

# Carbon monoxide (CO)

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<http://www.nutramed.com/environment/monoxide.htm>

Carbon monoxide (CO) is a colorless, odorless, poisonous gas. Deaths are usually caused by carbon monoxide poisoning from combustion in poorly ventilated enclosures. The symptoms of carbon monoxide poisoning are: headache, nausea, shortness of breath, dizziness and confusion. The severity of symptoms depends on the concentration of gas. Low level exposure produces chronic, flu-like symptoms and is usually not recognized.

Carbon monoxide gas is produced when fossil fuel burns incompletely because of insufficient oxygen. During incomplete combustion, the carbon and hydrogen combine to form carbon dioxide, water, heat, and deadly carbon monoxide. In properly installed and maintained appliances gas burns clean and produces only small amounts of carbon monoxide. Anything which disrupts the burning process or results in a shortage of oxygen can increase carbon monoxide production. Wood, coal, and charcoal fires always produce carbon monoxide, as do gasoline engines. Exposures in parts per million (PPM)

30 PPM Permissible	Average over 8 hours
200 PPM	Maximum for acute exposure
800 PPM Lethal	2 hour exposure

Sources: Combustion - furnaces, boilers, space-heaters, stove tops, hot water heaters ( gas), clothes dryers (gas), wood stoves, fireplaces, BBQ's, tobacco smoking, combustion engines, candles, incense, kerosene lanterns, propane appliances. Official recommendation: concentration levels should be below 30 PPM average exposure.

Our recommendation: safe concentration levels are 0 ( zero), the hazard increases dramatically above 30 PPM. Average occupational exposures above 10PPM (sustained through the work day) are unacceptable if your goal is normal function and good health long term. Smokers provide their own personal supply of carbon monoxide and may have exposure levels above safe limits when their personal CO exposure is added to ambient air exposure.

## Measurement

1. Stain indicator tubes - only useful for screening industrial environments.
2. electronic devices - use transducers for continuous monitoring
3. electrochemical devices - accuracy +/- 5%

## Physiology

When Carbon Monoxide is inhaled, the CO combines with the hemoglobin to form carboxyhemoglobin or COHb. The CO displaces the oxygen on hemoglobin. The COHb bond is over 200 times stronger than oxygen's bond with hemoglobin. The strong COHb bond also makes it difficult for the body to eliminate CO from the blood. Carbon Monoxide can poison slowly over a period of several hours, even in low concentrations.. Sensitive organs such as the brain, heart, and lungs suffer the most from a lack of oxygen. Unfortunately, the symptoms of CO poisoning are easily mistaken for other common illnesses and CO poisonings are often misdiagnosed.

Symptoms such as headaches, dizziness and fatigue are common to a number of illnesses such as the flu or the common cold. These symptoms can occur with a COHb blood saturation levels of 10-30%. At 30-50% COHb symptoms are nausea, severe headaches, dizziness, and increased pulse and respiration. COHb levels over 50% cause progressive symptoms proceeding to loss of consciousness, collapse, convulsions, coma, and finally death.

**How much is dangerous?** High concentrations of carbon monoxide kill in less than five minutes. At low concentrations it will require a longer period of time to affect the body. Exceeding the EPA concentration of 9 ppm for more than 8 hours will have adverse health affects. The U.S. Occupational Health and Safety limit for healthy workers is 50 ppm.

Carbon monoxide detectors, which are designed to protect against high concentration of carbon monoxide are required to sound an alarm when concentrations are greater than 100 ppm. Continued exposure to carbon monoxide can cause permanent brain, nerve, or heart damage. Some people require years to recover while others might never fully recover. The time of exposure, the concentration of CO, the activity level of the person breathing the CO, and the person's age, sex, and general health all affect the danger level. Exposure to Co at a concentration of 400 ppm will cause headaches in 1 to 2 hours; in 3 to 5 hours the same concentration can lead to unconsciousness and death. Physical exertion, with an accompanying increase in respiration rate, shortens the time to critical levels by 2 or 3 fold. Respiratory capacity decreases and the risk of heart attack increases at levels well below 50 ppm.

### **CO poisoning should be suspected when:**

- Entire family is sick at the same time.
- Flu-like symptoms decrease while away from the house.
- Illness is present when gas appliances are in use.
- Excess moisture on the interior of windows.

