



CARBON MONOXIDE (CO)

1. INTRODUCTION

- 1.1 Due to increased public awareness and the availability of carbon monoxide (CO) detectors for the home, the Fire Department is being called to investigate activated CO detectors and other CO related emergencies.

2. PROPERTIES

- 2.1 CO is a colorless, odorless, tasteless, non-irritating, toxic gas.
- 2.2 CO is a natural by-product of incomplete combustion from fuels such as (gasoline, wood, coal, propane, oil and methane).
- 2.3 In the home, heating and cooking equipment are possible sources of CO. Vehicles running in an attached garage can also produce dangerous levels of CO. When a faulty appliance or unusual condition exists, CO may be vented into areas where people are present. CO has been known to vent into nearby buildings from manhole fires.
- 2.3 Virtually undetectable without special instruments.
- 2.4 It is a flammable gas with an auto ignition temperature of 1128 Degrees F., and a Lower Explosive Level (LEL) of 12.5% and an Upper Explosive Level (UEL) of 74%.
- 2.5 CO has a vapor density which makes it slightly lighter than air (.968). Since warm air rises, CO rises with it. E.g. air from a furnace, hot water heater, or a fire. Once this emitted air cools to room temperature, CO will disperse evenly through the room.
- 2.6 All ladder companies have been issued CO meters. Units responding to suspected CO incidents shall be guided by the procedures in Sections 4.

3. Health Hazards

- 3.1 CO can kill before its presence is known.
- 3.2 Provides no early warning signs.
- 3.3 Displaces O₂ in bloodstream and asphyxiates victim.
- 3.4 Highly toxic.
- 3.5 CO is absorbed into the body through the lungs where it is transferred to your blood.
- 3.6 Once in the body it combines with hemoglobin and becomes a deadly compound called carboxyhemoglobin (COHb). Poisoning is measured by percentage of COHb in the blood.
- 3.7 COHb reduces blood's ability to transport O₂ to the body.
- 3.8 Reduced O₂ harms life support functions (brain, cardiac and respiratory activity).
- 3.9 CO has a greater affinity for hemoglobin than O₂ . CO is about 210 more attracted to hemoglobin than O₂.
- 3.10 Final levels of COHb depend on the following factors:
 - a. Initial COHb concentration.
 - b. Concentration of CO inhaled.
 - c. Length of CO exposure.
 - d. Activity while inhaling CO.
 - e. Body size and other physiological factors.
- 3.11 To reverse the buildup of COHb in the body, over 200 parts of oxygen are required to replace one part of CO.
- 3.12 Symptoms of CO Poisoning:
 - a. Low Level CO Poisoning- can mimic flu symptoms, headache (mild/severe), fatigue, nausea, dizziness, confusion, irritability.
 - b. Medium Level CO Poisoning- vomiting, drowsiness, loss of consciousness.
 - c. High Level CO Poisoning- seizure, coma, permanent brain damage, death.

3.13 Signs and Symptoms at Various Carboxyhemoglobin Concentrations

COHb Level % / Signs and Symptoms:

0	Usually none
10	Frontal headache
20	Throbbing headache, shortness of breath on exertion.
30	Impaired judgment, nausea, dizziness, visual disturbance, fatigue
40	Confusion, loss of consciousness
50	Coma, seizures
60	Hypotension, respiratory failure
70	Death

Reference: CO Poisoning by Reisdorff & Wiegenstein / Emergency Medicine: A Comprehensive Study Guide 3rd Ed. New York McGraw Hill; 1992:704

3.14 Carboxyhemoglobin level is calculated by the following equation:

$$\begin{aligned} \text{Concentration Over a Time Period} &= \text{Dose} \\ (\text{How Much}) (\text{For}) (\text{How Long}) &= (\text{How Bad}) \\ \text{E.G.: } 100 \text{ PPM CO over } 90 \text{ Min.} &= 10\% \end{aligned}$$

3.15 The Occupational Safety and Health Administration has established a maximum safe working level for CO at 35 parts per million (p.p.m.) over an eight (8) hour period in the general work place. The U.S. Environmental Protection Agency (EPA) has established that residential levels are not to exceed 9 p.p.m. over an 8 hour average.

4. OPERATIONAL GUIDELINES

4.1 Operational Guidelines for Response to CO Detector Activation and CO Emergencies.

- 4.1.1 Are any individuals exhibiting symptoms of CO poisoning? If so immediately evacuate the affected area, ventilate, and request E.M.S. to respond.
- 4.1.2 Request the response of a company equipped with a CO meter if one is not already on the scene.

