

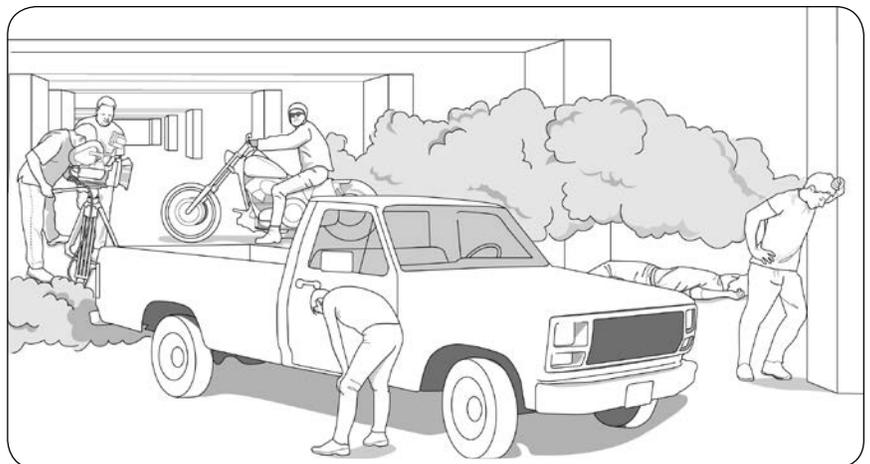
Carbon monoxide exposure during film shoots

A film crew was conducting a film shoot in an underground parkade using several operating motor vehicles, as well as theatrical fog. The parkade ventilation system was disabled for the shoot. One worker felt ill and tried to exit the parkade. The worker was later found unconscious and was taken to hospital by ambulance. The following day, two other workers reported to hospital with ongoing symptoms related to carbon monoxide exposure. The affected workers reported that they experienced symptoms that worsened progressively on the night of the film shoot. Their symptoms included nausea, dizziness, and headache, and progressed to disorientation, fatigue, and loss of consciousness.

Carbon monoxide (CO) is an odourless, invisible gas that is a product of combustion. When inhaled, CO blocks the body's ability to absorb oxygen. Workers may not know they are in danger until it's too late. Headache and nausea are the first symptoms. Unconsciousness and death can follow from prolonged exposure to high concentrations.

CO is a reproductive toxin, which means it can harm a developing fetus. For this reason, CO is also a designated toxic substance, meaning that it can have serious, irreversible effects on human health. As a result, CO comes with a set of specific rules governing worker exposure.

Ideally, employers would eliminate exposure altogether. When elimination is not feasible, employers must ensure any worker exposure levels are kept as low as reasonably achievable (ALARA) below the exposure limit. Commonly, this applies when working indoors or in enclosed spaces with operating motor vehicles, generators, or other sources of combustion.



During a film shoot involving older model vehicles in a parkade, workers experienced symptoms of carbon monoxide exposure.

In the incident described at the beginning of this bulletin, the film shoot included the use of older model vehicles, including motorcycles, a pickup truck, and an ambulance. Theatrical fog (propylene glycol-based) was used to create visual effects.

WorkSafeBC's investigation found that the following factors contributed to the workers' CO exposure:

- A pickup truck was in poor mechanical condition. It was tuned to run rich, potentially increasing CO emissions in the exhaust.

- A food truck, which used a propane-powered generator, was at times parked in an indoor loading bay where workers may have been exposed to the exhaust. The generator had a faulty choke. This made the generator run rich, likely increasing CO concentrations in the exhaust.
- The parkade's ventilation system had several deficiencies. At least one exhaust fan wasn't working, and the CO sensors were three years past due for servicing. It's unclear whether the ventilation system was set up to adequately protect workers occupying the parkade for extended periods of time.
- The parkade's ventilation system was disabled and exhaust fans were shut down for extended periods of time to eliminate noise during filming.
- The film shoot proceeded despite growing concerns from workers about the air quality in the parkade and its effects on their health and safety.

While theatrical fog may produce CO under unusual operating conditions, internal combustion engines were the main sources of CO in this incident.

