# Lead Exposure Control Plan

## Safety & Risk Services

## November 2023

THE UNIVERSITY OF BRITISH COLUMBIA

# 1. Purpose & Background

The University of British Columbia (UBC) is committed to providing a safe and healthy workplace by protecting campus occupants from the potential adverse effects from over-exposure to lead in accordance with the British Columbia *Occupational Health and Safety Regulation* (OHSR). Based on the OHSR, an employer is required to develop, implement and maintain a Lead Exposure Control Plan (ECP) if a risk assessment indicates that an employee is or may be at risk of exposure to lead dust, fumes, or mist.

At UBC, lead may be found in building materials, paint, tiles, roofing materials, lead sheets, anodes, solder materials, alloys, fittings and valves. The UBC Radiation Protection Program also promotes the use of lead bricks as shielding for gamma emitting radioisotopes. Any handling of lead-containing materials has the potential to cause a health risk and precaution must be taken to prevent exposures.

The most common and one of the highest risk activities that can result in exposure of UBC employees to hazardous lead levels involves the disturbance of lead-based coatings during renovations or excavations of buildings built before 1990. Lead-containing coatings do not pose a health risk if left intact; however, once disturbed or damaged, lead dust, fumes, or mist may be released. The result is a risk of inhaling and/or accidently ingesting lead contaminants if the appropriate controls and PPE are not in place.

Outside of operational settings, airborne lead may be generated as a by-product of the experiment/work being performed within UBC research spaces. For example, welding, grinding, or cutting lead coated surfaces within Faculty operated machine shops or production sites may cause the lead to become airborne.

As lead is known to be a highly toxic metal, with potential to cause cancer and/or severe neurological implications, it is important to ensure all individuals working with or in proximity to this hazard are aware of how to eliminate or mitigate exposure and control the spread of lead contamination outside the boundaries of the worksite.

# 2. Scope

This document is applicable to all UBC faculty, staff, and students who may come in contact with lead, lead-based products, or lead containing paints/coatings at UBC and where there is potential for lead exposure to occur.

# 3. References

- British Columbia's Occupational Health and Safety Regulation (OHSR) – Sections 6.58.1 - 6.69
- British Columbia's Occupational Health and Safety Regulation (OHSR) - Section 5.54 - 5.55
- British Columbia's Occupational Health and Safety Regulation (OHSR) - Section 5.57
- British Columbia's Occupational Health and Safety Regulation (OHSR) - Exposure Limits
- British Columbia's Occupational Health and Safety Regulation (OHSR) - Section 8.33 – 8.42
    - CSA Standard Z94.4-02, Selection, Use, and Care of Respirators
- University Health and Safety Policy - SC1

# 4. Legal Requirements

Sections 6.58.1-6.69 of the OHSR outlines the regulatory requirements for lead while sections 5.54 - 5.57 of the OHSR outlines the requirements for when an ECP is required and what elements must be included in the ECP. Furthermore, occupational exposure limits can be found in the Table of Exposure Limits for Chemical and Biological Substances within the OHSR. Where respiratory protective equipment is required, Part 8 of the OHSR provides the requirement for personal protective equipment and also references CSA Standard *Z94.4-02, Selection, Use, and Care of Respirators*. Additional requirements may be applicable depending on the nature of the work being performed.

All UBC faculty, staff, and students are expected to understand the legislative requirements and what must be done to protect themselves from lead exposure in the workplace.

# 5. Roles and Responsibilities

The roles and responsibilities described in this ECP are in accordance with the BC OHSR and the University Health and Safety Policy - SC1

## 5.1 Employer Responsibilities

- Ensure a Lead ECP has been developed, implemented and maintained to ensure lead exposure levels are within acceptable limits as per the BC OHSR
- Provide education and training to managers, supervisors, and employees who may be exposed to lead hazards
- Ensure employees are protected from lead hazards in the workplace by considering the hierarchy of controls (e.g. in order of elimination, substitution, engineering, administrative and personal protective equipment (PPE))
- Provide adequate washing facilities to ensure good hygiene principles are being practiced
- Ensure resources are made available for lead air monitoring, when required
- Ensure employees are provided with the necessary materials, tools and equipment to minimize lead exposure
- Evaluate new equipment and technologies that become available to assist with lead capture and/or suppression
- Ensure all lead exposures at the workplace are investigated and, based on findings, controls are implemented to prevent similar future incidents from occurring
- Ensure employees who are exposed to lead participate in health monitoring, when required

