

## Carbon Monoxide

The presence of carbon monoxide (CO) in our homes is dangerous. So, how can you protect your family from carbon monoxide? How do you choose the right CO detector for your home? The first step is to make sure that carbon monoxide never enters your home. The second step is to install at least one CO detector in your home.

This *About Your House* answers often-asked questions about carbon monoxide to help you make the right decision to make your home safe.

### WHAT IS CARBON MONOXIDE?

Carbon monoxide (CO) is a colourless and odourless gas. Because you can't see, taste or smell it, it can affect you or your family before you even know it's there. Even at low levels of exposure, carbon monoxide can cause serious health problems. CO is harmful because it will rapidly accumulate in the blood, depleting the ability of blood to carry oxygen.<sup>1</sup>

### WHERE DOES CARBON MONOXIDE COME FROM?

Carbon monoxide is a common byproduct of the combustion (burning) of fossil fuels. Most fuel-burning equipment (natural gas, propane and oil), if properly installed and maintained, produces little CO. The byproducts of combustion are usually safely vented to the outside. However, if anything disrupts the venting process (such as a bird's nest in the chimney) or results in a shortage of oxygen to the burner, CO production can quickly rise to dangerous levels.

The burning of wood, kerosene, coal and charcoal produces CO. Gasoline engines produce CO. CO production is at a maximum during the startup of a cold engine. Starting, then idling, your car or gas mower in the garage can be dangerous. The fumes that contain CO can enter a home through connecting walls or doorways and can quickly rise to dangerous levels (see CMHC's *About Your House: Attached Garages and Indoor Air Quality* for more information).

### HOW CAN I ELIMINATE SOURCES OF CARBON MONOXIDE IN MY HOME?

The most important step you can take to eliminate the possibility of CO poisoning is to ensure that CO never has an opportunity to enter your home. This is your first line of defence. Review this list to minimize the risk of CO in your home.

- Have a qualified technician inspect and clean fuel-burning appliances yearly, before the cold weather sets in, to ensure they are in good working order.
- Have a qualified technician inspect chimneys and vents yearly for cracks, blockages (e.g., bird's nests, twigs, old mortar), corrosion or holes.
- Check fireplaces for closed or blocked flues.
- Check with a qualified technician before enclosing heating and hot water equipment in a smaller room, to ensure there is adequate air for proper combustion.

- If you have a powerful kitchen exhaust fan or downdraft cooktop, have a qualified technician check that its operation does not pull fumes back down the chimney.
  - Never use propane or natural gas stove tops or ovens to heat your home.
  - Never start a vehicle in a closed garage; open the garage doors first. Pull the car out immediately onto the driveway, then close the garage door to prevent exhaust fumes from being drawn into the house.
  - Do not use a remote automobile starter when the car is in the garage; even if the garage doors are open.
  - Never operate propane, natural gas or charcoal barbecue grills indoors or in an attached garage.
  - Avoid the use of a kerosene space heater indoors or in a garage. If its use is unavoidable provide combustion air by opening a window while operating. Refuel outside after the unit has cooled.
  - Never run a lawnmower, snowblower, or any gasoline-powered tool such as a whipper snipper or pressure washer inside a garage or house.
  - The use of fossil fuels for refrigeration, cooking, heat, and light inside tents, trailers, and motorhomes can be very dangerous.
- Be sure that all equipment is properly vented to the outside and use electric or battery-powered equipment where possible.
- Regularly clean the clothes dryer ductwork and outside vent cover for blockages such as lint, snow, or overgrown outdoor plants.
  - Reduce or eliminate the use of fondue heaters indoors.
  - If you live close to a road with heavy traffic, outdoor carbon monoxide levels can affect your indoor air quality, especially during rush hour. Such levels should not set off a CO alarm, but slightly elevated CO levels might be observable on some types of CO detectors with a digital display.

## CARBON MONOXIDE DETECTORS

### Are they really necessary?

If you take the actions above, you greatly reduce your risk of CO poisoning. But unanticipated dangerous incidents may still occur despite your best efforts to avoid CO. The installation of at least one CO detector in your home is a good safety precaution and in some municipalities, it is the law. A detector might be your second line of defence, but it is necessary. You should have one in your home today.

