RESPONDING TO RESIDENTIAL CARBON MONOXIDE INCIDENTS

GUIDELINES
FOR
FIRE AND OTHER EMERGENCY RESPONSE
PERSONNEL

U.S. Consumer Product Safety Commission

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Products Identified
Excepted by

DISCLAIMER

This guide has been developed for use by public emergency response organizations such as professional and volunteer fire departments, emergency community service units, and other organizations delegated to respond to carbon monoxide (CO) incident calls; it is not directed toward non-emergency organizations that might receive CO incident calls.

These guidelines consist of procedures that emergency response personnel can use to help residents who call and report a suspected CO incident. The procedures are designed to help responders provide for their own safety when answering a call, determine the level of care needed by the residents, make a preliminary assessment of the CO condition in the residence, and determine when it is safe for occupants to re-enter the home. These procedures can help in finding a *significant* source of CO in the home; in some circumstances, it is possible that other professionals with technical expertise will need to be called to find the cause of hard-to-trace elevated CO levels in the home.

These guidelines assume that the responder has a basic level of familiarity with CO: how it is generated, how it can become abnormally elevated, how it is distributed through a home, and what the exposure symptoms are. References for background material are cited on page 15 of this document.

Finally, these guidelines are not a CPSC standard and are not mandatory requirements. CPSC believes that this document contains the basic information needed to provide a first emergency response to consumers. State and local fire departments and emergency response organizations can choose to adopt all or part of this material to meet their own needs and resources.

RESPONDING TO CARBON MONOXIDE INCIDENTS

This guide is intended to help people like you -- public emergency response *personnel -- act quickly and accurately when you receive a call that may* concern carbon monoxide (CO). Your response, and those of others like you, can save lives and reduce injuries caused by CO poisoning every year.

CO is associated with about 500 unintentional non-fire-related deaths each year. About 60 percent of these deaths are from motor vehicle exhaust, and about 40 percent are associated with consumer products. CO in its pure form is colorless and odorless; however, other gases that do have an odor often accompany it.

Whether you're part of a fire department or a public emergency response organization, you'll find information here that will help you:

- determine how much assistance occupants need,
- ensure your own protection from CO when entering a home,
- confirm whether a CO hazard exists,
- make a preliminary assessment of the potential sources of elevated CO,
- give advice to the resident on how to make the home safe for re-entry.

To use this guide most effectively, please follow these steps:

- read "What to Know Before You Respond to a CO Incident Call," page 3,
- become familiar with "CO Incidents: Guidelines for Dispatchers," page 4,
- follow the steps in the "CO Incident Reporting Form," beginning on page 5. This includes the "CO Measurement Form," where you record the readings from your CO meter/measuring equipment.
- read "CO Levels: Advice to Give, Actions to Take," page 12.
- fill in the form "Advice for Residents," page 15, and give a copy of this to occupants.

As you use this guide, please feel free to adopt all or part of it for your particular organization or community. If you have suggestions for future editions, let us know at the U.S. Consumer Product Safety Commission. You can contact us by calling our toll-free hotline at 1-800-638-2772 or visiting our Web site at www.cpsc.gov.

WHAT YOU NEED TO KNOW BEFORE YOU RESPOND TO A CO INCIDENT CALL

- Emergency response procedures for CO incidents are most effective when coordinated with local medical personnel, poison control centers, utilities, and heating and ventilating contractors.

- For your own protection, it is essential to establish a "Safe Entry Procedure" when entering a home where there is a reported CO incident.

- It is important to know what the potential sources of elevated CO are in a home. See pages 6 - 7 of this document for a list of these sources and page 15 for background references about CO.

- It is important to be familiar with the various types of residential CO alarms and how they work, including the differences among alarm, low-battery, malfunction, and error and warning signals. Manufacturers' product literature provides this information.

- CO incident calls may be made when a CO alarm has sounded or because the occupants suspect possible CO exposure due to illness or strange odors. A CO alarm signal should never be ignored. CO alarm signals require a different response than smoke alarms. CO alarms are designed to activate at exposures below those at which symptoms occur, while occupants still have time to take action to protect themselves. However, CO levels can build up quickly, so the CO alarm might be responding to a high level. Immediate evacuation is necessary when a CO alarm sounds. CO alarms should not alarm below 30 ppm.

