

# Saskatchewan Asbestos Abatement Manual

Guidelines for Asbestos Processes in Building Demolition and Renovation

2017

## PLEASE NOTE

This publication is not designed to replace the legislation. Please use the original legislation to find out exactly what requirements apply to your business.

**The words *must* and *should* in the Saskatchewan Asbestos Abatement Manual have been chosen with purpose. The word *must* indicates a requirement to ensure compliance with *The Occupational Health and Safety Regulations, 1996*, while *should* indicates an advisory recommendation that is highly desirable and is to be implemented where applicable.**

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# Table of Contents

<b>Glossary of Terms</b> .....	<b>1</b>
<b>Asbestos, Asbestos-Containing Materials and Risk Assessment</b> .....	<b>8</b>
Introduction .....	8
Uses of Asbestos .....	8
Friable Sprayed Products Used in Buildings .....	11
Pipe or Boiler Insulation .....	13
Assessing Health and Exposure Risk .....	14
Exposure Assessment Algorithm .....	14
Asbestos Risk Decision Tree .....	18
<b>Health Effects Associated With Exposure to Asbestos</b> .....	<b>19</b>
Physical Characteristics of Asbestos .....	19
Entering the lungs .....	19
Health Effects from Occupational Exposure .....	20
<b>Introduction to Asbestos Abatement Methods</b> .....	<b>22</b>
Removal .....	23
Encapsulation .....	24
Enclosure .....	25
Asbestos Management Program .....	26
<b>Asbestos Processes</b> .....	<b>28</b>
Introduction .....	28
Low Risk Asbestos Processes .....	28
Moderate Risk Abatement Activities .....	31
High Risk Abatement Activities .....	36
Special Cases .....	48
<b>Personal Protective Equipment</b> .....	<b>60</b>
Respiratory Protection .....	60
Protective Clothing .....	68
<b>Other Health and Safety Considerations</b> .....	<b>69</b>
Identifying the Hazards .....	69
Electrical Hazards .....	69
Ladders and Scaffolds .....	70
Slips, Trips and Falls .....	70
Heat Stress .....	71
Cold Stress .....	71
Carbon Monoxide .....	71
Limb and Body Protection .....	71
Hazardous Chemicals .....	72
Confined Space .....	72
Structural Hazards .....	72
Emergency Response .....	72
Emergency Plan .....	72
Emergency Procedures: Fire, Explosion and Spills .....	73
Emergency Procedures: Medical Emergencies .....	74

<b>Appendix A: Asbestos Analysis and Tests</b> .....	<b>76</b>
Bulk Sample and Analysis .....	76
Wipe Sampling .....	81
<b>Appendix B: Air Monitoring</b> .....	<b>82</b>
Types of Air Monitoring .....	82
<b>Appendix C: Air Monitoring Analytical Methods and Results Analysis</b> .....	<b>85</b>
NIOSH 7400 Phase Contrast Microscopy (PCM) Method .....	85
NIOSH 7402 Transmission Electron Microscopy (TEM) Method .....	86
<b>Appendix D: Analyst Qualifications, Training and Laboratories</b> .....	<b>89</b>
Asbestos Laboratories .....	89
<b>Appendix E: HEPA Filters and Enclosures Test Procedures</b> .....	<b>92</b>
Testing HEPA Filters .....	92
Smoke Testing of Enclosures .....	95
<b>Appendix F: Competency Profiles for Workers, Foreman, Site Supervisors and Consultants Working at Asbestos Abatement Projects</b> .....	<b>97</b>
Competency Profile for Workers at Asbestos Abatement Project Sites .....	97
Competency Profile for Foremen at Asbestos Abatement Project Sites .....	102
Competency Profile for Site Supervisors at Asbestos Abatement Project Sites .....	108
Competency Profile for Health and Safety Consultants (site-specific) at Asbestos Abatement Project Sites .....	115
<b>References</b> .....	<b>122</b>

## Glossary of Terms

**ACGIH:** American Conference of Governmental Industrial Hygienists. ACGIH® is respected for its dedication to the industrial hygiene and occupational health and safety industries. Specifically, the Threshold Limit Value (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEI) set standards and best practices for occupational health and safety and are widely referred to by the various regulatory agencies.

**Aggressive Air Sampling:** sampling of air that is deliberately disturbed or agitated (physically circulated) to produce a ‘worst case’ situation. Normally, this type of sampling would take place after the final clean-up (e.g., clearance sampling before the containment is torn down).

**AIHA:** American Industrial Hygiene Association.

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

**Airlock:** a device that allows persons to move from one room to another, while permitting minimal air movement between those rooms. An airlock is formed by two curtained doorways spaced a distance apart. To create an airlock, curtained doorways are constructed by placing two overlapping sheets of plastic over an existing or temporarily framed doorway. Each sheet along the top of the doorway, the vertical edge of one sheet along one vertical side of the doorway, and the vertical edge of the other sheet along the opposite side of the doorway must be secured. The door flaps must be constructed to allow make-up air to flow into the containment area.

**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 centimetre (f/cc). Asbestos air monitoring includes: area - conducted in a specific area, personal -conducted in a worker’s breathing zone and clearance - conducted in the enclosure after the final clean-up to ensure that asbestos fibres are below the criterion.

**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 allow for a more thorough wetting of asbestos fibres by reducing the water’s surface tension.

**Asbestos:** the fibrous form of crocidolite, amosite, chrysotile, anthophyllite, actinolite, and tremolite.

**Asbestos Abatement:** procedures to encapsulate, enclose or remove asbestos-containing material. Asbestos Abatement is a term used in the industry and has the same meaning as Asbestos Processes in *The Occupational Health and Safety Regulations, 1996*. In this guideline, asbestos abatement and asbestos processes are interchangeable.

**Asbestos-Containing Material (ACM):** any vermiculite determined to contain asbestos; or any material, other than vermiculite, that when tested according to an approved method contain a proportion of asbestos greater than 0.5 per cent, if the material is friable; or a proportion of asbestos greater than 1.0 per cent, if the material is non-friable. Any material likely to contain asbestos is deemed ACM until the material is determined to be asbestos free according to the above criterion.

**Asbestos Dust:** dust that consists of or contains asbestos fibres that are likely to become airborne. Asbestos dust can include asbestos fibres found in air or settled on surfaces. In this guideline, asbestos dust and asbestos fibre are interchangeable.

**Asbestos Fibre:** fibrous asbestos minerals to be ascertained on a microscopic level with fibres defined to be particles with an aspect ratio of 3 to 1 or larger.

**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 breathing.

**Asbestos Process:** any activity that may release asbestos fibres, and includes:

- (i) the sawing, cutting or sanding of asbestos-containing materials;
- (ii) the repair, maintenance, replacement or removal of asbestos surfaces;
- (iii) the cleaning or disposal of asbestos materials;
- (iv) the mixing or application of asbestos shorts, cements, grouts, putties or similar compounds;
- (v) the storing or conveyance of materials containing asbestos; and
- (vi) the demolition of structures containing asbestos.

**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.

**Assigned Protection Factor (APF):** the anticipated level of protection that would be provided by a properly functioning respirator or respirator class to properly fitted and trained users.

**ASTM:** ASTM International, formerly known as the American Society for Testing and Materials (ASTM).

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

**Clean Room:** the uncontaminated area of a decontamination facility where 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.

**Clearance Air Sampling:** sampling of air following a removal, encapsulation, enclosure, repair, operations and maintenance that might have disturbed ACM. To determine if the air meets regulatory clearance requirements (0.01f/cc) the preferred analytical method consists of aggressive air sampling and fibre counting using Transmission Electron Microscopy (TEM) or Phase Contrast Microscopy (PCM).

**Competent:** possessing knowledge, experience and training to perform a specific duty.

**Competent Person:** one who is capable of identifying existing asbestos hazards in the workplace, selecting the appropriate control strategy for asbestos exposure, has the authority to take prompt corrective measures to eliminate them and is specially trained in a training course on the appropriate subject material.

**Containment:** an enclosure built to completely seal asbestos-containing materials and contaminated air.

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

**CSA:** the Canadian Standards Association, which is accredited by the Standards Council of Canada, a crown corporation which promotes standardization and carries out standard development and certification in Canada. CSA is composed of representatives from industry, government and consumer groups.

**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 waste that must be removed from the work area.

**Demolition:** the wrecking or taking out of any load-supporting structural member and any related razing, removing or stripping of asbestos containing materials.

**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 High Efficiency Particulate Air (HEPA) filters such as industrial HEPA 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.

**Emery 3004:** a compound (Poly-Alpha Olefin- PAO) 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 and contaminated air behind airtight, impermeable, permanent barriers.

**EPA:** United States Environmental Protection Agency.

**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 that may be contaminated with asbestos.

**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 micrometre cellulose ester membrane to trap fibres.

**Fit Factor:** a quantitative measure of fit for a particular respirator specific to an individual. A fit factor is calculated by dividing the challenge aerosol concentration outside of the respirator, by the challenge aerosol concentration inside the respirator during a quantitative fit test.

**Fit Test:** the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

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

**Friable Material:** material that when dry may be crumbled, pulverized, or reduced to powder by hand pressure, and includes previously non-friable material that after such material becomes damaged to the extent that when dry it may be crumbled, pulverized or reduced to powder by hand pressure. 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 usually affects workers who sweat a lot during strenuous activity. This sweating depletes the body's salt and moisture levels. Low salt levels in muscles causes painful cramps. Heat cramps may also be a symptom of heat exhaustion. Symptoms include: muscle pain or spasms usually in the abdomen, arms, or legs.

**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 Rash:** a skin irritation caused by excessive sweating during hot, humid weather.



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

**Heat Stroke:** the stroke caused by the loss of the body's ability to cool itself through sweating. Heat stroke is the most serious heat-related disorder as the body is unable to control its own temperature. As a result, the body's temperature rises rapidly, the sweating mechanism fails and the body is unable to cool down. When heat stroke occurs, the body temperature can rise to 40 degrees Celsius or higher within 10 to 15 minutes. Heat stroke can cause death or permanent disability if emergency treatment is not given. Symptoms include: hot, dry skin or profuse sweating, hallucinations, chills, throbbing headache, high body temperature, confusion/dizziness, and slurred speech.

**HEPA Filter:** a High Efficiency Particulate Air Filter. HEPA filters are used in both respirators and air handling equipment. HEPA 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 micrometres and a maximum pressure drop of 1.0 inch water gauge when clean and operating at their rated airflow capacity. When referenced throughout this document, a HEPA filter must be certified.

**HEPA Vacuum:** an industrial vacuum with a properly fitted HEPA filter suitable for asbestos abatement processes.

**Homogeneous:** evenly mixed and similar in appearance and texture throughout.

**Immediately Dangerous to Life or Health (IDLH):** an atmosphere that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. NIOSH has established an IDLH value for 387 chemicals to ensure that workers can escape from a given contaminated environment in the event of respiratory protection equipment failure. The IDLH value is considered a maximum level above which only a highly reliable breathing apparatus providing maximum worker protection is permitted.

**Maximum Use Concentration (MUC):** the maximum atmospheric concentration of a hazardous substance from which a worker can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC usually can be determined mathematically by multiplying the assigned protection factor specified for a respirator by the contamination limit or occupational exposure limit, short-term exposure limit, ceiling limit, peak limit, or any other exposure limit used for the hazardous substance. MUCs shall not be used for IDLH conditions.

**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 Seal Check:** a method of checking 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. In the United States, NIOSH is responsible for conducting research and making recommendations for the prevention of work-related illnesses and injuries.

**Phase Contrast Microscopy (PCM):** an optical microscopy technique that converts phase shifts in light passing through a transparent specimen to brightness changes in the image. PCM is 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 micrometres 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):** an air-purifying respirator that uses a powered mechanism (blower) to pass ambient air through an air-purifying element to a respiratory inlet covering. The PAPR consists of a full-face mask, battery pack, air pump, high efficiency filter and hoses.

**Qualitative Fit Test:** a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to a test agent. It is 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 by using an instrument (for example a Portacount) to assess the amount of leakage into the respirator in order to assess the adequacy of respirator fit.

