

# Carbon Monoxide Safety

## A First Response Guide



**SCOTT/BACHARACH**  
*Gas Detection Products*

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# What is Carbon Monoxide (CO)?

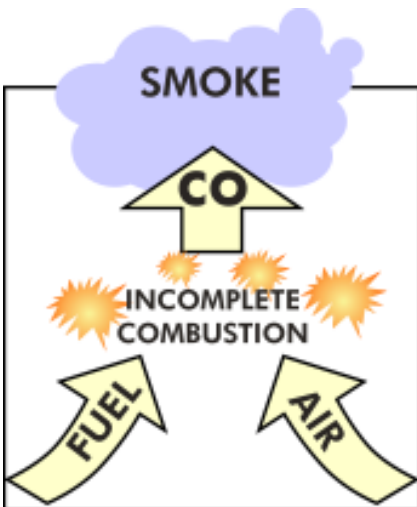
Carbon Monoxide is a toxic gas that can occur in homes and buildings. It is colorless, odorless, tasteless and non-irritating. CO is a poison and can be deadly at high levels. At low concentrations, CO can go undetected and contribute to nagging illnesses. It can compound pre-existing health problems and often times goes unblamed in premature deaths.



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# How CO is Produced

Carbon monoxide is produced by the incomplete combustion of fuels. This occurs when there is not enough oxygen mixed with fuel. This is commonly referred to as a "rich mixture." All fuel burning appliances have the potential to produce CO in varying concentrations. CO can result from improperly vented or malfunctioning combustion appliances such as furnaces, stoves and hot water heaters.



**A RICH MIXTURE**

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# How CO Affects the Human Body

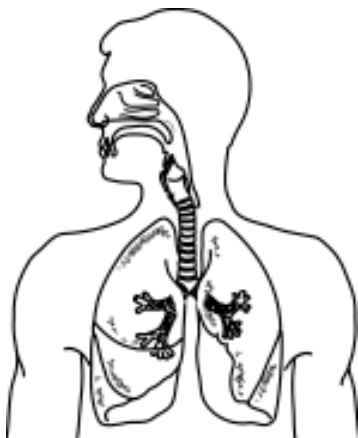
CO is inhaled into the lungs and bonds with hemoglobin in the blood to form carboxyhemoglobin (COHb). This condition limits the ability of the blood to carry oxygen and affects all major organs and muscles.

Extended exposure or brief high level exposure to CO can lead to unconsciousness, brain damage or death.

Early warning signs of CO poisoning are headaches, nausea, dizziness, shortness of breath and confusion.

High risk groups for CO poisoning include:

- *infants/children*
- *pregnant women*
- *elderly people*
- *heart patients*
- *anyone who has trouble breathing*
- *those with anemic conditions*



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# National Standards for CO Exposure

- ASHRAE**      *American Society Of Heating, Refrigerating and Air Conditioning Engineers*  
ASHRAE requires that ventilation air meet the outdoor air standard as determined by the EPA.
- EPA**      *Environmental Protection Agency* A person should not breath 9 PPM CO or over for any 8 hour period, or, 35 PPM or over for more than one hour.
- OSHA**      *Occupational Safety and Health Administration*  
The average exposure over an eight hour work day can not exceed 50 PPM.
- AGA**      *American Gas Association*  
The Maximum allowable concentration of CO should not exceed 400 PPM in flue gases.

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# Determining if an Individual has been Exposed to CO

Symptoms of CO poisoning are often confused with other medical conditions such as flu. Therefore, CO exposure is traditionally determined by drawing a blood sample and then sending it to a laboratory for blood/gas analysis. If run immediately, results may be available in as little as two hours.

Alternatively, CO breath analysis is a fast, effective field evaluation that can minimize unnecessary trips to the hospital. This reduces the need for invasive blood/gas testing since breath analysis screens individuals for CO exposure on-site.

## The Benefits of CO Breath Analysis...

- *Saves time and money in the field for fire and safety professionals.*
- *Saves time and money in the emergency room for CO patients and insurance providers.*
- *Is non-invasive.*
- *Can be done on-site providing immediate results.*
- *Allows you to administer treatment quickly. (high flow of oxygen)*
- *Limits unnecessary blood/gas tests.*
- *Eliminates guesswork regarding the seriousness of an individual's condition.*
- *Can help verify a CO incident even after the area is ventilated.*





When dealing with CO, time is crucial because CO poisons without warning, quickly becoming fatal. In the blood stream, CO attaches onto hemoglobin 200 times stronger than oxygen. The strong bond means that the threat of CO poisoning lingers. A toxic level of CO can remain in the blood for hours after exposure even when CO in the environment has dropped to acceptable levels. As a result, the individual may go untreated or return to the home with a potentially unsafe condition.

