EACO
Lead Guideline
For Construction, Renovation, Maintenance or Repair
October 2014

Foreword

This guideline has been prepared to assist building owners, constructors, contractors, subcontractors and workers who have duties under the Occupational Health and Safety Act and its Regulations to safely perform work activities involving lead, lead-containing or lead-contaminated materials. The guideline is intended to promote safe work practices, the use of appropriate personal protective equipment, worker awareness and training and is based in a thorough review of regulatory and guidance materials available to August 2014, as well as professional experience of the abatement industry in Ontario.

We believe that this guideline will not only help employers fulfill their responsibilities and due diligence, under the Occupational Health and Safety Act, but will also assist them to better address the challenges involved with implementing proper work procedures during activities involving lead, lead-containing or lead-contaminated materials.

Disclaimer

EACO disclaims any liability or risk resulting from the use of the work practices and recommendations discussed in the guideline. It is the user's responsibility to ensure that work practices and recommendations discussed in the guideline apply to specific workplaces and projects and to ensure compliance with all other applicable federal, provincial and local acts, codes and regulations.

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1. INTRODUCTION, GENERAL POINTS AND LIMITATIONS

1.1 Introduction

Interpretation and application of existing regulations and guidelines regarding lead are inconsistent within the construction and abatement industry, which impacts decisions regarding worker protection, occupant health and cost. Recognizing these issues, EACO has developed a guideline that transcends barriers between the assessment of lead in building materials and abatement and control procedures.

In this document, work on lead is defined as operations involving the handling, application, removal, disturbance or clean-up of Lead-Containing Materials (LCM) as defined in Appendix II and Section 3.2.

1.2 General Points

This guideline is intended for the environmental abatement industry, construction industry and the painting industry in general. The procedures identified herein are based on the current state of the science, practical experience and industry standard best-practices for lead abatement and dust control methods.

This guideline is not intended to address lead contamination in soil or in water.

1.3 Limitations

EACO is not responsible for the interpretation or use of the information contained within this document. It is the responsibility of the user to determine whether the information contained herein is appropriate to the user's specific activities. While EACO has attempted to identify and provide procedures for common scenarios, where lead abatement and control may be required, not all situations can be anticipated in advance. Therefore, the information contained within this document may not be suitable for all activities involving lead and caution should be used in applying the methods and procedures outlined in this document. Use professional judgement and if in doubt, contact a health and safety professional with experience in lead assessments and lead abatement operations.

2. REGULATIONS AND GUIDELINES

2.1 Canadian Federal Limits for Lead in Paints and Surface Coatings

The Canadian Federal Government began limiting the amount of lead in certain new paints to 0.5% by weight (5,000 mg/kg, µg/g, parts per million [ppm]) in 1976. The Surface Coating Materials Regulation (SOR/2005-109) dated April 19, 2005, as amended, pursuant to the 2005 Hazardous Products Act, revised the standard to limit the amount of lead in certain paints to 0.06% (600 ppm). In October 2010, this was revised to 0.009 % (90 ppm). As detailed in the Surface Coating Materials Regulation (SOR/2005-109), paints and surface coatings manufactured for the following uses are excluded from the limitation on lead content:

1) as an anti-corrosive or an anti-weathering coating applied on the interior or exterior surface of any building or equipment that is used for an agricultural or industrial purpose;
2) as an anti-corrosive or an anti-weathering coating applied on any structure, other than a building, that is used for an agricultural, industrial or public purpose;
3) as a touch-up coating for metal surfaces;
4) on traffic signs;
5) for graphic art on billboards or similar displays;
6) for identification marks in industrial buildings; or
7) as material for the purposes of arts, crafts or hobbies, other than material for use by children (SOR/2010-224, s.1).

2.2 Ontario Regulation 490/09 – Designated Substances

This regulation applies to every employer and worker at a workplace where lead is present, produced, processed, used, handled or stored and at which a worker is likely to be exposed to lead.

2.3 Ministry of Labour Guideline – Lead on Construction Projects

This document is intended to assists persons who have duties under the Occupational Health and Safety Act, and its regulations, to protect workers from exposure to inorganic lead on construction projects.

3. HISTORY OF LEAD AND LEAD USES

3.1 History

Lead has been commonly used for many industrial and commercial purposes for thousands of years, primarily because it is widely available, easy to extract and easy to work with. Lead is a naturally occurring heavy metal that is solid at room temperature and has a melting point of 327.5 degrees Celsius. Metallic lead has a bluish-white colour after being freshly cut and tarnishes to a dull gray when exposed to air. Lead was, and is, used in applications where low melting point, malleability and high density are useful.

3.2 Common Uses of Lead in Buildings

The following list includes the most common uses or application of lead in buildings. The list is not intended to be exhaustive.

1) Acoustic dampening baffles;
2) Additive in brass and other alloys;
3) Babbitt (bearing metal);
4) Batteries;
5) Cable and wire casing;
6) Cast iron pipe gaskets and connections;
7) Counterweights;
8) Decorative pieces;
9) Flashing;
10) Gaskets;
11) Glazing;
12) Indoor firing ranges;
13) Lead glass;
14) Late 19th and early 20th century tinted mortar at stone cladding;
15) Paint and surface coatings;
16) Pipes;
17) Radiation shielding (bricks or sheeting);
18) Solder (plumbing and electrical);
19) Stained glass and window came; and
20) Structural steel primer.

3.3 Exposure Risks to Workers by Activity

Exposure to lead can result in almost any trade. Primarily, workers at highest risk for lead exposure include those involved in iron work, construction work, demolition, painting, plumbing, welding, heating and air conditioning work, building maintenance and repair work, electrical work and carpentry, renovation, and remodeling work.

Operations with the potential to expose workers to lead include, but are not limited to, the following list of activities where lead-containing materials are being disturbed. The list is not intended to be exhaustive.

1) Abrasive blasting;
2) Application or removal (e.g. by scraping, sanding) of lead-based or lead-containing paints and surface coatings;
3) Heat gun applications;
4) Lead burning;
5) Demolition, renovation or repair of structures where lead, lead-based or lead-containing paints or surface coatings are present;
6) Removing, repointing or disturbing lead-containing mortar;
7) Welding, high temperature cutting, torch cutting and burning of primed or painted steel structures;
8) Soldering;
9) Removing lead paint from bridges, structural steel and other materials; and
10) Installing or removing lead products (such as lead panels, lead sheeting and lead bricks used for shielding radiation sources).

4. HAZARDS OF LEAD AND HEALTH EFFECTS

For the purpose of this document, lead refers to inorganic lead. Lead may affect the health of workers if it is in a form that may be inhaled or ingested. Inhalation of lead is considered the primary route of occupational exposure. When lead is present in the air as dust, fume or mist, it can be inhaled into the lungs and upper respiratory tract and then absorbed into the body. Incidental ingestion may occur when lead on work surfaces are transferred, to clothes and hands, and then to the mouth during eating, drinking, smoking, chewing or, touching of the face. Incidental ingestion may also occur when workplace surfaces are not properly cleaned, and good hygiene practices are not followed.

Lead exposure may occur in the form of dust (created through cutting, drilling, grinding, abrading, sanding, vibrating or polishing; as well as through activities related to renovation, demolition, repair or maintenance operations) or fume (created when lead is heated to temperatures above its melting point). Typically, temperatures above 500°C experienced during smelting, refining, welding and flame cutting or burning, are required before significant airborne concentrations of fumed lead are produced.

When lead is inhaled or ingested, it can enter the bloodstream and travel to soft tissues (such as the liver, kidneys, lungs, brain, spleen, muscles and heart). Some of this lead is filtered out of the body and excreted via urine, faeces, sweat and sloughing of dead skin. However, over time, lead in the body will move into the bones and teeth and can be stored there for a long time. Lead does not have a known function in the human body. It disrupts the function of enzyme systems that use other metals such as calcium, zinc and iron. Many of the health effects from lead take a long time to develop and may only become apparent after years of exposure.

Chronic exposure to small amounts of lead can result in a build-up of lead in the body over time, and the more lead in the body, the more likely that health problems will be experienced. Lead will naturally leave the body over time, but under conditions of continued exposure not all lead will be eliminated and will accumulate in body tissues and bone.

4.1 Symptoms of Lead Exposure

Harmful effects can follow a high exposure over a short-term (acute exposure), or a low exposure over a long-term (chronic exposure).

Table 1: Symptoms and Adverse Health Effects of Lead Poisoning

Acute	• Abdominal cramps • Acute encephalopathy, a condition affecting the brain that develops quickly into seizures, coma, and death from cardiorespiratory arrest (extremely rare) • Constipation	• Diarrhea • Headaches • Irritability • Metallic taste in the mouth • Muscle and joint pain • Tiredness • Vomiting
Chronic	• Anemia, a low number of blood cells • Anxiety • Blue line on the gums • Colic with severe abdominal pain • Constipation • Damage or impairment to the reproductive systems • Damage to the blood forming system • Damage to the brain and kidneys • Damage to the nervous system • Damage to the urinary system • Dizziness • Excessive tiredness • Headaches • High blood pressure	• Hyperactivity • Impaired intellectual development, behaviour, size and hearing of infants. • Insomnia • Loss of appetite • Metallic taste in the mouth • Muscle and/or joint pain or soreness • Nausea • Nervous Irritability • Numbness • Pallor • Possible carcinogen (cancer causing) • Tremors • Weakness (including in fingers, wrists, or ankles) • Wrist drop (the inability to hold the hand extended)

Symptoms listed above should not be relied upon to warn of or to self-diagnose lead-exposure. Some workers may not exhibit a change in health and two workers with similar exposures may exhibit significantly different symptoms. Proper medical assessment and testing by a physician is the only way to assess health impacts due to lead exposure.

Workers may carry lead-containing dust home on clothes, footwear, skin or hair, thereby increasing secondary exposure to themselves and potentially exposing family members to lead. The best approach in preventing lead exposure and lead poisoning is to be aware of its presence, ensure that proper engineering controls are in place and that control measures are properly implemented during the disturbance, handling, disposal and clean-up of lead and to follow proper worker hygiene (washing) procedures.

