Construction Sector
Occupational Exposure Summary Package

This package serves as a summary of CAREX Canada’s results on priority exposures to known or suspected carcinogens in the construction sector in Canada. Assembling various CAREX Canada data, tools, and resources, it provides an overview of the most prevalent exposures for those working in the sector, including solar radiation, crystalline silica, wood dust, asbestos, and diesel engine exhaust. Our aim is to provide a useful guide for those looking to better understand – and help reduce or eliminate – common carcinogenic exposures associated with the construction sector.

Construction sector in Canada

In 2006, the construction sector employed 1.1 million workers, many of those located in Ontario (36%) and Quebec (19%). According to the Canadian Construction Association, the construction sector is responsible for nearly $90 billion in economic activity or 7 percent of Canada’s overall gross domestic product every year.

The sector is comprised of establishments that construct, repair, and renovate buildings and engineering works, and subdivide and develop land. Excluded from this sector are establishments that: manufacture and install building equipment and pre-fabricated buildings; operate highways, streets, and bridges; provide project management services as a primary activity; maintain the rights of way for power, communication, and pipelines; and clean building exteriors after construction.

Estimates of prevalent exposures

CAREX Canada estimates of the number of workers exposed to carcinogens in the construction sector are summarized in Figure 1. They include solar radiation, crystalline silica, wood dust, asbestos, and diesel engine exhaust. Exposure level estimates, where available, are summarized in the Carcinogen Profiles below.

Figure 1: Top 10 prevalent carcinogen exposures for the construction sector, CAREX Canada Database, 2006

We classify carcinogens based on evaluations made by the International Agency for Research on Cancer (IARC). Most of the agents listed in Figure 1 are classified as known carcinogens (IARC 1), where there is sufficient evidence linking the agent with cancer in humans.
Exploring the CAREX Canada estimates

Our eWORK Tool allows users to explore CAREX exposure data by carcinogen, sector, occupation, province, sex, and exposure level. We offer two versions of the eWORK Tool: eWORK Excel and eWORK Online. eWORK Excel uses a Microsoft Excel PowerPivot interface that allows users to search for – and visualize – exposures of interest. eWORK Online is for users who prefer quick, accessible, yet high-quality statistics on occupational exposures to various carcinogens.

eWORK Excel and eWORK Online are available under the Tools tab of our website.

Carcinogen profiles

The CAREX Canada website contains detailed information on use, production and trade, exposure routes, and health effects for the top ten carcinogen exposures for the construction sector listed above. A sample of these are summarized below.

More information, including regulations and guidelines for each agent, methods for calculating exposure level estimates, and a list of references, is available under the Profiles and Estimates tab of our website.

Solar Radiation
Known Carcinogen (IARC 1)

What is solar radiation?
The sun, or solar radiation, is the main natural source of exposure to ultraviolet radiation. Ultraviolet radiation is a type of non-ionizing radiation. While ultraviolet radiation is produced by a variety of natural and artificial sources, CAREX exposure estimates for solar radiation only look at exposures from the sun.

Occupational exposure to solar radiation
Exposure to solar radiation can occur via skin or eyes. Levels of exposure vary depending on conditions related to geography, seasonality, time of day and meteorology, as well as time spent out of doors and the amount of exposed skin surface. All outdoor occupations have a potential for exposure to solar radiation. The occupations with the largest number of exposed workers in the construction sector include construction trades helpers and labourers, carpenters, and heavy equipment operators.

What are its health effects?
Cancer:
Solar radiation is the most important cause of skin cancer and the most common cancer worldwide. Additional studies identify associations between solar radiation and melanoma of the eye and non-Hodgkin lymphoma.
### What is silica?

Silica is **one of the most common minerals on earth** and is a basic component of soil, sand, and rocks including granite and quartzite. It exists in both crystalline and amorphous (non-crystalline) forms, and can convert from amorphous to crystalline forms at high heat. Quartz is the most common form of crystalline silica and the most commonly used industrially. Quebec, Ontario, and Alberta are the primary silica producers in Canada, followed by Saskatchewan, British Columbia, and Nova Scotia.

### What are the main uses of silica?

Crystalline silica is used in foundry castings, abrasives and sandblasting materials, hydraulic fracturing, silicon and ferrosilicon metal production, and as a filter for large volumes of water (i.e. in municipal water and sewage treatment plants). Very fine grades of crystalline silica called flours are used in the ceramic and pottery sector, in manufacturing chrysotile cement, as filler in rubber and paints, and as an abrasive in soaps and cleaners.

