

Know the Risks – Work Safely with CO₂



In addition to its vital role in photosynthesis, respiration and carbon cycle, carbon dioxide (CO₂) has many industrial applications. Both solid and liquid CO₂ are used in refrigeration and cooling. In the beverage industry, CO₂ gives the fizz to the drinks and prevents bacterial and fungal growth in soft drinks, beer and wine. CO₂ is an environmentally friendly propellant in aerosols and due to its unreactive nature it is used as an inert gas in various processes, packaging and fire extinguishers, to mention some applications. CO₂ is produced in combustion processes of carbon containing material.

In addition to its excellent refrigerant properties, the safety and the non-flammable nature of CO₂ have already been realized in the early days of refrigeration. CO₂ is one of the natural refrigerants that does not harm the ozone layer and has no or negligible climate impact. CO₂ has replaced the restricted CFC, HCFC and HFC refrigerants, which cause ozone depletion and are powerful greenhouse gases.

CO₂ Exposure Limits in the Working Environment

CO₂ is a non-toxic and non-flammable gas. However, it does not support life and exposure to elevated CO₂ concentrations can induce a risk to life. The leakage of odorless and colorless CO₂ refrigerant cannot be detected without proper sensors. Although CO₂ is

considered to be a non-toxic gas, CO₂ concentration can reach dangerously high levels in poorly ventilated spaces.

There are guidelines and regulations related to the acceptable levels of CO₂ in working environments. For example, the U.S. Occupational Safety & Health Administration, OSHA, has set limitation to CO₂ exposure. The permissible

exposure limit (PEL) describes the maximum daily human exposure to a substance allowed in a workroom's air over an 8-hour shift. PEL for CO₂ is 5 000 ppm measured as time weighted average (TWA) level of exposure. In addition, the American Conference of Governmental Industrial Hygienists, ACGIH, has set the short-term exposure limit to 30,000 ppm of CO₂.

Risks of CO₂

CO₂ is always present in the atmosphere at a low level of approximately 400 ppm. However, high concentrations of CO₂ are extremely dangerous. Drowsiness is experienced under continuous CO₂ exposure at a level of 10,000 ppm (1%). At 2-3% of CO₂ heaviness in the chest is experienced and breathing becomes more frequent and deeper. Headache and sweating will also develop during the exposure. Levels above 5% of CO₂ are considered toxic. At 4-5% of CO₂, breathing becomes uncomfortable and lack of oxygen starts causing dizziness. At 6% of CO₂ the sensory processing abilities start

deteriorating after some minutes. Less than one minute of exposure to 10-15% of CO₂ results quickly in unconsciousness. When the CO₂ level is between 17 and 30%, fatal exposure occurs in less than one minute.

At all places where CO₂ gas or CO₂ ice is used, produced, shipped or stored, the levels of CO₂ can rise dangerously high and the environment must be monitored with an appropriate sensor.

Selecting the Location for the CO₂ Measurement

When measuring CO₂ for the safety of the personnel, the CO₂

transmitter should be installed as close as possible to potential leakage points for early detection. Transmitters should also be placed in all human occupied spaces. When designing the CO₂ safety monitoring solution, the geometry of the monitored area should be considered, taking into account ventilation and air flow in the space. The number and location of the CO₂ transmitters should always be based on risk assessment of the monitored area.

Learn about Vaisala's reliable and accurate CO₂ transmitters at www.vaisala.com/gmp251 and www.vaisala.com/gmp252

Typical Concentrations and Effects

Effect	CO ₂ Concentration
Typical atmosphere	350 - 450 ppm
Acceptable indoor air quality	600 - 800 ppm
Tolerable indoor air quality	1000 ppm
Average exposure limit over 8 hours	5000 ppm
Concern, short exposure only	6000 - 30000 ppm
Increased respiration and headache	3 - 8 %
Nausea, vomiting, unconsciousness	10 % +
Sudden unconsciousness, death	20 % +

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