## 5.2 Department Manager/Supervisor Responsibilities

- Attend education and training sessions provided by the employer
- Identify occupations, areas, or tasks, where the potential for lead exposure exists
- Ensure employees are educated and trained on working with lead/lead-containing materials and demonstrate an adequate level of competency
- Ensure employees can identify health signs and symptoms associated with lead exposure
- Ensure the hierarchy of controls are considered and implemented accordingly

- Ensure qualified personnel, as defined in section 1.1 of the OHSR, develop and provide site-specific safe work procedures for tasks where lead is being generated. Ensure employees are familiar with and follow the procedures
- Provide employees with adequate supervision to ensure sustained implementation of work practices as needed to eliminate or minimize lead exposure
- Ensure lead exposure incidents are investigated appropriately and the results are posted at the workplace
- Ensure employees are trained, qualified and authorized to operate equipment, tools, and/or materials required for the job
- Ensure employees follow safe work procedures for handling, storing and maintaining equipment, tools, and materials
- Ensure ongoing participation of employees in the UBC Respirator Protection Program which includes the requirement of annual fit testing
- Ensure employees who are exposed to lead participate in health monitoring, where needed

## 5.3 Employee Responsibilities

- Follow the Lead ECP and safe work procedures
- Attend education and training sessions provided by the employer
- Understand the hazards of lead and the health signs and symptoms related to lead exposure
- Understand the importance of evacuating work areas where signs of lead exposure arise
- Adhere to the hierarchy of controls for lead
- Ensure all equipment, tools, and materials needed to control against lead are in good working condition and used appropriately
- Ensure respirators are being used, cared for, and maintained properly and annual fit testing is taking place
- Ensure proper clean up of work area, at the end of the work shift, to remove residual lead-containing dust and debris
- Report unsafe lead exposure conditions to the supervisor
- Report incidents/accidents to UBC's Centralized Accident/Incident Reporting System (CAIRS)
- Participate in incident/accident investigations, where required

## 5.4 Safety & Risk Services Responsibilities

- Develop and maintain a Lead ECP in accordance with the BC OHSR
- Assist in the implementation of this Lead ECP through training and consultation
- Provide education on lead exposure including how to recognize early health signs and symptoms
- Assist with lead risk identifications and assessments, as requested
- Advise when air monitoring for lead is required
- Perform risk assessments to determine respirator requirements
- Conduct respirator fit testing sessions for tight-fitting respirators
- Investigate lead-related concerns and recommend the appropriate corrective actions
- Collaborate with OPH when there is potential for workers to be exposed to hazardous lead levels that would warrant health monitoring
- Act as a resource to UBC Faculties and Departments on lead-related inquiries

## 5.5 Joint Occupational Health & Safety Committee Responsibilities

- Consult with the employer and employees on topics related to lead
- Provide recommendations on the improvement of the health and safety of employees that are participating in the UBC Lead Exposure Control Plan
- Participate in incident investigations relating to lead exposures

## 5.6 Occupational & Preventive Health (OPH) Responsibilities

- Act as an occupational health resource for UBC faculty, staff, and departmental managers
- Assist supervisors, managers, and Principal Investigators in assessing workplace exposure risks, as requested
- Develop and provide health monitoring services, where appropriate
- Follow-up on exposure incidents from an occupational health perspective
    - Provide accessible Occupational Health Nurse and/or Physician services to UBC employees
    - Advise the WSBC Claims Associate of exposure incidents that require reporting to the WSBC Exposure Registry Program

# 6. Lead Characteristics

Lead is a naturally occurring element found in the earth's crust and is bluish-grey in colour. Lead can also be found in plants, animals, water, air, dust, and soil. Lead is malleable, soft, durable, resistant to corrosion, and has a low melting point. Although lead can exist by itself as a metal, it is often combined with other elements to form either organic or inorganic lead, each of which has different properties and health effects. Organic lead was once used in gasoline but has since been removed and no longer presents a significant health and safety concern in British Columbia. Inorganic lead can still be encountered at the University as it is found in paints and coatings, especially within older buildings. Elemental lead is a type of inorganic lead. Only inorganic lead is covered in this Exposure Control Plan.

# 7. Routes of Exposure & Health Hazards

## 7.1 Routes of Exposure

The potential routes of exposure for lead to enter the human body are inhalation and ingestion. In an occupational setting, lead exposure takes place primarily through the inhalation route. Ingestion of lead is rare in adults but may occur through a lack of personal hygiene and cross-contamination.

