RESPONDING TO CO DETECTOR ACTIVATIONS

BY FRANK C. MONTAGNA

Carbon monoxide (CO), a potential killer, is produced by all fuel-burning appliances in the home. Until recently, there was no sure method of warning of dangerous levels present in the home. Now, readily available and affordable carbon monoxide detectors routinely provide such a warning and have been credited with saving lives. It appears that the problem has been solved. Why, then, are fire departments across the country so concerned about the carbon monoxide issue?

INCREASED WORKLOAD FOR FIRE DEPARTMENTS

With the solution to the carbon monoxide threat in homes came an increased workload for fire departments. When the detectors alarm as carbon monoxide builds up in the home, homeowners call the fire department, in accordance with manufacturers' instructions included with the detector. In December 1994, the Chicago (IL) Fire Department responded to 1,851 carbon monoxide detector alarms in a 24-hour period.[1] This occurred during a thermal inversion in which a layer of cold air was trapped under a layer of hot air, preventing pollutants, including carbon monoxide, from escaping into the atmosphere. The carbon monoxide reached a level high enough to set off many of the recently mandated carbon monoxide detectors installed in homes around Chicago.

Your department may never have to respond to 1,851 alarms in 24 hours, but your carbon monoxide responses certainly will increase. In 1992, fewer than 1,800 detectors were sold. In 1994, more than five million were sold. That number is expected to increase in 1995 as more and more companies produce carbon monoxide alarms and more homeowners protect themselves by purchasing them. Other municipalities certainly will mandate the use of these alarms. Perhaps your community will be among them. If you have not yet been concerned with carbon monoxide, don't worry; you will be.

PREPARING FOR RESPONSE

In an effort to make houses more energy-efficient, the objective becomes to try to keep heated or cooled air in while keeping unconditioned air out. This approach may have saved homeowners money, but it also allowed carbon monoxide and other pollutants to build up in homes, sometimes to dangerous levels.

The recent proliferation of carbon monoxide detectors in homes gives the fire service the opportunity to provide a new service to those we protect. How well we prepare to perform this service could mean the difference between life and death for entire families.

Being prepared entails the following:

- knowing what carbon monoxide is and how it affects victims,
- knowing how to treat victims overcome by carbon monoxide,
- recognizing a carbon monoxide detector and understanding how and why its alarm sounded, and
- knowing the sources of carbon monoxide in the home and how to locate and remove them.

Table 1. EFFECTS OF CARBON MONOXIDE EXPOSURE

PPM in air	*Percentage in Air*	*Time of Exposure*	*Effects*
200	.02	1 to 2 hours	Headache, nausea, dizziness
800	.08	45 minutes	Headache, nausea, dizziness
800	.08	3 hours	Death
3,200	.32	10 minutes	Headache, nausea, dizziness
3,200	.32	30 minutes	Death
12,800	1.28	1 to 3 minutes	Death

The time of exposure and quantity of carbon monoxide present combine to determine the COHb level and symptoms.

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CARBON MONOXIDE AND ITS EFFECTS

As firefighters, we already are familiar with carbon monoxide and know it can be deadly on the fireground. It can be just as deadly in the home in a nonfire situation. According to the *Journal of the American Medical Association*, carbon monoxide is responsible for 800 to 1,000 accidental deaths a year. This makes it the most common cause of unintentional poisoning deaths in the United States. It is estimated that 10,000 people annually seek medical attention as a result of carbon monoxide poisoning.[2]

Carbon monoxide, a colorless, odorless, and tasteless gas, is slightly lighter than air, with a specific gravity of 0.97 and has an explosive range of 12.5 to 74 percent. It is lethal in minutes at 1.28 percent in air and will asphyxiate long before it poses an explosion danger. Measured in the air in parts per million (ppm), carbon monoxide exposure of 800 ppm for 45 minutes can cause flu-like symptoms, while exposure to the same 800 ppm for three hours can cause death.