For additional information on the Health Effects of lead exposure, refer to "*Health Canada Final Human Health State of the Science Report on Lead*", February 2013.

4.2 Blood Lead Level and Total Body Burden

Worker exposure to lead is assessed by two primary exposure indices: Blood Lead Level (BLL) and Lead in Mineralizing Tissues, specifically bones and teeth. Thirdly, some lead may also accumulate in soft body tissue (liver, kidneys, lungs, brain, spleen, muscles and heart). The sum of these indices is referred to as Total Body Burden (TBB). BLL is a measure of the amount of lead in the blood and can be used to determine if additional control measures are required or if workers require removal from a work environment. In order to help ensure lead levels in the body do not reach the point where removal from work or treatment is required, airborne lead exposure limits have been established to control the inhalation exposure to workers and proper hygiene procedures are used to control worker ingestion of lead.

5. OCCUPATIONAL EXPOSURE LIMITS

Employers are required by Ontario Regulation (O. Reg.) 833 "*Control of Exposure to Biological or Chemical Agents*" to limit the exposure of workers to specified hazardous biological or chemical agents in accordance with the values set out in the Regulation. In addition, O. Reg. 490/09 "Designated Substances" specifies worker exposure limits to lead. If a hazardous biological or chemical agent is not listed, the regulation prescribes the use of the exposure values set by the American Council of Governmental Industrial Hygienists (ACGIH). These values restrict the amount and duration of worker exposure to airborne concentrations of hazardous biological or chemical agents.

Currently, construction site projects are exempt from these regulations, however, under the occupational health and safety act general duty requirements, employers are required to do everything reasonable and practicable to protect workers from workplace hazards. Maintaining worker exposure within the prescribed occupational exposure levels is considered best management practice for construction workers.

5.1 Airborne Lead Exposure Limits

Ontario Regulation 490/09

- 0.05 mg/m^3 Time-Weighted Average (TWA)(8 hour day or 40 hour week).

Ontario Regulation 833

- 0.05 mg/m^3 TWA(8 hour day or 40 hour week).

5.2 Rationale for Determination of De Minimis (i.e. virtually safe) Level

O. Reg. 490/09 and O. Reg. 833 prescribe time-weighted average (TWA) occupational exposure levels in Ontario for airborne lead in industry. The Ministry of Labour Guideline "Lead on Construction Projects" established measures and procedures for certain operations to protect worker health based on the type of work (lead operation being done) to maintain worker lead exposure within the TWA prescribed by O. Reg. 490/09 and O. Reg. 833. This guideline provides additional information and procedures for other activities, to enhance worker safety and assist in regulatory compliance.

Work activities involving lead are categorized by this guideline as Class 1, Class 2 or Class 3 Lead Operations. Classes of lead operations are defined in Section 7. Measures, procedures, controls and personal protective equipment requirements for each Class are provided in Section 8.

Various occupational and workplace safety authorities and agencies consider that, depending on the type of disturbance, airborne lead could be generated in hazardous levels from any amount of lead in a paint or surface coating. As such, these agencies have not set a level of lead in paint at which lead-related precautions are not required (a de minimis level). Similarly, there is no established concentration of lead below which lead procedures are not required if a lead-containing material is disturbed.

With no set level below which lead precautions are not required, lead precautions would be required when disturbing a material containing any measureable amount of lead. Several issues arise when abatement, construction repairs or maintenance are required:

- Lead is frequently present in low part per million concentrations in paints and surface coatings due to contaminants in the ingredients. Almost all coatings will be assumed to contain lead since it is not possible, using current analytical methods, to measure zero lead concentration. Therefore, no paint or surface coating can be said to be lead-free.

- If any concentration of lead in paint or surface coating can create an airborne hazard, then every disturbance, including disturbance of new paint or surface coating (legally containing up to 0.009% lead) is a hazard. This implies that tasks such as new paint applications, drilling a hole through a painted surface, or cutting an opening in a painted surface, no matter how small, would be considered a lead operation.
- Nearly every construction or maintenance worker would disturb lead at some point. Therefore, each worker would require lead abatement training, medical surveillance, and every employer would require a respirator program.
- Since there is no Ontario exposure limit for lead exposures in construction, workers on construction sites may not be protected to the same extent as workers in other workplaces.

This guideline establishes a de minimis (i.e. virtually safe) level of lead in paint or surface coatings where a hazard would not likely be present. The following rationale applies to tasks that do not create excessive or significant dust, mist or fume. Tasks that generate significant dust, mist or fume are excluded and always require adherence to Class 2 or Class 3 operations or require an exposure assessment.

Considering:

- The Ontario TWA for lead is 0.05 mg/m^3,
- The Ontario TWA for Particles Not Otherwise Specified (PNOS), sometimes termed "nuisance dust", is 10 mg/m^3 measured as inhalable dust; and
- The U.S. Environmental Protection Agency (EPA) and The Department of Housing and Urban Development (HUD) guideline states that a lead-based paint is any paint containing 0.5% lead (or 1 mg/cm^2 if measured by an X-Ray Fluorescence Analyzer (XRF).

If a paint or surface coating containing 0.5% lead was made completely airborne, but not diluted by other dusts (i.e. if all of the paint was sanded off and made airborne and the substrate untouched), then the PNOS TWA would have to be exceeded in order for the lead TWA to be exceeded:

10 mg/m^3 PNOS (nuisance dust) x 0.5% lead = 0.05 mg/m^3 airborne lead (which equals the TWA)

If work is done on lead-containing paint or surface coatings (containing up to 0.5% lead) and the PNOS TWA is not exceeded then the Occupational Exposure Limit (OEL) for lead cannot be exceeded. This is conservative as some of the substrate would be expected to become airborne in most disturbances (e.g. power tool disturbance of paint on plaster or wood, hand or power sanding of painted wood).

Similarly, if a painted surface with 0.25% lead was made completely airborne (and not diluted) then the TWA for lead could not be exceeded unless the TWA for PNOS was exceeded by at least a factor of two. This represents a concentration that is half the TWA (commonly called an action level) and, consistent with standard occupational hygiene practice, would not require respiratory protection.

The U.S. Occupational Safety and Health Administration (OSHA) has set 0.03 mg/m^3 (30 $\mu g/m^3$, TWA) as an action level:

> *The interim final standard establishes an action level of 30 micrograms of lead per cubic meter of air (30 $\mu g/m^3$), averaged over an 8-hour workday. The action level triggers several ancillary provisions of the standard such as exposure monitoring, medical surveillance, and training.*

Based on this approach OSHA does not require lead-specific precautions if the airborne exposure is below the action level. In this case, the non-lead portion of the paint (particulate matter) is the limiting hazard.

The Workplace Hazardous Material Information System (WHMIS) is enforced in all work places, and at less than 0.1%, an ingredient does not need to be listed on the Material Safety Data Sheet (MSDS). If a material containing less than 0.1% lead was to be made airborne then the TWA for PNOS would have to be exceeded by at least 5 times before the TWA for lead would be exceeded.

Lead content of 0.1% (i.e. 1000 µg/g or 1000 mg/kg or 1000 ppm lead) is considered a de minimis level of lead in paint or surface coatings, provided that aggressive disturbance or heating does not occur.

5.3 "De minimis" or "virtually safe" Lead Level for Paints and Coatings

For the purpose of this guideline:

- Paints or surface coatings containing less than or equal to 0.1% lead by weight (1000 µg/g or 1000 mg/kg or 1000 ppm lead) are considered low-level lead paints or surface coatings. If these materials (and the surfaces to which they are applied) are disturbed in a non-aggressive manner, performed using normal dust control procedures and are completed so that the TWA for PNOS is not exceeded, then worker protection from the inhalation of lead is not required. General health and safety precautions must still be implemented, which may include, in part, prohibiting eating, drinking, smoking and chewing in the work area, implementing dust suppression techniques and washing facilities for workers to wash hands and face.

- Paints or surface coatings containing greater than 0.1% lead by weight (1000 µg/g, or 1000 mg/kg, or 1000 ppm) but less than 0.5% lead by weight (5000 µg/g, or 5000 mg/kg, or 5000 ppm lead) are considered lead-containing paints or surface coatings. Tasks performed that disturb these materials must be completed in accordance with the Classifications of Work Operations (in Section 7) and corresponding procedures (in Section 8). Alternatively, a hygiene or exposure assessment can be performed to determine procedures that are required.
- Regardless of lead content in paints or surface coatings, tasks that create an aggressive disturbance of coatings such as torching/welding, abrasive blasting must always be completed in accordance with the procedures listed in the Classifications of Work Operations (in Section 7) and corresponding procedures (in Section 8). Alternatively, a hygiene or exposure assessment can be performed to determine procedures that are required.
- Construction operations involving lead-based paints or surface coatings (i.e. concentrations equal to or greater than 0.5% lead by weight (5000 µg/g, or 5000 mg/kg, or 5000 ppm lead) must always be completed in accordance with the procedures listed in the Classifications of Work Operations (in Section 7) and corresponding procedures (in Section 8). Alternatively, a hygiene or exposure assessment can be performed to determine procedures that are required.

5.4 Blood Lead Monitoring and Medical Surveillance

Even with appropriate measures to control lead in the workplace, some workers may be occupationally and non-occupationally exposed. Periodic medical examinations are important for determining if the control measures in place are effective and being properly followed. Medical surveillance is a method of early detection of lead over exposure and assists in prevention of lead poisoning.

EACO recommends that all lead workers be tested for blood lead levels to properly document lead accumulation from all exposure sources including inhalation and ingestion. Testing for blood lead levels is recommended as follows.

1) Prior to starting to work with lead;
2) Immediately prior to long-duration lead abatement projects (regardless of Class);
3) Monthly during;
    a. prolonged lead abatement projects (regardless of Class),
    b. frequently completed lead operations (regardless of Class), or

c. Class 3 lead abatement projects.

4) At the end of long-duration lead abatement projects (regardless of Class); and

5) At least annually for workers involved in incidental lead work.

Consideration should also be given to additional project-specific testing for Class 2B or Class 3 Operations.

