



Llywodraeth Cymru
Welsh Government

Covid infection risk control and improving ventilation

Carbon dioxide monitors in education settings

‘How to use’ guide for carbon dioxide monitors as an aid to managing ventilation in education settings.

Guidance

Guidance document no: 273/2021

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Carbon dioxide monitors in education settings

Audience	This guidance is aimed at schools, further education and higher education institutions.
Overview	The guidance will assist in the use of carbon dioxide monitors in learning spaces to support the management of ventilation.
Action required	The guidance can be used in all education settings utilising carbon dioxide monitors.
Further information	Enquiries about this document should be directed to: Education Business Planning and Governance The Education Directorate Welsh Government Cathays Park Cardiff CF10 3NQ Tel: 03000 257672 e-mail: 21stcenturyschools@gov.wales
Additional copies	This document can be accessed from the Welsh Government's website at Home GOV.WALES
Related documents	Local COVID-19 infection control decision framework for schools from autumn 2021 https://gov.wales/sites/default/files/pdf-versions/2021/8/5/1630058044/local-covid-19-infection-control-decision-framework-schools-autumn-2021.pdf Safe operation guidance: post-16 learning providers Safe operation guidance: post-16 learning providers GOV.WALES

Mae'r ddogfen yma hefyd ar gael yn Gymraeg.
This document is also available in Welsh.

Contents

1. Introduction	2
2. Where should you use CO ₂ monitors?	3
3. Placement of monitors and measuring	4
4. Understanding readings	5
5. Risk Assessments	6
6. Improving ventilation	7
7. Q and A	9
8. Quick guide	10

1. Introduction

This guidance sets out how education settings can use Carbon Dioxide (CO₂) monitors as an aid for the management of ventilation. The guidance will be dynamic in nature thus being kept under review during its implementation. The guidance should be read in conjunction with the decision framework and risk assessment for your location.

The requirement to take reasonable measures applies in a very broad range of circumstances, including every kind of workplace which is open. This includes for example; public services, health and social care premises, **schools and childcare settings, higher education, further education settings (including training centres and adult learning)**, call centres, hospitality businesses, travel and holiday accommodation, voluntary services, commercial and industrial premises, construction sites and other open sites such as roadworks and outdoor places including livestock markets.

The duty in law to take reasonable measures applies to the person or persons responsible for premises open to the public and on the person responsible for the work being undertaken in any workplace; that is the person responsible for management control of the premises.

It is the responsibility of those in control of premises (head teachers/principals etc.) to ensure good levels of ventilation are maintained in buildings. For schools, local authority estates and corporate health and safety teams should be contacted for support. Colleges and universities should work with their estates/facilities management and corporate health and safety teams. For non-state maintained childcare settings, owners should work with their own health and safety advisor and facilities management provider.

Good ventilation can help reduce the risk of spreading coronavirus, so a focus on improving general air flow, preferably through fresh air or effective mechanical systems, can help to create a safer environment for staff, pupils and students. You can generally maintain and increase the supply of fresh air by simply opening windows and doors – although internal fire doors must remain closed unless connected to a device that causes them to self-close upon activation of the fire alarm.

People exhale carbon dioxide (CO₂) when they breathe out. If there is a build-up of CO₂ in an area it can indicate that ventilation needs improving. You can use CO₂ monitors to help you:

- identify areas of poor ventilation; and
- gauge how much you need to open the windows or improve mechanical ventilation (including air conditioning).

It is **important to remember that CO₂ monitors are an indicator of ventilation status and not infection risk.**

There are many different types of CO₂ monitors available. The most effective portable devices to use are non-dispersive infrared (NDIR) CO₂ monitors. This is the type provided by the Welsh Government to state funded education settings over the autumn term 2021.



The monitors allow for assessment of ventilation in spaces and informs their risk assessment with regard to ventilation.

