

S.O.P. #: TACT #19

SUBJECT: CARBON MONOXIDE INCIDENTS

STANDARD OPERATIONAL PROCEDURE

Baltimore |  
County |  
Fire |  
Department |

---

S.O.P. #: TACTICAL OPERATIONS MANUAL #19

SUBJECT: CARBON MONOXIDE INCIDENTS

DIVISION: EMERGENCY OPERATIONS

---

Objective: This SOP provides personnel with guidelines for responses to carbon monoxide incidents. This SOP assures the safety of civilians and our personnel and identifies when occupants are to be evacuated from a structure for their health and well-being.

Section 1: General

- A. Carbon monoxide (CO) is a colorless, odorless gas that is slightly lighter than air and is flammable/explosive in very high concentrations. CO results from the incomplete combustion of fossil fuels, and is a common problem when appliances are not working properly or are not properly vented. CO is absorbed into the blood of persons who breathe it in, causing illness, coma and even death. Many dwellings and commercial occupancies have CO detectors that detect the presence of unsafe concentrations of CO and sound an audible alarm when CO is present.
- B. All suppression companies are equipped with gas meters that will detect CO.
- C. EMS units that are equipped with a LP15 or newer cardiac monitor device are capable of quickly measuring the carbon monoxide level in one's blood via a sensor that is placed on a patient's fingertip.

Section 2: Operations

A. Response Policy

- 1. Reports of CO detector activation with no one (including pets) exhibiting the symptoms of toxic CO exposure (headache, nausea, vomiting, loss of coordination, altered mental status, or flu-like symptoms):
  - a. Baltimore County Dispatch will advise the caller to leave the building.
  - b. The closest unit with CO meter will be dispatched (non-emergency response).
- 2. Reports of CO detector activations with persons (or pets) exhibiting symptoms of toxic CO exposure (headache, nausea, vomiting, loss of coordination, altered mental status, or flu-like symptoms):
  - a. Baltimore County Dispatch will advise the caller to alert all persons in the building to evacuate and go to an area with a safe atmosphere. A building's fire alarm system should be used, if equipped, by the caller to alert other occupants. The caller will be asked to await the arrival of Fire Department units.
  - b. A medic unit will be dispatched to assess those potentially exposed to CO.
- 3. Single sensor CO meters are affixed to each EMS unit's medical bag.
  - a. The single sensor CO meter is designed to go into alarm when CO readings are between 10-35 ppm.
  - b. If the single sensor meter activates, the EMS crew shall immediately request a CO response and follow the direction as per 2-a above. Responders should evacuate the structure, as well.

SUBJECT: CARBON MONOXIDE INCIDENTS

---

B. Documentation and Data

1. Companies responding to a carbon monoxide alarm shall use the Carbon Monoxide Worksheet (Form 153) to assist them in their investigation. This checklist is designed to assist in establishing the cause and origin of the CO.
2. The completed Carbon Monoxide Worksheet (Form 153) shall be sent to Fire Records via inter-office mail when the Officer returns to their Station.
3. All of the data entered on a Form 153 shall be completely entered into the NFIRS report as soon as possible.