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

**Renovation:** the modification of any existing structure, or portion thereof.

**Respirator:** a device that when chosen appropriately and worn correctly is designed to protect the wearer from inhaling harmful dusts, fumes, vapors, or gases. There are two main categories: the air-purifying respirator, which forces contaminated air through a filtering element, and the air-supplied respirator, in which an alternate supply of fresh air is delivered. Within each category, different techniques are employed to reduce or eliminate noxious airborne contents.

**Restricted Area:** an area within a work site where there is a reasonable chance of the exposing workers to airborne asbestos fibers.

**SCBA (Self-Contained Breathing Apparatus):** an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

**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 a 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.

# Asbestos, Asbestos-Containing Materials and Risk Assessment

## 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.

## 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 contained asbestos at one time 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 back plaster
- 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 lists 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.

### **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. The end result was a dense mixture, that was less likely to crumble when compared to similar materials applied dry. With the slurry-cementitious product, maximum application thickness was usually 20 to 25 mm ( $\frac{3}{4}$  to one inch), with most applications being six to 13 mm thick ( $\frac{1}{4}$  to  $\frac{1}{2}$  inches). 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, 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. They may be found on beams, beams and columns, or beams and decks. These materials may be found in good or bad (flaking) condition depending on maintenance, renovations or water damage. Additionally, these materials may have a hard or solid surface, but be very soft beneath the skin. Applications may range in thickness from almost no measurable thickness to 75 mm (three inches). 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.

## 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 blocks (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 type of material is frequently called asbestos-cement, asbestos-insulating cement, or blue mud. It may be used with other asbestos-containing insulations ors and 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.

## 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:

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

## 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 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

Ideally, asbestos-containing materials should not be located in supply or return air plenums. Actions including an annual inspection by a competent person and regular inspections by an employer, contractor or owner are required 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 Legend**

Once you have determined the condition of the asbestos-containing material (good, fair or poor) and the level of accessibility (high, moderate or low), choose appropriate control methods to contain the fibres. You may find the Asbestos Risk Decision Tree on page 18 helpful.

#### 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

#### Control 2

- Immediately prevent the asbestos fibres from entering the air distribution system through changes to the system, removal, clean-up and/or repair, and if not ultimately removed, implement an Asbestos Management Program (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 Program (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).

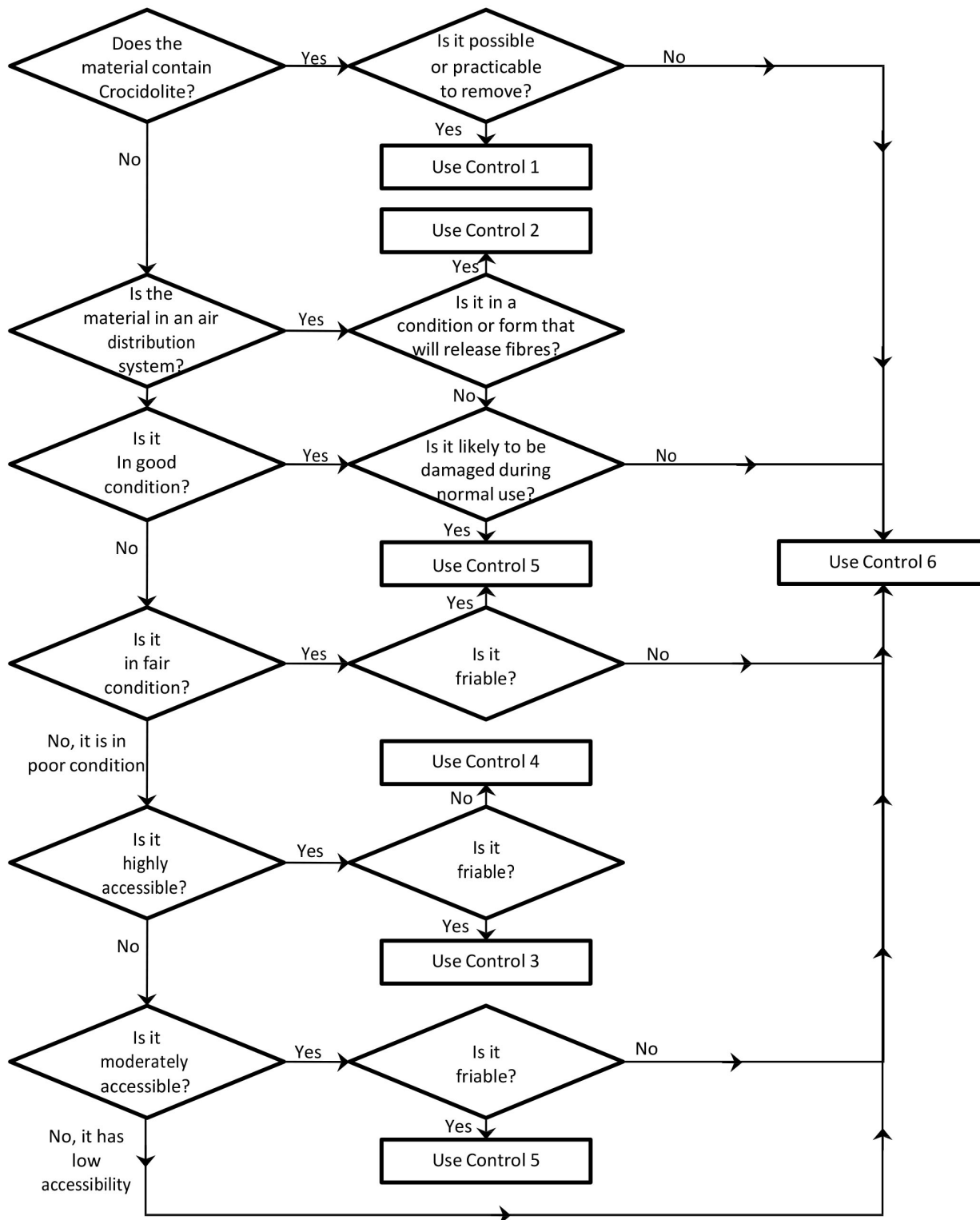
Control 5

- 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:
  - Inventory of asbestos-containing materials in the building;
  - Inspection frequency and procedures;
  - Training requirements for maintenance staff and others who may come into contact with the materials or work in proximity to the materials;
  - Procedures to follow in the event of damage or other emergency situations;
  - Procedures to follow should the condition of the materials change or work routines be altered;
  - Notification procedures for occupants and others in the building; and
  - Labeling of asbestos-containing materials and a plan for ultimate removal of asbestos.

# Asbestos Risk Decision Tree

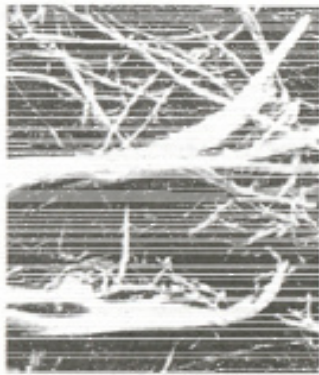


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## Health Effects Associated With Exposure to Asbestos

### Physical Characteristics of Asbestos

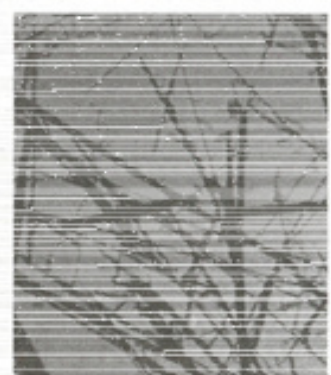
Asbestos fibres, unlike man-made fibres such as fiberglass, can be split into thinner and thinner fibres parallel to their length. At their finest, the fibres can hardly be seen by the best optical microscope. The average diameter of an airborne asbestos fibre ranges from 0.11 to 0.24 micrometers, depending on the type of asbestos. By comparison, a human hair is approximately 75 micrometers in diameter (more than 300 times thicker) and a glass fibre ranges between three to 15 micrometers 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.

### 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 depends on both fibre diameter and fibre length.

## 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.

### Asbestosis

Asbestosis is a condition associated with exposure to airborne asbestos fibres. 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.

### Lung Cancer

Short term exposure to asbestos fibres may be sufficient to cause lung cancer. Lung cancer takes approximately 15 to 25 years to develop, depending on the frequency and duration of exposure.

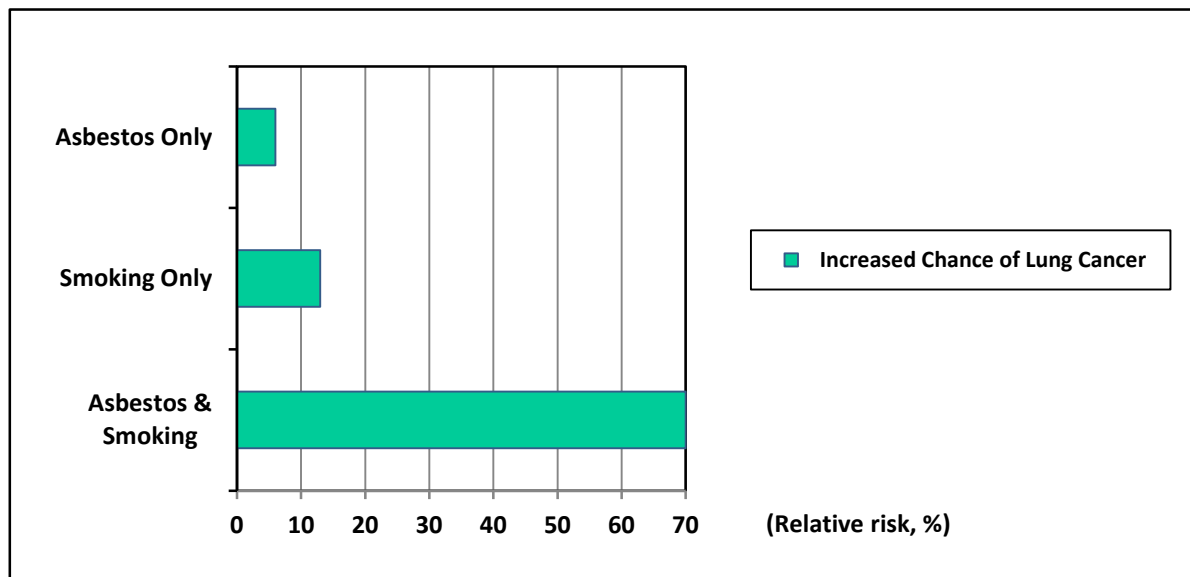
The combination of smoking and occupational asbestos exposure is extremely hazardous. Dr. Irving J. Selikoff, a medical leader in the study of asbestos-related disease, produced the figures shown in Figure 1.1 on the next page.

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.



**Figure 1.1: Risk of lung cancer caused by the combination of smoking and asbestos exposure  
Pleural and Peritoneal Mesothelioma**



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-term and short-term exposures.

#### **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.

## Introduction to Asbestos Abatement Methods

The first step in 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, a 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 an exposure has or is likely to occur, corrective actions must take place. 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. **Asbestos Management Program** — an Asbestos Management Program (AMP) helps to prevent the release of asbestos fibres into occupied areas of a building by identifying and managing asbestos-containing materials (ACM). It is intended to prevent the release of asbestos fibres into the air and to protect building occupants from exposure. The AMP must continue unless all material containing asbestos has been removed or the building has been demolished. Before ACM is removed, the area is inspected periodically for changes in exposure potential and maintenance staff are correctly notified and trained to deal with ACMs. An AMP 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 has been implemented, a management program will be required for the building.

Removal, encapsulation and enclosure are corrective methods that 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 has been implemented, a management program is still required for the building.

Since asbestos-containing materials remain within the building following an enclosure or encapsulation, these two approaches should only be considered as temporary control measures. The expected length of time before a building is set to be demolished or undergo major structural changes, are factors to consider when 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 on each exposure control approach.

## **Removal**

During removal, all asbestos-containing materials are taken off the underlying surface, collected and placed in containers for burial at an approved waste disposal site. In the short term, this is the most expensive control method 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 may be mandatory prior to demolition or major renovations.
- Removal is significantly cheaper if combined with renovation or demolition activities.

## 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.
- A risk assessment shall be done prior to encapsulation to determine how to categorize the project (high, medium or low risk). If the project is a high risk process, then a high risk asbestos procedure must be followed.
- Encapsulation is difficult to do where access to the asbestos material is awkward.

