



CAREX
CANADA

Exposure surveillance of environmental and occupational carcinogens for cancer prevention

Occupational Exposure Summary

Welders

This report serves as a summary of CAREX Canada's results on priority exposures to known or suspected carcinogens that welders and related machine operators in Canada are exposed to at work. Assembling various CAREX Canada data, tools, and resources, it provides an overview of the most prevalent exposures for those working in the sector, including welding fumes, artificial ultraviolet radiation, lead, nickel, and hexavalent chromium. Our aim is to provide a useful guide for those looking to better understand – and help reduce or eliminate – common carcinogenic exposures associated with welding and related machine operating.

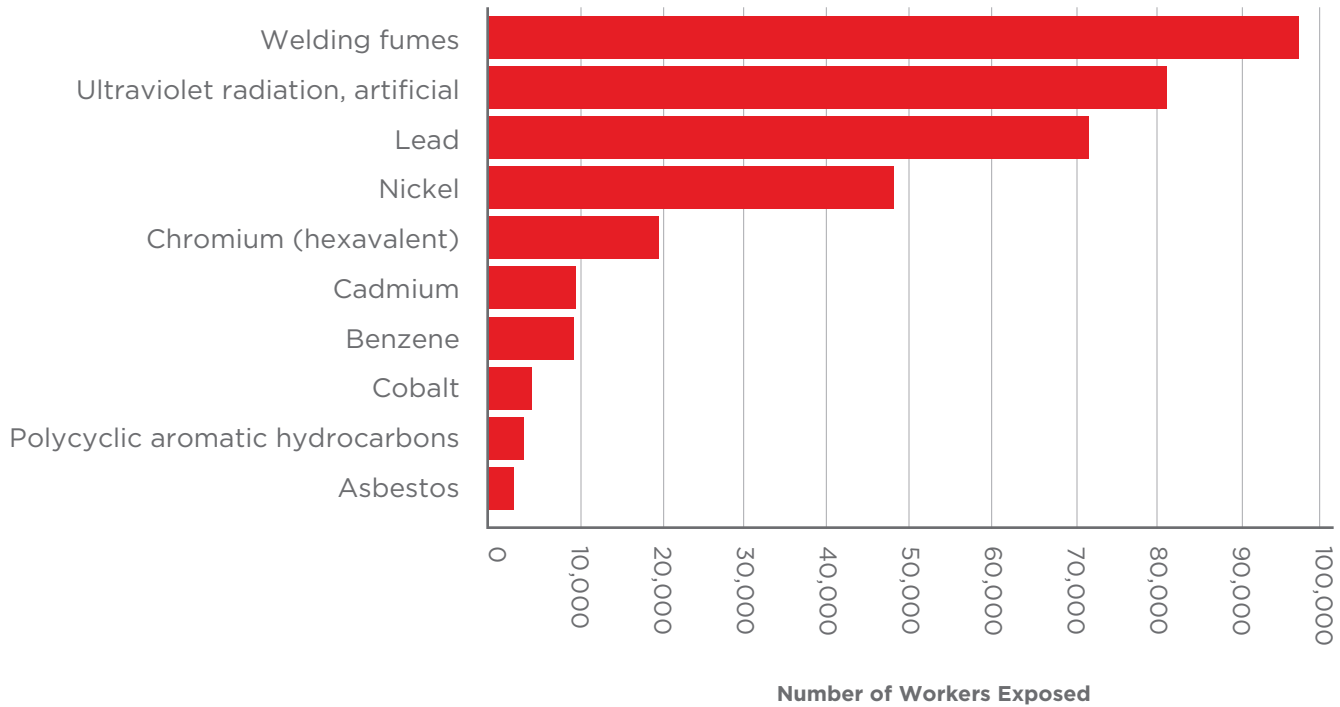
Welders in Canada

There are 97,000 welders in Canada, according to the 2016 Canadian census. Welders are workers operating welding equipment to weld or join together ferrous and non-ferrous metals. Those who operate production welding, brazing, and soldering equipment are also included in this classification. Although other occupations, such as contractors in metal forming, mechanics, machinists, plumbers, pipefitters, and other metal workers, may also weld as part of their job, they are not included within this classification. Welders and related machine operators will be referred to simply as welders for the remainder of this report, unless otherwise stated.

Estimates of prevalent exposures


CAREX Canada estimates of the number of welders exposed to carcinogens at work are summarized in Figure 1. They include welding fumes, artificial ultraviolet radiation, lead, nickel, and hexavalent chromium. These exposures are most likely to occur in the repair and maintenance, fabricated metal product manufacturing, and machinery manufacturing sectors. Exposure level estimates, where available, are summarized in the Carcinogen Profiles below.

Figure 1. Top 10 prevalent carcinogen exposures for welders, CAREX Canada, 2016



Note: High prevalence does not necessarily indicate a high cancer risk. For more information or assistance interpreting the data in this table, please contact us at info@carexcanada.ca.

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.

 More information, including detailed carcinogen information, exposure estimates, methods, and references, is available under the Carcinogen Profiles 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 welders listed above. A sample of these are summarized below.

