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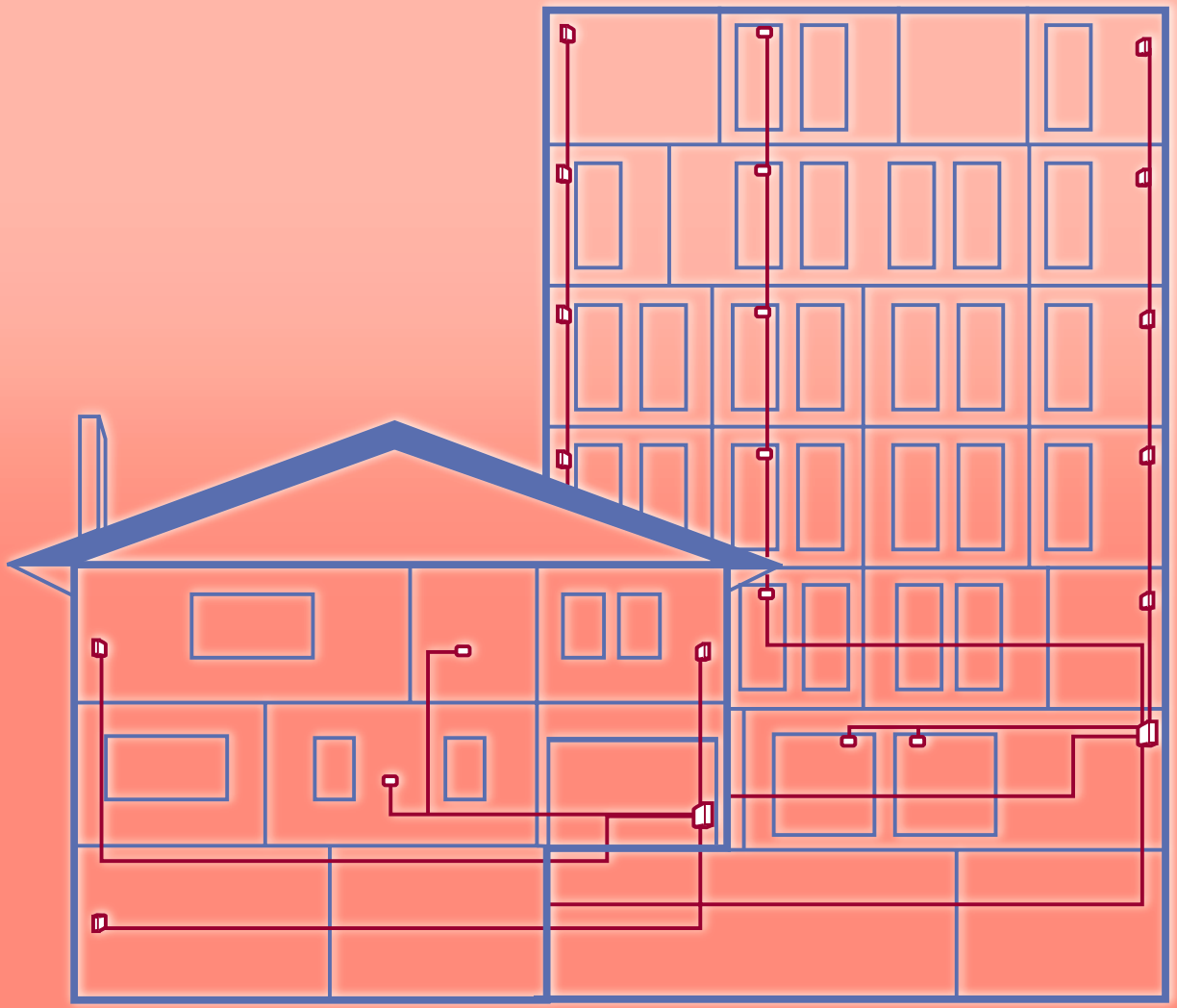
Carbon Monoxide Course



about Sentrol University

As a security and life safety professional, whatever you need to do, Sentrol wants to be there with you. Security and life safety are our business... our only business, and we've been doing it a long time. Sentrol was founded in 1977 and has grown through internal development, acquisitions and mergers, allowing us to bring the best of an array of brands to you. Our application expertise, advanced detection technology and false alarm reduction features reflect knowledge gained from millions of installations and millions of dollars invested in research and development.

