

Carbon Monoxide Poisoning at Home and Work

What is Carbon Monoxide?

Carbon monoxide (CO) is an odorless, colorless, tasteless gas that is slightly lighter than air. It is sometimes called carbonic oxide, exhaust gas, or flue gas. Under high pressure it becomes a liquid. It can also kill within minutes in high concentrations. Carbon monoxide is produced by the incomplete combustion of any fuel that contains carbon. This includes gasoline, natural gas, oil and propane, as well as coal and wood products. In the home, sources of carbon monoxide include gas and oil burning appliances like furnaces, dryers, water heaters, ovens, wood burning stoves, charcoal grills, and automobiles.

In the workplace, carbon monoxide buildups can occur in operations near furnaces, ovens, generators, forges and kilns when they are being fired up to operating temperatures. Other workplace exposure points include:

- Organic chemical synthesis, including some petroleum product processes
- Gasoline-powered tools such as high-pressure washers, welders and pumps
- As a reducing agent in metallurgical processes
- When air is supplied from reciprocating oil-lubricated compressors

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Because many of these sources are only used in cold weather, carbon monoxide poisoning is considered by many to be a "seasonal" risk. However, carbon monoxide gas can build up in any enclosed or semi-enclosed space at any time. Exposure can occur through inhalation of the gas and eye or skin contact with the liquid.

Carbon Monoxide Symptoms

Carbon monoxide is a chemical asphyxiant. When CO is inhaled into the lungs, it bonds with hemoglobin in the blood—hemoglobin is responsible for carrying oxygen throughout the body. The CO replaces the oxygen molecules in hemoglobin and deprives the heart, brain and body of the oxygen it needs to function. High concentrations of CO will displace enough oxygen in your body, resulting in oxygen starvation.

The symptoms of low-level CO poisoning include headaches, nausea, weakness, dizziness and confusion. CO exposure causes a victim's blood pressure to rise in an attempt to get more oxygen to the body. As a result, the skin may take on a reddish color. The symptoms at low levels are very similar to what a person might exhibit if affected by the flu or other common illnesses. Therefore, carbon monoxide is sometimes referred to as the "Great Imitator."

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As CO exposure increases, more serious symptoms develop; lack of coordination, chest pain, vomiting and loss of consciousness. If exposed to carbon monoxide long enough, coma and death can occur. A concentration of 1200 ppm CO is considered IDLH (Immediately Dangerous to Life or Health). This table lists common symptoms and effects on healthy adults at various carbon monoxide concentrations.

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Carbon Monoxide Level in ppm (Parts per Million)	Resulting Conditions / Effects on Humans
50	Permissible Exposure Level (PEL) for 8 hours (OSHA)
200	Possible mild frontal headache in 2 to 3 hours
400	Frontal headache and nausea after 1 to 2 hours; Occipital headache (back of head) after 2 to 3 hours
800	Headache, dizziness, and nausea in 45 minutes; Collapse and possible death in 2 hours
1,600	Headache, dizziness, and nausea in 20 minutes; Collapse and possible death in 1 hour
3,200	Headache and dizziness in 5 to 10 minutes; Unconsciousness and danger of death in 30 minutes
6,400	Headache and dizziness in 1 to 2 minutes; Unconsciousness and danger of death in 10 to 15 minutes
12,800	Immediate effects: unconsciousness; Danger of death in 1 to 3 minutes

Typically, upon removal from exposure to carbon monoxide, symptoms usually resolve themselves, unless there has been an episode of severe acute poisoning.

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Carbon Monoxide Detector Types

Due to the common sources of carbon monoxide and the inherent dangers, detection of carbon monoxide is crucial. Common methods of indoor air quality testing include using detector tubes, diffusion tubes, color badges, portable gas monitors and household or industrial fixed-gas monitors.

Detector Tubes determine the instantaneous CO concentration in the air at any point in time. A pump pulls a volume of air through the detection media. When CO is present within the detection limits of the tube, the media changes color indicating the concentration. Diffusion tubes and badges also use color to reveal the concentration of CO but are designed to determine the dose (concentration over time).

Portable CO Detectors monitor the current level of CO. Most of these monitors have a digital readout as well as visible and audible alarms. When the concentration of CO reaches a preset level, the instrument's alarm will activate. Portable alarms are commonly used in industrial settings where ongoing CO exposures are tracked as well as for monitoring air quality before and during confined space entries. When monitoring confined space entries, a multi-gas detector with an oxygen sensor, a combustible sensor and the appropriate toxic gas sensors should be used. (For more information on Confined Space Entry, please request EZ Facts Document #115.)

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Fixed-Location Detectors are commonly used in industrial settings to monitor the ongoing concentration at a fixed point or source. They are mounted in one location and are equipped with visible and audible alarms. These devices can be set up to read the concentration at the control box or be used in conjunction with transmitters to detect CO in remote areas. Another common feature of fixed detectors is a relay device which is designed to signal certain events during an alarm condition (e.g., opening a door or turning on an exhaust fan).

Several organizations now recommend that people have a carbon monoxide alarm on every level of their home or apartment. While they are usually less sophisticated than their industrial cousins, a home carbon monoxide detector should also be equipped with both a visible and audio alarm. The Consumer Product Safety Commission (CPSC) recommends installing at least one carbon monoxide alarm with an audible warning signal near the sleeping areas in your home.

Carbon Monoxide Exposure Levels and OSHA Air Quality

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for carbon monoxide exposure is 50 parts per million (ppm) parts of air (55 milligrams per cubic meter (mg/m³)) as an 8-hour time-weighted average (TWA) concentration.

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The National Institute for Occupational Safety and Health (NIOSH) currently recommends exposure levels below the OSHA air quality numbers. They recommend keeping exposure under 40ppm during an eight hour period. The ACGIH has assigned a carbon monoxide threshold limit value (TLV) of 25ppm for that same time period.

Carbon Monoxide Poisoning Prevention Measures

Regardless of what your application is, it is important to be aware of the dangers of carbon monoxide and how to protect yourself. The following are a few suggestions to help protect yourself from carbon monoxide effects:

- Install a carbon monoxide detector in your business and your home
- Educate yourself and your family on the effects of CO poisoning
- Check gas appliances periodically for proper operation and venting
- Ensure chimneys, flues and vents are free and clear of debris
- Do not use un-vented gas and wood stoves or charcoal grills indoors
- Do not permit automobiles or other gas powered equipment from running indoors without proper exhaust ventilation
- Ventilate areas to dilute or reduce the concentration of carbon monoxide