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LEAD MANAGEMENT IN OWNED AND SUPPORTED INFRASTRUCTURE

WHAT IS LEAD

Lead is a soft, bluish-grey metal that occurs naturally in the Earth's crust. It has a relatively low melting point, is readily malleable and exhibits strong resistance to corrosion. Lead is commonly found in association with other metals such as zinc, silver, and copper, with galena (lead sulfide) being the primary ore mineral. Due to its ability to be repeatedly melted and reprocessed without significant loss of properties, lead is among the most extensively recycled metals globally.

The predominant contemporary application of lead is in the manufacture of lead-acid batteries, which are widely used in automotive and industrial applications. A typical automotive battery contains approximately 10 kilograms of lead, and it is estimated that roughly 75% of global lead consumption is dedicated to battery production.

Lead continues to be used in the protection of telecommunications infrastructure, including underground and submarine cable systems. Certain lead compounds are used as pigments in coatings and paints, with lead oxides historically applied as primers for steel and iron substrates. Lead-based stabilizers have also been used in polyvinyl chloride (PVC) production, and lead-containing materials are employed in decorative glass manufacturing.

Owing to its corrosion resistance, lead is used in roofing applications, while its high density makes it effective for radiation shielding in medical, industrial, and electronic equipment. Lead alloys such as lead-antimony are used in specialized components, including pumps and valves, particularly in battery and chemical processing industries. Lead-tin solder is also used for joining metal components in select applications.

LEAD EXPOSURE AND HEALTH EFFECTS

Lead is a well-established toxicant with no known physiological benefit to the human body. Health effects are primarily associated with its accumulation in biological tissues following inhalation or ingestion of lead-containing dust, fumes, or contaminated materials.

The severity of effects is dependent on the level, duration, and frequency of exposure, as well as individual susceptibility.

At lower exposure levels, lead interferes with multiple enzymatic and cellular processes, with the most sensitive target systems being the nervous system and hematopoietic (blood-forming) system. Neurological effects may include reduced cognitive performance, impaired memory, decreased attention span, and behavioral changes. In adults, chronic exposure has been associated with peripheral neuropathy, fatigue, irritability, and reduced nerve conduction velocity.

Lead exposure also disrupts hemoglobin synthesis, potentially resulting in anemia. Additional systemic effects may include hypertension, renal impairment, and reproductive toxicity. In pregnant individuals, lead readily crosses the placental barrier and may adversely affect fetal development, contributing to low birth weight and neurodevelopmental deficits.

At higher exposure levels, acute toxicity may present with abdominal pain, gastrointestinal distress, encephalopathy, and in severe cases, seizures or coma. Children are particularly vulnerable to lead exposure due to increased absorption rates and the sensitivity of the developing nervous system, with even low-level exposure associated with long-term cognitive and behavioral impacts.

Lead is a cumulative toxicant; once absorbed, it is distributed to soft tissues and ultimately sequestered in bone, where it can remain for decades and serve as an endogenous source of ongoing exposure.

REGULATORY GUIDELINE EXPOSURE LIMIT

In Canada, occupational exposure to airborne lead is governed at the provincial and territorial level under occupational health and safety legislation, as there is no single federal exposure limit applicable nationwide. Regulatory limits are expressed as occupational exposure limits (OELs) and are intended to control airborne lead concentrations in workplace environments to protect worker health.

In Alberta, occupational exposure is regulated under the Alberta Occupational Health and Safety Code, which adopts exposure limits for hazardous substances, including lead, as occupational exposure limits for airborne contaminants in workplace air. These limits are based on an 8-hour time-weighted average (TWA) exposure and are applied to general workplace conditions where lead dust, fumes, or particulates may be present.

Across Canada, most jurisdictions align closely with internationally recognized guidance values for lead exposure, commonly based on the threshold limit values (TLVs) established by organizations such as the American Conference of Governmental Industrial Hygienists (ACGIH). For lead, exposure control programs are typically required when airborne concentrations approach or exceed applicable OELs, and many jurisdictions also include biological exposure monitoring requirements (e.g., blood lead level surveillance) as part of regulatory compliance.

In addition to occupational limits, public health guidance in Canada emphasizes that there is no known safe level of lead exposure for the general population. Health-based guidance focuses on minimizing exposure to the lowest achievable levels, particularly for vulnerable populations such as children and pregnant individuals.

In summary, regulatory compliance in Alberta and across Canada is based on controlling workplace exposure to lead through adherence to occupational exposure limits, implementation of exposure control programs, and, where required, biological monitoring to ensure exposures remain as low as reasonably achievable.

SOURCES AND BUILDING MATERIALS CONTAINING LEAD

Lead in buildings is most commonly associated with legacy construction materials and systems, particularly in older structures where lead-containing products were historically used.