An effective, non-invasive method of determining CO poisoning is breath analysis. Lungs in the human body absorb and store CO. Analyzing a breath sample is a potent means of verifying whether there was a true CO exposure as well as its severity.\*

\*Uncertain cases should receive medical attention immediately.



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# Levels of Concern in the Human Body

%COHb Levels:

(Carboxy-hemoglobin

Saturation)	Symptoms*
0-10%	None
10-20%	Tension in forehead, dilation of skin vessels
20-30%	Headache and pulsating temples
30-40%	Severe headache, weariness, dizziness, weakened sight, nausea, vomiting, prostration
40-50%	Same as above, plus increased breathing and pulse rates, asphyxiation and prostration
50-60%	Same as above, plus coma, convulsions, Cheyne-Stokes respiration
60-70%	Coma, convulsions, weak respiration and pulse, possible death
70-80%	Slowing and stopping of breathing, death within hours
80-90%	Death in less than one hour
90-100%	Death within a few minutes

Reference the conversation chart on the unit for PPM CO conversion to %COHb.

\*Symptoms may vary slightly depending upon individual and amount of time exposed. Smokers may display reading of up to 8% COHb without additional CO exposure.

*Source: Gordon E. Hartzell, Ed., "Understanding of Hazards to Humans," Advances in Combustion Toxicology, Volume One, Technomic Publishing, Inc. 1989. P.23.*



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# Levels of Concern on the Home

CO Levels:	Effects
12,800 PPM	Death within 1 to 3 minutes.*
1,600 PPM	Nausea within 20 minutes; death with in 1 hour.*
800 PPM	Nausea and convulsions, death within 2 hours.*
400 PPM	Frontal headaches 1 to 2 hours: life threatening after 3 hours.*
50 PPM	Maximum concentration for continuous exposure in any 8 hour period.
9 PPM	Maximum acceptable level of CO in a living space.

\*Effects can vary significantly based on age, sex, weight and overall state of health.

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# Suggested CO Sampling Protocols

Currently there is no national standard or protocol for carbon monoxide sampling. However, some basic requirements include:



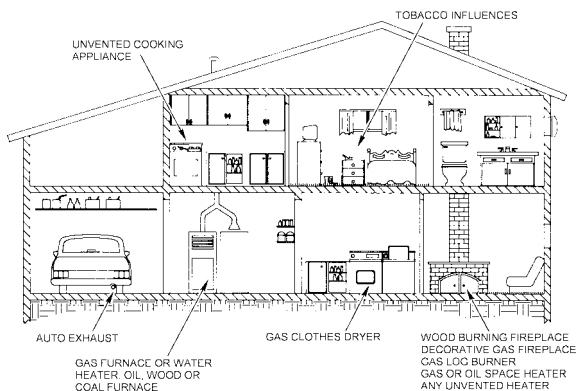
- *Zero the instrument in known fresh air prior to use.*
- *Check occupants for symptoms of CO exposure.*
- *Sample at the entrance before entering an area.*
- *Continue to sample at various heights upon entering the area.*
- *Sample near the location of the CO alarm and sample in and around all appliances that use or can cause combustion (i.e., stoves, furnaces, hot water heaters, gas dryers, unvented appliances, etc.) and any other location in which CO may be present.*

If at any time significant levels of CO are encountered, stop sampling and take the appropriate actions defined by your procedures.

