

Maintenance of fuel-burning equipment and vehicles (including autos) is crucial, and vehicle exhaust systems need to be regularly inspected for leaks, cracks, or other damage.

Since CO has no warning properties, MSHA recommends continuous monitoring plus an audible alarm system be in place wherever CO is a potential hazard. There are also portable CO detectors that can trigger an alarm.

* ACGIH Threshold Limit Value (TLV®) booklets, 1972 and 1973 editions
**1973 TLV® edition, with PA Rules, adopted by MNM
***1972 TLV® edition adopted by Coal Mine S&H

Want more information?

Contact your local MSHA office, or one of MSHA's national offices: Coal (202) 693-9510 or Metal/Nonmetal (202) 693-9630; or the Pittsburgh Safety and Health Technology Center at (412) 386-6901.

U.S. Department of Labor
Mine Safety and Health Administration
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Carbon Monoxide and Mining



Health Hazard Information Card HH-28

Carbon monoxide (CO) is one of the most common and serious hazards in mining operations, both surface and underground, all types of confined spaces, and in the cabs of vehicles. In major fires, victims usually die from exposure to CO and other gases rather than from burns or other causes.

What is carbon monoxide (CO)?

CO is a colorless, odorless, tasteless gas produced by the burning of carbon-containing materials such as gasoline, wood, diesel fuel, paper, explosives, or gases used in welding. Even at ambient mine temperatures, some coals slowly produce CO.

Gases such as ammonia and chlorine are irritating to the skin, eyes, and throat and have a very definite smell. CO, however, has no odor or other warning properties. This increases its hazard.

How does CO affect the body?

CO acts as a poison because it interferes with the body's chemical activity, causing chemical asphyxiation. CO passes easily from the lungs into the blood stream where it attaches to the red blood cells portion of hemoglobin, the oxygen carrier of the blood. This is because the body has a greater affinity for CO – that is, it prefers CO to oxygen, thus allowing CO to bind about 250 times faster and more strongly than oxygen. As the level of CO increases, the body continues to block and reduce oxygen from entering. As the oxygen in the blood is replaced by CO, the

body's organs and tissues – which depend on oxygen – become damaged and cannot work properly.

What are the symptoms of CO poisoning?

Health effects from exposure to CO levels of approximately 1 to 70 ppm (parts per million) are uncertain, but most people will not experience any symptoms. For healthy adults, CO becomes toxic when it reaches a level higher than 50 ppm with continuous exposure over an eight-hour period. When the level of CO is higher than that (between 70 ppm and 100 ppm), the initial symptoms of CO poisoning are similar to food poisoning or the flu (but without the fever). In fact, most of the early signs of acute CO exposure point to a lack of oxygen to the brain. They include:

- ›headache
- ›fatigue
- ›sore eyes
- ›dizziness, weakness
- ›runny eyes
- ›nausea

Medium exposure (a CO level between 150 ppm to 300 ppm) will produce increased dizziness, vomiting, reddened skin, drowsiness, ringing in the ears, and breathing difficulties. Other symptoms reported include chest pain, impaired judgment, confusion, memory and walking problems, depression, abdominal pain, hallucinations, agitation, visual changes, and seizures.

Once CO begins to affect alertness and coordination, it becomes a significant factor in on-the-job accidents.

Extreme exposure to a CO level of 400 ppm and higher for 3 to 5 hours will result in convulsions, coma, collapse, unconsciousness, brain damage, even death. Even if CO comprises only 0.64% (equal to 6400 ppm which is less than 1 percent) of the air

you're breathing, death from chemical asphyxiation can occur within a half an hour. Long-term exposure to lower levels of CO may show up as loss of coordination and fatigue, which are difficult to link to any one type of chemical exposure. Chronic exposure even at low levels may also be a factor in cardiac disease and nervous system damage. Also, survivors of CO poisoning still face the prospect of delayed neurologic dysfunction, which occurs in 14% to 40% of serious cases.

What is the law?

Operators of coal and all other mines may not allow workers to be exposed to CO over 50 ppm averaged over an 8-hour workday.* In metal and nonmetal mines, no one is allowed to be exposed to CO levels greater than 400 ppm for 15 minutes** without proper approved respiratory protection. The excursion (or short-term limit) for CO in coal mines is 75 ppm for 15 minutes*** without proper approved respiratory protection.

Other standards related to the generation of and potential exposure to CO mandate fire alarm systems, escape and evacuation plans, self-rescuers, good housekeeping (keeping flammable items removed), and controls.

How can CO be controlled?

Effective ventilation, which is specifically required underground and in confined spaces, is the major engineering control. General ventilation is used to move clean fresh air into and stale air out of an area such as a mine, a shop, or other work places. Local exhaust ventilation, such as a duct attached to vehicle tailpipes in repair areas, or extractors on drills, is another control measure for removing CO and other toxic gases.