

# DIVISION OF FIRE

## STANDARD OPERATING PROCEDURE

SOP #22

DATE: June 18, 2010

**SUBJECT: CARBON MONOXIDE RESPONSES**

### **POLICY**

Carbon Monoxide (CO) is the single most common poisoning exposure in the United States. Each year there are approximately 2,100 deaths and over 10,000 injuries attributed to CO exposures (AMA data). Often, CO exposure and poisoning are under diagnosed and under reported. Many cases of CO poisoning are simply dismissed as a patient having “the flu”. Patients are then returned to the CO potential environment only to assume they are simply still “sick”.

There are many incidents where knowledge of human CO exposure could improve and save lives. Until recently, the only way to diagnose CO poisoning was with an arterial or venous blood gas test in a hospital. The Masimo RAD 57 Pulse CO oximeter is a medical diagnostic meter that accurately measures CO levels in the blood up to levels of 40%. Arterial or venous blood gas tests may still be necessary but the knowledge of the exposure can assist with and speed up patient diagnosis and treatment.

### **PROPERTIES OF CARBON MONOXIDE**

- Carbon monoxide is colorless, almost odorless and tasteless gas.
- It is very slightly lighter than air. Vapor Density=14 [Vapor density of air =14.4].
- A highly poisonous gas. Air containing even less than 1% of carbon monoxide, can be fatal, if breathed in for about 10 to 15 minutes.
- Flammable Gas with a flammable range of 12.5% to 74.2%

### **PROCEDURE**

The following is the procedure for companies responding to calls from residents reporting their carbon monoxide (CO) detectors are alarming, indicating the presence of carbon monoxide in the atmosphere. This procedure shall also be used when a person or persons exhibit signs or symptoms of CO poisoning, on Medical Emergencies, at the scene of working fires and other incidents that may indicate the presence of CO in the bloodstream.

#### **Suspected Presence of CO in the atmosphere:**

If CO is suspected in the atmosphere, check for natural gas, oil, kerosene, coal, or wood fired heating appliances or internal combustion engines in or about the premises.

**Presence of CO in the atmosphere (continued):**

A. If you find natural gas, oil, kerosene, coal, or wood fired appliances check for:

1. Proper connection of vent pipe.
2. Loose or missing furnace panel.
3. Obstructed flue.
  - a) Sooting of appliance.
  - b) Debris or soot falling from chimney, fireplace, or appliance.
4. Proper combustion air.
5. Cracked or corroded combustion chamber.

B. If any of the above situations are found and cannot be easily abated:

1. Shut off fuel supply.
2. Inform and instruct residents.\*
3. Recommend evacuation of premises.
4. Notify Gas Company.
5. Notify Red Cross if necessary.
6. Ventilate area. Call additional resources to the scene if necessary.
7. Have residents sign Carbon Monoxide response form.

C. If an internal combustion engine is found to be the cause of Carbon Monoxide:

1. Shut down engine.
2. Inform and instruct residents.\*
3. Ventilate area. Call additional resources to the scene if necessary.

D. If no cause can be found, but there is indication of Carbon Monoxide in the atmosphere:

1. Shut off fuel supply.
2. Inform and instruct residents.\*
3. Recommend evacuation of premises.
4. Notify Gas Company.
5. Notify Red Cross if necessary.
6. Ventilate area. Call additional resources to the scene if necessary.
7. Have residents sign Carbon Monoxide response form.

E. Possible sources of Carbon Monoxide.

1. Room heater
2. Furnace
3. Charcoal grill
4. Range
5. Water heater
6. Auto in garage
7. Fireplace.

F. Signs of Carbon Monoxide poisoning:

1. Dizziness
2. Fatigue
3. Headache
4. Nausea
5. Irregular breathing
6. If residents exhibit any of the above symptoms, or any of the other symptoms listed in the suspected CO poisoning section, administer appropriate care, including taking a CO reading from the CO oximeter, filling out County Run Report for each suspected patient, and treatment as required (CO oximeter is not for use on persons less than 66 lbs). If CO oximetry was used on patients, this should also be noted on the carbon monoxide response form. CO oximetry readings shall be taken on suspected patients even if CFD atmospheric CO meters detect no CO (in case the premises were ventilated by occupants). CO oximetry readings will be taken and recorded even if the occupants are asymptomatic. Those exhibiting CO levels shall be treated as detailed below in the treatment section.