The CO₂ monitors provided by the Welsh Government are Rototherm AM60 units. This guidance should be read in conjunction with the Instruction Manual provided with this unit.



Other CO₂ monitors may be used to follow this guidance but care must be taken to ensure any differences in units are taken into account.

Estates and/or facilities management teams must ensure CO₂ monitors are maintained and calibrated in accordance with the Instruction Manual provided.

2. Where should you use CO₂ monitors?

CO₂ monitors are best suited to spaces which are densely occupied for approximately one hour or more.

In education and childcare settings this includes, but is not limited to:

- ✓ teaching spaces (including lecture rooms, classrooms and practical teaching spaces)
- ✓ indoor play spaces (e.g. rooms in nurseries)
- ✓ staff rooms, large offices, meeting rooms, group or breakout rooms

Monitoring is not recommended for use in areas where CO₂ monitors are unlikely to give reliable readings, including:

- ✗ large, open internal spaces and spaces with higher ceilings, such as sports halls or atriums
- ✗ spaces that are densely occupied for shorter periods, such as corridors or lobbies
- ✗ areas with low occupancy density including kitchens and toilets, or offices with one or two occupants

Rooms that already have CO₂ monitoring integral to their building management system may not require additional standalone monitors. Your estates or facilities management team should know if monitoring is already in place.

3. Placement of monitors and measuring

Placement

When deciding where to place monitors, you should initially prioritise spaces that feel constantly stuffy or persistent smell as these are likely to be under-ventilated. Using a monitor in these spaces first can help you prioritise action effectively. You should place CO₂ monitors:

- at head height when seated
- away from ventilation outlets, such as grilles or windows
- at least 0.5 m away from occupants (closer than this could give inaccurate readings)

If your measurements in an occupied space seem very low (far below 400ppm) or very high (over 1500ppm), it's possible your monitor is in the wrong location and you should move it to another location in the space to get a more accurate reading.

Monitors should be placed where the display can be seen by a member of school staff so that they can identify if the display colour changes to amber or red.

Measuring

- After 3 minutes warm-up the monitor provided by the Welsh Government will be ready for use.
- When to measure: Depending on how the room is being used, staff should check the measure shown on screen at the beginning of class and at the end and monitor this. Staff may wish to check mid-way if for instance, the class is over an hour duration. There should be no need to interrupt a lesson to take a reading.
- You may also wish to monitor more frequent measurements in situations whereby the 1500ppm is observed to be exceeded frequently. These measurements will help inform the average CO₂ levels across the day.
- Measuring need only be carried out in occupied rooms.

Rotation of monitors (if required)

You can rotate monitors around the building and the spaces that are suitable for monitoring, so that you can identify ventilation needs across your setting. Rooms should be monitored for at least one full day before rotating them to a different space. You can keep your rota simple: start with potentially under-ventilated rooms as set out above and then move your monitors to other rooms (prioritise those most used/with the highest occupation density).

If you find that rooms are consistently well ventilated there is no need to continue keeping them on your rota for monitoring CO₂ levels unless occupancy or use of room is changed. If placed in a new room, the monitor might need to refresh (produce a new measure) a few times before settling on a new reading.

4. Understanding readings

The amount of CO₂ in the air is measured in parts per million (ppm). A consistent value under 800ppm, indicated by a green light, does not require any action and implies that a space is well ventilated. Background ventilation should still be provided in order to maintain good air quality.

A value over 800ppm indicated by an amber light should be seen as an indicator of inadequate background ventilation and a need to increase the ventilation further. If not done so already, you should start to improve ventilation by simply opening windows and/or doors (fire doors must remain closed unless connected to a device that causes them to self-close upon activation of the fire alarm) or increasing the levels of mechanical ventilation.

A consistent value of over 1500ppm CO₂ concentration indicated by a red light in an occupied space is an indicator of poor ventilation. You should take action to improve ventilation where CO₂ readings are consistently higher than 1500ppm as described in section 6 -Improving ventilation.