5.5 Blood Lead Guidelines

Blood lead level (BLL), is measured in micrograms of lead per decilitre of blood (µg/dL) or micromoles of lead per litre of blood (µmol/L).

The current Ontario Code for Medical Surveillance of Lead indicates the following limits:

- > 70 µg/dL – remove from work
- > 60 µg/dL – Action Level: enquiry regarding work practices & personal hygiene
- ≤ 50 µg/dL – acceptable for return to work
- > 40 µg/dL – fertile woman must be removed from work

6. WORKER TRAINING

6.1 Training

Training is the first step in ensuring a safe and healthy workplace. It provides employers and workers with the knowledge required to protect themselves and others from injury and illness.

All workers involved in the disturbance or handling of lead-containing materials, or are otherwise exposed to lead, shall receive training.

Training shall be provided by a "Competent Person" as defined by the Occupational Health and Safety Act (OHSA) and ideally by an individual with lead identification and lead abatement training and experience.

The employer shall implement and document a training program for workers and ensure worker participation in the program. Training shall be completed for a worker conducting work which involves lead or may expose a worker to lead. Training shall be provided every 3 years at a minimum. For workers who conduct work that is routinely above the time-weighted average (TWA) for lead (i.e. Class 2 or Class 3 Operations), training shall be provided at least annually.

At a minimum training shall include:

a) Brief history of lead usage with a focus on lead in building materials,

b) Review of Material Safety Data Sheets (MSDS),

c) Review of the health hazards and illnesses association with lead exposure,

d) Discussion on the health effects of lead on adults and children,

e) Lead exposure symptom recognition,

f) Description of how lead is stored in the body and can cause health affects later in life, and the limitations of blood lead monitoring,

g) Explanation of routes of entry into the body including inhalation, ingestion and skin absorption. With attention paid to the risks associated with subsequent ingestion and the prohibiting of eating, smoking or chewing in the work area,

h) Explanation of secondary exposure and exposure of family by taking contamination home on work clothing,

i) The identification and nature of operations and activities that could result in lead exposure,

j) Definition of the di minimis level for lead in paints and surface coatings and an explanation of its concept,

k) Explanation of legislative exposure values for airborne lead,

l) The purpose of Personal Protective Equipment (PPE), particularly coveralls and respirators,

m) The selection, fitting, use, maintenance, and limitations of PPE,

n) The proper donning (putting on) and doffing (taking off) and disposal of PPE,

o) Review proper hand and face washing and hygiene techniques,

p) The benefits of using indicator and chelating soaps and wipes to ensure adequate hand washing,

q) The measures and procedures for various lead operations,

r) The purpose and benefits of a medical surveillance program, and

s) General non-lead hazards that may exist on lead projects.

6.2 Training Requirements – Lead Awareness and Class 1 Operations

In addition to the requirements of sections 6.1:

a) Lead Awareness Training shall be no less than four hours in duration,

b) Workers shall be trained in the measures and procedures prescribed in Class 1 Operations (Section 7.1), and

c) Proper waste classification and disposal in accordance with the Ontario Ministry of Environment Regulations.

6.3 Training Requirements – Class 2 and Class 3 Lead Operations

In addition to the requirements of section 6.2:

a) Class 2 and Class 3 Lead Operations Training Program shall at a minimum be 1 day (7.5 hours) in classroom theory and shall include a practical hands-on training component,

b) The employer shall ensure that every worker performing or involved with Class 2 and Class 3 Operations has successfully completed Lead Awareness Training and Class 2 and Class 3 Operations Training Program,

c) Shall clearly define Class 2 and Class 3 Operations, and

d) Proof of successful completion shall be issued to both the worker and employer in the form of a certificate.

NOTE: A worker certified with the 253H designation granted by the Ontario Ministry of Training Colleges and Universities (MTCU) is considered to have training equivalent to the requirements of Class 2 and Class 3 as stipulated in this guideline.

7. CLASSIFICATION OF WORK OPERATIONS

Each class of work specifies respirators, measures and procedures that shall be used and followed to protect workers and others from lead exposure. Work is classified based on the type of disturbance or activity that may cause lead exposure and/or the anticipated airborne concentration of lead. In this guideline, work involving lead is classified into three groups, Class 1, Class 2 and Class 3 Operations. Class 2 and Class 3 Operations are further subdivided. Airborne lead concentration typically increases as the classification increases.

NOTE: The application of a physical barrier (e.g. an encapsulant or new coat of paint) to a stabilized lead-containing material, or a paint or surface coating, is not considered a Lead Operation regardless of the concentration on lead in the underlying material. This also pertains to

applying new low-lead level paints or surface coatings to lead-containing or lead-based paints or surface coatings (e.g. repainting).

7.1 Class 1 Operations

a) Removal of lead-containing or lead-based paints and surface coatings with a chemical gel/stripper or paste.

b) Application of lead-containing or lead-based paints and surface coatings with a brush, roller or sponge.

c) Installation or removal of lead sheeting or flashing.

d) Installation or removal of lead-containing packing, babbitt, caulking, gasket or similar material.

e) Removal of materials coated with lead-containing or lead-based paints and surface coatings, using non-powered hand tools, where the material remains chiefly intact and is not crumbled, pulverized or powdered.

f) Operating construction or demolition equipment (e.g. excavator, bulldozer) during building renovation or demolition where lead-based paints or surface coatings are present on building materials and are being disturbed.

g) Soldering with lead solder.

h) Removing lead-containing or lead-based paints or surface coatings with a heat gun.

i) Removing lead-containing and lead-based paints and surface coatings using a high-pressure water jet (e.g. pressure washer).

7.2 Class 2 Operations

7.2.1 Class 2A Operations

a) Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool that has an effective dust collection system[1] equipped with a HEPA filter.

b) Welding, torching or high temperature cutting of lead-containing materials indoors when using an effective fume collector or smoke eater[2] that filters and exhausts lead fume and expels it directly outdoors (away from occupants, entrances, walkways, rest areas, etc.). Fume collector or smoke eater must

[1] An effective dust collection system, which is an engineering control, that controls airborne lead concentration levels (measured on the worker) to below 0.05 mg/m^3.

[2] An effective fume collection system/smoke eater, which is an engineering control, that controls airborne lead concentration levels (measured on the worker) to below 0.05 mg/m^3.

have effective source control and capture velocity, minimum of 0.5 metres per second (100 feet per minute) at the work surface.

c) Welding, torching or high temperature cutting of lead-containing and lead-based paints and surface coatings or lead-containing materials outdoors.

d) Removal of lead-containing mortar using handheld non-powered tools.

e) Removal of lead-containing and lead-based paints and surface coatings or lead-containing materials by scraping or sanding (including wet sanding) using non-powered hand tools.

f) Demolition of plaster or building components that crumble, pulverize or powder and are covered with lead-containing or lead-based paints or surface coatings.

g) Clean up and removal of a significant amount of lead-containing dust and debris (that can be made easily airborne) using wet methods or HEPA vacuums.

7.2.2 Class 2B Operations

a) Spray application of lead-containing paints and surface coatings.

7.3 Class 3 Operations

7.3.1 Class 3A Operations

a) Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool without an effective dust collection system equipped with a HEPA filter.

b) Welding, torching or high temperature cutting of lead-containing materials indoors or in a confined space (e.g. within a ditch or pit).

c) Removal of lead-containing mortar using a powered cutting device.

d) Burning of a material containing lead.

e) Removal, cleaning or repair of a ventilation system or ductwork used for controlling lead exposure.

f) Spray application of lead-based paints and surface coatings.

g) In the absence of an exposure assessment:

i. demolition or cleanup of a facility where lead-containing products were manufactured and significant dust and debris, which can be made easily airborne, is present.

ii. cleanup of dust and debris down range of a firing station in an indoor firing range.

iii. an operation that may expose a worker to lead dust, fume or mist that is not a Class 1, Class 2, or Class 3B operation.

7.3.2 Class 3B Operations

a) Abrasive blasting of lead-containing and lead-based paints and surface coatings or lead-containing materials (including wet, slurry and dry abrasive blasting and dry-ice blasting).

7.4 Alternate Work Classification Method

Alternatively, the classification of Lead Operations during construction can be based on airborne concentrations.

Table 2: Determination of Class by Airborne Lead Concentration

Class 1 Operations	Class 2 Operations		Class 3 Operations	
	Class 2a	Class 2b	Class 3a	Class 3b
0.025 to 0.05 mg/m^3	>0.05 to 0.50 mg/m^3	>0.50 to 1.25 mg/m^3	>1.25 to 2.50 mg/m^3	>2.50 mg/m^3

Procedures that generate airborne lead at concentrations below 0.025 mg/m^3 do not require the use of lead procedures or personal protective equipment, however general health and safety precautions must still be implemented, which may include, in part, prohibiting eating, drinking, smoking and chewing in the work area, implementing dust suppression techniques and establishing washing facilities for workers to wash hands and face.

Determination of airborne lead concentrations can be made by conducting a negative exposure assessment consistent with the principles of the American Industrial Hygiene Association (AIHA), "Strategy for Assessing and Managing Occupational Exposures". The assessment will measure the airborne lead concentrations during a specific work activity, under specific conditions, while implementing control measures detailed in Section 8. The assessment may demonstrate that engineering controls and other preventive measures are maintaining airborne concentrations of lead within an acceptable exposure range. This proof of exposure control can be used to classify a specific activity or to justify the use of alternative lead-specific precautions pertaining to an existing Class. In order to determine (or reduce) the Classification of a work operation, a negative exposure assessment shall be completed and must include worker personal air monitoring.

Local exhaust ventilation, dust collectors, enclosures or other engineering controls may be used to reduce airborne lead concentrations and reduce the measures and

procedures prescribed in the applicable Class. An exposure assessment shall be performed to ensure the effectiveness of the controls.

8. ENGINEERING CONTROLS, PROCEDURES AND HYGIENE

8.1 Planning

An evaluation of the site shall be completed by a competent person to identify classes of work and prepare a plan to satisfy site specific requirements.