Inhaled carbon monoxide is absorbed by the oxygen-carrying portion of the blood, hemoglobin. The carbon monoxide and hemoglobin combination is known as "carboxy hemoglobin" (COHb). Carbon monoxide is 240 times more likely to be absorbed by the hemoglobin than oxygen (O_2). As a result, small amounts of carbon monoxide in the air can rapidly increase the COHb level. Carbon monoxide replaces oxygen in the blood, depriving organs and cells of needed oxygen, and prevents the release of the oxygen in the blood, further reducing the oxygen available to the body. It is a one-two punch that can be fatal once the COHb level reaches 50 percent to 70 percent. At this elevated level, carbon monoxide causes asphyxiation and death. In fresh air, it takes about five hours to reduce a 10 percent COHb level by half, to five percent—giving it a half-life of five hours in the body's system.

TREATING CARBON MONOXIDE POISONING

Remove victims from the contaminated atmosphere and administer 100 percent oxygen through a tight-fitting face mask. The half-life of carbon monoxide in normal air is approximately 300 minutes. Breathing pure oxygen reduces this half-life to 80 minutes, and hyperbaric oxygen further reduces it to 23 minutes. Hyperbaric oxygen, available at selected medical facilities, delivers oxygen at greater than atmospheric pressure. It effectively pushes the carbon monoxide out of the blood. Hyperbaric oxygen should be considered for anyone who has suffered a serious carbon monoxide exposure, particularly victims who have lost consciousness as a result of carbon monoxide poisoning, although even a person with less exposure can benefit from it.[3]

Oxygen therapy, by reducing the half-life, reduces the time carbon monoxide has to harm the body and increases the amount of oxygen available in the blood. As first responders, we can administer oxygen on the scene and alert medical authorities to the fact that there may be a need for hyperbaric oxygen. If you don't know the location of the nearest hyperbaric chamber or how to get a patient to one, now is the time to set up a protocol for your department. Delaying this treatment can be deadly.

TRIAGE CARBON MONOXIDE DETECTOR ALARM CALLS

A call involving a sounding carbon monoxide alarm may be an emergency or a

it must be replaced. The expected life of a semiconductor detector is from five to 10 years.

• *Electrochemical.* Marketed by AIM Safety USA, Inc., this detector runs on a nonreplaceable battery, has an expected life of five years, and has a distinctive triangular shape. Its data-logging capability can download carbon monoxide activity for the preceding eight days. Unlike the other types, it alarms with a "ba-beep" sound so that it is not mistaken for a smoke detector alarm. It was not listed by Underwriters Laboratory at the time this article was written.

Standards

The First Alert biomimetic and numerous semiconductor models meet the requirements of Underwriters Laboratory (UL) 2034, published in April 1992. The standard takes into consideration that the harm caused by carbon monoxide is a function of the percentage that exists in hemoglobin over the time of exposure. As the percentage of carbon monoxide in the air increases, the time needed for it to cause harm decreases; therefore, the detector's reaction time (the time to alarm) decreases.

UL-listed carbon monoxide detectors must alarm at the above levels before the listed reaction times expire. Note that the alarm trigger point is at 10 percent COHb. This is considered a low-level carbon monoxide exposure. At this level, symptoms should not be evident in a healthy adult.

UL 2034 also requires that a carbon monoxide detector ignore low levels of carbon monoxide for specific periods of time, cutting down on nuisance alarms for levels that are not harmful. Earlier model biomimetic detectors were involved in the rash of carbon monoxide calls to Chicago fire departments. Amendments to UL 2034, effective October 1, 1995, mandate that the gel-cell detector be less sensitive and the semiconductor detectors be more resistant to chemical contamination. All new detectors require a silence button that will shut off the alarm sound but allow it to re-sound if the carbon monoxide level remains at a dangerous level—100 ppm. The new standard provides for increased resistance to low-level alarm and requires contrasting lettering to more easily identify it as a carbon monoxide detector. Biomimetic detector sensor modules manufactured under the new standard will be distinguishable by their white color and the word "Nicoron" on the labeling. The older sensor modules are black and contain the word "Facor" on the label. We can expect to find old and new standard detectors in the homes to which we respond; both remain UL-listed.

The old standard included instructions that directed the occupant to leave the building and call the fire department if the detector sounded. The new standard directs the occupant to call the fire department only if someone in the home is exhibiting symptoms. If no one in the living unit is exhibiting symptoms of carbon monoxide exposure, the occupant is further instructed to ventilate, shut down fuel-burning appliances, and have the appliances checked for malfunctions. I suspect that in spite of the new instructions, fire departments will still be called.

