Asbestos is a group of naturally occurring, fibrous silicate minerals. The manufacturing and use of asbestos-containing products is severely restricted in most western countries, including Canada, and in some countries it is banned. Asbestos has historically been useful for many commercial applications because of its heat resistance, tensile strength, and insulating and friction characteristics. It is found primarily in roofing, thermal and electrical insulation, cement pipe and sheets, flooring, gaskets, friction materials, coatings, plastics, textiles, and other products. The International Agency for Research on Cancer classifies asbestos as a known carcinogen (IARC 1).

### WHAT ARE ITS HEALTH EFFECTS?

- Mesothelioma (a cancer of the protective lining of many internal organs)
- Lung, laryngeal, and ovarian cancer
- Asbestosis (scar tissue in the lungs)

### THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO ASBESTOS IN CANADA

The term ‘burden’ refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

Results show that approximately 1900 lung cancers and 430 mesotheliomas are attributed to occupational asbestos exposure each year, based on 2011 cancer statistics. This amounts to 8% of all lung cancers and 81% of all mesotheliomas diagnosed annually (almost all of the remaining mesotheliomas are likely due to environmental asbestos exposure).

### WHAT IS THE ECONOMIC IMPACT?

Results show that work-related asbestos exposure resulted in approximately $2.35 billion in costs for newly diagnosed lung cancer and mesothelioma cases in 2011. This includes approximately:

- 65% in health-related quality of life losses
- 8% in direct costs including health care, out of pocket expenses, family care giving, and workers’ compensation administration
- 27% in indirect costs including output and productivity losses
The Burden of Occupational Cancer Study aims to quantify the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It is a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health, University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.

This fact sheet was produced by CAREX Canada in partnership with OCRC. The Burden of Occupational Cancer Study is led by OCRC and is supported by the Canadian Cancer Society. CAREX Canada is hosted at Simon Fraser University and supported by the Canadian Partnership Against Cancer. Acknowledgments for header photos: KOMUnews, Chris RubberDragon.
Diesel Engine Exhaust

Burden of Occupational Cancer Fact Sheet

WHAT IS DIESEL ENGINE EXHAUST?

The combustion of diesel fuel in engines produces diesel engine exhaust, a complex mixture of gases and particulates. This mixture 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.

The International Agency for Research on Cancer classifies diesel engine exhaust as a known carcinogen (IARC 1).

WHAT ARE ITS HEALTH EFFECTS?

- Lung cancer
- Irritation to eyes, throat, and bronchi
- Light-headedness, nausea, cough, and phlegm
- Allergic reactions

THE BURDEN OF LUNG CANCER FROM WORKPLACE EXPOSURE TO DIESEL EXHAUST IN CANADA

The term ‘burden’ refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

Results show that approximately 560 lung cancers and 200 suspected bladder cancers are attributed to occupational exposure to diesel engine exhaust each year in Canada, based on 2011 cancer statistics. This amounts to 2.4% of lung cancer cases diagnosed annually.

WHAT WORKERS ARE MOST AFFECTED?

Most occupational lung cancers associated with diesel engine exhaust occur among workers in the mining and oil and gas extraction sector (see pie chart on right). These cancers also occur among workers in the transportation and warehousing, wholesale and retail trade, and manufacturing sectors. Some of the other sectors affected include construction, forestry and logging, and public administration.

560
Lung cancers caused by workplace diesel exposure

MINING, OIL/GAS EXTRACTION (40%)
TRANSPORTATION/WAREHOUSING (23%)
WHOLESALE & RETAIL TRADE (10%)
MANUFACTURING (7%)
OTHER (20%)
Inhalation is the most common route of occupational exposure to diesel engine exhaust. Approximately 897,000 Canadians are exposed to diesel engine exhaust at work.

Industries with the largest number of exposed workers in Canada include:
- **Truck transportation** (206,000 people exposed)
- **Transit and ground passenger transportation** (110,000 exposed)
- **Public administration** (42,000 exposed)

Occupations with the largest number of exposed workers include:
- **Truck drivers** (305,000 exposed)
- **Heavy equipment operators** (83,000 exposed)
- **Transit operators** (79,000 exposed)

Results show the majority of workers exposed to diesel engine exhaust are in the low exposure level category, with a significant number at risk for moderate to high exposure (see pie chart above). To learn more about how these exposure levels are defined, visit the CAREX Canada website.

