# Carbon Monoxide Levels and Risks

| CO Level | Action |
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| **0.1 ppm** | Natural atmosphere level or clean air. |
| **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) |
| **3-7 ppm** | 6% increase in the rate of admission in hospitals of non-elderly for asthma. (L. Sheppard et al.,Epidemiology, Jan 1999) |
| **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). |
| **9 ppm** | EPA and WHO maximum outdoor air level, all ages, (TWA, 8 hrs). Maximum allowable indoor level (ASHRAE)<br>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).<br>Most common indoor air level triggering action by local Authorities of Jurisdiction. (CAL, Penny) |
| **10 ppm** | Significant increase in heart disease deaths and hospital admissions for congestive heart failure (JAMA, Morris, Penny) |
| **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) |
| **20 ppm** | Typical concentration in flue gases (chimney) of a properly operating furnace or water heater/boiler. (T.H, Greiner, ISU) |
| **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) |
| **27 ppm** | 21% increase in cardio-respiratory complaints. (Chest, Kurt et al , 1978) |
| **30 ppm** | Earliest onset of exercise induced angina (HbCO 4.96% - World Health Organization, 13) |
| **35 ppm** | Level which most fire department require that firefighters put on their oxygen masks.<br>Maximum allowable outdoor concentration for one-hour period in any yr. (EPA, ASHRAE) |
| **50 ppm** | In healthy adults, CO becomes toxic when it reaches a level higher than 50 ppm. |
| **70-75 ppm** | Heart patients experience an increase in chest pain. Significant decrease in oxygen available to the myocardium/ heart (HbCO 10%). |
| **100 ppm** | Headache, tiredness, dizziness, nausea within 2 hrs of exposure. At 5 hrs, damage to hearts and brains. (Lewey & Drabkin) |
| **200 ppm** | Healthy adults will have headache, nausea at this level.<br>NIOSH & OSHA recommend evacuation of the workplace at this level. |
| **400 ppm** | Frontal headache within 1-2 hours—life threatening within 3 hours. |
| **500 ppm** | Concentration in a garage when a cold car is started in an open garage and warmed up for 2 minutes. (Greiner, 1997) |
| **800 ppm** | Healthy adults will have nausea, dizziness and convulsions within 45 minutes. Unconscious within 2 hours then death (determined in 1930). |
| **800 ppm +** | Death in less than one hour. |
| **2000 ppm** | EPA standard for new vehicle emissions. |
| **1600 ppm** | Headache, tachycardia, dizziness and nausea within 20 minutes. |
| **3000 ppm** | Death in less than 30 minutes.<br>Typical emissions from propane lift trucks, gasoline powered tools etc. |
| **3200 ppm** | Headache, dizziness and nausea in 5 to ten minutes. Death within 30 minutes. |
| **6400 ppm** | Headache, dizziness, nausea in 1-2 mins. Thinking impaired before response is possible. Convulsions, respiratory arrest, and death in <15 minutes. |
| **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:**

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| AHA | American Heart Association |
| ASHRAE | American Society of Heating, Refrig & 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 |