In summary

LESS THAN 800 PPM	800 PPM TO 1500 PPM OCCASIONALLY	800 PPM TO 1500 PPM CONSISTENTLY	OVER 1500 PPM
<ul style="list-style-type: none"> No action required as this is an adequate level of ventilation. Continue monitoring If levels start to increase this is an early indication that ventilation may need to be increased Background ventilation should always be maintained 	<ul style="list-style-type: none"> Increase ventilation by simply opening windows and doors (fire doors should not be left open unless connected to a device that causes them to self-close upon activation of the fire alarm) Purge before and after each lesson by simply opening all windows and doors fully for up to ten minutes Limit learner number where possible Move high level activities such as dance, music or physical activities to well ventilated spaces 	<ul style="list-style-type: none"> Report to estates or facilities management or person responsible for the building to; Increase the rate delivered by mechanical ventilation (including air conditioning) units will help to optimise the efficiency of them and this is likely to reduce running costs. Extend timings of mechanical ventilation (including air conditioning) units to purge air before and after lessons Check and clean all local mechanical ventilation Consider whether additional measures and/or interventions could help 	<ul style="list-style-type: none"> Consult with estates or facilities management or person responsible for the building to consider introducing additional mechanical or natural ventilation best suited to the individual location. Purge ventilation will be necessary as soon as possible

Remember to look out for consistently high values: Because many factors influence the level of CO₂ measured in a space, a single snapshot reading is unlikely to be reliable. We therefore recommend waiting for 5 minutes before retaking a high reading, to allow for the monitor to settle. Measurements within a space can vary during the day due to changes in numbers of occupants, activities, or ventilation rates. Doors and windows being open or closed can also have an effect.

Instantaneous or 'snapshot' CO₂ readings can be misleading, so you should take several measurements throughout the day frequently enough to represent changes in use of the room or space. Then calculate an average value for the occupied period.

You may need to repeat monitoring at different times of the year as outdoor temperatures change and this will affect behaviour relating to opening windows and doors when your space relies on natural ventilation.

Your readings will help you decide if a space is adequately ventilated.

5. Risk assessments

The use of CO₂ monitors and any associated risk assessments for ventilation should be taken in conjunction with Welsh Government's published *Local COVID-19 infection control decision framework for schools from autumn 2021*.

Your setting risk assessment should cover identifying any poorly ventilated spaces, including through the use of CO₂ monitors if available. If you do not already address ventilation in your assessment, you should add this as soon as you receive your CO₂ monitors.

You should consider in your risk assessments the potential for certain activities to affect CO₂ levels e.g. singing, shouting, physical exercise, use of gas appliance such as cooking or Bunsen Burners in science labs.

You should note that health and safety law says that employers, including education and childcare settings which are the employers for their settings, must take reasonable measures to ensure there is an adequate supply of fresh air (ventilation) in enclosed areas of the workplace. This has not changed during the COVID-19 pandemic.

To whom does the legal requirement apply?

The requirement to take reasonable measures applies in a very broad range of circumstances, including every kind of workplace which is open. This includes for example; public services, health and social care premises, schools and childcare settings, higher education, further education settings (including training centres and adult learning), call centres, hospitality businesses, travel and holiday accommodation, voluntary services, commercial and industrial premises, construction sites and other open sites such as roadworks and outdoor places including livestock markets.

The duty in law to take reasonable measures applies to the person or persons responsible for premises open to the public and on the person responsible for the work being undertaken in any workplace; that is the person responsible for management control of the premises.

6. Improving ventilation

Where CO₂ readings are between 800ppm and 1500ppm small interventions such as opening windows and doors should be adequate to bring levels below 800ppm. High level open windows will provide ventilation without causing draughts. It is important to remember that a small amount of continuous background ventilation should always be maintained, even when monitors display levels below 800ppm.

