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Carbon Monoxide Safety Is Everybody's Business



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Do the buildings you walk into everyday have elevated levels of carbon monoxide in the living or work space air? Do you move through these buildings focused on your task at hand, unaware of the potential and foreseeable consequences of the presence of carbon monoxide? Is CO measurement and data collection occurring before or after the complaint, medical emergency or death? Who's responsible for testing CO in buildings?

Everyone in the service business should first evaluate their own knowledge and understanding of this harmful and deadly poisonous gas. They should ask themselves these and other important questions, such as: How much CO is too much? How is it measured? What are the potential sources of CO generation in my workplace?

Such questions cannot be answered without first providing a definition for carbon monoxide. CO is a toxic gas that can be found in homes and buildings where combustion byproducts are generated and allowed to disperse. Colorless, odorless and tasteless, it is an asphyxiant. As a poison, it is deadly at high levels. Chronic low levels may compromise any health condition, perhaps masking or hiding within a symptom. If you smell exhaust gases, CO is always present, though odorless by itself.

At low concentrations, CO can go undetected and contribute to nagging illnesses. It can compound preexisting health problems and can go undiagnosed in premature deaths. Failures to detect and diagnose must surely be influenced by insufficient or lack of measurement. It is hard to connect the dots when you can't see or recognize the dots.

CO can be produced when incomplete and improper burning of fossil fuels occurs. Gas and oil heating systems, gasoline- and diesel-driven vehicles, gas floor polishers, forklifts, generators, fire pits and other related systems are all around us at home, work and play, and all have the potential to produce harmful concentrations of carbon monoxide.

Technicians using proper electrochemical sensor-based test instruments can measure the operating exhaust of these systems during routine maintenance service and greatly reduce the hazard by correcting the diagnosed problem. Building pressure diagnostics can help assure generation and dispersion of CO is not occurring due to competing pressures and that energy systems are running safely, efficiently and as intended by the manufacturer.

In air, CO is measured in parts per million. Our air contains predominantly oxygen (O₂) at 20.9 percent by volume and nitrogen (N) at 79 percent. This air is passed across an electrochemical CO sensor, which measures the parts of CO found in a million molecules of air and measures it in real-time increments. The second it passes across the sensor, it is digitally displayed as PPM.

It is important to know electrochemical sensors are not found in UL 2034 listed home carbon monoxide alarm detectors. The common UL 2034 listed alarms, though it may have a digital display, are not competently accurate at levels under 30 PPM and come with advisories on use when people of vulnerable health are present. The degree of accuracy of the sensors found in these alarm detectors is extremely less accurate than devices utilizing electrochemical sensing systems.

Health Effects of Carbon Monoxide

When carbon monoxide is inhaled into the lungs and bonds with hemoglobin in blood, it forms carboxyhemoglobin (COHb). This condition displaces oxygen in the blood stream and affects all major organs and muscles. Heart rate can increase when oxygen-depleted blood moves through the body as the organ tries to compensate. This can be fatal to some people sooner than others.

Healthy adults may show no ill effects to low concentrations of carbon monoxide. However, headaches, a constant stuffiness or head pressure are very common symptoms of early CO poisoning and may be the prelude of a worsening condition. These conditions can also go undiagnosed.

Elderly people, infants, small children and anyone with poor health may experience effects much sooner than a healthy young adult. Respiratory problems, chronic heart disease, dizziness, vomiting, confusion, a general weakness of the body, and flu-like symptoms may be some of the effects of CO poisoning. Due to their smaller size and generally higher metabolic rate, pets may be more obviously and more severely affected by CO intoxication than their owners.

Blood sampling for CO in the field is not practical. It is most often not something a general practicing physician has the lab capabilities to perform. This traditional diagnostic technique coupled with an absence of correlation between a patient's symptoms and carbon monoxide exposure establishes foreseeable consequences of misdiagnosis. Existing technology can give field indications in less than a minute that a poisoning has or is occurring.

Once severe poisoning from carbon monoxide has been established, the main therapy is the administering of supplemental oxygen and ventilation support and the monitoring of heart rate. The goal of oxygen therapy is to improve the O₂ content of the blood. O₂ therapy and observations should continue long enough to

prevent additional poisoning once carboxyhemoglobin unloads from the cell.

No set guideline for length of therapy is given and health professionals readily admit that there is a tremendous amount of unknown health effects from CO exposure.

Monitoring CO Levels in Buildings

There are similarities in all buildings. Is it measurable? Did it get measured? Though each building will be unique, a monitoring model of "who, what, when, how and if" applies.

Why wait for the alarm or injury? Let's stop and look at a proactive preventative approach to carbon monoxide from a community perspective. Examined this way, there could be a small army of professionals taking and measuring vital air quality samples and making safety referrals that are based upon local codes and reasonable practice standards.

Service personnel from emergency responders, home and building inspectors, HVAC installers and estimators, building maintenance, industrial hygienists and others should use consistent diagnostic procedures when entering a building. The use of a checklist or data recording test instruments helps ensure consistency. Importantly, all of our checklists should have a recognizable standard, code or some other obvious or recognizable gradient of consistency that helps identify our level of participation in this public safety effort.

