

WHITEPAPER

Complying With Indoor CO2 Monitoring Regulations

Indoor Air Quality Legislation

It is a well-established fact that indoor carbon dioxide (CO₂) levels can cause a variety of health problems, including respiratory ailments, headaches, dizziness and fatigue(1). These changes can occur in concentrations as low as 500 ppm, not far above the typical outdoor 'fresh air' level around 400 ppm. Indoor CO₂ levels can also be used as a proxy to indicate the standard of ventilation, a key factor in preventing the spread of airborne diseases (2).

In order to avoid long-term health effects on building occupants and visitors, many governments around the world have enacted, or are considering, legal requirements for monitoring indoor CO₂ levels in offices, factories, schools and other workplaces, including the USA(3), UK4, Japan(5) and Germany(6).

For example, in the UK the Building Regulations (2010), which support the Health and Safety at Work Act (1974), require that action should be taken if indoor CO₂ concentrations exceed 1500 ppm, with 800 ppm recommended for areas where there are high levels of physical activity. This legislation also specifies desirable characteristics for CO₂ monitors, methods for taking accurate CO₂ measurements, and recommended actions to reduce indoor CO₂ levels.

CO₂ Monitor Requirements

There are many different makes and models of CO₂ monitor available, but many are unsuitable for accurate monitoring of indoor concentrations.

- Indoor CO₂ levels can vary from as low as 400 ppm to over 5,000 ppm, and so as a minimum the monitor should measure between these limits.
- The monitor should directly measure CO₂ itself, not provide an estimated CO₂ reading based on a different factor such as oxygen levels.
- The monitor must be calibrated, to ensure accurate readings, and it should only be used within the recommended calibration period. Monitors that can self-calibrate will save users time and money.





Best Practice for Using CO2 Monitors

It is vital that readings taken accurately represent the concentration of CO2 that users of a building will experience.

- A separate monitor should be located in each room or working area.
- Monitors should be positioned around head height, at least 0.5m away from occupants, to avoid directly measuring exhaled breath which will give misleadingly high readings.
- Monitors should also be placed away from windows, doors, ventilators or air conditioners, to avoid misleadingly low readings in those localised areas.
- Measurements should be taken at key times through the working day, frequently enough to capture changes in use or occupancy levels over time.
- Records should be kept, to allow analysis and understanding of long-term trends. The most effective way to do this is to use a data logging CO2 monitor that not only takes measurements but automatically stores them, for example via a Cloud data service

