



# Kansas RTAP Fact Sheet

A Service of The University of Kansas Transportation Center for Rural Transit Providers

## Clear the Air: Carbon Monoxide Poisoning Prevention

by Laura Snyder

**Y**ou wake up every morning feeling fine, but lately, after driving the bus all day, you go home with a severe headache. Maybe you even feel a little disoriented. If this sounds familiar, there could be a chance you are getting poisoned by carbon monoxide, and it's time to check your bus's exhaust system for leaks.

### What is it?

Carbon monoxide is a colorless, odorless gas that cannot be detected without special monitors. The gas is produced by internal combustion engines, found in all fuel-burning vehicles. Carbon monoxide is also found in cigarette smoke.

Once inhaled, carbon monoxide attaches itself to hemoglobin, a chemical in red blood cells that normally carries oxygen. However, the bond between carbon monoxide and hemoglobin is about 210 times stronger than the bond between oxygen and hemoglobin. That causes the red blood cells to carry carbon monoxide to body tissues, depriving them of oxygen.

It doesn't take much exposure to carbon monoxide for poisoning to occur. The harder you work and breathe, the faster carbon monoxide is absorbed into the blood. Flu-like symptoms, including drowsiness, dizziness, nausea, headache, or tightness across the chest might signify carbon monoxide poisoning. Exposure to very high levels of carbon



monoxide may cause vomiting, confusion, collapse, or muscle weakness.

### How much is safe?

Carbon monoxide in the air is measured in parts per million, or ppm. The Occupational Safety and Health Administration (OSHA) allows for carbon monoxide levels up to 50 ppm in private transit agencies. In the public sector, the Kansas Department of Labor (KDOL) uses the American Congress of Governmental Industrial Hygienists' stricter standard of 25 ppm, according to Rudy Leutzinger, Administrator of Industrial Safety and Health at KDOL.

Exposure of carbon monoxide at levels of 80 to 100 ppm for one or two hours reduces a person's physical abilities, according to the National Institute for Occupational Safety and Health (NIOSH). Without a carbon monoxide detector (see box on next page), workers often do not recognize the hazard or notice symptoms until they become so affected that they are unable to seek help. While the

incidence of accidental carbon monoxide related deaths is relatively low (about 500 Americans each year), it's still wise to be cautious.

### Identifying risk factors and prevention

**Leaks in exhaust systems.** Any driver can be exposed to carbon monoxide when his or her vehicle has a leak in the exhaust system. According to Jim Clayton, maintenance manager and Chairman of the Maintenance Department Safety Committee at the Kansas City Area Transportation Authority (KCATA), a leak can occur when a tail pipe or other part of the typically-sealed exhaust system breaks.

However, Clayton said, even then, most drivers would have little exposure to carbon monoxide. The engine and exhaust system tend to be located at the back of larger vehicles. On the KCATA's buses, the engine is in a sealed compartment in the back of the bus. The exhaust pipe is at roof-level and directs fumes back away from bus in what is called a vertical design. In the winter, however, the heater of your bus may create a negative pressure when the doors open, and suck in outside exhaust from other vehicles, according to Pete Broere, transit supervisor at OC Transpo in Ottawa, Ontario.

For vehicles with the engine in the front, like cars, the risk of exposure is greater, because the exhaust system runs along the entire underside of the vehicle. When a vehicle with a leak in

this type of exhaust system is stopped in traffic, the carbon monoxide is not directed away from the vehicle and puts both the driver and the passengers at a greater risk for poisoning.

### **Diesel as an alternative**

Even with the advent of hybrid buses, and those fueled by compressed natural gas and liquefied natural gas, most transit buses in the U.S. use diesel engines, according to William Schaller, Manager of Administration, Safety and Training for the Maintenance Department of the Milwaukee County Transit System in Milwaukee, Wisconsin. Some transit agencies may have gasoline engines in smaller vehicles, such as 15-passenger vans.

Diesel engines produce less carbon monoxide than gasoline engines, because diesel engines burn fuel more efficiently.

Gasoline cannot be used successfully in a diesel engine, nor can diesel fuel be used successfully in a gasoline engine. Gasoline is a more highly refined fuel, and has less potential thermal energy than diesel

in the exhaust system on a regular basis, according to Dave Dempsey, director of Pulmonary Care at Lawrence Memorial Hospital. The Milwaukee County Transit Authority has inspectors on their maintenance staff who also check brakes, suspension, lights, and other parts of the buses. Inspectors are trained to look for signs such as exhaust system pipe cracks, loose coupling or flange bolts, or telltale soot. However, Schaller says most often, you will hear a leak before you see it.