Welding Fumes

KNOWN CARCINOGEN
(IARC 1)



What are welding fumes?

Welding is a process that uses heat generated by electricity (e.g. arc welding) or fuel gases (e.g. oxyfuel welding) to fuse metal materials. **As the metals are heated, they produce welding fumes**, which are a complex mixture of fine particles and gases.

What are its health effects?

Cancer: Exposure to welding fumes is associated with **lung cancer**.

Non-cancer: Short-term exposure to welding fumes can cause nausea, dizziness, eye, nose, and throat irritation. Long-term exposure can cause metal fume fever, stomach ulcers, asthma, and damage to the lungs, kidney, and nervous system.

Occupational exposure to welding fumes

The primary route of exposure to welding fumes is inhalation. The magnitude of exposure to welding fumes is influenced by many factors, including the type of welding process, the composition and type of welding materials, the setting in which welding is performed, and the hazard control in place (e.g. ventilation type, work practices). **All 97,000 welders in Canada may be exposed to welding fumes.**

Welders exposed to welding fumes by exposure level



Artificial Ultraviolet Radiation

KNOWN CARCINOGEN (IARC 1)



What is ultraviolet radiation?

Ultraviolet radiation (UVR) is a **type of radiation that is emitted by artificial sources**, including welding arcs and UV lasers. It is found between visible light and x-rays on the electromagnetic spectrum.

What are the main sources of artificial ultraviolet radiation in welding?

Electric welding arcs can produce significant levels of UVR within a radius of several metres; gas welding and cutting torches do not produce high levels of UVR.

What are its health effects?

Cancer: Artificial UVR exposure is associated with **skin and ocular melanoma**. There is sufficient evidence for ocular melanoma in welders.

Non-cancer: Exposure to UVR may result in short term skin damage such as burning, fragility, and scarring. Welders are at risk of “arc flash”, an injury to the surface and mucous membrane (conjunctiva) of the eye.

Occupational exposure to artificial ultraviolet radiation

Occupational exposure to artificial UVR occurs via skin and eye exposure. Approximately 82,000 welders are exposed to artificial UVR at work. **Welders are the largest occupational group exposed to artificial UVR.**

Welders exposed to artificial ultraviolet radiation by exposure level



Lead

MULTIPLE CLASSIFICATIONS IARC 2A (PROBABLE CARCINOGEN), IARC 2B (POSSIBLE CARCINOGEN)



What is lead?

Elemental lead is a **soft, highly malleable and ductile metal** that is insoluble in water. Lead forms both inorganic and organic compounds with many substances, including acetate, arsenic, antimony, chlorine, oxygen, and phosphate.

What are the main sources of lead in welding occupations?

The main source of lead exposure in welders is **solder, brass, and bronze alloys, and primer or coating on steels**, according to the Canadian Centre for Occupational Health and Safety (CCOHS). Lead oxide, or red lead, is the primary paint primer for iron and steel.

What are its health effects?

Cancer: IARC has classified inorganic lead compounds as probably carcinogenic to humans and elemental lead as possibly carcinogenic to humans, while organic lead compounds were not classifiable. Increases in cancer of the **lung, stomach, kidney, brain, and nervous system** have been observed in humans following exposure to inorganic lead compounds.

Non-cancer: Fetal and childhood lead exposure can cause a variety of health effects, including anemia, learning disorders, and behavioural problems. Adult exposure to lead can also result in adverse effects on the neurological, cardiovascular, and hematological (blood) systems. Reproductive effects, including miscarriage and pre-term delivery in women, and decreased fertility in men are also associated with moderately high levels of lead exposure.

Occupational exposure to lead

Inhalation via welding fumes is the most important route of occupational lead exposure for welders, followed by ingestion. **Approximately 72,000 welders are exposed to lead at work**, and are the largest occupational group exposed to lead in Canada, followed by police officers.

Welders exposed to lead by exposure level





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 Online and eWORK Excel. eWORK Online is for users who prefer quick, accessible, yet high-quality statistics on occupational exposures to various carcinogens. eWORK Excel uses a Microsoft Excel PowerPivot interface that allows users to search for – and visualize – exposures of interest.

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

Reducing exposures

CAREX Canada’s resources and estimates can be used to inform programs, policies, and practices related to carcinogen exposures. Identifying the priority exposure scenarios and substances for exposure reduction can help guide agenda- and priority-setting for cancer prevention.