## **Urgent treatment- CO poisoning**

Move immediately into fresh air; administer oxygen if available. go to hospital for treatment. In severe cases, patients are treated in a hyperbaric chamber which forces carbon monoxide from the body.

The half-life of carboxyhemoglobin in fresh air is approximately 4 hours - complete flushing takes 12 to 24 hours. Oxygen and hyperbaric chambers, can reduce CO damage, speed recovery, and reduce medical problems.

Loss of consciousness suggests high levels of carbon monoxide poisoning, and patients tend to have symptoms for several weeks. They will suffer from headache, fatigue, loss of memory, difficulty in thinking clearly, irrational behavior, and irritability. Recover can be slow and frustrating. Some individuals suffer permanent brain and organ damage. Victims may be highly sensitive to CO for the rest of their lives.

A breath test can determine carbon monoxide levels. Medical laboratories can measure carboxyhemoglobin levels in the blood. Carboxyhemoglobin levels in the blood drop after the victim is removed from the carbon monoxide source. Because the effects of carbon monoxide poisoning may last for months, normal carboxyhemoglobin levels in the blood 24 or more hours after exposure are not relevant.

## **Protection from the dangers of carbon monoxide poisoning**

Purchase a carbon monoxide detector(s).

Check heating appliances by a qualified heating contractor.

Replace open heating units - space heaters, wood stoves and fireplaces with direct-vent, sealed combustion units.

## **Auto Emissions of CO**

### **US EPA Source**

In cities, about two-thirds of the carbon monoxide emissions come from transportation sources, with the largest contribution coming from highway motor vehicles. In urban areas, the motor vehicle contribution to carbon monoxide pollution can exceed 90 percent. In 1992, carbon monoxide levels exceeded the Federal air quality standard in 20 U.S. cities, home to more than 14 million people.

Carbon monoxide results from incomplete combustion of fuel and is emitted directly from vehicle tailpipes. Incomplete combustion is most likely to occur at low air-to-fuel ratios in the engine. These conditions are common during vehicle starting when air supply is restricted ("choked"), when cars are not tuned properly, and at altitude, where "thin" air effectively reduces the amount of oxygen available for combustion (except in cars that are designed or adjusted to compensate for altitude).

The Clean Air Act gives state and local governments primary responsibility for regulating pollution from power plants, factories, and other "stationary sources." The U.S. Environmental Protection Agency (EPA) has primary responsibility for "mobile source" pollution control. The EPA motor vehicle program has achieved considerable success in reducing carbon monoxide emissions. EPA standards in the early 1970's prompted automakers to improve basic engine design. By 1975, most new cars were equipped with catalytic converters that convert carbon monoxide to carbon dioxide. Catalysts typically reduce carbon monoxide emissions as much as 80 percent. In the early 1980's, automakers introduced more sophisticated converters, plus on-board computers and oxygen sensors to optimize the efficiency of the catalytic converter. Today's passenger cars are capable of emitting 90 percent less carbon monoxide over their lifetimes than their uncontrolled counterparts of the 1960's. As a result, ambient carbon monoxide levels have dropped, despite large increases in the number of vehicles on the road and the number of miles they travel. With continued increases in vehicle travel projected, however, carbon monoxide levels will begin to climb again unless even more effective emission controls are employed.

Carbon monoxide emissions from automobiles increase in cold weather. This is because cars need more fuel to start at cold temperatures, and because some emission control devices (such as oxygen sensors and catalytic converters) operate less efficiently when they are cold. Until 1994, vehicles were tested for carbon monoxide emissions only at 75° F. But recognizing the effect of cold weather, the 1990 Clean Air Act calls for 1994, and later, cars and light trucks to meet a carbon monoxide standard at 20° F as well.

The 1990 Clean Air Act also stipulates expanded requirements for Inspection and Maintenance programs. These routine emission system checks should help identify malfunctioning vehicles that emit excessive levels of carbon monoxide and other pollutants. The inspections will be complemented by requirements for on-board warning devices to alert drivers when their emission control systems are not working properly. Another strategy to reduce carbon monoxide emissions from motor vehicles is to add oxygen-containing compounds to gasoline. This has the effect of "leaning out" the air-to-fuel ratio, thereby promoting complete fuel combustion. The most common oxygen additives are alcohols or their derivatives.