Carbon Monoxide Concentrations and Effects

Concentration of CO in the Air	Effects, Inhalation Time, and Toxic Symptoms Developed
1-2 ppm (0.0001%)	Might be normal, from cooking stoves, spillage, outdoor traffic.
2 ppm (0.0002%)	Suggested maximum long-term allowable exposure. *Energy Conservatory*
Above 2 ppm	Raises questions about why CO is elevated. *Energy Conservatory*
9 ppm (0.0009%)	The maximum allowable concentration for short-term exposure in a living area. *ASHRAE*
15-20 ppm	Impaired performance in time discrimination (HbCO 2.0). Decrease in absolute exercise time (HbCO 2.5). Shortened time to angina response (HbCO 2.9). Vigilance decrement (HbCO 3.0). *World Health Organization*
27 ppm (0.0027%)	21 percent increase in cardiorespiratory complaints. *Kurt, 1978*
30 ppm (0.0030%)	Earlier onset of exercise-induced angina (HbCO 4.96%). *WHO-13*
35 ppm (0.0035%)	**The maximum allowable concentration for continuous exposure in any 8-hour period, according to federal law. *OSHA***
75 ppm (0.0075%)	Significant decrease in oxygen reserve available to the myocardium (HbCO 10%)
100 ppm (0.10%)	Level set by Chicago Fire Department for evacuation of the premises.
200 ppm (0.02%)	**Slight headache, tiredness, dizziness, nausea after 2-3 hours, might be life-threatening in long exposures. *Bacharach*** **This "ceiling level" should not be exceeded at any time. *OSHA***
400 ppm (0.04%)	Frontal headaches within 1-2 hours, life-threatening after 3 hours, maximum parts per million in flue gas under AGA test guidelines.
800 ppm (0.08%)	Dizziness, nausea and convulsions within 45 minutes. Unconsciousness within 2 hours. Maximum allowable gas oven concentration of a free air basis. Death within 2-3 hours.
1,200 ppm (0.12%)	Immediately Dangerous to Life and Health level set by OSHA.
1,600 ppm (0.16%)	Headache, dizziness and nausea within 20 minutes. Death within 1 hour.
3,200 ppm (0.32%)	Headache, dizziness and nausea within 5-20 minutes. Quickly impaired thinking. Death within 30 minutes.
6,400 ppm (0.64%)	Headache, dizziness and nausea within 1-2 minutes. Thinking impaired before response possible. Death within 10-15 minutes.
12,800 ppm (1.28%)	Death within 1-3 minutes.

Note: 10,000 ppm (parts per million) = 1% by volume

Residential Carbon Monoxide Detectors

UNITED STATES DEPARTMENT OF COMMERCE - National Institute of Standards and Technology (NIST) - Gaithersburg, Maryland 20899-0001

Public interest in residential carbon monoxide detectors has reached a very high level due to the increase in incidents of exposure to carbon monoxide, some of which have involved fatalities. Since this is a relatively new technology, many people are having difficulty in obtaining information on this subject. To address the need for reliable information, this document was put together by the National Institute of Standards and Technology in the public interest.

Carbon Monoxide Hazards

There are about 300 accidental carbon monoxide fatalities in American homes each year and thousands more are treated in hospitals for CO poisoning. Carbon monoxide is produced by combustion, and common causes of CO poisonings in the home include: defective gas or oil furnaces and water heaters, cracked chimney flues, and indoor use of charcoal grills.

Carbon monoxide is a colorless, odorless, and tasteless gas, so when present it is not noticed until its symptoms appear. Since its early symptoms include confused thinking, its victims often fail to make the connection and instead blame the flu or other causes. Frequently it takes someone who was not exposed to recognize the problem and obtain help for those affected. CO acts to reduce the ability of the blood to carry oxygen, suffocating its victims. Its effect is cumulative over time. Longer exposures to low concentrations can have the same effect as short exposure to higher concentrations. Symptoms begin with headache and confusion, progress to nausea and dizziness, and can lead to unconsciousness and death.

Carbon Monoxide Detectors

Since CO can't be seen, smelled, or tasted, the only way to know it's there is with a CO detector. While carbon monoxide monitors have been used in industrial settings for more than a decade, only in the past year have new sensor technologies made it possible to produce a reliable, low cost CO detector for the home. Designed much like home smoke detectors, there are some important differences which should be understood.

Like smoke detectors, CO detectors consist of a power source (either battery or AC power), a sensor, and a sounder to produce an audible alarm. They have a functional test feature which assures that they work and that their sensitivity has not fallen below a specified level.

How do carbon monoxide detectors work?

Two types of CO sensors are used. One has been used for years in fuel gas leak detectors, but is modified to react only to carbon monoxide. This is a solid state sensor which operates at an elevated temperature. Its internal heater consumes power, so that CO detectors using this type of sensor cannot be run from a battery. The sensor has a rated life of about ten years, at which time the entire detector should be replaced.

The other type of sensor uses a chemical which darkens when exposed to carbon monoxide. This chemical reaction is not reversible, so after a while the sensor needs to be replaced. In normal circumstances, the sensor will last for about two years; less if it is exposed to abnormally high levels of CO. Since the sensor consumes no power, this type of detector can easily be operated from a battery.

How can I identify a good CO detector?

The best way is by looking for the "UL" label. Underwriters Laboratories has developed a product performance standard for these detectors, called UL 2034. They subject CO detectors to over 30 tests to assure they are reliable, will not detect household products or other gases, and will respond to carbon monoxide before the onset of any effects on those exposed. UL 2034 requires that CO detectors react in the same way that people do - to a concentration over time. The alarm is delivered before the oxygen carrying capacity of blood is reduced by 10%. Thus, even those with lowered tolerance due to illness would be protected. Any CO detector which meets this standard will be marked "Underwriters Laboratories, Inc. Listed Single or Multiple Station Carbon Monoxide Detector."

How many do I need?

The best advice is to place a CO detector on every floor level of your home, near where your smoke detectors should be located. Carbon monoxide is neutrally buoyant, which means that it is carried along with the normal air currents. CO might enter your house at the furnace or water heater, but might also come from a crack in a flue pipe within a wall. Thus, to be protected, the whole house should be covered. Since CO concentration can be as high near the ceiling as near the floor, NIST recommends mounting them on the ceiling or high on the wall so they will not be accidentally struck and possibly damaged.

What do I do if it goes off?

The reaction to a CO detector should be the same as for the smoke detector -- get everyone out as quickly as possible and call the fire department. They will confirm the presence of CO, open windows to eliminate the gas, and then locate the source of the problem.

If I get a CO detector do I still need a smoke detector?

YES! While fires produce carbon monoxide, it will take longer for most fires to produce an alarm in a CO detector than for a smoke detector. Thus, CO detectors will provide less warning time for fires, and may not provide enough time to escape.