## 7.2 Health Hazards

Lead can cause various adverse health effects both in low doses over a long period of time and in high doses over short periods of time.

Lead can enter the body through inhalation or ingestion. Lead can be inhaled by breathing or smoking near lead dust, fumes, or mists. Ingestion can occur through drinking, eating, or chewing on anything that has been contaminated with lead. After entering the body, lead moves into the bloodstream and targets different tissues and organs. Eventually, most lead will be deposited in bones and teeth. However, the primary negative health effects from lead

are seen on the brain and nervous system. Lead levels in the body are expected to build up over time if the rate of intake is higher than excretion.

Lead exposure can lead to both acute and chronic health effects. The typical background lead concentration in blood is less than 0.1 micromoles/litre. If an individual's blood lead level is greater than 0.48 micromoles/litre, action should be taken to reduce exposure and improve controls. Adverse health symptoms from lead exposure generally begin when the lead concentration in blood is between 2 and 4 micromoles/litre.

### 7.2.1 Acute Health Effects

Lead poisoning could occur if individuals are exposed to high concentrations of lead over a short time period.

Examples of acute symptoms associated with lead poisoning include:

- Tiredness and weakness
- Headaches
- Lack of appetite
- A metallic taste in the mouth
- Abdominal aches or pains
- Constipation
- Muscle and joint aches and pains
- Memory problems

The health symptoms described above can often be mistaken for other health issues. For this reason, lead poisoning is often under-looked and not properly diagnosed.

### 7.2.2 Chronic Health Effects

Possible chronic, or long-term, health effects from exposure to high lead levels include:

- Anemia
- Nerve damage causing muscle weakness and tremors in fingers, wrists, and ankles
- Decrease in brain function
- Kidney damage
- High blood pressure
- Reproductive effects in men and women
- Low birth weight and development delays of infants due to lead exposure before or during pregnancy

#### *Carcinogenicity*

Inorganic lead is designated as an IARC 2A carcinogen and a reproductive toxin. As a 2A carcinogen, lead is probably carcinogenic to humans, however, there is still limited evidence. Sufficient studies have proven that high exposures to lead can cause cancer in animals. As a reproductive toxin, lead has a potential for causing adverse reproductive effects (e.g. developmental abnormalities in newborns). Elemental lead is categorized as a 2B carcinogen by IARC.

# 8. Hazard Identification & Risk Assessment

## 8.1 Hazard Identification

Hazard identification is the process by which existing hazards are inventoried in a workplace. Activities on campus where there is a potential for exposure to lead includes demolition, renovation, and/or abatement of buildings where lead-based coatings were used. The coatings in buildings or surfaces built prior to the year of 1990 will be considered as lead-containing until proven otherwise.

Other tasks that may result in airborne lead exposure includes the use of cutting, welding and/or brazing equipment where lead is in/on the metal or in the solder/braze.

During lead hazard identification, consider the following:

- Location of lead-containing materials/coatings
- Tasks or products that require the use of or disturbance of lead-containing materials
- Lead content of the material or coatings through field tests (e.g. X-ray fluorescence analyzers or lab analysis of coatings). Lead-containing coatings can contain 0.009% (90 mg/kg) to more than 50% (500,000 mg/kg) of lead. Note: The BC OHSR does not define what would be considered lead-containing coating
- Exposure routes (e.g. inhalation and ingestion)

Reviewing past inspection records, job/task demands, working procedures, first aid records, and incident investigation reports can help identify occupational exposure risks to lead.

## 8.2 Risk Assessment

Lead is not a health concern if left intact; however, once disturbed or damaged in any way, lead dust, fumes, or mists, may be released:

- Lead Particles: Solid particles often created during sanding, grinding, or electric/pneumatic cutting. Employees removing lead-based paint or demolishing walls coated in lead-based paint can be exposed to lead dust.
- Lead Fumes: Heating lead or a lead-based material above 500°C can produce vapours that condense into solid lead fume particles. Lead fumes can be generated during activities such as high temperature cutting, welding, soldering, refining, alloying, melting, casting or smelting operations. The improper disposal and/or recycling of lead-acid batteries not only generates lead particles but also lead fumes.
- Lead Mists: Liquid droplets containing lead that are suspended in the air. Lead mist is typically generated when lead-based paint is sprayed onto a surface for application.