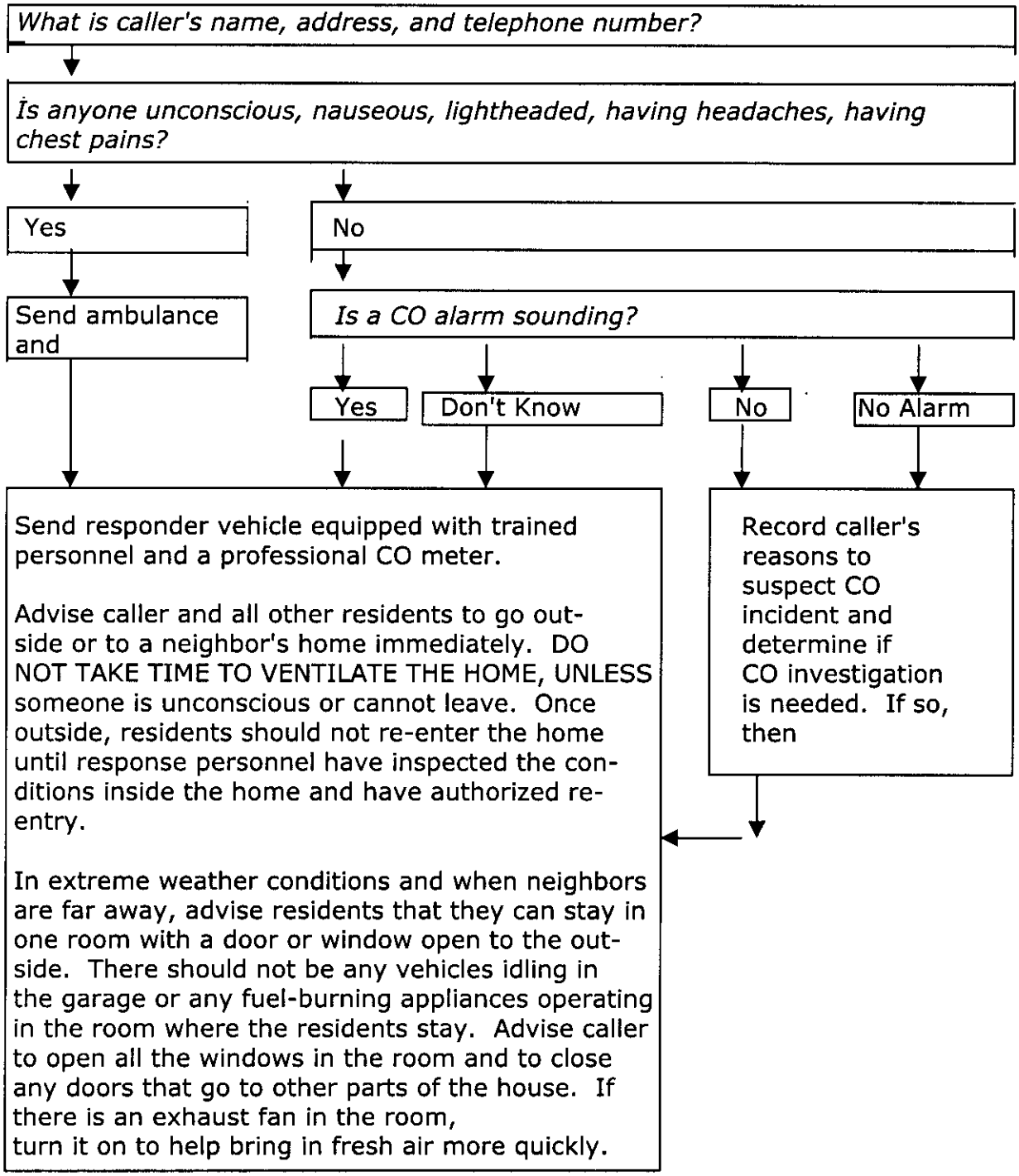
- There have been instances where CO alarms activated and neither a CO elevation nor source could be identified. Changes in the voluntary standard for CO alarms, effective October 1, 1998, have reduced the occurrence of unexplained alarms. If a resident has an alarm manufactured before October 1, 1998, and a CO elevation or CO source cannot be located, the resident should be advised to purchase a new CO alarm. The new alarm should meet one of the following standards: Canadian Standards Association (CSA) 6.19-01, 2001; Underwriters Laboratories Inc. (UL) 2034, Second Edition, October 1998; or International Approval Services (IAS) 6-96, Second Edition, June 1, 1998.