**NOTE: WHEN RESPONDING TO CO ALARMS, THE FIRST PRIORITY SHOULD BE THE SAFETY OF ALL INDIVIDUALS.**



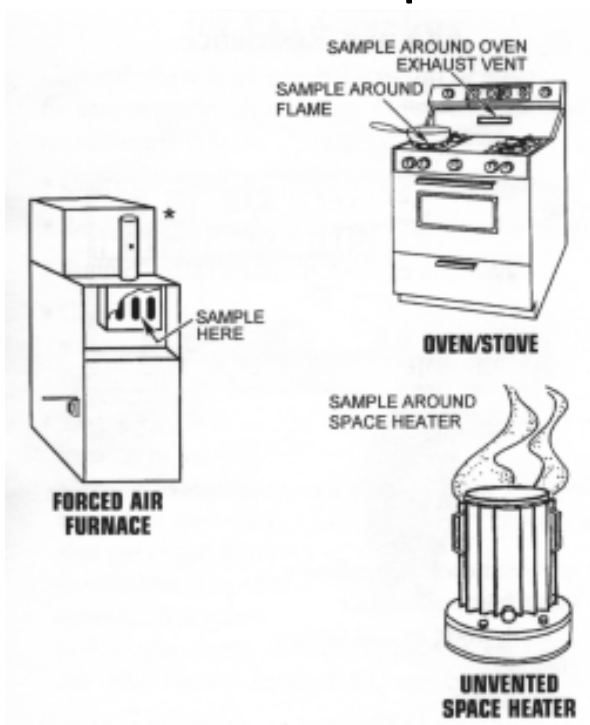
# Common Sources of CO in a Residence



There are many possible sources of carbon monoxide in a home:

- Unvented cooking appliances
- Wood burning fireplace
- Gas, oil, wood or coal furnace
- Chimney
- Water heater
- Gas refrigerator
- Gas clothes dryer
- Gas or oil space heaters
- Barbecue grill
- Attached garage
- Tobacco smoke
- Pool/spa heaters
- Unvented heaters
- Ceiling mounted unit heater

# Where to Sample

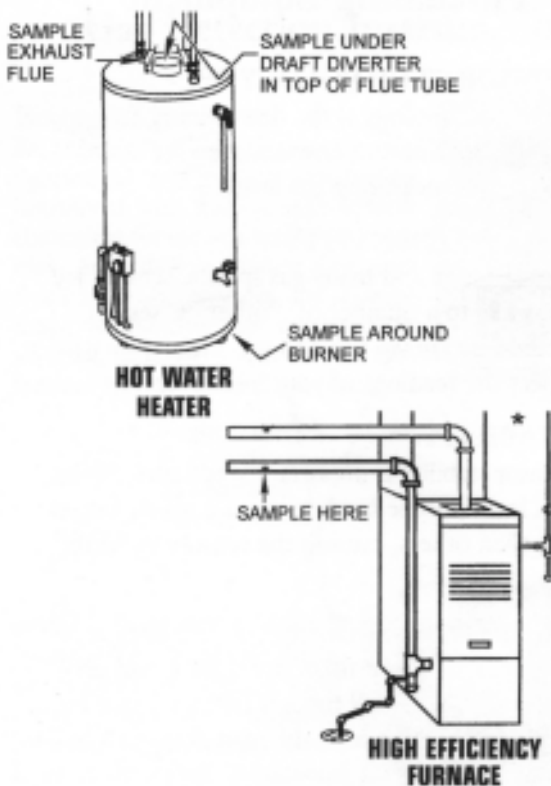


- Sample entrance of home and living area.
- Sample in warm air register.
- Sample near CO alarm area
- Sample near all combustion appliances (stove, oven, furnace, hot water heater & dryer).

\*Graphic copyright COAD



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- Sample around all unvented appliances (stove, ovens & space heaters).
- Sample in heat exchanger exhaust ports of furnace.
- Sample under draft diverter of an atmospheric hot water heater.
- Sample anywhere you may suspect CO.

\*Graphic copyright COAD

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# Considerations Before Purchasing Equipment

1. **SENSOR TECHNOLOGY**  
Sensor technology is the determining factor as to how specific and how accurate the instrument is to measuring gas levels.
2. **CROSS SENSITIVITY**  
Broad range and many gas specific sensors are sensitive to a number of "other" gases. It should be known prior to use what gases will affect the reading of your instruments(s).
3. **STABILITY**  
Sensor stability is important when quantifying gas leaks. Some instruments are much less stable than others, causing the sensors to "drift."
4. **SERVICE**  
Because these instruments can save lives, it is important to keep them operational and properly calibrated at all times. This can often be done by the user or at the manufacturer's locations.
5. **APPROVALS**  
When an instrument is "Approved," it usually has been tested by a third party to be in accordance with manufacture's claims and/or nationally recognized standards. These approvals serve as reassurance of instrument performance in the event of questionable circumstances.



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# Gas Detection Instruments For CO and more...