Sentrol University's combination of expertise and experience makes a viable professional training curriculum that will benefit management, sales, and technical service staff.

If you would like to receive more training or provide us with feedback, please call the Sentrol University Training Department at **800.547.2556 x602 or email us at sentroluniversity@sentrol.com**

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Carbon Monoxide Course

Contents

Carbon Monoxide,

Guarding Against the "Silent Killer"

CO (Carbon Monoxide) Detectors

Module FRS301

CEU # 99-0502 CEU Credits: .2

Learning Objectives

After completing this module you should be able to:

1. Determine the sources of CO (carbon monoxide) and identify how CO is formed.
2. Know how CO affects the human body.
3. Instruct a homeowner how to respond to a CO Detectors alarm.
4. Determine who is to be notified in the event of a CO Detectors alarm.
5. Properly select the correct sensor technology for your installation.
6. Understand the proper installation techniques of CO Detectors.
7. Understand the code requirements of CO Detectors.

This Module is about:

CO (Carbon Monoxide) and how it has become a serious life safety issue. This module will provide a full understanding of the deadly characteristics of CO. It will outline how CO is formed from common fuel sources and appliances, to what the consequences are of CO poisoning. It will give the installer necessary information to use in their selection of detectors and their proper installation. This module will help our industry save lives.

What is CO (carbon monoxide)?

Carbon monoxide is a gas that has a very similar shape and weight to that of an oxygen molecule. Although each has two atoms, CO is comprised of an oxygen and a carbon atom, while an Oxygen molecule has two oxygen atoms. CO is flammable if the concentration is between 12 and 75% by volume. CO fires rarely occur in other than a laboratory situation. Because CO is a colorless and odorless gas, the victims of CO poisoning succumb to its lethal poisoning effects without knowing why. Deaths caused by CO poisoning usually occur after flu-like symptoms progress to a coma state followed by heart or respiratory failure. This is why CO is known as "The Silent Killer".

The formation of CO is a by-product of the incomplete combustion of a carbon-hydrogen type fuel. Under normal conditions, carbon-hydrogen type fuels release their energy when the bonds that hold them together are broken. During this chemical reaction, other molecules are formed by the freed carbon and hydrogen atoms. Under ideal conditions, the free carbon and hydrogen atoms reform into H_2O (water) and CO_2 (carbon dioxide).

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This process can be seen with our family automobile. Shortly after the vehicle is running, water droplets can be seen dripping from the exhaust pipe. On a cold winter day plumes of steam can also be seen. What cannot be seen is the emission of other gases. If the fuel did not stay hot long enough, and/or there is insufficient oxygen during the combustion process, the freed carbon atoms will combine with only one oxygen molecule. This combination of one carbon atom and one oxygen atom forms a carbon monoxide (CO) molecule.

CO is just one of many different molecules that are formed during the incomplete combustion of a carbon-hydrogen fuel. Once the CO gas is formed, it tends to rise into the environment. This is due to the thermal lift it receives from the release of heat energy that is created during the combustion process. Once the CO gas has cooled, it will circulate just like normal air does, since it has the same relative density and specific gravity as O_2 (oxygen). Other gases that may form take a different path. Methane will rise, while CO_2 falls in relationship to the other gases. Unlike other gases that can be detected by our sense of smell or sight, CO escapes our ability to observe it. It has neither color nor odor.

