Fire | Facts

Carbon Monoxide

Carbon monoxide (CO) is an invisible, odourless, colourless, toxic gas. It is produced by the incomplete burning of common fuels such as gasoline, coal, natural gas, propane, heating oil, kerosene and methane, or any other combustible material such as wood, cloth, or paper. Fuels burn incompletely when an adequate supply of oxygen is not available.

Potential carbon monoxide sources in the home, camper/RV, and garage include all fuel burning appliances, commonly those used for heating and cooking, such as fireplaces, clogged chimney flues, water heaters, furnaces, gas space heaters, wood and gas stoves, charcoal grills, and barbeques, as well as vehicle exhaust fumes, generators, and tobacco smoke.

Fire Facts

- Smoke inhalation from fires is the most common form of CO poisoning.
- Vehicle exhaust is the most common source of exposure for most people.
- The risk of CO poisoning can increase during winter, when homes are more tightly sealed to conserve heat and fuel-burning appliances are used more often.
- Carbon monoxide is almost identical in weight to normal air and thus mix freely with air.
- Carbon monoxide can ignite or even explode when it builds up in an enclosed, unventilated area and comes in contact with a spark or flame (flammability range; 12.5-74%). A spark from the operation of a wall switch, a cell phone/telephone or transmitting 2-way radio can ignite CO gas. However, long before CO will ignite, anyone exposed to these high percentages will be killed.

Fire Hazards

Fuel burning appliances and CO production

- When properly installed, used and maintained, fuel burning appliances do not pollute your home's air with CO. Natural gas is the cleanest burning fossil fuel. Under correct operating conditions, the combustion products of fuel burning appliances are water and carbon dioxide, the same substances in our breath when we exhale.
- The improper installation, use, and maintenance of fuel burning appliances cause the formation of carbon monoxide gas.
- Correct operation of fuel burning appliances requires two key conditions:
  1. There must be an adequate supply of air for complete combustion to take place.
  2. Products of combustion must be properly ventilated to the outside.
- Regular home appliances, such as clothes dryers, fireplaces, kitchen and bathroom fans, central vacuum cleaners, and kitchen barbeques remove air from the home, decreasing the amount of air available to fuel burning appliances. When air starved fuel-burning appliances compete for air they can create a negative pressure vacuum, which pulls CO contaminated air back into the home.

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For more information, please contact the Fire Commissioner's Office at (780) 427-8392 or firecomm@gov.ab.ca or visit www.municipalaffairs.gov.ab.ca.
Dial 310-000 for toll-free access outside of Edmonton

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- Today's more energy-efficient, airtight homes can limit air inflow into the home, which may also cause fuel-burning appliances to compete for available oxygen and "back draft", pulling polluted or CO contaminated air back into the home.
- Any indoor workplace where engines are running presents a potential hazard. Workers must realize that fuel-powered machines can expose them to this deadly gas.

CO levels and your health

- When CO is inhaled, it is absorbed through the lungs and into the bloodstream where it prevents the body from absorbing oxygen by replacing the oxygen molecules attached to haemoglobin (the oxygen carrying agent in red blood cells) in the blood stream. CO bonds to haemoglobin about 250 times better than oxygen. Without oxygen, vital organs such as your heart and brain begin to deteriorate. To compensate, your heart rate increases, breathing may become difficult and in the most serious circumstances cardiac trauma, brain damage, coma and death will result.
- The health effects related to CO depend upon its concentration in the air and the length of exposure, as well as each individual's health condition. CO symptoms generally rise exponentially over time.
- The concentration levels of CO in the air are measured in parts per million (ppm)
- Health effects from exposure to CO levels in air of approximately 1 to 70 ppm are uncertain, but most people will not experience any symptoms.
- According to the Canadian Occupational Health and Safety Administration's CO standard for workplaces, the maximum amount of CO that a person can be continuously exposed to in any 8-hour period is 25 ppm. At this level, no toxic symptoms are developed.
- Exposure to low levels of CO (200 ppm for 2 hours) can cause headaches, confusion, dizziness, weakness/fatigue, nausea and other symptoms similar to the flu.
- High-level exposure (400 ppm for 3 hours, 800 ppm for 2 hours, 1600ppm for 1 hour) is life threatening, it can cause abdominal pain, diarrhea, impaired vision, convulsions, coma, and eventually death. Confusion -- a symptom of exposure to this colorless, odourless gas -- can interfere with a person's ability to recognize their life is in danger.
- Medical experts believe that the severity of the symptoms will increase for unborn babies, infants, children, seniors and people with heart or lung problems.
- CO poisoning is progressive. Prolonged exposure to even low levels of CO gas can cause the gas to build up to dangerous levels in your body over an extended period of time.

