

Diesel Exhaust: it takes your breath away

Version 2.0



Considered a significant threat to worker and public health, diesel exhaust can literally take your breath away. Coughing, wheezing and shortness of breath are just a few of the symptoms those exposed might experience.

Though, exposure can also lead to a range of chronic illnesses including cancer. In fact, the International Agency for Research on Cancer (IARC) has reclassified diesel engine exhaust from a probable human carcinogen (Group 2A) to a definite human carcinogen (Group 1)—a classification that includes asbestos, silica and tobacco smoke.

What is diesel exhaust?

Diesel powered trucks, buses, locomotives, ships and other heavy equipment are all major sources of diesel exhaust. Other sources can include stationary diesel engines such as generators as well as gas and oil production facilities and electrical utilities.

Diesel exhaust is a complex mixture of hundreds of different compounds found as particulates or gases. The specific chemical composition and particulate sizes of diesel exhaust differs depending on quality of fuel, engine type, fuel pump setting, workload demand, engine temperature and maintenance and emission control system.

Particulates:

The primary components of diesel particulate matter include elemental carbon, organic compounds including polycyclic aromatic hydrocarbons (PAHs), sulfate, nitrate and many other trace metals. Most diesel exhaust particles are tiny enough to be inhaled deep into the lungs where they pose significant risk to health.

Gases:

Gaseous compounds can include carbon monoxide, carbon dioxide, sulfur and nitrogen oxides, aldehydes (formaldehyde, acetaldehyde, acrolein), benzene and polyaromatic hydrocarbons (PAHs). Similar to diesel particulates, gases can be inhaled deep into the lungs.

Who is at risk?

According to CAREX Canada, 800,000 Canadians are exposed to diesel exhaust as a result of work. Here in Ontario, more than 275,000 workers are exposed including truckers, bus drivers, heavy equipment and farm tractor operators, miners, landscaping labourers and

maintenance workers.

As mentioned, diesel exhaust is also a significant threat to public health. With vehicles being a major source of diesel exhaust, anyone living, playing, working and going to school near busy highways and roads is at risk.

For those already exposed at work, other environmental exposures add to the risk of developing both acute and chronic health impacts.

Children are also especially vulnerable to air polluted with diesel exhaust. They generally spend a lot of time outside actively playing and inhale proportionally more air than adults. Many are transported to school in diesel-fueled school buses adding to their exposure burden (and that of the bus drivers). With their organs and body systems still developing, they are particularly sensitive to diesel exhaust and other toxins. This can affect both their short and long term health.

The elderly and those already suffering with compromised immune systems and other pre-existing medical conditions are also vulnerable.

What are the health effects?

According to CAREX Canada and many other experts there is no safe level of exposure for diesel exhaust.

Those exposed can suffer acute health effects including irritation of the eyes, nose, throat and lungs. Coughing, phlegm production, wheezing, chest tightness, nausea and headache are just a few of the symptoms they may experience.

Exposure can also lead to chronic health effects including respiratory illnesses. Examples include reduced lung function, chronic bronchitis, respiratory infection, chronic obstructive pulmonary disease (COPD), emphysema and asthma.

Diesel exhaust has also been found to aggravate existing respiratory and cardiovascular (heart and blood circulation) diseases. For asthma, even short periods of exposure can increase the severity and duration of attacks. This is of particular concern with more than three million Canadians suffering with this illness.

There is evidence diesel exhaust can damage the immune system. And as discussed IARC has determined there is sufficient evidence linking exposure with both an increased risk for lung and bladder cancer.

Researchers and public health

authorities report thousands of Canadians will suffer premature death annually because of exposure to diesel exhaust.

Are there regulations governing exposure?

Ontario and other jurisdictions in Canada have no legal occupational exposure limits for whole diesel exhaust or diesel particulate matter.

Though, Ontario has established allowable exposure limits for many of the gaseous compounds in diesel exhaust including carbon monoxide, carbon dioxide, benzene, and PAHs. These limits are outlined in the regulation respecting the Control of Exposure to Biological or Chemical Agents (O. Reg. 833).

Ontario Regulation 854 governing mines and mining plants mandate some requirements relating to the control of diesel exhaust. For instance, Section 183 of the *Mines and Mining Plants Regulation* outlines requirements for air flow in order to reduce the concentrations of toxic substances in diesel exhaust emissions. Regulations governing construction projects (O. Reg. 213), industrial establishments (O. Reg. 851) and health care and residential facilities (O. Reg. 67) rely on general requirements for vehicle emissions and/or ventilation as it relates to vehicle emissions.

Many communities have or plan to undertake anti-idling public awareness campaigns as they seek to reduce harmful vehicle emissions, including diesel exhaust. Others have taken efforts even further by introducing idling control by-laws.

Toronto, for instance, passed the first stand-alone idling by-law in 1996. This by-law now prohibits idling for more than one minute in any 60-minute period. More than 20 Ontario communities now have some form of idling control by-law.

Regulations under the *Canadian Environmental Protection Act* are also in place aimed at limiting harmful emissions relating to diesel fuel and diesel engines.

These include:

- *Sulphur in Diesel Fuel Regulations*;
- *On-Road Vehicle and Engine Emission Regulations*;
- *Off-Road Small Spark-Ignition Engine Emission Regulations*;
- *Off-Road Compression-Ignition Engine Emission Regulations*; and,

- *Marine Spark-Ignition Engine, Vessel and Off-Road Recreational Vehicle Emission Regulations.*

Ontario's *Environmental Protection Act* prohibits the alteration or removal of emission control equipment. The Act also prohibits excessive visible exhaust emissions. All vehicles on provincial highways are subject to this Act whether they are registered in Ontario or not.

