



What is Carbon Monoxide (CO) and how is it produced?

Carbon Monoxide (CO) is a deadly, colorless, odorless, tasteless, non-irritating poisonous gas. It is produced by the incomplete burning of various fuels, including coal, wood, charcoal, oil, kerosene, propane, and natural gas. Products and equipment powered by internal combustion engines such as portable generators, cars, lawn mowers, and power washers also produce Carbon Monoxide.

What is the difference between Carbon Dioxide (CO₂) and Carbon Monoxide (CO)?

Carbon Dioxide (CO₂) is NON-TOXIC, Carbon Monoxide (CO) is TOXIC. BAPI's Carbon Monoxide Transmitter measures Carbon Monoxide (CO), not Carbon Dioxide (CO₂). Many people unintentionally mix up CO & CO₂. The Carbon Monoxide (CO) molecule has 1 oxygen atom and one carbon atom, the Carbon Dioxide molecule (CO₂) has 2 oxygen atoms and one carbon atom. Carbon Monoxide is highly reactive and will readily combine with a free oxygen atom to become Carbon Dioxide. If a Carbon Monoxide molecule can't find a 2nd oxygen atom to react with, it will react with something else that has the chemical reaction properties of oxygen.

Carbon Dioxide's molecule is non-reactive, all chemical bonds are consumed. Most humans can tolerate high Carbon Dioxide concentrations. Very high concentrations of Carbon Dioxide can displace enough oxygen in the air to be harmful.

If you breathe in Carbon Monoxide, it will react with the hemoglobin in your blood. Hemoglobin combines with oxygen and releases the oxygen where it is needed in your body. Carbon Monoxide binds to your blood's hemoglobin approximately 200 times more readily than oxygen; it blocks the hemoglobin from carrying oxygen. This is why CO is toxic; it asphyxiates you through your blood.

What are the symptoms of CO poisoning?

Carbon Monoxide displaces oxygen in the blood and deprives the heart, brain, and other vital organs of oxygen. The symptoms of Carbon Monoxide poisoning are headache, fatigue, shortness of breath, nausea, dizziness, mental confusion, vomiting, loss of muscular coordination, loss of consciousness, and ultimately death. Carbon Monoxide poisoning often causes a victim's blood pressure to rise, turning the victim's skin a pink or red cast.

How do different Carbon Monoxide concentrations affect people?

The reliable way to determine how you are affected is to perform blood tests to determine the oxygen carrying capacity of your blood. Carrying around this type of medical equipment is inconvenient, therefore Carbon Monoxide toxicity levels are usually expressed in concentration levels (ppm) and duration of exposure.

Carbon Monoxide Concentration	Inhalation Time	Toxic Symptoms
9 ppm	Short term	ASHRAE recommended maximum in a living area
35 ppm	8 hours	OSHA maximum in a workplace in an 8-hour period
200 ppm	2-3 hours	Slight headache, tiredness, fatigue, nausea, and dizziness
400 ppm	1-2 hours	Serious headache, other symptoms intensify, life threatening in 3-hours
800 ppm	45 minutes	Dizziness, nausea, & convulsions, Unconscious in 2-hours, Death in 3 hours
1,600 ppm	20 minutes	Headache, dizziness & nausea, Death in 1 hour
3,200 ppm	5-10 minutes	Headache, dizziness & nausea, Death in 1 hour
6,400 ppm	1-2 minutes	Headache, dizziness & nausea, Death in 25-30 minutes
12,800 ppm	1-3 minutes	Death within 1-3 minutes

Source - http://www.engineeringtoolbox.com/carbon-monoxide-d_893.html

Are there regulations for acceptable Carbon Monoxide exposure?

Yes, the following organizations regulate Carbon Monoxide exposure:

- ACGIH: American Conference of Governmental Industrial Hygienists
- OSHA: Occupational Safety and Health Administration
- NIOSH: National Institute of Occupational Safety and Health
- CDC: Centers for Disease Control and Prevention
- EPA: Environmental Protection Agency

Their recommendations are:

- EPA 8-hour limit (TWA) 9 ppm
- EPA 1-hour limit (TWA) 35 ppm
- ACGIH TLV 25 ppm
- OSHA PEL 50 PPM
- NIOSH REL 35 ppm with a 200 ppm Ceiling
- NIOSH IDHL 1,200 ppm
- CDC IDHL 1,200 ppm

Glossary

- TWA: Time Weighted Average, average exposure over 8 hours
- TLV: Threshold Limit Value, TWA for 8hr/day, 40hr/week
- PEL: Permissible Exposure Limit, TWA for one 8hr day
- REL: Recommended Exposure Limit, TWA for 8hr/day, 40hr/week
- Ceiling: Never to exceed value
- IDHL: Immediately Dangerous to Life or Health

Due to the complexities of these regulations, BAPI recommends that you contact each organization for additional information on allowable Carbon Monoxide exposure levels.

I feel awful and think I may have been exposed to Carbon Monoxide, what should I do?

Immediately move everyone to fresh air, either outside, an open outside window, or open outside door. Account for all personnel. Call your local emergency services, fire department, or 911. Do not re-enter the building until cleared to do so by emergency responders. Seek medical attention.

