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| Ventilation in Prisons and Approved Premises during COVID-19 Operating Conditions Guidance  |
|  |
| **November 2021** Version 4 |

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**Preface**

Current guidance from Public Health (PH) and World Health Organisation (WHO) highlights the importance of good ventilation within buildings to reduce the risk of COVID-19 Transmission. However the principles in this document may be applied to a wider range of airborne communicable diseases.

Building ventilation is an important part of a healthy building environment as it ensures a steady stream of outside air brought into the building whilst stale air is exhausted. The maintenance of a supply of fresh air is important as a means of diluting and or replacing any contaminant, be it COVID-19 or otherwise. Hence the need to introduce fresh air and to avoid recirculating contaminated air and possibly progressively increasing concentrations of contaminants.

Whilst good hand hygiene practiced regularly, respiratory and cough hygiene, robust cleaning regimes and maintaining social distancing are the most effective lines of defence for infection control during COVID-19, evidence suggests that in poorly ventilated indoor spaces infected airborne aerosols (virus droplets) can remain in the air for longer and be a possible transmission route. (**See Annex 5**)

To reduce this risk, it is important that we maintain the best possible ventilation as part of the COVID-19 strategy.

This guidance is underpinned by the current guidance on transmission risk (PHE/NHS Covid 19 Infection Prevention and Control Guidance and CIBSE Covid-19 Ventilation Guidance: 23rd October 2020 & EMG role of ventilation in controlling SARS-CoV-2 Transmission SAGE-EMG.

HMPPS will continue to review guidance in-line with Public Health Authorities advice.

1. **Introduction**

Ventilation can be provided through a number of processes, including mechanical ventilation using fans and ducts, natural ventilation which relies on passive flow through openings (doors, windows, vents), or a combination of the two.

Except in fully mechanically ventilated buildings, user interaction with ventilation provision will have a major impact on its effectiveness. Buildings users, often driven by thermal comfort are generally unaware of air quality issues except in extreme situations. A number of studies show that actions such as opening windows are carried out in response to feeling warm rather than awareness of indoor air quality. In cold, wet or windy weather people may feel more reluctant to open windows or doors, which helps maintain good levels of ventilation. People may adjust or block ventilation supplies, including covering grilles and vents if they experience cold drafts.

Where ventilation in a building or room is poor and/or mitigating factors are not in place, there is an increased risk of transmission particularly in;

* Multi occupancy spaces, which are regularly occupied with a high level of occupancy
* Healthcare and dentistry settings with an enhanced aerosol generation risk due to aerosol generating procedures.
* Activities that make you breathe more deeply, for example aerobic exercise, shouting or singing will increase the generation of aerosol droplets. These activities increase transmission risk even in areas with adequate ventilation. If possible, these activities should be avoided or redesigned to reduce the risk, for example moving activities outside where possible.

Priority should be given to improving ventilation of spaces which are most likely to result in a high transmission rate such as those highlighted above where ventilation rates are very low, and where the use of that space cannot be delivered differently or accommodated elsewhere.

Measures to improve ventilation will be dependent on the particular setting, it is not possible to give a one fits all solution or a simple rule that everyone can follow. Any changes to ventilation must consider other negative consequences such as noise, security and health and wellbeing impacts from thermal discomfort.

**1.1** Further information on COVID ventilation guidance from CIBSE, SAGE and HSE can be found at;

* <https://www.cibse.org/coronavirus-covid-19/emerging-from-lockdown#1>
* <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/928720/S0789_EMG_Role_of_Ventilation_in_Controlling_SARS-CoV-2_Transmission.pdf>
* <https://www.hse.gov.uk/coronavirus/equipment-and-machinery/air-conditioning-and-ventilation.htm>
* [Research and analysis overview: EMG and SPI-B: Application of CO2 monitoring as an approach to managing ventilation to mitigate SARS-CoV-2 transmission, 27 May 2021 - GOV.UK (www.gov.uk)](https://www.gov.uk/government/publications/emg-and-spi-b-application-of-co2-monitoring-as-an-approach-to-managing-ventilation-to-mitigate-sars-cov-2-transmission-27-may-2021)
1. **Risk Assessment Process**

2.1 Within the Risk assessment process;

* Health and Safety Teams will provide professional support as required.
* Prison Maintenance Group will provide technical data relating to the built environment, service information and advice relating to remedial works.