**HOW CAN EXPOSURE BE REDUCED?**

There is currently no appropriate occupational exposure limit for diesel engine exhaust, apart from a few provinces where diesel particulate matter is regulated in underground mines. However, diesel-related cancers can be prevented by reducing the number of workers exposed and ensuring that the levels of exposures are as low as reasonably achievable (ALARA). Organizations should evaluate the risk of exposure in the workplace and implement the hierarchy of controls to address the safety needs of workers.

**ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY**

The Burden of Occupational Cancer Study aims to quantify the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It is a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health, University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.

For more information, please visit OCRC at www.occupationalcancer.ca or CAREX Canada at www.carexcanada.ca.

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Crystalline Silica

WHAT IS SILICA?

Silica is a naturally occurring mineral found in soil, sand, and rocks. Work processes such as breaking, grinding, or sawing these materials releases crystalline silica dust into the air. Workplace exposure to crystalline silica is common in several trades due to its presence in many handled materials such as concrete, mortar and brick.

The International Agency for Research on Cancer classifies crystalline silica as a known carcinogen (IARC 1).

WHAT ARE ITS HEALTH EFFECTS?

- Lung cancer
- Silicosis (thickening and scarring of the lungs)
- Chronic obstructive pulmonary disease (COPD)
- Rheumatoid arthritis
- Tuberculosis

THE BURDEN OF LUNG CANCER FROM WORKPLACE EXPOSURE TO SILICA IN CANADA

The term ‘burden’ refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

Results show that approximately **570 lung cancers** are attributed to occupational exposure to crystalline silica each year in Canada, based on 2011 cancer statistics. This amounts to **2.4% of lung cancer cases** diagnosed annually.

WHAT WORKERS ARE MOST AFFECTED?

Most occupational lung cancers associated with crystalline silica occur among workers in the **construction sector** (see pie chart on right). These cancers also occur among workers in the manufacturing, mining and oil and gas extraction, and transportation and warehousing sectors. Some of the other sectors affected include wholesale trade, public administration, and utilities.
ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study aims to quantify the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It is a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health, University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.

HOW CAN EXPOSURE BE REDUCED?

Silica-related cancers can be prevented by reducing the number of workers exposed and ensuring that the levels of exposures are as low as reasonably achievable (ALARA). Organizations should evaluate the risk of exposure in the workplace and implement the hierarchy of controls to address the safety needs of workers.

CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO SILICA

Inhalation is the most important route of occupational exposure to silica. Approximately 380,000 Canadians are exposed to silica at work.

Industries with the largest number of exposed workers in Canada include:

- **Specialty trade contractors** (141,000 people exposed)
- **Building construction** (65,000 exposed)
- **Heavy and civil engineering construction** (31,000 exposed)

Occupations with the largest number of exposed workers include:

- **Construction trades helpers and labourers** (105,000 exposed)
- **Heavy equipment operators** (41,000 exposed)
- **Plasterers and drywallers** (34,000 exposed)

Results show the majority of workers exposed to crystalline silica are in the low exposure level category, with a significant number at risk for moderate to high exposure (see pie chart above). To learn more about how these exposure levels are defined, visit the CAREX Canada website.

ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study aims to quantify the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It is a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health, University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.

For more information, please visit OCRC at www.occupationalcancer.ca or CAREX Canada at www.carexcanada.ca.

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Solar Radiation
Burden of Occupational Cancer Fact Sheet

**WHAT IS SOLAR RADIATION?**

The sun, or solar radiation, is the main natural source of exposure to ultraviolet radiation. Levels of exposure vary depending on geography, seasonality, time of day and meteorology, as well as time spent out of doors and the amount of skin exposed. All outdoor occupations have a potential for exposure to solar radiation. The International Agency for Research on Cancer classifies solar radiation as a known carcinogen (IARC 1).

**WHAT ARE ITS HEALTH EFFECTS?**

- Skin cancer
- Sunburns
- Heat stress/stroke
- Thick, scaly skin patches
- Cataracts
- Eye lesions and cancer

**THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO SOLAR RADIATION IN CANADA**

The term ‘burden’ refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

Results show that approximately **4,600 non-melanoma skin cancers** are attributed to occupational solar radiation each year, based on 2011 cancer statistics. This amounts to **6.3% of non-melanoma skin cancer cases** diagnosed annually.