8.2 Inspections

A pre-start inspection shall be completed by a competent person. The purpose of this inspection is to ensure and document that the prescribed measures are established and acceptable prior to the start of any work that will disturb lead. The following are minimum inspection requirements:

a) An inspection of the work area signage and containment, if applicable.

b) An inspection of the equipment.

c) An inspection of the hygiene facilities and intended procedures.

d) An inspection of ventilation controls, if applicable.

Routine inspections must be scheduled while the lead operations are ongoing to ensure and document that the prescribed measures remain in-place and the prescribed procedures are being followed.

Prior to each shift, a competent person shall inspect the work area, any enclosures and washing facility or decontamination facility for defects or deficiencies. All defects and deficiencies shall be corrected before work resumes. The decontamination facility shall be maintained in a clean and sanitary condition.

8.3 General Principles

The strategy for controlling airborne lead hazard is broken down into following basic principles:

a) Worker education,

b) Prevent lead from becoming airborne,

c) Prevent airborne lead from spreading,

d) Remove airborne lead,

e) Prevent workers from inhaling airborne lead and or ingesting lead, and

f) Adequate cleaning to control exposure to lead residue.

To avoid the ingestion, inhalation and unintentional transfer of lead from contaminated areas, it is essential to have the following control methods in place:

a) Engineering controls,

b) Work practices,

c) Hygiene practices, and

d) Protective clothing and equipment.

8.4 Engineering Controls

Workplace stakeholders, which may include owners, constructors, contractors, specification writers, supervisors and workers, involved in construction projects that may expose workers to lead should:

a) Substitute lead-containing materials with low lead content (or materials described commercially as lead-free) alternatives where possible.

b) Select methods and equipment for the removal or installation of lead-containing materials that will reduce dust generation (e.g. wet methods, such as wet sweeping and shovelling) and shall be used whenever practicable.

c) Provide general mechanical ventilation to remove contaminated air from the workplace. The replacement air entering the work area must be free from contamination with any hazardous dust, mist, fume, vapour, or gas.

d) Provide local mechanical ventilation to remove dust, mist and fumes at the source whenever possible. Local mechanical ventilation shall have adequate capture velocity at the source of generation to control worker exposure to dust mist and fumes containing lead. The following should be met.

   i. Cross draft 0.5 metres per second (100 feet per minute), and

   ii. Down draft 0.25 metres per second (50 feet per minute).

e) Unless working in a Class 3 enclosure, power tools used to remove lead-containing paints and surface coatings shall be equipped with an effective dust collection systems attached to HEPA Filters. The dust shroud shall be kept flush with the surface from which the paint or surface coating is being removed.

8.5 Work and Hygiene Practices

Work practices, personal protective equipment and hygiene practices are on-the-job activities that reduce exposure to lead. Lead-containing material can accumulate on the hands, clothing and hair and when disturbed, can be re-suspended in air and inhaled or ingested. Personal protective clothing and equipment for each Class of lead operation is described in Section 9. Workers shall decontaminate at the end of each shift. The specific washing and decontamination facilities that shall be provided for lead work are detailed in Section 10. For all work with the potential for lead exposure, there shall be no smoking, eating, drinking or chewing in contaminated areas. Food, beverages and tobacco products shall be left outside the work area.

An effective housekeeping program requires regular clean-up and removal of lead-containing dust and debris. Surfaces shall be kept clean by washing down with water or cleaning with a vacuum equipped with a HEPA filter. Lead waste containers shall be kept tightly covered (dust tight) to prevent dust from becoming airborne. Cleaning with compressed air or dry sweeping shall not be performed.

8.6 Measures and Procedures for Class 1, Class 2 and Class 3 Operations

This section of the guideline outlines the general measures and procedures for all work with lead-containing materials, followed by specific minimum recommendations for Class 1, Class 2 and Class 3 operations.

8.6.1 Class 1 Operations

a) Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators based on the scope of the Operation) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.

b) Respirators should not be necessary if all general health and safety procedures are followed. However, any worker who requests a respirator shall be provided with a respirator, as prescribed in Table 3, and the worker shall wear the respirator.

c) Coveralls should not be necessary if all general health and safety procedures are followed. However, any worker who requests coveralls shall be provided with coveralls, as prescribed in Section 9, and the worker shall wear the coveralls.

d) Gloves shall be provided, as prescribed in Section 9, and the worker shall wear the gloves.

e) Use removal methods that minimize dust generation whenever possible.

f) Suppress any dust generated.

g) Workers shall not eat, drink, chew or smoke in the work area.

h) Dust and waste shall be cleaned up at regular intervals and placed in a container that is;

   i. dust tight,

   ii. suitable for the type of waste,

   iii. identified as lead waste,

   iv. cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,

   v. removed from the workplace frequently and at regular intervals, and

   vi. evaluated for lead-content and disposed of in accordance with applicable regulations.

i) The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate for the type of waste. Double bagging of waste is recommended.

j) Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.

k) Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.

l) Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.

m) Wet methods should be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.

n) Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

o) All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or with a vacuum equipped with a HEPA filter, prior to removal from the work area.

p) Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.

q) Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.

r) Follow worker hygiene procedures as prescribed in Section 10.

8.6.2 Class 2 Operations

a) Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators based on the scope of the Operation) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.

b) Respirators shall be provided, as prescribed in Table 3, and the worker shall wear the respirator.

c) Gloves, coveralls and other Personal Protective Equipment (PPE) shall be provided, as prescribed in Section 9, and the worker shall wear the PPE.

d) Signage is required and the area shall be delineated to control access. Signs shall be posted in sufficient numbers to warn of the lead hazard and shall state in large clearly visible letters that, i) there is a lead hazard, and ii) Access to the work area is restricted to persons wearing protective clothing.

e) Use removal methods that minimize dust generation whenever possible.

f) Suppress any dust generated.

g) Workers shall not eat, drink, chew or smoke in the work area.

h) Dust and waste shall be cleaned up at regular intervals and placed in a container that is;

   i. dust tight,

   ii. suitable for the type of waste,

   iii. identified as lead waste,

   iv. cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,

   v. removed from the workplace frequently and at regular intervals, and

   vi. evaluated for lead-content and disposed of in accordance with applicable regulations.

i) The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate to the type of waste. Double bagging of waste is recommended.

j) Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.

k) Air-handling (supply and return) systems servicing the area of the Class 2 Operation shall be removed from service or isolated to prevent migration of lead through the air handling system.

l) Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.

m) Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.

n) Wet methods shall be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.

o) Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

p) All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or using a vacuum equipped with a HEPA filter, prior to removal from the work area.

q) Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.

r) Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.

s) Where a dust generating operation is carried out, additional local mechanical ventilation shall be provided to remove dust, mist and fumes at the source. Local mechanical ventilation is recommended for welding, burning or high temperature cutting and for the removal of lead-containing and lead-based paints and surface coatings using power tools that are equipped with a dust collection device attached to a HEPA filter. Where local mechanical ventilation is used, the following should be met:

    i. Air velocity at the source of dust, mist or fume generation shall be no less than 0.5 m/sec (100 ft./min).

    ii. Air discharged from the local mechanical ventilation system shall pass through a HEPA filter.

t) Follow worker hygiene procedures as prescribed in Section 10.

8.6.3 Class 3 Operations

a) A competent supervisor must be present at all times during Class 3 Operations. Only workers and supervisors with proper training shall perform Class 3 Operations.

b) Washing facilities consisting of a wash basin, clean water, soap (consider the use of lead-specific soaps and hygiene indicators) and towels shall be provided. Workers shall use these washing facilities upon leaving the work area and before eating, drinking or smoking.

c) Respirators shall be provided, as prescribed in Table 3, and the worker shall wear the respirator.

d) Gloves, coveralls and other PPE shall be provided, as prescribed in Section 9, and the worker shall wear the PPE.

e) Signage is required and the area shall be delineated to control access. Signs shall be posted in sufficient numbers to warn of the lead hazard and shall state in large clearly visible letters that, i) there is a lead hazard, and ii) access to the work area is restricted to persons wearing protective clothing.

f) Use removal methods that minimize dust generation whenever possible.

g) Suppress any dust generated.

h) Workers shall not eat, drink, chew or smoke in the work area.

i) Dust and waste shall be cleaned up at regular intervals and placed in a container that is,

   i. dust tight,

   ii. suitable for the type of waste,

   iii. identified as lead waste,

   iv. cleaned with a damp cloth or a vacuum equipped with a HEPA filter, or placed in a clean bag so that a clean exterior surface is achieved immediately prior to removal from the work area,

   v. removed from the workplace frequently and at regular intervals, and

   vi. evaluated for lead-content and disposed of in accordance with applicable regulations.

j) The use of 6 mil polyethylene bags as a waste container is acceptable provided it is appropriate for the type of waste. Double bagging of waste is recommended.

k) Enclosures shall be used to separate the work area from other construction activities or work areas, and to prevent lead exposure to persons not directly involved in the lead operation. Barriers should only be used where full and partial enclosures are not practicable.

u) Drop sheets shall be used below all lead operations that may produce dust, chips, or debris containing lead.

l) For Class 3a operations conducted indoors where work areas are not accessible to the public, barriers, partial enclosures, or full enclosures may be used.

m) For all other all other Class 3 operations conducted indoors full enclosures shall be used.

n) For Class 3a and 3b operations conducted outdoors, barriers, partial enclosures, or full enclosures shall be provided.

o) ***Barriers, Partial Enclosures and Full Enclosures***

i. Ropes or barriers do not prevent the release of contaminated dust or other contaminants into the environment. However, barriers can be used to restrict access to only workers who are adequately protected with proper PPE, and prevent entry of individuals not directly involved in the operation. Ropes or barriers shall be placed at a distance far enough from the operation that allows the lead-containing dust to settle. If this is not achievable, warning signs shall be posted at the distance where the lead-containing dust settles to warn that access is restricted to persons wearing PPE. Ropes or barriers shall be located no less than 10 metres from the work area.

ii. Partial enclosures may consist of vertical and/or horizontal tarps and drop sheets (e.g. polyethylene sheeting). The tarps shall overlap and be securely fixed together at the seams. A partial enclosure is not a recommended containment system if significant dust is being generated, however is suitable for containing flakes and chips.

iii. Full enclosures are tight enclosures (with tarps that are generally impermeable (e.g. polyethylene sheeting) with fully sealed joints and chambered air lock entryways/exits and upper seals). Full enclosures allow minimal or no fugitive emissions to reach the area outside the enclosure. For full enclosures, the following requirements shall be met:

a) The enclosure shall be made of windproof materials that are impermeable to dust.

b) The enclosure shall be supported by a secure, adequate and safe structure.

c) All joints in the enclosure shall be fully sealed.

d) Entrances to the enclosure shall be equipped with air locks (curtain walls, flap doors, zipper doors or solid doors).

e) The escape of dust, mist, fume, waste, blast media and debris from the enclosure shall be prevented.

f) General mechanical ventilation shall be provided by a HEPA filtered unit to remove contaminated air from the enclosure. Clean and safe make-up air that is free from hazardous dust, mist, vapours or fumes shall be provided to replace the exhausted air.

g) Filters used on ventilation equipment shall be adequate to ensure that exhausted air quality meets applicable environmental legislation and standards.

h) The air velocity within the enclosure shall provide an average minimum cross-draft or down-draft past each worker during abrasive blasting operations as follows.