Other local interventions to consider:

- purge the classroom before and after each class / lesson by simply opening all windows and doors fully for up to ten minutes
- having doors or windows at opposite ends or sides of classrooms open rather than just one or two centrally will provide better air flow circulation
- limit learner numbers where possible
- in further or higher education provide comfort breaks during longer lessons
- move activities such as dancing or singing to larger and/or better ventilated spaces
- where windows are sealed or difficult to open, or air vents are blocked, this should be remedied as soon as possible through your estates or facilities management. For schools, this will be your local authority

Where readings still remain between 800ppm and 1500ppm despite local interventions you should consult your estates or facilities teams (or person responsible for the building) to consider such things as:

- ensuring regular maintenance (including filter changes) and running of mechanical; ventilation (including air conditioning) will help to optimise the efficiency of them and this is likely to reduce running costs;
- extend timings of mechanical ventilation (including air conditioning) to purge air before and after lessons;
- check, clean and increase ventilation rates of all local mechanical ventilation (including air conditioning); and
- consider whether additional measures and/or interventions could help.

Additional ventilation, mechanical or natural, should be considered if the readings are consistently over 1500ppm, and your estates or facilities teams (local authority for schools) should advise on the best solution to each individual case. In the interim, you should consider moving to other rooms, repurposing space elsewhere in the estate or limiting numbers.

Levels of above 1500ppm are a sign of poor ventilation and should be addressed as part of your workplace/teaching space assessment.

Care needs to be taken of draughts from open windows or doors causing hazards, particularly in Science and Design and Technology classrooms in secondary schools. Having doors open may pose safeguarding and security issues. Purge ventilation between lessons or mechanical ventilation may be required for such areas, and form part of the school's risk assessment.

Comprehensive advice on how to improve ventilation in your setting is available from Public Health Wales, and the Health and Safety Executive. Details can be accessed via:

- Public Health Wales's (PHW) guidance on ventilation of indoor spaces to stop the spread of coronavirus (COVID-19)

[Ventilation and Air Conditioning - Public Health Wales \(nhs.wales\)](https://www.nhs.uk/ventilation-and-air-conditioning)

- The Health and Safety Executive's (HSE) guidance on ventilation and air conditioning during the coronavirus (COVID-19) pandemic

[Ventilation and air conditioning during the coronavirus \(COVID-19\) pandemic \(hse.gov.uk\)](https://www.hse.gov.uk/ventilation-air-conditioning)

7. Questions and Answers

Question: My CO₂ monitor delivery hasn't arrived, what can I do?

Answer: For schools please contact your local authority and for colleges and universities please contact your estates or facilities management team. They will be able to assist on all questions relating to deliveries.

Question: My CO₂ monitor is faulty, what can I do?

Answer: Please contact the supplier of your device directly. For Welsh Government supplied units this will be Lyreco via their Corporate Account Manager Milena-Jane Thomas milena.thomas@lyreco.com ; they will be able to assist on all questions relating to faults.

Question: I haven't got enough CO₂ monitors, how can I access more?



Answer: You will receive roughly one device per classroom. We recommend creating a rota plan and move monitors around the premises, if needed. If you have fewer devices than this and you suspect there has been a mistake please get in touch with the 21st Century Schools and Colleges team.

Question: I have taken the suggested remedial actions but my CO₂ monitor is still persistently reading over 800ppm, what should I do?

Answer: We expect the vast majority of fixes to be relatively minor, however if levels are consistently over 800ppm you should consult with your estates or facilities team (local authority for schools) to review remedial options.

Question: I already have CO₂ monitors in my education settings, should I continue to use them?

Answer: Yes, if you already have CO₂ monitors installed you should continue to use them. Any additional CO₂ monitors you receive can be used to check rooms that are not fitted with monitors.

VENTILATION IN EDUCATION SETTINGS Carbon Dioxide (CO₂) monitors as an aid to managing ventilation in education settings		 	
Quick guide to actions to take at different CO ₂ levels			
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