### How do CO detectors work?

There are three basic types of CO sensors—metal oxide, biomimetic and electrochemical. Note that while there may be performance differences between these technologies, all detectors are tested and approved for their operation. The retail cost of a detector will generally relate to the number of features included and its warranty conditions.

#### *Metal-oxide-semi-conductor (MOS)*

This is the original technology for detecting CO. Heated tin oxide reacts with CO to determine the levels of the toxic gas. There is no need to remember to check batteries as units must be connected to house power. Models that offer up to 20 hours of battery backup are available.

#### *Biomimetic*

Biomimetic detectors have gel-coated discs that darken in the presence of CO and the colour change sounds an alarm. This technology is less expensive and can be battery operated.

#### *Electrochemical*

In this type of detector, a chemical reaction with CO creates an electrical current that sets off an alarm. Electrochemical detectors are highly sensitive and offer accurate readings at all CO levels. Most units come with a continuous digital readout and a memory

feature that allows you to check past CO levels. This technology offers a fast reset time. Most units sound an alert when the sensor needs to be replaced.

### What features should I look for when purchasing a CO detector?

Most CO detectors are designed to give an alarm when CO levels reach a high level in a short time. However, health agencies advise that long-term, low-level exposure is also of concern, especially for the unborn and young children, the elderly and those with a history of heart or respiratory problems.<sup>1</sup> Detectors that can display both high and low levels are more expensive but they do provide greater accuracy and more information.

Here are some features to consider when purchasing a CO detector:

- Look for a detector that is listed with the Canadian Standards Association (CSA) standard. The logos of the testing agency will be on the product.
- Choose a detector with a memory if you want to monitor long-term, low-level exposure and short-term, high-level exposure. Even though product standards do not allow manufacturers to display low levels of CO, these units monitor and store this information. Peak levels, no matter what the level of concentration, can be viewed by pressing a button.

- Battery-operated units allow detector placement in the most convenient location. However, any battery-operated device requires the user's diligence in replacing worn-out batteries.
- Do not connect plug-in units to an electrical outlet that is controlled by a wall switch.
- No detectors will operate properly forever. Replace them at least every five years, unless the manufacturer specifies a shorter or longer life. Eventually, manufacturers may be required to print expiry dates on their CO detectors. This will ensure that you are purchasing an up-to-date product with a full sensor life.

### Where do I put a CO detector?

Most manufacturers specify where you should locate their CO detector. In general, the best place to put the detector is where you will hear it while sleeping. CO is roughly the same weight as air and distributes evenly throughout a room, so a detector can be placed at any height in any location, as long as its alarm can be heard. Additional units could be installed in several other locations around the home, such as a child's bedroom; check the following list before installing.

### Detector sensitivity issues

The standards organizations of Canada (CSA) and the United States (Underwriters Laboratories or UL) have coordinated the writing of CO standards and product testing. The standards as of 2010 prohibit showing CO levels of less than 30 ppm on digital displays. The most recent standards also require the alarm to sound at higher levels of CO than with previous editions of the standard. The reasoning behind these changes is to reduce calls to fire stations, utilities and emergency response teams when the levels of CO are not life threatening. This change will also reduce the number of calls to these agencies due to detector inaccuracy or the presence of other gases. Consequently, new alarms will not sound at CO concentrations up to 70 ppm. Note that these concentrations are significantly in excess of the Canadian health guidelines.

Detectors with a digital display and a "history" option can provide the true CO concentrations in a house. A low-level display would be useful for people with existing respiratory problems or for those who like to spot evolving problems, rather than having to wait for the situation to become serious. Low-level CO detection products are becoming commercially available. They will not be certified to CSA or UL standards, as these standards currently prohibit low-level displays.

To avoid both damage to the unit and to reduce false alarms, do not install CO detectors:

- in unheated basements, attics or garages
- in areas of high humidity
- where they will be exposed to chemical solvents or cleaners, including hair spray, deodorant sprays, etc.
- near vents, flues or chimneys
- within 2 m (6 ft.) of heating and cooking appliances
- near forced- or unforced-air ventilation openings
- within 2 m (6 ft.) of corners or areas where natural air circulation is low
- where they can be damaged, such as an outlet in a high traffic area
- where directly exposed to the weather.

### Testing your CO detector

Most CO detectors have a test button that should be pressed once a week to confirm that the device is in operation. Detectors with displays can be tested with a known source of CO such as smoke from an incense stick. Hold the CO source about 20-25 cm (8-10 in.) away and watch the digital display respond to the presence of even a small amount of CO, but an alarm will most likely not sound with this test.

