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DANGERS OF CARBON DIOXIDE (CO_2) Page 1 of 2.

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Health Effects of Carbon Dioxide Gas.

This document has been written by K.D. Fisher & Company Pty Ltd. It consists of selected reproductions from the CCOHS (Canada's National Occupational Health & Safety Resource), with minor Australian applications modifications. Refer to www.ccohs.ca/oshanswers/chemicals/chem_profiles/carbon_dioxide/health_cd.html

- **What are the main health hazards associated with breathing in carbon dioxide gas?**

Carbon dioxide (CO_2) is naturally present in the atmosphere at levels of approximately 0.035%, also expressed as 350 parts per million (ppm). Short-term exposure to CO_2 at levels below 2% (20,000 ppm) has not been reported to cause harmful effects. Higher concentrations can affect respiratory function and cause excitation followed by depression of the central nervous system. High concentrations of CO_2 can displace oxygen in the air, resulting in lower oxygen concentrations for breathing. Therefore, effects of oxygen deficiency may be combined with effects of CO_2 toxicity.

The Australian [NOHSC:1003(1995)] National Exposure Standards sets the STEL (Short Term Exposure Limit) at 30,000ppm (or 3%) CO_2 in air. The TWA (Time Weighted Average) limit is 5,000ppm (or 0.5%) CO_2 in air.

The STEL is a 15 minute limit for exposure. See www.ascc.gov.au/NR/rdonlyres/317D25BA-E837-4F5B-AC65-24FE588888CA/0/ExposureStandards4AtmosphericContaminants_Nov06version.pdf

Volunteers exposed to 3.3% or 5.4% CO_2 for 15 minutes experienced increased depth of breathing. At 7.5%, a feeling of an inability to breathe (dyspnea), increased pulse rate, headache, dizziness, sweating, restlessness, disorientation, and visual distortion developed. Twenty minute exposures to 6.5 or 7.5% decreased mental performance. Irritability and discomfort were reported with exposure to 6.5% for approximately 70 minutes. Exposure to 6% for several minutes, or 30% for 20-30 seconds, has affected the heart, as evidenced by altered electrocardiograms.

Workers briefly exposed to very high concentrations showed damage to the retina, sensitivity to light (photophobia), abnormal eye movements, constriction of visual fields, and enlargement of blind spots. Exposure of up to 3.0% for over 15 hours, for six days, resulted in decreased night vision and colour sensitivity.

Exposure to 10% for 1.5 minutes has caused eye flickering, excitation and increased muscle activity and twitching. Concentrations greater than 10% have caused difficulty in breathing, impaired hearing, nausea, vomiting, a strangling sensation, sweating, stupor within several minutes and loss of consciousness within 15 minutes. Exposure to 30% has quickly resulted in unconsciousness and convulsions.

Several deaths have been attributed to exposure to concentrations greater than 20%.

Effects of elevated CO_2 can become more pronounced upon physical exertion, such as heavy work.

- **What happens when carbon dioxide gas comes into contact with my skin?**

(1) **CO_2 gas is not irritating to the skin,** but CO_2 escaping from a pipework leak will cause a frostbite risk.

(2) **Contact with liquefied CO_2 can cause frostbite.** Symptoms of mild frostbite include numbness, prickling and itching in the affected area. Symptoms of more severe frostbite include a burning sensation and stiffness of the affected area. The skin may become waxy, white or yellow. Blistering, tissue death and gangrene may also develop in severe cases. **Gloves and face shield usage when handling gas reticulation is recommended.**

- **Can carbon dioxide gas hurt my eyes?**

(1) Exposure to very high concentrations of the gas may cause a stinging sensation. Inhaling of high concentrations of CO_2 has been reported to produce effects on vision. See "Health Hazards associated when I breathe in Carbon dioxide gas" above for details.

(2) Direct contact with liquefied CO_2 may cause freezing of the eye. **Permanent eye damage or blindness could result.**

- **What happens if carbon dioxide gas is accidentally swallowed (enters the digestive system)?**

(1) **No effect.** All carbonated drinks have bubbles of CO_2 emerging from the liquid. **However, ingestion of liquid CO_2 would cause severe freezing of the digestion tract with very severe and permanent damage and potential death.**

- **Is there potential for carbon dioxide gas to build-up or accumulate in my body?**

- **No.** Small amounts of CO_2 are produced during cellular metabolism and CO_2 is a normal component of the body. CO_2 is present in the blood as dissolved CO_2, carbonic acid, and the bicarbonate ion. The majority of CO_2 is excreted from the body in exhaled air.

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Personal Protective Equipment (PPE) Information for Carbon Dioxide Gas

Definitions of Abbreviations / Acronyms

SCBA = Self-Contained Breathing Apparatus.
SAR = Supplied-Air Respirator.
IDLH = Immediately Dangerous to Life or Health

- **If I need to wear a respirator, what kind should it be?**

If a CO_2 leak is detected, do not enter the confined area unless suitable Self-Contained-Breathing-Apparatus (SCBA) is worn. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection. Refer to **the Australian Standards AS1715 "Selection, Use & Maintenance of Respiratory Protective Devices"**, available from the Standards Association of Australia (www.saiglobal.com.au).

RESPIRATORY PROTECTION GUIDELINES from the USA National Institute Of Safety & Health (NIOSH):

USA NIOSH / OSHA RECOMMENDATIONS FOR CARBON DIOXIDE CONCENTRATION IN AIR: UP TO 40,000 ppm (i.e. 4%): Either full-facepiece SCBA, or SAR.

EMERGENCY OR PLANNED ENTRY INTO UNKNOWN CONCENTRATIONS or IDLH (Immediately Dangerous to Life & Health) CONDITIONS i.e. >40,000ppm or 4% CO_2: Only persons wearing positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary, positive pressure SCBA should enter.

ESCAPE: Escape-type SCBA. N.B. In most pub cellars, the exit door is close enough that rapid exit is faster than applying an escape respirator. In a large cellar, the requirement to carry an escape-type SCBA must be professionally assessed.

- **NOTE: The IDLH concentration for CO_2 is 40,000 ppm (i.e. 4%). The purpose of establishing an IDLH value is to ensure that any worker can escape from a given contaminated environment in the event of a failure of the most protective respiratory protection equipment. In the event of failure of respiratory protective equipment every effort should be made to exit immediately.**

The respirator use limitations specified by the approving agency and the manufacturer must be observed.

- **What eye / face protection is recommended for working with carbon dioxide gas?**

(1) It is good practice to avoid eye contact (causes frostbite).
A protective full-face mask (as used for grinding work) is recommended when connecting / disconnecting cylinders to reticulation pipework.

- **What skin protection measures are recommended when working with carbon dioxide gas?**

(1) It is good practice to avoid skin contact with liquified CO_2 (causes frostbite).
(2) Gloves are recommended when connecting / disconnecting cylinders to reticulation pipework. Any minor points of leakage of gas in reticulation pipework will also cool significantly to hazardous "skin-stick" temperatures.

References: Section 5 of "Carbon Dioxide Gas". Selected reproduction from the CCOHS (Canada's National Occupational Health & Safety Resource), with modifications by K.D. Fisher & Company Pty Ltd for Australian applications. In order to read the original CCOHS document, Refer to:
www.ccohs.ca/oshanswers/chemicals/chem_profiles/carbon_dioxide/health_cd.html