## CO Sniffer

- Simple and effective CO poisoning assessment
- Fast, accurate CO readings
- Measures CO from 0- 2,000 ppm
- Rugged construction
- Compact design with a large, easy to read backlit display
- Internal sampling pump
- FDA Listed



*On-scene CO poisoning assessment is one easy breath away with the CO Sniffer Emergency Response Kit.*

With its Breath Analysis Module the CO Sniffer becomes a powerful ally to emergency response personnel. Simply exhale into the disposable mouthpiece and balloon and CO levels in the bloodstream are quickly and accurately assessed. With a powerful built-in pump the CO Sniffer also quickly converts to a portable CO detector for on the scene hazard assessment.

Part#	Description
19-8010	Co Sniffer Carbon Monoxide Gas Indicator with Breath Analysis Module (BAM) for Carboxy Hemoglobin Measurement. Complete with carrying case, (5) filter disks, (30) mouthpieces and (30) balloons.



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# BodyGuard 4 Four Gas Portable Gas Detector

- Rugged, durable and easy to use
- Menu driven push-button operation
- Visual, audible and vibratory alarms
- Large backlit display
- Water resistant
- RFI shielded
- Automatic calibration



*Let the Bodyguard 4 be your escort into the heart of danger. The Bodyguard 4 gives emergency personnel the extra edge they need for a spectrum of response calls.*

From confined space entry situations to probing for gas presence or oxygen deficiency, the versatile Body Guard 4 offers lightweight portability for monitoring multiple atmospheric hazards — *simultaneously*. Its intuitive menu driven display and three large, tactile buttons make operation easy - even with gloves on. New enhanced software gives added instrument functionality that makes calibration easier than ever and the datalogging feature provides a record of operation and gas readings for incident reports.

Part#	Description
096-2398	Oxygen, %LEL, Carbon Monoxide
096-2400	Oxygen, %LEL, Carbon Monoxide, Hydrogen Sulfide
54-8001	Complete Confined Space Kit With Bodyguard 4 Four Gas Instrument for O <sub>2</sub> , %LEL, CO and H <sub>2</sub> S

# LeakAlert

- Ultra-bright LED Indicators
- Audible indicator
- 30 hour battery life
- Long-life sensor (4+ years)
- Durable construction
- 20 inch flexible probe

*Easy, cost effective combustible gas leak detection, down to as little as 20 ppm in a small, hand-held package.*



Equipped with a patented solid state sensor at the end of the flexible twenty inch probe, Leak Alert gets you into hard to reach areas. Both audible and visual indicators let the user quickly determine the presence of gas and location of the highest concentration.

Part#	Description
19-7051	LeakAlert with carrying case, calibrated and installed gas sensor, flexible probe and manual.

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# TLV Sniffer

- Ranges from: 0-100 ppm; 0-1,000 ppm; 0-10,000 ppm
- Audible gas detection alarm
- Long-life sensor
- Recorder output
- Rechargeable battery pack
- Intrinsically safe
- Low battery alarm



*Arson investigation and combustible leak detection just got a little easier.*

In the aftermath of a suspect fire scene, the TLV Sniffer can detect a spectrum of hydrocarbon-based accelerants in ultra-low levels on spent materials and debris. Equipped with a powerful built-in pump and multiple ranges for greatest sensitivity, the TLV Sniffer also performs as a combustible gas leak detector in even hard-to-trace situations such as natural gas leaks. It's portable and completely self-contained for incredible on-site flexibility.

Part#	Description
096-2401	TLV Sniffer Kit (Calibration: Hexane) With TLV Sniffer, NiCad battery and charger, ten inch aluminum probe and carrying case



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# 6<sup>TH</sup> Sense Heat Alert

- Weighs only 7 ounces
- Flame and water resistant housing
- Gloved-hand-accessible switch
- Audible and 4-position LED visual alert
- Latching heat alarm
- Auto On/Off
- Two-year battery life
- Low battery warning



*Increase personnel awareness to heat hazards - the easy way.*

With today's more advanced firefighting apparel, fire rescue personnel are more insulated than ever from the heat and flame they battle most everyday - sometimes without knowing they're in a dangerous heat situation. Like the turn-out gear they wear, the new Sixth Sense offers firefighters added assurance of protection from rapid, high temperature increases or prolonged heat exposure. It's loud alarm and flashing LED quickly alerts personnel of dangerous heat levels and the rugged flame retardant housing lets it stand up to the daily abuse of everyday use.