SOURCES OF CARBON MONOXIDE IN THE HOME

All combustion devices in the home can generate carbon monoxide. Although manufacturers test appliances to see that they do not produce excessive carbon monoxide, the test is done in controlled settings, not in a particular living unit. These test results may not apply to where or how appliances are used by owners or how they have been maintained. Even properly operating appliances can produce lethal doses of carbon monoxide over time in a house that does not allow for sufficient air exchange.

A properly functioning stove can give off 400 ppm or more of carbon monoxide once it reaches operating temperature. That number can be as high as 800 ppm when the unit is cold. A properly adjusted stovetop flame gives off excessive carbon monoxide when the flame contacts a cold pot. Even an improperly adjusted pilot light can cause a dangerous carbon monoxide buildup over time in a tightly sealed house. A hot-water heater also can generate excessive carbon monoxide if its flame is not properly adjusted or if its burner is covered with rust or debris. The debris prevents the flame from achieving a proper operating temperature, resulting in the generating of excessive carbon monoxide. A hot-air furnace with a cracked heat exchanger can deliver lethal doses of carbon monoxide throughout a house by way of the heat registers. A blocked chimney or flue pipe will prevent the products of combustion from exiting the house and instead spill them into the living space. An unvented space heater, too, can be a source of deadly carbon monoxide in the home.

A properly designed fireplace flue operates on a natural draft. As long as the flue is hot and there is active flaming, there is a good draft and carbon monoxide is drawn up and out of the house. A problem can occur when the fire burns down and just glowing embers remain. The glowing embers give off more carbon monoxide than the flaming logs, and also less heat. This reduction in heat can reduce the natural draft. If a house is tight and "operating" at negative pressure, the draft in the fireplace flue can be reversed and carbon monoxide can spill into the home. Negative pressure can be brought about by wind drafting air up and out of an unused chimney or out of openings on the leeward side of the house. This phenomenon is called "downdrafting" (also known as backdrafting.[10,11] The air drawn out of the house creates a negative pressure inside and can result in the drawing of carbon monoxide gas down the flue into the house instead of up and out the flue. This phenomenon can occur in any natural draft combustion appliances including the furnace and water heater.

Reverse stacking—essentially, a mechanically induced downdraft—also can cause flue gases to be drawn into the home. In today's airtight homes, many appliances vent to the outside with little or no air being brought back into the house, creating a negative pressure. Constant air wars are going on in a house as various appliances fight for fresh air. In these wars, fans win. The bathroom vent fan, attic fan, clothes dryer, and forced-air vent heating unit all blow air out of the house. If sufficient air is not brought in to replace it, flue gases can be drawn down the furnace, water heater, or fireplace flue.

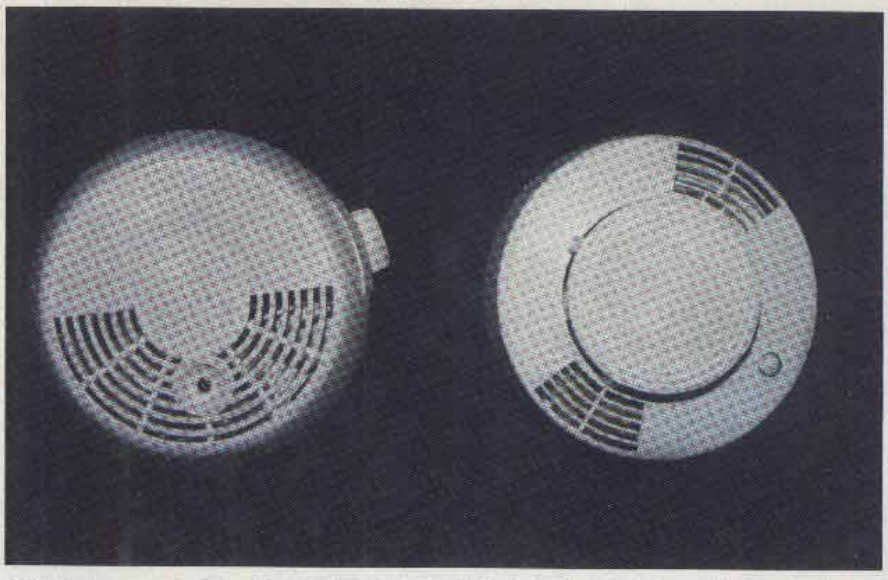
Carbon monoxide need not come from inside the home. An attached garage can significantly contribute to carbon monoxide in the house. A house operating at negative pressure has been shown to draw 200 ppm from an attached garage with the connecting door closed. The negative pressure pulls the carbon monoxide through the door cracks after the car has left, even with the exterior garage door left open.

