



East County Fire and Rescue Standard Operating Guidelines

Title Hazmat Response-Carbon Monoxide Incidents	SOG # 4.6.2
Policy Adoption 	Date 2/6/2024
Standard Operating Guideline Adoption 	Date 2/6/2024

Purpose

Unintentional, non-fire-related Carbon Monoxide (CO) poisoning is responsible for many injuries and deaths in the United States each year. CO exposure may result from fires and malfunction or misuse of fuel burning appliances and equipment. Safe and effective response to this type of incident requires an understanding of the characteristics of carbon monoxide, its physiological effects, atmospheric monitoring, and mitigation procedures.

Scope

This Standard Operating Guideline (SOG) defines appropriate response to carbon monoxide alarms, where there has been or may be a release of carbon monoxide, and carbon monoxide poisoning.

Policies

ECFR has established the following policies related to carbon monoxide incidents:

- All carbon monoxide alarm activations shall be considered an indication of the presence of carbon monoxide unless atmospheric monitoring determines that no hazardous level of carbon monoxide is present.
- Incidents in which a medical patient is reported to have or exhibits the signs and symptoms of carbon monoxide poisoning shall be considered an indication of the presence of carbon monoxide until atmospheric monitoring determines that no hazardous level of carbon monoxide is present.
- In incidents involving carbon monoxide alarm activation or where an elevated level (>9 ppm) of carbon monoxide is detected, occupants shall be provided with an informational handout on the hazards of carbon monoxide and function of carbon monoxide alarms.
- Subject to the availability of funds, carbon monoxide alarms will be installed in owner occupied homes containing fuel burning appliances. In rental properties, loaner alarms will be provided, and the property owner advised of the requirement to install carbon monoxide alarms as required by RCW 19.27.530

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

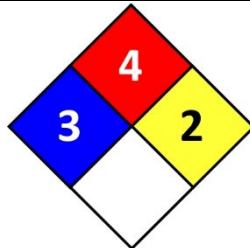
Procedure

The following procedures have been established for response to incidents where a hazardous concentration of carbon monoxide is or may be present except for structure fires and other fire incidents (all of which present a risk of exposure to carbon monoxide). Procedures for response to fire incidents are addressed in other ECFR Standard Operating Guidelines (SOGs).

Carbon Monoxide

Carbon Monoxide (CO) is produced by the process of incomplete combustion of organic materials. Common sources include vehicle exhaust, cooking appliances, hot water heaters (gas or oil), and heating equipment (gas, oil, solid fuels). Table 1 provides an overview of the characteristics and physiological effects of CO.

Table 1. Characteristics & Physiological Effects of Carbon Monoxide

Product Name (UN/NA ID) Carbon Monoxide (1016)		Formula CO	NAERG Guide 119	
Description Colorless, tasteless, odorless gas.				
Molecular Weight 28.01	Vapor Density 0.97	Specific Gravity n/a (gas)	Vapor Pressure >35 atm	Ionization Potential 14.01 eV
Solubility 2%	Flash Point n/a (gas)	LFL 12.5%	UFL 74.0%	Ignition Temperature 1128° F (608.8° C)
TLV-TWA (ACGIH) 25 ppm	STEL (15 min) 200 ppm	IDLH 1200 ppm	Routes of Entry Inhalation	
Physiological Effects Chemical asphyxiant, attaches to hemoglobin which has 210 times greater affinity for CO than O ₂ . Effects are persistent and are cumulative.				
Symptoms of Exposure Acute exposure: The signs and symptoms of acute exposure to carbon monoxide may include headache, dizziness, lassitude (weakness, exhaustion), confusion, hallucinations, tachypnea (rapid respiration), flushing, nausea, vertigo, irritability, cyanosis, syncope (unconsciousness), depressed S-T segment of electrocardiogram and in persons with preexisting heart disease and atherosclerosis, angina (chest pain) and leg pain. 200 ppm - Slight headache within two to three hours with loss of judgment 400 ppm - Frontal headache within one to two hours with loss of judgment 800 ppm - Dizziness, nausea, and convulsions within 45 min; insensible within 2 hours Chronic exposure: repeated exposures to carbon monoxide poisoning may cause persistent signs and symptoms, such as anorexia, headache, lassitude, dizziness, and ataxia.				
Other The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) has established 9 ppm as a voluntary standard for maximum residential concentration of carbon monoxide (ASHRAE, 2013).				

