



12-2025 HAZMAT Tactical Guideline – Carbon Monoxide Responses

General CO info

Unintentional, non-fire-related CO poisoning is responsible for approximately 15,000 emergency department visits and nearly 500 deaths annually in the United States. CO poisoning is the number one (#1) NON-intentional poisoning death in the US. The majority of deaths due to NON-intentional CO poisoning occur between November and February (over 50%), with a majority of the incidents occurring in the Midwest and the Northeast parts of the country. The two (2) most common locations where the incidents occurred are in a residence (77.6%) or the workplace (12.0%).

Product info

Carbon Monoxide (CO) is produced by the process of incomplete combustion. This typically occurs in automobile exhaust, cooking appliances, heating equipment (i.e, anything that burns fuel can produce unhealthy levels of CO).

Carbon Monoxide (CO) – NFPA 704

Health – 3
Flammability – 4
Instability – 0
Special - none

Carbon Monoxide Physical Properties

- Colorless, tasteless, odorless gas
- Molecular weight 28.01 (air is 28.97) CO is slightly lighter but will mix throughout the space and not collect only at the ceiling
- Ionization Potential (IP) 14.01 and CAN NOT be seen by most Photo Ionization Detectors (PID)
- Upper Explosive Limit (UEL) 74%, Lower Explosive Limit (LEL) 12.5%

Carbon Monoxide's Physical and Health Effects on Humans

Carbon Monoxide is an asphyxiant to humans with no warning properties. CO has 210 times greater affinity to attach to hemoglobin than oxygen. Inhalation of CO causes tissue hypoxia by preventing the blood from carrying sufficient oxygen. CO combines reversibly with hemoglobin to form carboxyhemoglobin. Carbon monoxide can be transported across the placental barrier, and exposure in utero constitutes a special risk to the fetus. Infants and young children are generally believed to be more susceptible to carbon monoxide than adults. The elderly are also believed to be more susceptible to carbon monoxide poisoning. It is not quickly removed from your system, so the effects can be cumulative.

- NIOSH recommended maximum exposure limit is 35 ppm
- 100 ppm - Slight headache in two to three hours
- 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
- 1,200 ppm - Immediately Dangerous to Life and Health (IDLH) – Acute Exposure

Acute exposure: The signs and symptoms of acute exposure to carbon monoxide may include headache, flushing, nausea, vertigo, weakness, irritability, unconsciousness, and in persons with preexisting heart disease and atherosclerosis, chest pain and leg pain. Chronic exposure: repeated exposures to carbon monoxide poisoning may cause persistent signs and symptoms, such as anorexia, headache, lassitude, dizziness, and ataxia.

Carbon Monoxide is the greatest threat to public/responders

Death due to asphyxiation

Incident taking

A majority of CO-related incidents are dispatched due to a CO alarm activation at residential occupancies. But a significant number of CO incidents are initiated as an ill or unconscious person EMS call where the caller is unaware their symptoms are being caused by CO.

Blue Card highly encourages departments to attach a one (1) gas CO meter on their EMS equipment. These devices have alerted EMS responders countless times that the patient's symptoms are being caused by high CO levels (while also protecting the EMS workers).

Alarm/Dispatch should try to obtain the following information for CO alarm-generated incidents:

- Verify the problem (CO detector vs. smoke detector)
- Advise occupants to evacuate the building to a safe area
- Are there any medical issues, if yes, how many people are involved?
- Does the occupancy have gas or electric appliances? If gas appliances are being used, also dispatch the appropriate natural gas provider

Carbon Monoxide Response Levels

CO Still Assignment - Carbon Monoxide detector activation only (no symptoms)*:

- 1 Engine

CO ALS Assignment - Carbon Monoxide detector activation with one (1) sick person*:

- At least 1 response unit ALS capable
- 1 Engine
- 1 Ladder
- 1 EMS transport unit
- 1 Chief

CO 2-1 Assignment - Carbon Monoxide detector activation (or information that would indicate CO present) affecting multiple people*:

- At least 2 response units, ALS capable
- 2 Engines
- 1 Ladder
- 2 EMS transport units
- 1 Chief

*Any of these responses could be scaled-up with a higher EMS and HAZMAT response based on the caller information and the associated Critical Factors (i.e., high CO meter readings (over 35ppm), high life density – multi-family/apartment, theater, mall, etc.).