- Professional CO detection equipment, and training in its use, is essential in finding the source of elevated CO. Use, maintenance, and periodic calibration procedures should be established. Manufacturers of such equipment generally provide recommendations and instructions for maintenance and re-calibration; follow these instructions carefully.

- In most cases where a CO incident is reported, a professional CO monitor that measures room CO concentrations will help you assess the immediate risk. Finding the reason for the CO alarm can be time-consuming and difficult, particularly if the elevated CO levels are the result of a transient condition such as downdrafting from an exhaust flue. Heating, ventilating, and air conditioning (HVAC) contractors may be needed to assess conditions in the residence and provide advice to the resident.

CO INCIDENTS: GUIDELINES FOR DISPATCHERS

Dispatchers are the first contact when residents call for help about a CO incident. You can use these guidelines to decide what kind of help is needed and what type of equipment should be sent to the residence.



CO INCIDENT REPORTING FORM

The following CO measurement procedures can help you and any subsequent investigators identify the cause of the resident's request for help. It can also help you assess when it is safe for a resident to re-enter the home.

When you arrive on the scene to investigate a call about CO, follow the steps listed below. Plan to make multiple copies of this form, so you can fill out separate forms for each separate investigation. Be sure to keep a copy of each completed investigation form.

Step 1: Determine the Level of Care Needed by Household Members

A) If residents are inside the house, go to Part B below. If residents are outside the house, find out the following information:

- Are any members of the household feeling ill? Yes No
- Which symptoms are they experiencing?
  Headache Nausea Dizziness Confusion
  Shortness of Breath Chest Pains
  Other (describe) _____

Note: Cardiac patients are the most susceptible to CO poisoning and may experience chest pains.

Note: The symptoms of moderate CO poisoning are similar to those of the flu and CO poisoning can be misdiagnosed.

It is important that residents who show symptoms of CO poisoning be examined on the scene by EMS or appropriately trained personnel. If medical treatment is indicated, then the residents should be taken to the appropriate medical facility. Residents should not be allowed to drive themselves to a doctor's office or a hospital. Residents should not go back inside until you have inspected the conditions inside the home and authorized re-entry.

B) If residents are inside the house, then follow your local procedures for safe entry before determining the condition of the residents. If no local safe entry procedures for a CO incident exist, then:

1) Have Self-Contained Breathing Apparatus (SCBA) available and ready for use. Follow your jurisdiction's guidelines for using this equipment. If there is any doubt about CO levels, use SCBA.

2) Using your CO meter and following the manufacturer's instructions, take a CO reading outside. Make sure you are standing away from any vehicle exhaust or other source of CO.

3) Record the outside reading on the *CO Measurement Form*, page 10. This will be the baseline reading.

4) Before entering the home (standing in the doorway), take a second CO reading.

5) Record this reading on the *CO Measurement Form*, page 10.

6) Make sure you continue to be properly protected until safe CO levels are attained. Leave windows and doors open or closed - just as you found them - until you begin Step 3 of this investigation.

7) Take all residents outside. Occupants should remain outside until you have inspected conditions inside the home and authorized re-entry.

8) Determine the medical condition of all of the residents by following part A) above. This should be done by appropriately trained EMS/firefighter personnel.

