibres.
- (3) Obtain the necessary building permit(s) by contacting the municipality or accredited agency that issues building permits.
- (4) Have the following documentation available:
 - (a) required permits;
 - (b) written lock-out procedures;
 - (c) proof of worker training;
 - (d) names of supervisory personnel;
 - (e) shop drawings of work area layout/decontamination facility;
 - (f) construction schedule;
 - (g) certification of HEPA-filtered equipment; and
 - (h) code of practice for respiratory protection.
- (5) Ensure all HEPA-filtered equipment has been tested before the job commences (see Section 5.6.1).
- (6) Ensure workers are adequately trained in the hazards and proper methods of working with asbestos. Workers must have successfully completed a course of instruction approved by a Director of Occupational Hygiene and have a valid Asbestos Worker Card.
- (7) Ensure that building occupants, tradespeople, etc. are notified, in advance, of the location, duration and type of work to be performed.

- (8) Procedures to deal with emergencies such as a fire or injury must be developed and in place prior to work starting. One worker, who is appropriately trained, must be stationed outside the containment to respond to emergencies and contact rescue personnel if required. Workers inside the containment should have some form of communication with the worker outside the containment. Emergency exits should be clearly marked, both inside and outside of the containment.

5.4.5 Site Preparation

- (1) Isolate the asbestos work area by placing signs around it warning persons not to enter the area unless authorized to do so. The signs should read as follows and also include the name of a contact person on-site.

**Caution
Asbestos Dust Hazard**

**Avoid Breathing Dust
Wear Protective Equipment**

**Breathing Asbestos Dust May
Cause Cancer**

**Entry is Prohibited
Except to Authorized Persons**

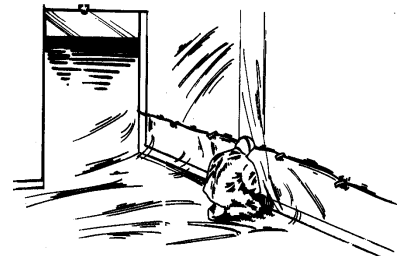
**Eating, Drinking and Smoking
are Prohibited in this Area**

- (2) Clearly mark the boundary of the work area by placing barricades, fencing or similar structures around it.
- (3) The entire work area should be enclosed to prevent the escape of asbestos fibres. Use polyethylene sheeting at least six mil thick, or a similar impervious material, held in place with appropriate tape and adhesive. It may be necessary to erect a temporary wooden or metal frame to which the plastic barrier can be attached. All joints must overlap by approximately 30 cm and be double-taped to ensure the area is completely sealed off.

- (4) A HEPA-filtered exhaust unit must be installed to create a negative air pressure of approximately five Pascal (gauge) within the enclosure relative to the surrounding area. The exhaust unit must provide at least four complete air changes per hour. In this arrangement, the major and usually only route of air into the removal area is through the decontamination unit.
- (5) A negative air pressure in the enclosed space relative to the surrounding area must be maintained so that air flow is always from clean outside areas into the contaminated area. Negative pressure must be maintained in the enclosed space until site decontamination work is complete and air monitoring tests confirm fibre levels are low enough to permit dismantling of the enclosure. Exhaust air from the enclosure must be discharged to the outdoors through a HEPA filter. The airflow pattern in the work area must ensure that the clean room and shower room of the decontamination facility are safe for workers who are not wearing respirators. The HEPA-filtered exhaust unit must remain in continuous operation to maintain negative pressure in the enclosure while the removal is in progress and during clearance procedures after the removal.
- (6) Ideally, HEPA-filtered exhaust units should be positioned to allow access to the filters from within the removal area, while the units themselves are kept outside the removal area. This makes decontamination of the units easier.

Where it is not possible to change the filter while within the removal area, a temporary enclosure should be constructed around the unit during filter replacement.

- (7) HEPA filters must have a minimum filtration efficiency of 99.97 per cent. A coarse pre-filter should be installed upstream of the HEPA filter to prolong its life. Where practical, the discharge point for any exhaust unit should be to the outside air, away from other work areas, air-conditioning inlets or breathing air compressors. In the rare case where exhaust air cannot be discharged to the outside, or where it must be discharged to areas close to heating, ventilation or air conditioning (HVAC) inlets or breathing air compressors, the discharge must be routinely monitored for airborne asbestos.
- (8) Testing of exhaust units must take place completely on-site, before the start of the job (see Section 5.6.1), and at least once a month or as required to ensure the integrity of the HEPA unit. The best way to inspect the filter and seal fittings is by using a static pressure alarm which indicates a failure in the system.



Containment Area

- (9) If a complete enclosure cannot be constructed, cover any windows and doors leading into the area with a plastic sheeting barrier. Cut the plastic sheeting so it overlaps the framework of the window or door by 10 to 15 cm. Ensure a good seal by wiping the area around the window or door with a moist cloth so that the tape sticks.
- (10) Seal off stairways and elevators. Where asbestos is removed from an entire floor of a multi-storey building, all passenger elevators must be prevented from stopping at that floor. Removal workers may gain access to the floor via the fire staircase or from an elevator dedicated for this purpose.
- (11) Seal heating and ventilation ducts and close dampers to eliminate air flow. Aside from specific asbestos exhaust units, all ventilation and air conditioning equipment that services the removal area must be shut down for the duration of the removal job, if possible. All vents must be sealed to prevent asbestos dust from getting into the duct network. Upon completion, and after final cleaning of the removal area, all mechanical ventilation filters for recirculated air should be replaced if possible.
- (12) Use a layer of seamless or seam-sealed, fibre-reinforced polyethylene sheeting on the floor of the containment, covered by a second layer of at least six mil thick polyethylene sheeting. Use double-sided tape or adhesive to prevent movement between layers. A turn-up of 30 cm should be used where the floor joins the walls. Sheeting covering the walls should overlap the turn-ups on the inside of the containment to prevent leaks of asbestos-contaminated water running outside of the containment. Extra strength in the containment floor can be achieved by running the double layers of plastic at 90 degrees to one another.
- (13) Power sources with ground fault circuit interrupters must be used to protect workers against electric shock from electrical equipment operated in the presence of water inside the enclosure. All existing electrical circuits or lighting must be physically locked-out to prevent unintentional start-up of electrical equipment.
- (14) Remove all movable furniture, equipment and fittings from the asbestos removal area. Immovable items should be carefully wrapped and sealed in suitable plastic sheeting so they are effectively isolated from the removal area. In areas of heavy traffic or high wear, additional physical barricading may be necessary.
- (15) Where set-up operations may release asbestos fibres, all personnel in the removal area must wear appropriate personal protective equipment, including respiratory protective equipment approved for use with asbestos. All other high risk preparation such as isolation of the work area, shut down of the heating, ventilation and air conditioning system, installation of HEPA-filtered exhaust units and the worker decontamination facility must be completed first.

The need for appropriate respiratory protective equipment is particularly important when removing barriers or partitions such as false ceilings. Where asbestos-containing materials have fallen onto a false ceiling, the ceiling should only be removed by following at least the procedures required during moderate risk abatement activities. Any utility or service line which hangs down into the ceiling space should be sealed up if it cannot be sealed from outside the removal area.

- (16) Care should be taken to ensure that asbestos dust cannot escape at points where pipes and conduit leave the removal area. Additional attention to sealing and compliance testing is required at these points, particularly if service riser shafts pass through the removal area.
- (17) When planning and building an asbestos removal containment, special consideration must be given to the impact on the fire rating of the building and to the provision of fire fighting facilities and emergency lighting.
- (18) Power, telephone and fire alarm cables may lie beneath asbestos insulation. To prevent the cables from being damaged or creating a hazard to workers, the cables must be clearly identified prior to commencing any cutting. Cables should be re-routed or disabled during the removal period.
- (19) The containment and material transfer rooms may be fitted with a clear acrylic panel or some other form of window so that the work within may be monitored from outside.
- (20) A decontamination facility must be attached to the work area to allow workers to remove contaminated clothing and properly shower before leaving the area. The decontamination facility consists of a series of connected rooms separated by airlocks (see Section 5.4.7). Use of this facility prevents the spread of asbestos beyond the contaminated area. An additional decontamination facility should be attached to the containment for waste transfer.

5.4.6 Work procedures

- (1) Unless more imminently dangerous hazards dictate, asbestos-containing materials must be handled and removed only when wet. Surfactants and wetting agents can be used with water to assist in thoroughly wetting asbestos-containing materials. Surface soaking with a spray jet is useful for small areas and where total saturation is not practicable. The spray can be from an adjustable pistol-grip garden hose fed from a main water supply. Where no supply is readily available, a portable pressurized vessel such as a pump-up garden sprayer can be used. Constant water pressure is desirable. High pressure water spray should not be used.

- (2) Dry sweeping must NOT be used to clean up waste materials. Compressed air must NOT be used for any cleaning purpose.
- (3) Exhaust air from the containment must pass through a HEPA filter and be discharged outdoors.
- (4) Vacuum cleaners used to clean up asbestos materials must be fitted with a HEPA filter.
- (5) Asbestos-containing materials near workers performing bulk removal activities should be continually misted with water, if practicable.
- (6) All surfaces exposed to asbestos fibres must be effectively cleaned by vacuum cleaning or damp wiping.
- (7) If asbestos is encapsulated, the sealant must penetrate the material and effectively bind the asbestos fibres together.
- (8) After completing the removal of asbestos-containing materials, exposed surfaces must be washed or vacuum cleaned and treated with a sealant.
- (9) The pressure from streams of water, sealants or encapsulants must be controlled to prevent excessive generation of airborne asbestos fibres. Use of airless or low pressure application systems is recommended.
- (10) Workers must not eat, drink or smoke in the asbestos removal area as doing so requires workers to remove their respirators, exposing them to high concentrations of asbestos dust. Workers must leave the work area and fully decontaminate themselves prior to performing these activities or using a washroom.
- (11) Breaking through finishing compound and cutting reinforcing wire in lagging are operations that can generate considerable quantities of dust. Insulation should be kept wet and tools should be selected to allow insulation to be cut into small sections while keeping dust levels in the removal area to a minimum.
- (12) Power tools used in asbestos removal activities should be selected carefully since not all types are appropriate for use in dusty and wet conditions. In general, power tools driven by compressed air or hand tools are preferable.

5.4.7 Decontamination

- (1) For high risk removal jobs, the only satisfactory method of providing an appropriate decontamination facility is with a mobile or specially constructed on-site unit. The decontamination facility is located immediately adjacent to, and joined to, the enclosed asbestos removal area. The facility is divided into three distinct rooms; Dirty Room, Shower Room and Clean Room.
- (2) The decontamination facility's three rooms are separated from one another by means of a suitable airlock or buffer zone. This airlock defines the boundary between each segment of the decontamination facility. The airlock allows personnel to access the removal area and restricts the flow of air between areas. Partitions between rooms in the decontamination facility must be self-closing so that each room functions as an airlock. These partitions are normally constructed of overlapping sheets of heavy weight plastic suspended to form a curtain.
- (3) Generally, no more than 10 persons should use one decontamination facility so that adequate access to shower and cleaning facilities is provided and line ups are avoided.
- (4) The Dirty Room should have provision for:
 - (a) hosing down contaminated clothing and footwear or cleaning it with a vacuum cleaner fitted with a HEPA filter;
 - (b) storage of contaminated clothing and footwear;
 - (c) bins for waste materials; and
 - (d) airflow towards the removal area.
- (5) The Shower Room should have provision for:
 - (a) a shower area with an adequate supply of soap, shampoo and hot and cold water; and
 - (b) airflow towards the dirty decontamination area.
- (6) The Clean Room should have provision for:
 - (a) storage of individual respirators in containers or lockers;
 - (b) a mirror to assist in donning respiratory protective equipment;
 - (c) storage of clean clothing;
 - (d) separate storage of clean and dirty towels; and
 - (e) airflow towards the shower and dirty area.
- (7) All water from the decontamination facility should pass through a 10 micrometre filter before it passes into the sewer mains.

- (8) The worker enters the clean room and removes all street clothes and personal belongings, leaves these in the clean room and changes into clean work clothes. A respirator is put on and checked for fit and proper operation. The worker then passes through the shower room into the dirty room. Alternatively, work clothing which is worn throughout the job may be stored and put on in the dirty room. Respirators however, must always be donned in the clean room.
- (9) On leaving the contaminated work area but before entering the dirty room, asbestos material on the worker or their protective equipment should be removed with a vacuum cleaner fitted with a HEPA filter.
- (10) In the dirty room, the worker removes all protective clothing and equipment except the worker's respirator. Any waste material must be placed in plastic bags or bins for disposal.
- (11) The worker then enters the shower room and showers while wearing their respirator. After the worker's head and the respirator's facepiece and associated harness have been thoroughly rinsed, the respirator may be removed and the shower completed. An adequate supply of warm water, soap and shampoo should be provided.
- (12) After showering, the worker enters the clean room and dresses in street clothes. The respirator is then thoroughly cleaned, disinfected and stored until required.
- (13) Hand tools and supplies are kept in an equipment transfer room associated with the dirty room. This room is also used when transferring asbestos waste containers or any equipment that has been decontaminated.
- (14) In circumstances where the decontamination unit cannot be located adjacent to and joined to the removal area, enclosure procedures to minimize asbestos contamination must be implemented. Usually this requires workers to discard their coveralls, overshoes or other outer garments in an isolated changing area attached to the removal area enclosure and thereafter change into fresh outer clothing for the journey to the decontamination facility. Following initial cleaning, the worker enters the dirty room, removing coveralls, boots and any other clothing. While still wearing a respirator, the worker proceeds to the shower room and follows the personal decontamination procedures described in point (11). Following this shower, the worker passes through the second airlock or buffer zone into the clean change area. Here the worker changes into conventional work or street clothing stored in the locker provided.

- (15) A final decontamination, including wash down and cleaning of the enclosure area with a vacuum cleaner fitted with a HEPA filter removes all visible signs of asbestos contamination from the enclosure and equipment. This decontamination must be completed before dismantling the enclosure barriers.
- (16) Effective glue-bonding or spraying with an appropriate sealant should be done throughout the containment to seal down any invisible dust and fibre undetected during the final inspection following abatement activities. Following confirmation of effective decontamination of the space by final air tests, the containment can be dismantled. All dismantling work should be completed following at least low risk work procedures.
- (17) All tools and electrical equipment such as vacuum cleaners and power tools must be left in the removal area until completion of the removal job. Before the equipment is removed, it should be vacuumed thoroughly and all accessible surfaces wiped with a damp cloth. Where decontamination is not possible, the item should be plastic wrapped and sealed and only opened when inside the containment area of another asbestos project.
- (18) On completion of asbestos removal jobs, all tools and equipment not needed for the final clean-up should be thoroughly washed and removed from the site.

5.4.8 Disposal

- (1) Waste material from within the enclosed asbestos work area must be placed in impervious containers (doubled polyethylene bags at least six mil thick are acceptable), sealed and clearly labelled to indicate that:
 - (a) they contain asbestos;
 - (b) asbestos is carcinogenic; and
 - (c) asbestos fibres should not be inhaled.

If the waste materials are likely to puncture the polyethylene bags, suitable rigid containers must be used.

- (2) Clean the external surfaces of sealed containers of asbestos waste by wiping with a damp cloth that is also to be disposed of as asbestos waste, or by using a vacuum cleaner fitted with a HEPA filter, before the containers leave the contaminant area/transfer room.
- (3) In the equipment transfer room, sealed containers must be packaged to withstand handling and transportation to the disposal site without being punctured or otherwise damaged.

- (4) A continuous clean-up and disposal program must be in place to prevent unnecessary accumulation of asbestos-containing waste materials at the work site. At the end of each workshift, all asbestos waste material must be properly contained. Prior arrangement must be made with appropriate authorities to deliver asbestos-containing waste to assigned dump sites. Transport drivers must be informed of the precautions that must be taken. Transport vehicles may be required to carry signs or placards specifying the nature of the cargo (see Section 3 and the *Transportation of Dangerous Goods Act*).
- (5) Disposal sites must conform to provincial and municipal requirements (refer to Section 3 on legislation and contact the Waste Management Branch of Alberta Environment for more information).