- 4.1.3 Using a CO meter, take an initial reading at the front door of premises, then continue investigation to find source of CO in premises.
- 4.1.4 If no one exhibits any symptoms of CO poisoning, evacuation is not necessary, unless a level of over 9 PPM is recorded by the meter.
- 4.1.5 The Incident Commander (IC) shall request the utility company to respond if:
 - a. A CO level over 9 PPM is recorded by a meter.
 - b. Units on the scene shut off a gas appliance.
 - c. An individual(s) is exhibiting symptoms of CO poisoning.
 - d. The IC feels a response by the utility company is required.
- 4.1.6 If the source of the CO is not found in the building, the origin may be in an attached exposure or from outside the building.
- 4.2 CO investigation will determine if the response is an “Incident” or an “Emergency”.
 - 4.2.1 CO Incidents: No occupants are symptomatic and meter readings of 9PPM or less.
 - 4.2.2 CO Emergencies: Occupants are symptomatic or meter readings greater than 9PPM
 - 4.2.3 CO meter needed to test for a suspected CO presence.
 - 4.2.4 CO meters are to be used according to manufacturer’s instructions.
 - 4.2.5 SCBA shall be worn at all CO investigations, and used at all CO Emergencies.
 - 4.2.6 Search of the premises is to be conducted by a radio equipped team of a least two firefighters.
- 4.3 CO Incidents: Meter readings of 9 PPM or less:
 - 4.3.1 Inform occupant that our meter has not detected an elevated CO level.
 - 4.3.2 Attempt to reset detector, if detector does not reset or it does not have a reset , recommend that the occupant refer to the manufacturer’s instructions.

4.3.3 Inform occupants that if detector activates again that they should again call 911 to notify the Fire Department.

Note: The condition may have been caused by reverse stacking or a downdraft. Leaving a window open could eliminate the problem.

4.4 CO Emergency: Meter readings of greater than 9 PPM but less than 100 PPM:

4.4.1 Readings of greater than 9 PPM shall not be considered normal.

4.4.2 Inform occupants that they have a potentially dangerous level of CO.

4.4.3 Recommend that all persons leave the affected area and begin ventilation.

4.4.4 If it is determined that an appliance is malfunctioning and thereby producing CO, it should be shut down.

4.4.5 Once the faulty appliance is shut down and ventilation has reduced the CO level to 9 PPM or less the premises may be reoccupied.

4.4.6 Attempt to reset the detector as in section 4.3.2

4.4.7 Inform the occupant of all actions taken and that the utility company has been requested to respond.

4.4.8 Inform the occupant that if the detector activates again they should again notify the Fire Department by calling 911.

4.5 CO Emergency: Meter Readings of 100 PPM and Greater:

4.5.1 Inform occupants that we have detected a potentially lethal level of CO.

4.5.2 Begin evacuation of the affected area and ventilate.

4.5.3 If a malfunction appliance is found producing CO it should be shut down.

4.5.4 Once the source of CO has been mitigated and the level of CO reduced to 9 PPM or less the area may be reoccupied.

4.5.5 Attempt to reset the detector as in section 4.3.2.

4.5.6 Inform occupants of the actions taken, and that the utility company has been requested to respond.

4.5.7 Inform occupants that if the detector activates again they should again notify the Fire Department by calling 911.

5. REPORTING (FIRE REPORT CODES, AND RADIO SIGNAL CODES)

5.1 In order to track Carbon Monoxide investigations the following procedures will be in effect:

5.1.1 The Incident Commander shall transmit the following Radio Code Signal:

10-38 Carbon Monoxide Response

Any type of Carbon Monoxide Response

Code 1: Detector Activation: Carbon Monoxide Investigation (low battery, defective detector, unwarranted alarm, etc.)

Code 2: Detector Activation: Carbon Monoxide **Incident** (CO Meter Reading of 1-9ppm).

Code 3: Detector Activation: Carbon Monoxide **Emergency** (CO Meter Reading of greater than 9ppm).

Code 4: **No** Detector Activation: Carbon Monoxide Incident or Emergency (Specify) e.g.: No detector present in affected area, detector present in affected area, but did not activate.

5.1.2. A BF-25A, BF-25B or BF-25 shall be utilized in accordance with AUC 210. Use fire report code number 28 (Defective Alarm Device) when transmitting 10-38-Code 1 and fire report code 18 (Leaks, Illum., Gas. Flam Vapor) when transmitting 10-38 Codes 2, 3 or 4.

BY ORDER OF THE FIRE COMMISSIONER AND THE CHIEF OF DEPARTMENT