### **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.

## Asbestos Management Program

When asbestos-containing materials remain in place, a written record must be developed and implemented. This written record is known as an Asbestos Management Program (AMP) and must address the following:

- Identifying and labeling asbestos-containing materials (ACM) that can release asbestos fibres;
- Keeping a current written record of all ACM present in the workplace;
- Regularly surveying and maintaining asbestos materials to prevent fibre release;
- Conducting, at minimum, annual inspections of all friable asbestos-containing materials, and all sprayed-on asbestos surfaces by a competent person;
- Conducting work in a way that prevents the release of asbestos fibres as much as possible;
- Developing procedures to follow in the event of damage or other emergency situations;
- Developing procedures to follow should the condition of the materials change or work routines be altered;
- Notifying, informing and training workers;
- Notifying Occupational Health and Safety (OHS) at least 14 days before beginning a high risk asbestos process when in need; and
- Developing an asbestos work plan and implement the work plan if an asbestos process is planned.

For more information about developing an asbestos management program, please refer to the *Guidelines for Managing Asbestos in Buildings* available at [saskatchewan.ca/asbestos](http://saskatchewan.ca/asbestos).

Workers who may be exposed to asbestos dust as a result from asbestos processes must be provided training in accordance to *The Occupational Health and Safety Regulations, 1996*. Training must include but is not limited to the nature and risk to health, along with safe handling and procedures including decontamination and disposal.

**Please note:** The OHS Division of the Saskatchewan Ministry of Labour and Workplace Safety does not recognize, certify, or endorse any third party training for asbestos. Additionally, the OHS Division does not prescribe specific courses be provided by any particular firm. Training you take and pay for with any external third party will be done at your own risk. Doing research and performing reference checks for any training you require is recommended.

The cost of a management program 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 programs 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 program 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 Program**

- Initially the lowest cost and minimal disruption to building operation.

**Disadvantages of a Management Program**

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

## Asbestos Processes

### Introduction

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

All asbestos processes 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 asbestos processes, namely asbestos 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.

### Low Risk Asbestos Processes

#### Description of Projects

Abatement activities and operations classified as ‘low risk asbestos processes’ 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 may include:

- The installation or removal of manufactured asbestos-containing products where sanding, cutting or similar disturbance is not required;
- The use of hand tools to cut, shape, drill or remove a manufactured asbestos-containing product;
- The removal of drywall material where asbestos joint filling compounds have been used;
- The use of personal protective equipment made of asbestos-containing textiles;
- The transporting or handling of asbestos-containing materials in sealed containers;
- The cleaning or disposing of minor amounts of asbestos debris that has come loose or fallen from a friable surface; and
- The removal of small samples of asbestos-containing material for the purpose of identification.

#### Equipment

**Note:** When referenced throughout the entirety of this manual, a HEPA filter must be certified as required by the *The Occupational Health and Safety Regulations, 1996*.



As required, the equipment should include:

- An industrial HEPA vacuum cleaner fitted with a HEPA filter;
- Polyethylene drop sheets having a minimum six mil thickness if in need ;
- Six mil thick labelled asbestos disposal bags;
- A spray bottle or hand pump garden sprayer or other alternative wetting equipment to wet asbestos;
- Barriers and warning signs;
- Hand powered tools for abatement work;
- Mops and/or rags and water for clean-up;
- Fire extinguishers, as needed;
- An appropriate first aid kit; and
- Other tools that are suitable for the process

### **Personal Protective Equipment**

Appropriate personal protective equipment must be chosen based on a project specific risk assessment. However, when performing low risk asbestos processes, general best practice recommends workers who may be exposed to asbestos fibres should wear:

- 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 as the minimum respiratory protection;
- Disposable coveralls that resist penetration by asbestos fibres to prevent contamination;
- Disposable shoe covers, gloves; and
- Personal protective equipment appropriate to other hazards present at the work site.

### **Pre-job Planning**

1. Establish a job specific written work plan including procedures to be followed and assemble the equipment required to perform the job.
2. Ensure workers are adequately trained in the hazards and proper methods of working with asbestos.
3. Procedures to deal with emergencies such as fire or injury must be developed and in place prior to work starting.

### **Site Preparation**

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

## Work Procedures

1. Dry removal of asbestos-containing material is not permitted by using a low risk process. 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 an industrial HEPA 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 must be wetted whenever possible to minimize the release of airborne fibres. If the material cannot be wetted, there is a higher risk of asbestos fibers becoming airborne and contaminating the area.



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, or chew gum or tobacco at the work site except in a designated clean area. It is best practice for workers to remove protective equipment and clothing and clean their hands and faces prior to any of these activities.

## Decontamination

1. During and immediately upon completing the work:
  - a) Clean up dust and waste by vacuuming with an industrial HEPA vacuum cleaner fitted with a HEPA filter, or by wet sweeping or 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 an industrial HEPA vacuum cleaner fitted with a HEPA filter or by wet methods .
3. Non-disposable coveralls or other clothing contaminated with asbestos must be laundered following proper procedures. If shoe covers are not used, footwear must be properly decontaminated.

## **Disposal**

Asbestos waste, including contaminated disposable clothing, must be double-bagged and placed in sealable containers labelled as “Asbestos.” 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 (wet methods), or by using an industrial HEPA vacuum cleaner fitted with a HEPA filter. The cleaned containers must then be removed from the work area.

Asbestos waste must be disposed to a designated asbestos landfill by following procedures required by the municipal authority.

## **Air Monitoring**

In low risk asbestos processes, air monitoring is recommended to determine typical exposure levels during abatement activities and to ensure workers have been adequately protected. Additionally, in some low risk project cases a baseline measurement may be beneficial as this determines the background airborne fibre concentration before starting a project. For these reasons, if air monitoring is chosen, results should be below 0.01 fibres per cubic centimetre (f/cc) during all phases of the work. After cleanup, additional air monitoring may be required to ensure there are no residual fibres. Please see Appendix B for more information regarding appropriate air monitoring methods.

## **Site Inspection**

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

## **Moderate Risk Abatement Activities**

### **Description of Projects**

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

- The use of a power tool equipped with HEPA filtration to cut, shape or grind any asbestos-containing surface or product;
- The removal of a false ceiling or part of a false ceiling where friable asbestos-containing material is, or is likely to be, lying on the surface of the false ceiling; and
- The removal, the encapsulation or enclosure or the disturbance of minor amounts of friable asbestos-containing material during the repair, alteration, maintenance, demolition, or dismantling of a structure, machine or equipment or part of a structure, machine or equipment.

## Equipment

As required, the equipment should include:

- An industrial HEPA vacuum cleaner fitted with a HEPA filter;
- A negative air unit (if chosen);
- Polyethylene drop sheets having a minimum six mil thickness;
- Six mil thick labelled asbestos disposal bags;
- A spray bottles or hand pump garden sprayers or other appropriate tools to wet asbestos;
- Barriers and warning signs;
- Mops, rags, brushes, water and other supplies for clean-up;
- Other appropriate tools;
- Fire extinguishers, as needed; and
- A first aid kit.

## Personal Protective Equipment

1. Appropriate personal protective equipment must be chosen based on a project specific risk assessment. However, when performing moderate risk asbestos processes, general best practice recommends workers who may be exposed to asbestos fibres should wear protective clothing that:
  - a) Is made of material 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.

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 assigned 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.

## Pre-Job Planning

1. Establish the work procedures and a written project specific work plan to be followed and assemble the equipment required to perform the job.
2. Ensure all equipment fitted with HEPA filters has been certified annually and inspected for defects before the job commences.

3. If a negative air unit is chosen to contain asbestos dust in the enclosure and exhausts into the interior of a place of employment that is occupied by unprotected workers, the unit must be tested in an approved manner by a competent person.
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. Written procedures to deal with emergencies such as a fire or injury must be developed and in place prior to work starting.

### Site Preparation

1. Barriers and warning signs must be posted in areas where access to unauthorized persons needs to be restricted until the work is completed. It is recommended that proper signage read as follows and include the name of a contact person on-site.



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 an industrial HEPA 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. If a containment is chosen, it should be constructed using six mil thick polyethylene

sheeting. A HEPA- filtered exhaust unit should be connected to the containment to provide negative pressure for the duration of the project.

7. A worker decontamination room should be attached to the containment

### **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 must include vacuuming with an industrial HEPA 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, consider performing clearance air monitoring after a minimum drying period of four hours.

### **Decontamination**

1. Immediately upon completing the work:
  - a) Dust and waste must be cleaned up by vacuuming with an industrial HEPA vacuum cleaner fitted with a HEPA filter, or if not possible by wet sweeping or 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 an industrial HEPA 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.

### **Disposal**

1. Place double-bagged 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 an industrial HEPA vacuum cleaner fitted with a HEPA filter.
3. Remove containers from the work area.
4. Asbestos waste must be disposed to a designated asbestos landfill by following local municipal laws.

### **Air Monitoring**

For reasons stated previously in the “Low Risk Asbestos Processes,” best practice recommends performing air monitoring prior to the commencement of abatement work (baseline or background samples), during abatement activities and upon completion of the job. Air monitoring must be performed by competent personnel following approved methods. Please see [Appendix B](#) within this manual for more information.

### **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.

## High Risk Abatement Activities

### Description of Projects

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

- The removal, encapsulation, enclosure or disturbance of anything but minor amounts of friable asbestos-containing material during the repair, alteration, maintenance, demolition, or dismantling of any part of a plant;
- The cleaning, maintenance or removal of air-handling equipment in buildings where sprayed fireproofing asbestos-containing materials have been applied to the airways or ventilation ducts;
- The dismantling or the major alteration or repair of a boiler, furnace, kiln or similar device, or part of a boiler, furnace, kiln or similar device, that is made of asbestos-containing materials; and
- The use of power tools not equipped with HEPA filtration to grind, cut or abrade any asbestos-containing surface or product.

### Equipment

As required, the equipment should include:

- Portable HEPA-filtered exhaust units with extra fuses;
- An additional HEPA- filtered exhaust unit in the event of total failure (best practice);
- Replacement certified HEPA filters;
- Flexible or rigid duct;
- Industrial HEPA vacuum cleaners fitted with HEPA filters;
- Electrical extension cords;
- A portable ground fault circuit interrupter (GFCI);
- Garden hose;
- Hand pump garden sprayer to wet asbestos;
- Wetting agent (50 per cent polyoxyethylene ether and 50 per cent polyoxyethylene, or equivalent);
- Scrapers, nylon brushes, dust pans, shovels, etc.;
- Scaffolds with railings;
- Duct tape or an alternative tape with similar or better adhesive qualities;
- Polyethylene sheeting having a minimum six mil thickness;
- Six mil thick labelled asbestos disposal bags; and /or six mil thick polyethylene sheeting to enclose the waste containers i.e., dumpsters.
- Barriers and warning signs;
- Mops and/or rags, water and other supplies for clean-up;
- Encapsulant for sealing edges;



- Manometre, pumps and smoke generator;
- Communication equipment when necessary;
- A fire extinguisher; and
- An appropriate first aid kit.

### **Personal Protective Equipment**

1. Appropriate personal protective equipment must be chosen based on a project specific risk assessment. However, when performing high risk asbestos processes general best practice recommends workers who may be exposed to asbestos fibres follow the guidance stated below and wear protective clothing that:
  - a) Is made of material 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. All PPE must be cleaned before use or reuse.

2. If contaminated clothing is to be laundered, it must first be HEPA 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 and protected from 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, appropriate respiratory protection with a sufficient assigned protection factor (APF) must be worn by asbestos abatement workers. For more information and general guidance on how to select appropriate respiratory protection, please see the Personal Protective Equipment section of this manual and approved standards such as CSA Z94.4-11.

It is recommended at minimum that workers performing high risk processes wear a full face piece PAPR (Powered Air Purifying Respirator) equipped with a P100 (oil Proof), R100 (Resistant to oil) or N100 (Not resistant to oil) particulate filter cartridge. Positive pressure supplied air respirators equipped with the appropriate filter (ex. P100) may be required if wet removal is not possible. Should the supply of breathing air be cut off or temporarily interrupted, it is best practice to utilize positive pressure supplied air respirators with the appropriate filter, as an escape provision.

It should be noted that in high risk abatement processes, disposable single-use respirators must not be used. However, 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.