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

Note: Characteristics and physiological effects of carbon monoxide references included the *NIOSH Pocket guide to chemical hazards*. (NIOSH, 2020). And *Emergency response guidebook* (DOT, 2020)

Initial Incident Information

Many carbon monoxide incidents are dispatched due to CO alarm activation at residential occupancies. But carbon monoxide incidents are also initiated as an ill or unconscious person EMS call where the caller is unaware their symptoms are being caused by carbon monoxide.

Carbon Monoxide Incident Response Levels

Carbon monoxide incident response can result from a variety of computer aided dispatch (CAD) event types:

- **Alarm Activation:** This event type results in dispatch of a single engine.
- **Alarm Activation without Priority Symptoms:** This event results in dispatch of a single engine and medic unit.
- **Carbon Monoxide/Inhalation/Hazmat:** If the information provided by the reporting party indicates potential carbon monoxide poisoning, this results in dispatch of two engines, a medic unit, and command officer.
- **Medical Incident Reflecting Symptoms of Exposure:** These event types may not indicate presence of carbon monoxide, but simply that the patient has a headache, nausea, weakness, altered mental status including loss of consciousness or other symptom of exposure.

If information provided in the CAD notes or initial size-up indicates potential for hazardous levels of carbon monoxide, ensure that a minimum of two engines, medic unit and command officer are dispatched. Consider adding additional medic units if the cad notes indicate multiple patients.

Hazmat Qualifications & Equipment

Qualifications Requirements: Carbon monoxide is a hazardous material commonly encountered in fire incidents. As such, hazardous materials responders at the operational level and/or firefighters may make entry and operate offensively to rescue exposed civilians and mitigate hazards presented.

Atmospheric Monitoring Equipment: Determining presence and quantifying the concentration of carbon monoxide requires the use of atmospheric monitoring equipment. Each first line engine is equipped with a MSA Altair four-gas monitor that contains flammability (% LEL), oxygen, carbon monoxide, and hydrogen sulfide sensors.

Personal Protective Equipment: As carbon monoxide is a toxic and flammable gas with no warning properties (odorless and colorless), self-contained breathing apparatus and structural firefighting clothing is indicated where there is or may be hazardous concentrations present.

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

Strategic Decision-Making Model

The strategic decision-making model is at the core of incident operations at all incidents (Figure 13). Consider the fixed and variable critical hazmat incident factors illustrated in Table 4 when operating at hazardous materials incidents.

Figure 1. Strategic Decision-Making Model

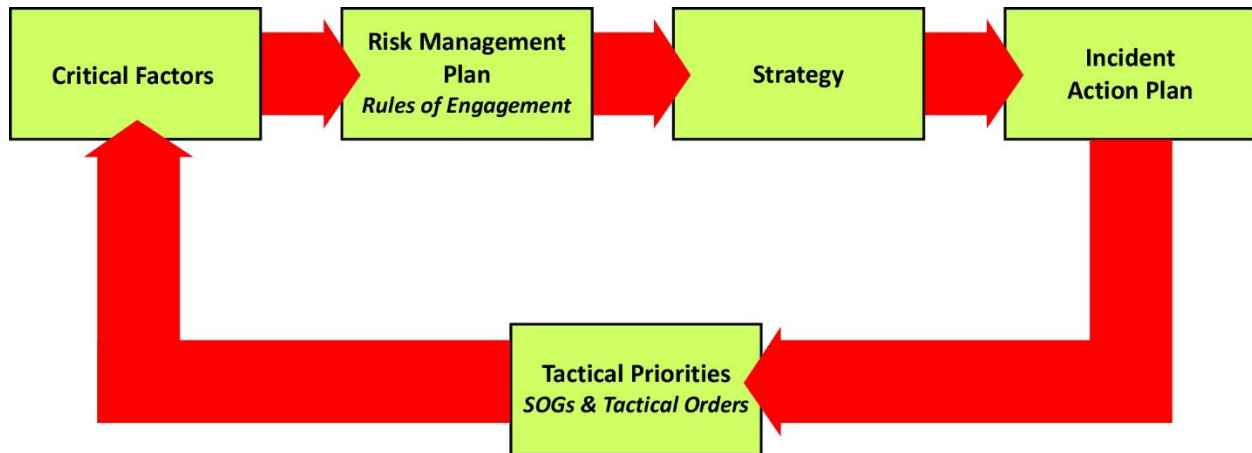


Table 2. Critical Incident Factors

Fixed Factors	Variable Factors
Structure Fire • Building • Occupancy • Arrangement	• Life Hazard • Fire or Incident Conditions • Resources • Impact of Tactical Action • Special Circumstances
Hazmat Incident • Location • Container(s) and Product (s) • Arrangement	

For carbon monoxide incidents, critical factors like a structure fire (building, occupancy, and arrangement) must be considered as well as critical factors related to the product (carbon monoxide).