Sources of CO (carbon monoxide)

Unfortunately the same modern appliances we have to enhance our lives could also end them. The savings we attribute to a building's efficiency may cost us more than dollars and cents.

The trick to keeping the threat of CO poisoning to a minimum is good ventilation. If CO did not mix with fresh air even our *friendly* campfires would become deadly. Concentrations of CO are not always allowed to dilute themselves to humanly safe levels. Modern residential and commercial building designs, in conjunction with our modern lifestyles and conveniences have now created mini-toxic ecosystems in our homes and places of work.

Our concern should not be just with appliances that we vent to the outdoors, but with the appliances that we directly vent into our living space: Gas Stoves, Fireplaces, Space heaters, etc. Today's buildings are designed to minimize outside air infiltration. Today's standards allow a structure to have .35 air exchanges with the outside per hour. This is in stark contrast to 2 to 3 air exchanges per hour using older methods of construction. These improvements have led to a large increase in the building's energy efficiency since the late 60's.

This new air efficiency has created what is called the "Sick Building Syndrome." The by-products of our surroundings pollute our air and poison our bodies, sometimes with deadly consequence. The most common sources of CO in a residence are: gasoline engine exhaust, furnaces, water heaters, dryers, other gas appliances, kerosene heaters, and fireplaces. The source that surprises people the most is gasoline engine exhaust. The CO molecules have been known to percolate through sheet rock, concrete or brick walls while the odors attributed with exhaust fumes stayed within the garage area. The number one source of accidental CO poisoning is the family automobile. The dangers of appliances depend on how well the appliance works within the environment.

Signs that a device is not functioning properly

- Rust or streaking on the vents/chimney
- Carbon buildup on the ports or nozzle of the furnace
- Debris or soot falling from the chimney
- Increased condensation inside windows
- Inadequate updraft in chimney
- Unfamiliar or burning odor
- Furnace runs constantly
- Decreasing hot water supply

If we don't keep our appliances well maintained and properly ventilated, we are living in a toxic gas chamber of our own design.

Understanding the Threat of CO (carbon monoxide)

The US Consumer Product Safety Commission issued a report in September 1998. It stated in 1995, death certificate data was refined to specify not only the cause of death (CO poisoning), but also the source of the CO. Further studies will create a more detailed analysis of CO poisoning trends.

Between 1991 and 1997 the average annual number of confirmed accidental CO poisonings were 12,060. During this time, 10,700 people required emergency hospital care, while the remaining 560 poisonings resulted in death. Symptoms are mainly mis-diagnosed. Complaints of fatigue, nausea, dizziness, shortness of breath, chest pain and diarrhea are commonly attributed to the flu. Only when the victim's blood has been checked for COHb (corboxyhemoglobin, the level of carbon monoxide in a person's blood), can a physician be sure of the prognosis. Of the 560 deaths attributed to accidental CO poisoning, 60% were from motor vehicles, while the remaining 40% were associated with consumer products.

COHb – corboxyhemoglobin, the level of carbon monoxide in a person's blood

Vehicles running in the garage or just adjacent to the house have been the major cause of CO poisoning. Other sources of CO poisoning from exhaust were lawn mowers, tractors, electric generators and gas powered pumps.

Accidental CO Poisoning Deaths Caused by Consumer Products (non-auto)

Heating Systems	74%
Charcoal Grills	10%
Gas Water Heaters	4%
Camp Stoves & Lanterns	6%
Gas Ranges	4%
Other	2%

Furnaces were powered by various sources in this study: LP gas, Natural Gas, Coal, Wood, Kerosene and Oil. LP gas furnaces had the highest incidents of CO poisoning (19%) with Natural gas being second (17%).

