

Some Miscellaneous Carbon Monoxide Information

Tech to Tech Column—January 08

“Make daily deposits to your box of knowledge, soon it will have many reference cards.”--Randal S. Ripley

Carbon Monoxide poisoning is called the silent killer for a reason. Just like a well executed sucker punch, the victim never sees it coming.

Carbon Monoxide is an odorless, colorless, tasteless, non-irritating gas that is an asphyxiant and cannot be detected by any of the human senses. In low concentrations it can aggravate existing health conditions especially for children, the elderly and pets and in higher concentrations is deadly.

Its chemical make up is one atom of carbon (C) and one atom of oxygen (O) and is denoted as CO.

When victims inhale CO, the toxic gas enters the bloodstream and replaces the oxygen molecules that normally attach themselves to the critical blood component “hemoglobin” and are then transported throughout the body, forming Carboxyhemoglobin (COHb) depriving the heart, brain, organs and muscles of the oxygen necessary to function properly.

Testing has proven that carbon monoxide molecules bond with hemoglobin in the blood up to 200 times better than oxygen.

Because of this you could encounter a CO poisoning victim who is taking deep breaths but is not getting the oxygen their bodies require and is effectively suffocating from the inside out.

Normal levels of COHb in non-smokers are approximately 0.5-1.5% and can be as high as 9% in heavy smokers. Healthy people usually exhibit no symptoms at less than 10% COHb.

COHb levels of:

- 15% Mild headaches
- 25% Nausea and severe headaches followed by death if exposure is prolonged
- 45% Unconsciousness followed by death
- +50% Death

Once carbon monoxide is in your bloodstream, it has a half life of four to five hours which means it continues to do damage until it gets down to non-symptomatic levels (less than 10%). For example: if you had a COHb level of 45%, you would be unconscious and death would follow even if you were removed from the contaminated environment immediately because it would take four or five hours for your COHb levels to get down to just half of the 45% level.

For the most part HVAC technicians in the field do not have the equipment or expertise to measure COHb content in the bloodstream, although some combustion analyzers can be adapted to perform breath test for those who are suspected of CO poisoning.

More commonly, a combustion analyzer or hand held CO detector is used to measure it in parts-per-million or (PPM). High PPM and long exposure cause high COHb percentages and the associated symptoms.

CO Numbers to Remember:

- 9 PPM--24 hours--National ambient air quality limit for CO (EPA’s outdoor), (ASHRAE indoor) CO “Action” level for many public safety organizations
- 35 PPM--8 hours-- Maximum 8 hr workplace exposure limit (OSHA)
- 200 PPM--3 hours-- Mild headache, fatigue, nausea and dizziness

- 400 PPM--2 hours-- Serious headache, dizziness, and nausea. Life threatening after 3 hours
- 800 PPM--45 min-- Dizziness, nausea, convulsions, and unconsciousness. Death within 2-3 hours
- 3200 PPM--5-10 min-- Dizziness, nausea, convulsions, and unconsciousness. Death within 25-30 minutes
- 6400 PPM--1-2 min-- Death within 10-15 minutes
- 12,800 PPM--30 seconds-- Death within 1-3 minutes

If a victim of CO poisoning is fortunate enough to be correctly diagnosed and treated in a hyperbaric chamber, CO can be completely removed from their system in just 90 minutes. The only problem with this is CO poisoning is a widely misdiagnosed ailment especially at low levels.

Because CO poisoning often causes a victim's blood pressure to rise, the victim's skin may become pink and flushed.

Mild exposure is often described as flu-like symptoms, including slight headache, nausea, vomiting, and fatigue.

Medium exposure is often described as severe throbbing headache, drowsiness, confusion and a fast heart rate.

Extreme exposure symptoms are: unconsciousness, convulsions, cardio respiratory failure and death.