5.4.9 Air monitoring

Air sampling to determine airborne asbestos fibre concentration is required before and during the abatement work, and prior to removal of the enclosure. All air sampling must be completed by competent personnel following methods specified in the OHS legislation. Where possible, results should be made available to workers on the same day (or as soon as possible following the sampling). Sampling should include the following:

- (a) *before work starts in the work areas* — background samples to establish baseline airborne fibre levels;
- (b) *on a daily basis outside the enclosure* — sample when there are unprotected workers in the immediate vicinity of the enclosure. In some cases, sampling may be required in other areas such as the floors above or below, or in adjacent rooms, depending on the set-up of the work site and occupancy of these areas;
- (c) *during initial and subsequent stages of the abatement project* — personal sampling of workers conducting removal. Ensure that results are within acceptable limits for the respiratory protection selected. Personal samples should be collected at least daily, but can be collected more frequently depending on work conditions. Filters must be analyzed and results provided to workers within 24 hours;
- (d) *on a daily basis in the clean room* — sample during bulk removal operations. Sampling must cover at least half of the workshift and at least one shift of decontamination. Samples must be analyzed and results provided to workers within 24 hours;
- (e) *before the enclosure is dismantled* — the air inside the enclosure must be sampled. At a minimum, one sample should be collected for every 450 m² of enclosure area to determine suitability for re-occupancy. The final air test should be completed using aggressive sampling techniques (see Section 5.6.2).

The following criteria should be applied when reviewing airborne fibre test results:

- (1) If fibre levels inside the containment exceed the protection factor (see Section 6.1.3) of the type of respiratory protective equipment being used, work must stop until appropriate respirators are supplied and airborne fibre levels can be controlled.
- (2) If fibre levels measured outside the containment or in the clean room exceed 50 per cent of the OEL, work practices and the containment structure should be reviewed. If high levels continue, work must stop until the reasons for the high levels are identified and corrected. If fibre levels outside the containment approach the OEL, work must immediately stop until the reasons for the high levels are identified and corrected. Fibre levels outside the work area must never exceed the OEL.
- (3) Final air monitoring test results should be less than 0.01 fibres per cubic centimetre using aggressive sampling techniques (see Section 5.6.2). If the final air test fails, the containment cannot be dismantled. The work area should be glue-sprayed again and re-tested.

5.4.10 Site inspection

A competent person must perform the following checks regularly during the project:

- (1) Perform a smoke test to check the integrity of the removal area enclosure *before* any asbestos removal begins and *before* the exhaust units begin operating (see Section 5.6.3).
- (2) Visually inspect the enclosure *before* the start of removal work and at the beginning of each work shift. Any defect revealed during the inspection must be remedied immediately. Where necessary, additional air monitoring might be required to assess the impact of defect(s) noted.
- (3) Inspect all equipment used for the removal of asbestos material *before* the removal job begins, *following* repair and at least *once every seven days* where continually used. Maintain a record containing details of the equipment inspection and any repairs.
- (4) Inspect the temporary enclosure and the entire decontamination facility at least daily for gaps and breaks. This inspection includes a visual check as well as smoke testing to ensure that air flows from clean areas into contaminated areas. A record of these inspections should be kept.

- (5) *Continuously* measure and record air pressure differentials between clean and contaminated areas during the abatement project. Pressure differentials should be maintained at a minimum of five pascals (0.02 in water gauge).
- (6) Complete a walk-through inspection *after* the removal is complete and *before* sealant spray is applied to ensure that all visible asbestos in the area has been removed and the clean-up is satisfactory.
- (7) To ensure the site is adequate for re-occupancy by unprotected workers, complete a final walk-through inspection *after* the containment has been removed, but *before* the contractors complete demobilization.

5.5 Special cases

Removal of the numerous forms of asbestos-containing products, from various types of facilities, under a wide variety of circumstances, creates numerous special cases requiring non-standard approaches. However, the four basic principles of handling asbestos should always be followed:

- (a) isolate the work area;
- (b) protect workers;
- (c) minimize the release of fibres; and
- (d) ensure adequate clean-up and decontamination.

Using these principles, the detailed information describing low, moderate and high risk procedures can be modified to make asbestos abatement faster and more economical without sacrificing workers' health and safety.

5.5.1 Vinyl floor tiles

Asbestos fibres in floor tiles are bound within a vinyl matrix, contain relatively little asbestos (approximately 10 per cent by weight) and present little risk of being released into the environment during removal as long as proper procedures are followed.

Only hand tools such as ice scrapers are to be used during floor tile removal. Low risk procedures are adequate if no power tools or abrasive methods such as sanding are used during the removal. Pre-wetting or flooding of the tiles in advance of removal will greatly aid in their release from the floor. Mastic used to glue tiles to the floor also may contain asbestos fibres. This mastic should be removed using work procedures similar to those used for the removal of floor tiles. Floor tiles need not be removed before demolition unless they have an asbestos backing or asbestos containing leveling compound or adhesives are present under the tiles.

5.5.2 Dry removal

Dry removal should only be done where wetting the asbestos would create unacceptable worker and other safety hazards. Examples include working adjacent to electrical power sources that cannot be suitably protected from moisture or working around very sensitive equipment where the risk of water damage is unacceptable.

Workers must wear supplied-air respiratory protective equipment during dry removal of friable asbestos. For dry removal of non-friable materials, the respirator selected must provide adequate protection to ensure that worker exposure is below the OEL. Potential non-asbestos-related hazards such as electrical contact should be reviewed and appropriate steps taken to prevent an incident.

The dry removal area should be continually cleaned to prevent the accumulation of waste, with vacuuming preferred over dry sweeping. Barriers should be inspected regularly to ensure there are no breaks or holes.

Waste must be immediately placed in disposal containers. Where possible, use a high velocity local exhaust system at the point of removal to capture fibres released at the source. Where very small quantities of waste are involved, direct vacuuming with a vacuum cleaner fitted with a HEPA filter will greatly reduce fibre levels.

Since dry removal results in much higher airborne fibre levels within the containment, frequent and more intensive monitoring and more stringent procedures are required to minimize fibre release.

5.5.3 Outdoor removal

Weather conditions may influence whether or not work can be performed, with heat, cold or high winds making work unsafe. Mobile decontamination facilities, special work platforms and other specialized equipment may be required for outdoor removal.

Air samples taken each shift should include the air downwind of the removal area, around workers in the removal area and personal sampling of workers performing the removal. Personal samples should be taken at least once per day.

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 more information



http://humanservices.alberta.ca/documents/WHS-PUB_GS006.pdf

Best Practice – Working Safely in the Heat and Cold (GS006)

5.5.4 Removal under hot conditions

Hot removal should be avoided unless circumstances do not allow for the shut down of equipment and cooling off of the work area and equipment. When this is not possible, many of the standard high risk procedures are blended with special equipment and techniques to allow removal of asbestos from pipes, vessels or systems at high ambient temperatures. Standard glovebags can be effectively used up to 65 °C. Where boilers, vessels and other large systems are involved, hoardings must be erected to contain asbestos fibres. Fire resistant polyethylene is recommended where very high temperatures are encountered. The circulation of cooled air into the enclosure and very high rates of air exhausted through HEPA units will assist in controlling ambient temperatures. Only encapsulants with a temperature rating equivalent to the surface temperatures encountered should be used.

Workers should wear gloves, aprons and other heat resistant clothing to protect themselves from burns. Cloth coveralls rather than disposable ones will be more comfortable and afford greater protection. Vests with the ability to circulate a coolant may be considered.

An enclosure must be capable of withstanding and compensating for expected heat loads. Appropriate fire extinguishers and first aid supplies for burns and heat stress must be available in the work area. Localized exhaust at the point of removal activities can help cool the area and minimize the spread of airborne fibres via heat convection. Thorough wetting of asbestos-containing materials may be difficult when working next to extremely hot surfaces. Dry removal techniques may be required. The work area should be inspected to ensure that combustible materials cannot come into contact with hot surfaces.

The employer must have an emergency plan in the event of a fire or heat-related injury. Appropriate fire fighting equipment and personnel must be able to respond quickly. Workers should be trained and drilled in emergency escape routines in the event of fire. Workers must also be trained to spot and treat heat stress illnesses and minor burns.

Heat stress and burn hazards are potential problems. Therefore,

- (a) a buddy system for workers should be used to monitor signs of heat stress;
 - (b) heat stress monitoring should be done;
 - (c) a plentiful source of cool drinking water located outside the work area should be available for break periods;
 - (d) strict work/rest schedules must be carefully followed to prevent heat stress.
- Frequent rest breaks will be needed depending on the working conditions; and
- (e) cool lunchrooms or break areas should be provided.

The publication “Best Practice – Working Safely in the Heat and Cold” describes precautions to be taken when working under hot conditions.

5.5.5 Crawl spaces and attics

Work in crawl spaces may present unique problems such as the presence of dirt floors and confined space entry hazards. Wheeled dollies to allow greater mobility may be needed, as well as extra lighting, kneepads and hard hats.

Where practicable, glovebag removal is recommended. If not, high risk removal practices are required. Examples of such situations include where the quantity of asbestos prevents a cost-effective job, where the asbestos is mixed into the dirt floor of a crawl space or where there are space constraints.

The employer must have plans in place to deal with workers who get stuck in tight spots or with getting them out in the event of an injury. The use of a buddy system and two-way radios may be appropriate. Areas considered confined spaces require stringent site-specific procedures and a written code of practice for confined space entry.

Where high risk procedures are followed and the dirt floor is contaminated, polyethylene sheeting on the floor is not required. Any openings in the floor or walls should be sealed airtight and the rest of the preparation practices for high risk removal must be followed.

Where dirt floor crawl spaces are encountered, any asbestos mixed in with the dirt must be removed. Contaminated dirt must not be spread around either within or outside of the work area. All dirt removed must be disposed of as asbestos waste. If it is not practical to remove contaminated dirt, it may be possible to apply a sealant to the surface to trap asbestos fibres. However, if the dirt is left in place, a management plan is required.

After removal of the contaminated dirt, the crawl space should be checked to verify that all gross contamination has been removed. This can be done by digging through the dirt in several test spots, taking samples and checking them for asbestos.

5.5.6 Encapsulation

Encapsulation involves the application of a sealant to the surface of asbestos-containing materials to prevent or minimize the release of asbestos fibres. This process is not recommended on highly friable surfaces because of the risk of fibre release during sealant application. Bridging encapsulants bond to the surface of asbestos-containing materials to provide a protective seal while penetrating encapsulants are absorbed into the material and bond fibres together.

Manufacturers' directions should be followed to determine the appropriate equipment required when applying an encapsulant. The encapsulant should comply with Canadian General Standards Board (CGSB) Standard CAN/CGSB-1-205-94, *Sealer for Application to Asbestos Fibre Releasing Materials*, or an equivalent standard.

High or moderate risk removal methods should be used, depending on the size of the job, the friability of the asbestos and the potential for fibre release. Encapsulated asbestos-containing materials must be inspected to ensure that:

- (a) the entire asbestos surface has been adequately encapsulated;
- (b) the thickness of the encapsulating film meets the manufacturer's requirements if a bridging encapsulant has been used (make test holes as required); and
- (c) penetration of a penetrating encapsulant meets the manufacturer's requirements if a penetrating encapsulant has been used (make test holes as required).

5.5.7 Enclosure

Enclosure involves covering asbestos-containing materials with a physical barrier such as plywood or gypsum board. For mechanical insulation, the physical barrier may consist of painted and labelled canvas wrap or labelled metal jacketing. The intent of enclosure is to prevent physical contact with asbestos-containing materials, thereby preventing fibre release. Where friable materials are enclosed, the same precautions used for high risk removal in terms of work area set-up, personal protection, decontamination, etc., should be followed. Moderate risk procedures may be appropriate where the potential for fibre release is much lower as may be the case when enclosing non-friable products.

The appropriateness of enclosure must be considered, as well as the materials and their means of application. The disadvantages of enclosure include its complexity and the fact that asbestos is still left in place.

Personal protective equipment selection must be based on expected levels of airborne fibre concentrations generated during the project. Equipment selection and use criteria appropriate for moderate and high risk abatements should be used.

During installation of the enclosure material and required support system, the release of asbestos fibres can be minimized by lightly misting the asbestos-containing materials and using care when contacting them. All barriers and materials used during the installation that cannot be cleaned must be disposed of as asbestos waste.

Upon completion, the enclosure must be inspected to ensure that:

- (a) the entire surface of the asbestos-containing material is adequately enclosed;
- (b) the enclosure forms an air-tight barrier; and
- (c) the enclosure is securely fastened to nearby support structures or directly to the asbestos-containing material.

5.5.8 Glovebag removal

A glovebag allows the removal of asbestos-containing materials from mechanical components such as piping, valves, fittings and small dimension duct work without constructing an elaborate containment. This becomes cost effective where small quantities of material are removed from within a large area, eliminating the need to completely hoard the area. Glovebag removal of asbestos-containing materials is considered a moderate risk project unless the work area meets the definition of a "restricted area".

Glovebags come in a variety of types and styles. Some are multi-use, meaning they can be moved along a pipe as removal progresses. Other glovebags are taped in place and used only in that one location before being discarded.

Other equipment required for glovebag removal includes:

- (a) vacuum cleaner fitted with a HEPA filter;
- (b) polyethylene drop sheets having a minimum six mil thickness;
- (c) six mil thick labelled asbestos disposal bags;
- (d) spray bottle or hand pump garden sprayer to wet asbestos;
- (e) water and wetting agent;
- (f) duct tape or tape having similar or better strength;
- (g) utility knife with retractable blade;

- (h) wire cutters; and
- (i) flexible wire saw.

Determine the type, style and quantity of bags appropriate for the job. If possible, work should be performed when building occupants or other workers are not present in the immediate vicinity of the work area. In any event, the work area should be cordoned off using banner tape and warning signs.

Glovebags must not be used on pipe insulation that is not covered with a wrap such as Caposite. Without a wrap, fibres can be released during installation of the glovebag and when it is moved along the pipe.

5.5.8.1 Work Procedures

Before working with a particular type of glovebag, workers should read and understand the manufacturer's instructions for use. In general:

- (1) Place a polyethylene drop sheet beneath the area in which the glovebag is to be installed.
- (2) Prior to applying the bag, seal any loose insulation by wrapping it with polyethylene.
- (3) Prior to starting the removal, clean up any loose asbestos debris on or around the pipe with a vacuum cleaner fitted with a HEPA filter.
- (4) Assemble all the required tools and equipment.
- (5) Place the tools in the bag and seal the bag to the pipe. Insert the nozzle of the garden sprayer into the bag and seal the opening. Similarly, insert the nozzle of the vacuum cleaner fitted with a HEPA filter into the bag and seal the hole. Ensure that the weight of the hose does not pull the bag off of the pipe.
- (6) Place hands into the gloves and using the tools, cut and remove any jacketing. Wet exposed insulation to reduce fibre release.
- (7) Remove the insulation, wetting it and arranging it in the bottom of the bag.
- (8) Using a wire brush, abrasive pad or scraper, clean asbestos residue off of the pipe or fittings.

- (9) Wet and seal the exposed ends of the insulation. The sealant should also be applied to the inside upper section of the bag prior to removal of the bag.
- (10) Place tools in the glove and pull the glove out of the bag so the tools are inside the glove. Twist and double tape the glove to create a pouch that can be cut off. The tools may now be placed into the next glovebag or into a pail of water for cleaning. For cleaning, open the pouch under water and clean the tools thoroughly.
- (11) Suck the air out of the glovebag using the vacuum cleaner. Twist the lower section of the bag containing the waste and seal it with tape. Slowly remove the tape connecting the bag to the pipe. Place the bag into an asbestos waste disposal bag and seal. Disposable clothing and drop sheets must also be disposed of as asbestos waste.
- (12) All work equipment, including work clothing, should be cleaned by damp wiping or with a vacuum cleaner fitted with a HEPA filter.
- (13) Workers should wash their hands and face before leaving the work area.
- (14) The surfaces from which asbestos has been removed should be visually inspected after removal of the glovebag to ensure that there is no remaining asbestos residue.

Glovebags are to be used once and then disposed of. They must not be cleaned and reused. Standard glovebags must not be used on piping at temperatures exceeding 65 °C. Check with the glovebag manufacturer for the recommended range of temperatures in which the bag can be used.

5.5.8.2 Air Monitoring

Personal or breathing zone air samples should be taken at least once per shift to ensure that the work is being performed without the release of fibres (measured levels should not be above baseline or background sample results). However, there may be circumstances where air monitoring is not required or practical. These include the following:

- The employer has documentation that fibres will not be released. This would apply to a long term project where glovebag activities are occurring over a period of time or to ongoing maintenance activities where the same workers and procedures are used each time. In these cases, monitoring would be required occasionally to demonstrate that fibres are controlled when the work is done, but not necessarily each time a glovebag operation is performed.

