Carroll County Department of Fire & EMS
Standard Operating Procedure

DOCUMENT DETAILS

Standard Operating Procedure: 4.10	**Effective Date: July 1, 2025**
Subject: Carbon Monoxide Emergencies	**Section: Fire Rescue Operations**
Authorized: Deputy Chief Paul Supko	**Revision Date: July 1, 2025**

Applicability: **[X] Volunteer** **[X] Career**

I. PURPOSE

Responding to a reported carbon monoxide alarm presents unique safety challenges to fire departments. The chemical and physical properties associated with carbon monoxide increase the reliance on detection equipment. This document provides information and guidance pertaining to incidents involving carbon monoxide (CO) responses.

II. DEFINITIONS

Carbon monoxide - A colorless, odorless, and flammable gas that interferes with the body's ability to transport oxygen, leading to tissue hypoxia and potentially death.

Chemical asphyxiant - A toxic gas or vapor that interferes with the body's ability to transport or utilize oxygen, leading to unconsciousness or death.

III. BACKGROUND

Carbon Monoxide (CO) is a colorless, odorless gas that can cause chemical asphyxiation. CO is produced by automobiles, kitchen stoves, water heaters, furnaces, etc. When such devices are faulty or unusual circumstances exist, carbon monoxide may be vented into occupied areas, thereby creating the possibility of carbon monoxide poisoning.

CO poisoning may be difficult to diagnose. Its symptoms are similar to the flu and may produce headache, nausea, fatigue, and dizziness. Any patient potentially exposed to carbon monoxide should be evaluated for elevated carboxyhemoglobin levels and treated according to protocol. Pets and children may exhibit signs and symptoms before adults.

Carbon Monoxide Detection:

There are known causes of false alarm activations for many CO detectors/sensors. Responders must determine if a CO alarm/sensor activation is a true alarm or an interference gas triggering an alarm.

Hydrogen and Acetylene can be cross interference gases and can cause a false reading on a residential carbon monoxide alarm and a fire department atmospheric monitor. Hydrogen can be released from a lead acid battery when overcharged, (ex. Sump pump battery) causing elevated CO readings on the atmospheric monitor.

IV. PROCEDURES

A. Pre-Entry

1. Remove all occupants from the structure and determine if any are showing potential signs of carbon monoxide poisoning.

2. Determine any potential causes for carbon monoxide alarms/concerns.

3. Turn on the carbon monoxide monitor, "zero" in a clean environment.

4. Clear the peak readings from the last carbon monoxide incident that was stored in the monitor's memory.

5. The first due engine crew will have PPE/SCBA donned for CO investigations. Members will don PPE to include turnout gear and SCBA when operating in the potential IDLH on CO incidents.

B. Investigation

1. Verify the type of incident: gas odor vs carbon monoxide release.

2. If carbon monoxide is detected, enter the structure and proceed slowly to the most likely cause of the carbon monoxide. Observe the readings while moving through the structure.

3. Determining the source may require the process of elimination, shutting down one source at a time to determine if the CO levels continue or dissipate.

4. Ensure **all** levels of structure are monitored.

5. If the structure was ventilated prior to fire department arrival, close the structure's doors and windows to assist in locating the source.

C. Action Levels

1. 0-9 ppm

a. Isolate the source by shutting off the combustion appliance/motor and or shut off the gas to the appliance/motor at the valve and ventilate the structure.

i. Crews shall adequately ensure that the CO levels do not return following ventilation.
ii. This may include closing the structure back up and re-monitoring.

b. Advise occupants to have the appliance serviced.

c. Occupants can reoccupy the structure per EPA standards.

d. Advise occupants to call the fire department back if carbon monoxide alarm re-activates or if an occupant feels symptoms consistent with carbon monoxide poisoning.

2. 10-35 ppm

a. Isolate the source by shutting off the combustion appliance/motor and or shut off the gas to the appliance/motor at the valve and ventilate the structure.

i. Crews shall adequately ensure that the CO levels do not return following ventilation.
ii. This may include closing the structure back up and re-monitoring.

b. Advise occupants to have the appliance serviced.

c. If unable to get CO levels less than 10ppm after ventilation, occupants should not reoccupy the structure until service or repairs are made.

d. Advise occupants to call the fire department back if carbon monoxide alarm re-activates or if an occupant feels symptoms consistent with carbon monoxide poisoning.

3. 35 ppm or greater

a. Firefighters will don SCBA and request an additional unit to ensure compliance with two in - two out.

b. Request a special service to assist with ventilation.

c. Isolate the source by shutting off the combustion appliance/motor and or shut off the gas to the appliance/motor at the valve and ventilate the structure.

i. Crews shall adequately ensure that the CO levels do not return following ventilation.
ii. This may include closing the structure back up and re-monitoring.

d. Advise occupants to have the appliance serviced.

e. If unable to get CO levels less than 10ppm after ventilation, occupants should not reoccupy the structure until service or repairs are made.

f. Advise occupants to call the fire department back if carbon monoxide alarm re-activates or if an occupant feels symptoms consistent with carbon monoxide poisoning

D. Termination

1. Only in circumstances when units are unable to isolate and/or determine the source of the carbon monoxide, will the gas be shut off at the meter to the structure.