* If gas appliances are being used, also dispatch the appropriate gas provider

HAZMAT Quals to control

- FF 1 & 2 with HAZMAT Operations Level credential
- Understanding of Gas Monitoring and its limitations
- Trained in the process of metering to include where to meter
- Understanding of the properties of Carbon Monoxide (slightly lighter than air)
- Carbon monoxide response does not require any specialized training, PPE, or equipment outside what most all Fire Departments have available

PPE and allied equipment required

- All members working in the warm and hot zone of the incident will wear full structural FF PPE, SCBA on, with the member's face piece available to don rapidly

- Preferably 2 (two) 4 gas meter with the following sensors – O2, LEL, H2S, CO. The meter must be “zeroed out” in fresh air before using it in the hazard zone.
- FD personnel in the warm zone will be limited to the absolute minimum required to size up the incident.
- Fan

Responding to CO Incidents

When responding to a CO alarm, it's easy to become complacent because of the high instance of false alarms. Responders should avoid this attitude and take these responses seriously. A CO alarm should never be ignored.

CO alarms are designed to alert before symptoms occur, while occupants still have time to take action to protect themselves. Occupants should be directed to immediately evacuate the building when a CO alarm sounds.

Most frequent causes of CO exposures

- Faulty HVAC gas heating and cooking systems
- Faulty gas hot water heater ventilation systems
- Running gas-powered devices located too close to an enclosed space
- Outside cooking equipment located too close to an enclosed space (gas BBQ, charcoal grills, etc.)
- Marine/Boating environment
- Cars running in an enclosed space
- Malfunctioning fireplace chimneys

CO Size-Up

Responding size-up considerations:

- Is it a CO alarm or CO alarm with illness
- Is it a CO alarm or other alarming device (CO vs. smoke)
- Are the people suspecting they are sick due to CO
- What could be the problem:
 1. Car in Garage
 2. Appliances
 3. Fire place
 4. Furnace / water heater
 5. Cooking appliances/grills

Specific 2016 ERG page numbers

- Carbon Monoxide
- Guide 119 – Pages 176 - 177
- ID Number 1016

GUIDE 119	GASES - TOXIC - FLAMMABLE
POTENTIAL HAZARDS	
HEALTH	
<ul style="list-style-type: none"> • TOXIC; may be fatal if inhaled or absorbed through skin. • Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite. • Fire will produce irritating, corrosive and/or toxic gases. • Runoff from fire control may cause pollution. 	
FIRE OR EXPLOSION	
<ul style="list-style-type: none"> • Flammable; may be ignited by heat, sparks or flames. • May form explosive mixtures with air. • Those substances designated with a (P) may polymerize explosively when heated or involved in a fire. • Vapors from liquefied gas are initially heavier than air and spread along ground. • Vapors may travel to source of ignition and flash back. • Some of these materials may react violently with water. • Cylinders exposed to fire may vent and release toxic and flammable gas through pressure relief devices. • Containers may explode when heated. • Ruptured cylinders may rocket. • Runoff may create fire or explosion hazard. 	
PUBLIC SAFETY	
<ul style="list-style-type: none"> • CALL EMERGENCY RESPONSE Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover. • As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions. • Keep unauthorized personnel away. • Stay upwind, uphill and/or upstream. • Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks). • Ventilate closed spaces before entering. 	
PROTECTIVE CLOTHING	
<ul style="list-style-type: none"> • Wear positive pressure self-contained breathing apparatus (SCBA). • Wear chemical protective clothing that is specifically recommended by the manufacturer. It may provide little or no thermal protection. • Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible. 	
EVACUATION	
Spill	
<ul style="list-style-type: none"> • See Table 1 - Initial Isolation and Protective Action Distances for highlighted materials. For non-highlighted materials, increase, in the downwind direction, as necessary, the isolation distance shown under "PUBLIC SAFETY". 	
Fire	
<ul style="list-style-type: none"> • If tank, rail car or tank truck is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions. 	
 In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping document and/or the ERAP Program Section (page 391).	
Page 176	ERG 2016

GASES - TOXIC - FLAMMABLE	GUIDE 119
EMERGENCY RESPONSE	
FIRE	
<ul style="list-style-type: none"> • DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED. 	
Small Fire	
<ul style="list-style-type: none"> • Dry chemical, CO₂, water spray or alcohol-resistant foam. 	
Large Fire	
<ul style="list-style-type: none"> • Water spray, fog or alcohol-resistant foam. • FOR CHLOROSILANES, DO NOT USE WATER; use AFFF alcohol-resistant medium-expansion foam. • Move containers from fire area if you can do it without risk. • Damaged cylinders should be handled only by specialists. 	
Fire Involving Tanks	
<ul style="list-style-type: none"> • Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. • Cool containers with flooding quantities of water until well after fire is out. • Do not direct water at source of leak or safety devices; icing may occur. • Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. • ALWAYS STAY AWAY from tanks engulfed in fire. 	
SPILL OR LEAK	
<ul style="list-style-type: none"> • ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). • All equipment used when handling the product must be grounded. • Fully encapsulating, vapor-protective clothing should be worn for spills and leaks with no fire. • Do not touch or walk through spilled material. • Stop leak if you can do it without risk. • Do not direct water at spill or source of leak. • Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. • FOR CHLOROSILANES, use AFFF alcohol-resistant medium-expansion foam to reduce vapors. • If possible, turn leaking containers so that gas escapes rather than liquid. • Prevent entry into waterways, sewers, basements or confined areas. • Isolate area until gas has dispersed. 	
FIRST AID	
<ul style="list-style-type: none"> • Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. • Move victim to fresh air. • Call 911 or emergency medical service. • Give artificial respiration if victim is not breathing. • Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. • Administer oxygen if breathing is difficult. • Remove and isolate contaminated clothing and shoes. • In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. • In case of contact with liquefied gas, thaw frosted parts with lukewarm water. • In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin. • Keep victim calm and warm. • Keep victim under observation. • Effects of contact or inhalation may be delayed. 	
ERG 2016	Page 177

