

# Carbon Dioxide (CO<sub>2</sub>) in the Indoor Environment

## Introduction

This fact sheet provides information from the Minnesota Department of Health (MDH) on carbon dioxide sources, typical levels and health effects.

## What is carbon dioxide (CO<sub>2</sub>) and what are the sources?

Carbon dioxide is a colorless, odorless gas. It is produced both naturally and through human activities, such as burning gasoline, coal, oil, and wood. In the indoor environment, people exhale CO<sub>2</sub>, which contributes to CO<sub>2</sub> levels in the air.

## What levels of CO<sub>2</sub> are typical indoors?

The outdoor concentration of carbon dioxide can vary from 350-400 parts per million (ppm) or higher in areas with high traffic or industrial activity.

The level of CO<sub>2</sub> indoors depends upon:

- the number of people present
- how long an area has been occupied
- the amount of outdoor fresh air entering the area
- the size of the room or area
- whether combustion by-products are contaminating the indoor air (e.g., idling vehicles near air intakes, leaky furnaces, tobacco smoke)
- the outdoor concentration

Carbon dioxide concentrations indoors can vary from several hundred ppm to over 1000 ppm in areas with many occupants present for an extended period of time and where outdoor air ventilation is limited.

## Why do we measure CO<sub>2</sub>?

Carbon dioxide is often measured in indoor environments to quickly but indirectly assess approximately how much outdoor air is entering a room in relation to the number of occupants.

CO<sub>2</sub> can be measured with relatively inexpensive real-time digital air monitoring equipment. CO<sub>2</sub> measurements have become a commonly used as a screening test of indoor air quality because levels can be used to evaluate the amount of ventilation and general comfort.

Outdoor “fresh” air ventilation is important because it can dilute contaminants that are produced in the indoor environment, such as odors released from people and contaminants released from the building, equipment, furnishings, and people’s activities. Adequate ventilation can limit the build up of these contaminants. It is these other contaminants and not usually the CO<sub>2</sub> that may lead to indoor air quality problems, such as discomfort, odors, “stuffiness” and possibly health symptoms.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has developed ventilation guidelines that should maintain a comfortable environment for most occupants. The amount of fresh air that should be supplied to a room depends on the type of facility and room. For example, in elementary school classrooms, ASHRAE recommends 15 cubic feet per minute person of outdoor air (for a 1000 square foot room occupied by 35 people). In office spaces, ASHRAE recommends 17 cubic feet per minute person (for a 1000 square foot occupied by 5 people). In addition, a Minnesota Department of Labor and Industry (MNDOLI) Rule states that “outside air shall be provided to all indoor workrooms at the rate of 15 cubic feet per minute per person (MN Rule 5205.110)”.

These rates of ventilation should keep carbon dioxide concentrations below 1000 ppm and create indoor air quality conditions that are acceptable to most individuals.

## What levels of CO<sub>2</sub> are considered safe?

Carbon dioxide is not generally found at hazardous levels in indoor environments. The MNDOLI has set workplace safety standards of 10,000 ppm for an



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8-hour period and 30,000 ppm for a 15 minute period. This means the *average* concentration over an eight hour period should not exceed 10,000 ppm and the *average* concentration over a 15 minute period should not exceed 30,000 ppm. It is unusual to find such continuously high levels indoors and extremely rare in non-industrial workplaces. These standards were developed for healthy working adults and may not be appropriate for sensitive populations, such as children and the elderly. MDH is not aware of lower standards developed for the general public that would be protective of sensitive individuals.

What are the health effects of CO<sub>2</sub> poisoning?

Occupants may experience health effects in buildings where CO<sub>2</sub> is elevated, but the symptoms are usually due to the other contaminants in the air that also build up as a result of insufficient ventilation. At high levels, the carbon dioxide itself can cause headache, dizziness, nausea, and other symptoms. This could occur when exposed to levels above 5,000 ppm for many hours. At even higher levels CO<sub>2</sub> can cause asphyxiation as it replaces oxygen in the blood—exposure to concentrations around 40,000 ppm is immediately dangerous to life and health. CO<sub>2</sub> poisoning, however, is very rare.

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