If it is determined that employees may be exposed to lead, a walkthrough survey should be conducted to assess the potential for exposure while considering all routes of entry into the body (inhalation and ingestion).

Any indications that show an employee may be at risk for overexposure to lead must have reliable air sampling done to confirm risk level. The level of risk from lead exposure is dependent on:

- The concentration of lead in the material
- The type of activity being performed (e.g. scraping vs. sanding vs. torch cutting)
- The duration of the activity being performed
- The scale/size of the activity
- The controls used during the activity being performed
- The airborne concentration of lead within the employee's breathing zone

With the implementation of controls such as proper decontamination, personal hygiene, and use of PPE, the risk of accidental ingestion will be greatly reduced. However, employees not as mindful of clean versus contaminated surfaces and proper hygiene will have a higher risk of exposure. Therefore, the risk of ingestion at a UBC workplace may range from low to moderate.

If employees are in the area where lead-containing material/coating is present, but there is no disturbance causing lead to become airborne, the risk of exposure via inhalation is very low. However, if lead becomes airborne, the risk of exposure via inhalation ranges from low to high.

Table 1 below describes the level of exposure risk through inhalation for various activities. Due to limited air monitoring results, the table only provides preliminary assigned risk levels for each activity and is based on the type of work conducted and WorkSafeBC's *Safe Work Practices for Handling Lead* (2017). The table will be updated as more data is gathered.

Table 1: Preliminary Lead Exposure Risk Assessment

| Risk Level | Work Activity |
|---|---|
| **Low**<br>Employee exposure to airborne lead will likely be less than the 8-hour exposure limit of 0.05 $mg/m^3$ | • Moving or transporting lead-containing waste in a sealed container<br>• Installing or un-installing sheet metal that contains lead |
| **Low to Moderate**<br>Employee exposure to airborne lead is likely ≥0.05 $mg/m^3$ but ≤0.50 $mg/m^3$ over an 8-hour work-shift | • Conducting hot work such as welding, burning, or cutting on surfaces where lead-containing coating has been removed<br>• Using power tools with an effective dust suppression system and HEPA filter to remove lead materials<br>• Scraping or sanding (including wet sanding) of lead-containing coatings using non-powered hand tools |
| **Moderate**<br>Employee exposure to airborne lead is > 0.50 $mg/m^3$ but does not exceed 1.25 $mg/m^3$ over an 8-hour work-shift | • Scraping or sanding lead-containing materials using non-powered hand tools (large projects)<br>• Manually demolishing lead-painted plaster walls or building components using sledgehammer or similar tool<br>• Cleaning up and removing lead-containing dust and debris |
| **Moderate to High**<br>Employee exposure to airborne lead is >1.25 $mg/m^3$ but <2.50 $mg/m^3$ over an 8-hour work-shift | • Using an electric or pneumatic cutting device for dry removal of mortar that contains lead<br>• Removing or repairing ventilation systems used for controlling lead exposure<br>• Removing lead-containing surface coatings using a high-pressure waterjet |

UBC employees must not conduct the following activities without consultation from SRS:

- Removing lead-containing coatings with a heat gun (>370°C)
- Abrasive blasting of lead-containing surfaces (including wet, slurry, and dry abrasive blasting)
- Dry-ice blasting of lead-containing surfaces
- Using an air mist extraction system to remove lead dust
- Conduct welding or torch cutting on surfaces with lead-containing coatings
- Use power tools on lead-containing coatings without the use of dust suppression systems (e.g. shroud and HEPA-filter)
- Removing lead-containing materials using power tools without an effective dust collection system equipped with HEPA filter

If employees are or may be exposed to lead dust, mists, or fumes, air monitoring must be conducted to ensure the effectiveness of the control measures in minimizing exposure to lead. Air monitoring can be done using either approved National Institute for Occupational Safety and Health (NIOSH) or Occupational Safety and Health Administration (OSHA) sampling methodologies. These methodologies typically involve the use of filters with a sampling pump followed by analysis at an accredited laboratory. The air must be monitored during the first shift of a lead related work activity or process and as necessary throughout the activity or process. Monitoring may not be necessary if a qualified person determines that the control measures are sufficient in minimizing exposure and the employer has air monitoring data from a previous, equivalent lead related work activity or process. If objective air monitoring data is used, the source and/or data itself must be kept on record for 10 years.