4. Protective clothing and respiratory protective equipment must be provided for authorized visitors.
5. Workers must use body protection and safety equipment appropriate to other hazards present at the work site.

### **Pre-Job Planning**

1. Establish the written project specific work plan to be followed and assemble the equipment required to perform the job.
2. Submit a completed [Notification of High Risk Asbestos Process Form](#) to Occupational Health and Safety 14 days prior to commencing the project. In some cases, such as an emergency situation, the notification shall be submitted as soon as possible. In the meantime, the employer or owner shall take all precautions to ensure that no workers are exposed to asbestos fibres. This form should be submitted via email ([OHSAsbestosNotification@gov.sk.ca](mailto:OHSAsbestosNotification@gov.sk.ca)) or fax (306-787-2208).
3. Obtain the necessary building permit(s) by contacting the municipality or accredited agency that issues building permits.
4. Have the following documentation available:
  - Required permits;
  - Written lock-out procedures;
  - Proof of worker training;
  - Fit testing records
  - Names of supervisory personnel;
  - Shop drawings of work area layout/decontamination facility;
  - Construction schedule;
  - Certification of HEPA-filtered equipment; and
  - Written program for respiratory protection.
5. Ensure all HEPA-filtered equipment has been tested before the job commences.
6. Ensure workers are adequately trained and competent in the hazard assessment, and proper methods of working with asbestos.
7. Ensure that building occupants, tradespeople, etc. are notified, in advance, of the location, duration and type of work to be performed.
8. Written 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 should 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.

### 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. It is recommended that proper signage read as follows and also includes the name of a contact person on-site.



2. Clearly mark the boundary of the work area by placing barricades, fencing or similar structures around it.
3. The entire work area must 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. Best practice suggests that 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 (0.02 inches of water gauge) within the enclosure relative to the surrounding area. General guidance suggests that exhaust unit should 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 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. HEPA-filtered exhaust units should be positioned to allow access to the filters from within the removal area. 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, it is strongly recommended that the discharge be routinely monitored for airborne asbestos.
8. When exhaust units vent air into interior areas of the workplace that are occupied by workers the testing of exhaust units must take place completely on-site, before the start of every job. Otherwise the exhaust ventilation equipment must be certified at least once a year 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.
9. It is recommended that 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. Best practice suggests to 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 should be shut down for the duration of the removal job, if possible. All vents should 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 minimum, 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 firefighting 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 work within can 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. 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.

## 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.
4. Industrial HEPA 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 using an industrial HEPA vacuum or by 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 HEPA 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 or drink 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.

## 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 provisions for:
  - Hosing down contaminated clothing and footwear or cleaning it with an industrial HEPA vacuum cleaner fitted with a HEPA filter;
  - Storage of contaminated clothing and footwear;
  - Bins for waste materials; and
  - Airflow towards the removal area.
5. The Shower Room should have provisions for:
  - A shower area with an adequate supply of soap and tempered water; and
  - Airflow towards the dirty decontamination area.
6. The Clean Room should have provisions for:
  - Storage of individual respirators in containers or lockers;
  - A mirror to assist in donning respiratory protective equipment;
  - Storage of clean clothing;
  - Separate storage of clean and dirty towels; and
  - 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. An appropriate and fit tested 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 ideally should be removed with an industrial HEPA 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 proper disposal.
11. The worker then enters the shower room and showers while wearing their respirator. After the worker's head, respirator facepiece and associated harness have been thoroughly rinsed, the respirator may be removed and the shower is considered completed. An adequate supply of tempered water and soap must 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 personal decontamination procedures described in point 11 of this manual. 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 an industrial HEPA 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 must be done throughout the containment to seal down any invisible dust and fibres undetected during the final inspection following abatement activities. Following confirmation of effective decontamination of the space by clearance air monitoring, the containment can be dismantled. All dismantling work should be completed following, at minimum, low risk work procedures.



17. Best practice recommends that all tools and electrical equipment such as vacuum cleaners and power tools 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.

### **Waste 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 as “Asbestos” and ideally that:
  - They contain asbestos;
  - Asbestos is carcinogenic; and
  - 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 an industrial HEPA 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 and trained in the precautions that must be taken. Transport vehicles may be required to carry signs or placards specifying the nature of the cargo.
5. Disposal sites must conform to provincial and municipal requirements.

## Air Monitoring

Ideally, air sampling to determine airborne asbestos fibre concentration is suggested before and during the abatement work. However, clearance air monitoring is required prior to removal of the enclosure.

The protocols listed for the various types of air monitoring provided below are best practice guidelines. These recommendations are intended to assist in the best set-up for air sampling. In general, best practice suggests air monitoring should include the following:

- Before work starts in the work areas: background samples to establish baseline airborne fibre levels;
- 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;
- 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 as soon as possible, but not later than the start of the next shift;
- 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 as soon as possible, but not later than the start of the next shift;
- Before the enclosure is dismantled: the air inside the enclosure must be sampled. See [Appendix B](#) for best practice recommendations regarding air clearance monitoring. For example, at minimum one sample should be collected for every 450 m<sup>2</sup> of enclosure area to determine suitability for re-occupancy. The final air test should be completed using aggressive sampling techniques.

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

1. If fibre levels inside the containment exceed the assigned protection factor 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 air sampling is completed during the project the following guidance can be applied to the air monitoring results. If fibre levels measured outside the containment or in the clean room exceed 50 per cent of 0.1 f/cc (ACGIH TLV for asbestos), work practices and the containment structure should be reviewed. If fibre levels outside the containment exceed 0.1 f/cc, work must immediately stop until the reasons for the high levels are identified and corrected.

Clearance air monitoring test results must be less than 0.01 fibres per cubic centimeter. Aggressive air sampling techniques are recommended, but not required for final clearance air monitoring. If the final air test fails, the containment cannot be dismantled. The work area should be glue-sprayed again and re-tested. All air sampling must be completed by competent personnel following approved methods. Where possible, results should be made available to workers as soon as possible, but not later than the start of the next shift.

### **Site Inspection**

1. A competent person should 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.
2. A competent person must 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. A competent person must 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. A competent person must ensure that the enclosure is under negative pressure.
6. A competent person should regularly 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 inch water gauge).
7. A competent person must 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.
8. A competent person must 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.
9. Document all records.

## 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:

- Isolate the work area;
- Protect workers;
- Minimize the release of fibres; and
- 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.

### Vinyl Floor Tiles

Asbestos fibres in floor tiles that 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 before 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.

### 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. 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. Discharged air cannot be recirculated in the work environment unless it is passed through an effective HEPA dust removal system and monitored in an effective manner to warn workers if the system is not working effectively. Where very small quantities of waste are involved, direct vacuuming with an industrial HEPA 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 recommended to minimize fibre release.

### **Outdoor Removal**

Weather conditions may influence whether or not work can be performed, with heat, cold, location of building air intakes or high winds making work unsafe. Mobile decontamination facilities, special work platforms, air sampling and other specialized equipment may be required for outdoor removal based on the risk assessment.

### **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 must wear appropriate personal protective equipment based on the results of risk assessment, but at a minimum 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. As such, 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 firefighting equipment and personnel must be able to respond quickly. Workers should be trained and drilled in emergency escape routines in the event of fire. It is recommended that workers are 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.

### **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, glove bag removal is recommended. If not, high risk removal practices may be required depending on the situation. 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.

As crawl spaces and attics are not built for human occupancy and may pose airborne hazards, crawl spaces and attics may be considered confined spaces. A risk assessment must be performed by a competent person on each confined space. Where a confined space is determined to be hazardous an entry plan, rescue procedures, worker training and air monitoring are required. Please consult *The Saskatchewan Occupational Health and Safety Regulations 1996* to ensure compliance with additional confined space (hazardous or non-hazardous) requirements.

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 should be followed.

Where dirt floor crawl spaces are encountered, any asbestos mixed in with the dirt should 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.

### **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.

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 by a competent person to ensure that the entire asbestos surface has been adequately encapsulated.

### **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 when 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 must be appropriate for moderate and high risk abatements.

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:

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

## 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 process. If there is potential for worker exposure to asbestos fibers such as the airborne asbestos fibre concentration may potentially reach 0.05 f/cc, the work area should be restricted. 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:

- An industrial HEPA vacuum cleaner fitted with a HEPA filter;
- Polyethylene drop sheets having a minimum six mil thickness;
- Six mil thick labelled asbestos disposal bags;
- A spray bottle or hand pump garden sprayer to wet asbestos;
- A water and wetting agent;
- Duct tape or tape having similar or better strength;
- A utility knife with retractable blade;
- Wire cutters; and
- A 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 should not be used on pipe insulation that is friable or can easily break unless it is covered with an appropriate method and material by following appropriate procedures. Otherwise, fibres can be released during installation of the glovebag and when it is moved along the pipe.

### Work Procedures

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

1. Prior to starting the removal, clean up any loose asbestos debris on or around the pipe with an industrial HEPA vacuum cleaner fitted with a HEPA filter.
2. Place a polyethylene drop sheet beneath the area where the glovebag is to be installed.
3. Prior to applying the bag, seal any loose insulation by wrapping it with polyethylene.



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 industrial HEPA 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 industrial HEPA 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 it. Disposable clothing and drop sheets must also be disposed of as asbestos waste.
12. All work equipment, including work clothing, must be cleaned by damp wiping or with an industrial HEPA 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.

### 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 may 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 and therefore cannot meet the minimum volume requirements for an approved standard method. Where air monitoring cannot be done due to the short duration of the work, the employer should have written work procedures in place and supervise the work to ensure that there is minimal potential for worker exposure to asbestos.

### **Pre-Demolition Asbestos Removal**

All asbestos-containing materials that could release fibres upon demolition must be removed, including those in hidden areas. The type and quantity of materials present will dictate the procedures used for abatement during demolition projects.

An effective method of removing asbestos covered pipes during demolition projects is the 'wrap and cut'. This method involves glovebagging of asbestos-containing material at the points where the pipe is to be cut, followed by 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.

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 is suggested however can be less intensive for pre-demolition if the building is not occupied. For example, personal or breathing zone, clean room, and clearance air test samples would suffice.

In some specific cases, asbestos-containing materials may be left in place during demolition. However, the employer or the contractor shall ensure that:

- 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; and
- The operator must have appropriate training and PPE for asbestos processes.

### **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](http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/insulation-isolant-eng.php)).

### 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 asbestos-containing materials must be removed from a structure before the building is demolished. However, in some cases, the ACM in the building will not be removed before demolition. In that case, other controls methods must be used to protect workers due to potential fibre release when disturbed, and all rubble from the demolition project must be treated and disposed of as asbestos waste.

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 completely removed without compromising the structural integrity of the building, remaining vermiculite must be taken into account at demolition sites to ensure that workers handling or moving debris are adequately protected and all rubble may need to be handled or disposed of as asbestos waste.

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. 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. Containment should be set up around the work area. This may range from a full containment 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
2. A waste bag is taped to the wall to catch the draining material.
3. A hole is made in the concrete block wall while negative pressure is maintained in the containment by HEPA vacuum or negative unit.
4. As insulation drains into the bag, the waste in the bag should be wetted down.
5. Waste bags are cleaned and double bagged. Since, the material meets the definition of ACM, it must be handled and labelled "Asbestos" waste.
6. Worker decontamination facilities should include a shower and clean change room.
7. 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.
8. 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.

9. Final visual inspection, glue spray and air testing should be done prior to teardown of the containment.
10. Workers on the project should be provided with appropriate protective equipment ([High Risk Abatement Activities - Personal Protective Equipment](#))

#### 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. Air monitoring during the removal is suggested to ensure that fibre levels do not exceed the maximum use concentration of the respirator assigned.

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 must be installed to remove air from the work area and maintain a high level of air movement. 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 must be provided with protective equipment and decontamination facilities appropriate to the risk.
3. Waste must be disposed of in receptacles impervious to asbestos.
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, must 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.

**Note:** 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.

## 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.

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

- 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); and
- 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.

### **Removal of Asbestos Insulation on Outdoor 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 in contact with exposed lines. In this situation, one option is to use 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. Meanwhile 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); and
- 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. 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 (perimetre) 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; and
- Spill procedures.

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).