Carbon monoxide-laden fumes from a neighbor's car, barbecue, or lawnmower can be drawn into a home by a ventilation fan or through an open window. If the home is attached, a deteriorating flue serving one house can leak deadly carbon monoxide fumes into the other house's living space.

LOCATING THE CARBON MONOXIDE SOURCE

When called to a sounding carbon

monoxide alarm, responders must be part firefighter and part detective. The firefighter must recognize the danger and then rescue and treat the victims of carbon monoxide poisoning. The detective must track the carbon monoxide to its source and shut it down, leaving the home in a safe condition. Colorless, odorless, and tasteless carbon monoxide cannot be detected or tracked without a field survey meter that can detect carbon monoxide in low and high concentrations (although in some instances, other odors in the flue gases may give a hint as to the source). The meter may be equipped to detect a single gas or multiple gases—depending on the department's needs and resources. A meter that gives a constant readout and is calibrated 0 to 999 ppm is adequate. Following are some suggested guidelines for responding to a call involving elevated carbon monoxide levels.



At first glance, some of the older biomimetic models (left) look quite similar to smoke detectors (right). (Photo by Lawrence Petrillo.)

GUIDELINES FOR RESPONSES

• Interview the occupant(s) *before* taking level readings. This is the time to verify the information given to the dispatcher. Is anyone exhibiting symptoms? Observe the occupants as you interview them. Look for signs of disorientation. Account for all occupants of the house, including the baby who just went to sleep and grandma sleeping in the attic. Both are in high-risk groups and might be suffering from carbon monoxide poisoning, and not just sleeping.

• Find out what was happening in the house for several hours preceding the call. If 10 people each took a long shower, the water heater will have operated for a long time and should be considered a possible source of the carbon monoxide. Did the occupant shut down any appliances? If so, when? Even though the appliance may be shut off at the time of your arrival, it might have contributed to a carbon monoxide buildup prior to being shut off. Were any appliances recently installed or repaired? An inadvertently disconnected flue pipe or improperly adjusted appliance can be deadly. Even newly installed windows could be the cause. They could have changed the airflow into and out of the house, resulting in a carbon monoxide buildup. Remember, be a detective.

• With meter in hand, *most* sources of carbon monoxide can be effectively tracked and located. Take the initial reading at the door to the dwelling. If you find elevated levels there, use SCBA. How do you define elevated levels? There is no one accepted standard at this time. Various government agencies have set conflicting acceptable levels of carbon monoxide exposure. OSHA allows an eight-hour exposure to 35 ppm in the workplace.

• Different departments mandate the use of SCBA at different levels of carbon monoxide exposure during an investigation. Some departments with which I am familiar have set levels that range from 10 ppm to 36 ppm to 100 ppm. When setting your policy, consider the concentration level vs. time and frequency of expected exposures. In any case, having a backup mask-equipped team standing by outside the door makes sense. It is better to be safe than sorry.

• Occupants should leave the house if elevated readings are found and should not be allowed to return until the levels have dropped to a safe level. Some departments use 100 ppm as the trigger point for evacuation and nine ppm as a safe level. If the level is between 10 ppm and 99 ppm, they warn occupants of the danger, but do not force them from the house. Again, there is no accepted standard for evacuation.

• After you have taken the initial reading at the entrance door, slowly move through the house reading the meter as you go. Some meters can be set to alarm at a predetermined warning threshold. If the level increases to your chosen danger point, the meter will sound; and you then can switch to an SCBA-equipped investigation.

• Once the interview is over and you have taken readings throughout the house without discovering the source, check individual appliances. Some departments use a checklist (see sidebar) to be sure a potential source is not missed and to record the readings. Leave the checklist with your readings for the utility company or repair crew; it will help them locate or correct the problem. Check the stove vents at the rear of the stove top. Check around the oven and pilot light. Blocked air vents on the stove can increase the carbon monoxide output. If the stove is lined with aluminum foil, the foil can block air vents as well as prevent the stove from reaching its operating temperature (as can a dirty oven). If proper temperature is not achieved, carbon monoxide output is increased. If the stove has been used for a prolonged time to heat a cold house, carbon monoxide concentrations certainly will have increased. Warm all appliances for 10 minutes before taking readings. Doing this will allow them to reach operating temperature. The stove may take as long as 30 minutes on broil to reach operating temperature.