It is the responsibility of workplace managers/supervisors to identify hazards and ensure qualified personnel perform risk assessments. SRS is available to provide guidance in this process and able to advise when sampling is required. All risk assessments must be reviewed and re-evaluated in the following cases:

- There is reason to believe the current assessment is no longer valid
- The scope, circumstances or nature of the work activity has changed significantly i.e. change in material, equipment, and/or process
- The results of any exposure or health monitoring suggest that a review is necessary

## 9. Exposure Limits

The OHSR has established exposure limits for hazardous substances, including lead, which if exceeded can result in employees developing adverse health effects. Three exposure limit categories that must be adhered to in all workplaces include:

- TWA: the time weighted average (TWA) concentration of a substance in the air that cannot be exceeded over an 8-hour work day and 5-day work week
- STEL: the short-term exposure limit (STEL) TWA concentration of a substance in the air that cannot be exceeded over a 15-minute period, limited to no more than 4 such periods in an 8-hour work shift with at least one hour between any 2 successive 15-minute excursion periods
- Ceiling Limit: the concentration of a substance that cannot be exceeded at any point in the work period

The BC OHSR lists an 8-hour TWA occupational exposure limit (OEL) for lead as 0.05 milligrams per cubic metre ($mg/m^3$). There is no short-term exposure limit or ceiling limit for lead.

Inorganic lead is also considered a designated substance due to its carcinogenic and reproductive health effects. All designated substances must have their levels kept **A**s **L**ow **A**s **R**easonably **A**chievable (ALARA), with the aid of appropriate controls, even if exposure limits are met.

# 10. Risk Controls

Once a risk of exposure to lead has been identified and assessed, the hierarchy of controls must be implemented to ensure the exposure risk is eliminated or mitigated. The hierarchy of controls is a systematic approach to control for risks in a workplace from most to least effective. Sections 10.1 to 10.4 lists various control options available at UBC; however, also refer to the site-specific Lead Safe Work Procedures.

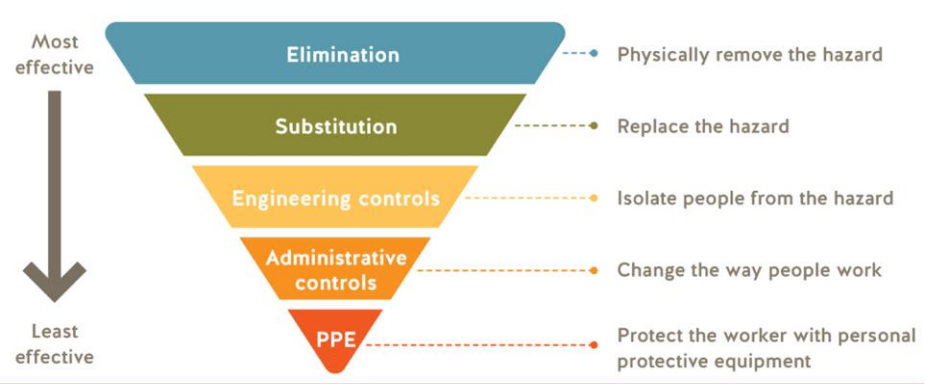


**Figure 1**: Hierarchy of Controls Diagram received from Controlling risks - WorkSafeBC

## 10.1 Elimination / Substitution

Where possible, UBC will substitute products that contain lead with products that do not contain and/or contain a lower percentage of lead. An example of elimination is, where feasible, replacing lead-containing paint with lead-free paint. If substitution controls are being considered, the new material or process should be assessed to ensure that it is less hazardous than the original material or process. Safety data sheet of products can assist with this assessment.

## 10.2 Engineering

Engineering controls aim to minimize the release of lead into the environment through physical modifications to facilities, equipment and processes. This method seeks to reduce exposure from the source and prevent lead from reaching the employee. Containment, local exhaust ventilation (LEV), wet dust suppression systems, and fume hoods are examples of engineering controls used to reduce employee exposure to lead.

### 10.2.1 Containment

#### *Enclosure*

Enclosures are used to contain lead in the work area and can be either a partial enclosure, using poly draping or plywood hoarding, or a full enclosure. For partial enclosures, the airflow inside could be created by setting up a ventilating (blower) fan where the dust containing air would be discharged to an unoccupied outdoor location. This option should only be used when dust levels are low or as a supplement to local exhaust ventilation (LEV) or wet methods.