C. Tactical Considerations

1. **DO NOT VENTILATE** the building until a functioning CO meter is on the scene to assist in determining the source of the CO leak/problem. The source of the leak must be identified prior to ventilation. The exception would be for life safety when the building cannot be immediately evacuated.
2. If your CO meter is in alarm, evacuate the building. If the building must be entered for any reason with an alarming meter, full protective equipment, including SCBA, will be worn. The Two-In, Two-Out Policy must be followed.
3. Readings that result in an "OR" or Over Range response from the meter are in excess of 999 PPM. These levels are extremely hazardous to unprotected personnel. The area where these levels are detected shall be evacuated immediately.
4. If anyone has signs or symptoms of CO exposure, a medic unit should be requested. The reading from the CO pulse oximeter on the LP15 or newer cardiac monitoring device is not the sole determining factor in patient priority. Symptomatic patients with low readings may need to be transported to the closest appropriate facility.
5. Once the CO meter is on the scene, crews will attempt to locate the source of any leaks. They should monitor adjoining structures/buildings for CO when the primary structure has CO levels of 10 PPM or more. For example, if a primary structure is a middle of group townhouse with CO levels of 25 PPM throughout, crews should monitor any adjoining townhouses for CO.
6. If it is determined that a malfunctioning appliance is emitting CO, it shall be shut down. The Fire Department's responsibility is to mitigate the situation and advise the occupant that the equipment must not be turned back on until it has been serviced by a qualified technician and determined to be in proper working order. Servicing of the appliance/equipment and/or determining that it is in proper working order is the sole responsibility of the homeowner/building owner or in the case of a rental property, the owner of the rental property.
7. The Department of Permits, Approvals and Inspections (PAI) will receive any NFIRS data that indicates CO in excess of 50 PPM in a rental property. They will follow up and inspect a malfunctioning appliance at a rental property regardless of the number of dwelling units upon receipt of this data. The purpose of inspection by PAI is to ensure that the property owner or its management agency has had a licensed contractor correct the problem. PAI does not inspect any other properties when they have experienced malfunctioning appliances.
8. The Notice of Dangerous Situation – Form 152 (Appendix C) will be filled out whenever the level of CO is 10 PPM or greater, as determined by a Baltimore County Fire Department approved CO monitor. The Notice of Dangerous Situation - Form 152 (Appendix C) will provide the IC and the homeowner with some established guidelines for CO response. These guidelines are established from a variety of sources.

SUBJECT: CARBON MONOXIDE INCIDENTS

---

9. The Notice of Dangerous Situation form is to be completed and explained to the occupant. The occupant should be informed that the readings the fire department obtained are direct readings of current ambient levels. Some residential detectors accumulate CO just as the body does. This can occur over days, weeks, and months. The meters that we use directly read the atmosphere and provide a reading in real time and may not indicate any level of CO, even though the detector activated.
  10. The Form 152 will be sent to Fire Records via inter-office mail when the Officer returns to their Station.
  11. There are four levels of action as established by this form:
    - a. Less than 10 PPM: Advise the homeowner that they should check the CO detector per manufacturer's recommendations, and install a replacement detector/battery module. If it activates again, call 911. Advise the resident that our monitors did not find any significant levels of CO at this time.
    - b. Between 10 PPM and 34 PPM: Advise the homeowner that we have detected marginal levels of CO. This level is a potential health hazard for pregnant women, small children, elderly people and persons suffering from respiratory or heart problems. Evacuation is recommended while the investigation/mitigation takes place.
    - c. Between 35 PPM and 99 PPM: Advise the homeowner that we have detected excessive levels of CO. This level is a potential health hazard for pregnant women, small children, elderly people and persons suffering from respiratory or heart problems. Evacuation is highly recommended while the investigation/mitigation takes place.
    - d. Over 100 PPM: Advise the homeowner that we have detected dangerous levels of CO. Evacuation is mandatory while the investigation/mitigation takes place.
  12. Anyone exhibiting signs or symptoms of CO exposure should be monitored with a CO pulse oximeter, transported to the closest appropriate facility or, at a minimum, be examined by a physician, especially if the person is pregnant.
  13. If anyone who shows any signs or symptoms of CO poisoning refuses transport, a Medical Refusal must be completed.
  14. Carbon Monoxide leaks at Assisted Living Facilities (including private homes with Assisted Living Care) must be reported to the State of Maryland. Call the Complaint Coordinator at 410-402-8184. The State will send someone out to inspect the facility and ensure that any CO problems have been handled and necessary repairs completed.
  15. All actions taken at a CO incident scene will be documented in the narrative section of the NFIRS report. This will include all recommendations/directions given to the occupants(s) of the structure. In addition, the carbon monoxide specific tab in NFIRS will be completed on each response.
-

Appendix A: Medical Symptoms of CO Exposure (NIOSH)

1. Background of Carbon Monoxide (CO)

CO causes systemic poisoning by interfering with the binding of Oxygen to Hemoglobin in the blood. Hemoglobin has a 200-300 times greater affinity to CO than Oxygen. This binding process results in a decrease of Oxygen transport function at the Hemoglobin cellular level. When CO binds to Hemoglobin it produces Carboxyhemoglobin. Carboxyhemoglobin is unable to bind with Oxygen and can result in death secondary to hypoxia.