## Personal Protective Equipment

Every person working at an asbestos abatement project must wear appropriate personal protective equipment based on the risk assessment. Workers must use:

- Respiratory protective equipment during all construction work and most maintenance work around friable asbestos where fibre levels are not controlled;
- Protective clothing to reduce the risk of contaminating street clothing, skin and hair; and
- 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, respiratory and breathing difficulties).

### 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, fitted, 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.

#### 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 vapors, 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.

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).

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.



Air purifying half-mask respirator equipped with P100 cartridges.



Air purifying full facepiece respirator equipped with P100 cartridges.



### 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.



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)

### **Written Respiratory Protection Program**

Whenever the atmospheric concentration of dust, vapor, mist or gas requires the use of respiratory protective equipment, a written program, 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 CSA Z94.4-11.

### **Protection Factor**

“Protection factor” is often used as an umbrella term to describe the degree of protection-encompassing assigned protection factors (APF) and fit factors. Assigned protection factors are numerical values determined by manufacturers and/or standards based on extensive research. Inherent to a respirator, assigned protection factors represent the anticipated level of protection provided by a properly functioning respirator to a properly fitted and trained user.

An important step in the respiratory selection process is to calculate the hazard ratio (HR). A hazard ratio is calculated by the expected or measured airborne concentration outside the respirator ( $C_{out}$ ), divided by the workplace contamination limit (CL):

$$HR = \frac{C_{out}}{CL}$$

The calculated hazard ratio should then be compared to Table 1.1 in this manual (see page 62), which summarizes APFs for selected respirators. To choose an appropriate respirator, the APF must be equal to or greater than the calculated hazard ratio. It is important to note that the higher the assigned protection factor, the greater the degree of protection.

Appropriate respiratory protection must be selected by a competent person in accordance with an approved standard, such as CSA Z94.4-11. It is important to remember that there are additional factors and concepts one must understand prior to selecting a respirator to ensure it is suitable for required duties and environment.

**Table 1.1 Assigned Respiratory Protection Factors for Selected Respirators**

Type of Respirator		Assigned Protection Factor
Air Purifying	Disposable Half Facepiece	NOT ACCEPTABLE
	Half Facepiece	10
	Full Facepiece	50
Powered Air Purifying (PAPR)	Half Facepiece	50
	Full Facepiece	1000
	Loose Fitting Facepiece	25
	Helmet or Hood	1000
Air Line Continuous Flow Supplied Air	Half Facepiece	50
	Full Facepiece	1000
	Loose Fitting Facepiece	25
	Helmet or Hood	1000
Air Line Pressure Demand	Half Facepiece	50
	Full Facepiece	1000
SCBA Pressure Demand	Full Facepiece	10000
	Tight-fitting Hood	10000
	Multi-functional SCBA plus Airline	10000

1. The values listed in this table are based on CSA Standard Z94.4-011, *Selection, Use and Care of Respirators*, WorkSafe BC (2012), OSHA 29 1910.134; and the 3M *Respirator Selection Guide* (2015). Where other APFs in an applicable standard or manufacturer's user manual are lower than those listed here, they should be used instead.
2. For self-contained breathing apparatus (SCBA), the only acceptable fit testing method is quantitative fit testing (QNFT) as per CSA Standard Z94.4-11.
3. Note the values of the protection factor may be different depending on whether a quantitative (QNFT) or qualitative (QLFT) fit-test is performed.
4. In accordance with the CSA Z94.4-11, the maximum APF that can be used for all tight fitting respirators operated in air purifying (negative-pressure) mode is 10 where a QLFT method is used.
5. For the pressure demand mode of respirators, it shall be only tested in the negative-pressure mode regardless of how it will be used.

## **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. Additional information on completing seal checks can be found in the CSA Z94.4-11. 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 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 because the shape of the facepiece becomes 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.

## Health Surveillance

Prior to fit testing and respirator use, the employer shall ensure that documentation, such as a user screening form, is completed. An example of a user screening form can be found in CSA Z94.4-11. This screening form is intended to direct workers to obtain a medical assessment prior to respirator use if they have or may have physiological or psychological conditions that could prevent them from wearing a respirator. Workers filling out the screening form should be instructed not to specify the specific condition(s) they have or may have, but rather to indicate that a medical assessment is required. All health information shall be treated as medically confidential.

Some examples of physiological or psychological conditions that may seriously affect an worker's ability to wear a respirator include:

- Shortness of breath
- Lung disease
- Hypertension
- Neuromuscular disease
- Temperature susceptibility
- Panic attacks
- Vision impairment
- Back/Neck problems
- Breathing difficulties
- Chest pain on exertion
- Cardiovascular disease
- Fainting spells
- Claustrophobia/ Fear of heights
- Colour blindness
- Reduced sense of smell
- Unusual facial features/skin conditions
- Chronic bronchitis
- Heart problems
- Thyroid problems
- Dizziness/Nausea
- Hearing impairment
- Asthma
- Reduced sense of taste
- Dentures
- Emphysema

- Allergies
- Diabetes
- Seizures
- Pacemaker

When concern about physiological or psychological conditions exists that could preclude the use of a respirator, an opinion from the health care professional shall be obtained regarding the person's ability to use a respirator. The opinion shall be obtained before the person is permitted to use a respirator or if a change in conditions warrants an additional opinion. The written opinion from a medical care professional shall indicate if the user:

- a) Meets the medical requirements;
- b) Meets medical requirements with limitations; or
- c) Does not meet medical requirements to use the selected respirator.

### **Methods of Fit Testing**

There are two accepted methods for fit testing respirators — qualitative and quantitative tests. 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 at least every two years in accordance to the CSA Z94.4-11.

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 vapor 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 tastes 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 Z94.4-11, 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, Z94.4-11, 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 fit factor determined by quantitative fit testing, it is the assigned protection factor that determines the conditions under which the respirator is used.

### 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. Records must be available for workers and be available to an occupational health committee upon request.

## **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 before and after each use. If shared by different people who have been fit tested to wear the same size, respirators must be sanitized between uses. If no defect was found before the use but after, the worker must report the incident to the supervisor and seek medical care if necessary. The incident must be documented.

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

During a project, when a respirator is temporarily stored, the contaminated filter cartridge must be covered with a piece of duct tape or other tapes to prevent the release of fibres from the contaminated cartridge. Respirators should be stored in a clean location, in a sealed 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.

Additional information describing inspection, cleaning, storage and maintenance can be found in CSA Standard Z94.4-11, Selection, Use and Care of Respirators.

## 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 facility 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.

The employer or contractor shall conduct a risk assessment to determine the proper personal protective equipment (PPE) and work plan to deal with health and safety issues related to the project. Duct Tape or other tapes shall be made available for temporarily repairing coveralls or other PPE in an emergency situation.



## 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.

### 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:

- Housekeeping;
- Electrical hazards;
- Ladders and scaffolds;
- Slips, trips and falls;
- Heat stress;
- Cold stress;
- Carbon monoxide poisoning;
- Limb and body injuries;
- Exposure to hazardous chemicals;
- Confined space; and
- Structural hazards.

### 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.

When dry removal is necessary, the employer or contractor shall develop a work plan to address related issues.

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.

## **Ladders and Scaffolds**

Asbestos abatement work frequently requires the use of approved ladders and scaffolds that are appropriate for the tasks 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 metre away from the point below the upper contact point for every four metres 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.

## **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.

## Heat Stress

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:

- Acclimatizing workers to the heat;
- Ensuring that workers drink plenty of water;
- Having workers strictly follow a work/rest schedule; and
- Cooling and ventilating the work area to the extent possible.

## Cold Stress

Cold conditions may be a concern when the asbestos abatement project is done in winter outside or when the heating system was not available during the demolition. The employer or contractor must plan to reduce the risk of accidents and frostbite during work in cold conditions.

Appropriate protection, a warm-up shelter and a stringent work and warm-up schedule must be provided in accordance with the occupational health and safety regulations and publications.

## 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.

## Limb and Body Protection

A work site 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.

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

## 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, safety data sheets (SDSs) are available at the workplace, and information about protective measures is provided to workers through training.

## Confined Space

An asbestos abatement project may need to be conducted in a confined space such as an attic or crawlspace. Due to the nature of a high-risk asbestos project, these confined spaces would likely be deemed hazardous.

The employer or contractor shall assess the risks and decide what measures are necessary for work activities in the written work plan. The employer shall identify the hazards present, assess the risks and determine what precautions to take before entering the confined space. In most cases the assessment will include consideration of the task; the working environment and procedure, materials and tools and emergency rescue plan.

## Structural Hazards

An asbestos abatement project may need to be carried out during the building abatement and renovation; therefore, structural collapse of buildings or part of buildings may occur and cause serious injury and fatality. The employer and contractor must be aware of the hazards and precautions must be taken to prevent worker injury from structural hazards during the asbestos abatement process.

## 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.

## Emergency Plan

The employers involved in the abatement activities are responsible for preparing an emergency plan and ensuring workers are trained in the following procedures.

The emergency plan must address:

- The location of work site fire alarms;
- Instructions for who to contact in the event of an emergency;
- The exit routes out of the enclosure and immediate work area;
- The evacuation procedures and routes out of the building;

- The muster point for workers wearing contaminated clothing (this should be separate from the muster point used for other personnel evacuated from the building);
- The procedures for decontamination or segregation of workers who may be contaminated;
- The repair and clean up of the abatement work area once the emergency has been dealt with; and
- The decontamination of any areas that may have been contaminated during the course of the emergency response process.

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.

## **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 an industrial HEPA vacuum cleaner fitted with a HEPA filter 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.

## 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 aid attendants must be present at the work site. If it is safe to do so, first aid attendants 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 aid attendants must decide whether it is appropriate (or possible) to decontaminate the injured worker or remove other protective clothing and equipment.

The emergency plan must also consider that paramedics or other emergency responders may not arrive with the appropriate level of protective equipment and or proper training about asbestos processes to enter the containment. Therefore, it is recommended that the employer or contractor has trained personnel to assist the rescue; also, extra personal protective equipment is made readily available for emergency responders to safely extract any injured workers from the containment.

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 industrial HEPA vacuum and wet wiped. If it is not possible to decontaminate protective equipment and clothing before leaving the worksite, 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, equipment and supervision. 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 an industrial HEPA filtered vacuum and wet wiping should be done to ensure that surfaces in the vehicle are decontaminated.

## Appendix A: Asbestos Analysis and Tests

### Bulk Sample and Analysis

#### 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 must 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 must 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; and
  - 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 an industrial HEPA 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 (general guidance suggests at least a half- mask air-purifying respirator equipped with high efficiency particulate filters) and should also wear disposable gloves. Gloves must be changed each time a sample is collected to prevent cross contamination of samples. 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 bags appropriate for asbestos waste.

For homogenous materials, it is recommended that the minimum number of bulk samples collected be done as noted in Table 1.2. 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 1.2 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 <sup>2</sup> (< 1000 ft <sup>2</sup> )	3
	90 or more square metres, but less than 450 square metres (1000-5000 ft <sup>2</sup> )	5
	450 or more square metres (> 5000 ft <sup>2</sup> )	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.

### Collecting Samples 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. Unless it is tested to be asbestos free, vermiculite insulation shall be deemed to be asbestos-containing material.
2. The concentration of asbestos in the product is highly variable, so more than one sample is required.
3. Because asbestos fibres can be present at low concentrations, typically a larger sample size is required.
4. 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. For example:

### 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)

### 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.

### **Bulk Sample Analysis**

Currently, the following methods for the purposes of bulk asbestos analyses are available:

- NIOSH Method 9000, Asbestos Chrysotile by XRD;
- NIOSH Method 9002 Asbestos (bulk) by PLM;
- EPA Test Method for the Determination of Asbestos in Bulk Building Materials (EPA/600/R-93/116, July 1993);
- EPA Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation (EPA/600/R-04/004, January 2004);
- Other acceptable bulk sampling methods (refer to Table 1.3 for details).

These methods describe the techniques used for the qualitative identification of asbestos and the semi-quantitative or quantitative determination of asbestos in bulk samples, and they include sections outlining:

- The accuracy of the method (e.g., range, precision, limit of detection);
- Interferences (e.g., other fibres that look like asbestos);
- Calibration and quality control (mandatory provisions for intra- laboratory quality control systems, and recommendations for inter-laboratory quality control programs); and
- Reporting of results (e.g., consideration of layers of materials and the estimation of asbestos percentages).