Action to Reduce CO2 Levels

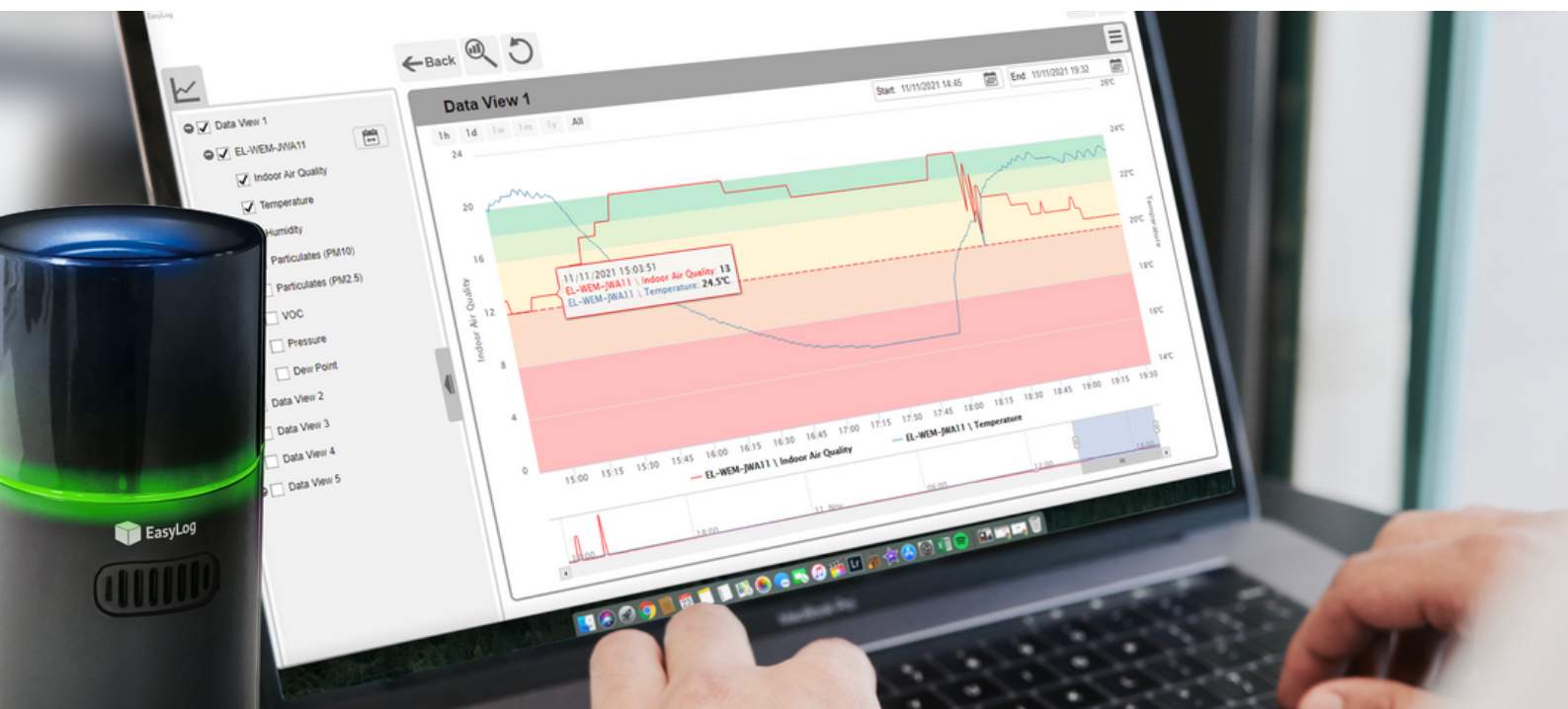
It is incumbent upon those responsible for occupied indoor spaces to not only measure CO2 concentrations, but also to reduce them to recommended levels. To do this effectively requires both top-down and bottom-up action, and so the results of monitoring should be discussed with everyone who has responsibility for the way indoor spaces are used and managed, as well as regular users.



- Improve natural ventilation by fully or partly opening windows, air vents and doors, but never prop fire doors open. It can be good practice to fully air a room whenever it is unoccupied.
- Use mechanical ventilation, including fans and air conditioning, to bring fresh air into a building from outside. Don't lower mechanical ventilation rates if the number of people in an area reduces temporarily, ventilation rates should be based on the maximum 'normal' occupancy of an area.
- Where possible, reduce occupancy levels in rooms or areas with poor ventilation, for example by staggering working times to decrease the peak number of users.
- Consider the way in which an area is utilised: one used for exercise, sport or singing will need higher levels of ventilation to keep CO2 concentrations within recommended limits.

Ensuring the health and well-being of buildings users is an ongoing duty, and so even when CO2 levels have been reduced to recommended levels, monitoring must continue as conditions will often change throughout the year.

Finally, aside from fulfilling legal requirements, CO2 monitoring can play a key role in building maintenance, as any failure or fault with ventilation and air conditioning systems will quickly be revealed in measured CO2 data.



References

1. 'Effects of low-level inhalation exposure to carbon dioxide in indoor environments: A short review on human health and psychomotor performance', by Kenichi Azuma, Naoki Kagi, U. Yanagi and Haruki Osawa, 30th August 2018 '
2. 'Predictive and retrospective modelling of airborne infection risk using monitored carbon dioxide', by Henry C. Burridge, Shiwei Fan, Roderic L. Jones, Catherine J. Noakes and P. F. Linden, 28th September 2021 '
3. 'Indoor Air Quality in Commercial and Institutional Buildings', Occupational Safety and Health Administration, 2011 '
4. 'The Building Regulations', UK Government, 2010 '
5. 'Ventilation Required for Indoor Air Quality', Air Conditioning and Sanitary Engineering Society, October 31st 2016 '
6. 'Indoor Air Guide Values', German Committee on Indoor Air Guide Values, January 7th 2022