Part#	Description
40014900	6th Sense

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# Mini-SA Single Gas Personal Monitor

- Rugged, durable and easy to use
- Menu driven push-button operation
- Visual, audible and vibratory alarms
- Large backlit display
- Water resistant
- RFI shielded
- Automatic calibration



*The Mini-SA was designed with the firefighter in mind.*

The large rubber buttons were designed for use by gloved hands and the large display can be read in low light and with Air-PAK donned. It's rugged, super-compact package houses many features found in larger, more expensive instruments and includes audible, visual, and vibratory alarms, automatic calibration, and interchangeable sensors.

Part#	Description
40014770	Mini-SA Carbon Monoxide
40014771	Mini-SA Hydrogen Sulfide
40014772	Mini-SA Oxygen



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# SCOTT®

A SCOTT TECHNOLOGIES COMPANY



## Scott Air Supplied and Thermal Imaging Products

All Scott products have an unsurpassed record of reliable performance and rugged dependability. In addition, products are constantly improved and enhanced based on user input and constant field trials. At the same time, optimum versatility is maintained by designing products that are upgradeable as well as compatible with other Scott products. This means Scott products do not become obsolete as new or enhanced products are introduced.

### **SCOTT** Eagle Imager™ Thermal Camera

The Eagle Imager thermal camera contains such advanced technology that its sensor can detect temperature differences to one-tenth of a degree,



*continued...*

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permitting clearer, sharper images. Hot spots and victims can be detected as close as two feet away and up to 600 feet away.

It's simple to operate since it was designed for gloved-hands, and it is built in the same tradition of rugged, worry-free reliability found in all Scott products.

## **SCOTT** Air-Pak Fifty™

**2.2/3.0/4.5/**

From first-breath activation, Scott offers an SCBA with outstanding breathing performance and an airflow that exceeds NFPA requirements. In fact, the Scott Air-Pak is the most advanced SCBA available. Reliable performance and rugged dependability make Scott SCBA the first choice of professionals.



## **SCOTT** Pak-Alert SE®

The Pak-Alert is the first personal alert safety system to be integrated into an SCBA. This powerful safety tool offers redundant audible and visual alarms. It is designed to assist in locating incapacitated SCBA users.



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## **SCOTT** Ska-Pak® Plus

For emergency respiratory protection in hazardous atmospheres including those considered dangerous to life and health (IDLH). The 5- and 10-minute versions are available with a Kevlar®, nylon or fall protection harness. Other accessories are also available.



## **SCOTT** Carri-Air™

A portable lightweight means of extending respirator wear times. Air supplied respirator wearers can work up to 300 ft from the Carri-Air. Can be used with Air-Pak, Swat-Pak, and Ska-Pak.



## **SCOTT** RIT-PAK™

Specifically designed for RIT teams. Fast connection provides air to downed/trapped firefighters. Also available with SCBA's and/or Eagle Imager Thermal Camera



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Products

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## **SCOTT** Mobile Air Cart

The Scott Mobile Air Cart provides an uninterrupted supply of breathing air for up to four air-supplied respirators or air-driven tools. Continuous air supply is maintained by rotating fully-charged cylinders. Compact and light-weight, its low profile design permits access into standard-size manholes.



For more information on Scott® Air  
Supplied and Thermal Imaging  
Products

Call **800-633-3915**

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# For More Information on CO Safety, Call or Write to:

## **AGA**

Public Relations  
(703)841-8660  
1515 Wilson Boulevard  
Arlington, VA 22209  
[www.aga.org](http://www.aga.org)

## **ASHRAE**

(404) 636-8400  
1791 Tullie Circle NE  
Atlanta, GA 30329  
[www.ashrae.org](http://www.ashrae.org)

## **EPA**

Indoor Air Information Clearing House  
1-800-438-4318  
P.O. Box 37133  
Washington, DC 20013-7133  
[www.epa.gov/iaq/](http://www.epa.gov/iaq/)

## **OSHA**

Information and Consumer Affairs  
200 Constitution Avenue NW  
Washington, DC 20210  
[www.osha.gov](http://www.osha.gov)

*Compliments of*



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# Get Professional Training

*This booklet was designed to inform the reader about carbon monoxide safety and alarm response. It is not intended to be used as a substitute for training, nor is it the complete authority on carbon monoxide. Please refer to page 5 which provides national standards for CO exposure and the names of agencies responsible.*