Rescue

- Structural firefighting gear along with SCBA will provide adequate protection for making entry on all CO incidents
- If a rescue is imminent upon arrival at a Carbon Monoxide incident crews will make entry and remove all occupants to an open-air environment
- Patient care must be transferred to the appropriate EMS personnel

From this point on, the IC will facilitate:

- The appropriate patient treatment
- Executing the procedures in this SOP

Required metering equipment

- Preferably 2 meters that have been calibrated per the manufacturer recommendations
- 1 meter for evaluation and 1 meter for confirmation
- Both meters should be a 4-gas to meter for Oxygen, Carbon Monoxide, Lower Explosive Limit (LEL), and Hydrogen Sulfide (H₂S)

Metering techniques

Prepare the gas meter prior to entry, including fresh air calibration. Once calibrated, begin using the meter to monitor the atmosphere outside of the structure, working your way to the interior of the structure.

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

- What gas appliances were operating?
- Have any vehicles been running inside the garage or next to any openings?
- Where are the gas appliances located?
- Have they done anything since the alarm sounded and prior to the Fire District's arrival?

Control method

A majority of Carbon Monoxide responses result in a false alarm. The most common types of Carbon Monoxide alarm malfunctions are:

- Old and non-functioning alarms
- Maintenance issue (dirty or exposed to other household products that have caused the malfunction)
- Batteries need to be replaced

False alarms will be verified by thorough metering of the occupancy with insignificant CO readings.

Once entry has been made, begin an organized, systematic metering of the structure to determine the cause, making sure to check all fuel-burning appliances and document readings. Any meter readings above 15ppm CO are unusual. With meter readings over 15 ppm:

- Attempt to identify the source(s)

- If identified, turn off the affected appliance, vehicle, engine or motor
- If the fuel supply to the device can be shut off, do so
- Ventilate (using PPV) when appropriate
- Notify occupant of results, including the need to contact a qualified technician to service or correct condition, as it poses a danger to its continued use
- Advise the occupant to call 911 should the alarm sound again

Members will need to go on air with any reading over 35 ppm. Anytime an SCBA is used, the IC must ensure that two-in/two-out is in place.

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 attended to by a qualified technician before being placed back into service.

If any natural gas appliance or meter has had the gas shut off, the local gas authority must be notified and dispatched to the incident. AT NO TIME will any FD member turn on a gas meter or any gas appliance that has its gas supply in the off position. Transfer all CO incidents that involve any natural gas-powered equipment over to the appropriate utility company

Once the source has been identified and controlled, ventilation should be started to reduce high CO concentrations. Once started, over-ventilation is recommended

Ventilation to move the CO will potentially move the cloud to areas such as exit stairways, a long way away from the original, contaminated area. Because it is odorless and colorless, other FD members located in stairwells, hallways, or near the ventilation exit points may not realize they are in an area high in CO concentration until they are overcome.

All areas of the structure must be re-monitored after ventilation is completed to confirm all product has been removed from the structure.

Decontamination

Decontamination is not required for CO-only issues.

Organization used for CO incidents

Most CO incidents are handled by the first responding unit and the local utility company, and these incidents don't require large command organizations.

Unless the hazards are widespread or are affecting multiple people, these types of incidents will not require large HAZMAT organizations. If levels of CO are encountered over 35ppm, the standard OSHA groups will be required to conduct Hot Zone operations. Most notably:

- Research/Recon
- Entry
- Back-up
- No decon is needed for inert gas-only issues

Review and Revise

If a gas meter is secured to control the problem (or anything other gas equipment up-meter) arrangements will need to be made for agencies (FD and Utility company) to meet at a designated command post, in the cold zone, to perform a face-to-face on what both agencies need to do to support each other.

Continue, Support, and Terminate Command

Law enforcement (LE) may be necessary to coordinate intermediate and large-scale evacuations when they are required on CO incidents. When LE is required for the incident, follow the evacuation SOP outlined in the HAZMAT command function section.

CO gas incidents exposing large numbers of people may require the IC to expand the command structure to include EMS and/or a HAZMAT branches.