• Take readings at the draft diverter (an opening into the flue), located at the top of a gas hot-water heater, after warming up a gas hot water heater. Spillage of carbon monoxide here after the water heater has warmed up indicates downdrafting, reverse stacking, or a blocked flue. Take readings along the flue pipes. Look for rust spots that might have perforated the pipe, allowing spillage. Use an incense stick or match to test for a good draft. If smoke is drawn into the draft diverter, the draft is good. If it spills out, then it is contributing carbon monoxide to the home. To check for a cracked heat exchanger, take readings at

the heat registers.

- The problem may be as simple as an improperly installed detector. Is it installed too close to a fuel-burning appliance? Check the manufacturer's recommendations.
- Sometimes a detector may sound, but the meter will give no indication of the presence of carbon monoxide. This might occur if a gel-cell detector was exposed to low-level carbon monoxide over a prolonged time and the source is no longer active. There also may be no reading if the occupant had ventilated the home before you arrived. Despite the absence of detectable carbon monoxide, the alarm is indicating that a potentially dangerous buildup of carbon monoxide has occurred. High levels of carbon monoxide in a structure might also be attributed to a buildup of carbon monoxide from several appliances that were shut down or a source that was removed from the structure.

One strategy for finding such sources of carbon monoxide is to create a worst-case scenario. Shut all the windows, and turn on all of the home's fuel-burning appliances and exhaust fans. Wait a while. Take readings again. You can also try to recreate what was happening in the house prior to the alarm's sounding.

When the source cannot be located but the carbon monoxide level is high, occupants can be protected from carbon monoxide by shutting down all the fuel-burning appliances and ventilating the structure. Occupants can return once the carbon monoxide level drops to a safe level. The occupant must have all appliances checked to see if they must be repaired or replaced, or, if necessary, increase the airflow into the structure. If fuel-burning appliances are shut down, consider the effect on the occupants. In sub-zero weather, going without heat can be deadly. Make provisions to

MANITOWOC (WI) FIRE DEPARTMENT POLICY AND STANDARD OPERATING PROCEDURE

CARBON MONOXIDE CALLS

It shall be the policy of the Manitowoc Fire Department to respond to reports of a possible dangerous environment caused by the presence of carbon monoxide and to take measures to protect the welfare of those living or working in that environment.

PROCEDURE

1. It shall be determined whether anyone exhibits signs of CO poisoning when the call is received.
2. If symptoms are present, the caller should be instructed to evacuate the building.
3. The nearest available engine company or squad with a meter shall be assigned to investigate in the absence of CO symptoms.

If any person displays symptoms of CO poisoning, they should be evaluated by rescue squad personnel and encouraged to seek medical attention, including CO level tests.

4. No one is to enter the building until a CO level had been checked just inside the door. No one is to enter without the monitor.
5. An SCBA must be worn by anyone entering if a reading above 35 ppm is obtained.
6. If the circumstance in No. 5 exists, a backup crew must be on the scene prior to further interior operations.
7. Wisconsin Fuel and Light (WF&L) must be notified if any of the following conditions exist:

a. A meter reading above 9 ppm for CO and the presence of natural gas-burning appliances.

b. Anyone has reported symptoms of CO poisoning and natural gas-burning appliances are present.

c. A CO alarm has reached an alarm state and natural gas-burning appliances are present.

d. The natural gas supply has been shut off.

8. Prior to beginning a meter survey of the building, the interview sheet should be completed.

If the occupants are able to safely do so, all exhaust fans should be turned on. Next, all fossil fuel appliances should be turned on and allowed to warm up for ten minutes. This should be done prior to the arrival of WF&L. If the occupants cannot do it safely, wait for WF&L to arrive.

A thorough check of the building with the CO meter should then be done using the CO incident checklist of WF&L or, if it is not present, the Manitowac Fire Department (MFD) checklist. The building check should be delayed until WF&L arrives if it is known that it is responding. The check should then be done jointly by WF&L and MFD personnel.