2. Advise communications of the highest levels of carbon monoxide found, and the disposition of the call. When transmitting this message, the unit will state:

*" (Unit) to Carroll, **enter into the CAD notes**, we had 12 ppm on the first floor isolated to the hot water heater. Gas to the water heater has been secured, house has been ventilated to zero PPM.*

V. RECISION

This Standard Operating Procedure rescinds all directives regarding Carbon Monoxide Emergencies or similar content previously issued for personnel of the Carroll County Department of Fire & EMS.

VI. RELATED STANDARD OPERATING PROCEDURES / DOCUMENTS

N/A

VII. ATTACHMENTS

Appendix 1 Carbon Monoxide Emergencies

Appendix 1: Carbon Monoxide Emergencies Information Sheet

I. DEFINITIONS

ACGIH/ American Conference of Governmental Industrial Hygienists – Not law unless incorporated through reference. Establishes TLV's for chemicals that are often more restrictive than OSHA PEL's.

AEGL – Acute exposure guideline levels, describe the human health effects from once-in-a-lifetime, or rare, exposure to airborne chemicals on specified time periods of 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours.

AEGL 1 - Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL 2 - Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL 3 - Life-threatening health effects or death.

Carbon monoxide - A colorless, odorless, and flammable gas that interferes with the body's ability to transport oxygen, leading to tissue hypoxia and potentially death.

Ceiling – Set by OSHA, the value that shall not be exceeded at any time

Chemical asphyxiant - A toxic gas or vapor that interferes with the body's ability to transport or utilize oxygen, leading to unconsciousness or death.

NIOSH/National Institute of Occupational Safety and Health – Not law unless incorporated through reference. Research arm of OSHA. Sets REL's

OSHA/Occupational Safety and Health Administration – Laws for workplaces, we have to follow. These values are not necessarily designed for the elderly or young population. 1910.1000 Table Z lists exposure levels for many chemicals. OSHA sets PEL's, Ceiling and STEL values.

PEL – Set by OSHA. Permissible exposure level. OSHA's TWA is specified as a PEL

REL – Set by NIOSH. Recommended exposure level, up to a 10 hour TWA

STEL – Short term exposure level, typically a 15 minute exposure that can occur 4 times a day and is separated by 1 hour

TLV – Set by ACGIH. Level to which it is believed a worker can be exposed day after day for a working lifetime without adverse effects.

TWA – Time weighted average over an 8 hour period of a 40 hour work week. May not be applicable for a non workplace environment.

II. BACKGROUND

Carbon Monoxide (CO) is a colorless, odorless gas that can cause chemical asphyxiation. A chemical asphyxiant can prevent the delivery of oxygen from the bloodstream to cells but does not necessarily cause an oxygen deficient atmosphere. Carbon monoxide can be produced during incomplete combustion but can also be released from a variety of chemical reactions, where the traditional combustion process is not present.

Responders could encounter CO during the following type of incidents:

- Malfunctioning gas fed appliances
- Post fire environments
- Diesel/gas powered vehicle exhaust
- Intentional/unintentional chemical reaction

Carbon Monoxide Hazards:

A high-level acute exposure can cause headache, fatigue, dizziness, drowsiness, nausea, chest pain, vomiting, confusion and loss of consciousness. A low-level chronic exposure can cause other health effects. Carbon monoxide can also serve as a fuel. The flammable range is 12.5% (125,000 ppm) to 74% (740,000 ppm)

Carbon Monoxide Detection:

There are known causes of false alarm activations for many CO detectors/sensors. Responders must determine if a CO alarm/sensor activation is a true alarm or an interference gas triggering an alarm.

Any patient potentially exposed to carbon monoxide should be evaluated for elevated carboxyhemoglobin levels and treated according to protocol. Pets and children may exhibit signs and symptoms before adults. Specific information pertaining to the exposure should be passed on to everyone involved in the treatment process. (ie engine companies on scene investigating after EMS crew transport patients)

CO has a relative gas density of .97 (air = 1)2 which means that although it is slightly lighter than air, it can be found almost anywhere as convection currents and other environmental factors can cause the gas to “pocket” inside a structure.

Armor All™ and other protective cleaners sprayed in close proximity to CO alarms/sensors can cause false readings.

Hydrogen and Acetylene can be cross interference gases and can cause a false reading on a residential carbon monoxide alarm and a fire department atmospheric monitor. Hydrogen can be released from a lead acid battery when overcharged, causing elevated CO readings on the atmospheric monitor.

NIOSH has established a maximum safe working level for carbon monoxide at 35 ppm over an 8-hour period in the general workplace; which means that the CO reading should never exceed this number at any given point in the general workplace. The EPA has established that residential levels are not to exceed 9 ppm over an 8-hour period; this means that the CO reading should never exceed this number at any point in the residential setting.

Reference values:

OSHA PEL/TWA: 50 ppm

OSHA Ceiling: 200 ppm

NIOSH REL: 35 ppm

NIOSH IDLH: 1200 ppm

AEGL 2 (10 min): 420 ppm