- cross draft capture velocity of 0.5 m/sec (100 ft./min) at the worker breathing zone.
- Down draft capture velocity of 0.25 m/sec (50 ft./min) at the worker breathing zone.

p) The spread of lead dust from the work area shall be prevented by creating and maintaining within the enclosed area a minimum negative air pressure of 0.02 inches of water column (5 pascal), relative to the area outside the enclosed work area and/or 6 air changes per hour. Pressure differential readings must be taken and logged at regular intervals during lead removal.

q) Air-handling systems (supply and return) servicing the area of the Class 3 Operation shall be removed from service or isolated to prevent migration of lead through the air handling system.

r) Dry removal of lead-containing or lead-based paints and surface coatings shall be minimized whenever possible.

s) Wetting of materials shall be conducted whenever possible to control dust. The addition of wetting agents should be considered. Wetting should not be used if it may create a hazard or cause damage.

t) Wet methods shall be incorporated in the operation to reduce dust generation. Examples of wet methods include wetting surfaces, wet mist, wet scraping and wet shovelling.

u) Cleaning with compressed air or dry sweeping shall not be performed. Sweeping compounds shall be used where wetting is not possible.

v) All equipment, tools, respirators and clothing shall be cleaned by damp wiping, or using a vacuum equipped with a HEPA filter, prior to removal from the work area.

w) Protection of porous or fibrous surfaces is imperative as it is very difficult to remove lead-containing dust from these surfaces. If the material cannot be adequately protected from lead dust or waste it shall be removed and disposed of.

x) Any water generated from cleaning or removal operations must be appropriately contained, treated or disposed of in accordance with applicable legislation.

y) Where a dust generating operation is carried out, additional local mechanical ventilation shall be provided to remove dust, mist and fumes at the source. Local mechanical ventilation is recommended for welding, burning or high temperature cutting and for the removal of lead-containing and lead-based paints and surface coatings using power tools that are not equipped with a dust collection device attached to a HEPA filter. Where local mechanical ventilation is used, the following should be met:

   i. Air velocity at the source of dust, mist or fume generation shall be no less than 0.5 m/sec (100 ft./min).

   ii. Air discharged from the local mechanical ventilation system shall pass through a HEPA filter.

Class 3 Decontamination Facility

Establishing a decontamination facility is required for workers conducting Class 3 operations. The decontamination facility shall be located as close as practicable to the work area and shall consist of:

a) A suitable area for taking off contaminated protective clothing.

b) A shower that includes;

   i. Hot and cold water with individual controls inside the room to regulate water flow and temperature; or

   ii. Water of a constant temperature that is not less than 40° Celsius or more than 50° Celsius.

   iii. Clean towels.

   iv. Soap that is suitable for removing lead, and

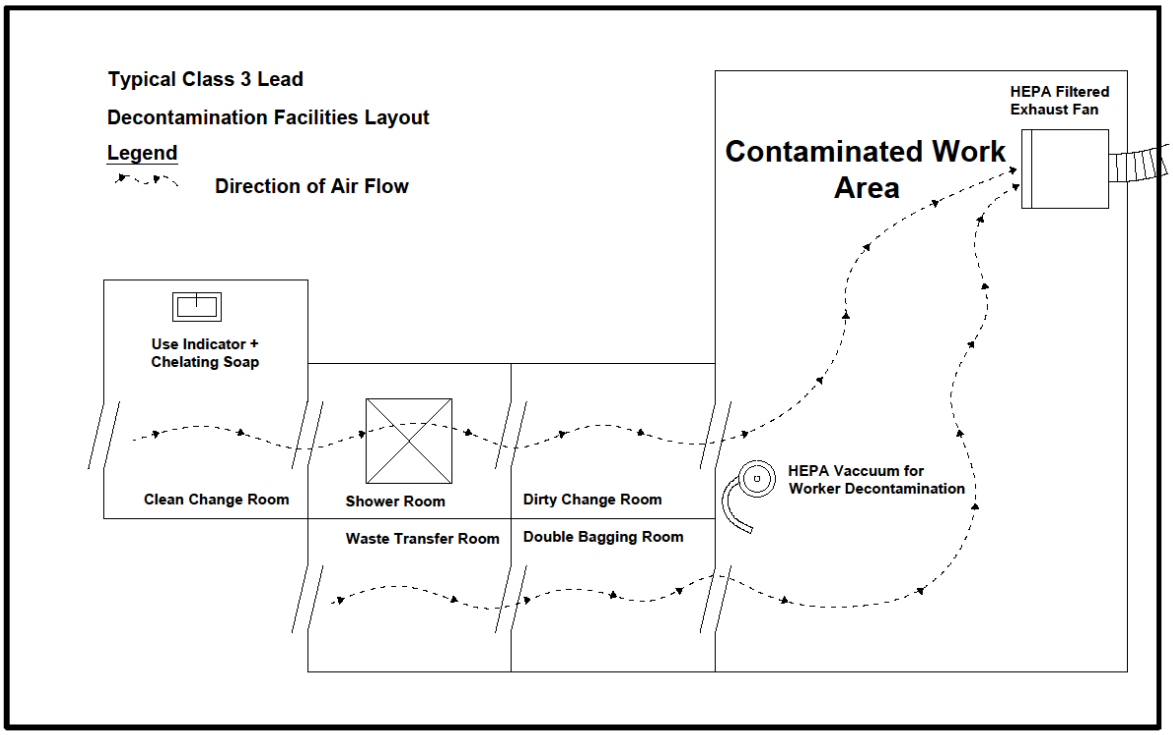
   v. Hygiene indicators to visually confirm that lead has been removed from workers hands.

c) a suitable area for changing in to street clothes and for storing clean clothing and equipment.

d) Follow worker hygiene procedures as prescribed in Section 10.

Refer to Figure 1 as an example of a typical Class 3 Lead Operation decontamination facility layout.

Figure 1: Typical Class 3 Lead Operation Decontamination Facilities Layout



9. PERSONAL PROTECTIVE EQUIPMENT

Employers must ensure workers who are involved in Lead Operations, are provided with appropriate personal protective equipment (PPE) including:

a) Dust-impermeable gloves appropriate for the work being completed and disposable chemical resistant gloves for application of solvents, strippers and detergents. Refer to the Material Safety Data Sheets (MSDS) for recommended glove selection. Consideration should be given to wearing two layers of gloves in high lead exposure operations to reduce contaminant transfer during removal of protective clothing.

b) Full body coveralls made of a material that does not readily retain nor permit penetration of lead, is equipped with a hood or head covering, and that fits snugly at the ankles, wrists and neck, in order to prevent lead dust from reaching the garments and skin under the protective clothing. Coveralls shall be repaired or replaced if torn. Suitable footwear or coverings shall be worn.

c) Respirators as prescribed by Table 3.

The following table indicates anticipated airborne concentrations of lead, associated with each Class of lead operation, with the corresponding minimum recommended respiratory protection. Respirators shall be NIOSH approved and the worker shall be fit-tested for the specific type and size of respirator.

Table 3: Lead-Specific Personal Protective Equipment

Class 1 Operation	Minimum Respirator Requirement	Lead-Specific PPE
(0.025 - 0.05 mg/m^3)	Respirators should not be necessary if the general procedures listed in Section 8 are followed and if the level of lead in the air is less than 0.05 mg/m^3. If a worker requests to wear a respirator, a half-face air purifying respirator with N-, R- or P- series filters, and 95, 99 or 100% efficiency shall be provided.	Appropriate gloves. If a worker requests, coveralls, boot covers and respirator shall be provided.
Class 2a Operation	**NIOSH APF = 10**	
(>0.05 to 0.50 mg/m^3)	Half-face air purifying respirator with N-, R- or P-series filter, and 95, 99 or 100% efficiency.	Appropriate gloves, coveralls and boot covers, respirator
Class 2b Operation	**NIOSH APF = 50**	
(>0.50 to 1.25 mg/m^3)	Full-face piece air-purifying respirator with N-, R- or P- series filter, and 100% efficiency.	Appropriate gloves, coveralls and boot covers, respirator
Class 3a Operation	**NIOSH APF = 50**	
(>1.25 to 2.50 mg/m^3)	Full-face piece air-purifying respirator with N-, R- or P- series filter, and 100% efficiency. Tight-fitting powered air-purifying respirator with a high efficiency filter. Full-face piece supplied-air respirator operated in demand mode. Half-mask or full-face piece supplied air respirator operated in continuous-flow mode.	Appropriate gloves, coveralls and boot covers, respirator
Class 3b Operation	**NIOSH APF ≥ 1000**	
(> 2.50 mg/m^3)	Type CE abrasive-blast supplied air respirator	Appropriate gloves,

	operated in a positive pressure mode with a tight-fitting half-mask face piece. Full-face piece supplied-air respirator operated in pressure-demand or other positive-pressure mode.	coveralls and boot covers, respirator

NIOSH APF – National Institute of Occupational Safety and Health Assigned Protection Factor.