It is best practice to acquire the above information and the Laboratory Analysis Certificate, along with the following:

- Unique lab sample number;
- Brief description of location where the sample was collected;
- Material sampled (e.g., drywall mud, texture coat, floor tile, etc.) (Note: where there is more than one layer, each layer should be listed separately);
- Type of asbestos present and the percentage;
- A copy of the chain-of-custody; and
- Any accreditations held by the laboratory (e.g., NVLAP, AIHA, or CALA).

### **Sample Analysis for Vermiculite**

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*.

Some laboratories may not be able to provide this type of analysis as this method uses transmission electron microscope (TEM) which is a very costly equipment (and investment). However TEM can achieve detection limits from 0.1 to 0.0001 per cent.

The more common method for analyzing vermiculite samples is the NIOSH method 90002, Asbestos (bulk) by PLM and its EPA equivalent EPA/600/R-93/116. These are qualitative methods (inspection of the sample under a stereoscope which can be combined with point counting). A detection limit of less than one per cent can be achieved, depending on the point count method used.

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 further determine the precise asbestos concentration in the sample. In this case, all precautions must be taken to control the asbestos exposure. However, a negative result by PLM examination may not necessarily mean that the vermiculite does not contain any asbestos. In this case, XRD or TEM should be used to confirm if the samples contain asbestos.

Table 1.3 Summary Methods for Analysis of Asbestos in Bulk Materials

Technique	PLM				TEM				SEM
Discrimination	Can distinguish asbestos from non-asbestos and can distinguish between asbestos types based on refractive index, other optical attributes.				Can distinguish between asbestos and non-asbestos and between different asbestos types based on energy-dispersive X-ray spectroscopy (EDS, EDX) which characterizes the elemental content and selected area electron diffraction (SAED) which characterizes the crystalline structure of the particle.				Same as TEM
SOP	NIOSH 9002	CARB 435	EPA/600/R-93/116	SRC-LIBBY-03	EPA/600/R-93/116	EPA/540/R-97-028	EPA-LIBBY-03	EPA-LIBBY-07	SRC-LIBBY-02
Common Name	NIOSH 9002	CARB 435	Asbestos in Bulk Materials	Libby PLM-VE Libby PLM-PC	Asbestos in Bulk Materials	Berman/ Crump Elutriator, or Superfund method for Releasable Asbestos in Soil	'EPA-600'	Water Sedimentation	SEM
Basics for Quantitation	Visual area estimation or point counting	Point counting	Visual area estimation or point counting	Visual area estimation (using calibration standards) or point counting	Not clear; probably based on particle dimensions and estimated mass	Data are reported as s/g; conversion to mass per cent requires assumptions	Mass % estimated from size of observed structures or else from a calibration curve (s/g vs mass %)	Mass % estimated from size of observed structures or else from a calibration curve (s/g vs mass %)	TBA
Counting Rules	No particle size restrictions; must be asbestos	AR > = 3:1; mineral type = one of 5 defined asbestos types	No particle size restrictions; must be asbestos	AR > = 3:1; must be asbestos; classify as LA, OA, or C	No particle size restrictions specified; must be asbestos	Same as ISO 10312 AR > = 5:1 Length > = 0.5 um	AR > = 3:1 Classify into 3 types (LA, OA, or C)	AR > = 3:1 Classify into 3 types (LA, OA, or C)	AR > = 3:1 (may be < 3:1 for clearly fibrous particles). Classify into 3 types (LA, OA, or C)
Magnification	100-400				10,000-20,000 or higher				50-20,000
Sensitivity/ Detection Limit	about 1% asbestos by mass	0.25% asbestos (400 node point count)	Method is vague; implies 1% is possible	TBD; probably about 0.2% (semi-quantitative)	1/0%-0.0001% (depending on degree of separation of asbestos from matrix and number of GO counted)	Scan 1-8 grid openings at 20,000x for sensitivity of SE + 07 s/g; Scan 15-133 grid openings at 10,000x for sensitivity of 3E + 06 s/g	TBD (probably about 0.02%)	TBD (probably about 0.01%)	Unknown at present
Comments				Based on NIOSH 9002, EPA Method 600/R-93/116, and CARB Method 435	Values much below 1% are difficult since no significant separation occurs for soil				
References	NIOSH (1994)	CARB (1991)	USEPA (1993)	SRC (2003)	USEPA (1993)	USEPA (2000)	USEA (2003)	USEPA (2003)	SRC (2003)

## Wipe Sampling

There are currently no criteria for asbestos levels on surfaces. Surface sampling is a good method to determine if the area is contaminated with asbestos.

Generally, a particle free wipe material (wipe) is used to collect samples from surface areas. It is recommended to consult the analytical laboratory for guidance regarding the collection of wipe samples. Factors influencing the collection efficiency of wipe samples depend on surface texture, adhesiveness and fibre distribution. Sample collection technique and the experience of the technician are crucial factors and therefore, only a competent person should carry out a wipe sample.

### Wipe Sampling and Test Methods

There are two methods for sampling asbestos dust on surfaces developed by the American Society for Testing and Materials (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](http://www.astm.org).

### Wipe Sampling Procedure

Wipe sampling procedure includes:

1. Following a written procedure for collecting wipe samples.
2. Selecting the area where samples will be collected, determining the number of samples required and making sure that proper sampling tools and equipment are available.
3. Making sure that the technician collecting the sample is proficient and has been provided with proper personal protective equipment and training.
4. During sampling, identify and document all areas which have been sampled with a complete description of the sampling site, location, surface type and materials etc.
5. Shipping samples to an analytical laboratory, separately packed from any bulk or air samples.

## Appendix B: Air Monitoring

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 by following a well-developed air sampling strategy.

The air monitoring strategy shall take into account of the asbestos-containing materials, work conditions, work areas, work methods, work duration, jobs and tasks, workers' experiences and training, as well as the circumstances and conditions in the surrounding areas of the work site. For example, if the work site is located inside an occupied office building, residential area, school, hospital or public building, a more stringent monitoring strategy shall be followed, on the contrary, less would be needed if it is located in an abandoned building, rural area or outdoors.

### Types of Air Monitoring

For high risk asbestos processes air monitoring is required, and recommended for both low and medium risk asbestos processes. Four types of asbestos fibre air sampling can be used to determine airborne fibre concentrations:

#### 1. Personal Sampling

Personal samples (also referred to as 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.

The sampling duration must be in accordance with the methodology selected, for example, NIOSH 7400 requires a minimum 400 litre air to be sampled if the fibre concentration is at 0.1 f/cc. Assuming the airborne fibre concentration in high risk containment is 1.0f/cc and the sampling flow rate of the pump is 2.0 L/M, then the personal sample must be conducted for at least 20 minutes.

#### 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:

- 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 m<sup>2</sup> of space (3000 to 10,000 litres of air volume in the work space).
- Area air samples outside the work area, but inside the building: samples are collected at each shift 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:
  - the clean room;
  - the clean side of the containment barrier;
  - in multi-storey buildings, one floor above and one floor below (if these areas are occupied) and on the floor where abatement activities are occurring; and
  - at any other locations representative of those that could be contaminated due to fibre migration should there be a loss of containment.
- 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.

### **3. Clearance Sampling**

Clearance sampling is a type of area air monitoring conducted after the 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 four hours (ideally eight to 12 hours), followed by clearance monitoring. Negative air units should remain running until the final clearance air test has been completed, analyzed and deemed 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. Refer to an accepted sampling method for specifics on volume, flow rates and sampling durations. For example, NIOSH recommends collecting 3,000-10,000 liters of air in a relatively clean atmosphere for a 25 mm diameter filter.

Clearance sampling must be conducted by a qualified person who is completely independent to the abatement contractor. Since circumstances vary among abatement sites, professional judgment must be made to determine the samples number and location to ensure the samples accurately represent the airborne asbestos fibre levels inside and outside the containment (or work site if containment is not built).

According to an EPA guideline (1989) developed for AHERA, clearance sampling should include a minimum of five samples taken inside and another five samples outside the containment or work site, plus three blanks. For a large or complex containment or work site that consists of several rooms or distinct areas, at least one sample must be taken in each room or area.

Inside the containment or work site, samplers should be located to provide a representative sample of air within the containment or work site. If the containment or work site is a single room, locate the samplers throughout the area. If the work area consists of several rooms, place a sampler in each room. Outside the containment or work site, samples should be representative of air entering the area. Place samplers so that they do not sample any air that may escape from the containment or work site. Recommended distances are at least 15 metres (50 feet) from the entrance or polyethylene sheeting of the containment or barrier of the work site, if practicable.

If any clearance sample collected (but blank sample) does not pass the criterion (0.01f/cc), the site must be further cleaned and re-tested. Following guidelines within AHERA (EPA, 1989), if more than five samples were taken in the containment or work site, and an appropriate statistical test confirms with 95 per cent confidence that the result is below 0.01 f/cc clearance criterion, it is equally acceptable even if one or more samples are above the criterion.

#### **4. Aggressive Air Sampling**

Aggressive sampling inside the containment or work site involves mechanically disturbing air to simulate the actual conditions of air movement. As a result, aggressive sampling is a more reliable indication of the degree of containment cleanliness. Therefore, the use of aggressive air sampling techniques following the completion of a high or moderate risk project but prior to enclosure removal, is highly recommended. 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:

1. 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 m<sup>2</sup> (1000 ft<sup>2</sup>) of floor area.
2. Place a 51 cm (20 in) fan in the centre of the room (use one fan per 283 m<sup>3</sup> or 10,000 ft<sup>3</sup> of room space). Put the fan on low speed and point it towards the ceiling.
3. Start the sampling pump(s) and sample for the period of time required to collect the volume of sample.
4. Turn off the pump(s) and fan(s) when sampling is completed.



## Appendix C: Air Monitoring Analytical Methods and Results Analysis

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 or equivalent 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 millimetre (f/mm<sup>2</sup>) 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 Litre air sample.
- The limit of detection is based on the volume of the sample collected and fibre density.

### **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 micrometre 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 vapor. 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 micrometres 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* also referenced in [Table 1.4](#) of this manual.

## 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/mm<sup>2</sup>. 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/mm<sup>2</sup> are probably over-counted (positive bias) and counts above 1300 fibres/mm<sup>2</sup> are probably under-counted (negative bias).
3. The Limit of Detection (LOD) is 7 fibres/mm<sup>2</sup> 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/mm<sup>2</sup> 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 less than 0.01 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. Increasing the volume of air collected does allow the user to report LODs lower than 0.01 f/cc.

## 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 micrometre 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).

NIOSH method 7401 (TEM) is not a stand-alone method, it is designed to be used with NIOSH method 7500 (PCM).

### **Result 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.

It is recommended that a laboratory analysis certificate include:

- A unique lab sample number;
- The date the sample was collected and the date analyzed;
- The type of air sample (e.g., ambient, occupational, blank);
- The flow rate of the pump (litres per minute);
- The total sampling time (minutes), start and end time if necessary;
- The volume of air collected (litres);
- The fibre concentration (fibres/cm<sup>3</sup> or fibres/mL);
- A copy of the chain-of-custody form and reference the analytical method used;
- The methodology used;
- The accuracy of the method (e.g., range, precision, limit of detection);
- Interferences (e.g., other fibres that look like asbestos);
- The calibration and quality control;
- Reporting of results; and
- Any accreditations held by the laboratory (e.g., , AIHA or CALA).

Acceptable methods for analysis of asbestos in air samples are listed in Table 1.4 (next page).