The Law

Safety Codes Act, Permit Regulation:

Gas Fuelled equipment

- A gas permit is required before installing, replacing, altering, or making an addition to any gas fired appliance in a residential property.

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- A gas permit is required to replace a gas fired appliance in any occupancy other than a home.
- Routine or on-going maintenance of a gas fired appliance, in any occupancy, does not require a permit; however, personnel performing the work shall be properly trained in such functions.
- According to the recently adopted Alberta Building Code (2006), carbon monoxide alarms are required in certain rooms or spaces of buildings that contain a residential occupancy. Carbon monoxide alarms need to be provided within bedrooms or corridor areas where a fuel-burning appliance is installed in a suite of residential occupancy, or where a suite of residential occupancy shares a wall or floor/ceiling assembly with a vehicle storage garage.

Solid and liquid fuelled equipment

- A building permit is required for the installation of a solid-fuel or liquid fuel burning appliance in a building.
- Replacement or addition to these appliances may also require a building permit. Contact your local Authority Having Jurisdiction for more information.
- Normally, no alterations for solid and liquid fuel appliances are permitted by the code, contact your local authority having jurisdiction for more information.

Electrical

- A permit is required to carry out work to which the Electrical Code applies. This does not include electrical work performed in replacing fuses, receptacles, switches and utilization equipment with proper units of a similar type where the replacement can be made without other modifications to the electrical installation being required.

Part 1 of the Safety Codes Act:

- It is the responsibility of the owner of any thing, process or activity to which this act applies (fire protection, design, manufacture, construction, installation, operation and maintenance of buildings and gas systems) to ensure that it meets code requirements, is maintained as required by regulation, and is undertaken in a safe manner.

Part 2 of the Alberta Fire Code:

- Heating, ventilating, and air-conditioning systems shall be used and maintained so as not to create a hazardous situation.

Safety Tips

Preventing the Risk of CO poisoning

The first line of defence in preventing CO poisoning is the proper installation, use, and maintenance of your fuel burning appliances.

Installing Fuel Burning Appliances

- Installation, repair or adjustment of fuel-burning appliances is a job for a qualified technician. If you are a do-it-your selfer, you may need a permit before beginning the job, and an inspection of your work after the job is complete. Contact your fire department, local Authority Having

Jurisdiction, or the Safety Services website at http://www.municipalaffairs.gov.ab.ca/mahome/ss/Permit.cfm for more information.

Using Fuel Burning Appliances

- Ensure that the exhaust from all fuel burning appliances is vented to the outdoors.
- Ensure indoor fuel burning appliances such as fireplaces, furnaces, water heaters, wood and coal stoves, clothes dryers, space heaters, are equipped with air intakes to supply fresh air, and flue vents or pipes to exhaust toxic gases outdoors.
- Use re-locatable fuel burning devices such as vehicles, generators, engines, barbecues, camping stoves, or motors (lawnmowers and snowblowers) in a well-ventilated outdoor area.
- If you need to warm a vehicle, open the door before starting it and remove it from the garage immediately after starting it. Once the running vehicle is located outside, close the garage door to prevent carbon monoxide from accumulating inside the garage.
- An open wood-burning fireplace, when in use, can consume up to five to ten times as much air in your home as a furnace. Always open a fresh air supply, like a window, before lighting the fire to ensure that the products of combustion are properly expelled up the chimney.
- Do not use ovens, clothes dryers or gas ranges to heat your home.
- Ensure that doors between attached garages and homes are tightly sealed and contain effective weather stripping to provide a barrier against the passage of exhaust fumes.
- Keep the area around your fuel burning appliances free and unobstructed of any items that could restrict air circulation.
- Do not use fuel-burning appliances that have leaking exhaust systems.
- Keep a labelled and approved ABC-type fire extinguisher near all fuel burning appliances.