Compressed air systems used with supply air respirators shall meet the requirements of CSA Standard Z180.1-13.

10. WORKER HYGIENE PROCEDURES

Good hygiene practices must be implemented during lead-related work to protect the worker from lead exposure. Every Class of lead work requires that workers thoroughly wash hands and face when leaving the work area and prior to eating, drinking, smoking or chewing. Proper hand washing techniques specific to lead decontamination shall be posted in the washing facility and products including lead specific hand soaps which combine surfaction, chelation, *p*H adjustment and mechanical removal of lead from the skin may be used. The use of post washing indicator methods that demonstrate workers have adequately removed lead from skin is strongly recommended.

Using lead wipe indicators will help the worker identify if washing was effective in removing lead. Standard soap and water alone may not be effective at removing lead from skin which can result in secondary exposure by ingestion.

10.1 Class 1 Operations

10.1.1 Decontamination and Personal Hygiene Facilities

a) Clean change areas with lockers or hangers and hooks for workers' street clothes and personal belongings. The Clean Room will also have a mirror to permit workers to fit respiratory equipment properly.

b) The Clean Area will accommodate at least one worker allowing sufficient space to change comfortably.

c) A clean lunch/break area will be provided and kept as free as practicable of lead contamination.

10.1.2 Entering the Work Area

Workers will use the following sequence when entering the work area:

a) Remove street clothes, if required.

b) Don appropriate PPE, as prescribed in Table 3, before entering the work area.

10.1.3 Exiting the Work Area

a) Remove gross contamination from coveralls, if worn, person and personal protective equipment by wet wiping, and/or using a vacuum equipped with a HEPA filter, before leaving Work Area.

b) If worn, remove coveralls while minimizing contact with undergarments or body (i.e. by removing coveralls downwards and outwards while rolling onto itself).

c) Proceed to decontamination facility to wash hands and face.

d) Washing procedure should be similar to the following sequence.

i. Wet hands and face (and respirator if worn) with water.

ii. Apply soap to cover hand surface.

iii. Rub palm to palm, back of the hands, and in between fingers for 15-20 seconds.

iv. Wash and rinse face (and respirator if worn).

v. Remove respirator if worn.

vi. Wash face, ensuring all surfaces cleaned including ears and neck.

vii. Rinse hands and face with running water.

viii. Dry hands with a single use towel.

ix. Turn off faucet with the towel and dispose of the towel.

10.2 Class 2 Operations

10.2.1 Decontamination and Personal Hygiene Facilities

a) Clean change areas with lockers or hangers and hooks for workers' street clothes and personal belongings. The Clean Room will also have a mirror to permit workers to fit respiratory equipment properly.

b) The Clean Area will accommodate at least one worker allowing sufficient space to change comfortably.

c) A clean lunch/break area will be provided and kept as free as practicable of lead contamination.

10.2.2 Entering the Work Area

Workers will use the following sequence when entering the work area:

a) Remove street clothes, if required.

b) Don appropriate PPE, as prescribed in Table 3, before entering the work area.

10.2.3 Exiting the Work Area

a) Remove gross contamination from coveralls, if worn, person and personal protective equipment by wet wiping, and/or using a vacuum equipped with a HEPA filter, before leaving Work Area.

b) If worn, remove coveralls while minimizing contact with undergarments or body (i.e. by rolling coveralls downwards and inwards into it).

c) Leave respirator on and place contaminated disposable PPE in waste container.

d) Wash hands, face, and respirator prior to respirator removal then wash face and hands again before leaving the work area.

e) Washing procedure should be similar to the following sequence.

i. Wet hands, face and respirator with water.

ii. Apply soap to cover hand surface.

iii. Rub palm to palm, back of the hands, and in between fingers for 15-20 seconds.

iv. Wash and rinse face and respirator.

v. Remove respirator.

vi. Wash face, ensuring all surfaces are cleaned including ears and neck.

vii. Rinse hands, face and respirator with running water.

viii. Dry hands and face with a single use towel.

ix. Turn off faucet with the towel and dispose of the towel.

f) Don street clothes in Clean Room prior to leaving work site.

g) Upon completion of lead abatement, dispose of shoe coverlets as contaminated waste or clean thoroughly inside and out using lead-specific soap and water, and test with lead indicator wipes before removing from the Work Area.

10.3 Class 3 Operations

10.3.1 Decontamination and Personal Hygiene Facilities

a) Establish a decontamination facility in accordance with Section 8.

b) A clean lunch/break area will be provided and kept as free as practicable of lead contamination.

10.3.2 Entering the Work Area

Workers will use the following sequence when entering the work area:

a) Remove street clothes, if required.

b) Don appropriate PPE, as prescribed in Table 3, before entering the work area.

c) Proceed through the shower facility.

d) Don reusable PPE that remains in the ‘dirty change area’.

10.3.3 Exiting the Work Area

a) Remove gross contamination from coveralls, if worn, person and personal protective equipment by wet wiping, and/or using a vacuum equipped with a HEPA filter, before leaving Work Area.

b) If worn, remove coveralls while minimizing contact with undergarments or body (i.e. by rolling coveralls downwards and inwards into itself).

c) Leave respirator on and place contaminated disposable PPE in waste container. Shower without removing the respirator and clean respirator while in the shower.

d) Proceed to clean room, remove cleaned respirator and store in a sealed plastic bag/container.

h) Washing procedure, prior to leaving the clean room, should be similar to the following sequence.

i. Wet hands, face and respirator with water.

ii. Apply soap to cover hand surface.

iii. Rub palm to palm, back of the hands, and in between fingers for 15-20 seconds.

iv. Wash and rinse face and respirator.

v. Remove respirator.

vi. Wash face, ensuring all surfaces are cleaned including ears and neck.

vii. Rinse hands, face and respirator with running water.

viii. Dry hands and face with a single use towel.

ix. Turn off faucet with the towel and dispose of the towel.

e) Don street clothing before leaving the work area

11. WORK AREA CLEANING PROCEDURES

The following final cleaning procedures are minimum requirements. Additional final cleaning procedures may be necessary to meet project-specific requirements.

11.1 Class 1 Operations

a) Cleaning shall be completed in a top-to-bottom methodology (i.e. start in high locations and clean down towards floor level) and beginning at the farthest point of the work area from the entrance (i.e. clean towards the entrance to the work area).

b) Compressed air or dry sweeping shall not be used to clean the work area.

c) Clean all surfaces in the work area by wet wiping and/or using a vacuum equipped with a HEPA filter.

d) When using wet wipe cleaning, frequently and at regular intervals,
   i. Use folding technique to expose a clean surface of the cloth.
   ii. Rinse cloth with clean water.
   iii. Replace soiled cloth with clean cloth.
   iv. Replace dirty water with clean water.

e) Clean and rinse a small area at a time before proceeding to the next area.

f) Place waste in an appropriate container frequently and at regular intervals.

g) Wet and carefully roll drop sheets toward the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.

h) Place drop sheets in an appropriate waste container.

i) Inspect work area for cleanliness. Deficiencies shall be corrected when they are identified.

j) Complete rinsing with clean water.

k) Avoid re-contamination of clean areas.

l) Clean all tools, supplies and equipment in the work area by wet wiping and/or using a vacuum equipment with a HEPA filter. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be cleaned to the extent that is practical and placed in sealed containers before removing from the work area.

m) Waste containers shall be thoroughly cleaned on the exterior and sealed prior to leaving the work area.

n) Conduct clearance testing if required.

o) Following a successful visual inspection, and clearance testing if required, a sealant or an encapsulant may be applied.

11.2 Class 2 Operations

a) Cleaning shall be completed in a top-to-bottom methodology (i.e. start in high locations and clean down towards floor level) and beginning at the farthest point of the work area from the entrance (i.e. clean towards the entrance to the work area).

b) Compressed air or dry sweeping shall not be used to clean the work area.

c) The use of lead-specific cleaning solutions may be required as part of the cleaning process.

d) Clean all surfaces in the work area by wet wiping and/or using a vacuum equipped with a HEPA filter.

e) When using wet wipe cleaning, frequently and at regular intervals,

   i. Use folding technique to expose a clean surface of the cloth.

   ii. Rinse cloth with clean water.

   iii. Replace soiled cloth with clean cloth.

   iv. Replace dirty water with clean water.

f) Clean and rinse a small area at a time before proceeding to the next area.

g) Place waste in an appropriate container frequently and at regular intervals.

h) Wet and carefully roll drop sheets toward the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.

i) Place drop sheets in an appropriate waste container.

j) Inspect work area for cleanliness. Deficiencies shall be corrected when they are identified.

k) Complete rinsing with clean water.

l) Avoid re-contamination of clean areas.

m) Clean all tools, supplies and equipment in the work area by wet wiping and/or using a vacuum equipment with a HEPA filter. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be cleaned to the extent that is practical and placed in sealed containers before removing from the work area.

n) Waste containers shall be thoroughly cleaned on the exterior and sealed prior to leaving the work area.

o) Conduct clearance testing if required.

p) Following a successful visual inspection, and clearance testing if required, a sealant or an encapsulant may be applied.

11.3 Class 3 Operations

a) Cleaning shall be completed in a top-to-bottom methodology (i.e. start in high locations and clean down towards floor level) and beginning at the farthest point of the work area from the entrance (i.e. clean towards the entrance to the work area).

b) Compressed air or dry sweeping shall not be used to clean the work area.

c) The use of lead-specific cleaning solutions may be required as part of the cleaning process.

d) Clean all surfaces in the work area by wet wiping and/or using a vacuum equipped with a HEPA filter.

e) When using wet wipe cleaning, frequently and at regular intervals,

   i. Use folding technique to expose a clean surface of the cloth.

   ii. Rinse cloth with clean water.

   iii. Replace soiled cloth with clean cloth.

   iv. Replace dirty water with clean water.

f) Clean and rinse a small area at a time before proceeding to the next area.

g) Place waste in an appropriate container frequently and at regular intervals.

h) Wet and carefully roll drop sheets toward the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.

i) Place drop sheets in an appropriate waste container.

j) Inspect work area for cleanliness. Deficiencies shall be corrected when they are identified.

k) Complete rinsing with clean water.

l) Avoid re-contamination of clean areas.

m) Clean all tools, supplies and equipment in the work area by wet wiping and/or using a vacuum equipment with a HEPA filter. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be cleaned to the extent that is practical and placed in sealed containers before removing from the work area.

n) Waste containers shall be thoroughly cleaned on the exterior and sealed prior to leaving the work area.

o) When HEPA Filtered Exhaust Fan (negative air units) are used, cleaning shall start at the farthest locations from the negative air units (i.e. cleaning shall be completed moving towards negative air units).

p) Cleaning shall include the worker decontamination chambers and waste transfer rooms.

q) Minimize water pooling within the work area.

r) Leave the work area and surrounding areas dry and visibly free of dust and debris for visual inspection by the project authority.

s) Conduct clearance testing if required.

t) Following a successful visual inspection, and clearance testing if required, a sealant or an encapsulant may be applied.