Ontario's *Occupational Health & Safety Act* also imposes a duty on Ontario employers to take every precaution reasonable in the circumstances for the protection of a worker. The following are just some examples of reasonable precautions workplaces can implement to eliminate and/or reduce exposure.

How can exposure be eliminated or controlled?

Cleaner Burning Diesel Engines

The Canadian government regulates emissions for most diesel engines including those in heavy-duty trucks, buses, marine vessels along with "off-road" engines. In part to meet these standards, diesel engine technology continues to improve leading to new low-emission engines that burn fuel more efficiently. Emission control systems are thus also making important advances.

When purchasing new vehicles, generators or other diesel-fueled equipment many workplaces are ensuring they are equipped with the most advanced emission control system(s). Meantime, some workplaces have purchased or are exploring the option of buses, street sweepers, garbage trucks and many other heavy and light duty vehicles powered by cleaner fuels.

Cleaner Fuel and Power Sources

Canada's *Sulphur in Diesel Fuel Regulations* mandates the use of cleaner burning diesel fuel in on- and off-road vehicles, vessels, locomotives and both large and small stationary diesel engines. The point of this regulation is to ensure the effective operation of advanced emission control technologies installed on vehicles and engines (post 2007 models) which will lead to lower harmful emissions and improved air quality for all Canadians. Much of this Regulation is now in force including the use of ultra-low-sulphur diesel (ULSD) in on-road vehicles and off-road engines.

Many other options exist to replace or limit the use of diesel. This includes the replacement of older diesel engine buses and other heavy and light duty trucks and equipment with those powered by compressed natural gas, diesel-electric hybrid engines and engines powered with biodiesel and reformulated diesel. The City of Ottawa uses more than 150 diesel-electric hybrid buses. Diesel-electric hybrid engines use less diesel fuel as they rely on electric power generated by the braking system.

Blending biodiesel fuels with ULSD fuel can lead to less particulate emission, carbon monoxide and hydrocarbons (though, it can increase the production of nitrogen oxides).

The City of Brampton was the first

municipality in Canada to use biodiesel fuel in its fleet of vehicles and equipment in 2003-04. According to the City, cost savings can be as high as 25 per cent per litre.

Compressed natural gas (CNG) powered heavy-duty vehicles and buses can be purchased new or older technology diesel engines can be converted to run on CNG. The City of Hamilton has more than 90 CNG buses in its fleet.

Hydrogen fuel cell technology is also a clean(er) option. British Columbia Transit in Vancouver has acquired and is operating the 20 hydrogen fuel cell buses (and fueling systems) used in Whistler during the 2010 Olympic and Paralympic Games.

The use of diesel-powered trains is also a significant source of harmful emissions. Since 2001, Calgary Transit's light rail line has been powered entirely by electricity generated from 12 wind turbines. Passenger rail service has expanded in Toronto with a Pearson Airport rail service. The agency overseeing this expansion is proposing the use of diesel powered trains. Citizens, community coalitions and others are pressing for the cleaner option—an electric train system.

Cleaner energy sources can also be tapped to replace stationary diesel engines, including generators. Solar, wind and hydroelectric power are a few examples. Hybrid battery banks are another option. They are used to capture and store excess energy produced by diesel generators. Depending on the energy needs, this excess can then be used without the operation of a diesel generator.

Retrofit Technology

Diesel engines are designed to last. For this reason many older engines remain in use on our roads, in our workplaces and in our communities. The following are examples of available retrofits aimed at reducing emissions from these older engines into the environment and/ or directly into the vehicle, cab or direct vicinity of workers:

- diesel oxidation catalyst;
- diesel particulate filters;
- closed crankcase filters (helps prevent emissions from entering the vehicle);
- diesel multi-stage filters;
- exhaust extenders that re-direct emissions away from workers and others; and,
- use of idle stop technology.

Workplace policies and practices

When the elimination of diesel exhaust cannot be achieved, safe work practices and policies can help limit emissions in the workplace and community. Training workers, supervisors, joint health and safety committee members and representatives to understand the hazardous potential of diesel exhaust and the safe work practices and policies is essential.

The following are just a few exposure prevention strategies:

- turn off engine when not in use;
- use of auxiliary power units and generator sets;

- operation of diesel engines outdoors when possible and away from air intake for nearby buildings;
- both general and local exhaust ventilation where operation required indoors;
- climate-controlled pressurized cab equipped with HEPA filters;
- regular inspection and testing to ensure operators and other workers aren't being exposed;
- regular inspection and maintenance of engines and vehicles (must include particulate filters and other retrofits); and,
- respirators used as a temporary control measure only (and must follow an effective respiratory protection program including fit-testing and worker training).

Exposure to diesel exhaust at work and in the community is leading to the premature death of thousands of Canadians annually. Though many have committed to the efforts needed to eliminate or reduce this preventable exposure, much work remains. With prevention efforts in your workplace and/or community, workers, children and others will breathe a little easier.

NOTE: CAREX Canada is a multi-institution research project that combines academic expertise and government resources to generate an evidence-based national carcinogen surveillance program. Visit CAREX Canada at: www.carexcanada.ca



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