Maintenance of Fuel Burning Appliances

- Ensure that intakes, vents, and pipes on fuel burning appliances are kept clear of debris or other blockages.
- Have a qualified technician inspect and clean your fuel burning appliances and chimney at least once a year, preferably before the season of increased use.
- Visually inspect fuel-burning equipment and their venting systems on a regular basis for signs of cracks, wear, soot, rust or corrosion. Contact a qualified technician to repair equipment with signs of damage.
- Equipment that uses natural gas should show a clear blue flame. Have a qualified technician inspect flames with a yellow or orange hue as this colour may indicate problems.

Detection Devices

The installation of a CO detector is the second line of defence against CO poisoning. A CO detector must never be substituted for prevention measures.
There are three basic types of CO detection devices: Gel Cell, Electro-chemical, and Semiconductor. Each senses carbon monoxide by a different principle of operation.

Gel cell

- Uses a sensing process in which a chemically treated filter changes color when exposed to CO. The color, which is read by a photoelectric eye, changes at the same rate as haemoglobin in human blood, getting darker as it absorbs higher levels. When a light sensor in the detector recognizes the colour change, the alarm goes off.

Electro-chemical

- Uses a chemical reaction that generates a current. The current flows through a circuit at a rate proportional to CO levels in the air. A microprocessor in the detector measures the CO concentration in the air, based on the current in the circuit.

Semiconductor

- Uses metal oxide as a semiconductor, which changes its level of conductivity when exposed to CO. An electronic circuit senses the change in current through the semiconductor and sets off the alarm.

Which Type of Detector is Better?

- All three types of detectors will assist in the detection of carbon monoxide.

How are CO Alarms Powered and Installed?

CO Alarms can be powered in three ways – battery, plug-in, or hardwired.

Battery Operated

- Are the easiest and cheapest to install. These alarms use adhesives, fasteners, and screws to mount to walls or ceilings.
- Can be moved and/or replaced in any location.
- Batteries need to be present and replaced at least once a year, or as needed, in order to continue operation of the alarm.

Plug-In

- Can be directly plugged in to a standard 120-volt electrical outlet.
- Usually located in an easy to see and reach area, which can provide easy access for testing and resetting, but also allows for easy tampering.
- Requires no annual battery replacement.

Hardwire

- Can be wired permanently into an AC power supply.
- Installation can be complicated and/or expensive. They often need to be installed by a licensed electrician.
- Location is less flexible.
- Provides a more reliable power source. These alarms always have the power they need to operate as long as there is a current in the circuit to which they are connected. They are less prone to have their power source disconnected or removed. However, in the event of a power failure, these alarms will become inoperable and require a battery back up.

- Multiple alarms can be interconnected so that every alarm sounds regardless of the location to the CO leak. This is an advantage in early warning as it gives occupants extra time to escape if they are in one part of the home and a CO reaches dangerous levels in another part.

Which Power Source is Better?

- Either power source is acceptable. However, hardwired are recommended, as they are less prone to be tampered with or have their power source disconnected or removed.

Buying CO Alarms

- Several brands and types of alarms are available in hardware, department, and discount stores. The type of detector and brand you choose will be the one that meets your individual needs.
- Despite brand or type, ensure your CO alarm has been approved and labelled by an independent testing laboratory such as Underwriters Laboratories of Canada (ULC), Underwriters Laboratories (UL) or the Canadian Standards Association (CSA).
- Choose an alarm that features a test button.
- Consider a battery back-up power source for alarms powered by household electricity.
- Ensure your CO Alarm is equipped with an audible warning alarm.