11.3.1 Work Area Tear Down

a) Inspect the work area prior to starting tear down. Ensure the work area has achieved the appropriate level of cleanliness, that clearance sample requirements have been met, and that clearance has been accepted by the project authority.

b) Remove polyethylene sheeting used during abatement by wetting and carefully rolling towards the centre of the work area. Remove visible dust and debris by wet wiping and/or using a vacuum equipped with a HEPA filter.

c) Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape. Clean the cabinet by wet wiping before removal from the work area.

d) Following enclosure dismantling, a post tear down visual inspection should be completed. If required, additional cleaning should be completed by wet wiping and/or using a vacuum equipped with a HEPA filter.

12. LEAD CLEARANCE STANDARDS

12.1 Lead Clearance Assessments

12.1.1 Class 1 and Class 2 Operations

A lead clearance assessment shall be conducted upon the completion of Class 1 and 2 Operations and shall consist of a visual assessment. The area shall pass the inspection if it is visually clean. Special consideration shall be given to areas that are difficult to access, or clean, such as corners or rough surfaces.

Lead clearance wipe sampling may be considered for large scale Operations conducted in areas of buildings occupied by sensitive populations including:

a) Children (e.g. daycares and primary schools).

b) Pregnant and nursing women.

c) Food preparation, processing and serving areas.

d) Pediatrics, labour and delivery, and maternity areas of hospitals.

e) Residential buildings.

12.1.2 Class 3 Operations

Lead clearance testing shall be conducted upon the completion of Class 3 Operations. The purpose of clearance testing is to verify that work areas have been cleaned sufficiently and to demonstrate that it is safe for workers and occupants. The clearance assessment and testing must be completed by a competent person.

The clearance assessment has two components:

1. A visual assessment

The work area passes the visual inspection if it is adequately cleaned of dust and debris. Special consideration shall be given to areas that are difficult to access or clean such as corners or rough surfaces. The presence of dust, debris or residue indicates that the cleaning was insufficient and additional cleaning shall be completed. Following additional cleaning, a follow-up inspection is required.

2. Collection and analysis of wipe samples

Wipe sampling shall not be completed until the area passes visual inspection. Wipe samples shall be collected in accordance with a validated analytical method. Wipe samples may not be required if a physical barrier will be installed over cleaned surfaces in a manner that prevents access (to the cleaned surfaces) by building occupants.

12.2 Clearance Wipe Sampling

Clearance wipe sampling provides analytical confirmation that an area has been adequately cleaned. Representative sample locations and sample quantities must be collected from the project area in order to effectively demonstrate that the lead concentration is within acceptable levels. Samples shall be collected in accordance with the procedures in Section 13. The following table lists the minimum number of clearance wipe samples to be collected.

Table 4: Minimum Number of Clearance Wipe Samples

Area of Work or Cleaned Surface(s)	**Minimum Number of Wipe Samples**
1 square meter or less	1
Greater than 1 square meter but less than 10 square meters	2
Greater than 10 square meter but less than 100 square meters	3
Every additional 100 square meters	1
If present, inside the clean room entrance/exit to the work area	1
Clearance for Indoor Firing Ranges	
Exhaust fan inlet area and outlet area (1 sample in each area)	2
Range floor	3
Horizontal surfaces other than the floor (i.e. counters, sills)	3
Bullet trap area	3
Vertical surfaces such as walls, frames	3
Horizontal surfaces exterior to range (i.e. at entrances)	3

If present, inside the clean room entrance/exit to the work area	1

A minimum of 1 field blank shall be collected for each clearance sampling event. No less than 1 field blank for every 10 field samples, or part thereof, shall be submitted for laboratory analysis.

12.2.1 Wipe Sampling Clearance Criteria

Lead concentrations of clearance wipe samples, when at or below the assigned clearance criteria, provides analytical confirmation that an area has been adequately cleaned.

Wipe sampling clearance criteria, as detailed in Table 5, are not intended to be an action level or trigger to initiate cleanup activities.

Table 5: Wipe Sampling Clearance Criteria

Area or Surface to be Tested	Clearance Criteria[3]	
	µg/100 cm^2	µg/ft^2
Exterior concrete and rough surfaces	86.1	800
Interior concrete, window troughs, rough surfaces	43	400
Interior window sills	26.9	250
Firing ranges and work places where lead is used	21.5	200
Floors and other surfaces: Non-Residential	21.5	200
Floors and other surfaces: Residential	4.3	40
Child care facilities, primary schools, food preparation, food processing, pediatrics, labour and delivery, and maternity areas of hospitals (all surfaces routinely accessible by occupants or used in food processing).	4.3	40

12.3 Air Sampling for Lead Clearance

Surface wipe sampling is the preferred clearance testing method over air sampling as it more accurately represents the remaining lead and the potential for future worker or occupant exposure. Air sampling should not be used alone for clearance purposes, but can be considered to supplement clearance wipe sampling.

12.4 Composite Wipe Sampling

Composite wipes are wipe samples consisting of more than one co-mingled wipe per container. Composite samples provide an average level of lead over the

[3] If these levels cannot be achieved, a barrier (e.g., drywall, paint or surface coating, tile) may be installed to prevent access to the cleaned surface by building occupants.

multiple samples and, therefore, low levels in some samples may mask higher levels (that exceed clearance standards) in others.

There is a lack of inter-laboratory proficiency testing programs for analysis of composited wipe samples that may place the validity of the data under scrutiny. Due to accreditation reporting requirements most laboratories will be obligated to place significant disclaimers and limitations on the results of composite wipes which may further confound interpretation and call into question the value of the results.

If a composite sample is analyzed and exceeds the clearance criteria, all areas encompassed by that composite sample must be re-cleaned (possibly multiple rooms or a large area). Alternatively, if a discrete sample is collected in each room/area, only the room/area associated with a sample that exceeds the criteria will require re-cleaning.

If a competent person determines that composite wipe sampling is appropriate for clearance or pre-abatement assessment of lead, then the following recommendations, in addition to general wipe sample requirements and quality assurance and quality control measures, should be observed:

a) Confirm that the laboratory is accredited to perform lead analysis and can analyze composite samples and, if so, whether special quality assurance practices are required.

b) Wipes used for composite samples shall meet the requirements of a validated analytical method.

c) Composite samples must not contain subsamples from different component or surface types. All the subsamples must be collected from same building components and surface type (e.g. a single composite sample shall not be collected from a carpeted floor and a concrete floor).

d) The same type of wipe must be used for all subsamples of a composite sample.

e) The surface areas of subsamples used in a composite sample must swab the same surface area. For example, each subsample in a single composite sample would wipe 100 square centimeters.

f) The areas to be sampled and composited shall be determined prior to the start of sampling.

g) A new wipe must be used for each area sampled. No more than four subsamples shall make up a composite sample.

h) All subsamples must be inserted into the same container.

i) Composite samples must not be taken from rooms/areas that have dramatically different conditions.

j) Laboratory-supplied containers must be used to contain wipe samples to facilitate quantitative rinsing.

The clearance level criterion must be adjusted relative to the number of subsamples in the composite sample. This is done by dividing the clearance level by half the number of subsamples in the composite.

> **Example:** A composite wipe sample contains four (4) subsample wipes. The applicable clearance level for the surface sampled is 40µg/ft^2. Divide 40µg/ft^2 by 2 (which is half of the 4 subsamples). The adjusted clearance level is 20µg/ft^2. All samples must meet the adjusted clearance level to be considered a pass.

The total number of required samples shall meet the requirements of Table 4 (i.e. where two samples are required in the table, either two discrete samples or two composite samples are required).

13. LEAD SAMPLING ANALTYICAL METHODOLGY

Prior to sample collection, an accredited laboratory and validated analytical method shall be selected for the sample analysis. Samples shall be collected by a competent person in accordance with the validated method.

13.1 Laboratory Accreditations

Ensure laboratories are accredited to perform the analysis requested. The following accrediting agencies are recommended as accrediting bodies for the National Lead Laboratory Accreditation Program (NLLAP):

- Canadian Agency for Laboratory Accreditation (CALA)
- American Industrial Hygiene Association (AIHA)
- American Association for Laboratory Accreditation (A2LA)
- Perry Johnson Laboratory Accreditation, Inc. (PJLA)
- ANSI-ASQ National Accreditation Board/ACLASS
- Laboratory Accreditation Bureau

13.2 Analytical Methods and Limits of Detection

The following table is a summary of analytical methods, applicable to a specific sample matrix (i.e. paint chips, solids, dust wipes, air), and the corresponding limit of detection for each method. An accredited laboratory should be consulted if additional information or clarification is required.