Responding to Carbon Monoxide Incidents

Do not be complacent! Frequency of false carbon monoxide alarms does not indicate that the current incident is a false alarm. Medical incidents with a patient having symptoms like carbon monoxide poisoning may have other medical causes. However, they also may in fact be related to carbon monoxide exposure (which also presents a threat to responders).

Situational Awareness Responding to Medical Incidents: Many carbon monoxide incidents are initially reported as a medical emergency with a patient experiencing a headache, weakness, nausea, or altered mental status including loss of consciousness. Maintain a high index of suspicion for carbon monoxide

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

poisoning (which may be increased if there are multiple symptomatic patients and/or symptoms are concurrent with cold weather, power loss, use of fuel burning (propane, natural gas, oil, or wood) appliances or central heating.

Size-Up & Investigation of Carbon Monoxide Incidents: Carbon monoxide incidents generally will not present obvious visible indicators of the nature and extent of the incident. Most often, these types of incident will be *nothing showing, investigating in the offensive strategy*. Consider the following as part of size-up of carbon monoxide incidents.

- Reported conditions, including alarm activation and/or patient symptoms.
- Visible conditions will not indicate the presence of carbon monoxide (but propane storage or evidence of solid fuel use may indicate potential).
- When responding to carbon monoxide alarm activation wear self-contained breathing apparatus (SCBA) with facepiece in the ready position (ready for rapid donning).
- Atmospheric monitoring should be performed on approach, around the building (performing a 360° recon during an alarm activation), and on entry at carbon monoxide incidents (other than structure fires) where carbon monoxide is likely to be present.

Important: Consider the potential for presence of carbon monoxide when responding to medical incidents where the patient is complaining of symptoms related to acute or chronic carbon monoxide exposure. In these cases, turn on and carry a four-gas monitor or single gas carbon monoxide monitor when entering the building.

- Conduct focused monitoring in areas where fuel burning appliances, equipment, and vehicles are or may be located.
- If a carbon monoxide alarm is sounding or single gas monitor indicates the presence of CO at concentrations above the PEL/TLV-TWA, wear SCBA while conducting size-up inside the building.

Important: If your apparatus is not equipped with SCBA (e.g., ambulance) evacuate the occupants, immediately withdraw from the building, and special call the appropriate resources.

Carbon monoxide alarms operate on a time weighted principle. They will activate at lower concentrations over a long period of time or at higher concentrations in a shorter period. Carbon monoxide alarms meeting *UL Standard 2034* will activate at the following time weighted alarm points (alarms may differ but should meet these requirements at a minimum).

Table 3. *UL 2034 Standard for Safety for Single and Multiple Station Carbon Monoxide Alarms*

Concentration	Alarm Time
400 ppm	Between 4 and 15 Minutes
150 ppm	Between 10 and 50 Minutes
70 ppm	Between 60 and 240 Minutes

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

Life Safety: If the building is occupied and carbon monoxide is detected above 9 ppm (ASHRAE, 2013), evacuate the occupancy until the hazard has been mitigated. Keep in mind; carbon monoxide concentrations below regulatory action levels (PEL, TLV-TWA) may be hazardous to sensitive populations (older adults, children, and individuals with other medical issues).

Atmospheric Monitoring

Required atmospheric monitoring equipment for carbon monoxide incidents:

- Atmospheric monitoring equipment used by ECFR can detect and monitor the concentration of carbon monoxide (Altair four gas or single gas (carbon monoxide) monitors).
- If possible, two atmospheric monitors shall be used, one to monitor the concentration of carbon monoxide and the other to validate the readings obtained by the first.

Check with occupants prior to entry for information related to incident:

- What gas or other fuel burning appliances were operating (furnace, space heater, water heater, or generator)?
- Have any vehicles been running inside the garage or next to any building openings?
- Where are fuel burning (e.g. gas, oil, wood) appliances or equipment located?
- Have they done anything since the alarm sounded and prior to the fire district's arrival (e.g., shut off fuel burning appliances or equipment, changed the ventilation profile)?