Full enclosures can be fitted with a negative air unit that pumps air from inside the structure. Negative air units draw particulates through a high efficiency particulate air (HEPA) filter before the air is discharged outside the enclosure. HEPA filters are designed to capture particulates that are 0.3µm in diameter or larger with 99.97% efficiency.

#### *Barrier*

Barriers are used to isolate the work area and prevent entry by unauthorized employees. Unlike enclosures, barriers will not prevent lead dust from leaving the work area, but can be implemented if the exposure risk is low or an enclosure is not practicable. It is important to note that barriers do not prevent dust drift and should only be used where ventilation is sufficient and dust release is controlled. There should be enough space between the barrier and lead-generating activity to allow any lead dust to settle. Appropriate signage should be posted to notify others that work is underway and access to the immediate work zone is restricted to authorized personnel only.

### 10.2.2 Local Exhaust Ventilation (LEV)

LEV systems are available on some tools and machinery. LEV systems for tools typically consist of a shroud assembly, a hose attachment, and a vacuum system. Airborne contaminants will be collected within the shroud, then drawn into the hose, and finally through the HEPA filter in the vacuum. For machines or work stations with a fixed or flexible (i.e. snorkel) LEV arm, the airborne contaminant will be captured at the hood and then through the duct and HEPA filter.

LEV's can be used to capture lead-containing dust close to the point of generation. This system is designed so that contaminants are drawn away from the employee's breathing zone. The exhaust should pass through a HEPA filter and be exhausted in a manner so that contaminants do not re-enter the work area. The air velocity at the opening of the localized ventilation extraction system should be tested to ensure efficient capture of the lead-containing dust.

Situations where LEV can be used include:

- During soldering, welding, and high-temperature cutting of surfaces
- During the use of power tools to remove lead-containing coatings
- During work with enclosed lead process operations

The use of LEV systems will require the following to take place:

- LEV's must be placed as close to the source as possible. When using a flexible LEV arm (snorkel), the face of the hood should be located within one duct diameter from the source
- LEV's are equipped with HEPA vacuum systems and are operated and maintained as per manufacturer's instructions

- HEPA vacuum units (approved for use with lead contaminants) are used and maintained in accordance with the manufacturer's instructions

### 10.2.3 Wet Dust Suppression (WDS) Systems

Most tools are equipped with WDS systems, which are designed to apply water to the cutting or grinding surface to wet the area and prevent the resulting dust from becoming airborne. However, if WDS systems are not available, a similar effect can be accomplished through manual wetting with a mister or a hose.

The use of WDS systems will require the following to take place:

- Pneumatic powered equipment must be used instead of electrically powered equipment, unless the electrical equipment is specifically designed to be used in such circumstances
- Pressure and flow rate of the water must be controlled in accordance with the tool manufacturer's specifications
- Any slurry generated must be cleaned from surfaces once work is complete so that lead-containing dust does not dry and become airborne. Additional details on the disposal of this slurry can be found under Section 13: Housekeeping.

### 10.2.4 Fume Hoods

In laboratory settings, where lead may be used in research activities, fume hoods are an engineering control that can minimize exposure risks. Listed below are the precautionary measures that will allow for good containment of lead in fume hoods:

- Fume hood sashes should be lowered to the correct height, be free of cracks, and be clear
- Cross drafts created from doors, windows, etc. should be minimized as much as possible
- Equipment/chemicals should be positioned at least 6 inches into fume hoods, away from the face opening, to minimize obstruction of air moving into the hoods
- Fume hoods should not be overloaded with unnecessary tools, equipment, and materials. The presence of these objects may affect air flow within the fume hood
- Any equipment placed inside fume hoods should be elevated off the hood surface to allow air to flow easily around and under the equipment
- Containers of chemical waste should be properly discarded and not stored inside fume hoods
- Fume hoods should be audited annually, through UBC SRS, for proper airflow

## 10.3 Administrative

Administrative controls aim to minimize the release of lead dust, fumes, mists using safe work methods and procedures. Common examples of administrative controls include, but are not limited to:

- Providing education and training to employees on the hazards of lead
- Developing written Safe Work Procedures for the specific work to be done with lead containing materials and ensuring the documents are available for employees. Note: this ECP should be used as a guidance document but does not replace the need for site or process specific safe work procedures that must be written by qualified personnel
- Planning and scheduling work to minimize lead exposures for others in the area

- Posting warning signs to communicate to employees that lead-generating activities are taking place
- Providing adequate washing facilities to ensure hygiene requirements are followed
- Ensuring adequate supervision is provided to employees
- Performing regular inspections and maintenance of equipment
- Air monitoring for employee exposure to lead, when necessary

## 10.4 Personal Protective Equipment (PPE):

Personal protective equipment is the least effective control option and should only be used in conjunction with other controls (e.g. engineering and administrative) as a means to further reduce an employee's exposure to lead.