Table 1.4 Summary Methods for Analysis of Asbestos in Air or Dust

Technique		PCM	TEM						
<b>Magnification</b>		450	10,000-20,000 or higher						
<b>Discrimination</b>		Cannot distinguish asbestos types or distinguish asbestos from non-asbestos	Can distinguish between asbestos and non-asbestos and between different asbestos types based on energy-dispersive X-ray spectroscopy (EDS, EDX) which characterizes the elemental content and selected area electron diffraction (SAED) which characterizes the crystalline structure of the particle.						
<b>Sensitivity/Detection Limit</b>		Counts < 7 fibres/mm <sup>2</sup> filter area are ranked as ND. This is usually about 0.05 s/cc.	<p><b>AIR:</b> Depends on volume of air collected, filter area, dilution factor (F) and number of GO counted. Sens.(air) = EFA/(GO*Ag<sub>o</sub>*V*1000*F). Usually 0.001-0.01 s/cc for direct perp (F = 1). Higher for indirect (F = 0.1-0.01)</p> <p><b>DUST:</b> Depends on area vacuumed, number of GOs counted and dilution factor. Sens.(dust) = EFA/(GO*Ag<sub>o</sub>*Area*F). Typically &lt; 1000 s/cm<sup>2</sup>.</p>						
<b>SOP</b>		NIOSH 7400	ISO 10312	ISO 13794	EPA/540/2-90/005a	AHERA	ASTM 5755-95	NIOSH 7402	Yamate
<b>Common Name</b>		PCM	ISO Direct	ISO Indirect	Superfund Method for Air	AHERA	ASTM dust method	NIOSH 7402	Yamate
<b>Comments</b>		Least expensive method, widely used in past. Basis of current EPA slope factor.	Used for most air samples	Used for heavily loaded air samples and for all dust samples	Direct/ Indirect preparation	Basic method is direct prep air only; at Libby adapted for indirect air and dust as well	Dust method only. Give full details for micro-vacuum dust collection	Intended as a supplement to NIOSH 7400 (PCM). Used mainly for personal air samples.	Draft method, never finalized?
<b>Reference</b>		NIOSH (1994)	ISO (1995)	ISO (1999)	USEPA (1990)	USEPA (1987)	ASTM (1995)	NIOSH (1994)	Yamate et al. (1984)
<b>Counting Rules</b>	<b>Fibre</b>	AR > 3:1 Length > = 5 um Thickness > detection limit (about 0.25 um)	AR > = 5:1 length > = 0.5 um	Same as ISO 10312	AR > = 5:1 length > = 0.5 um	Same as AHERA	Count PCME fibres only (AR > = 3:1, Length > 5 um, Thickness > 0.25 um). Classify as chrysotile, amphibole, or ambiguous.	Fibre = AR > 3:1 Length > 0.05-0.06 um	
	<b>Higher Order Structures</b>	Count bundles as 1 structure unless individual fibres can be distinguished	Generally count all individually recognizable fibres, even if in higher order structures	Same as ISO 10312	Simplified approach for bundles and dusters	Same as AHERA	See NIOSH 7400	Count bundles and clusters as individual structures	

## Appendix D: Analyst Qualifications, Training and Laboratories

It is critical that laboratory analysts be properly qualified and trained to perform their work, as is expected of other workers who handle asbestos.

It is recommended that asbestos identification analysts have credit for an internationally recognized, 40-hour course of instruction in the microscopical identification of asbestos. Asbestos fibre counting analysts should have credit for a NIOSH 582 course (Sampling and Evaluating Airborne Asbestos Dust). The American Industrial Hygiene Association maintains a list of AIHA-approved NIOSH 582 equivalency courses and providers.

If an employer chooses to implement an in-house training program for air sampling analysis, this training must be supported by an instruction manual and performance criteria (exercises and examinations). Training should include a minimum of 30 hours of contact and analytical time by a qualified instructor. The instructor should have taken a NIOSH 582 equivalent course from an approved vendor within the previous three years. If the analysts cannot demonstrate that they have been adequately trained, the owner, employer, project manager and contractor, as well as occupational health officer will consider the laboratory results are invalid and will not accept the results.

### Asbestos Laboratories

The asbestos laboratory provides information on the form and percentage of asbestos or airborne fibre concentrations present in bulk or air samples. Therefore the precision and accuracy of the laboratory analysis is one of the most critical components of the risk assessment involving any asbestos survey or processes. Any misidentification or failure to detect asbestos in samples could result in worker exposure to asbestos or inadequate protection during asbestos processes.

All laboratories involved in asbestos analysis should develop a written quality assurance program; if practicable seek for accreditation from AIHA, CALA and other recognized organizations.

The written program should include a statement of quality assurance and ethics policy, management and administration of the laboratory, responsibilities of management, supervisor and technicians, personnel qualifications and training records, description of laboratory and capital equipment, maintenance and audit of the laboratory, reporting, documentation and record keeping, and standard operating procedures.

General guidance suggests that if consulting services or laboratories are planning to perform asbestos analysis at the project site, certain criteria must be met and a written plan for field laboratory analysis must be established, including:

- The analysis must be performed on the site or in the very close proximity to the project, or a controlled area to ensure no asbestos fibres are released into other part of workplaces.
- It must be performed by a trained asbestos analyst.

- It must have documented procedures to be applied when setting up a field laboratory.
- The owner, employer or contractor must be notified.
- Field conditions must be reviewed and documented to ensure no interference or other conditions result in a false test.

The written plan must meet regulatory requirements in occupational health and safety regulations including provisions related to asbestos, WHMIS, first aid, emergency plans and record keeping.

### **Asbestos Analysis Quality Control Program**

The analytical methods for asbestos identification and fibre require the implementation of a quality control program. A quality assurance officer should be appointed to oversee the program. A quality assurance officer's duties would include:

- a) Obtaining and/or creating sets of reference slides (for fibre counting) and asbestos reference standards (for asbestos identification).
- b) Overseeing blind recounts on a minimum of 10 per cent of filters counted and asbestos bulk samples analyzed.
- c) Identifying any sample custody errors (lost samples, mixed up samples, etc.).
- d) Checking chemicals (e.g., refractive index liquids) for contamination.
- e) Analyzing blank filters for the presence of asbestos contamination.
- f) Performing proficiency checks on analysts (which could include the use of statistics and control charts).
- g) Maintaining quality assurance manuals for both asbestos identification and fibre counting, including sample custody procedures, microscope resolution and calibration checks, equipment maintenance records, results from blank samples, records of analyst proficiency, etc.

The quality control program manual and the latest set of quality control results must be available for inspection.

Laboratories that offer asbestos identification and/or fibre counting services should also participate in external proficiency testing programs. The American Industrial Hygiene Association (AIHA) offers the following proficiency analytical testing (PAT) programs for both asbestos fibre counting and asbestos identification. They are the:

- Proficiency Analytical Testing Program for Asbestos;
- Bulk Asbestos Proficiency Analytical Testing Program; and
- Asbestos Analyst Registry-designed to recognize individual fibre counting analysts outside of established.

### **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. Certificates and participation should be submitted to clients for records. Where unsatisfactory results are returned the laboratory must investigate the cause, retrain the counters and establish other corrective action.

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 ON K1Z 8R1  
[www.cala.ca](http://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/](http://www.aihapat.org/)

## Appendix E: HEPA Filters and Enclosures Test Procedures

### Testing HEPA Filters

HEPA filters are rated for a minimum particulate removal efficiency of 99.97 per cent for particles 0.3 microns in diameter. All HEPA filters should be factory tested using a 'hot' DOP (Dioctyl Phthalate) challenge or its equivalent. While there is no requirement for the tester to be certified, they must still be competent (have suitable training and experience) and follow an appropriate testing procedure including the appropriate instruments, calibration and testing efficiency rating 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/PAO aerosol generator capable of producing particles down to 0.3 microns in diameter. A photometre is used on the downstream side of the filter to detect leaking particles. The photometre 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 (PAO) 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. If a DOP smoke generator is used it 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 photometre 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 photometre 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 photometre 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 industrial HEPA vacuum cleaners fitted with a HEPA filter, introduce DOP smoke at the vacuum cleaners suction inlet and monitor the exhaust with the photometre 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. (Industrial HEPA 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.

Information to be included on a DOP testing certificate label that is attached to the tested equipment should contain the following information as a minimum:

- Testing company name and contact information
- Certificate or test number
- Date of testing
- Location of equipment testing
- Tested equipment includes manufacturer, make/model/serial number
- Testing efficiency rating for example 99.97 per cent
- Test result such as a 'pass'
- Technician name and signature

Except the testing certificate label, the asbestos contractor or employer must also obtain a copy of DOP Certificate of Testing from the service provider; the certificate must be kept for record and inspection. Information included in the certificate must contain the following as a minimum:

1. General Information:
  - a) Testing company name and contact information;
  - b) Certificate or test number;
  - c) Equipment used and calibration date;
  - d) Date of testing; and
  - e) Technician's name and signature.
2. Equipment Owner Information:
  - a) Equipment owner, company name and contact information;
  - b) Location of equipment testing (civic address with description as necessary); and
  - c) Equipment owner contact name and signature.
3. Information of Tested Equipment:
  - a) Manufacturer;
  - b) Make/Model;
  - c) Serial Number and/or Contractors' in-house tracking numbers; and
  - d) Condition of equipment (e.g., good or damaged). Provide details where the condition of equipment is not reported as good.
4. DOP/PAO Test Information for Each Piece of Equipment:
  - a) Test efficiency rating (e.g., 99.97 per cent); and
  - b) Test result (e.g., pass or fail).

## Smoke Testing of Enclosures

For high risk abatement projects, the integrity of the enclosure must be completed. To confirm, tests such as smoke testing or other acceptable methods must be done in conjunction with a thorough visual inspection of the enclosure.

Smoke testing may be done using a 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

If smoke is to be used:

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.

If smoke generators are used:

- The operator of the smoke generator should wear appropriate eye and respiratory protective equipment;
  - The operator should be aware of the heat produced by the generator and exercise caution;
  - In a logical pattern, starting at the top or area furthest away from the decontamination area, expel smoke to fill the containment; and
  - Visibly confirm that the smoke is evenly dispersed and exit the containment.
7. Conduct visual inspections:
    - a) Of 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.
8. The integrity of the containment is confirmed if smoke is not detected outside the containment.
9. 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 (ft<sup>3</sup>) 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.
10. Document the smoke test results and clearing times.

## Appendix F: Competency Profiles for Workers, Foreman, Site Supervisors and Consultants Working at Asbestos Abatement Projects

This appendix describes the skills that workers, foremen, site supervisors and consultants should have prior to working at an asbestos abatement project.

### Competency Profile for Workers at Asbestos Abatement Project Sites

	Major Responsibilities			Skills		
<b>Job Execution A</b>	<b>A1</b> Review Work Procedures with Supervisor	<b>A2</b> Identify Material Supply Needs	<b>A3</b> Maintain Site and Services	<b>A4</b> Isolate Work Area	<b>A5</b> Install Negative Pressure Air System	<b>A6</b> Set Up Decontamination Facility
	<b>A7</b> Minimize Fibres in the Air	<b>A8</b> Maintain Good Housekeeping	<b>A9</b> Prepare Waste Material for Disposal	<b>A10</b> Maintain Decontamination Facility	<b>A11</b> Operate Asbestos Removal Equipment	<b>A12</b> Maintain Asbestos Removal Equipment
<b>Health &amp; Safety B</b>	<b>B1</b> Review Health & Safety Procedures with Supervisor	<b>B2</b> Demonstrate Knowledge of Asbestos Health Hazards	<b>B3</b> Demonstrate Knowledge of Requirements, Responsibilities, and Rights Under OHS Legislation	<b>B4</b> Report Violations of Health & Safety Regulations	<b>B5</b> Report Potential Site Safety Hazards	<b>B6</b> Report Potential Site Electrical Hazards
	<b>B7</b> Use and Maintain Personal Protective Equipment Properly	<b>B8</b> Use Decontamination Facility	<b>B9</b> 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 the 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 the 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.
- d) Use practical and safe practices when handling material for disposal.

A8. Maintain Good Housekeeping

- a) Follow established work procedures as directed.
- b) Use an industrial HEPA 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 the waste material and seal it.
- e) Mark the waste material with the approved label.
- f) Store the 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 the safe operation of removal equipment used at the work site.
- b) Notify the 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 the 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 the 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 a worker has the right to refuse work that is unsafe.
  - c) Cooperate in health monitoring by the employer.
  - d) Perform work according to *The Occupational Health and Safety Regulations, 1996* for asbestos removal.
- B4. Violations of Health & Safety Requirements
- a) Report any violations of safe work procedures to the foreman.
  - b) If violations continue, report them to the Ministry of Labour Relations and Workplace Safety, Occupational Health and Safety.
- B5. Potential Site Safety Hazards
- a) Report potential site safety hazards to the foreman.
  - b) Rope off the area and/or tag equipment until the hazard is corrected.
  - c) Do not use unsafe equipment.
- B6. 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 the proper fitting, use and maintenance of respirators, including filter replacement.
- b) Use the 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 the contaminated area.
- b) Remove all contaminated clothing and place in the 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 the 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.