If fossil fuel-burning appliances other than natural gas are present, a heating contractor with the appropriate expertise should be requested to respond and provide assistance in the investigation.

If more than 35 ppm are detected, only MFD personnel using breathing apparatus may remain in the building. They should attempt to determine the location of the highest concentration of CO, then ventilate the building and allow WF&L personnel to determine the source after the CO reading has dropped below 35 ppm.

9. A CO detector tube should be left at any building where the presence of CO is suspected and its source has not been identified. Reasons for leaving a tube include a CO detector's going into alarm mode, presence of CO poisoning symptoms, or any detected level of CO.

The occupant should be advised to call us both 24 hours and seven days later to advise that he is OK and report the tube readings. A call-back number for the occupant should be placed on the upper and lower calendars at Station 1, and the on-duty crew should call to check the results with the occupant if call-backs are not received. Notations regarding the follow-up checks should be made in the narrative section of the original computer report.

10. Pamphlets on carbon monoxide dangers and carbon monoxide detectors should be left with the occupants, as should a report of findings. The findings should be explained to the occupants.

11. A copy of the interview sheet and report of findings should be forwarded to the Deputy Chief. WF&L will retain the investigation check sheet, a copy of the interview sheet, and a copy of the report of findings for its records. If WF&L does not respond, a copy of the investigation check sheet should also be forwarded to the Deputy Chief. ■

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relocate the occupants until necessary repairs or adjustments have been made and the house once again is safe.

- Consider that the carbon monoxide may not be coming from within the structure. Expand your search to adjoining buildings. In New York City, one person died and 25 were made ill from carbon monoxide thought to have entered the apartment building through underground electrical conduits. Burning wires ignited old wooden conduits that burned and released carbon monoxide into an apartment building. Would you have located that source of carbon monoxide?
- Carbon monoxide responses may tax our resources at a time when resources are becoming scarce. Since few of us can conduct a time-consuming investigation for those hard-to-find sources, we must include others in the solution. Utility companies, repair services, appliance manufacturers, and other government agencies can be called to continue the search for the source and then correct the problem.

Let the occupant know what you did and found. Leave with the occupant a notice of findings that provides the information needed to get the problem corrected. The notice also will assist the utility or repair service in the follow-up.

- Our job at these incidents is to abate the hazard, not repair the appliance. When we leave, the home should be safe for occupancy or evacuated pending additional investigation or needed repair. Make every effort to restore the home detector to service so it can continue to protect the occupants. If the occupant's detector is not operational, one option may be to loan the occupant a detector or sensor until the original detector clears itself or can be replaced—if feasible based on the size of your response area, the status of your resources, the frequency of carbon monoxide alarms, and liability considerations.

RESOURCES

As we gear up for the coming heating season, we must be prepared to meet this new challenge. Armed with the proper equipment and training, we can effectively respond to these calls. The intent of this article is to make you aware of some of the problems associated with responding to carbon monoxide alarms and to suggest possible solutions. Additional information may be needed and can be obtained from many sources, including the following:

- Neighboring departments. Find out how your neighbors are dealing with this challenge (see sidebar for one example).

MANITOWOC (WI) FIRE DEPARTMENT CARBON MONOXIDE INCIDENT CHECKLIST

Location_____Date_____Time_____

INVESTIGATION PORTION

METER CHECK: Tested Today_____Zeroed Outside_____

INVESTIGATE:

PPM inside door_____

FIRST, turn on all exhaust fans to create possible backdrafting situation.

Done_____(Range Hoods, Bathroom Vent, Attic Fans, Clothes Dryer)

Operate all combustion appliances for about 10 minutes. Done____

If car is present in attached garage, run it with the overhead garage door open. Done____

Ductwork

CO reading at heat-outlet grill-convection system _____PPM

Furnace:

Monitor around vent pipes____ PPM____

Look for gaps, corrosion, soot, rust____

Monitor around burners____PPM____

Pilot light and flame blue____

Duct insert into chimney OK____ PPM____

Match test for draft OK____

Water Heater:

Monitor around vent pipes____PPM____

Look for gaps, corrosion, soot, rust____

Monitor around burners____PPM____

Pilot light and flame blue____

Duct insert into chimney OK____PPM____

Match test for draft OK____

Possible reverse stacking due to multiple ducts into chimney? Yes____No____

Dryer: (Run electric to create possible backdraft situation)