A National Institute for Occupational Safety & Health (NIOSH) approved air purifying respirator fitted with a HEPA filter can assist with minimizing the inhalation risk to airborne lead. Depending on the effectiveness of the other controls being implemented, either a full-facepiece or half-facepiece respirator should be chosen. Full-facepiece respirators are assigned a higher protection factor and therefore can be used to protect against higher concentrations of contaminants. A risk assessment will help determine the respiratory requirements needed.

Prior to any tight-fitting respirators being used for the first time, employees must successfully pass a respirator fit test to ensure the respirator forms a tight seal around the face and contaminants cannot enter the breathing zone. A respirator fit test will then be required, at minimum, annually thereafter. More information on respirator fit testing and the registration process can be found at: SRS Respiratory Safety.

Specific criteria for the appropriate use, care, and maintenance of respirators can be found in Section 8.33 of the BC OHSR. Key concepts from this section of the Regulation are outlined below:

- A negative and positive pressure check should be performed every time a respirator is donned to ensure a tight seal is present
- Damaged respirators must not be used at the workplace
- Respirators must be properly cleaned and sanitized after use. The following procedures can be used when cleaning and sanitizing most elastomeric respirators:
    - Remove filters or cartridges from the respirator and place in clean plastic bag
    - Wash the respirator, and its associated components, other than the cartridges, with warm water and mild detergent
    - Rinse the respirator in clean warm water
    - Wipe the respirator with disinfectant wipes
    - Once dry, place the respirator in a clean plastic bag
    - All respirators should be stored in a clean safe environment (i.e. away from sunlight, moisture, contaminants, etc.)

Coveralls should be worn to protect an employee's personal clothing from lead and to prevent lead dust from being brought out of the workplace. Coveralls should be made of a material resistant to the penetration of lead. Coveralls should be either disposable or laundered regularly, depending on the level of exposure.

Depending on the tasks being performed, impervious gloves, approved safety eyewear, safety footwear, hearing protection, and additional PPE may also be needed.

Proper decontamination is required prior to the removal of all PPE to prevent the transfer of lead contaminants to clean work spaces and personal belongings. Decontamination is essential for protecting the UBC community and family members from lead exposure due to uncontrolled contaminant transport. Decontamination could involve bagging and disposal, surface wiping, use of washing facilities, HEPA vacuuming, and/or laundering. The specific steps for decontamination are dependent on the risk rating of the work activity being performed and the equipment needed. As such, activity specific safe work procedures should also outline the decontamination process for removing lead contaminants that have accumulated on protective clothing, respirators, goggles, and other PPE.

## 11. Education and Training

Prior to employees performing activities where lead exposures might occur, employees must receive education and training. Personnel should be trained to a level of "demonstrated competency". While not an exhaustive list, education and training will include:

- Potential routes of lead exposure resulting from specific work activities or lead processes
- Hazards and risks associated with exposure to lead
- Signs and symptoms of lead related diseases
- Safe work practices and procedures
- Lead exposure reduction methods/strategies as detailed in the ECP
- Use of equipment and control systems (e.g. LEV and WDS systems)
- Personal hygiene and decontamination procedures to reduce exposure
- Use, selection, fitting, care, maintenance, limitations, and purpose of respirators and other PPE
- Completion of a respirator fit test prior to the first use of a tight-fitting respirator and at minimum on an annual basis thereafter
- Location of safety data sheets for the products being used
- How to seek UBC first aid (604-822-4444) and report occurrences of lead exposure

Records documenting the attendance list, training dates, and training materials must be kept on file.

## 12. Safe Work Procedures

OHSR 6.60 requires the implementation of a lead ECP if a risk assessment indicates that an employee is or may be exposed to lead dust, fumes, or mist.