### Occupational exposure to silica

Health concerns arise when silica-containing products are disturbed by grinding, cutting, drilling or chipping, which creates respirable particles. Inhalation is therefore the most important route of occupational exposure. Occupations with the largest number of exposed workers in the construction sector include **construction trades helpers and labourers; plasterers, drywall installers and finishers, and lathers; and heavy equipment operators**.

### What are its health effects?

**Cancer:**

Epidemiological studies show a relationship between occupational exposure to crystalline silica and increased risk of lung cancer, with the strongest link in quarry and granite work and ceramic, pottery, refractory brick and diatomaceous earth industries.

**Non-cancer:**

Silicosis, a non-reversible fibrotic lung disease, is caused by inhaling crystalline silica particles. Occupational silica exposure is also linked to pulmonary tuberculosis, chronic obstructive pulmonary disease (COPD), and autoimmune disease (rheumatoid arthritis).
Wood Dust
Known Carcinogen (IARC 1)

What is wood dust?
Wood dust and other by-products, including wood chips, sawdust, and shavings are produced in the process of converting logs into finished wood products. Wood dust is composed of cellulose, polyoses, and lignin compounds. A variety of compounds may also be present depending on the tree species, including alcohols, terpenes, sterols, glycerols, tannins, and proteins. Some by-products have end-uses in particleboard as fuel, or in composting, but no specific use exists for fine particulate wood dust.

Occupational exposure to wood dust
Inhalation is the most important route of occupational exposure, although dermal exposures are important for skin-related health outcomes such as dermatitis. Occupations with the largest number of exposed workers in the construction sector include carpenters, construction trades helpers and labourers, and carpentry trades contractors and supervisors.

What are its health effects?
Cancer:
Exposure to wood dust has a clear relationship with cancers of the nose and throat region, including the nasal cavities, paranasal sinuses, and nasopharyngeal region.

Non-cancer:
Other adverse health effects of short-term wood dust exposure include irritated eyes, nose and throat. Decreased lung function, increased respiratory symptoms, asthma, and allergic reactions are also associated with exposure. Skin contact can cause allergic and/or irritant dermatitis.

Asbestos
Known Carcinogen (IARC 1)

What is asbestos?
Asbestos is a general term for a group of naturally occurring, fibrous silicate minerals. There are two main classes of asbestos: serpentine and amphibole. The only serpentine variety, chrysotile is the most abundant form and is the most common asbestos fibre used commercially. The five amphibole varieties include amosite, crocidolite, actinolite, tremolite, and anthophyllite.

What are the main uses of asbestos?
The manufacturing and use of asbestos-containing products is banned or severely restricted in most western countries. including Canada. Asbestos has historically been useful for many commercial applications because of its heat resistance, tensile strength, insulating and friction characteristics, as well as its ability to be woven. It is found primarily in roofing, thermal and electrical insulation, cement pipe and sheets, flooring, gaskets, friction materials, coatings, plastics, textiles, paper, and other products.

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**DIESEL ENGINE EXHAUST**

**Known Carcinogen (IARC 1)**

The combustion of diesel fuel in engines produces diesel engine exhaust, a complex mixture of gases and particulates that can contain other known and suspected carcinogens such as benzene, polycyclic aromatic hydrocarbons (PAHs), metals, and particulate matter. The composition of the mixture depends on a number of factors including the type of engine (heavy or light duty), the type of fuel and oil, sulphur levels, speed and load of operation, and emission control systems.

**Occupational exposure to diesel engine exhaust**

Inhalation is the most common route of exposure. Assessing exposures to diesel engine exhaust is complex because it is difficult to separate diesel exhaust from other air contaminants with similar characteristics. There is also controversy in the best practices for measuring exposure.

Occupations with the largest number of exposed workers in the construction sector include heavy equipment operators, truck drivers, and construction trades helpers and labourers.

**What are its health effects?**

**Cancer:**

As there is sufficient evidence linking diesel engine exhaust to lung cancer, and limited evidence for bladder cancer in humans.

**Non-cancer:**

Short-term exposure to diesel engine exhaust can irritate the eyes, throat, and bronchi, and cause light-headedness, nausea, and respiratory symptoms such as cough and phlegm. Diesel exhaust may initiate allergic reactions or increase immunological response to other allergens.

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**ASBESTOS continued**

**Occupational exposure to asbestos**

Inhalation is the most common route of occupational exposure. Asbestos fibers vary in length, diameter, and chemical composition, which impacts their ability to enter the body and influences the body’s ability to clear them. Of those exposed to asbestos in Canada, the construction sector has the largest group of exposed workers. Occupations with the largest number of exposed workers include carpenters, construction trades helpers and labourers, and electricians.