Step 2: Identify Potential Sources of Elevated CO in the Home and Attached Garage

Potential sources of CO include: automobiles; motorcycles; trucks; golf carts; RV's; gasoline, propane, or diesel-fueled appliances; lawn mowers; power generators; furnaces; water heaters; clothes dryers; natural gas or propane refrigerators; ranges; ovens; space heaters; fireplaces; gas logs; wood and coal stoves; charcoal or gas grills; kerosene heaters; wood stoves; and any other equipment or appliance that burns fuel.

A) List on the next page the potential sources of elevated CO in the home that were in operation at the time of the call or were in use in the 24 hours before the call. Note their location in the home, and if they are vented or unvented to the outside of the home.

These potential sources can be improperly installed, used, or maintained, leading to elevated levels of CO. Improper home remodeling can cause CO problems by interfering with combustion air supplies, for example. It is important to note whether you see any indication of this. For example, gasoline generators improperly used indoors and gas ovens improperly used for heating or lined tightly on the bottom with aluminum foil can increase CO emissions and lead to CO buildup in homes.

Potential Source	Location	Vented or Unvented	
(Example) Kerosene Heater	Living Room		X

B) Examine flues, vents, and chimneys for blockage by birds' or other animals' nests or by debris, such as chipped or cracked masonry. Note any loose or disconnected vent or chimney connections, any loose or missing furnace panels, and any debris or soot in the chimney. Advise occupants to have flues, vents, and chimneys professionally serviced if problems are indicated.

_____

_____

_____

C) If there is an attached garage, answer the following questions:

Were any vehicles in the garage in the last 12 hours? Yes No

Were any vehicles' engines on in the last 12 hours? Yes No

Step 3: Take Indoor CO Measurements

A) Before taking indoor CO measurements,

1) Plan to take one set of CO measurements in areas or rooms of the house where there are potential sources of elevated CO that were in operation at the time of the call or were in use in the 24 hours before the call.

2) Plan to record your measurements on the *CO Measurement Form*, page 10.

3) To complete the entire investigation, you will need to take one set of measurements. These measurements will help you assess whether there are elevated levels of CO in the home and what the source(s) of those elevated levels might be.

B)Taking indoor measurements

1) If you have not already taken (and recorded) a CO reading outside and at the entry to the home, then return to Step 1, parts B)1 through B)5, and follow those instructions. After taking indoor readings, you will need to subtract the outdoor reading from the indoor reading in order to determine the contribution that indoor sources make to any measured CO indoors. For example, if the outdoor reading is 25 ppm and the indoor reading is 40 ppm, then the contribution from indoor sources is 15 ppm.

2) Close all windows and doors. Turn on the fuel-burning appliances and other CO sources that have been in operation in the past 24 hours and let them reach operating temperature (about 15 minutes). Keep them on during the measurements. Be sure to put pots with water in them on all range-top burners that have been used in the past 24 hours because cold pots on the burner can elevate CO readings.

3) Measure and record indoor CO levels throughout the house. IMPORTANT: Take measurements in the ambient air in the center of each room, standing back approximately 5 feet from any potential CO source. Do NOT take measurements in or near vents or flue pipes.

4) Check for proper draft in a natural draft furnace by using a smoke test. Hold a lit match near the draft hood of the appliances that you turned on. Blow the match out. The smoke will be drawn into the hood if there is proper draft.

5) When you have finished taking all measurements and if you measured elevated CO levels, then open all doors and windows of the residence so that the home will be ventilated.

Step 4: **Evaluate Information**

A) Consider all of the information gathered in the investigation. Review the CO measurements you recorded.

B) Consider whether a vehicle was left idling near the home or in an attached garage (even with the garage door open).

C) Consider whether a portable propane, diesel, or gasoline-powered appliance was in use.

D) Consider whether any ventilation equipment or exhaust fans were used in the past 24 hours before the call.

Step 5: **Complete the Investigation**

Gather the following information:

1) Resident's Name _____
2) Address _____
3) Phone Number _____
4) Incident Location (if different than address)

_____

5) Type of residence: Apartment Single-family Townhouse Duplex Commercial Establishment Other

6) Today's Date _____

7) Time and Date of Call _____

8) Time and Date Alarm Sounded (if applicable) _____

Step 6: **Advice and Follow-up**

A) Read *CO Levels: Advice to Give, Actions to Take,* page 11.