Monitor throughout the occupancy with an emphasis on areas containing fuel burning appliances or equipment.

- Any reading over 9 ppm is unusual and the source should be identified (this may result in adverse health effects over time or may worsen, increasing risk).
- If a reading over 25 ppm is detected, immediately don your SCBA facepiece and go on self-contained air.

Important: If your apparatus does not have respiratory protection (e.g., ambulance) and a hazardous level of carbon monoxide is detected, evacuate the occupants, and immediately withdraw from the structure.

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

Hazard Mitigation

Carbon Monoxide alarm responses may be the result of a low battery voltage condition or alarm malfunction. If the response is the result of low voltage replace the batteries as needed. If activation is the result of a defective alarm, replace the alarm (owner occupied property) or provide a loaner alarm and notify the property owner (rental property). If a hazardous concentration of carbon monoxide is detected:

- Attempt to identify the source(s).
- If identified, turn off the appliance or equipment causing the release.
- If the fuel supply to the device can be shut off, do so.
- Ventilate (using PPV) when appropriate.
- All areas of the structure must be re-monitored after ventilation is completed to confirm that the carbon monoxide has been removed from the building.
- Notify occupant of results, including the need to contact a qualified technician to service or correct the conditions found as continued use poses a danger to occupants.
- Offer to install carbon monoxide alarms if none are present (see the installation of carbon monoxide alarms section of this SOG for additional detail).
- Advise occupants to call 911 should the carbon monoxide alarm sound.

Important: Any appliance that has been turned off, unplugged, disabled, or had the fuel shut off to it, must be red tagged, put out of service, and be attended to by a qualified technician before placing back into service. If the gas supply to propane appliances or equipment is shut off, notify the propane supplier. ECFR members **shall not** turn on a gas supply, appliance, or equipment that has its gas supply in the off position. Transfer all CO incidents that involve securing propane appliances or equipment to the propane supplier.

Decontamination

As carbon monoxide is a gas that simply presents an inhalation hazard, decontamination is not required for incidents that involve **only carbon monoxide**. Fire incidents result in the release of a complex mixture of hazardous products of combustion including carbon monoxide and require on-scene decontamination and subsequent cleaning of personal protective equipment.

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

Installation of Carbon Monoxide Alarms

Since 2010, carbon monoxide alarms have been required in buildings classified as residential occupancies where fuel burning appliances or heating systems are used. However, single family dwellings occupied prior to 2009 are exempt unless renovated or sold (RCW 19.27.530, WAC 51-51-0315 Section R315, ICC, 2015).

East County Fire and Rescue installs both smoke and carbon monoxide alarms as part of the Home Safety Survey Program. If during response to a carbon monoxide incident, it is determined that an owner-occupied residential occupancy does not have working carbon monoxide alarms, offer to install carbon monoxide alarms (outside each sleeping area). If the occupant agrees, install the alarms, and document the installation with an e-mail to the community risk reduction program manager.

If the residential occupancy involved is a rental property, offer to provide loaner carbon monoxide alarms, obtain property owner contact information, and forward this information to the ECFR community risk reduction manager, who will provide notice to the owner regarding the requirement to install carbon monoxide alarms.

Carbon monoxide alarms are required outside of each sleeping area of the home (and in the sleeping room if a fuel burning appliance is located inside the room). Single function carbon monoxide alarms may be installed on a wall 2' to 3' above the floor (level of a person sleeping on a bed). Combined smoke and carbon monoxide alarms are installed on the ceiling as required for single function smoke alarms.

Note: Also check the presence, distribution, and function of smoke alarms and if necessary, address any deficiencies by offering to install or replace (battery operated) alarms. If hard wired smoke alarms are inoperative, offer to provide battery operated loaner alarms outside each sleeping area.

References

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). (2013). *Standard 62.1 ventilation for acceptable indoor air quality*. Retrieved January 28, 2024, from <https://www.mintie.com/assets/pdf/education/ASHRAE%2062.1-2007.pdf>.

National Institute for Occupational Safety and Health (NIOSH). (2016) *NIOSH pocket guide to chemical hazards*. Retrieved January 28, 2024, from <https://www.cdc.gov/niosh/npg/npgd0105.html>.