Potential Sources of CO

Equipment and appliances used by your customers may produce carbon monoxide if they are not properly operated, ventilated, or maintained. Any of these are potential threats:


Forklift


Vehicle and engine exhaust


Space Heater


Stove/oven


Dryer


Gas furnace


Water heater

CO Poisoning Deaths by Age of Victims

Under 5	4.5%
5-14	5.0%
15-24	20.0%
25-44	27.0%
45-64	23.0%
65 and over	20.5%

Non-fatal poisoning

Under 5	15%
5-14	21%
15-24	13%
25-44	32%,
45-64	14%
65 and over	6%

As the statistics show, The young, unborn and elderly are those most threatened by CO.

CO Poisoning Deaths by Gender

Male	70%
Female	30%

CO Poisoning Deaths by Location

Home	66%
Campers / Tents	14%
Auto	7%
Other	6%
Unknown	8%

How CO Poisoning Occurs

Hemoglobin is a protein in the red blood cells that carries oxygen throughout the body.

CO (carbon monoxide) combines with hemoglobin, a protein in the red blood cells that carries oxygen throughout the body, with an affinity of about 250 times that of oxygen. This absorption of CO and the formation on carboxyhemoglobin (COHb) in the blood interferes with the body's ability to transport, deliver, and utilize oxygen efficiently. CO poisoning can result from exposure to high concentrations for a short period of time or exposure to low levels of CO for a long period of time. The absorption is bio-accumulative. The body can not purge itself of CO unless the source is removed. Symptoms are mainly mis-diagnosed, since the complaints of fatigue, nausea, dizziness, shortness of breath, chest pain, diarrhea, are common to symptoms of the flu. Only when the victim's blood has been checked for COHb can a physician be sure of the prognosis. The absorption and symptoms of CO are reversible. However, prolonged poisoning may result in irreversible neurological damage or death. Time is of the essence with any type of poisoning.

Once the CHOb reaches 50%, neurological damage starts to occur. Severe poisoning requires the use of hyperbaric treatment to stop and reverse the damage done by high concentrations of CO in the blood. The treatment consists of putting the victim in a chamber containing 100% oxygen that is pressurized to 3 atmospheres. This treatment may require up to 5 days to administer.

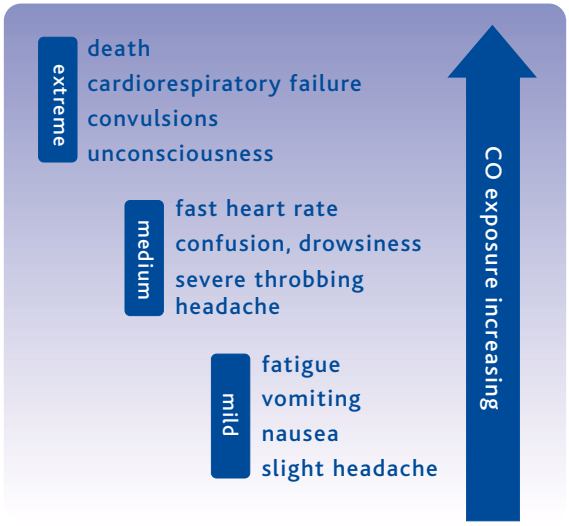
Symptoms based on Saturation in the blood.

COHb %	Symptoms
0-10	None
11-20	Tension in forehead, dilation of skin vessels
21-30	Headache and pulsating temples
31-40	Severe headache, weariness, weakness, nausea, vomiting
41-50	Same as above, plus increase breathing and pulse rate, asphyxiation
51-60	Same as above, plus coma, convulsions, labored respiration
61-70	Coma, convulsions, weak respiration and pulse
71-80	Slowing and stopping of breathing, death within hours.
81-90	Death within 1 hour
91-100	Death within minutes

Symptoms based on Concentration

Parts per million	Symptoms
35	No adverse effects within 8 hours.
200	Mild headache after 2 - 3 hours
400	Headache and nausea after 1 - 2 hours
800	Headache, nausea and dizziness after 45 minutes. collapse after 2 hrs.
1000	Loss of consciousness after 1 hour.
1600	Headache, nausea and dizziness after 20 minutes.; unconsciousness after 30 minutes.
3200	Headache, nausea and dizziness after 5-10 minutes.; unconsciousness after 30 minutes.
12,800	Immediate physiological effects, unconsciousness and death after 1-3 minutes

Symptoms of Carbon Monoxide Poisoning



These symptoms represent CO effects on the average adult. Others who may experience symptoms sooner include the elderly, children, pets and those with health problems.