B) Give residents written advice based on this and on the information you gathered in your investigation. Use the section in "Advice for Residents," page 15.

C) Write here for your files the advice you gave to the resident:

_____
_____
_____
_____
_____
_____
_____
_____
_____

D) Tell occupant that regular maintenance of fuel-burning appliances is the first line of defense against CO poisoning.

E) Keep a copy of this report (including the *CO Measurement Form*) for your files.

Your Name (Print):

_____

Your Signature:

_____

CO MEASUREMENT FORM

Record levels of CO found throughout the home. Take measurements in the center of each room under the conditions specified in the *CO Incident Reporting Form.*

Draw diagram of house (on the next page) showing locations of rooms and possible sources of CO.

	Measurements (CO ppm)
Outdoors (baseline)	_____
Entrance (doorway)	_____

	Measurements (ppm) with Recently Used Potential CO Sources Turned On and Doors and Windows Closed
Attached Garage	_____
Basement	_____
Utility Room	_____
Recreation Room	_____
Den	_____
Living Room	_____
Dining Room	_____
Kitchen	_____
Family Room	_____
Powder Room	_____
Bedroom 1	_____
Bedroom 2	_____
Bedroom 3	_____
Bedroom 4	_____
Bedroom 5	_____
Bathroom 1	_____
Bathroom 2	_____
Bathroom 3	_____
Bathroom 4	_____
Other Rooms	_____
_____	_____
_____	_____

DIAGRAM OF HOUSE SHOWING LOCATION OF CO SOURCES

CO LEVELS: ADVICE TO GIVE, ACTIONS TO TAKE

During the investigation process, residents should be evacuated from the home. After the investigation is complete, it is time to assess the information you have and provide advice to the residents, including whether they can safely re-enter their home. The final decision on re-entry may need to be made by someone other than the first responder.

The CO levels you measured in various rooms of the residence should have been taken in the center of the room in ambient air, making sure you were about 5 feet away from any appliance. Based on those measurements and your evaluation of the information you gathered in your investigation, identify any areas of the house with measured CO levels of: 1) 70 ppm or higher, 2) between 30 ppm and 70 ppm, or 3) less than 30 ppm. Then use the guidelines below to give advice to residents.

CO Levels: 70 ppm or higher

1) *If the source of these CO levels appears to be a vehicle or an appliance, such as a lawn mower or generator, in a garage, then:*
   a) Turn off the engine if it is still on.
   b) If you suspect that an appliance or a generator or a vehicle engine that was idling in a garage several hours earlier is the cause of elevated CO levels, then advise the consumer that engines should not be left idling in an attached garage, even with the garage door open.

2) *If the source of these CO levels appears to be a permanently installed appliance, then:*
   a) Turn off the appliance.
   b) If the fuel supply can be shut off, do so. Where appropriate, contact the fuel supplier and advise it of the possible need to "red tag" the appliance.
   c) Advise residents that dangerous levels of CO have been detected and that they should not use the appliance until the cause of the elevated CO has been identified and corrected by a qualified technician.
   The appliance may not need to be repaired or replaced; it is possible that an adjustment to exhaust fans or some other house situation may need attention.

3) *If the source of these CO levels appears to be a portable appliance, then:*
   a) Turn off the appliance.
   b) Advise residents that dangerous levels of CO have been detected and the appliance must be inspected and repaired or replaced before being used again.

c) Advise residents that if the appliance passes inspection, but the CO problem recurs, then a qualified contractor or service person should investigate the appliance while it is being operated in the home. This may help identify why elevated CO levels are in the home and what is causing elevated CO levels.

4) *If you believe that misuse is the cause of CO* (for example, using a charcoal grill or a gas oven to heat a home during a power outage), then educate the resident about the causes and dangers of CO and the proper use of appliances.

5) *If you cannot find an apparent source of elevated levels of CO*, then follow your jurisdiction's guidelines or advise the resident to call a heating, ventilating, or air conditioning (HVAC) company immediately to identify and correct the conditions causing the elevated CO levels.