Revised Code of Washington (RCW) 19.27.530 Carbon monoxide alarms—Requirements—Exemptions—Adoption of rules. Retrieved January 28, 2024, from <http://apps.leg.wa.gov/rcw/default.aspx?cite=19.27.530>

Washington Administrative Code (WAC) 51-51-0315 Section R315—Carbon monoxide alarms. Retrieved January 28, 2024, from <http://apps.leg.wa.gov/WAC/default.aspx?cite=51-51-0315>.

International Code Council (ICC). (2015). *International building code (IBC) section 915 carbon monoxide detection*. Retrieved January 28, 2024, from <https://fortress.wa.gov/ga/apps/sbcc/File.ashx?cid=4633>.

Title Hazmat Response-Carbon Monoxide	SOG # 4.6.2
---	-----------------------

East County Fire and Rescue. (2024). *Board minutes February 6, 2024*. [Adoption of Purpose, Policy, and Scope of SOG 4.6.2 Hazmat Response-Carbon Monoxide]. Coupeville, WA: Author.

U.S. Department of Transportation (US DOT). (2020). *Emergency response guidebook*. Retrieved January 28, 2024, from <https://bit.ly/3rHE8xE>.

Appendix A-Carbon Monoxide Hazards Fact Sheet



Community Risk Reduction

Carbon Monoxide-Keeping Your Family Safe!

Carbon monoxide (CO) is a colorless and odorless toxic gas created when fuels burn incompletely. In your home, heating and cooking equipment, generators, and motor vehicles are all sources of carbon monoxide.



You can be poisoned by a low concentration of CO over a long period of time, or quickly if the concentration of this toxic gas is higher. Infants, pregnant women, and people with physical conditions that limit their body's ability to use oxygen such as emphysema, asthma, heart disease) can be more severely affected by lower concentrations of CO than healthy adults.

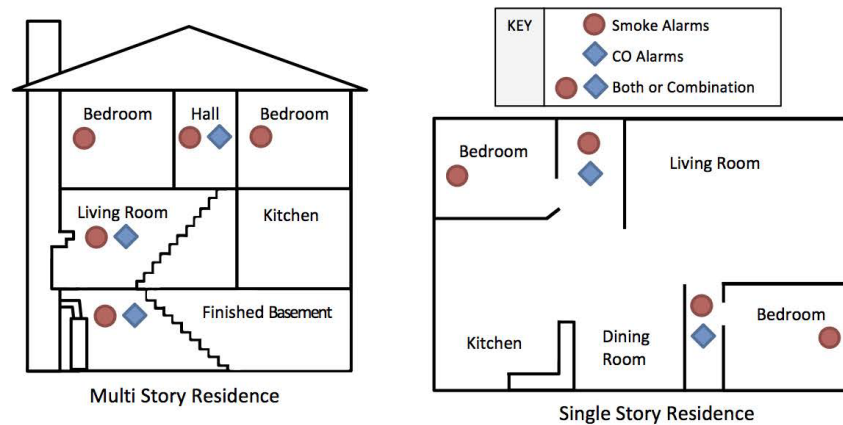
Initial symptoms of CO poisoning are like the flu but without the fever). Symptoms include headache, fatigue, shortness of breath, nausea, and dizziness. This can quickly progress to unconsciousness and death.

Take these simple steps to keep your family safe:

- Have fuel burning heating equipment and chimneys inspected and serviced annually.
- Don't use unvented fuel burning appliances such as portable heaters, grills, and generators indoors or near building vents.
- Install and maintain CO alarms outside each sleeping area and on each level of your home. Check CO (and smoke) alarms monthly.
- If your carbon monoxide alarm sounds, go outside and call 911.

CARBON MONOXIDE-KEEPING YOUR FAMILY SAFE!

Since 2010, carbon monoxide alarms have been required in buildings classified as residential occupancies where fuel burning (gas, oil, or wood) appliances or heating systems are used. Carbon monoxide alarms are required outside of each sleeping area of the home (and in the sleeping room if a fuel burning appliance is located inside the room). Single function carbon monoxide alarms may be installed on a wall 2' to 3' above the floor (level of a person sleeping on a bed). Combined smoke and carbon monoxide alarms are installed on the ceiling as required for single function smoke alarms.



East County Fire and Rescue would be happy to perform a home safety survey to check the operation of your smoke and carbon monoxide alarms, install alarms if you do not have them, help you identify home safety hazards, and assist you in developing a home fire escape plan.

Please call us if you have any questions or would like to schedule a home safety survey!