Normal CO concentration

Concentration	Location / Condition
2.04 +/- 2.55 ppm	U.S. homes
2.5 - 28 ppm	Offices, restaurants, bars, arenas
3.1 - 7.8 ppm	Home kitchens with gas stoves
1 - 5 ppm	Median outdoor conc. in cities, 1979
0 - 3 -27 ppm	Max. 1 hr. average outdoor concert.
0 - 3 - 22 ppm	Max. 1 hr. average indoor concert.
20 ppm	Room polluted with cigarette smoke

Types of CO (carbon monoxide) Detectors

Since CO cannot be observed using human senses, we must use its reaction with other chemicals to tell us of its presence. There are three technologies used for the detection of CO gas.

Biomimetic

Biomimetic technology uses a gel-coated disc that reacts to the presence of CO gas. A light is projected through the disc onto a light receptor. The gel darkens as it absorbs CO obscuring the light being received. At a pre-determined level of light obscuration, the unit will activate. Units of this type are battery powered and are sensitive to extreme high or low temperature and humidity. The gel needs to be free of any CO to zero out or reset itself. Failure to zero out in a timely manner is a large cause of false alarms. The unit's life expectancy is 5 to 6 years

Oxide Semi-conductor

Oxide Semi-conductor technology is the most common sensor used in today's market. A segment of tin dioxide is heated. In the presence of CO, the tin dioxide acting like as semi-conductor, reacts in proportion to the concentration of the gas present. At a pre-determined level of current flow, the unit will activate. The unit will reset very fast once the CO source is removed. Because of the current that is needed to allow the unit to function, most units are AC powered. The unit's life expectancy is 5 to 6 years

Electrochemical

Electrochemical technology is the most accurate, but is the least common of the technologies manufactured due to its higher cost. The unit functions by placing platinum electrodes in an electrolyte solution or gel. The platinum electrodes, in the presence of CO, generate energy in proportion to the concentration of the gas. At a pre-determined level of current flow, the unit will activate. The unit will reset very fast once the CO source is removed. This technology requires a very small power source. This is the best technology to date. The units life expectancy is 5 to 6 years.

Important to Remember

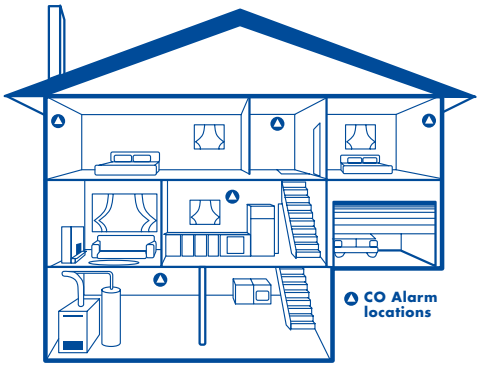
None of today's technologies last forever. The device must be replaced after their anticipated life has expired. Your clients must be aware of this fact prior to their installation. Some detectors go to sleep, while others fail in an alarm condition. Always know what your detector will do.