Managers and Supervisors are to ensure qualified personnel, as defined in section 1.1 of the OHSR, develop site specific safe work procedures which provides step-by-step instructions to complete specific activities or tasks where employees are or may be exposed to lead. The procedures must include the necessary controls and PPE, as well as emergency and decontamination protocols. All lead related safe work procedures must be made available to employees. Safe work procedures should be developed and implemented for:

- Hazardous tasks
- Complicated tasks, so that important steps are not missed
- Frequently performed tasks
- Less routine tasks, to remind employees of the hazards and how to control the risks

According to the BC OHSR, lead written safe work procedures must address the following:

- Containment through enclosures or barriers, if used as a control measure for lead generating activities
- Effective controls against employee exposure to lead dust, fumes, or mist, including decontamination and personal hygiene
- Safe work practices and procedures on the tasks/activities being performed
- Use, selection, care, and maintenance of necessary personal protective equipment and clothing
- Emergency procedures
- Removal, cleanup, and disposal of lead dust and debris

## 13. Housekeeping

Worksites where exposure to lead dust, fumes, or mist is a risk must have written and properly implemented housekeeping procedures. HEPA filtered vacuums and wet sweeping are preferred for housekeeping as both techniques will generate minimal levels of airborne dust. All HEPA vacuums must undergo dioctyl phthalate (DOP) testing at least annually and any time after a HEPA filter is replaced. In addition, controls must be in place to ensure any waste generated from wet sweeping is not released into the environment where it can leach into soil or groundwater.

Dry sweeping, dry mopping, using blowers or compressed air are prohibited in situations where lead hazards are present. These methods can cause lead dust to become airborne, creating a secondary inhalation risk for employees.

All work areas and equipment that is coated with lead containing dust should be cleaned as soon as the work is completed. All lead-containing waste materials must be sampled and analyzed using the standard Toxicity Characteristic Leaching Procedure (TCLP). This procedure is designed to determine the “mobility” or “leachability” of lead in liquid and solid wastes. The waste slurry generated from the wet cleanup must be placed in sealable bags. All waste needs to be disposed in a manner to prevent its re-entry of waste into the workplace. Note that lead containing paint is also regulated under the federal Transportation of Dangerous Good Act and by the British Columbia Ministry of Environment.

Lead dust deposited on personal protective clothing and equipment should be handled carefully to avoid disturbing the dust and causing it to become airborne. Hygiene facilities must be made available to allow proper hand washing and cleaning of reusable personal protective equipment such as respirators and safety eyewear. Employees must also wash exposed skin before eating, drinking, or smoking and before leaving the worksite.

Reusable coveralls must be laundered and changed regularly. Contaminated coveralls must not be worn outside the designated work area to prevent the transfer of lead into lunch rooms, office spaces, vehicles, and homes. Disposable coveralls must be discarded accordingly.

HEPA filtered vacuums and damp wiping may be used to clean dust off clothing and any contaminated equipment. The use of dry sweeping and compressed air are prohibited for removing lead-containing dust from skin, clothing, or equipment. Refer to site specific safe work procedures for more details on decontamination steps.

## 14. Health Monitoring

A health monitoring program may be implemented if employees are potentially exposed to hazardous lead levels. The goal of health monitoring is to detect adverse health effects at an early stage to prevent the progression of symptoms and disease. A lead health monitoring program may consist of the following elements:

- Pre-project medical examinations
- Periodic medical examinations conducted during the project
- Clinical testing (typically the collection of blood samples)
- Referral to physician, where appropriate
- Employee education
- Record keeping

Please contact UBC Occupational & Preventive Health (OPH) for further information on health monitoring.

## 15. Documentation and Record Keeping

Documentation associated with the Lead Program will need to be maintained and managers/supervisors should be aware of where this documentation can be found. This documentation includes, but is not limited to:

- Lead exposure control plan (ECP)
- Lead safe work procedures
- Lead education and training records
- First aid records pertaining to lead exposures
- Incident/accident investigation reports or near misses pertaining to lead exposures
- WorkSafeBC inspection reports, if applicable
- Equipment maintenance and repair logs (i.e. HEPA filters)
- Respirator fit test records
- Toolbox talk records
- Safety meeting minutes
- Program review

## 16. Program Review

The Lead Exposure Control Plan will be reviewed annually and updated as needed by Safety & Risk Services and in consultation with UBC stakeholders, as applicable.

The following will be considered in the review:

- Evaluation of the control options and work procedures used
- Evaluation of any new technologies and methods that have come onto the market
- Review of first aid reports and any reported health-related symptoms
- Review of documentation for training and education
- Review of the Respirator Protection Program