



IOWA STATE UNIVERSITY of Science and Technology AEN-207
Agricultural and Biosystems Engineering Extension

CARBON MONOXIDE POISONING

Garages

Carbon monoxide (CO) is a highly toxic gas produced when fuels burn incompletely. The typical combustion engine used in most cars and trucks, can produce extremely high concentrations of carbon monoxide. Changes in engine design, fuel, and emission control devices have dramatically reduce emissions of carbon monoxide. Still, operating a motor vehicle introduces risk from carbon monoxide poisoning.

How dangerous is it to operate an engine in a closed building? So dangerous that it must NEVER be done, even for a short time. The extremely high concentrations of carbon monoxide produced by a car can raise CO concentrations in a closed building so quickly that a person may collapse before they realize there is a problem. Carbon monoxide reduces the amount of oxygen to the brain, causing CO intoxication, and lack of reasoning. Studies by the Centers for Disease Control found that CO concentrations reach the Immediately Dangerous to Life and Health (IDLH) concentration of 1,200 parts per million in only 7 minutes when a small 5 horsepower gasoline engine is run in a 10,000 cubic foot room. Iowa State University investigated the death of two men in a car wash. Operation of their poorly tuned truck in the car wash raised CO concentrations to the immediately dangerous concentration of 1200 ppm in less than 10 minutes. After only 22 minutes concentrations reached 3500 ppm. The two men had died without being able to move toward the outside door. Survivors of similar occurrences say they did not realize they were being poisoned, became dizzy, then quickly collapsed, and were unable to move toward the door.

Is it safe to briefly warm up a car in an open garage? No. In an Iowa State study, warming up a car for only two minutes with the overhead door open raised CO concentrations in the garage to 500 ppm. **Hours** after the car had been backed out of the garage, there was still a measurable concentration of CO in the garage. Persons working in the garage for a long period of time would breathe a dangerous amount of carbon monoxide.

How do attached garages increase CO problems in the home? In the typical house during winter (and CO) flows from attached garages into the house. The amount of this flow varies from house to house. A Minnesota study found from 5% to 85% of the air leaking into the house came from the garage, carrying carbon monoxide and other contaminants into the house.

What happens when CO from the house enters the garage? The garage serves as a large source of carbon monoxide. As the CO leaks into the house it is diluted, so CO concentrations in the house are lower than those in the garage. It can take several hours for CO concentrations in the house to reach the level reached in the garage. Often CO detectors alarm several hours after the vehicle left the garage. Persons in the house, especially those in all day, might experience typical CO symptoms such as headache or flu-like symptoms.

Why is the problem of carbon monoxide from attached garages worst in the winter? In winter houses are closed up, keeping more CO in the house for longer periods of time. Often a larger portion of the CO flow into the house comes through the garage in winter than in summer. In cold weather, more vehicles are warmed in the garage and they are warmed up for longer periods of time. And last, in cold weather engines produce higher concentrations of carbon monoxide and produce it for longer periods of time. In cold start, the engine is cold, the fuel mixture is rich (causing more CO), and the catalytic converter is cold and ineffective. Even well-tuned engines will produce over 80,000 ppm for the first minute or two of operation. The CO concentration will typically drop to 1,000 ppm or less after 5 to 15 minutes of operation.

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operations. In one Iowa example, an engine produced over 80,000 ppm for 3-minutes. The concentration dropped to 60,000 for the next 2-minutes and then continued to drop. After 15 minutes the engine producing only 300 ppm.

Can I place a CO detector or alarm in the garage to warn me of excessive CO? No. Resident detectors are not designed or approved to operate in garage conditions. Temperatures and humidity variations are too large, and the high start-up amounts of carbon monoxide can easily damage or destroy the sensing cell. CO detectors should never be placed or used in the garage.

Can I seal the wall between the garage and the house to prevent CO from entering the house? Sealing the garage/house wall has proven only marginally effective. It is difficult to form an air tight seal between the house and garage after the house has been constructed.

Does the problem only exist when heat runs are located in the garage? No, several of the houses that did not have heat runs in the garage and carbon monoxide still entered the house.

Will an exhaust fan in the garage prevent CO from entering the house? Yes, an exhaust fan from the garage to outdoors will lower the pressure in the garage. A sufficiently sized fan designed and installed by a qualified contractor will prevent CO from entering the house and speed the removal of CO from the house. The fan can depressurize the house so vented appliances (furnaces, water heaters, and boilers) must be checked for proper operation after a garage fan is installed. Even with a garage fan it is not safe to run an engine in the garage.

How can I protect myself from CO exposure from vehicles in my existing attached garage? To maintain the vehicle including the engine, exhaust system, emission controls, and car body. Never enter or operate a vehicle in the garage or other enclosed area, even if the garage door is open. Do not start the vehicle until everyone is in the vehicle and vehicle doors closed. Open the garage door, start the vehicle and immediately back the vehicle out of the garage. Then close the garage door and drive away. The engine while backing the car out of the garage should be monitored with a CO detector in the house (several detectors have digital displays and memories that can help determine if the CO in the house is elevated by the vehicle out of the garage). If carbon monoxide enters the house, it will be necessary to leave the garage open after backing out until the CO clears.

How long will it take to remove the CO from the garage? Carbon monoxide does not attach to surfaces in the garage, so a complete air change will remove all the CO. With doors open on opposite sides of the garage, this will probably take 5 minutes or less. With doors open on only one side the time will be longer and vary depending on wind and air flow.

When building a new home, how should I protect against carbon monoxide from the garage? There are no approved, standard methods. The American Lung Association suggests building a detached garage. Other possible solutions include: tightly sealing walls and doors to the house, or using an exhaust fan in the garage. The main means to protect yourself from CO from the garage are:

- Install a CO detector in the house.
- Never run a vehicle in the garage any longer than the time required to move it out of the garage.

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