Where should I mount Carbon Monoxide transmitters?

Mount in an area that provides access for maintenance personnel and their equipment.

Carbon Monoxide and air are nearly equal in density, air = 1, Carbon Monoxide = 0.957. Carbon Monoxide will disperse evenly throughout the air. Mount the Carbon Monoxide transmitters as specified by your jurisdiction's building code. If no building code is in force, BAPI recommends 3 to 5 feet (0.9 to 1.5 meters) above the floor level.

If your building code does not specify coverage area, BAPI recommends 5,000 ft² (465 m²), roughly a circle 80 feet (24.4 meters) in diameter. For more information and coverage diagrams see BAPI's application note referenced below.

Go to www.bapihvac.com, select **RESOURCE LIBRARY** from the banner, Click on **Application Notes**, Look down the page for the heading **Air Quality Related**, and choose the link titled **Coverage Area and Mounting Recommendations for BAPI Indoor Air Quality Sensors**. The direct link is:

http://www.bapihvac.com/content/uploads/IAQ_Coverage_Mounting.pdf



Can I interconnect multiple Carbon Monoxide transmitters to cover larger areas?

Yes. The relay contacts are galvanically isolated from the rest of the circuitry in the Carbon Monoxide transmitter. The normally open or normally closed contacts may be connected together in a wired "OR" configuration. Please see the transmitter's installation instructions for further details.

Is there anywhere I shouldn't install carbon monoxide alarms?

Do not install Carbon Monoxide transmitters in any extremely dusty, dirty, humid, or greasy areas. Do not install transmitters in direct sunlight. Carbon Monoxide transmitters should not be installed in alcoves covered by curtains or other obstructions. Do not install in turbulent air near ceiling fans, heat vents, air conditioners, fresh air returns, or open windows. Blowing air may prevent carbon monoxide from reaching the Carbon Monoxide transmitter.

What are the recommendations for setting the alarm relay values?

Be sure to follow any requirements of local building codes or regulations. Contact your local building inspector, fire marshal, fire department, or emergency services for recommendations.

If local codes, regulations, or officials do not have recommendations, use the regulation requirements presented at the top of page 2. BAPI recommends any value of 35 ppm or less. Use the value that is most appropriate for your situation as required by ACGIH, NIOSH, EPA, or OSHA.

If local codes or regulations require 2-stage alarms, BAPI recommends setting the stages according to the local codes, regulations or officials. If local codes, regulations, or officials do not have recommendations, BAPI recommends setting the 1st stage to any value of 35 ppm or less, as recommended in the previous paragraph. BAPI recommends setting the 2nd stage to a value above the 1st stage that is most appropriate for your situation.

BAPI's recommendations cannot substitute for good engineering judgment by the professionals involved.

What are the recommendations for setting the alarm relay times?

After the Carbon Monoxide has dissipated, the alarm relay times hold the relays on for the specified time. This allows more time to purge the Carbon Monoxide before releasing the alarm condition.

Be sure to follow any requirements of local building codes or regulations. Contact your local building inspector, fire marshal, fire department, or emergency services for recommendations.

Each installation is unique. Using chemical smoke to determine air movement and drift velocities may be required. Once air velocities are determined, set the timers accordingly.

How often should BAPI's Carbon Monoxide transmitter be calibrated?

Every BAPI Carbon Monoxide transmitter is factory calibrated. Each unit is ready for operation after installation and the 60 second start-up time.

BAPI's factory calibrated CO Module is inexpensive enough to replace, rather than calibrate with expensive and inconvenient gas tanks, regulators, and laptop computer. BAPI's sensor element vendor has performed long term testing that shows the sensor drifts less than $\pm 2.5\%$ in 3 ½ years. The long term testing shows that the sensor's drift may be up to $\pm 5\%$ from 3 ½ to 7 years. BAPI recommends replacing the sensor whenever the Replace Sensor alarm is active, every 3 ½ years, or at the recalibration intervals required by the local jurisdiction.

Replacing the CO Module is as simple as; opening the lid, removing the CO Module by pulling straight off the board, plugging in the new sensor, and closing the lid until it clicks. Remember to replace the tamper resistant screws.



What are the maintenance requirements for BAPI's Carbon Monoxide transmitters?

BAPI understands that it may be good practice to inspect Carbon Monoxide transmitter on an annual basis. We are not concerned that the transmitter will fail, but we are concerned that other environmental factors may physically damage the sensor, careless workmen dropping tools for example. Each installation is unique and has its own requirements. BAPI's technical service representatives will be happy to consult with you and make recommendations based on your requirements.

The Carbon Monoxide sensor/transmitter unit should be vacuumed clean once a year or more, depending on the rate of accumulation of any dust or dirt. To avoid sensor damage, the unit **MUST NOT** be submerged in any liquids. Hosing or splashing of the unit with any liquids must also be avoided and may void the warranty.

The sensor in the Carbon Monoxide Transmitter has a life typically over 7 years. When the sensor reaches the end of its useful life, the transmitter will alarm when a replacement is required. Factory calibrated replacement sensors are available from BAPI.