6) Advise residents that they can return to the home after it is cleared of CO. When your equipment shows levels of CO below 30 ppm, residents can return to the home. If your equipment shows a CO level below 30 ppm and if a household CO alarm is still sounding, then remove the alarm and advise the consumer to replace it as soon as possible.

7) Advise residents to have their fuel-burning appliances inspected immediately and maintained once a year by qualified professionals.

8) Advise residents to use a CO alarm manufactured to one of the following standards: Canadian Standards Association (CSA) 6.19-01, 2001; Underwriters Laboratories Inc. (UL) 2034, Second Edition, October 1998; or International Approval Services (IAS) 6-96, Second Edition, June 1, 1998.

9) Advise all residents to call again if their CO alarm sounds - particularly if they have followed the above recommendations.

CO Levels: Between 30 ppm and 70 ppm

1) *If the source of these CO levels appears to be a vehicle or an appliance, such as a lawn mower or generator, in a garage, then:*
   a) Turn off the engine if it is still on.
   b) If you suspect that an appliance or a generator or a vehicle engine that had been idling in a garage several hours earlier is the cause of elevated CO levels, then advise the consumer that engines should not be left idling in an attached garage, even with the garage door open.

2) *If the source of these CO levels appears to be a permanently-installed appliance or a portable appliance, then:*
   a) Turn off the appliance.
   b) Advise residents that potentially dangerous levels of CO have been detected and that they should not use the appliance until the cause of elevated CO levels has been identified and corrected. Advise residents that a condition in the home may be the cause and that a qualified

contractor or serviceperson may need to be in the home while the appliance is in operation to identify and repair the CO source.

3) *If you believe that misuse is the cause of CO* (for example, using a charcoal grill or a gas oven to heat a home during a power outage), then educate the resident about the causes and dangers of CO and about the proper use of appliances.

4) *If you cannot find an apparent source of elevated levels of CO*, then follow your jurisdiction's guidelines or advise the resident to call a heating, ventilating, and air conditioning (HVAC) company immediately.

5) Advise residents that they can return to the home after it is cleared of CO. When your equipment shows levels of CO below 30 ppm, residents can return to the home. If your equipment shows a CO level below 30 ppm and a household CO alarm is still sounding, then remove the alarm and advise the consumer to replace it as soon as possible.

6) Advise residents to have their fuel-burning appliances inspected immediately and maintained once a year by qualified professionals.

7) Advise residents to use a CO alarm manufactured to the requirements of one of these standards: Canadian Standards Association (CSA) 6.19-01, 2001; Underwriters Laboratories Inc. (UL) 2034, Second Edition, October 1998; or International Approval Services (IAS) 6-96, Second Edition, June 1, 1998.

8) Advise residents to call again if their CO alarm sounds – even if they have followed the above recommendations.

CO Levels: Less than 30 ppm

1) Advise residents that you did not find high levels of CO.

2) If the call was the result of a sounding CO alarm, advise the resident to review the manufacturer's instructions about a sounding CO alarm and to contact the manufacturer if necessary. If the alarm was manufactured before October 1, 1998, advise residents that they may want to purchase a new alarm that meets the requirements of one of these standards; Canadian Standards Association (CSA) 6.19-01, 2001, Underwriters Laboratories Inc. (UL) 2034, Second Edition, October 1998, or International Approval Services (IAS) 6-96, Second Edition, June 1, 1998. Alarms made before that time were subject to nuisance alarming; the new standards reduce the possibility of nuisance alarming. Advise residents that CO alarms have a limited life and that their alarm may need to be replaced. Advise residents never to ignore a sounding CO alarm and to call you again if the alarm activates.

(For information about why 30 ppm and 70 ppm are used as benchmark levels, please read: "A Note about Benchmark CO Levels", page 16.)

ADVICE FOR RESIDENTS

Based on my investigation of CO levels in your home, I recommend that the following actions be taken:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Information provided by: _____

Name/Organization/Phone/Date: _____

MORE INFORMATION ABOUT CO

To learn more about CO and CO poisoning, contact the U.S. Consumer Product Safety Commission (CPSC) at our toll-free hotline: 1-800-638-2772 or visit our Web site at: www.cpsc.gov.