2. Signs & Symptoms of CO Exposure by Systems

a. Cardiovascular

- Cardiovascular collapse, arrhythmias and angina.
- Exposure can precipitate an acute myocardial infarction.

b. Respiratory

- Tachypnea, followed by slow irregular respirations and ultimately respiratory arrest.
- Signs of pulmonary edema.

c. Central Nervous System (CNS)

- CNS depression and coma.
- Dizziness, headache, tinnitus, weakness, hallucinations, and seizures.
- Confusion, visual disturbances, irritability impaired judgment, loss of memory, and
- Fatigue.
- Increased intracranial pressure secondary to cerebral edema.

d. Gastrointestinal

- Nausea and vomiting.

e. Eyes

- Chemical conjunctivitis.

f. Skin

- Cyanosis, pallor, and cherry red color. Rarely is the cherry red skin color displayed

g. Renal

- Kidney damage and myoglobinuria.

h. Hepatic

- Liver damage.

i. Metabolism

- Lactic acidosis.

j. Blood

- Carboxyhemoglobin formation.

k. Other

- The period between exposure and toxic signs and symptoms is shortened by any factor that speeds circulation or respiration, such as exercise, exertion or trauma.

l. Onset of Symptoms for a Significant Acute Exposure

- Immediate.
- Neurological and neurobehavioral effects can be delayed

SUBJECT: CARBON MONOXIDE INCIDENTS

Appendix B: Carbon Monoxide Properties

- Carbon monoxide is a gas by-product of combustion which is colorless, odorless, tasteless, and deadly. Carbon monoxide can be 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. Carbon monoxide poisoning may be difficult to diagnose. Its symptoms are similar to flu and may produce headache, nausea, fatigue, and dizziness. Carbon monoxide causes poisoning by interfering with the binding of oxygen to hemoglobin in the blood, myoglobin in the heart, and muscle tissue throughout the body.

OSHA has established a minimum safe working level for carbon monoxide at 35 ppm over an 8 hour period in the general work place. The EPA has established that residential levels are not to exceed 9 ppm over an 8 hour average.

- Properties:

Lower Explosive Limit (LEL) 12.5%  
 Upper Explosive Limit (UEL) 74 %  
 Vapor Density 0.967  
 Auto ignition temperature 1128 degree Fahrenheit

- NFPA 704mclassification

Health 3  
 Fire 4  
 Reactivity 0

- Health

PPM CO	Time	Symptoms
35	8 hours	Maximum exposure allowed by OSHA in the workplace over an eight hour period
200	2-3 hours	Mild headache, fatigue, nausea and dizziness.
400	1-2 hours	Serious headache-other symptoms intensify. Life threatening after 3 hours.
800	45 minutes	Dizziness, nausea and convulsions. Unconscious within 2 hours. Death within 2-3 hours.
1600	20 minutes	Headache, dizziness and nausea. Death within 1 hour.
3200	5-10 minutes	Headache, dizziness and nausea. Death within 1 hour.
6400	1-2 minutes	Headache, dizziness and nausea. Death within 25-30 minutes.
12,800	1-3 minutes	Death

S.O.P. #: TACT #19

SUBJECT: CARBON MONOXIDE INCIDENTS

Appendix C – Form 152

## BALTIMORE COUNTY FIRE DEPARTMENT

### NOTICE OF DANGEROUS SITUATION – CARBON MONOXIDE

The Fire Department responded to the building at \_\_\_\_\_  
on \_\_\_\_\_ (Date) (Address)

1. Readings: Highest carbon monoxide (CO) level found was \_\_\_\_\_ PPM (parts per million).

Final reading after mitigation of carbon monoxide (CO) level was \_\_\_\_\_ PPM.

2. The symptoms of carbon monoxide poisoning are headache, nausea, vomiting, fatigue, flu-like symptoms, altered mental status, or loss of coordination. Any occupants experiencing any or all of these symptoms should seek medical attention.

3. Carbon Monoxide Levels and Significance:

	PPM	LEVEL	SIGNIFICANCE
<input type="checkbox"/>	0 to 9	Normal	<ul style="list-style-type: none"> <li>None</li> </ul>
<input type="checkbox"/>	10 to 34	Marginal	<ul style="list-style-type: none"> <li>Potential health hazard for pregnant women, small children, elderly people and persons suffering from respiratory or heart problems.</li> </ul>
<input type="checkbox"/>	35 to 99	Excessive	<ul style="list-style-type: none"> <li>Medical Alert.</li> <li>Evacuation recommended while investigation/mitigation takes place.</li> </ul>
<input type="checkbox"/>	Over 100	Dangerous	<ul style="list-style-type: none"> <li>Medical Alert. Emergency conditions exist.</li> <li>Evacuation mandatory until CO source is identified and mitigated.</li> </ul>

4. Disposition:

\_\_\_ Our instrument did not detect elevated CO levels at this time.