Installation of CO (carbon monoxide) Detectors

- RTIF (Read the Instructions First) *Always read the manufacturer's instructions first*.
- Selecting a suitable location is critical to the operation of the CO Detector.
- A CO Detector should be located in every bedroom and on each level of a dwelling (similar to smoke detectors).
- A minimum of one detector should be placed outside of each sleeping area.
- Mount the CO Detector on a ceiling or wall at least 5 feet up from the floor.
- Mount the CO Detector at least 5 feet from outside doors and windows.
- Mount the CO Detector at least 5 feet from open flame appliances such as furnaces, stoves, and fireplaces. Mount the CO Detector at least 5 feet from any cooking appliances.
- On a sloped, gabled or peaked ceiling, locate the alarm 3 feet from the highest point.
- In long hallways of 12 feet or more, two or more CO Detectors are to be installed.
- Locate the CO detector in a suitable environment:

  Temperature between 40° F and 100° F

  Humidity between 15 and 90% non-condensing
- Locate away from air conditioners, heating registers and any other ventilation source.
- Do not mount where furniture or drapes may obstruct the airflow.
- Always mount on a firm permanent surface.
- Never connect the CO Detector's alarm output to an initiating circuit with fire and/or security devices.
- CO Detector's alarm notification appliances should be unique in sound and different from other types of notification devices (Temporal 4, NFPA).



NFPA 720 States:

"When installed as part of a Single or Combination System

- Fire signals shall take precedence over any other signal, even if initiated first.
- Distinctive alarm signals should be obtained, even if using a common sounding notification appliance.
- Units shall be installed on supervised circuits only.
- Visible notification appliances shall be installed in bedrooms of hearing impaired persons."

Who should be notified of CO (carbon monoxide) detector Actuation?

The notification of emergency services may vary from municipality to municipality due to the confusion created when CO detectors first entered the market place. To this day, some alarm dealers refuse to install and service CO detectors because of the implied liability that existed due to the lack of response from emergency centers. The dealer, by taking a few steps, could alleviate these concerns and provide a level of life safety that a plug in CO detector could not.

Call the non-emergency phone number of your local fire or police department. Ask them how they would like the notification of a CO Detector activation to be reported.

- Some municipalities send the Police Department.
- Some municipalities send the Fire Department.
- Some municipalities send the Rescue Squad.
- Some municipalities send all three.

Be sure to inform both the end user and your central station which emergency service will respond.

Disposition of Signals

- Immediate notification of the supervisory signal to the fire service communication center.
- Notification of the subscriber by the quickest method.

If you notice, verification of signal is not permitted by NFPA until after the Fire Service is notified. Using the proper modern technology and with proper installation, this should not be a concern.

What does the client do when a CO (carbon monoxide) detector actuates?

The first thing all users of CO detectors must understand is the characteristics of CO. It is a gas that acts as normal air, but is deadly and cannot be seen or smelled. Everyone should adhere to the following guidelines:

- Always treat a CO detector alarm activation as a life threatening situation. The presence of CO can kill you.
- Notify your local emergency response authority of the situation. (usually your fire or police department)
- Immediately move to fresh air or to an open door or window. (Don't delay, seconds count)
- Do a head count to verify that all persons are accounted for.
- Do not reenter the premises nor move away from the open door/window until emergency services arrive.
- Do not reenter the premises until the premises are aired out and your alarm returns to normal operation.
- If the alarm reactivates within 24 hours, repeat all of the above steps and call a qualified technician to examine your gas/kerosene/oil-burning appliances. The risk is too great to take. The chances of a defective CO detector, using the new state of the art sensors and microprocessors, are minimal.

Present CODE Requirements

The mandatory use of CO detectors is currently enacted in eleven cities in six states for new residential dwellings.

CITY	STATE
Chicago	Illinois
Lincolnwood	Illinois
Frankfurt	Illinois
Des Moines	Iowa
St. Louis	Missouri
Baltimore	Maryland
Kingston	New York
Albany	New York
Greenburg	New York
South Orange	New Jersey
Bel Air	Texas

Three states, New Jersey, Rhode Island, and West Virginia have legislation requiring homeowners to install CO detectors. New York State already requires CO detectors in certain rental properties. Six states now have pending legislation regarding CO detector installation.

Sources

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- U.L.C.
- Virginia Polytechnic Institute & University
- U.S. Center for Disease Control
- U.S. Consumer Product Safety Commission