- The work is of very short duration. When NIOSH Method 7400 is used to evaluate exposure, the air flow rates during sampling may range from 0.5 to 16 litres per minute. The limits of quantification in the method are based on passing 400 to 1000 litres of air through the filter during the sampling period. So, assuming the maximum flow rate is used, the sample period must be at least 25 minutes to meet the minimum volume requirements in the NIOSH method. A longer sampling period is required if a lower collection flow rate is used. This applies to an individual glovebag operation; it is not acceptable for the employer to split the work into shorter periods to avoid conducting air sampling. Also, this would not apply in cases where the workers are conducting a number of glovebag operations consecutively (for the same or different materials) over the work shift. Where air monitoring cannot be done due to the short duration of the work, the employer must have written work procedures in place and supervise the work to ensure that there is minimal potential for worker exposure to asbestos.

5.5.9 Pre-demolition asbestos removal

Prior to demolition of a building, all asbestos-containing materials which can release fibres during the demolition must be removed. The type and quantity of materials present will dictate the procedures used for abatement, although some special considerations need to be made for demolition projects. Because the building is being demolished, all asbestos-containing materials must be removed, including those hidden in shafts, chases, between walls, above false ceilings and in other hidden locations. Cutting holes into these potential spaces may be required. Care must be taken to ensure that all these spaces are examined. All pipes should be traced from their source to their termination and all asbestos-containing materials removed.

An effective method of removing asbestos covered pipes during demolition projects is the “wrap and cut”. The method involves wrapping a portion of the insulated pipe with polyethylene and then the pipe itself is cut through on either side. The wrapped pipe and insulation are then disposed of as asbestos waste. Normally this “wrap and cut” operation can be conducted as a low risk removal. Glovebag removal of asbestos-containing materials at the points where the pipe is to be cut must be done first.

Where high risk procedures are used, applying polyethylene sheeting to floor and wall surfaces is usually unnecessary. Openings in the floor or walls should be sealed airtight and the rest of the preparation practices for high risk removal should be followed. Drop sheets are useful in collecting bulk debris during early stages of removal.

Air monitoring can be less intensive for pre-demolition if the building is not occupied. Personal or breathing zone, clean room and final air test samples would suffice.

In some specific cases, asbestos-containing materials may be left in place during demolition. However, an Acceptance from Section 34 of the OHS Code is required.

Criteria that are evaluated when granting the Acceptance are:

- the asbestos content of the material is less than five per cent chrysotile
- the asbestos containing material is non-friable
- demolition will be done by machine
- water will be used for dust control
- the material is problematic to remove and removal would create more of a hazard to workers
- alternative work procedures will provide equivalent or better protection to workers.

For more information, refer to the following Occupational Health and Safety publication



http://humanservices.alberta.ca/documents/WHS-PUB_ASB003.pdf

Asbestos Containing Materials in Buildings to be Demolished – ASB003

5.5.10 Handling or removal of vermiculite containing asbestos

A form of vermiculite insulation, called Zonolite, which was produced from the W.R. Grace and Company mine in Libby, Montana from the 1920s to 1990, may be contaminated with asbestos. Not all Zonolite that was produced came from the same mine, and even within the product from the Libby mine there was considerable variation in the concentration of asbestos fibres. The only way to know whether the material contains asbestos is to have it tested. However, even where the concentration of asbestos fibres is less than one per cent in the product, hazardous concentrations of airborne fibres can result when the material is disturbed.

More information on vermiculite insulation containing asbestos is available on the Health Canada website www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/insulation-isolant-eng.php

5.5.10.1 Collecting a Sample of Vermiculite Insulation

Procedures for sampling vermiculite insulation are somewhat different than for other asbestos containing materials. The objective is to determine whether or not the product is of the type that is asbestos contaminated (contains asbestos fibres) rather than determine how much asbestos is present. There are three important factors that must be considered when sampling this material:

- (1) The concentration of asbestos in the product is highly variable, so more than one sample is required.

- (2) Because asbestos fibres can be present at low concentrations, typically a larger sample size is required.
- (3) Asbestos fibres tend to fall off from the product and settle at the bottom of the insulation layer. Samples must be taken that represent the entire thickness of the insulation layer.

The sampling procedure should follow the basic steps outlined below. This procedure may need to be modified, depending on where and how the material is installed.

Equipment

- four litre plastic bag (such as a large heavy duty zip lock freezer bag)
- metal scoop with a flat edge
- appropriate protective equipment (gloves, coveralls, half-mask respirator with high efficiency particulate filters such as P100s)

Procedure

- (1) Insert the scoop into the insulation until it reaches the bottom substrate, move it along the bottom and raise it through the remaining material. Deposit the material collected into the plastic bag.
- (2) Collect multiple scoops at random spots to make up the sample.
- (3) Seal the bag and wipe the outside with a damp cloth (or place bag into another bag).
- (4) Label the sample.
- (5) At least three four litre samples should be taken at each sampling site. The scoop should be cleaned between samples.

Sample Analysis

It is not unusual for vermiculite to contain asbestos in concentrations below one per cent. However, the concentration can be variable and hazardous concentrations of airborne asbestos fibres can be generated even when the concentration is below one per cent if the material is disturbed. There are a few options for sample analysis; some methods are quantitative (provide a precise concentration), some are qualitative (provide an estimate of concentration). In either case, the key is to determine whether the product is contaminated with asbestos. In the absence of sampling and analysis data or other information that shows that the vermiculite is not contaminated with asbestos, it is assumed that the product is contaminated.

For quantitative analysis, the US Environmental Protection Agency (EPA) has developed a specific analytical method for vermiculite in their publication *“Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation”*.

It is noted that some laboratories may not be able to provide this type of analysis. This method uses transmission electron microscopy (TEM) and can achieve detection limits from 0.1 to 0.0001 per cent.

For more information:

<http://www.epa.gov/asbestos/pubs/vairesearchmethodfinal.pdf>

Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation

www.epa.gov/asbestos/pubs/vermiculite.pdf

Sampling and Analysis of Consumer Garden Products that Contain Vermiculite

The more common method for analyzing vermiculite samples is the USEPA Method EPA/600/R-93/116 "*Method for the Determination of Asbestos in Bulk Building Materials*". There is also a NIOSH method (NIOSH Method 9002, *Asbestos (bulk) by PLM*). These are qualitative methods (inspection of the sample under a stereoscope which can be combined with point counting). A detection limit of 0.1 to 0.25 per cent can be achieved, depending on the point count method used. While not quantitative, these methods may be sufficient for vermiculite samples, if a competent analyst completes the analysis. If the analyst visually detects asbestos fibres, either during stereoscope examination or during the PLM examination, the sample is positive for asbestos and it is not necessary to determine the precise asbestos concentration to confirm that there is a risk of asbestos exposure so precautions are required. If the analyst does not visually detect asbestos fibres during the analysis, then the sample should be sent for TEM analysis.

For more information:

www.epa.gov/ne/info/testmethods/

USEPA Test Methods

www.cdc.gov/niosh/docs/2003-154/

NIOSH Manual of Analytical Methods

5.5.10.2 Handling and Removal of Vermiculite Insulation

If vermiculite insulation is known or suspected to be contaminated with asbestos, it must be treated as an asbestos containing material, even if the actual concentration of asbestos in the product may be less than one per cent. For demolition projects, the materials must be removed from a structure before the building is demolished due to its potential to release asbestos fibres when disturbed.

Two of the most common removal scenarios are when loose vermiculite is present in concrete block walls or in attics as insulation.

Vermiculite in Concrete Block Walls

In concrete block walls the vermiculite was often poured into the vertical cavities. The material may be present in the vertical cavities and there may be small amounts in the joint cavities. The vermiculite that is in the joint cavities cannot be removed without compromising the structural integrity of the building. This remaining vermiculite must be taken into account at demolition sites to ensure that workers handling or moving debris are adequately protected.

Work procedures will depend on the construction of the wall and conditions at the work site. Usually the material is removed by creating an opening at the base of the wall and allowing the material to drain by gravity. Where holes will be made in a wall to remove the vermiculite, an engineer may need to be consulted to ensure that the removal does not compromise the building integrity. Wetting the insulation in the wall is usually not effective, as the insulation will then stick to the inside of the wall. As a result, fibres will be released as the material drains from the wall. Results from occupational measurements on workers involved in removing vermiculite from concrete block walls using high risk procedures and water to mist the area near the wall opening, show that exposure levels can reach 0.3 f/cc. If the work is done with no water and no negative air units, fibre levels can reach 0.9 f/cc. Work areas in which the OEL for asbestos (0.1 f/cc) is exceeded are defined as “**restricted areas**” in the OHS Regulation. For this reason, abatement projects involving the removal of vermiculite from concrete block walls are considered “high risk” projects.

If the insulation is removed by gravity, the following work procedures should be used:

- (1) Employers must ensure that requirements in Part 4 of the OHS Code that apply to asbestos are complied with.
- (2) Containment should be set up around the work area. This may range from a full containment as described in Section 5.4 to a small containment built around the opening in the wall from which the material is drained. The containment should be designed so that negative pressure can be maintained inside it and so that there is sufficient air flow (at least four air exchanges per hour).
- (3) A waste bag is taped to the wall to catch the draining material.
- (4) A hole is made in the concrete block wall while negative pressure is maintained in the containment.
- (5) As insulation drains into the bag, the waste in the bag should be wetted down.

- (6) Waste bags are cleaned and double bagged. Since, the material meets the definition of an “asbestos waste” in the OHS Code, it must be handled as such.
- (7) Worker decontamination facilities should include a shower and clean change room.
- (8) Some residual material will remain in cavities in the concrete blocks. If the wall is to be demolished following removal of the insulation, wet demolition techniques should be used.
- (9) Air monitoring should be done before work commences, during the opening of the wall and during the removal. Air monitoring should also be done outside the containment area.
- (10) Final visual inspection, glue spray and air testing should be done prior to teardown of the containment.
- (11) Workers on the project should be provided with appropriate protective equipment (see Section 5.4.3)

Loose Fill Insulation in Attics

Vermiculite used in attics as insulating material is generally loose and exposed. There is a high risk of fibre release if the material is disturbed. Fibre levels ranging from 0.15 to more than 1 f/cc have been measured in the breathing zone of workers involved in the removal of this material. If proper removal techniques are used, the project can be done using moderate risk removal procedures. However, monitoring must be done during the removal to ensure that fibre levels do not exceed the OEL. Otherwise, high risk removal procedures are required.

In general:

- (1) Removal of material should include:
 - Isolation of the work area to control fibre release.
 - Use of a HEPA filtered vacuum truck to suck out loose insulation. This should be done with as little direct contact with the insulation as possible.
 - If a HEPA filtered vacuum truck is not used, then a negative air unit equipped with HEPA filters should be installed to remove air from the work area and maintain a high level of air movement (six to 12 air changes per hour). This will help reduce airborne fibre levels in the work area and reduce the chance of leakage to occupied areas of the structure.
 - Water may be used to control dust, however it may also cause the vermiculite and asbestos fibres to adhere to the rough surfaces of the attic space.

- (2) Workers should be provided with appropriate protective equipment (usually full facepiece powered or non-powered respirator with P100 filters) and decontamination facilities (depending on the extent of work, showers may be required).
- (3) Waste should be disposed of in leak-tight containers.
- (4) Air sampling should be conducted during the work to ensure that workers are protected. Air monitoring should be done in the area where the material is being disturbed, as well as in a location outside this area.
- (5) Once the removal is complete, the area, particularly rough surfaces, should be thoroughly HEPA vacuumed and visually inspected for residual material. Once this is complete, all surfaces must be glue sprayed and clearance air sampling done to ensure that the clean up is complete (see Section 5.6.2).

Note that if the material is contained in an enclosed space where there is little potential for contact or being distributed, it can be safely left in place. If it is left in place, the employer must develop a suitable management plan.

5.5.11 Asbestos in Asphalt

From about the early 1960s to the mid-1980s, asbestos was put in some asphalt mixes used in road paving and curbing to improve durability. The products contained one to two per cent chrysotile asbestos by weight. While these products were not used in every jurisdiction, their use was fairly widespread in Canada. This product does not present a hazard where the paving material remains intact and is not abraded or ground up. There may be a potential hazard where the asphalt is resurfaced or processed and stored for recycling. Since there are limited records available as to where these products were used in Alberta, it is assumed that asphalt paving on roads contains asbestos unless there are test results to show otherwise.

There are a number of operations in which asphalt may be disturbed:

- Planing (grinding up asphalt using planers and transferring the wetted material into trucks)
- Hauling (transferring milled asphalt or new asphalt to trucks)
- Stockpiling (storage of bulk aggregate and recycled asphalt in a yard, stockpiles must be maintained using a variety of equipment at the yard)
- Loading and handling
- Saw cutting and jackhammering (small sections of road are cut and broken out)

- Recycling (material is broken down, separated and mixed at a recycling plant to form new asphalt)
- Paving (new asphalt is applied over old asphalt or previously milled surfaces)

When conducting asphalt removal, cutting, milling, grinding or grooving:

- (1) Removal methods that may create airborne dust should be avoided.
- (2) Water should be applied during these activities to control dust.
- (3) Air monitoring should be done. There should not be asbestos levels in air samples above background levels while these activities are done.
- (4) Stockpiles of recycled asphalt should be kept covered or enclosed as much as possible.

For operations that involve handling the asphalt in which the material can be kept wet or hot, asbestos related precautions are not required, as long as monitoring data shows that asbestos levels in air samples are not above background levels. For operations that are done with no water (e.g. dry cutting), low risk asbestos procedures are needed. Note that the use of these procedures will have the added benefit of protecting workers from other hazards (such as airborne particulate) associated with this type of work.

5.5.12 Emergency Response

Emergency responders (fire department personnel, paramedics, on-site emergency response teams) may be required to deal with situations such as fires, spills and medical emergencies during an asbestos abatement project. Though dealing with the emergency will take precedence over standard asbestos abatement work procedures, care must still be taken to protect workers who may be involved.

5.5.12.1 Emergency Plan

The employers involved in the abatement activities are responsible to prepare an emergency plan and ensure that workers are trained on the procedures to follow.

The emergency plan must address:

- Location of work site fire alarms
- Instructions for who to contact in the event of an emergency
- Exit routes out of the enclosure and immediate work area

- Evacuation procedures and routes out of the building
- Muster point for workers wearing contaminated clothing (this should be separate from the muster point used for other personnel evacuated from the building)
- Procedures for decontamination or segregation of workers who may be contaminated
- Repair and clean-up of the abatement work area once the emergency has been dealt with

The employer must ensure that they know who is present at the work site at any given time so that all personnel can be accounted for if an evacuation is necessary.

The employer must inform emergency responders, when they arrive at the work site, where the safe entry and exit points are located and whether all workers are accounted for. As well, the employer must ensure that emergency responders are informed that the area is contaminated with asbestos.

5.5.12.2 Emergency Procedures: Fire, Explosion and Spills

Fire can create an immediate danger to life and health. For example, a fire hazard may become so severe that workers may need to break through the polyethylene barriers on the abatement containment. In a fire emergency, workers may not have time to decontaminate before leaving the work area. If this is the case, workers should keep all protective clothing and respirators on while they evacuate to the muster area.

In the course of responding to the fire or spill, fire department personnel and emergency responders may disturb materials that contain asbestos. Standard duty gear and SCBAs will provide acceptable protection from the asbestos hazard. However, this equipment must be properly decontaminated by fire department personnel before responders enter their vehicles and leave the work site. Cleaning with water and a mild detergent solution is acceptable for this purpose. Gear that cannot be wetted can be vacuumed with a HEPA filtered vacuum and then wiped with a damp cloth or disposable wipe. Decontamination should be done in a separate outside area, designated for this purpose. Workers should wash their face and hands once they have removed their protective equipment. Water used should be collected and may be disposed of in a sanitary sewer. If it is not possible to decontaminate gear before leaving the work site, the equipment (including respirators and footwear) must be placed in plastic bags which then must be sealed and labeled as asbestos contaminated. This equipment must be sent to the appropriate location for decontamination before it is used again. Workers must not take equipment or clothing home for cleaning or laundering.

In responding to circumstances that involve a fire or spill, there may be additional chemical or physical hazards at the work site for which responders require protection,

over and above the asbestos hazard. Depending on the hazards involved, standard duty gear may not be sufficient or appropriate. Prior to entry into the work site, responders must ensure that they check with on-site personnel to identify other hazards that may be present and that they have the appropriate protective clothing and equipment for these hazards.