Many cases of reported carbon monoxide poisoning indicate that while victims are aware they are not well, they become so disorientated that they are unable to save themselves by either exiting the building or calling for assistance

Misinformed people think "CO either kills you or it doesn't" and that is true if you are looking at it from a strictly live or die perspective but if it doesn't kill you, it can actually leave you with some devastating long term health issues including memory loss, constant pain and unending tiredness. Many who have been exposed to long term, low level doses or those who have been exposed to high doses remain incapacitated and unable to work.

Causes and things to look for:

Although there are several sources of potential CO generation within a structure & possible visual signs to numerous to list here of potential CO over-exposure conditions none of these should be accepted as evidence instead of actual testing.

In fact, the technician should check the ambient CO levels upon entering the basement, house, boiler room, or crawl space before testing any equipment in the space and if at any time during this test the ambient CO levels go above 100 PPM, evacuate the occupants and ventilate the building immediately.

If carbon monoxide is detected check all sources of potential CO generation, including but not limited to, hot water tanks, the furnace, space heaters--vented and non-vented, appliances like gas fireplaces, gas dryers, gas ovens & stoves, even cars idling in a garage-under or near air intakes or generators running during power outages, etc.

Carbon monoxide is the product of incomplete combustion caused by insufficient combustion air, flame impingement or contaminated combustion air.

Insufficient combustion air can be caused by a lack of combustion air intakes, plugged air intakes, intake air grille area not large enough causing a negative pressure in the mechanical room, incorrect primary air or over firing of equipment.

Sooting can be a sign that there is a lack of combustion air but is not always the case. Excessive combustion air or insufficient fuel supply can cool the burner flame to a point below 1128 degrees Fahrenheit and cause sooting and CO production.

This cooling of the flame causes quenching in cracked heat exchangers and is the reason soot builds up in the tubes of a heat exchanger that has a crack (s) in it. In any case, sooting is a good indicator of the need for testing.

Flame impingement, also known as quenching, can also occur when the burners are improperly positioned and the flame is hitting on a larger mass such as the side of the heat exchanger cooling it to a point of causing soot and CO to be generated.

Contaminated combustion air not only can cause CO to be generated but can also cause premature failure of the heat exchanger and/or venting system.

Contamination can come from sources such as laundry products, chlorine, paint, varnish, solvents & glues or even from the recirculation of vent products in improperly designed direct vent systems.

Equipment not venting is the main cause for CO and flue gases to enter the building. Even if the equipment is producing a high level of carbon monoxide, if the integrity of the vent has not been breached the flue products would simply go out the vent and cause no harm to anyone.

Keep in mind if you have rust or a white powder (corrosion) on burners, heat exchangers, draft hoods or flues; you are looking at some telltale signs of venting problems.

All homes should have CO Alarms:

Many experts and localities recommend every home have a CO detector in it for maximum safety of the occupants and this is reflected in the codes of many localities & states.

Under UL Standard 2034, Carbon Monoxide alarms should sound when a concentration of carbon monoxide of 70 to 150 ppm is present for no more than 50 minutes or as early as 10 minutes.

A CO alarm should be installed high on a wall or the ceiling of a space but at least (8') from a gas appliance such as a kitchen stove to prevent false alarms.

At 78 degrees Fahrenheit, CO has a specific gravity of .98, slightly lighter than air, so it will slowly rise to the ceiling of the space.

Technicians should be aware that low-level alarms are available for those who are at greater risk of CO poisoning like the elderly, children, small pets, people with respiratory problems, etc.

CO alarm sensors have a life of about three-years (see manufacturer's instructions) and may not be functioning when you need it most.

Pushing the test button only proves the test button and the battery are functioning. Proper testing should be done with a test kit that simulates a concentration of CO reaching the alarm.

This article is obviously just the tip of the iceberg about what all of us should know about carbon monoxide and testing for it. I recommend the book "Carbon Monoxide—A Clear and Present Danger" by Esco Press for those who want to learn more.

I leave you with these words of wisdom from an article by Jim Davis, one of the country's leading CO experts, "If you test, you know for sure, if you don't, you're only guessing.