Additionally, more and more buildings have inexpensive CO detectors in them that sound off and source investigations are increasing. Training and proper use of test equipment are helping to improve the quality of those investigations and can help reduce the number of alarms. If proper testing is performed routinely, the opportunities for detecting problems before they become emergencies or alarm calls increase.

It is vital, therefore, that we know the CO and code standards for each and every community we work in because they may be somewhat different for each. If standards or codes do not exist in some areas, the liability rules of "reasonable work practices" apply. The consumer may have limited knowledge or understanding of these codes or standards.

We measure CO outside before we enter and, upon entering, determine if there is too much CO and perhaps where it is coming from. We may even fix the problem by utilizing the help of combustion gas analyzers for CO and efficiency. At minimum, we make the proper referral. We

must have an understanding of carbon monoxide dynamics and how much is too much.

How Much CO Is Too Much

Always check with the authority having jurisdiction. Know who is in the building being tested.

- ASHRAE 62-89: 9 PPM – The maximum allowable concentration for continuous (24-hour) exposure. ASHRAE states the ventilation air shall meet the outdoor air standard referenced to EPA and 9 PPM.
- U.S. Environmental Protection Agency: 9 PPM – This level or lower as an ambient air quality goal averaged over eight hours. This outdoor air standard is exceeded in many urban areas due to auto exhaust.
- Common action level: 9 PPM or more above what you measured outside is the most common action level in the U.S. by local authorities of jurisdiction for further testing. Some jurisdictions require fuel shut off until the problem is diagnosed and corrected.
- Cautionary chronic levels: 10–35 PPM is a marginal level in reference to potential or foreseeable problems in some situations. Occupants should be advised of a potential health hazard to infants and small children, elderly people and persons suffering from respiratory or heart problems. If a building has an attached auto garage, CO levels should be documented there. Accept this level as normal where unvented appliances are in use. These levels are unacceptable when originated from vented appliances.
- UL 2034 (Underwriters Laboratories, CO alarm detector designation): 30 PPM is the concentration required for UL 2034 listed alarms to sound when this concentration is present for 30 days minimum. This allows the sensor to clear itself. People of vulnerable health may require alarms with lower PPM concentration trigger levels. (NOTE: Alarms listed under UL 2034 may not have been able to meet this requirement.)
- EPA: 35 PPM – This level or lower as an ambient air quality goal averaged over one hour outside.
- Common action level: 35 PPM is a common action level for fire department or other emergency responders to utilize self contained breathing apparatus when occupation of that environment is to be sustained by that responder. 35 PPM or less averaged over an eight-hour day within that workday is a common goal of certain states' occupational health and safety agencies. This is

also a common goal of many employers despite higher regulated concentration standards and may require the measurement of several simultaneous reference locations.

- Occupational Health and Safety Administration: 50 PPM – Maximum allowable concentration for a worker's continuous exposure in any eight-hour period. This eight-hour average requires continuous measurement and accurate reporting in the workplace.
- UL 2034: 70 PPM concentration required for UL 2034-listed CO alarms to sound when concentration is present for no more than 240 minutes (four hours) or as early as 60 minutes (one hour).
- Foreseeable hazardous levels: 36–99 PPM is excessive. Medical alert and health consultation recommended especially if levels displayed chronic conditions. It is recommended to get out of the space where these conditions exist. Air packs recommended if sustained conditions and presence required. Conditions must be mitigated. Ventilation required. Always test garage space. Individually test combustion appliances. All repairs are to be conducted by a qualified technician with proper test equipment.
- Evacuation advisory levels: 100–200 PPM is dangerous (and is a common building evacuation standard.) Medical alert conditions exist. It is suggested that occupant health inquiries be conducted. It is advisable that someone else transports them to seek medical help; 15-minute maximum exposure upon discovery. Report all incidents to authority of jurisdiction.
- UL 2034: 150-PPM concentration required for UL 2034 listed CO alarms to sound when concentration is present for no more than 50 minutes or as early as 10 minutes.
- Evacuation! The extremely dangerous measurement of 200 PPM is universally accepted as an evacuation action level. The health of occupants should be monitored and emergency conditions may exist. Building should be ventilated and searched for additional occupants. Combustion systems should be thoroughly tested for CO production and dispersion. Report incident to an authority of jurisdiction.
- UL 2034: 400-PPM concentration required for UL 2034 listed CO alarms to sound if concentration is present for no more than 15 minutes or as early as four minutes.

Any increase in PPM from outside to inside warrants further source investigation and is documented, reported and even fixed is common in jurisdictions where a fuel supplier also is

considered an authority of jurisdiction. This standard is also common to some federally and state-funded weatherization programs as well as protocol to some private companies engaged in CO testing.

Every home or building where people live, work or play should have a carbon monoxide alarm detector. Please install one that meets the needs of all people. Read the instructions and install them to the manufacturer's specifications. Please note the health advisory listed on all alarm packages.

Knowledgeable service providers test for CO going into a building and test continuously until they leave. Problem buildings are applied with data-logging.

An unfortunate argument used with reference to carbon monoxide testing often includes a statement suggesting that "it is not my job." Personal safety is every service provider's "job." The duty to warn and inform is paramount in all service. If you don't test, you don't know! Carbon monoxide is everybody's business.

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