5.5.12.3 Emergency Procedures: Medical Emergencies

A serious injury or medical emergency is a more immediate concern than short-term asbestos exposure. The employer is responsible to ensure that workers are trained on how to respond to a medical emergency and designated first aiders must be present at the work site. If it is safe to do so, first aiders must remove the injured worker from the abatement area to the clean room unless the worker has sustained a head, neck or back injury. Moving the worker minimizes exposure of emergency response personnel and their equipment to asbestos. The first aiders must decide whether it is appropriate (or possible) to decontaminate the injured worker or remove other protective clothing and equipment.

In cases where it is not safe to move the worker from the abatement area, external emergency personnel may be contacted to do so, such as the fire department. Standard duty gear and SCBAs will provide acceptable protection to fire department personnel from the asbestos hazard. Paramedics who respond to a medical emergency must at least wear disposable coveralls and properly fitted half-face respirators equipped with R or P-100 filters. Emergency responders may be required to remove the worker's contaminated protective clothing. If so, this clothing should be placed in a plastic bag which is then sealed and labeled as asbestos contaminated. If not, contaminated clothing should be covered with a blanket or towel while the worker is transported to hospital for treatment. Emergency response personnel must inform hospital staff that the worker is wearing contaminated clothing or equipment. The worker should be placed in a negative air room until they can be decontaminated, if possible. Paramedics should continue to wear their protective clothing while transporting the worker in this case.

Emergency response personnel should ensure that their protective clothing and respirators are removed before leaving the work site unless the injured worker cannot be decontaminated. Disposable equipment and clothing should be placed in a plastic bag which is then sealed and disposed of as asbestos waste. Re-useable equipment should be cleaned with water and mild detergent solution or vacuumed with a HEPA filtered vacuum and wet wiped. If it is not possible to decontaminate protective equipment and clothing before leaving the work site, the equipment (including respirators and footwear) must be placed in plastic bags which then must be sealed and labeled as asbestos contaminated. This equipment must be sent to the appropriate location for

decontamination before it is used again. Workers must not take equipment or clothing home for cleaning or laundering.

If the worker is transported while wearing contaminated equipment or clothing, the ambulance may also require decontamination. The employer must ensure that workers involved have suitable training and equipment. This may be limited by covering the worker with a blanket or towel (the blanket or towel must be treated as asbestos contaminated). Cleaning with a HEPA filtered vacuum and wet wiping should be done to ensure that surfaces in the vehicle are decontaminated.

5.5.12.4 Removal of Asbestos Insulation on Elevated Insulated Pipelines

There are situations, primarily on industrial worksites, where insulation has to be removed from pipelines that are hot because the processes are still operational. In these circumstances, conventional glovebag techniques may not work since the bags would melt when they come into contact with the exposed lines. One option is referred to as the “Trough” or “Open Air” Method. This method may also be used when the application of traditional glovebag to abate cold line systems is not practical, however other options for abatement should be considered first.

Unlike traditional glovebag removal methods loose debris is contained in a catch-basin or trough suspended under the area being abated while intact sections of insulation are removed and placed in bags or other suitable containers. Since there is no enclosure, this process is considered a high-risk abatement.

Before undertaking this form of abatement, the following items must be considered:

- Type of material being removed
- Condition of material
- Use of appropriate fibre control methods (e.g. use of amended water may not be applicable or effective)
- Environmental conditions (e.g. wind speed, temperature)
- Access to work area (e.g. scaffold, man-lift)

Specific procedures for this type of abatement must be developed based on the criteria above and any other work site specific conditions.

One of the key factors that must be considered is the control of fibre release. Both workers directly involved in the abatement and those in adjacent areas must be protected from airborne asbestos fibres. Use of amended water is one of the main methods of control used for this method, however there is a risk of contaminated water

being spilled or released which can result in asbestos contamination below. Water used during the abatement will have to be disposed of appropriately. In addition, water may not be effective for fibre control on very hot lines (water will evaporate too quickly) or very cold lines (water will freeze).

Due to the higher risk of fibre generation, this process requires constant air monitoring using personal samples to assess the adequacy of the control measures being used and ensure that adequate respiratory protection is used by workers. If the fibre concentrations in the personal samples reach or exceed 0.05 fibres/cm³, the work should stop and work procedures reassessed.

Work procedures should address:

- High wind events (e.g. greater than 20 kilometres/hour)
- Encountering sections of damaged or degraded insulation
- Elevated fibre concentrations on personal and area (perimeter) samples
- Situations where water cannot be used or is ineffective
- Worker and tool decontamination (a remote location will need to be used)
- Rescue of an injured worker from an elevated work platform
- Fire evacuation procedures
- Spill procedures

5.6 Test procedures

5.6.1 Testing HEPA Filters

HEPA filters are rated for a minimum particulate removal efficiency of 99.97 per cent for particles down to 0.3 microns in diameter. All HEPA filters should be factory tested using a “hot” DOP challenge or its equivalent. While there is no requirement for the tester to be certified, they still must be competent (have suitable training and experience) to do the testing.

When field testing HEPA filters,

- (a) filters must be tested at their rated air flow for proper results;
- (b) filters should not be used in equipment that exceeds their labelled air flow rate; and
- (c) testing is designed to detect leaks in filters, gaskets or related equipment. It will not be as accurate as factory testing since air flow and temperature cannot be controlled as accurately.

Test procedures

Equipment used to test HEPA filters consists of a DOP hot smoke generator capable of generating particles down to 0.3 microns in diameter. A photometer is used on the

downstream side of the filter to detect leaking particles. The photometer must be able to detect particles down to 0.3 microns in diameter. Agents other than DOP may be used if they can produce equivalent results. Poly-alpha olefin type material, approved as a substitute for DOP, is one such agent.

- (1) The equipment is visually inspected for sources of leakage such as cracked frames, holes or damage. The filter must be properly installed and meet or exceed the air flow rating of the equipment in which it is installed.
- (2) The DOP smoke generator must reach the proper temperature to ensure that small range particles are generated.
- (3) For draw-through style negative air units (air is drawn through the filter and then blower),
 - (a) place the photometer probe in the duct, directly in the exhaust of the blower;
 - (b) control the DOP smoke generated with a hose; and
 - (c) pass the smoke slowly over the entire filter and gaskets. While doing so, watch the photometer for signs of leakage in excess of 0.03 per cent.

If a leak is detected, repairs can be made or the filter changed and the equipment retested. It is recommended that no more than two per cent of the filter and gasket surface be affected by the repair.

- (4) For blow-through negative air units (air is passed through the blower and then through the filter),
 - (a) DOP smoke is generated at the air intake where it is misted into the blower unit and dispersed over the filters; and
 - (b) the photometer probe is passed over the entire area of the gasket and back and forth over the filter.

If leaks in excess of 0.03 per cent are detected, the filter must be repaired or replaced and then re-tested.

- (5) For vacuum cleaners fitted with a HEPA filter, introduce DOP smoke at the vacuum cleaner's suction inlet and monitor the exhaust with the photometer probe to detect leaks in excess of 0.03 per cent.

If the unit fails, it may be repaired but no direct repairs to the filter should be done — a new filter should be installed. If exhaust air is used to cool the motor fan, some particulate may be produced from the carbon brushes of the motor and affect the test. Test the vacuum exhaust, not the fan cooling exhaust. (Vacuum cleaners fitted with HEPA filters should be tested each time the filter is replaced and at least once per year if they are only used occasionally).

- (6) Equipment passing the DOP test should be labelled with the test date and the name of the tester. A log should be kept for each piece of equipment.
- (7) The person performing the test should check and note the physical condition of the equipment, e.g. electrical connections, wheels, etc., at the time of the test.
- (8) DOP test equipment should be maintained and factory calibrated at least annually. The person performing DOP testing should be trained to understand the test procedure and equipment being tested.

5.6.2 Aggressive air sampling

Aggressive air sampling is done at the completion of a high or moderate risk project prior to removal of the enclosure. The following procedure, developed by the U.S. EPA and published in the Agency's manual *Guidance for Controlling Asbestos Containing Materials in Buildings*, is an example of a procedure that can be used:

- Before starting air sampling pumps, direct the exhaust from forced air equipment such as a 1 horsepower leaf blower, against all walls, ceilings, floors, ledges and other surfaces in the enclosure. This should take at least five minutes per 93 m² (1000 ft²) of floor area.
- Place a 51 cm (20 in) fan in the centre of the room (use one fan per 283 m³ or 10,000 ft³ of room space). Put the fan on low speed and point it towards the ceiling.
- Start the sampling pump(s) and sample for the period of time required to collect the volume of sample.
- Turn off the pump(s) and fan(s) when sampling is completed.

If testing reveals that contamination levels are exceeded, the sampling equipment must either be properly decontaminated, wrapped for use on subsequent projects (if this is possible), or discarded.

5.6.3 Smoke testing of enclosures

For high risk abatement projects, a smoke test is conducted to check the integrity of the enclosure prior to the removal beginning and before exhaust units are operated. This test is done in conjunction with a thorough visual inspection of the enclosure.

Smoke testing may be done using a smoke bomb or smoke generator. Other procedures may be used if they can produce equivalent or better results. For simple containments where there is little possibility of leakage to adjacent areas, a smoke pencil may be adequate to test airflow patterns.

Workers required to be inside the enclosure during the smoke test must wear appropriate protective equipment.

Test procedure

- (1) The fire department and building occupants, as applicable, should be notified prior to the smoke test.
- (2) Conduct a thorough visual inspection of the containment to ensure it is free of unintended holes or openings.
- (3) Ensure that DOP tested negative air units are functional and equipped with exhaust ducting that is vented outside the building.
- (4) Ensure all door flaps are in place and are able to both seal the containment under static conditions and allow inward flow of make-up air when negative air units are running.
- (5) Turn off all negative air units.
- (6) The smoke used must be able to stay dispersed in the air for 30 minutes.
- (7) (a) If smoke bombs are used:
 - (i) follow the manufacturer's recommendations on the quantity or size of smoke bombs required to produce an adequate coverage of smoke;
 - (ii) use a metal pail or equivalent non-flammable container, placing it on the floor or the containment. Place an insulating material such as a sheet of fiberglass, fire blanket, etc. between the container and the containment floor to prevent melting the polyethylene drop sheet;
 - (iii) ignite the smoke bomb(s) and place it in the non-flammable container. The worker igniting the smoke bomb(s) must wear appropriate eye and respiratory protective equipment;
 - (iv) exit the containment as soon as the smoke bomb(s) ignites; and
 - (v) allow approximately 10 minutes for the smoke to evenly disperse throughout the containment. Even disbursement can be confirmed visually.
- (b) If smoke generators are used:
 - (i) the operator of the smoke generator should wear appropriate eye and respiratory protective equipment;
 - (ii) the operator should be aware of the heat produced by the generator and exercise caution;

- (iii) in a logical pattern, starting at the top or area furthest away from the decontamination area, expel smoke to fill the containment; and
 - (iv) visibly confirm that the smoke is evenly dispersed and exit the containment.
- (8) Conduct visual inspections:
 - (a) all external surfaces of the containment and structures to which the containment is attached should be inspected for leaking smoke;
 - (b) once leaks have been identified, activate the negative air units. Take note of the time required for the smoke to clear;
 - (c) verify that all areas within the containment are clear of smoke to ensure that “dead air spots” are not present;
 - (d) when the smoke has cleared, necessary hoarding repairs can be made; and
 - (e) repeat the smoke test to verify that repairs are adequate.
- (9) The integrity of the containment is confirmed if smoke is not detected outside the containment.
- (10) Activate the negative air units. Time how long it takes for the smoke to clear. Verify that all areas within the containment are clear of smoke to ensure that “dead air spots” are not present. Based on clearing time, calculate the actual number of air exchanges per hour. Calculations involving negative air flow (ft³) and the containment volume only establish the theoretical number of air exchanges per hour. The industry standard is at least four actual exchanges per hour.
- (11) Document the smoke test results and clearing times.

5.6.4 Sampling of materials suspected to contain asbestos

5.6.4.1 Bulk Sampling

Bulk samples of materials suspected to contain asbestos must be collected by a competent person. It is considered to be a low risk activity and the appropriate procedures need to be followed.

- (1) Sample materials when the immediate area is not in use and there are no unprotected workers nearby. (Only the persons doing the sampling should be in the immediate area.)
- (2) Spray the material with a light mist of water.

- (3) Take the sample in a manner that avoids disturbing it any more than necessary. If there is a cover over the suspected asbestos which must be damaged for access, it must be properly repaired immediately after the sample is collected.
- (4) Take a representative sample from within the material by penetrating the entire depth of the material, since materials may have been applied in more than one layer or covered with paint or another protective coating.
- (5) Ensure that materials having different appearances, colours or textures are sampled separately.
- (6) Place the samples in sealable, impervious containers and label them as laboratory samples. The containers should have WHMIS labels that contain the following information (sample quantity less than 10 kg):
 - Product identifier
 - A statement to the effect that the material may contain asbestos.
 - The statement "Hazardous laboratory sample. For hazard information or in an emergency call ..." and an emergency telephone number.
- (7) If pieces of the material break during sampling, clean the contaminated area with a vacuum cleaner equipped with a HEPA-filtered exhaust or by wet-wiping. Where necessary, polyethylene drop cloths should be placed under the sample area to catch and contain loose waste generated during sampling.
- (8) The workers doing the sampling must wear an appropriate respirator (at least a half-mask air-purifying respirator equipped with high efficiency particulate filters) and should also wear disposable gloves and change gloves each time a sample is collected. The gloves will be disposed of as asbestos waste.
- (9) Ensure that sampling tools and other equipment used during sampling are properly decontaminated.
- (10) Put waste materials into labelled bag appropriate for asbestos waste.

For homogenous materials, it is recommended that the minimum number of bulk samples collected be done as noted in Table 3. If analysis establishes that a bulk material sample does contain asbestos then the entire area of homogeneous material from which the bulk material sample was taken is considered to be asbestos-containing material.

Table 3 Bulk Material Samples

Type of material	Size of area of homogeneous material	Minimum number of bulk material samples to be collected
Any homogenous material, including but not limited to fireproofing, drywall joint compound, ceiling tile stucco, acoustical and stipple finishes and visually similar floor tiles.	Less than 90 m ² (<1000 ft ²)	3
	90 or more square metres, but less than 450 square metres (1000-5000 ft ²)	5
	450 or more square metres (>5000 ft ²)	7

Samples should be collected at random locations and need to be representative of the materials sampled. One quality assurance/quality control sample should be collected for every 20 samples or per building.

There are methods that can be used to analyze bulk samples. NIOSH has two methods, NIOSH Method 9002, *Asbestos (bulk) by PLM* or Method 9000, *Asbestos Chrysotile by XRD* (if the material is chrysotile). Method 9002 involves the viewing of the sample under a polarized light microscope. Identification is based on appearance and colour. The percentage of asbestos in the sample is expressed as an estimate of the area per cent of all material present (diagrams are provided to assist with this). Method 9000 involves preparing the sample and doing an x-ray diffraction scan using an x-ray powder diffractometer with a copper target x-ray tube and scintillation detector. Chrysotile is identified by specific diffraction peaks and the size of the peaks determines the content.

US EPA has test method EPA/600/R-93/116, *Method for the Determination of Asbestos in Bulk Building Materials*. The method uses PLM, XRD and analytical transmission electron microscopy for qualitative identification of materials. Quantitative analysis is done by comparing gravimetrically prepared standards of known composition with unknown samples using a combination of visual comparison, point counting, gravimeter and quantitative XRD. The method is available on line at:



www.epa.gov/ne/info/testmethods/pdfs/EPA_600R93116_bulk_asbestos_part1.pdf



www.epa.gov/ne/info/testmethods/pdfs/EPA_600R93116_bulk_asbestos_part2.pdf

If more precise results are needed or the content of asbestos may be low, the bulk samples may also be analyzed by Transmission Electron Microscopy.

5.6.4.2 Wipe sampling

While there are currently no criteria for asbestos levels on surfaces, there are two methods for sampling dust on surfaces that have been developed by ASTM:

- (1) D6480-05, *Standard Test Method for Wipe Sampling of Surfaces, Indirect Preparation and Analysis for Asbestos Structure Number Concentration by Transmission Electron Microscopy*.
- (2) D5756-03, *Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Mass Surface Loading*.