G. Signs of appliance malfunction:

1. Decreased hot water.
2. Furnace unable to heat or runs constantly.
3. Sooting
4. Unfamiliar or burning odor.

\* Informing residents includes advising them of causes and symptoms of Carbon Monoxide poisoning, and ways to prevent future occurrences if possible. Residents should be assessed to see if they have absorbed CO into their bloodstream using a CO Oximeter if indicated (see attachment). Residents should also be advised to seek reliable certified appliance contractors for any repairs or servicing. If there are questions regarding the safety of an appliance it should be turned off. Residents may also be advised to leave the residence if the situation indicates (see guidelines listed below). **Under these circumstances a signed Carbon Monoxide response form should be obtained to insure proper notification and documentation.**

## **CARBON MONOXIDE AMBIENT AIR MONITORING**

Officers using an ambient air CO Monitor to detect the presence of Carbon Monoxide should use the following guidelines.

1. Zero the monitor. Do not zero the instrument inside an atmosphere that may be contaminated, make sure it is done in clean environment.
2. Make checks in “free air”. Do not take readings of undiluted flue-gases from appliance outlets, combustion chambers, draft diverters, or vent pipes. Direct exposure of meter to large amounts of contaminant may damage the cell and give improper readings.
3. AGA suggests the following order for testing ambient air, especially if the suspected appliance is turned off prior to the arrival of the Fire Department
  1. Close all windows and doors to the outside.
  2. Test the air prior to starting the suspected appliance.
  3. Test again just after the appliance is turned on.
  4. Test after the appliance has operated for at least 15 minutes. Have SCBA on or leave area during this test.
  5. This procedure may allow you to isolate a problem appliance.
4. If an appliance cannot be isolated and turned off after the above checks are made, the following actions should be taken.
  - A. **Less than 10 ppm in a residence:**  
Recommend having a certified technician check any suspected appliances and /or check monitor for proper response. Reading less than 10 ppm throughout the house without any vented gas appliances are to be considered within normal (safe) limits with the exception of infants.
  - B. **Above 10 ppm in a residence**  
Potentially dangerous levels of Carbon Monoxide. Recommend residents to leave immediately and complete carbon monoxide response form.
  - C. **Above 50ppm in a residential or commercial structure:**  
This level is above accepted safety levels without respiratory protection. Advise evacuation if source cannot be located and controlled quickly. Contact Gas Company and/or building department. Minimize time spent and members exposed in this atmosphere without SCBA. Have owner sign carbon monoxide response form.

## **CARBON MONOXIDE AMBIENT AIR MONITORING (continued)**

- D. **Above 100ppm but less than 200ppm in residence or commercial structure:**  
Potentially lethal levels of Carbon Monoxide. This structure is not suitable for occupancy. Notify the gas company and/or building department. Shut off appliances and/or gas, and evacuate. Must have SCBA on if operating in this atmosphere.
- E. **Above 200 ppm in residence or commercial structure:**  
Immediately evacuate the structure and notify Gas Company. Treat any victims for high Carbon Monoxide levels. Enter the structure only for rescue and evacuation with approved SCBA. Shut off fuel source to building preferably at the street

**Suspected CO Poisoning (F/R Medical Emergencies):** At Medical Emergencies, especially but not exclusively during the heating season, CO oximetry shall be performed on all patients exhibiting any of the following signs/symptoms/complaints:

- ❖ Minor-moderate-severe headache
- ❖ Dyspnea
- ❖ Nausea
- ❖ Malaise
- ❖ Fatigue
- ❖ Dizziness
- ❖ Vomiting
- ❖ Altered level of consciousness
- ❖ Confusion
- ❖ Syncope
- ❖ Tachycardia
- ❖ Seizures
- ❖ Shock
- ❖ Apnea
- ❖ Unconsciousness
- ❖ General or “flu like symptoms
- ❖ Any other condition the EMT suspects potential CO exposure/poisoning
- ❖ Situations where multiple patients are complaining of similar symptoms

**At the scene of working fires:** The CO oximeter shall be utilized when CFD members are evaluating and treating fire victims of possible smoke inhalation. Note: Often, the incapacitating factor in smoke inhalation cases is cyanide poisoning in addition to the CO exposure. (Consider cyanide antidote if available per protocol/medical direction). Treatment of these victims shall follow the current City of Cleveland Patient Care Protocols for the injuries discovered during assessment. The CO oximeter data shall be collected and recorded as part of the vital signs assessment. As noted in the treatment section below, any reading above 25% (or 5% in pregnant females) contact medical command to discuss transport to a hospital with hyperbaric treatment capabilities along with all other transport considerations i.e.: patient stability, major trauma etc. CO treatment alone shall follow the treatment section below.

**Fire/Hazmat Incidents or incidents of longer duration requiring firefighter rehab:**

RAD 57 CO oximeter data shall be collected and recorded as part of the return to duty vital signs assessment in the rehab sector. Return to duty shall be denied for non smokers reading >5% and >10% in smokers if these levels cannot be lowered after 30 minutes on 100% oxygen. Those exhibiting CO levels shall be treated as detailed below in the treatment section of this order as well as the Firefighter Rehab general order.

