



Carbon Dioxide and Carbon Dioxide Monitors – Your Questions Answered

May 2021

1. Carbon Dioxide

Carbon dioxide, known as CO₂, is a naturally occurring gas in the atmosphere and is important with regard to the environment and climate. It is generated by natural processes and human activities. Humans are one of the largest sources of indoor carbon dioxide. By breathing, the body cells take in oxygen to complete a process called cellular respiration. During this series of chemical reactions, the body produces carbon dioxide, which it releases through exhaling. Typically this carbon dioxide disperses into the air but in rooms with no ventilation the CO₂ has nowhere to go.

2. The best way to deal with carbon dioxide

The best way to reduce indoor CO₂ is to dilute it with fresh air. If a room feels stuffy, open a window to release any excess carbon dioxide. Outdoor air concentrations are approximately 400-480 parts per million (ppm).

3. CO₂ Levels and SARS-Covid -2

In the context of SARS-CoV-2 transmission, CO₂ measurements are not a reliable proxy of risk to airborne exposure to the virus (SAGE, 2020). Nevertheless, CO₂ measurements can be used to identify poorly ventilated multi-occupancy spaces. However CO₂ measurements are a less reliable measure of ventilation performance in single or low occupancy spaces or in very large spaces (SAGE UK¹, 2020, AIVC, 2021). Both the AIVC² and CIBSE³ advise that CO₂ concentrations above 1400 – 1500 ppm are likely to be indicative of poor ventilation (CIBSE, 2020, AIVC, 2021).

4. Measuring CO₂

It is possible to measure CO₂ levels with a CO₂ monitor. The use of CO₂ monitors can provide a useful general indication that areas/rooms may not be adequately ventilated and can enable occupants to become familiar with the impact that activities, outdoor weather and window openings have on levels of good ventilation within a room.

5. Different Types of CO₂ Monitors

CO₂ monitors come in many shapes and forms, it is important that they are CE Marked and that the sensor in the unit is based on non-dispersive infrared (NDIR) technology. Equivalent CO₂ sensors that estimate concentrations based on measurements of other indoor pollutants are not recommended.

6. Portable CO₂ Monitors

Many CO₂ monitors are portable and capable of working from battery and electricity. Many can be powered just like a mobile phone from a USB cable connected to a laptop/PC or mains power adaptor. They do not have to be permanently fixed in place.

Electrical powered units are preferable to battery powered units as they are capable of providing pre-set, illuminated traffic-light style indication of indoor air quality feedback without the ongoing need to replace batteries.

Portable units are also preferable, as they will facilitate measurements in a wider range of locations.

7. Frequency of checking the accuracy of CO₂ readings

It is recommended to check the sensor response weekly by measuring the CO₂ concentration outdoors, where recorded values should be approximately between 400 and 480 ppm. Measurements in rooms should be made over a minimum of 1 hour, to allow the readings to reach a steady state and to collect a representative sample of data (AIVC, 2020). Short term/spot measurements are unreliable and should not be used to interpret ventilation performance.

Measurements taken over several days or weeks can enable occupants to become familiar with the impact of activities and outdoor weather conditions on ventilation and could be used to inform a strategy for improved ventilation.

8. Locating CO₂ monitors

Human exhaled breath contains high concentrations of CO₂ and measurements should therefore be made at least 0.5 metres away from people. Similarly, as outdoor air contains approximately 400 - 480 ppm of CO₂, indoor measurements should not be made near windows or ventilation grilles.

It is not recommended to use CO₂ measurements as an indicator of room/building ventilation when there are CO₂ sources present other than people, such as cooking and bunsen burners.

9. Safe CO₂ readings

In the context of SARS-CoV-2 transmission, CO₂ measurements are not a reliable proxy of risk to airborne exposure to the virus (SAGE, 2020). Both the AIVC and CIBSE advise that CO₂ concentrations above 1400 – 1500 ppm are likely to be indicative of poor ventilation (CIBSE, 2020, AIVC, 2021).

Where the ventilation is controlled by the occupant (for example, by opening windows in naturally ventilated rooms), CO₂ sensors can provide information to occupants to indicate poor ventilation.

10. Action to take if the CO₂ reading is above 1400-1500 ppm

Increase ventilation by opening doors and windows to address high CO₂ levels. The *Practical Steps for the Deployment of Good Ventilation Practices in Schools* provides guidance on how this should be achieved.

11. CO₂ readings in small and large rooms

In general the lower the reading the better the ventilation in the room.

CO₂ measurements can be used to identify poorly ventilated multi-occupancy spaces.

CO₂ measurements are a less reliable measure of ventilation performance in single or low occupancy spaces or in very large spaces (SAGE UK, 2020, AIVC, 2021).

1. SAGE UK is a Scientific Advisory Group for Emergencies providing scientific and technical advice to support UK government decision makers during emergencies.

2. The Air infiltration and Ventilation Centre (AIVC) is the International Energy Agency's information centre on energy efficient ventilation.
3. CIBSE: Chartered Institute of Building Services Engineers