Monitor around vent tubing____PPM____

Ductwork not kinked and intact____

Monitor area of burners____PPM____

Pilot light and flame blue____

Vent Pipes:

Could they be blocked?____

Space and Wall Heaters:

Vented properly? Yes____No____

Monitor around them for CO level____PPM____

Gas Fireplace:

Monitor around pilot light—PPM

Monitor around it after on and warmed up—PPM

Fuel-Burning Fireplace:

Vented properly? Yes____No____

Creating backdraft of other appliances?____

Flue clear? Yes____No____

Damper Open? Yes____No____

PPM around fireplace____

Intake open on models that use outside air source?

Yes____No____NA____

Stove:

Monitor inside after warmed up____PPM____

Monitor 2 feet above burners after on high for several minutes____PPM____

Flame and pilot light blue____PPM____

Garage:

Monitor around garage man-door into house____PPM____

Barbecue Grill:

Reading near barbecue grill if appropriate____NA or____PPM

Person Completing Check Sheet _____Time_____

MANITOWOC (WI) FIRE DEPARTMENT
CARBON MONOXIDE INCIDENT CHECKLIST

Location_____ Date_____ Time_____

INTERVIEW PORTION

ASK:

Did anyone display symptoms of CO poisoning?

	Yes	No
Headaches	___	___
Nausea	___	___
Dizziness	___	___
Shortness of Breath	___	___
Confusion	___	___

Did they feel better when they left the house for work, school, etc.? Yes ___ No___

Are there at-risk individuals in the home:

	Yes	No
Pregnant individuals?	___	___
Young children?	___	___
Individuals with heart or lung disease?	___	___
Does anyone smoke in the house (6 ppm possible for one smoker)?	___	___
Fuel-burning appliances?	___	___

List:

_____

_____

Was a fireplace and furnace running at the same time? Yes ___ No___

Are there fireplaces, unvented heaters, or wood- or coal-burning stoves? Yes ___No___

List:

_____

_____

	Yes	No	
Was the oven operated?	___	___	How long? ___
Was a car running in an attached garage?	___	___	
What time did the CO alarm go off? _____			
Biomimetic sensor discolored?	___	___	
or			
High reading on digital alarm?	___	___	
Was the home ventilated after the alarm went off?	___	___	
Were appliances shut off?	___	___	
Was a barbecue grill used near the structure recently?	___	___	

FOLLOW-UP PORTION

CO TUBE:

Instruct on use ___

Ask for call-backs ___

Note on daily calendars up and down ___

PAMPHLETS:

CO Info___

CO Detector Info ___

REMINDERS:

Clean detector regularly___

Annual maintenance checks of fossil fuel-burning appliances ___

Annual checks of flues and ducts ___

REPORT OF FINDINGS:

Given to occupant___

MFD REPRESENTATIVE

_____

Date_____Time_____

WF&L Representative

_____

Date_____Time_____

Original-MFD Copy-WF&L

- Manufacturers of detectors and survey instruments. They can provide literature, videos, and training.[12]
- Detector manufacturers: First Alert, (800) 323-9005; Night Hawk Industries, (800) 880-6788; American Sensors Electronics, Inc., (800) 387-4219; AIM Safety USA, Inc., (800) 275-4246.
- Survey Instrument manufacturers: Bacharach, (800) 736-4666; Industrial Scientific, (800)-DETECTS; MSA, (800) MSA-2222.
- The Consumer Product Safety Commission. Provides literature.
- Underwriters' Laboratories. Provides literature and lists manufacturers of detectors and survey instruments, (708) 272-8800, (800) 677-5227.
- Utility companies. Can provide training, equipment, and assistance in the field.
- Medical services. Provides medical information and emergency response.
- International Association of Fire Chiefs. Provides information on and training in fire department response to CO emergencies, (703) 273-0911. ■

Endnotes

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10. Johnson, D. "How a House Works," *The Family Handyman*, Oct. 1994.

11. "Backdrafting, Your Last Gasp?" *Mother Earth News*, Nov.-Dec. 1988.

12. Some manufacturers produce field instruments as well as home detectors. They are not listed in the article. Lists of manufacturers of detectors and survey instruments are not complete and offer only a small sampling of resources.