To obtain a free copy of the following information, visit www.cpsc.gov, or send your name and address on a postcard to: CPSC, Washington, DC 20207 and mention the publication you want.

- *The Senseless Killer - Can You Tell What It Is?*
- *Carbon Monoxide Questions and Answers*
- *Combustion Appliances and Indoor Air Pollution*
- *CO Poisoning with Camping Equipment*
- *Portable Generator Safety Tips*
- *Preventing Carbon Monoxide Poisoning from Small Gasoline-Powered Engines and Tools*
- *Indoor Air Pollution: An Introduction for Health Professionals*

Another source of information about CO and CO response procedures is:

- National Fire Protection Association, Quincy, Massachusetts, *National Fuel Gas Code Handbook, 1999, Supplement 3*, "Technical Background for Residential Carbon Monoxide Responders".

A Note about Benchmark CO Levels

You may have read or heard about standards or recommendations for allowable (or safe) CO levels. Usually, these apply to particular environments, such as outdoors or the workplace. There is no U.S. federal government standard that sets an allowable *residential indoor* level for carbon monoxide; however, there are industry standards for allowable CO emissions from individual indoor appliances, such as furnaces or ovens.

Varying levels of CO exposure may cause varying health effects; there are levels that are not likely to cause adverse health effects in healthy adults, higher exposure levels that can be potentially life threatening, and levels so high as to cause death. The effects of CO exposure depend on the length of time that a person has been exposed to CO, how high the CO concentration is, how physically active the person is at the time of exposure, and the person's general state of health. When a person breathes in CO, the CO combines with oxygen in the blood to form poisonous carboxyhemoglobin (COHb). The amount of COHb in a person's blood is expressed as a percent. For example, a person exposed to CO might be described as having eight percent COHb. Heavy smokers may have baseline levels of ten percent COHb.

A ten percent COHb level is a reference value that is widely regarded by physicians as confirmation of CO poisoning, even if there are no symptoms; when used as an upper limit, it is widely recognized as protecting healthy adults against the harmful effects of CO. At this level, a person generally is still able to take action to alleviate a potentially life-threatening CO exposure. This benchmark is built into industry standards for CO alarms; a CO alarm MUST sound at exposures predicted to reach ten percent COHb in heavily exercising individuals. This will occur at concentrations and times of 70 ppm CO for slightly more than three hours, a level of 150 ppm for 50 minutes, or a level of 400 ppm for approximately 15 minutes. At these same exposures, less active individuals will have less than ten percent COHb. At levels less than 30 ppm, it is unlikely that adverse health effects will occur in healthy adults. This is a second benchmark level in the industry standards for CO alarms; alarms cannot sound at 30 ppm or less. This helps prevent false or nuisance alarms from temporary "spikes" in CO that may occur when there is an outdoor air inversion or when an appliance is turned on and used for a relatively short time.

For the reasons described above, CPSC uses two benchmarks in this document as the basis for advice on what actions a resident should take when CO is present in the home. The first is the false alarm resistance level of 30 ppm. The second is 70 ppm, the lowest level that can cause COHb to exceed ten percent.

The benchmark levels in this document, and the resulting advice, are suggested guidelines and do not constitute a standard. As noted earlier, these benchmark levels do not constitute a standard. The benchmark levels are conservative in that they recommend action BEFORE potentially life-threatening CO exposure occurs. You may already be using or have come across other published Standard Operating Procedures (SOP's) that use different CO ppm levels as a benchmark. If your jurisdiction has an SOP that works well for your needs and resources, and if the benchmark levels of that SOP, based on your experience and that of medical personnel in your community, adequately provide for the safety of residents, then you may want to continue using that SOP.

To learn more about CO and CO poisoning, contact the

U.S. Consumer Product Safety Commission (CPSC)

Washington, DC 20207

toll-free hotline: 1-800-638-2772

Web site: www.cpsc.gov

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