The standards can be purchased by contacting ASTM at www.astm.org

If asbestos fibres are detected on surfaces, additional air monitoring may be required to determine if there is a potential worker exposure issue. Where wipe sampling is chosen as a method to evaluate the effectiveness of asbestos abatement, sample will need to be collected before and after asbestos-containing materials are distributed and compared. If asbestos fibres are found on surfaces outside the abatement area, work practices will need to be reviewed.

Chapter 6 Personal Protective Equipment

Every person working at an asbestos abatement project must wear appropriate personal protective equipment. Workers must use

- (a) respiratory protective equipment during all construction work and most maintenance work around friable asbestos where fibre levels are not controlled;
- (b) protective clothing to reduce the risk of contaminating street clothing, skin and hair; and
- (c) other protective equipment such as eye protection, hard hats, hearing protection and steel toe footwear as site conditions or regulations require.

The employer must ensure that personal protective equipment provided to workers will not cause medical problems e.g. latex allergies, respirators and breathing difficulties.

For more information



http://humanservices.alberta.ca/documents/WHS-PUB_ppe001.pdf

Respiratory Protective Equipment – An Employer’s Guide – PPE001



http://humanservices.alberta.ca/documents/WHS-PUB_ppe004.pdf

Guideline for the Development of a Code of Practice for Respiratory Protective Equipment – PPE004

6.1 Respiratory protection

For protection against airborne asbestos, three main types of respiratory protective equipment are available: air purifying, supplied air, and self-contained breathing apparatus (SCBA). The purpose of a respirator is to provide clean air to the person wearing it.

Respiratory protective equipment works properly only when selected, used, maintained and cared for in the proper manner. Only approved respirators may be used. Approved respirators are those that have undergone testing and have been granted NIOSH approval. The “TC” number is a NIOSH classification given to all approved respirators. Respirator cartridges and filters must also bear their own TC approval number.

6.1.1 Types of respirators

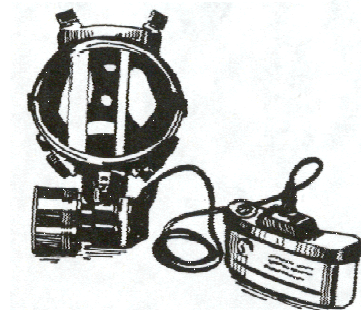
Air purifying respirator

Air purifying respirators clean contaminated air by passing the air through a filter before it is inhaled. A mechanical filter for particulates or fumes, a chemical cartridge filter for vapours, mists and gases, or a combination of the two can be used. Air is drawn through the filter when the person wearing it breathes in, or, in the case of a powered air respirator, by a battery-powered blower. Dual cartridge respirators are classified as air purifying respirators.



Air purifying half-mask respirator equipped with P100 cartridges

An air purifying respirator does not protect the wearer against an atmosphere deficient in oxygen. The air must already have enough oxygen content to meet the minimum standard for breathable air (19 per cent). An air purifying respirator is also not intended for use in an atmosphere that is immediately dangerous to life or health (IDLH).

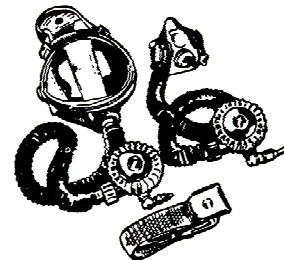


Powered air purifying respirator equipped with P100 filters

Filters used for asbestos fibres must be high efficiency (99.97 per cent) as classified by NIOSH. NIOSH approves three types of high efficiency particulate respirators — N, R and P. N class respirator filters may only be used where the work area is free of oil. R class filters are oil resistant and can only be used for a total of eight hours. P class filters are oil proof and can be used for more than one work shift.

Supplied air respirator

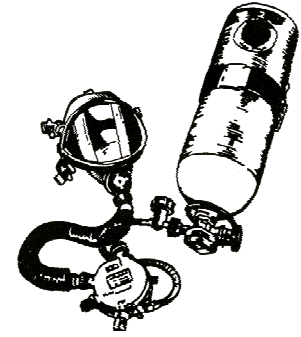
These respirators provide breathable air from an external air source through an air hose connecting the air source to the breathing mask. They can provide protection against higher levels of airborne contaminants than can air purifying respirators. Air supplied to the respirator must meet the requirements of CSA Standard Z180.1-00 *Compressed Breathing Air and Systems*.



Supplied air respirator

Self-contained breathing apparatus (SCBA)

The air supplied in this system is contained in a cylinder which the wearer usually carries on the back. The wearer's air is completely independent of the ambient atmosphere. SCBAs are used in areas where very high levels of protection are required. SCBAs may not be practical for the majority of asbestos abatement projects.



Self-contained breathing apparatus (SCBA)

6.1.2 Code of practice for respiratory protection

Whenever the atmospheric concentration of a dust, vapour, mist or gas requires the use of respiratory protective equipment, a code of practice describing the selection, use and maintenance of that equipment must be developed. Employers and workers responsible for developing a code of practice should refer to the following Occupational Health and Safety Bulletin, *Guideline for the Development of a Code of Practice for Respiratory Protective Equipment* (PPE004)

6.1.3 Protection factor

Respirators offer varying degrees of protection against airborne contaminants. The degree of protection is described by the concept of Protection Factor (PF). Protection factor is defined as the concentration of an airborne contaminant in the worker's breathing zone outside the respirator facepiece divided by the concentration of contaminant inside the respirator facepiece:

$$PF = \frac{\text{concentration of fibres outside respirator facepiece}}{\text{concentration of fibres inside respirator facepiece}}$$

The higher the protection factor, the greater the degree of protection provided by the respirator. The actual protection factor achieved by a respirator is greatly dependent on the fit of the mask to the wearer's face. This can vary with the worker's activities, facial movements and shaving habits. Assigned protection factors have been developed for different respirators based on extensive research. These protection factors can be used to select a respirator that will maintain the asbestos fibre concentration inside the facepiece at an acceptable level. Table 4 summarizes protection factors assigned to a number of selected respirators.

Table 4 Assigned respiratory protection factors for selected respirators

Type of Respirator	Assigned Protection Factor and Comments ¹
Single use (disposable) respirator	NOT ACCEPTABLE FOR ASBESTOS RELATED WORK
Reusable half-mask air purifying respirator equipped with high efficiency filter	APF = 10, can be used for work where airborne concentrations are less than 10 times the OEL.
Full facepiece air purifying respirator equipped with high efficiency filter	APF = 100 ² , can be used for work where airborne concentrations are less than 100 times the OEL
Full facepiece powered air purifying respirator (PAPR) equipped with high efficiency filter	APF = 1000, can be used for work where airborne concentrations are less than 1000 times the OEL
Positive pressure supplied air full-face respirator	APF = 1000, can be used for work where airborne concentrations are less than 1000 times the OEL
Pressure-demand or positive pressure self contained breathing apparatus (SCBA)	APF = 10,000, can be used for work where airborne concentrations are less than 10,000 times the OEL.

6.1.4 Factors affecting respirator fit

A major limitation of the protection provided by a respirator is the effectiveness of the seal between the facepiece and the wearer's skin. Persons who are or may be required to wear a respirator must ensure they have an effective facial seal each time they put on their respirator. This is done by performing a user seal check following the manufacturer's instructions. Two types of seal checks are commonly used:

- (1) *Negative Pressure Check* — Wearing the respirator, the wearer places the palm of each hand over the cartridge assemblies or inhalation points and inhales. The facepiece

¹ The values listed in this table are based on CSA Standard Z94.4-02, Selection, Use and Care of Respirators, Table 1.

² To use this protection factor, a quantitative fit-test must be done. If qualitative fit-testing (see Section 6.1.5) is done, the APF is 10 for the full face air-purifying respirator.

should collapse slightly as one breathes in, and no inward rush of air should be felt against the wearer's face.

- (2) *Positive Pressure Check* — Wearing the respirator, the wearer places the palm of their hand over the exhalation valve and presses lightly while exhaling gently into the facepiece. The fit is satisfactory if no air escapes around the edges of the respirator.

Various factors affect the facial seal of a respirator, including:

Facial hair

Facial hair, even a single day's growth of stubble, can seriously reduce the effectiveness of the facial seal. Whiskers lying between the sealing edge of the respirator facepiece and the skin will break the seal and cause leakage. For this reason, the person wearing a respirator must be clean shaven at least where the respirator contacts the face.

Respirator design

Since respirators are designed and constructed differently, they tend to fit differently. A proper fit can be difficult to achieve if the facepiece material is too soft or too hard, if the facepiece straps are improperly adjusted, or if the wrong size of facepiece is selected.

Headstrap tension

Some respirator wearers tighten headstraps as much as possible in the belief that doing so provides a better seal and fit. The exact opposite is often the result, the shape of the facepiece becoming distorted in such a way as to break the seal. Headstraps should be snug, yet comfortable, and fit testing will demonstrate just how tight or loose the straps must be.

Facial shapes

The sizes and shapes of human heads vary widely. High cheek bones, narrow faces, double chins and broad noses ensure that one size and one design of respirator cannot possibly fit everyone.

Other factors

Facial scars, eyeglasses, wrinkles and dentures can also affect the seal obtained with certain respirators. Prescription glasses cannot be worn with a full-facepiece respirator as the arms of the eyeglasses will break the seal. Alternatives such as eyeglass inserts should be considered for those who require prescription glasses.

6.1.5 Methods of fit testing

There are two accepted methods for fit testing respirators — qualitative and quantitative tests. Positive and negative pressure fit checks need to be done each time that the respirator is donned. The type of fit test method will affect the assigned protection factor for the respirator if air-purifying equipment is used.

Qualitative fit test

Qualitative fit testing consists of relatively quick and simple tests to confirm that the worker has an effective seal. This testing consists of positive and negative pressure checks followed by an odourous chemical or irritant smoke test. *Qualitative fit testing should be done when the respirator is first issued and then repeated on a regular basis.*

Chemical or irritant smoke tests involve the release of an odourous chemical inside a test chamber (enclosure head) or irritant smoke around the edges of the respirator while it is being worn. The wearer performs actions that simulate movements typically made during work activities such as talking, bending, reaching or nodding. If the wearer detects the chemical or irritant smoke, the respirator must be re-adjusted or exchanged and the test repeated until no odours, tastes or smoke are detected.

Commonly used test agents include banana oil (isoamyl acetate), irritant smoke (stannic chloride or titanium tetrachloride), artificial sweetener (saccharin), and bittering compound (Bitrex™). The respirator must be equipped with organic vapour cartridges when administering the banana oil test agent; high efficiency particulate filters must be used for the irritant smoke agent; particulate filters must be used for the saccharin and Bitrex™ agents.

Depending on the test agent, the wearer will either detect the smell of banana, will sense irritation of the nose and throat due to the irritant smoke, taste the sweetness of the saccharin or the bitterness of the Bitrex™ if there is leakage. The person administering the test relies on the wearer's ability to smell, notice, or taste the test agent. A properly administered qualitative fit test takes a minimum of 15 to 20 minutes to perform, assuming a perfect fit during the first attempt. Additional information describing fit testing can be found in CSA Standard Z94.4-02, *Selection, Use and Care of Respirators*.

Quantitative fit test

Quantitative fit tests are more sophisticated and involve measurement of actual respirator leakage by monitoring leakage inside the facepiece. Unlike qualitative fit testing, this testing does not depend on a person's sense of smell or taste to tell whether or not the facepiece leaks. Portable computerized equipment accurately measures leakage of contaminant into the respirator during various test exercises.

According to CSA Standard, 294.4-02, when a respirator undergoes quantitative fit testing, the resulting protection factor must be at least 10 times the nominal protection factor assigned to the respirator. If this condition is not met, the fit of the respirator is inadequate and the respirator should be readjusted or a different respirator selected and tested.

Regardless of the protection factor determined by quantitative fit testing, it is the assigned protection factor that determines the conditions under which the respirator is used (see Table 3).

Record keeping

A permanent record of individuals who are fit tested and issued with respiratory protective equipment should be maintained. These records form part of the overall respiratory protection program and are useful for future reference.

6.1.6 Inspection, cleaning, storage and maintenance

Inspection

Regular cleaning and inspection of respirators is extremely important and must be done according to the manufacturer's instructions. Respirators must be cleaned and inspected *daily* by routine users, and *before and after* each use by occasional users. If shared by different people, respirators must be sanitized between uses.

Prior to cleaning a respirator, each part of the respirator should be inspected. Defective parts must be replaced before the respirator is used. The facepiece must be checked for cuts, tears, holes, melting, stiffening or deterioration. If the unit is damaged, it must be replaced. Headstraps must be checked for breaks, frays, tears or loss of elasticity. Cartridge sockets can be inspected by removing the cartridges. Special attention should be given to the rubber gaskets located at the bottom of the cartridge sockets. Cracks or flaws may contribute to an ineffective seal.

The cover on the exhalation valve should be removed and the rubber valve carefully examined to ensure it seals properly and has not become brittle. The edge of the valve should be examined for holes, cracks and dirt which may interfere with a proper seal. The exhalation valve is a critical component of the respirator and must be replaced if there is any doubt about its ability to function properly. The valve cover is also important and must not be damaged or fit too loosely.

Finally, the interior of the facepiece and inhalation valves should be examined. Dust or dirt accumulating on the inhalation valves can interfere with their operation. Inhalation valves should be soft, pliable and free of tears or cuts to the flaps.

Cleaning

Following inspection, the respirator should be cleaned according to the manufacturer's instructions. Strong detergents, hot water or household cleaners or solvents must not be used because they may deteriorate the rubber parts. A stiff bristle brush (not wire) can be used to remove dirt if necessary. The respirator should then be rinsed thoroughly in clean, warm water. This is important because detergents or cleaners that dry on the facepiece may later cause skin irritation. The respirator can be hand-dried with a clean, lint-free cloth, or air-dried and then reassembled. The respirator should be tested to ensure all parts work properly prior to being used.

Storage

Respirators should be stored in a clean location, preferably in a plastic bag in a locker or on a shelf. They should be stored away from sunlight, solvents and other chemicals, extreme cold or heat, and excessive moisture. Respirators must not be left out on a bench or hanging on a nail in the shop where they can gather dust and dirt or be damaged or abused.

Maintenance

All respirator manufacturers suggest regular maintenance and parts replacement. Respirators should be maintained and inspected according to the instructions provided with each respirator. Only approved replacement parts should be used. Mixing and matching of parts from one respirator brand or model to another must never be allowed. Makeshift parts for respirators must never be installed.

6.2 Protective clothing

Protective clothing for asbestos abatement work usually consists of disposable, impermeable coveralls, foot coverings, gloves and head coverings. Protective clothing reduces contamination of the worker's body and hair and makes decontamination when leaving the work area much easier.

Protective clothing with an attached hood and foot coverings provides the most complete protection. Alternatively, laceless rubber boots can be worn as long as they are properly decontaminated prior to removal from the work site. Disposable types of protective clothing are made of products such as Tyvek™. Permeable outer clothing is

not recommended for asbestos abatement work as fibres can penetrate the clothing, contaminating clothing worn beneath it and contaminating the skin.

Protective clothing *does not include* street clothes, shoes, T-shirts, socks, blue jeans, sweat bands, etc. If these items are used inside the work area, they should remain there and be disposed of as asbestos waste at the end of the job. Protective clothing that is reused must be collected, handled and washed in a manner that prevents the spread of asbestos fibres and ensures that the clothing is free of asbestos. Workers must never take contaminated clothing or towels home for laundering. Reusable clothing and towels must be collected at the work site and sent to a laundry that specializes in cleaning clothing contaminated with asbestos.

Protective clothing may also be required to protect workers from physical hazards. If the asbestos-containing materials being removed contain wire mesh, lath or other sharp objects, heavy gloves should be worn to protect workers' hands. Appropriate footwear must also be worn to provide protection from sharp or heavy objects and wet or slippery conditions. Other safety equipment such as head, eye and hearing protection should be worn if hazardous conditions requiring their use are encountered.

Chapter 7 Asbestos Analysis

Air Monitoring and Analysis

Air monitoring is important in evaluating how well workers are being protected, the selection of respiratory protective equipment, the effectiveness of decontamination and the integrity of the containment during abatement activities. Collection of reliable data requires a thorough knowledge of air sampling, analytical techniques and when a particular technique should be used. Air monitoring must only be performed by competent personnel.

7.1 Air monitoring techniques

Air sampling is conducted to estimate airborne asbestos fibre concentrations before, during and after abatement activities. The device used to capture airborne fibres consists of a 25 mm diameter, 50 mm long electrically conductive extension tube connected via tubing to an air sampling pump. A three-piece filter cassette is placed inside the extension tube. The type of filter used depends on the analysis method. During sampling, the front cover of the cassette is removed and air drawn by the pump passes through the cassette, trapping airborne fibres in the filter media.