A loud roaring noise indicates escaping exhaust gases. "The louder the roar, the bigger the leak," said OC Transpo's Broere. Broere also said blue, black, or excessive white smoke indicates a malfunction that could mean carbon monoxide is present. Although carbon monoxide is odorless, odors and exhaust fumes should be investigated. The fumes indicate a problem in the exhaust system, and carbon monoxide may be released along with other gases.

Inspection frequency varies from agency to agency, depending on what the manufacturer requires to maintain

prevented fatalities.

Mechanics can reduce the risk of poisoning by operating gasoline-powered tools only in open areas. Gasoline powered engines should be stationed outside and away from air intakes, with hoses or lines from the tool running inside. Carbon monoxide detectors can be used indoors as an extra safety precaution. You may want to consider replacing gasoline powered engines with tools that use electricity or compressed air.

Office workers can also be exposed to carbon monoxide just as you might be in your home, due to problems like malfunctioning gas-operated furnaces, water heaters, and space heaters. In addition, idling vehicles stationed at loading docks may give off carbon monoxide fumes that find their way up air ducts and into the office.

### **Office inspections**

Gas-operated water heaters should be inspected periodically and furnaces should be inspected at least annually to be sure they are in good condition, according to Chuck Hoag, Operations Manager at Aquila Gas Company. However, without a carbon monoxide detector, there is no way to know for certain if you have a leak. Also, be sure your office has good a ventilation system that doesn't take in any outside exhaust fumes. Don't allow vehicles to idle near outside air intakes.

If you suspect a carbon monoxide leak, Hoag said gas companies provide free inspections. Aquila uses combustible gas indicators, (also called CGIs). These indicators test primarily for combustible gas in the air, but also have sensors that detect carbon monoxide. The CGIs are held into air streams produced by furnaces, such as air coming out of vents, and in the gas that comes out of the flue in a water heater or furnace. The CGIs measure carbon monoxide in parts per million.

### **Pay attention to symptoms**

Take time for you and your staff to familiarize yourselves with the signs of carbon monoxide poisoning. Douglas County Fire Marshal Rich Barr said employees should take note if they



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fuel. Diesel's greater heat energy offers increased fuel economy, longer diesel engine life expectancy, and decreased emissions. During compression, the diesel fuel heats to a much higher degree, making the engine more efficient. The heat energy gives increases fuel economy and engine life expectancy, as well as decreasing emissions.

"A gasoline engine may reach 20 percent efficiency, but a diesel can go as high as 40 percent," said Schaller. Carbon monoxide accounts for only one percent of the diesel engine's exhaust emissions.

### **Vehicle inspections**

Vehicles should be inspected for leaks

the warranty. At the KCATA, buses are refueled daily, which Clayton said provides another opportunity to inspect the buses for problems, including leaks. Major inspections are also performed every 6,000 miles.

Drivers at the KCATA also fill out "operator's defect cards." These report cards reflect any problems drivers have with their buses.

### **Other transit workers**

The risk of carbon monoxide poisoning is not limited to drivers and passengers. Mechanics or custodians using gasoline-powered tools in enclosed spaces like garages are also in danger. In some instances, even opening doors and windows to an enclosed space has not

## Carbon monoxide detectors

Buying a carbon monoxide detector is a simple preventive measure. Plug-in detectors for the home and office can be purchased in your local hardware store for \$20 to \$60. They plug into an electrical socket and will sound a warning alarm when carbon monoxide reaches a dangerous level. Portable, battery-operated detectors are an option for bus drivers and mechanics, and can be purchased online from Web sites like [www.safehomeproducts.com](http://www.safehomeproducts.com) or [www.avshop.com](http://www.avshop.com) for around \$45. Small, business card-size detectors with adhesive backing can be stuck on hard surfaces or carried in your pocket, and cost around \$10 each. These cards do not give an audible alert, but change color as the level of carbon monoxide increases. The card detectors are also available online from [www.safehomeproducts.com](http://www.safehomeproducts.com).

have such symptoms but only experience them at work.

If you think someone has carbon monoxide poisoning, help them get to an open area with fresh air, and call an ambulance. If they are unconscious, move them if you can. But if you yourself feel significant symptoms while helping, quickly leave the room. The CO level might be too high; you might end up with two tragedies instead of one. In any event, call 911.

Carbon monoxide poisoning is a hazard in the transit business, but it is rare, and it can be averted in most cases. For more information, contact Rich Barr at [rbarr@ci.lawrence.ks.us](mailto:rbarr@ci.lawrence.ks.us), or Rudy Leutzinger at (785) 296-4386 or [Rudy.Leutzinger@dol.com](mailto:Rudy.Leutzinger@dol.com).

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