**WHAT WORKERS ARE MOST AFFECTED?**

Most occupational non-melanoma skin cancers associated with solar radiation occur among workers in the **agricultural** and **construction sectors** (see pie chart on right). These cancers also occur among workers in the transportation and public administration sectors. Some of the other sectors affected include forestry and logging, manufacturing, and mining and oil and gas extraction.

![Pie chart showing the distribution of skin cancers by sector]

**AGRICULTURE (28%)**

**CONSTRUCTION (23%)**

**TRANSPORTATION (9%)**

**PUBLIC ADMINISTRATION (8%)**

**OTHER (32%)**
ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study aims to quantify the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It is a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health, University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.

For more information, please visit OCRC at www.occupationalcancer.ca or CAREX Canada at www.carexcanada.ca.

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Welding and Welding Fumes
Burden of Occupational Cancer Fact Sheet

WHAT ARE WELDING AND WELDING FUMES?

Welding is the process of joining materials, usually metals or thermoplastics. Workers who operate production welding, brazing, and soldering equipment are also included in this classification. Welding fumes are a mixture of very fine particles of metallic oxides, silicates, and fluorides that come from both the electrode (welding rod) and the material being welded. This mixture can also contain known and suspected carcinogens such as nickel, chromium VI, cadmium, polycyclic aromatic hydrocarbons (PAHs), benzene, and particulate matter. Significant levels of ultraviolet (UV) radiation are also produced during electric arc welding operations. The International Agency for Research on Cancer classifies welding fumes and UV radiation from welding as known carcinogens (IARC 1).

WHAT ARE ITS HEALTH EFFECTS?

- Lung cancer (welding fumes)
- Chronic bronchitis
- Metal fume fever
- Occular melanoma (UV radiation from welding)
- Irritation to eyes, nose, throat, and bronchi
- Allergies and other respiratory problems

THE BURDEN OF CANCERS FROM WORKPLACE EXPOSURE TO WELDING AND WELDING FUMES

The term ‘burden’ refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

Results show that approximately 310 lung cancers and 15 ocular melanomas are attributed respectively to occupational exposure to welding fumes and welding each year in Canada, based on 2011 cancer statistics. This amounts to 1.3% of lung cancer cases and 5.4% of ocular melanomas diagnosed annually.

WHAT WORKERS ARE MOST AFFECTED?

Most occupational lung cancers associated with welding fumes occur among workers in the manufacturing sector (see pie chart on right). These cancers also occur among workers in the trade, other services, and construction sectors. Some of the other sectors affected include mining and oil and gas extraction, and transportation and warehousing.
Inhalation is the most important route of occupational exposure to welding fumes. According to the 2011 Canadian census, there were approximately 89,200 welders and related machine operators in Canada. Industries with the largest number of welders in Canada include:

- **Fabricated Metal Product Manufacturing (16,500 welders)**
- **Repair and Maintenance (16,200 welders)**
- **Machinery Manufacturing (10,000 welders)**

Other occupations that involve occasional welding operations are those of sheet metal workers, boilermakers, structural metal and platework fabricators and fitters, and iron workers.

To learn more about the carcinogens associated with welding operations, visit the [CAREX Canada website](www.carexcanada.ca).

The present occupational exposure limit for welding fumes does not take into account their carcinogenic effect and there are currently no occupational exposure limits for UV radiation emitted during welding. However, cancers related to welding fumes can be prevented by reducing the number of workers exposed and ensuring that the levels of exposure are as low as reasonably achievable (ALARA). Organizations should evaluate the risk of exposure in the workplace and implement the hierarchy of controls to address the safety needs of workers.

This fact sheet was produced by the IRSST in partnership with CAREX Canada and OCRC. The Burden of Occupational Cancer Study is led by OCRC and is supported by the Canadian Cancer Society. CAREX Canada is hosted at Simon Fraser University and supported by the Canadian Partnership Against Cancer. Acknowledgments for header photos: Dako99, Mgschuler, Hortlander.