\_\_\_ Pregnancy: For occupants who may be pregnant; it is advised that they seek medical attention due to the potential effect on the mother and fetus.

\_\_\_ Check your carbon monoxide detector per the manufacturer’s recommendation or call the manufacturer for additional information. Attempt to reset the CO detector. If it activates again, call 9-1-1 immediately.

\_\_\_ Appliance: We have shutoff the following appliance as a possible source of CO \_\_\_\_\_

\_\_\_\_\_ This appliance should remain shut off until examined and repaired by a qualified, licensed service technician.

\_\_\_ Building was successfully ventilated, and CO reading is now below 10 PPM.

\_\_\_ It has been determined that excessive/dangerous levels of carbon monoxide are still present. We were unable to locate/mitigate the source of the carbon monoxide.

Officer:	Occupant Signature:
Unit #:	Occupant Name Printed:
	Date:

S.O.P. #: TACT #19

SUBJECT: CARBON MONOXIDE INCIDENTS

Appendix D – Form 153

**Baltimore County Fire Department – Carbon Monoxide Worksheet**

Address: \_\_\_\_\_ Incident #: \_\_\_\_\_ Box #: \_\_\_\_\_

Occupants CO detector: Make \_\_\_\_\_ Model: \_\_\_\_\_ Location in building: \_\_\_\_\_ Alarming: \_\_\_\_\_

<b>Rental</b>	<input type="checkbox"/> Yes	For rental properties, Permits Approvals and Inspections will follow up when CO is 50 ppm and above. Data MUST be entered into NFIRS for notification.
---------------	------------------------------	--

**Building Type:**  Individual  Semidetached  Row House  Apartment / Condo  Commercial /Industrial

<b>CO Checklist:</b>	Initial reading outside	PPM (background)
	Highest reading inside	PPM
	Final reading after ventilation	PPM

**BGE / Gas Company on scene?**  Yes  No

Area monitored	Circle fuel type			Location	PPM reading
	Gas	Coal	Wood		
Occupant CO detector					
Fireplace	Gas	Coal	Wood		
Furnace	Gas	Coal	Wood		
Other heater	Gas	Kerosene			
Water heater	Gas	Oil			
Dryer	Gas				
Oven/range	Gas				
Barbecue	Gas	Charcoal			
Car running	Gas	Diesel			
Batteries on charge					
Dried-out drain trap					

<b>Suspected cause:</b>	
<input type="checkbox"/> Malfunctioning appliance	<input type="checkbox"/> Improper or misuse of appliance
<input type="checkbox"/> Improper installation	<input type="checkbox"/> Chimney downdraft
<input type="checkbox"/> Lack of proper ventilation	<input type="checkbox"/> other:

**Note problem (i.e. Blocked or clogged flue, closed damper, cracked firebox, chimney downdraft)**

<b>Does any occupant have any of the following symptoms?</b> <i>Occupants with symptoms are the top priority.</i>							
<input type="checkbox"/> Fatigue	<input type="checkbox"/> Headache	<input type="checkbox"/> Nausea	<input type="checkbox"/> Confusion	<input type="checkbox"/> Dizziness	<input type="checkbox"/> Flu like		

**If yes to any of the above symptoms, request EMS if not already dispatched. If any of the occupants are pregnant, no CO level is preferred. Sometimes the normal background reading is above zero for the area.**

- If CO is above 100 PPM, evacuation is mandatory. If CO is above 34 PPM, evacuation is recommended.
- Appliances producing CO greater than 50 PPM after 2-3 minutes of operation should remain shut off until examined and repaired by a qualified, licensed service technician.
- Once the problem is identified the building should be ventilated to reduce CO levels below 9 PPM.
- If the problem cannot be identified, request a local hazmat box.

Unit # \_\_\_\_\_ Monitor Type  TMX-412  M40  MG140  MULTIRAE  Cricket  PAC 3000/7000

Officer completing report (PRINT)