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.*

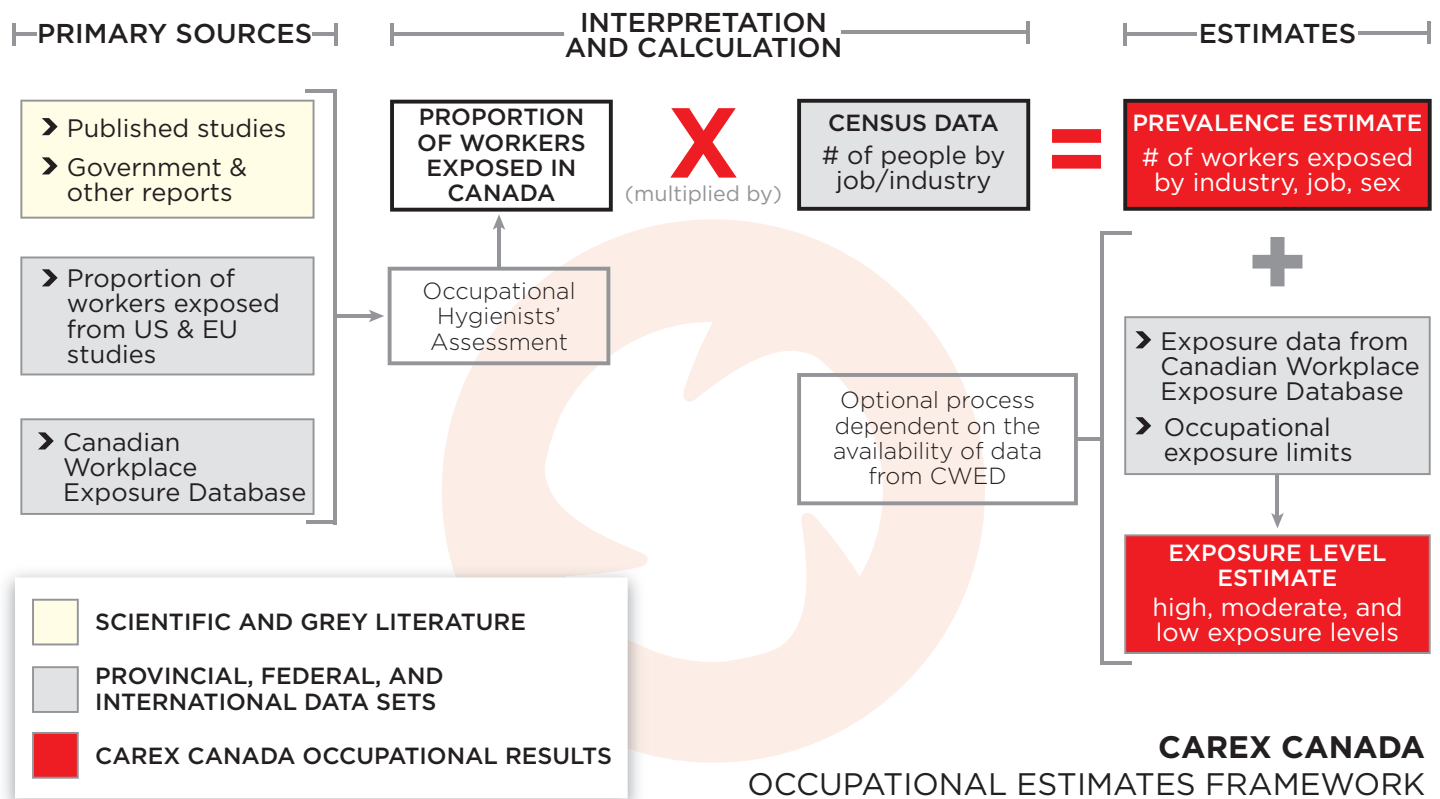
 A compilation of additional exposure reduction resources, including the Canadian Partnership Against Cancer’s Prevention Policies Directory and the Canadian Cancer Society’s Cancer Information portal, is available on our website.

Methods

The goal of the CAREX Canada project is to estimate Canadians' potential exposures to known and suspected carcinogens in the workplace, prioritizing agents that are most relevant to Canadians. Estimates of the numbers of workers exposed to these agents are calculated by sector, occupation, province, sex, and level of exposure (where data are available). They are developed using information gathered in a scientific literature review, data included in the Canadian Workplace Exposure Database (CWED), information from previous CAREX projects in Europe, Canadian-specific information on exposure from government and other sources, and CAREX occupational hygienists' expert assessment. Most of our estimates use the 2016 Census of Population, with some exceptions noted in our documentation. CAREX Canada's general approach to producing occupational prevalence and exposure level estimates is summarized in Figure 2.

 More information on our methods and data is available under the Carcinogen Profiles tab on our website

Figure 2. CAREX Canada's occupational estimates framework



Relevant publications and reports

IARC Monographs Volume 100C: A Review of Human Carcinogens: Arsenic, Metals, Fibres, and Dusts | International Agency for Research on Cancer, 2012.




IARC Monograph Volume 100D: A Review of Human Carcinogens: Radiation | International Agency for Research on Cancer, 2012.

IARC Monographs Volume 87: Inorganic and Organic Lead Compounds | International Agency for Research on Cancer, 2006.

CAREX Canada is hosted at Simon Fraser University and is funded by the Canadian Partnership Against Cancer



Where can you learn more?

-  Visit our website at www.carexcanada.ca
-  Follow us on Twitter [@CAREXCanada](https://twitter.com/CAREXCanada)
-  Email us at info@carexcanada.ca