**What are its health effects?**

**Cancer:**

Asbestos has well-established links to mesothelioma, a cancer of the protective lining that covers many of the internal organs of the body, and to lung cancer. A strong synergistic effect exists between tobacco use and asbestos exposure, further increasing the risk of lung cancer. There is also sufficient evidence in humans for laryngeal and ovarian cancer.

**Non-cancer:**

Asbestosis, a disease characterized by scar tissue in the lungs and in the pleural membrane, is caused by exposure to high concentrations of asbestos. Symptoms include difficulty breathing, coughing, and in severe cases, heart enlargement, disability, and death.

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**Construction Industry Carcinogenic Exposures**

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Exposure reduction strategies

As outlined by the **Canadian Centre for Occupational Health and Safety** (CCOHS), a variety of strategies can help protect workers from exposures to harmful substances such as carcinogens. These strategies are listed in order of effectiveness in controlling a risk.

- **Elimination** is the most effective way to control a risk; it involves removing the hazard from the workplace. This process may also involve substitution.
  - An example of substitution is using lead-free paints and glazes instead of those that contain lead.

- **Engineering controls** minimize risk of exposure through strategic designs or modifications, which include process controls, enclosure/isolation of the source, and ventilation.
  - An example of a process control is using wet methods instead of dry when grinding or drilling to reduce dust.

- **Administrative controls** alter the way the work is done through rules or policies.
  - An example of an administrative control is shorter work times in areas where exposure may occur.

- **Personal protective equipment (PPE)** provides a barrier between the worker and the hazard.
  - Examples of PPE include respirators, eye protection, face shields, gloves, and footwear.

For more information on these strategies and which one is appropriate for a situation, please visit the hazard control page of the CCOHS website.

A compilation of exposure reduction resources, including the Canadian Partnership Against Cancer's Prevention Policies Directory and the Canadian Cancer Society's Cancer Information portal, is available on our website.

### Data sources

Data used in developing the occupational estimates for crystalline silica, wood dust, and asbestos were collected from several sources, including the **Canadian Workplace Exposure Database** (CWED), which contains approximately 7,600 measurements for crystalline silica exposure, 9,600 measurements for wood dust exposure, and 6,700 measurements for asbestos exposure. These measurements were collected between 1981 and 2004 in Ontario and British Columbia workplaces.

Data for occupational exposures to diesel engine exhaust, crystalline silica, wood dust, and asbestos was also collected from scientific peer reviewed publications that addressed exposure in Canada and the United States, as well as technical reports from governments and international bodies.

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The main methods used by CAREX Canada to identify occupational exposure levels and prevalence estimates involved:

1. **Published studies**
2. **Government & other reports**
3. **Proportion of workers exposed from US & EU studies**
4. **Canadian Workplace Exposure Database**

The interpretation and calculation process involves:

- **Proportion of workers exposed in Canada**
- **Occupational Hygienists Assessment**
- **Census Data**
  - # of people by job/industry
  - # of workers exposed by industry, job, sex

The exposure level estimate is influenced by:

- **Exposure data from Canadian Workplace Exposure Database**
- **Occupational exposure limits**

Potential data sources include:

- **Scientific and grey literature**
- **Provincial, federal, and international data sets**
- **CAREX Canada occupational results**

**Strengths and limitations**

One of the key strengths is the **transparent, systematic, and scientifically rigorous methods** used to develop prevalence and exposure estimates. However, a significant challenge is the general lack of current occupational exposure data, particularly from regulatory agencies across Canada. Variations in data retention and accessibility, as well as reduced access to non-electronic data, limit the available information. This can affect estimates, especially for substances whose use has changed since the 1990s. Another limitation is the lack of detailed information about specific work environments, making it difficult to determine appropriate exposure proportions for some occupations and industries. These instances are noted in the documentation.
Where can you learn more?

Visit our website at www.carexcanada.ca
Follow us on Twitter @CAREXCanada
Email us at info@carexcanada.ca

Relevant publications and reports

IARC Monographs Volume 105: Diesel and Gasoline Engine Exhausts and Some Nitroarenes

IARC Monographs Volume 100C: A Review of Human Carcinogens: Arsenic, Metals, Fibres, and Dusts

IARC Monograph Volume 100D: A Review of Human Carcinogens: Radiation

Prevalence of exposure to solar ultraviolet radiation (UVR) on the job in Canada

Exposure-response estimates for diesel engine exhaust and lung cancer mortality based on data from three occupational cohorts

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