- ***Lead-based coatings and paints***: Frequently present in buildings constructed prior to the restriction of lead in architectural coatings. Deterioration, renovation, or surface disturbance can generate lead-containing dust and debris.
- ***Plumbing systems and solder joints***: Lead may be present in service lines, fittings, solder, and associated plumbing components, particularly in older potable water distribution systems.
- ***Dust and soil pathways***: Lead contamination may be present in settled dust and surrounding soils, often resulting from the degradation of lead-based paints, historical industrial emissions, or exterior building deterioration (i.e. wildfires).
- ***Legacy and industrial building components***: Certain older or industrial facilities may contain lead in specialized applications, including corrosion-resistant coatings, roofing materials, glazing compounds, and other historical building assemblies.

LEAD MANAGEMENT PROGRAM

The Lead Management Program establishes a comprehensive, risk-based framework for the identification, assessment, control, and ongoing management of lead-containing materials within built environments. The program is designed to protect occupant and worker health by minimizing exposure to lead through standardized procedures for inspection, characterization, risk evaluation, and implementation of appropriate control measures. It applies to facilities where lead may be present in building materials, systems, or legacy infrastructure, particularly in older structures.

The program defines clear roles and responsibilities for facility owners, managers, contractors, and workers, and establishes requirements for safe work practices during maintenance, renovation, repair, and demolition activities that may disturb lead-containing materials.

It incorporates applicable occupational health and safety legislation, exposure limits, and public health guidance to support regulatory compliance and alignment with best practices.

In addition, the program includes requirements for hazard communication, worker training and competency development, exposure monitoring and medical surveillance where applicable, and standardized documentation and record-keeping protocols.

Collectively, these elements ensure consistent implementation across facilities and support a proactive approach to risk reduction, regulatory compliance, and continuous improvement in lead hazard management.

WHO SHOULD INVESTIGATE

Multiple stakeholders may be involved in the identification, assessment, and resolution of lead related concerns, including building owners, property managers, maintenance personnel, and building occupants.

Lead assessments and sampling activities shall be conducted by qualified personnel with demonstrated experience in inspecting and testing lead-containing materials.

Individuals responsible for measurements, analytical interpretation, and evaluation of findings shall possess a thorough understanding of applicable methodologies, sampling protocols, and building science principles relevant to lead assessments.

Occupational hygiene professionals engaged in hazardous building materials assessments shall possess the appropriate education, training, experience, and competencies required to perform their duties. At a minimum, personnel shall meet the competency requirements outlined in the following Alberta Occupational Health and Safety publications:

- Occupational Hygiene Reports: Requirements and Tips (GS019); and
- Occupational Hygiene Competency: Frequently Asked Questions (GS020).

For Alberta Infrastructure Owned and Supported facilities, additional project-specific requirements related to sample collection, interpretation of analytical results, evaluation of findings and technical report sign-off may be required to ensure the quality and completeness of assessment deliverables and support Alberta Infrastructure compliance with applicable Occupational Health and Safety legislation.

APPLIED ECOSCIENCES UNIT

Typical Support Services

Historically, Alberta Infrastructure has followed an "opportunistic removal" approach to the management of lead-containing materials. Under this approach, lead-containing materials that are in good condition and do not present an immediate exposure risk may remain in place, provided they are not disturbed and their condition is periodically assessed and documented.

Where renovation, repair, or demolition activities are planned that may disturb lead-containing materials, consideration should be given to their removal as part of the project scope.

Any proposed lead abatement or management activities should be reviewed in consultation with the Applied Ecosciences Unit to ensure appropriate risk management measures and regulatory requirements are addressed.

The Applied Ecosciences Unit provides technical expertise and support related to the assessment and management of lead-containing materials, including but not limited to:

- Hazardous building materials surveys and inventories;
- Preparation of technical specifications, scopes of work, and contract documents;
- Development and delivery of lead management workshops and technical training;
- Lead hazard awareness and educational presentations; and
- Technical guidance and support for the development and implementation of lead management plans.

These services support the proactive management of lead and helps maintain a safe and healthy environment as well as support building operations and integrity of Government facilities while maintaining compliance with applicable regulatory requirements and industry best practices.

CONTACT INFORMATION

Technical Services Branch

The above services may be provided by Alberta Infrastructure and/or a private occupational hygiene consultant.

Where the engagement of an external consultant is identified as the preferred delivery model, the Applied Ecosciences Unit can provide technical support in the development of the project scope, preparation of detailed terms of reference, and oversight support throughout project implementation and construction activities.

Additionally, our Unit offers a comprehensive range of applied indoor air quality and occupational hygiene advisory services to support project planning, regulatory compliance, assessment, and operational execution.

For information or assistance, contact the Manager of Applied Ecosciences Unit at 780-422-7472.