Location and Placement of CO Alarms

- Install at least one CO alarm on every level of your home, including the basement (but not in unfinished attics).
- Locate a CO alarm outside of each bedroom or sleeping area in your home, and keep bedroom doors closed while you sleep.
- Follow the manufacturer's directions for location instructions. Manufacturers of CO alarms must ensure that their installation requirements meet CSA standards.
- If a CO alarm is to be mounted on a ceiling, it should be installed away from any existing smoke alarms in order to allow for differentiation between a CO alarm and a smoke alarm in an emergency.
- On floors without bedrooms, install the alarm in or near each living area such as dens, living rooms or family rooms.
- Locate CO alarms about 5 feet away from fuel burning appliances such as furnaces, or fireplaces. Under normal conditions these will emit low levels of CO that will quickly dissipate and thus are not dangerous.
- Locate CO alarms about 5 feet away from areas where household gases or vapours may be present. Gases and chemicals can damage the sensing device in your alarm.
- Do not install an alarm near a window or air register where drafts can reduce the alarm operation and sensitivity.

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How to Ensure Reliable Operation of your CO Alarm

Maintenance

- Replace the batteries in CO alarms once a year, or as soon as the alarm “chirps” warning that the battery is low. **Helpful hint:** schedule battery replacements for the same day you change your clock from daylight to standard time in the fall.
- CO alarms don't last forever. Replace your CO alarms according to the manufacturer’s instructions.
- Never disconnect or disable a CO alarm, even temporarily. CO alarms can't warn you of CO if their power source is dead, missing or has been removed for other purposes.
- Regular vacuuming or dusting of your CO alarm can help keep it working properly. Follow manufacturer's instructions for cleaning directions.
- Don't paint your CO alarms. Paint, stickers or other decorations could keep them from working properly.

Testing

- Test your CO alarm at least once a month. Follow manufacturers instructions for proper testing procedures.
- Ensure you test both the circuitry and the sensor inside the alarm.

What to do When the Alarm Sounds

- Know who to call. Contact your local fire department’s non-emergency telephone number to find out what number to call if the CO alarm sounds. Post that number by the telephone and ensure everyone in the household knows where it is located.
- If no one in the household has CO symptoms (headache, dizziness, nausea, fatigue), consumers should push the test/reset button to silence it, turn-off fuel burning appliances, and immediately ventilate their home by opening windows and outside doors. A qualified technician should be called immediately to inspect for sources of CO.
- If anyone is experiencing CO symptoms, immediately evacuate the home and call your local emergency service (9-1-1). Do not re-enter your home until a qualified technician has corrected the problem.
- Ventilation may dissipate CO build-up and prevent determination of the problem. Although your problem may appear to be temporarily solved, it is crucial that the source of the CO is determined and appropriate repairs made.
- Make sure everyone in your home can hear and recognize the sound of the alarm and knows how to react immediately.
- Plan regular fire drills (twice a year is best) to ensure that everyone knows exactly what to do when the CO alarm sounds. Ensure two ways out of every room and establish a meeting place outside the home.

If your alarm does not sound

- For battery operated alarms, check the battery. If the battery is dead, replace it immediately.

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- For alarms hooked up to your homes electrical system, check the fuse box/breaker panel or contact an electrician.
- The CO alarm may not be working properly. Replace the CO alarm with a new one.

Avoiding False Alarms

Unfortunately, CO alarms are electronic devices and, like any other electronic device, they may fail. Failures may range from not working at all to alarming for no apparent reason or alarming too late when subjected to a fire signal. The following may cause nuisance alarms:

- **Improper location.** Installing an alarm next to fuel burning appliances, or gases and vapours from chemicals, cleaning products or cigarette smoke can activate a false alarm. Keep all CO alarms at least 5 feet away from these items.
- **Wear and tear.** A CO alarm may wear out, regardless of type or quality. Follow manufacturer instructions for replacement schedules.
- **Poor maintenance.** False alarms can be heightened in dirty or greasy environments. Dirt will often collect in the alarm, making it dirty and more sensitive to activation.
- **Early Installation.** If alarms are installed too early during the construction or renovation of a home or building the alarm may become contaminated, dirty, clogged or inactive.
- Never ignore an alarm. Even if you suspect false activation of your CO alarm, follow the steps above and contact a qualified technician to investigate the cause