When conducting analyses that involves counting fibres, NIOSH Method 7400 must be applied and only to particles that meet the size criteria for fibres in the method.

The following are key points regarding air sampling:

- Calibrate pumps before and after sampling with representative sample collection equipment such as filters connected to the sampling port.
- Submit at least two field blanks (or 10 per cent of the total samples, whichever is greater) for each set of samples.
- Flow rates can range from 0.5 to 16 litres per minute depending on anticipated fibre concentrations. The sampling flow rate should be adjusted to produce a fibre density of 100 to 1300 fibres per square millimeter (f/mm²) on the filter.
- Untreated polystyrene foam packing material must not be used when shipping sampling cassettes as electrostatic forces may remove fibres from sample filters.
- Fibre counts must be reported with an accuracy of two decimal places e.g. < 0.01 f/cc.
- The working range for the method is 0.04 to 0.5 f/cc for a 1000 L air sample.
- The limit of detection is based on the volume of sample collected and fibre density (see Appendix D of the NIOSH Method 7400).

Two types of sampling can be used to determine airborne fibre concentrations:

(1) Personal/breathing zone/occupational sampling

Personal, breathing zone or occupational samples are collected using a portable battery-powered pump worn by the worker during specific abatement activities. The sampling cassette is positioned facing downward in the worker's "breathing zone" (as close to the mouth as possible) and the pump is attached to a belt worn around the worker's waist. Typically, phase contrast microscopy is used to analyze the samples.

Personal sampling should be done during a repair, renovation or abatement project to determine the worker's exposure to asbestos fibres. Representative samples should be taken to confirm proper selection of respiratory protective equipment and the effectiveness of removal or control techniques in reducing worker exposure to airborne asbestos fibres.

(2) Area sampling

Area samples are usually taken at flow rates ranging from 0.5 to 16 litres per minute using electric-powered pumps. The sample cassette is attached to the pump via tubing and is positioned facing downward at a height of approximately 1.5 metres above the ground.

Area sampling should be used in the following situations during abatement projects:

- (a) *Before abatement activities begin* — air monitoring conducted prior to abatement work commencing is called "background sampling" or "prevalent level sampling". Background samples provide valuable information for documentation purposes. Generally, one background sample should be taken for each 450 m² of space (3000 to 10,000 litres of air volume in the work space).
- (b) *Area air samples outside the work area but inside the building* — samples are collected throughout the duration of the asbestos abatement project to determine how well asbestos fibres are being contained in the work area. These samples are very important when abatement activities are performed in an occupied building. Samples should be collected from:
 - (i) the clean room;
 - (ii) the clean side of the containment barrier;
 - (iii) in multi-storey buildings, one floor above and one floor below (if these areas are occupied) and the floor on which abatement activities are occurring; and
 - (iv) at any other locations representative of those that could be contaminated due to fibre migration should there be a loss of containment.

- (c) *Area sampling outside the building* — area sampling can be conducted outside the building during abatement activities to determine if any asbestos fibres are leaking from the work area. Suggested sampling locations include windows, doors, the exhaust from negative air units, waste load-out areas and areas downwind of abatement activities.
- (d) *Area air sampling after final clean-up of the work area* — after a thorough final visual inspection has been completed and the clean-up is considered acceptable, the abatement contractor encapsulates all surfaces inside the containment with a glue spray. The spray is allowed to settle and dry for a minimum of 4 hours (ideally 8 to 12 hours) and then final air tests can be conducted. Negative air units should remain running until the final air test is completed and analyzed as acceptable unless dust from construction or other activities would be drawn into the containment. Care must be taken to collect a sufficient volume of air to achieve quantifiable loadings on the filter (see item (b)).

“Aggressive sampling” for final air tests involves mechanically disturbing the air to simulate actual conditions of air movement. Aggressive sampling gives a more reliable indication of the degree of cleanliness of the containment. A procedure for aggressive sampling is described in Section 5.6.2 of this manual.

7.2 Analytical methods

7.2.1 NIOSH 7400 phase contrast microscopy (PCM) method

PCM is the most common and frequently used analytical method. It is also the least expensive method and has a well-established protocol. However, the NIOSH method for PCM analysis does not distinguish between asbestos and other types of fibres. All fibres are counted and assumed to be asbestos.

A cellulose ester filter, having a 0.8 micrometer effective pore size, is analyzed to determine the concentration of fibres present on the filter. A section of the filter is mounted and “cleared” on a microscope slide using a special mounting solution or acetone vapour. Using a phase contrast microscope with 400X to 500X magnification, fibres on the prepared slide meeting the method criteria are counted. Fibres less than 0.3 micrometers in diameter are below the resolution of the microscope. Fibres are counted according to the counting rules specified for analytical method 7400 in the NIOSH Manual of Analytical Methods.

Results of analysis

- (1) Results are expressed in fibres per cubic centimetre (f/cc) taking into account the number of fibres and fields counted, the filter and graticule area, and the volume of air collected. The following formula is used:

$$f/cc = \frac{\text{average count} \times \text{sampling area}}{\text{field area} \times \text{flow rate} \times \text{sample time} \times \text{conversion}}$$

- (2) The working range is 100 to 1300 fibres/mm². The main problem with the PCM method is variability among analysts counting the fibres. Variability is reduced by collecting samples within the working range. Counts below 100 fibres/mm² are probably over-counted (positive bias) and counts above 1300 fibres/mm² are probably under-counted (negative bias).
- (3) The Limit of Detection (LOD) is 7 fibres/mm² or 5.5 fibres counted in 100 fields. This value was obtained from the Proficiency Analytical Testing (PAT) program from blank values. This means that any filter that is counted with fewer than 5.5 fibres in 100 fields is not statistically reliable because the number is below the blank value. Sample results below the Limit of Detection should be reported as such.
- (4) The Limit of Quantitation (LOQ) is 100 fibres/mm² which is the lower end of the working range. The LOQ is an amount of analyte at which a certain acceptable level of precision has been reached. If a sample result falls below this value, it should be reported that there is diminished statistical reliability.
- (5) The LOD of the method is 0.003 f/cc. Fibre concentrations below this should be reported as < 0.01 f/cc. This is based on the collection of at least 1000 L of air. If less air is passed through the filter, the detection limit will increase (see Appendix D of the Method). Increasing the volume of air collected does allow the user to report LODs lower than 0.01 f/cc.

7.2.2 NIOSH 7402 transmission electron microscopy (TEM) method

This analytical method can distinguish asbestos from other fibres and can detect very thin fibres. TEM analysis is valuable when other airborne fibres are present that may interfere with the PCM method. The disadvantages of TEM include increased cost compared to PCM, a more complicated sample preparation procedure and a longer time required for analysis.

Method 7402 provides a means of determining the fraction of asbestos fibres collected on the sample (fraction count) as well as estimating the total fibre concentration of fibres (distribution count). The cassette used for TEM has a 0.45 to 1.2 micrometer pore size and samples are collected in a similar fashion to PCM. At a flow rate of 0.5 to 16 litres per minute, 700 to 2800 litres of air should be drawn through the filter in dusty atmospheres and 3000 to 10,000 litres of air in clean atmospheres. The filter is initially viewed under high magnification (10,000X) and then the fibres are counted under low magnification (500 - 1000X).

While TEM may be used on asbestos projects, results should be reported using NIOSH method 7400 PCM for regulatory purposes.


Results of analysis

- (1) Results are expressed as an asbestos fibre count. The type of asbestos present is also reported.
- (2) The working range is 0.04 to 0.5 f/cc for a 1000 litre air sample.
- (3) The LOD is less than 0.01 f/cc for atmospheres free of interference, but depends on sample volume and the quantity of interfering dust.

7.3 Laboratory quality control

7.3.1 Proficiency testing by inter-laboratory comparison

All laboratories engaged in asbestos counting should participate in a proficiency testing program and routinely exchange field samples with other laboratories to compare the performance of counters. Proficiency testing programs available to laboratories include:

- (1) Canadian Association for Laboratory Accreditation (CALA)
CAEL Proficiency Testing Program for Asbestos Analysts
310-1565 Carling Avenue
Ottawa, Ontario K1Z 8R1
 www.cala.ca

(2) American Industrial Hygiene Association (AIHA)

Asbestos Analysts Registry (AAR)

2700 Prosperity Avenue, Suite 250

Fairfax, Virginia

USA 22031



<http://www.aiharegistries.org/Pages/default.aspx>

(3) American Industrial Hygiene Association (AIHA)

Proficiency Analytical Testing Program (PAT)

2700 Prosperity Avenue, Suite 250

Fairfax, Virginia

USA 22031



www.aihapat.org/

7.3.2 U.S. EPA's Guidelines for Checking a Laboratory's Quality Control (QC) Program

Training and experience

All persons producing measurements must be trained and understand their roles. Only laboratories with demonstrated proficiency in asbestos analysis should be selected. When selecting a laboratory, its QC program should be reviewed as well as the lowest levels of fibres it routinely reports.

Quality control checks

Field and laboratory blanks should be used to check for fibre contamination, coded sample labels to avoid analyst bias, duplicate analysis to confirm precision and a second laboratory to spot check the accuracy of results.

Chain-of-custody

Responsibility for security of the samples should be assigned to specific persons at each stage of the analysis. Each step in the passage of samples from the field to the laboratory must be documented.

Documentation

Laboratory results and their labelling must be checked and documented. The building owner should retain all test results and records documenting the testing process.

Chapter 8 Other Health and Safety Considerations

Asbestos abatement work is potentially hazardous. Workers must not ignore other hazards such as falls, cuts and bruises, electrocution, exposure to chemicals and heat stress. This chapter summarizes some of the other common occupational health and safety hazards at asbestos abatement project sites.

8.1 Identifying the hazards

During pre-job inspection, work site preparation and removal activities, many potential hazards can be identified and eliminated. The most common occupational health and safety hazards inherent to asbestos abatement work are:

- (a) housekeeping;
- (b) electrical hazards;
- (c) ladders and scaffolds;
- (d) slips, trips and falls;
- (e) heat-related disorders;
- (f) carbon monoxide poisoning;
- (g) limb and body injuries; and
- (h) exposure to hazardous chemicals.

8.1.1 Electrical hazards

One of the most common hazards is contact with electricity since abatement procedures involve the use of water. Electrical hazards resulting from improper grounding, incorrect wiring and lack of proper shielding are especially dangerous.

Wiring faults may include open ground paths, reverse polarity and incorrectly connected hot, neutral or ground wires. These faults can be identified with plug-in type circuit testers and may need to be corrected prior to the project starting.

Asbestos abatement often occurs in partially renovated or demolished buildings where damaged equipment or electrical fixtures may be present. Where possible, all circuits that will not be used during the removal should be tagged and locked out. All wiring should be treated as energized unless tested and proven to be de-energized.

Transformers or control boxes that must remain energized during the abatement project often cannot be sealed due to heat build-up. Dry removal may be necessary in this situation to maintain air circulation.

All electrical equipment used during the abatement project must be regularly checked for damage, proper grounding and integrity of insulation. Non-metallic tools should be used for scraping; wooden or fiberglass ladders should be used to reduce or eliminate the possibility of a path to ground if a worker contacts an energized circuit or equipment.

Due to the presence of water, power to removal areas must be supplied through ground fault circuit interrupters (GFCIs). GFCIs protect all circuits and provide the safest power source since any ground fault will trip the circuit.

8.1.2 Ladders and scaffolds

Asbestos abatement work frequently requires the use of ladders and scaffolds to reach asbestos-containing materials. Improper use or inadequate maintenance of this equipment can cause worker injury.

Ladders should be inspected regularly for damage and repaired or replaced. Workers must be instructed to use ladders correctly. Ladders must not be used as a work platform or walk board. Stepladders should be used only when completely open. If extension ladders are used, the base location should be one m away from the point below the upper contact point for every four m of elevation.

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.

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. Guardrails should always be installed on scaffolds to prevent worker falls. Toe boards should be installed to prevent tools and other objects from dropping on workers below.

8.1.3 Slips, trips and falls

Areas sealed with polyethylene sheeting and kept damp to reduce airborne fibres may become very slippery. Rubber boots with non-skid soles are recommended. Asbestos-containing materials or other debris should be bagged immediately to reduce slipping and tripping hazards. Hand tools, cords and hoses should be organized and moved away from where workers could trip over them.

Where there is a danger of falling from a height, appropriate fall protection equipment or methods must be used. Floor openings in the work area must be protected by a securely installed temporary cover (including a warning sign) or by a guardrail and toe boards.

Running and horseplay in work areas should never be allowed.

8.1.4 Heat-related disorders

Heat-related disorders are common to asbestos abatement work. Hard physical labour, potentially non-breathable protective clothing and the need to use a respirator combine to reduce the body's ability to cool itself. Heat exhaustion is not usually life-threatening unless left untreated. If untreated, heat exhaustion may develop into heat stroke which is life-threatening and a serious medical emergency.

Heat-related disorders can be prevented by:

- (a) acclimatizing workers to the heat;
- (b) ensuring that workers drink plenty of water;
- (c) having workers strictly follow a work/rest schedule; and
- (d) cooling and ventilating the work area to the extent possible.

8.1.5 Carbon monoxide

Respiratory protective equipment supplied with air from a compressor powered by an internal combustion engine may be a source of carbon monoxide poisoning. Engine exhaust may be drawn into the fresh air intake of the breathing air compressor. Since it is not irritating and has no odour, a worker may remain unaware of their exposure to carbon monoxide for some time.

Workers monitoring the breathing air system should be familiar with the symptoms of carbon monoxide poisoning. If an airline respirator supplied from a compressor is used, the filter on the compressor should be equipped with a carbon monoxide monitor or alarm.

For more information



http://humanservices.alberta.ca/documents/WHS-PUB_ch031.pdf

Carbon Monoxide at the Work Site (CH031)

8.1.6 Limb and body protection

A work site hazard assessment should be conducted to identify limb and body hazards. Workers must wear properly fitting hand, arm, leg or body protective equipment, appropriate to the work being done and the hazards involved.

Hardhats, 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.

8.1.7 Hazardous chemicals

Chemicals such as glues, encapsulants, paints and other solvents used at an asbestos abatement site may be hazardous. The Workplace Hazardous Materials Information System (WHMIS) is a system of legislation developed to ensure that the hazards of chemicals used at the workplace are identified, material safety data sheets (MSDSs) are available at the workplace, and information about protective measures is provided to workers through training.

For more information



http://humanservices.alberta.ca/documents/WHIS-PUB_ch007.pdf

WHMIS — Information for Workers (CH007)



http://humanservices.alberta.ca/documents/WHIS-PUB_ch008.pdf

WHMIS — Information for Employers (CH008)

Both Safety Bulletins are also available as convenient booklets.

Chapter 9 Competency Profiles for Workers, Foremen, Site Supervisors, and Consultants Working at Asbestos Abatement Projects

This chapter describes the skills that workers, foremen, site supervisors and consultants should have prior to working at an asbestos abatement project. The information presented is based on Competency Analysis Profiles (CAP) and Standards of Performance developed by Human Services.

9.1 Competency profile for workers at asbestos abatement project sites

Major Responsibilities

Skills

Job Execution A	A1 Review Work Procedures with Supervisor	A2 Identify Material Supply Needs	A3 Maintain Site and Services	A4 Isolate Work Area	A5 Install Negative Pressure Air System	A6 Set Up Decontamination Facility
	A7 Minimize Fibres in the Air	A8 Maintain Good Housekeeping	A9 Prepare Waste Material For Disposal	A10 Maintain Decontamination Facility	A11 Operate Asbestos Removal Equipment	A12 Maintain Asbestos Removal Equipment
Health & Safety B	B1 Review Health & Safety Procedures With Supervisor	B2 Demonstrate Knowledge of Asbestos Health Hazards	B3 Demonstrate Knowledge of Requirements, Responsibilities and Rights Under OHS Legislation	B4 Report Violations of Health & Safety Requirements	B5 Report Potential Site Safety Hazards	B6 Report Potential Site Electrical Hazards
	B7 Use and Maintain Personal Protective Equipment Properly	B8 Use Decontamination Facility	B9 Report Worker Health Problems			

Standards of Performance

A. Job Execution

Skill

A1 Review Work Procedures with Supervisor

- (a) Verify all work procedures with immediate supervisor.
- (b) Visually inspect the job with the foreman.
- (c) Discuss concerns/problems of job with the foreman.
- (d) Recommend changes in procedures when necessary.
- (e) Implement work procedures as agreed to with foreman.

