Monitoring

- CO can be monitored continuously throughout the workshift with direct-reading instruments or colormetric detector tubes
- An 8-hour, time-weighted average can be determined with a CO-specific dosimeter:
  - 8-hour, time-weighted average: 35 parts of CO per million parts of air (35ppm)
  - Ceiling limit: 200ppm
  - Short-term exposure limit: none established

Personal Protective Equipment

- Engineering controls are the best way to reduce and control the hazard. Supplied-air respirators or self-contained breathing apparatus may be used for operations that require entry into confined spaces. Air purifying respirators cannot be used, as CO is an odorless and colorless gas.

First Aid

- Move the exposed person to fresh air and seek medical help. Perform artificial respiration if breathing has stopped and you are trained to do so.

This information is based on the MIOSHA Occupational Health publication OH-929 (3/96).

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Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless and tasteless gas with no warning properties.

Sources

- CO is generated environmentally in combustion processes as the result of incomplete combustion. It is a common air pollutant.
- Common sources of CO indoors:
  - Fuel-powered vehicles (powered industrial trucks)
  - Poorly ventilated or malfunctioning heating furnaces
  - Fuel-powered equipment
  - Welding, cigarettes, fires

Toxic Effects

- CO poisoning occurs by inhalation — symptoms are related to CO exposure, which is dependent on concentration in the air and duration of exposure
- CO competes with oxygen for the hemoglobin in the red blood cells — binding tightly to hemoglobin to form *carboxyhemoglobin*
- The affinity of hemoglobin for CO is nearly 210 times greater than oxygen
- CO bound with hemoglobin decreases the amount of hemoglobin available to bind with oxygen, resulting in a lack of oxygen for body tissues

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Toxic Effects *(continued)*

- Individual exposures can be determined by measuring concentrations of CO in the air or carboxyhemoglobin in the blood
- A victim of CO poisoning has the same problem as the anemic patient — inability to transport the proper amount of oxygen for the body, even if the air inhaled contains the normal amount of oxygen (20–21%)
- Carboxyhemoglobin levels in the blood of a non-smoker range from 1–3%; in a heavy smoker the range is 5–10%

Symptoms of CO Exposure

- Early symptoms are nonspecific — headache, dizziness, weakness, nausea, visual disturbances and confusion
- Absence of a sore throat or fever can distinguish CO poisoning from the flu
- Symptoms are reduced when exposed to fresh air
- Carboxyhemoglobin levels in the blood:
  - ➢ 10–20% tightness around the forehead, slight headache, an increase in the size of blood vessels at the skin
  - ➢ 20–30% headache and throbbing in the temples
  - ➢ 30–40% severe headaches, weakness, dizziness, dimness of vision, nausea, vomiting and collapse
  - ➢ 50–60% results in fainting, increased respiration and pulse, coma with intermittent convulsions, and irregular heart action and respiration
  - ➢ 60–70% results in coma and possible death
  - ➢ 70–80% weak pulse, respiration and death

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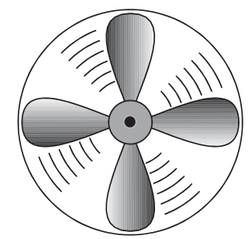
Exposure Control Methods

Depending on the source of CO, any or all of the following control methods should be used to reduce the exposure:

- Provide general and/or local exhaust ventilation, along with tempered make-up air to prevent backdrafting
- Inspect and maintain equipment on a periodic basis
- Install carbon monoxide alarms in those areas which may have recurring high levels of carbon monoxide
- Keep powered industrial trucks well tuned
- Use catalytic converters that remove most of the CO from the exhaust, if applicable for the type of powered industrial trucks used
- Turn off vehicles when not in use
- Provide general dilution ventilation if local exhaust ventilation is not possible
- Monitor employee work areas
- Replace fuel-powered powered industrial trucks with electric driven where possible



Training

- Train employees on the health effects of CO and on the measures to protect themselves

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