

Carbon Monoxide Levels and Risks

CO Level	Action	CO Level	Action
0.1 ppm	Natural atmosphere level or clean air.	70-75 ppm	Heart patients experience an increase in chest pain. Significant decrease in oxygen available to the myocardium/ heart (HbCO 10%).
1 ppm	An increase of 1 ppm in the maximum daily one-hour exposure is associated with a 0.96 percent increase in the risk of hospitalization from cardiovascular disease among people over the age of 65. (Circulation: Journal of the AHA, Sept, 2009)	100 ppm	Headache, tiredness, dizziness, nausea within 2 hrs of exposure. At 5 hrs, damage to hearts and brains. (Lewey & Drabkin)
3-7 ppm	6% increase in the rate of admission in hospitals of non-elderly for asthma. (L. Shepard et al., Epidemiology, Jan 1999)	200 ppm	Healthy adults will have headache, nausea at this level. NIOSH & OSHA recommend evacuation of the workplace at this level.
5-6 ppm	Significant risk of low birth weight if exposed during last trimester - in a study of 125,573 pregnancies (Ritz & Yu, Environ. Health Perspectives, 1999).	400 ppm	Frontal headache within 1-2 hours—life threatening within 3 hours.
9 ppm	EPA and WHO maximum outdoor air level, all ages, (TWA, 8 hrs) Maximum allowable indoor level (ASHRAE) Lowest CO level producing significant effects on cardiac function (ST-segment changes, angina) during exercise in subjects with coronary artery disease. (Allred et al., Environ. Health Persp., 1991). Most common indoor air level triggering action by local Authorities of Jurisdiction. (CAL, Penny)	500 ppm	Concentration in a garage when a cold car is started in an open garage and warmed up for 2 minutes. (Greiner, 1997)
10 ppm	Significant increase in heart disease deaths and hospital admissions for congestive heart failure (JAMA, Morris, Penny)	800 ppm	Healthy adults will have nausea, dizziness and convulsions within 45 minutes. Unconscious within 2 hours then death (determined in 1930).
15-20 ppm	World Health Organization lists as causing impaired performance, decrease in exercise capability, shortened time to angina response and vigilance decrement. (WHO, 13)	800 ppm +	Death in less than one hour.
20 ppm	Typical concentration in flue gases (chimney) of a properly operating furnace or water heater/boiler. (T.H, Greiner, ISU)	2000 ppm	EPA standard for new vehicle emissions.
25 ppm	Chronic exposure during pregnancy to miniscule levels of carbon monoxide damages the cells of the fetal brain, resulting in permanent impairment. (UCLA Study, BMC Neuroscience, June 22, 2009)	1600 ppm	Headache, tachycardia, dizziness and nausea within 20 minutes.
27 ppm	21% increase in cardio-respiratory complaints. (Chest, Kurt et al , 1978)	3000 ppm	Death in less than 30 minutes. Typical emissions from propane lift trucks, gasoline powered tools etc.
30 ppm	Earliest onset of exercise induced angina (HbCO 4.96% - World Health Organization, 13)	3200 ppm	Headache, dizziness and nausea in 5 to ten minutes. Death within 30 minutes.
35 ppm	Level which most fire department require that firefighters put on their oxygen masks. Maximum allowable outdoor concentration for one-hour period in any yr. (EPA, ASHRAE)	6400 ppm	Headache, dizziness, nausea in 1-2 mins. Thinking impaired before response is possible. Convulsions, respiratory arrest, and death in <15 minutes.
50 ppm	In healthy adults, CO becomes toxic when it reaches a level higher than 50 ppm.	12800 ppm	Unconsciousness after 2-3 breaths. Death in less than three minutes.
		35000 ppm	Tailpipe exhaust concentration from warm carbureted gasoline engines without catalytic converters. (Greiner, ISU, 1997)
		70000 ppm	Typical tailpipe exhaust concentrations from cold gasoline engine during first minute of cold weather start. (Greiner, 1997)
		Key: AHA American Heart Association ASHRAE American Society of Heating, Refriger & Air Conditioning EPA Environmental Protection Agency HbCO Carboxyhaemoglobin - CO bound to hemoglobin JAMA Journal of the American Medical Association NIOSH National Institute for Occupational Safety & Health OSHA Occupational Safety & Health Administration ppm parts per million TWA Time weighted averages WHO World Health Organization	