A2 Identify Material Supply Needs

- (a) Report shortages of materials and supplies to the foreman.
- (b) Determine the need for special supplies and request them through the foreman.

A3 Maintain Site and Services

- (a) Repair damage to the enclosure and report the damage to the first line foreman.
- (b) Report to the foreman any interruption to, or lack of, water, power or lighting.

A4 Isolate Work Area

- (a) Rope off all work areas.
- (b) Properly post signs outside the contaminated area.
- (c) Maintain air-tight isolated work areas.
- (d) Post the entrance and exit points.
- (e) Assemble the airlock as directed.
- (f) Seal air handling system as directed.

A5 Install Negative Pressure Air System

- (a) Install the negative pressure air system.
- (b) Seal the negative pressure air system as directed.
- (c) Visually inspect the work site to confirm that negative pressure is established in the enclosed area.

A6 Set Up Decontamination Facility

- (a) Construct the decontamination facility as directed.
- (b) Report any sanitation supply shortages to the foreman.

A7 Minimize Fibres in the Air

Follow established procedures to control the release of asbestos fibres:

- (a) wet, remove and bag asbestos-containing materials where practicable;
- (b) encapsulate areas as directed;
- (c) contain waste material as soon as possible; and
- (d) use practical and safe practices when handling material for disposal.

A8 Maintain Good Housekeeping

- (a) Follow established work procedures as directed.
- (b) Use a vacuum cleaner fitted with a HEPA filter to clean up waste material.
- (c) Place waste material in containers; seal and remove to disposal area.
- (d) Decontaminate all tools, scaffolding and equipment prior to removal from the work site.

A9 Prepare Material for Disposal

- (a) Use effective techniques to minimize airborne fibre release during removal of isolation enclosures.
- (b) Take care to prevent puncturing waste material bags.
- (c) Clean the exterior of bags prior to their removal to the transfer area.
- (d) Double-bag waste material and seal.
- (e) Mark waste material with approved label.
- (f) Store waste material in established storage area.

A10 Maintain Decontamination Facility

- (a) Maintain a housekeeping schedule.
- (b) Clean and sanitize floors and walls.
- (c) Repair airlocks as directed.
- (d) Maintain services for decontamination facility.

A11 Operate Asbestos Removal Equipment

- (a) Be able to demonstrate procedures for safe operation of removal equipment used at the work site.
- (b) Notify foreman and obtain approval for any equipment modification.

A12 Maintain Asbestos Removal Equipment

- (a) Perform maintenance and minor repairs to equipment as directed by the foreman.
- (b) Check filter on negative pressure air system as required or directed.
- (c) Report to the foreman the need for any repairs to equipment.

B. Health and Safety

Skill

B1 Review Health and Safety Procedures with Supervisor

- (a) Check with foreman on any site-specific health and safety procedures.
- (b) Be able to explain why procedures must be followed.
- (c) Review with the foreman emergency procedures to be followed.

B2 Demonstrate Knowledge of Asbestos Health Hazards

- (a) Describe the specific health hazards that could be encountered through asbestos exposure.
- (b) Describe the increased risks of smoking and asbestos exposure.

B3 Demonstrate Knowledge of Requirements, Responsibilities and Rights Under OHS Legislation

- (a) Recognize the limitations of respiratory protective equipment used at the work site according to the airborne asbestos fibre concentrations expected.
- (b) Describe situations where worker has the right to refuse work that is unsafe.
- (c) Cooperate in health monitoring by the employer.
- (d) Perform work according to the code of practice or occupational health and safety regulations for asbestos removal.

B4 Report Violations of Health & Safety Requirements

- (a) Report any violations of safe work procedures to the foreman.
- (b) If violations continue, report them to Human Services, Occupational Health and Safety.

B5 Report Potential Site Safety Hazards

- (a) Report potential site safety hazards to the foreman.
- (b) Rope off area and/or tag equipment until hazard is corrected.
- (c) Do not use unsafe equipment.

B6 Report Potential Site Electrical Hazards

- (a) Report any electrical hazards to the foreman.
- (b) Rope off and restrict access to the area until the hazard is eliminated.
- (c) Use a ground fault circuit interrupter system for power distribution.

B7 Use and Maintain Personal Protective Equipment Properly

- (a) Demonstrate proper fitting, use and maintenance of respirators, including filter replacement.
- (b) Use disposable clothing provided according to work site procedures.
- (c) Decontaminate footwear used at the work site as directed.

B8 Use Decontamination Facility

- (a) Follow established procedures for leaving contaminated area.
- (b) Remove all contaminated clothing and place in isolation containers provided.
- (c) Maintain a schedule of cleaning the contaminated side of the decontamination facility to minimize fibre levels.
- (d) After showering (with respirator on), remove filters (if applicable) and dispose of them in containers provided.
- (e) Place all towels in the recycling containers provided.
- (f) Clean and disinfect respirators.
- (g) Maintain a housekeeping schedule for the decontamination facility.
- (h) Treat all equipment, tools and clothing used inside the contaminated area as contaminated material and remove only through a decontamination facility.

B9 Report Worker Health Problems

- (a) Watch for and assist any co-worker showing signs of physical or heat-related distress.
- (b) Report any relevant worker health concerns.

9.2 Competency profile for foremen at asbestos abatement project sites

Major Responsibilities

Job Execution A	Skills					
	A1	A2	A3	A4	A5	A6
Supervision B	Validate Site Conditions	Ensure Isolation of Work Area	Ensure Installation of Negative Pressure Air System	Check the Set-Up of Decontamination Facility	Minimize Fibres in the Air	Monitor Air Testing Equipment
	A7	A8	A9	A10		
	Identify Material Supply Needs	Ensure Proper Operation of Equipment	Ensure Maintenance of Equipment	Implement Abatement Procedures		
	B1	B2	B3	B4	B5	B6
Health & Safety C	Plan and Assign Daily Work	Review Work Procedures with Workers	Review Health & Safety Procedures with Workers	Monitor Worker Performance	Monitor Use of Materials	Ensure Use of Decontamination Facility
	B7	B8	B9			
	Ensure Adequacy of First Aid	Recognize and Act on Worker Health Problems	Ensure Maintenance of Site and Services			
	C1	C2	C3	C4	C5	C6
	Explain Health Hazards of Asbestos	Demonstrate Knowledge of Requirements, Responsibilities & Rights Under OHS Legislation	Inspect and Act on Health and Safety Hazards	Monitor and Ensure Compliance with Health and Safety Procedures	Ensure Control of Electrical Hazards	Ensure Proper Use and Maintenance of Personal Protective Equipment
	C7	C8	C9			
	Ensure Maintenance of Decontamination Facility	Monitor the Preparation of Waste Materials for Disposal	Ensure Good Housekeeping			

Standards of Performance

A. Job Execution

Skill

A1 Validate Site Conditions

- (a) Identify and locate essential services and work areas prior to job set-up.
- (b) Review site access and equipment set-up with supervisor prior to job set-up.
- (c) Review site-specific concerns such as unusual work routines or site conditions.

A2 Ensure Isolation of Work Area

- (a) Review isolation procedures with supervisor prior to project start-up.
- (b) Implement isolation procedures as described in the work plan prior to start of removal process.
- (c) Ensure that isolation of work areas during removal is maintained.
- (d) Ensure sealing of heating, ventilation and air conditioning systems according to work plan, and review prior to starting any removal.

A3 Ensure Installation of Negative Pressure Air System

- (a) Ensure installation and testing of negative pressure air system according to work plan or as directed.
- (b) Visually inspect the work area to confirm that negative pressure is established in the enclosed area.

A4 Check the Set-up of Decontamination Facility

- (a) Construct and equip decontamination facility according to work plan or as instructed by supervisor.
- (b) Have decontamination facility completed prior to start of the removal phase.

A5 Minimize Fibres in the Air

- (a) Implement control procedures to minimize airborne fibre concentrations during the removal process.
- (b) Visually check work procedures and correct as necessary.

A6 Monitor Air Testing Equipment

Monitor air testing equipment during sample period to ensure continuous operation.

A7 Identify Material Supply Needs

- (a) Manage materials required for the job.
- (b) Maintain an inventory of materials and equipment.
- (c) Report material needs to supervisor to ensure a constant supply.

A8 Ensure Proper Operation of Equipment

- (a) Verify worker knowledge of the correct and safe operation of all equipment.
- (b) Demonstrate proper and safe use of equipment to workers as required.

A9 Ensure Maintenance of Equipment

- (a) Inspect equipment for proper maintenance.
- (b) Train workers in proper maintenance of equipment.
- (c) Identify and correct any equipment failure.
- (d) Maintain an inventory of equipment parts and materials.
- (e) Ensure proper decontamination or containment of equipment upon job completion.

A10 Implement Abatement Procedures

- (a) Implement agreed-to abatement procedures.
- (b) Monitor worker adherence to abatement procedures.
- (c) Correct any observed deviations from abatement procedures.
- (d) Ensure correct waste handling, transportation and disposal procedures are followed.

B. Supervision**Skill****B1 Plan and Assign Daily Work**

- (a) Plan and assign workers and equipment according to the task and worker experience.
- (b) Check worker understanding of assigned task(s).

B2 Review Work Procedures with Workers

Provide worker orientation to work procedures, emphasizing health and safety, decontamination, material handling, supplies, equipment and area security.

B3 Review Health and Safety Procedures with Workers

- (a) Discuss critical health and safety topics with workers.
- (b) Highlight and explain problem areas and question workers for understanding.
- (c) Clarify any changes to safety procedures.
- (d) Identify and show workers evacuation routes and emergency procedures.

B4 Monitor Worker Performance

Observe and correct performance of workers in:

- (a) using and maintaining personal protective and safety equipment;
- (b) work practices; and
- (c) handling and preparing materials for transportation/disposal, effective and complete removal, encapsulation, or enclosure of asbestos.

B5 Monitor Use of Materials

- (a) Ensure that sufficient materials are available at the work site.
- (b) Correct misuse of materials.
- (c) Maintain and reorder supplies as needed.
- (d) Verify that ordered supplies are received.

B6 Ensure Use of Decontamination Facility

- (a) Train workers in proper use of decontamination facility according to work procedures.
- (b) Verify through spot checks that workers are using decontamination facility correctly.
- (c) Correct workers' improper use of decontamination facility.

B7 Ensure Adequacy of First Aid

- (a) Identify the on-site first aid person and first aid station to all workers.
- (b) Verify daily that adequate first aid supplies are on site.
- (c) Ensure that first aid person possesses a current certificate.

B8 Recognize and Act on Worker Health Problems

- (a) Rotate staff if necessary to avoid physical or heat-related distress.
- (b) Observe workers on an on-going basis for symptoms of heat stress.
- (c) Immediately reassign workers with symptoms of distress.

B9 Ensure Maintenance of Site and Services

- (a) Check site services regularly.
- (b) Rectify any interruption to services.

C. Health and Safety

Skills

C1 Explain Health Hazards of Asbestos

- (a) Explain health hazards of asbestos exposure to workers.
- (b) Explain the increased risk of illness resulting from smoking combined with asbestos exposure.
- (c) Provide a health and safety procedures orientation to workers prior to starting the job.

C2 Demonstrate Knowledge of Requirements, Responsibilities and Rights Under OHS Legislation

- (a) Demonstrate working knowledge of regulations applicable to asbestos abatement procedures for the project being undertaken.
- (b) Identify requirements and procedures described in the OHS Act and regulations.
- (c) Reinforce rules when a violation is observed.
- (d) Outline and discuss responsibilities and requirements of employers and workers as described in the OHS Act and regulations.

C3 Inspect and Act on Health and Safety Hazards

- (a) Monitor site for health and safety hazards on an ongoing basis.
- (b) Visually inspect site for violations of established health and safety procedures.
- (c) Ensure that hazard warning signs are posted.
- (d) Check that fire alarm sensors, smoke detectors and other sensors/alarm system components are working properly.

C4 Monitor and Ensure Compliance with Health and Safety Procedures

- (a) Take corrective action to ensure compliance with health and safety practices.
- (b) Ensure that all health and safety regulatory requirements are followed.
- (c) Report to supervisor any ongoing violations and describe corrective action taken.

C5 Ensure Control of Electrical Hazards

- (a) Ensure, where possible, that all electrical circuits are locked-out prior to starting work on the job.
- (b) Check to ensure that circuits are locked-out at the beginning of each shift.
- (c) Ensure that the ground fault circuit interrupter system is checked by a qualified person prior to job start-up and when repairs are required.

C6 Ensure Proper Use and Maintenance of Personal Protective Equipment

- (a) Observe worker use and maintenance of personal protective equipment and correct any errors.
- (b) Check personal protective equipment daily.

C7 Ensure Maintenance of Decontamination Facility

- (a) Monitor the integrity of the decontamination facility, including airlocks.
- (b) Maintain and correct immediately any failure in the decontamination facility or airlocks.

C8 Monitor the Preparation of Waste Materials for Disposal

- (a) Observe and correct any practices involving the handling of waste and hazardous materials prior to their removal from the work site.
- (b) Monitor and correct practices involving the improper handling of contaminated clothing.
- (c) Check all equipment for proper decontamination prior to removal from the work site.

C9 Ensure Good Housekeeping

- (a) Establish and maintain a clean-up schedule that is monitored at least once per shift.
- (b) Monitor and ensure the maintenance of the decontamination facility.

9.3 Competency profile for site supervisors at asbestos abatement project sites

Major Responsibilities

	Skills					
	A1	A2	A3	A4	A5	A6
Supervision/ Management A	Complete Written Documentation	Verbally Communicate with Others	Identify Potential & Existing Problems	Resolve Problems & Monitor Solution Effectiveness	Evaluate Performance of Workers and Foremen	Ensure Proper Performance of Workers and Foremen
	A7 Review Job Schedule	A8 Ensure Compliance with Work Procedures and Codes of Practice				
Job Planning B	B1 Review Specifications, Blueprints & Job Procedures	B2 Determine Needs of Client and/or Contractor	B3 Evaluate Site Conditions	B4 Determine Specific Job Requirements	B5 Schedule Job	B6 Coordinate Schedule
Health and Safety C	C1 Identify Site-Specific Health and Safety Hazards	C2 Demonstrate a Knowledge of Requirements, Responsibilities & Rights Under OHS Legislation	C3 Implement Health and Safety Control Measures	C4 Establish Site Emergency Procedures	C5 Act on Worker Health Problems	
Job Execution D	D1 Verify Work Plan and Specific Job Requirements	D2 Inspect Isolation of Work and Storage Areas	D3 Advise Associated Trades of Specific Work Issues and Schedules	D4 Coordinate Air Monitoring	D5 Maintain Job Schedule	D6 Order and/or Purchase Supplies and Equipment

Standards of Performance

A. Supervision/Management

Skill

A1 Complete Written Documentation

- (a) Develop written site-specific safe work procedures.
- (b) Maintain daily work logs.
- (c) Complete progress reports.
- (d) Obtain required forms and permits.
- (e) Develop a written work plan.
- (f) Develop contingency plans, as required.
- (g) Maintain training records for site personnel.

A2 Verbally Communicate With Others

- (a) Explain work plan to foremen and workers.
- (b) Solicit input from foremen and workers.
- (c) Question foremen and workers of their understanding of work plans.
- (d) Describe or clarify standards required.
- (e) Negotiate differences of opinion.
- (f) Direct others on completion of work assignments.
- (g) Negotiate special job needs with client/contractor (e.g. job and access safety needs).
- (h) Instruct affected people on site, as required.
- (i) Communicate with government occupational health and safety and environment agencies.

A3 Identify Potential and Existing Problems

- (a) Review site conditions with owner.
- (b) Examine blueprints and specifications, if available.
- (c) Visually inspect site to note actual site conditions. Determine hazards or problem areas such as electrical, mechanical e.g. operating equipment, computers, or other dust/moisture-sensitive equipment.
- (d) Review layout and design of containment barriers with respect to security.
- (e) Observe effectiveness of restrictions (unauthorized personnel entry) to area.
- (f) Inspect site to verify compliance with OHS regulations and owner requirements.
- (g) Conduct hazard assessment of work area.