There are CO detector test kits available, where CO detectors are sold, that provide a vial containing a high level of CO (1,000 ppm) and a plastic tent to house the unit during the test. This test only proves that your detector will sound an alarm with a very high level of CO.

### WHAT DO I DO IF I HEAR THE CARBON MONOXIDE DETECTOR ALARM?

Do not ignore the CO detector's alarm if it sounds. Treat each alarm as serious and respond accordingly. CO detectors are designed to sound an alarm before a healthy adult would feel any symptoms. Infants, the elderly and those with respiratory and heart conditions are at particular risk and may react to even low levels of CO poisoning.<sup>1</sup>

### Response to an obvious source of CO

If your detector sounds an alarm and you have an obvious source of CO, such as an unvented kerosene heater:

- evacuate the house, including pets and do a head count
- if anyone is suffering from flu-like symptoms, call 911
- remove or turn off the source
- ventilate the house
- reset the alarm
- do not re-occupy the house until the alarm ceases
- take steps to avoid this situation in the future.

### Response to an unknown source of CO

If your CO detector is sounding an alarm and there is no obvious source of CO:

- evacuate the house, including pets and do a head count
- if anyone has flu-like symptoms, call 911; if there are no health problems, call your gas utility, heating contractor or the fire department to have your house tested
- if you live in a single-family home: do not ventilate your home, turn off fuel-burning appliances or reset your CO detector prior to someone testing your home. Many CO alarm calls have been classified as "false alarms" because the homeowner had ventilated the home and turned off the equipment before firefighters or technicians could measure the CO levels and find the source
- if you live in a duplex, row house, apartment, or otherwise attached house, do ventilate the house and turn off fuel-burning appliances. In this case, the safety of your neighbours is more important than trying to find the CO source
- have a qualified service technician inspect and repair all fuel-burning appliances, if they are identified as being the CO source

- do not re-occupy the house unless those who tested the house inform you that the danger is over.

## SYMPTOMS OF CARBON MONOXIDE POISONING<sup>2</sup>

Be sure that all members of your family know the symptoms of CO poisoning:

### Mild exposure

Flu-like symptoms such as headache, running nose, sore eyes, etc.

### Medium exposure

Drowsiness, dizziness, vomiting. The sense of disorientation and confusion may make it difficult for some victims to make rational decisions like leaving the home or calling for assistance.

### Extreme exposure

Unconsciousness, brain damage, death.

### Continued low-level exposure to CO

While this may not lead to observable symptoms, you should still avoid such exposure.

Table 1 Carbon monoxide concentrations and their effects

CO concentration in parts per million (ppm)	Effects
0-2	Normal conditions in and outside Canadian houses.
11	Maximum tolerable indoor concentration over an 8-hour period. <sup>1</sup>
25	Maximum allowable concentration for continuous exposure for healthy adults in any 8-hour period. <sup>1</sup>
30	CO detectors are not allowed to sound alarm unless this concentration is maintained for more than 30 days. <sup>2</sup>
70	CO detectors must sound alarm within 1 to 4 hours. <sup>2</sup>
150	CO detectors must sound alarm within 10 to 50 minutes. <sup>2</sup>
200	Slight headache, fatigue, dizziness and nausea after 2 to 3 hours. CO detector alarm must sound within 35 minutes. <sup>3</sup>
400	CO detectors must sound alarm within 4 to 15 minutes. <sup>3</sup>
800	Dizziness, nausea and convulsions within 45 minutes, death within 2 to 3 hours. <sup>3</sup>
1,600	Death within 1 hour. <sup>3</sup>
13,000	Danger of death after 1 to 3 minutes. <sup>3</sup>

<sup>1</sup> Canada. Health Canada, *Exposure Guidelines for Residential Indoor Air Quality* (Ottawa: Ministry of Supply and Services Canada, 1989).

<sup>2</sup> Canadian Standards Association, *CAN/CSA 6.19-01: Residential Carbon Monoxide Alarming Devices* (Canada: Canadian Standards Association, 2001).

<sup>3</sup> T. H. Greiner, *Carbon Monoxide Poisoning (AEN-172)* (Ames: Iowa State University of Science and Technology, 1997).

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