**Procedure for using the RAD 57 CO Oximeter:**

- Insert the finger into the sensor, ensuring sensor is on right side up (cable should run over the top of the hand). Insert the finger only as far as the black stop block on the bottom of the sensor! Ring finger is preferred. Do not use the thumb or fifth digit.
- Power up the unit. The display will run through a series of alarm settings. This takes ~8 seconds and indicates the device is calibrating. When the display shows scrolling zeros followed by dashed lines, the device is calculating. This takes ~15-20 seconds. The first parameter to display will be SpCO. The SpCO value will display on top, with dashed lines on the bottom. Record the value as %SpCO in the narrative of penbase, or below the vital signs section of the county paper run sheet (along with SpO2).
- Press the gray display button once.
- The next screen shows SpO2 on top; heart rate on bottom. Record this information in the usual manner. Press the gray display button to cycle through the PI (Perfusion Index) screen back to the SpCO screen.
- Repeat with each vital signs assessment.
- Continuous monitoring is not generally necessary. The victim should be removed to fresh or non-contaminated air and CO should not increase once removed.

**Treatment:**

- Routine medical or trauma care (Protocol Routine-1 or Routine-2)
- Treat any other condition per specific protocol
- Treat CO poisoning according to the chart below:

LEVEL	Pre-Hospital Treatment
0-4 non-smoker, 5-10 smoker	Observe
5-9 non smoker, 10-15 smoker	100% O2 reassess after 10 minutes
10-19 non smoker, 15-19 smoker	100% O2, transport
20-25 all	100% O2, transport
>25 all, >5 if pregnant female	100% O2, contact medical command to discuss transport to hyperbaric capable Hospital

**Special considerations:**

- ❑ Low perfusion (a PI < 0.5) may reduce the reliability of the SpCO reading. The SpO2 is designed to read in very low perfusion states and so will not be affected.
- ❑ ALWAYS confirm any elevated reading by taking 2 additional readings on 2 different fingers. Use the rough average of the readings as the patient's SpCO value.
- ❑ Excessive ambient light can interfere (falsely elevate) or interrupt (no reading) the SpCO value. This includes strobe lights or bright sunlight. The device will continuously attempt to calculate (display will show continuous scrolling zeros and dashed lines) or display a CO level too high for the patient's presentation. In this case, shield the sensor completely from light- using a Masimo light shield or anything readily available (hat, towel, jacket, pillow, blanket, etc).
- ❑ Misapplied sensors will cause inaccurate readings. Ensure the finger is inserted only as far as the black stop block.
- ❑ Finger clip sensor not intended for use on patients weighing less than 66lbs.
- ❑ Heavy smokers may have a baseline level of up to 10%. Take into consideration during treatment decisions.
- ❑ Fetal CO poisoning rate can be 10-30% higher than the mother. Ask female patients of pregnancy status during assessment.
- ❑ SpO2 (oxygen saturation) readings are unreliable in patients with CO poisoning. The pulse ox unit will read the carbon monoxide molecule bound with hemoglobin as oxygen, resulting in a false high or normal reading.
- ❑ Any CFD member can apply the RAD 57 according to the procedure above, however, a member holding a minimum of EMT Basic certification shall interpret the data, provide treatment, transport care and documentation.

**Conclusion:** The RAD 57 CO Oximeter is a tool to be used to help with diagnosing a hidden CO poisoning situation. Elevated SpCO levels from a RAD 57 should always be confirmed with a blood gas test in a hospital.

By Order of:

Paul Stubbs, Chief  
DIVISION OF FIRE

Attachment: Carbon Monoxide Response Form

PS/pjk

# CLEVELAND FIRE DEPARTMENT

## CARBON MONOXIDE RESPONSE FORM

You are hereby informed of the potential dangers that **may** be encountered if you continue to occupy this building.  
(unconsciousness, physical injury or death)

It is recommended that you leave the premises until such time as the cause of the carbon monoxide in the atmosphere can be determined and the situation rectified by you.

DATE: \_\_\_\_\_

ALARM TIME: \_\_\_\_\_ INCIDENT # : \_\_\_\_\_

ADDRESS: \_\_\_\_\_

UNITS RESPONDING: \_\_\_\_\_

PPM READING: \_\_\_\_\_ WAS CO OXIMETER USED: \_\_\_\_\_

ACTION TAKEN: \_\_\_\_\_

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OCCUPANTS SIGNATURE: \_\_\_\_\_

BATTALION CHIEFS SIGNATURE: \_\_\_\_\_

**(RETURN FORM TO CHIEF OF OPERATIONS)**