What employers must do to prevent similar incidents

Build safety into the planning stage

Adequately consider and plan for the safety of workers before conducting a film shoot. This includes putting a system in place to do the following:

- Identify potential hazards (for example, hazardous substances such as vehicle exhaust).
- Assess the risk posed by those hazards.
- Ensure that effective controls are in place to ensure worker safety. Consider if risks could be controlled by elimination or substitution. For example, in this case, is substituting CO-producing equipment with electric or cleaner-running equipment possible?
- Ensure that qualified persons participate in this process. The services of professional consultants

may be required if qualified in-house personnel are unavailable.

Train everyone on the crew

Adequately train **supervisors** to make sure that they:

- Know the sections of the *Workers Compensation Act* and the Occupational Health and Safety Regulation that apply to their work.
- Make their workers aware of all known or reasonably foreseeable health and safety hazards.
- Ensure the health and safety of workers under their supervision.
- Investigate reports of unsafe conditions immediately, including symptoms of overexposure to air contaminants, and take necessary corrective actions without delay.

Adequately train **workers** to ensure that they:

- Know the hazards they may be exposed to, and how to protect themselves.
- Know of their right to refuse unsafe work.
- Know of their responsibility to:
 - Report unsafe conditions (including air contaminants) to a supervisor or the employer.
 - Report symptoms of air contaminant exposure to first aid and their supervisor.

Where workers may be exposed to CO, such as from vehicle exhaust, workers must be made aware of:

- The hazards and symptoms of CO exposure
- How to control their exposure

Use well-maintained equipment

Maintain equipment, including vehicles and gas- or propane-powered generators, in safe operating condition. When using such equipment, do the following:

- Regularly inspect equipment and take corrective actions or make repairs if deficiencies are identified.

- Ensure that exhaust emissions are minimized, particularly when the equipment is used indoors or in enclosed spaces. This typically requires emissions testing.
- Keep records of equipment maintenance and testing. Review these records before using the equipment.

Manage exposure

Where internal combustion engines are operated indoors or in enclosed spaces, do the following:

- Conduct an assessment of the work area to determine the potential for worker exposure to harmful air contaminants in the exhaust.
- Regularly monitor the air for unsafe concentrations of CO.

Assessment and monitoring will typically require the services of a qualified professional (i.e., an industrial hygienist or similar). The assessment will determine the risk to workers and identify appropriate controls that must be implemented to ensure worker health and safety.

Where a risk of worker exposure to carbon monoxide has been identified, and in order to meet ALARA requirements, implement an exposure control plan (ECP). An ECP is an employer-developed plan that sets out a detailed approach to protecting workers from harmful exposure to certain substances. By identifying the hazards, and by monitoring and controlling the assessed risks, exposure can be minimized or even eliminated. For more information on ECPs, see [OHS Guideline G5.54-1](#).

Ensure compliance, coordinate work activities, and support the joint health and safety committee

Finally, a safe film shoot depends on employers having effective systems in place to ensure the following:

- Compliance with the Act and the Regulation.

- Coordination of work activities among all employers, workers, and others at the workplace, including trades and sub-trades.
- A supported and well-functioning joint health and safety committee. Keep in mind that the work of the committee does not replace the duty of the employer, managers, and supervisors to ensure the health and safety of workers under their supervision.

For more information

WorkSafeBC resources

- [Carbon monoxide page](#)
- [Carbon monoxide in industry](#)

Workers Compensation Act

- [Section 115, General duties of employers](#)
- [Section 117, General duties of supervisors](#)
- [Section 118, Coordination at multiple-employer workplaces](#)
- [Section 135, Educational leave](#)
- [Section 136, Other employer obligations to support committee](#)

Occupational Health and Safety Regulation and Guidelines

- [Section 3.5, General requirement \(for workplace inspections\)](#)
- [Section 3.10, Reporting unsafe conditions](#)
- [Section 4.11, Startup \(of equipment, machinery or work processes\)](#)
- [Section 5.53, Workplace monitoring](#)
- [Section 5.54, Exposure control plan](#)
- [Guideline G5.54-1, Exposure control plan](#)
- [Section 5.57 Designated substances](#)
- [Section 5.73, Indoor operation \(of internal combustion engines\)](#)