## Competency Profile for Foremen at Asbestos Abatement Project Sites

### Major Responsibilities

### Skills

<b>Job Execution A</b>	<b>A1</b> Validate Site Conditions	<b>A2</b> Evaluate Isolation of Work Area	<b>A3</b> Ensure Installation of Negative Pressure Air System	<b>A4</b> Isolate Work Area	<b>A5</b> Minimize Fibres in the Air
	<b>A6</b> Monitor Air Testing Equipment	<b>A7</b> Identify Material Supply Needs	<b>A8</b> Ensure Proper Operation of Equipment	<b>A9</b> Ensure Maintenance of Equipment	<b>A10</b> Implement Abatement Procedures
<b>Supervision B</b>	<b>B1</b> Plan and Assign Daily Work	<b>B2</b> Review Work Procedures with Workers	<b>B3</b> Review Health & Safety Procedures with Workers	<b>B4</b> Monitor Worker Performance	<b>B5</b> Monitor Use of Materials
	<b>B6</b> Ensure Use of Decontamination Facility	<b>B7</b> Ensure Adequacy of First Aids	<b>B8</b> Recognize and Act on Worker Health Problems	<b>B9</b> Ensure Maintenance of Site and Services	
<b>Health and Safety C</b>	<b>C1</b> Explain Health Hazards of Asbestos	<b>C2</b> Demonstrate Knowledge of Recruitments, Responsibilities & Rights Under OHS Legislation	<b>C3</b> Inspect and Act on Health and Safety Hazards	<b>C4</b> Monitor and Ensure Compliance with Health and Safety Procedures	<b>C5</b> Ensure Control of Electrical Hazards
	<b>C6</b> Ensure Proper Use and Maintenance of Personal Protective Equipment	<b>C7</b> Ensure Maintenance of Decontamination Facility	<b>C8</b> Monitor the Preparation of Waste Materials of Disposals	<b>C9</b> 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 the 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 the supervisor prior to project start-up.
- b) Implement the 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 the sealing of heating, ventilation and air conditioning systems according to work plan, and review it prior to starting any removal.

#### A3. Ensure Installation of Negative Pressure Air System

- a) Ensure installation and testing of the negative pressure air system according to the 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 the decontamination facility according to the work plan or as instructed by the supervisor.
- b) Have the decontamination facility completed prior to the 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 the 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 the 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 the decontamination facility according to work procedures.
- b) Verify through spot checks that workers are using the decontamination facility correctly.
- c) Correct workers' improper use of the 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 the first aid attendant 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

*Skill*

- 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 Saskatchewan Employment Act* and the regulations.
  - c) Reinforce rules when a violation is observed.
  - d) Outline and discuss the responsibilities and requirements of employers and workers as described in *The Saskatchewan Employment Act* and the regulations.
- C3. Inspect and Act on Health and Safety Hazards
  - a) Monitor the site for health and safety hazards on an ongoing basis.
  - b) Visually inspect the 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 the 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.

## Competency Profile for Site Supervisors at Asbestos Abatement Project Sites

	Major Responsibilities		Skills			
<b>Supervisor/ Management A</b>	<b>A1</b> Complete Written Documentation	<b>A2</b> Verbally Communicate with Others	<b>A3</b> Identify Potential & Existing Problems	<b>A4</b> Resolve Problems & Monitor Solution Effectiveness	<b>A5</b> Evaluate Performance of Workers and Foreman	<b>A6</b> Ensure Proper Performance of Workers and Foreman
	<b>A7</b> Review Job Schedule	<b>A8</b> Ensure Compliance with Work Procedures and Codes of Practice				
<b>Job Planning B</b>	<b>B1</b> Plan and Assign Daily Work	<b>B2</b> Review Work Procedures with Workers	<b>B3</b> Review Health & Safety Procedures with Workers	<b>B4</b> Monitor Worker Performance	<b>B5</b> Monitor Use of Materials	<b>B6</b> Ensure Use of Decontamination Facility
<b>Health and Safety C</b>	<b>C1</b> Identify Site-Specific Health and Safety Hazards	<b>C2</b> Demonstrate a Knowledge of Requirements, Responsibilities & Rights Under OHS Legislation	<b>C3</b> Implement Health and Safety Control Measures	<b>C4</b> Establish Site Emergency Procedures	<b>C5</b> Act on Worker Health Problems	
<b>Job Execution D</b>	<b>D1</b> Verify Work Plan and Specific Job Procedures	<b>D2</b> Inspect Isolation of Work and Storage Areas	<b>D3</b> Advise Associated Trades of Specific Work Issues and Schedules	<b>D4</b> Coordinate Air Monitoring	<b>D5</b> Maintain Job Schedule	<b>D6</b> 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 the work plan to the foremen and workers.
- b) Solicit input from the foremen and workers.
- c) Question the foremen and workers of their understanding of work plans.
- d) Describe or clarify the 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 the owner.
- b) Examine blueprints and specifications, if available.
- c) Visually inspect the 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 the effectiveness of restrictions (unauthorized personnel entry) to the area.
- f) Inspect the site to verify compliance with OHS regulations and owner requirements.
- g) Conduct a hazard assessment of the work area.

- A4. Resolve Problems and Monitor Solution Effectiveness
- a) Solve site safety problems with site safety personnel and/or the Occupational Health and Safety Division.
  - b) Arrange for removal/protection of sensitive equipment with the owner.
  - c) Monitor operations of removal equipment.
  - d) Conduct scheduled checks of the area and equipment.
- A5. Evaluate Performance of Workers and Foremen
- a) Evaluate adherence to safe work procedures through observation and communication.
  - b) Monitor the workers'/foremen's use of decontamination facility.
  - c) Monitor the workers'/foremen's use of protective equipment and supplies.
  - d) Observe supervision of workers by the foremen.
  - e) Observe the health and safety performance of the workers/foremen.
  - f) Monitor the 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.
  - 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 the foremen on the assignment of workers for optimal performance.
- A8. Ensure Compliance with Work Procedures and Codes of Practice
- a) Review the established work procedures and respiratory, confined space procedures (as necessary) with the foremen.
  - b) Ensure that foremen review work procedures with workers.
  - c) Ensure that workers and foremen are trained with respect to work.
  - d) Explain to workers and foremen the penalties of failing to comply with the work procedures.

## 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-site 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 the 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 the decontamination facility.
  - g) Schedule disposal of waste materials.
  - h) Schedule additional client requirements such as shift work.

B6. Coordinate Schedule

- a) Establish the 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 the laboratory.

C. Health and Safety

*Skill*

C1. Identify Site-Specific Health and Safety Hazards

- a) Prior to the job starting, visually inspect the 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 the right-to-refuse legislation and legislated code of practice requirements to the foremen.
- e) Outline and explain to the 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 the 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 the site security plan.

C4. Establish Site Emergency Procedures

- a) Provide fire protection and ensure that personnel are completely trained in equipment use.
- b) Establish the emergency entry/exit plan.
- c) Ensure that competent first aid attendants 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 the work plan.
- b) Ensure proper dismantling of the 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 the integrity of enclosure.
- b) Check the installation and operation of the negative pressure air system.
- c) Check the proper set-up of the decontamination facility at the beginning of the job and on an ongoing basis.
- d) Check the 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 the 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 the client.

D6. Order and/or Purchase Supplies and Equipment

- a) Plan equipment and material needs with the 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.

## Competency Profile for Health and Safety Consultants (site-specific) at Asbestos Abatement Project Sites

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

**Standard of Performance**

*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 the 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 the contractor and/or client.
  - b) Advise on developing procedures for asbestos, respiratory protective equipment and confined spaces.
  - c) Monitor the 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 the work site for key hazard areas prior to asbestos abatement.
- b) Determine the 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 Saskatchewan Employment Act* and the regulations.
- b) Monitor the site to ensure safe work procedures are followed.
- c) Monitor the site to ensure conformance to work procedures.
- d) Advise the 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 Saskatchewan Employment Act* and the 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 the client/contractor.
- b) Advise the 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.
- 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 the 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 Saskatchewan Employment Act*.
- b) Monitor the site to ensure that safe work procedures are followed.
- c) Monitor the work site for conformance to work procedures.
- d) Inspect for compliance with health and safety legislation under *The Saskatchewan Employment Act* and the 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 the integrity of enclosure for leaks and conduct leak testing.
- d) Inspect disposal, labelling and transportation procedures.

C2. Evaluate Environmental Hazards

- a) Examine the 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 the 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 the contractor's/client's approach to the project.
- c) Evaluate site-specific requirements.
- d) Recommend amendments to plans and specifications, if necessary.

E3. Develop Consultant's Plan of Activities

- a) Plan activities to meet the contractor's/client's needs.
- b) Develop the 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 the supervisors/foremen.
- c) Negotiate special needs/activities with the supervisors/foremen.

## References

- 3M, Centers of Expertise: Worker Health and Safety, *Respiratory Protection*, [http://www.3m.com/3M/en\\_US/safety-centers-of-expertise-us/respiratory-protection/respirator-selection/](http://www.3m.com/3M/en_US/safety-centers-of-expertise-us/respiratory-protection/respirator-selection/)
- Alberta Human Services (2013). *Alberta Asbestos Abatement Manual*.
- ASTM(2010). *Standard Test Method for Wipe Sampling of Surfaces, Indirect Preparation and Analysis for Asbestos Structure Number Surface Loading by Transmission Electron Microscopy*.
- CSA (2011). *CSA Standard Z94.4.11 Selection, Use and Care of Respirators*.
- Environmental Abatement Council of Ontario (2013). *DOP/Pao Testing Guideline*.
- EPA (1973). *Control Techniques for Asbestos Air Pollutants*.
- EPA (1979). *Asbestos-containing Materials in School Buildings (Part 1)*.
- EPA (1983). *Method for Determination of Asbestos in Bulk Building Materials*.
- EPA (1989). Chesson, J., Leczynski, B., Berner, T., & Hudson, T. (1989). Guidelines for conducting the AHERA (Asbestos Hazard Emergency Response Act) TEM (Transmission Electron Microscopy) Clearance Test to Determine Completion of an Asbestos Abatement Project: Final Report
- EPA (1992). *Asbestos Abatement Projects Worker Protection Rules*.
- EPA (2004). *A Discussion of Asbestos Detection Techniques for Soil and Air*.
- Jimmy Perkins (2011), *Modern Industrial Hygiene, Volume 3: Control of Chemical Agents*
- Manitoba Workplace Safety and Health Division (2007). *Guidelines for an Asbestos Operations and Maintenance Program*.
- NIOSH (1976). *Revised Recommended Asbestos Standard*.
- NIOSH (1986). *A Guide to Respiratory Protection for the Asbestos Abatement Industry*.
- NIOSH( 2014). *Manual of Analytical Methods*.
- NIOSH (2016), *Heat Stress*, <http://www.cdc.gov/niosh/topics/heatstress/default.html>
- Ontario Ministry of Labour Operations Division (2011). *A Guide to the Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations*.
- TSI (2012), *Fit Factors vs. Protection Factors*, [http://www.tsi.com/uploadedFiles/Site\\_Root/Products/Literature/Application\\_Notes/ITI-023.pdf](http://www.tsi.com/uploadedFiles/Site_Root/Products/Literature/Application_Notes/ITI-023.pdf)

United Kingdom Health and Safety Executive (2013). *Managing and Working with Asbestos*.

United States Department of Labour, OSHA, Regulations, Part 1910, *Respiratory Protection*, [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=12716](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=12716)

WorkSafeBC (2011), *Breathe Safer: How to Use Respirators Safely and Start a Respirator Program*, [http://www.worksafebc.com/publications/health\\_and\\_safety/by\\_topic/assets/pdf/breathe\\_safer.pdf](http://www.worksafebc.com/publications/health_and_safety/by_topic/assets/pdf/breathe_safer.pdf)

WorkSafeBC (2012). *Safe Work Practices for Handling Asbestos*.

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## Guidelines for Asbestos Processes in Building Demolition and Renovation

2017

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