- A4 Resolve Problems and Monitor Solution Effectiveness
- (a) Solve site safety problems with site safety personnel and/or Human Services, Occupational Health and Safety.
 - (b) Arrange for removal/protection of sensitive equipment with owner.
 - (c) Monitor operations of removal equipment.
 - (d) Conduct scheduled checks of area and equipment.
- A5 Evaluate Performance of Workers and Foremen
- (a) Evaluate adherence to safe work procedures through observation and communication.
 - (b) Monitor workers'/foremen's use of decontamination facility.
 - (c) Monitor workers'/foremen's use of protective equipment and supplies.
 - (d) Observe supervision of workers by foremen.
 - (e) Observe health and safety performance of workers/foremen.
 - (f) Monitor workers/foremen for compliance with asbestos disposal procedures.
- A6 Ensure Proper Performance of Workers and Foremen
- (a) Ensure that workers and foremen comply with correct work procedures and codes of practice.
 - (b) Act as an example for safe work practices.
 - (c) Discipline workers as required.
 - (d) Ensure competence of workers and foremen for assigned tasks.
- A7 Review Job Schedule
- (a) Check for crew rotation to avoid heat stress and improve efficiency.
 - (b) Consult with foremen on the assignment of workers for optimal performance.
- A8 Ensure Compliance with Work Procedures and Codes of Practice
- (a) Review established work procedures and respiratory, confined space and asbestos codes of practice (as necessary) with foremen.
 - (b) Ensure that foremen review work procedures and codes of practice with workers.
 - (c) Ensure that workers and foremen are trained with respect to work procedures and codes of practice.
 - (d) Explain to workers and foremen the penalties of failing to comply with the work procedures and codes of practice.

B. Job Planning

Skill

B1 Review Specifications, Blueprints and Job Procedures

- (a) Collect information for job requirements.
- (b) Review specifications, documentation and job procedures with management and other involved parties such as the owner, client, architect, health and safety consultant, foreman, worker representative, occupant, etc.
- (c) Cross-reference job procedures to job specifications.

B2 Determine Needs of Client and/or Contractor

- (a) Identify contractor and client responsibilities.
- (b) Determine specific contractor and client requirements.
- (c) With the consultant, determine the scope of air monitoring required.
- (d) Identify and inform the client of parties potentially affected by the abatement project both on- and off-site.
- (e) Outline site security requirements for the client.

B3 Evaluate Site Conditions

- (a) Identify water and power sources.
- (b) Identify health and safety hazards.
- (c) List pre-job deficiencies of site conditions.
- (d) Determine if background fibre counts are required.
- (e) Identify locations for decontamination unit, waste storage, assembly room, disposal room, entry and exit, etc.

B4 Determine Specific Job Requirements

- (a) Identify site-specific concerns that affect contingency plans.
- (b) Identify specific job requirements such as water and electricity.

B5 Schedule Job

- (a) Determine manpower, materials and equipment requirements.
- (b) Schedule ordering of necessary materials, tools and equipment.
- (c) Set up work schedule to include rotation of workers.
- (d) Schedule sequence of job performance.
- (e) Schedule the duration and frequency of work periods.
- (f) Schedule construction of decontamination facility.
- (g) Schedule disposal of waste materials.
- (h) Schedule additional client requirements such as shift work.

B6 Coordinate Schedule

- (a) Establish schedule with other trades and affected parties.
- (b) Coordinate material requirements with suppliers.
- (c) Coordinate air monitoring requirements.
- (d) Coordinate analysis of air samples with laboratory.

C. Health and Safety

Skill

C1 Identify Site-Specific Health and Safety Hazards

- (a) Prior to job starting, visually inspect site for specific health and safety hazards.
- (b) Perform regular daily inspections to monitor for unexpected health and safety hazards.

C2 Demonstrate a Knowledge of Requirements, Responsibilities, and Rights Under OHS Legislation

- (a) Select appropriate work procedures.
- (b) Determine the appropriate respiratory protective equipment to be used.
- (c) Identify the monitoring of worker health as required by regulations/standards.
- (d) Outline right-to-refuse legislation and legislated code of practice requirements to foremen.
- (e) Outline and explain to foremen and client current health and safety legislation that relates to the job site.

C3 Implement Health and Safety Control Measures

- (a) Correct health and safety problems identified during inspections.
- (b) Ensure that work plan and procedures are implemented.
- (c) Ensure that workers have been adequately trained and are continually upgraded to maintain their competence.
- (d) Protect others who are required to come on site.
- (e) Implement site security plan.

C4 Establish Site Emergency Procedures

- (a) Provide fire protection and ensure that personnel are completely trained in equipment use.
- (b) Establish emergency entry/exit plan.
- (c) Ensure that competent first aiders are available and advise all personnel of their location.
- (d) Ensure that foremen and workers understand and can perform the procedures required in the event of a medical emergency e.g. heart attack – disregard decontamination procedure for life-threatening circumstances.

C5 Act on Worker Health Problems

- (a) Ensure that staff rotation occurs as planned and revise plan as required.
- (b) Check that foremen are observing workers on an ongoing basis to recognize symptoms of heat stress.
- (c) Ensure that foremen take immediate action when workers experience symptoms of heat stress.
- (d) Ensure that asbestos-exposed workers are subjected to medical surveillance as required by health and safety legislation.

D. Job Execution**Skill****D1 Verify Work Plan and Specific Job Requirements**

- (a) Visually check site conditions daily to ensure adherence to work plan.
- (b) Ensure proper dismantling of containment at job completion.
- (c) Ensure proper decontamination of all equipment prior to it leaving the site.

D2 Inspect Isolation of Work and Storage Areas

- (a) Examine integrity of enclosure.
- (b) Check installation and operation of negative pressure air system.
- (c) Check proper set-up of decontamination facility at the beginning of the job and on an ongoing basis.
- (d) Check proper set-up of storage areas at the beginning of the job and on an ongoing basis.

D3 Advise Associated Trades of Specific Work Issues and Schedules

- (a) Coordinate work schedules with other trades as determined in the job plan.
- (b) Advise other trades of hazards on the job that could affect them.
- (c) Review any changes to schedule with other trades.

D4 Coordinate Air Monitoring

- (a) Ensure that air monitoring is performed as required.
- (b) Ensure that samples are forwarded promptly for analysis.
- (c) Implement report results and change work procedures where necessary.
- (d) Determine if more monitoring is necessary during changes to work procedures.

D5 Maintain Job Schedule

- (a) Monitor the job schedule to make sure jobs are completed as planned.
- (b) Reschedule changes with workers, other trades and client.

D6 Order and/or Purchase Supplies and Equipment

- (a) Plan equipment and material needs with foremen on a daily basis.
- (b) Order material and equipment as needed.
- (c) Verify that ordered material and equipment arrives.
- (d) Receive and distribute supplies.

9.4 Competency profile for health and safety consultants (site-specific) at asbestos abatement project sites

Major Responsibilities	Skills					
Health A	A1 Identify Suspected Asbestos-Containing Materials	A2 Recognize Asbestos Health Hazards	A3 Recognize Other Health Hazards Associated With Asbestos Removal	A4 Advise on Work Procedures	A5 Evaluate Health Hazard Knowledge of Site Personnel	A6 Evaluate Asbestos Health Hazards
	A7 Evaluate Suitability of Personal Protective Equipment	A8 Evaluate Effectiveness of Control Measures	A9 Advise on Controls for Health Hazards	A10 Audit Compliance with Health & Safety Legislation		
Safety B	B1 Recognize Safety Hazards	B2 Advise on Corrective Actions for Safety Hazards	B3 Advise on Safe Work Procedures	B4 Advise on Emergency Equipment and Procedures	B5 Evaluate Safety Hazard Knowledge of Site Personnel	B6 Audit Compliance with Health and Safety Legislation
Environment C	C1 Recognize Environmental Hazards	C2 Evaluate Environmental Hazards	C3 Advise on Controls For Environmental Hazards	C4 Evaluate Environmental Hazard Knowledge of Site Personnel	C5 Audit Compliance with Environmental Standards	
Communication D	D1 Establish Lines of Communication	D2 Provide Health, Safety and Environmental Instruction	D3 Establish Reporting Process			
Project Preparation & Coordination E	E1 Assess Scope of Work	E2 Review Project Plans and Specifications	E3 Develop Consultant's Plan of Activities	E4 Coordinate Activities with Others		

Standards of Performance

A. Health

Skill

A1 Identify Suspected Asbestos-Containing Materials

- (a) Identify and locate where asbestos-containing materials may be present.
- (b) Recognize the type(s) of asbestos.
- (c) Carry out bulk sampling and analysis for identification of asbestos in materials, interpreting the results in accordance with recognized standards and methods.

A2 Recognize Asbestos Health Hazards

- (a) Visually inspect the work site for signs of asbestos exposure.
- (b) Locate asbestos hazards.
- (c) Assess the risks based on the results of pre-abatement sampling.
- (d) Anticipate the health hazards associated with changes to work site procedures.

A3 Recognize Other Health Hazards Associated with Asbestos Removal

- (a) Describe symptoms of heat stress, dermatitis, noise, ergonomic and other non-asbestos health stressors.
- (b) Visually inspect the work site and identify the stressors.
- (c) Monitor workers for signs of distress.
- (d) Identify if monitoring for non-asbestos health hazards is required and advise the employer.
- (e) Interpret and assess results of non-asbestos health hazards.

A4 Advise on Work Procedures

- (a) Review and discuss written work site procedures with contractor and/or client.
- (b) Advise on developing codes of practice for asbestos, respiratory protective equipment and confined spaces.
- (c) Monitor site for proper work procedures and provide recommendations for solving problems.

A5 Evaluate Health Hazard Knowledge of Site Personnel

- (a) Evaluate knowledge of site personnel regarding health hazards, abatement procedures and control measures.
- (b) Develop recommendations to correct skill or knowledge deficiencies in workers, foremen and supervisors.

A6 Evaluate Asbestos Health Hazards

- (a) Evaluate work site for key hazard areas prior to asbestos abatement.
- (b) Determine number and location of air samples to be collected.
- (c) Check for proper sampling techniques, competent lab analysis and data interpretations.
- (d) Inspect the security of air samples.

A7 Evaluate Suitability of Personal Protective Equipment

- (a) Describe and implement current practices and requirements for personal protective equipment and respiratory protective equipment.
- (b) Ensure that PPE and RPE have been appropriately selected to maximize health protection.
- (c) Determine the need for medical assessment prior to respirator use.
- (d) Check that RPE is properly selected, fitted, used and maintained.
- (e) Review the code of practice for RPE with supervisors and foremen, and observe that it has been implemented at the work site.
- (f) Observe and correct the inappropriate use and maintenance of protective equipment and clothing.

A8 Evaluate Effectiveness of Control Measures

- (a) Examine contractor's equipment e.g. negative air pressure system, ventilation system, for proper operation.
- (b) Evaluate integrity of enclosure, effectiveness of area segregation, etc.
- (c) Evaluate post-removal/abatement air monitoring.
- (d) Evaluate the work site for proper worker, equipment and work site decontamination procedures.

A9 Advise on Controls for Health Hazards

- (a) Advise on the integrity of containment structure.
- (b) Recommend strategies for control e.g. safe work practices.

A10 Audit Compliance with Health and Safety Legislation

- (a) Interpret and describe current health and safety legislation under the Occupational Health and Safety Act and regulations.
- (b) Monitor site to ensure that safe work procedures are followed.
- (c) Monitor site to ensure conformance to the codes of practice.
- (d) Advise site supervisor on the need for medical surveillance (distress from asbestos and non-asbestos health hazards, PPE and RPE).
- (e) Inspect for compliance with health and safety legislation under the Occupational Health and Safety Act and regulations.

B. Safety

Skill

B1 Recognize Safety Hazards

- (a) Identify and evaluate potential safety hazards associated with asbestos abatement projects.
- (b) Visually inspect the work site for electrical, scaffolding, tripping, slipping, fire hazards, etc.

B2 Advise on Corrective Actions for Safety Hazards

- (a) Report safety problems to client/contractor.
- (b) Advise client/contractor on proper training procedures, housekeeping, PPE, etc.
- (c) Assist in resolving on-site safety hazards.

B3 Advise on Safe Work Procedures

- (a) Assist in developing safe work procedures and codes of practice.
- (b) Assess and provide support for the training of personnel.

B4 Advise on Emergency Equipment and Procedures

- (a) Identify potential emergency hazards.
- (b) Assist in developing and improving emergency response procedures.
- (c) Assist in developing and improving fire procedures.
- (d) Monitor safe handling of equipment and make recommendations as necessary.
- (e) Assist in delivering emergency procedure training sessions.
- (f) Monitor site for compliance with regulations and standards associated with emergency situations (fire regulations, building and first aid standards), and report non-compliance to site supervisor.

B5 Evaluate Safety Hazard Knowledge of Site Personnel

- (a) Evaluate work practices of site personnel for adherence to safety procedures.
- (b) Develop recommendations to correct skill or knowledge deficiencies in workers, foremen and supervisors.

B6 Audit Compliance with Safety and Safety Legislation

- (a) Advise on current health and safety legislation under the Occupational Health and Safety Act.
- (b) Monitor site to ensure that safe work procedures are followed.
- (c) Monitor work site for conformance to the codes of practice.
- (d) Inspect for compliance with health and safety legislation under the Occupational Health and Safety Act and regulations.

C. Environment

Skill

C1 Recognize Environmental Hazards

- (a) Identify potential environmental hazards associated with asbestos abatement.
- (b) Inspect air and water filtration systems in relation to the abatement project.
- (c) Inspect integrity of enclosure for leaks and conduct leak testing.
- (d) Inspect disposal, labelling and transportation procedures.

C2 Evaluate Environmental Hazards

- (a) Examine area for air, water and soil contamination.
- (b) Review disposal, labelling and transportation procedures.

C3 Advise on Controls for Environmental Hazards

- (a) Recommend improvements to air/water filtration systems.
- (b) Recommend sampling, packaging and disposal procedures.

C4 Evaluate Environmental Hazard Knowledge of Site Personnel

- (a) Assess the skills of site personnel in dealing with environmental hazards and disposal procedures.
- (b) Develop recommendations to correct skill or knowledge deficiencies in workers, foremen and supervisors.

C5 Audit Compliance with Environmental Standards

- (a) Advise on current federal, provincial and municipal environmental, transportation and disposal regulations.
- (b) Inspect for compliance with environmental, transportation and disposal regulations.

D. Communication

Skill

D1 Establish Lines of Communication

- (a) Identify who needs to be informed and establish the communication link.
- (b) Establish reporting procedure with client/contractor.
- (c) Determine and indicate the persons responsible for decisions at the site, and their level of authority.
- (d) Set out a communication process with the client/contractor.
- (e) Establish roles and expectations with the client/contractor and consultant.
- (f) Establish and maintain contact with professionals in the health and safety and environmental fields.

D2 Provide Health, Safety and Environmental Instruction

- (a) Train supervisors how to properly select, fit, use and maintain RPE.
- (b) Train supervisors on current emergency, decontamination and safe work procedures.
- (c) Assist in delivering training sessions to workers, as requested.
- (d) Conduct meetings to promote health and safety.
- (e) Interpret health, safety and environmental standards for others.

D3 Establish Reporting Process

- (a) Communicate oral and written information through established communication links.
- (b) Prepare agendas for meetings.
- (c) Prepare presentations, allowing room for discussion.
- (d) Establish a record-keeping procedure.
- (e) Collect, interpret and evaluate data.
- (f) Prepare reports that focus on key issues.
- (g) Solicit feedback on reports, recommendations and actions from the client/contractor.

E. Project Preparation and Coordination**Skill****E1 Assess Scope of Work**

- (a) Review specific job requirements.
- (b) Review decontamination requirements.
- (c) Determine if an adequate assessment of the scope of the work has been made.
- (d) Negotiate additional site-specific contractor/client needs.
- (e) Assess job requirements/client or contractor needs on an ongoing basis.

E2 Review Project Plans and Specifications

- (a) Collect and review the contractor's/client's plans and specifications and building plans and specifications, if available.
- (b) Identify contractor's/client's approach to the project.
- (c) Evaluate site-specific requirements.
- (d) Recommend amendment to plans and specifications, if necessary.

E3 Develop Consultant's Plan of Activities

- (a) Plan activities to meet contractor's/client's needs.
- (b) Develop consultant's schedules and allocate equipment resources.
- (c) Anticipate changes and develop contingency plans.

E4 Coordinate Activities With Others

- (a) Organize consulting activities to coincide with the work plan.
 - (b) Coordinate contingency plans with supervisors/foremen.
 - (c) Negotiate special needs/activities with supervisors/foremen.
-