Table 6: Analytical Methods and Corresponding Limits of Detection

Method	Matrix	Limit of Detection (LOD)	Weight/Area/ Volume required for the LOD
Flame Atomic Absorption Spectrometry			
SW846-7000B	Paint Chips	100 mg/Kg (0.010% wt.)	0.2 g
	Solids	40 mg/Kg (0.004% wt.)	0.5 g
	Dust (wipes)	10 µg/ft^2	144 in^2
NIOSH 7082	Air	0.004 mg/m^3	1000 L
Inductively Coupled Plasma Atomic Emission Spectrometry			
SW846-6010B/C	Solids	1 mg/Kg (0.0001% wt.)	0.5g
	Dust (wipes)	0.5 µg/ft^2	144 in^2
NIOSH 7300 modified	Air	0.0005 mg/m^3	1000 L
Graphite Furnace Atomic Absorption Spectrometry			
SW846-7010	Solids	0.3 mg/Kg (0.00003% wt.)	0.5 g
	Dust (wipes)	0.075 µg/ft^2	144 in^2
NIOSH 7105	Air	0.00003 mg/m^3	1000 L

13.3 Sample Collection

13.3.1 Air Sampling / Air Monitoring

Air monitoring may be necessary to:

a) Ensure work operations are not producing airborne concentrations of lead which exceed the Time-Weighted Average (TWA) or the protection factor for the respirators being used.

b) Ensure that workers or occupants in areas adjacent to the work area are not being exposed to airborne lead at concentrations exceeding the TWA.

Air monitoring may be performed inside or outside of the Work Area. If airborne lead levels in the Work Area exceed the Maximum Use Concentration specified for the assigned respirator, work procedures shall be reviewed and altered to reduce airborne lead levels or determine if alternate respiratory protection is required.

If airborne lead is detected at concentrations exceeding the TWA in occupied areas adjacent to the Work Area, an evaluation to determine the cause shall be conducted and an adequate means to control the exposure implemented.

Air sampling collection should be completed following approved analytical methods.

13.3.2 Paint and Surface Coating Bulk Sampling

Collect samples of distinctive paint finishes and surface coatings, present in more than an insignificant application, where removal of the paint is possible. Collect samples by scraping the paint or surface coating to include all layers.

The following is designed for use as a reference. Samples shall be collected in accordance with the requirements of the analytical method selected and in consultation with the analytical laboratory.

Required Equipment

a) Appropriate, sealable sample container – one per sample.

b) Sampling tool (e.g. scraper, knife).

c) Disposable Gloves.

d) Indelible Marker.

e) Chain of Custody Form.

Sampling Procedure

a) Don clean disposable gloves in preparation for sample collection.

b) Select discreet area for sample collection.

c) Remove all layers of paint (to substrate), place into a sample container and seal the sample container.

d) Using indelible marker, label the container with a unique sample number identifier.

e) Clean up sampling area by wet wiping or using a vacuum equipped with a HEPA filter.

f) Encapsulate or repair damaged area, as appropriate.

g) Complete the Chain of Custody form and submit to an accredited laboratory.

13.3.3 Wipe Sampling

Wipe sample collection should follow NIOSH method 9100 “Lead in Surface Wipe Samples” or NIOSH method 9102 “Elements on Wipes”.

13.4 Sampling Using Portable X-Ray Fluorescence (XRF) Analyzer

The U.S. Environmental Protection Agency (EPA) and U.S. Department of Housing and Urban Development (HUD) historically stated that concentrations of lead in paints and surface coatings of one milligram per square centimetre (mg/cm^2) were comparable to 0.5% and were considered “elevated” for lead.

In cases when laboratory analysis is impractical, or when virtually immediate results are required, a hand-held portable X-Ray Fluorescence Analyzer (XRF) may prove useful. An XRF can provide fast, non-destructive, on-site, analysis of lead concentration in paints and surface coatings, soil, air and surface dust.

13.4.1 Paint and Surface Coating Sampling by XRF

It is of critical importance to understand the Limit of Detection (LOD) of an XRF analyzer. Although the accuracy of XRF analyzers has improved in recent years, the LOD for portable XRF analyzers varies depending on the model used. An XRF can readily determine what paints and surface coatings contain elevated lead above 1mg/cm^2 (comparable to 0.5 % lead by weight), however, may not be able to determine if lead concentrations are below the de minimis level (i.e. 0.1%). Portable XRF analyzers may be used as a screening tool to confirm if paints and surface coatings are considered to be lead-based (i.e. lead concentration of 1mg/cm^2 or greater). Physical samples of paints or surface coatings with readings below 1mg/cm^2 should be collected for laboratory analysis to confirm lead content.

13.4.2 Air Sample and Dust Wipe Sample Analysis by XRF

An XRF analyzer can quickly determine the composition of elemental lead collected on an air filter cassette and dust wipe sample. This can be beneficial for worker exposure monitoring, providing instructions to workers regarding cleaning methods, evaluating the efficacy of engineering controls and hygiene practices and to perform clearance sample analysis. It is important to realize that the use of portable direct-read instrumentation is not necessarily directly comparable to laboratory analytical methods. Consideration should be given to using portable direct-read instruments in conjunction with laboratory analysis.

To properly obtain and analyze air samples by XRF, samples must be collected and analyzed in accordance with U.S. National Institute of Occupational Safety and Health (NIOSH) Manual of Analytical Methods, Fourth Edition, Method 7702, Issue 1 Lead By Field Portable XRF (January 15, 1998).

APPENDIX I

LIST OF LEGISLATION, GUIDELINES AND RELEVANT DOCUMENTS

Environmental Protection Agency (EPA). (2001, January 5). *40 CFR Part 745 Lead; Identification of Dangerous Levels of Lead; Final Rule.*

Government of Canada. (2005, April 19). *Surface Coating Materials Regulations SOR/2005-109 CANADA CONSUMER PRODUCT SAFETY ACT*.

Government of Canada. (2011, June 6). *Hazardous Products Act R.S.C., 1985, c. H-3* .

Health Canada. (2013, February). *Final Human Health State of the Science Report on Lead.* Ottawa: Publications, Health Canada.

Health Canada. (2013, February). *Risk Management Strategy for Lead.* Ottawa: Publications, Health Canada.

Occupational Safety and Health Administration. (2004). *OSHA3142-12R200; Lead in Construction.*

Occupational Safety and Health Administration. (n.d.). *Regulations (Standards - 29 CFR) - Table of Contents; Part Number: 1910; Part Title: Occupational Safety and Health Standards; Subpart: I; Subpart Title: Personal Protective Equipment; Standard Number: 1910.132; Title: General requirements.*

Occupational Safety and Health Administration. (n.d.). *Regulations (Standards - 29 CFR); Part Number: 1926; Part Title: Safety and Health Regulations for Construction; Subpart: D; Subpart Title: Occupational Health and Environmental Controls; Standard Number: 1926.62; Title: Lead*

Ontario Ministry of Labour. (2011, April). *Lead on Construction Projects*.

Service Ontario. (2009, December 18). *Occupational Health and Safety Act*

Service Ontario. (2013, April 8). *Occupational Health and Safety Act, ONTARIO REGULATION 213/91 CONSTRUCTION PROJECTS.*

Service Ontario. (2013, January 1). *Occupational Health and Safety Act, ONTARIO REGULATION 490/09 DESIGNATED SUBSTANCES*.

U.S. Department of Health and Human Services: Public Health Service: Agency for Toxic Substances and Disease Registry. (2007, August).*Toxicological Profile for Lead*.

U.S. Department of Housing and Urban Development. (2012, July). *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing; Office of Healthy Homes and Lead Hazard Control Second Edition, July 2012.*

U.S. Environmental Protection Agency; New York City Department of Health and Mental Hygiene; Agency for Toxic Substance and Disease Registry; New York State Department of Health; Occupational Health and Safety Administration. (2003, May). *World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks.*

United States of America Department of the Navy; Bureau of Medicine and Surgery. (2002, May). *Indoor Firing Ranges Industrial Hygiene Technical Guide.*

Worksafe B.C. (2011). *Lead-Containing Paints and Coatings, Preventing Exposure in the Construction Industry.*

APPENDIX II DEFINITIONS	
Term	**Definition**
Action Level	Concentration of ½ of the Occupation Exposure Limit (OEL) for an airborne contaminant at which precautions are implemented to be protective of worker health.
Clearance Tests	Samples collected and analyzed following abatement to verify an acceptable level of cleanliness.
Competent Person or Supervisor	As defined under the Ontario Occupational Health and Safety Act.
Contaminated Area	The portion of the Project where active disturbance, handling or cleanup of lead is occurring.
Designated Substance	As defined in Ontario Regulation 490/09 under the Ontario Occupational Health and Safety Act.
Dust Suppression	Measures taken to reduce the release of dust during work.
Fit-test	A qualitative or quantitative method to evaluate the efficiency of a specific make, model and size of respirator on an individual.
HEPA Filter	High Efficiency Particulate Air filter capable of capturing and retaining particles greater than or equal to 0.3 micrometers in diameter, at a minimum efficiency of 99.97%.
Lead	A malleable metal that can cause acute and chronic health effects in humans. Lead is an additive and contaminant in many frequently used building materials.
Lead-Containing Material (LCM)	Building materials comprising of lead or which contain lead. Examples are provided in Section 3.2.
Low-level lead paints and surface coatings	Paint or surface coating containing less than or equal to 0.1% lead by dry weight (1000 µg/g, mg/kg, ppm).
Lead-containing paints and surface coatings	Paint or surface coating containing greater than 0.1% lead by dry weight, (1000 µg/g, mg/kg, ppm) and less than 0.5% lead by dry weight (5000 µg/g, mg/kg, ppm).
Lead-Based Paints and Surface Coatings	Paint or surface coating containing equal to or greater than 0.5% lead by dry weight (5000 µg/g, mg/kg, ppm).
MSDS	Material Safety Data Sheet, required by Workplace Hazardous Materials Information System (WHMIS) legislation, and giving information on hazardous materials, including properties, hazards, first-aid, emergency response, and personal protection.
NIOSH	National Institute for Occupational Safety and Health
Polyethylene Sheeting	Plastic sheeting installed with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required, to provide a continuous membrane to protect underlying surfaces from damage and to prevent escape of airborne contamination into occupied areas.
Respirator	An apparatus worn over the mouth and nose or the entire face to prevent the inhalation of dust, mist, fume, vapours or other noxious substances.
Wetting Agent	A chemical substance, also called surfactant, that increases the spreading and penetrating properties of a liquid by lowering its surface tension. 235 millilitres (1 cup) of detergent to 20 litres of water.

EACO
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