2.2 Whilst the local risk assessment will assess all practical options and opportunities to enable the use of key spaces, it may be necessary in extreme circumstances for certain areas and/ or specific rooms within the building not to be used. Before space in a building is deemed unusable due to poor ventilation, the following guidance should be considered, and an appropriate assessment of that space made to ensure rooms or areas of a building aren’t put out of use unnecessarily. (See **Annex 1, 2 and 4**)

2.3 It may be necessary to consult with the FM provider to gain specialist advice on ventilation to ensure the existing ventilation/ air changes are adequate particularly where there is an increased risk due to an activity involving AGP i.e., within Healthcare and Dental Suites.

2.4 The larger the area, the lower the risk. This is because larger areas:

* have more air to help dilute the virus
* tend to be designed with higher ventilation rates
* mean it takes longer for aerosols to build up

2.5 Where ventilation is poor, it may be necessary for additional measures to be implemented to mitigate the risk taking into account the nature of the building and users (for example – limiting the amounts of people present in poorly ventilated areas). There are some simple ways to identify poorly ventilated areas:

* Look for areas where there is no mechanical ventilation or no natural ventilation, such as lack of open windows, doors or vents etc.
* Identify areas that feel stuffy or smell badly
* Check that mechanical systems provide outdoor air, temperature control or both. If a system (e.g., a local air conditioner) is recirculating only and doesn’t have an outdoor air supply, or a separate source of outdoor air, the area is likely to be poorly ventilated.

2.6 Where there may need to be financial or technical support to improve ventilation, further advice and support should be obtained from site Area Property Operations Manager (HMPPS) especially in connection with repairs, maintenance, upgrading etc. who will manage the necessary arrangements with the FM Provider.

2.7 As part of the risk assessment process, consideration should be given to the following: -

* Creating air circulation that provides fresh air i.e., opening windows, trickle vents and doors (this should not include propping fire doors open) when practical during the day to ventilate internal spaces.
* It is important not to close windows or doors completely when people are using or occupying a naturally ventilated area. This can result in very low levels of ventilation.
* Lower temperatures and windy weather conditions in the winter months will increase natural ventilation through openings. This means windows and doors don’t need to be opened as wide.
* Use of fire engineering natural ventilation system to ventilate and aid air exchange within the space for a short period of time.

**NB** Mechanical Fire Engineering ventilation systems should not be used for the purpose of aiding ventilation outside of its designed function.

* Use of Tactical fans to aid air change (see point 6.5)
* Use of local air cleaning and filtration units to reduce airborne transmission where it isn’t possible to maintain adequate ventilation.
* Design layout; situating staff out of direct line of draughts; prioritising the opening of high-level windows or vents (not low level) where possible so that incoming air is warmed as it flows down onto the room thereby reducing cold draughts.
* Use of heating systems and portable heaters to balance thermal discomfort where natural ventilation is required to support air flow during winter conditions. (See 2.10)
* The choice of room for meetings/group sessions with access to external windows/vents where possible
* Timings of sessions to maximise periods of air circulation/venting of the space before re occupation
* Minimising the number of people and time spent within a room particularly those with limited ventilation. The more people who use or occupy an area the greater the risk that an infected person is there, increasing possible exposure to aerosol transmission. Reducing the number of people who use or occupy an area reduces this risk.
* Use of desk fans to aid air circulation (see point 6.6).
* Use of face masks in line with the HMPPS staff and prisoner face masks strategies
* Maintaining physical distancing measures applicable to the local COVID risk (where possible) and in accordance with HMPPS Operational Guidance and Safe Operating Procedures
* Use of fixed screens or barriers to separate people from each other
* Good hand hygiene (practised regularly)
* Robust cleaning regimes
* Robust Track and Trace system and COVID Testing
	1. Fire doors should not be propped open to aid ventilation without seeking advice from the Health, Safety and Fire Team or Health and Safety point of contact for the site.
	2. Cross ventilation, where air travels from one occupied room /zone into another, should be avoided, if possible, by keeping internal partition doors closed.

2.10 Where a room only has one side with windows/vents that can be opened, consideration must be given to areas within the room where air may become stagnant and not circulated. It may be necessary to use a recirculation unit or fan at the back of the room to enhance air distribution and reduce the risk of stale air.

2.11 Fan convector heaters should only be used in well ventilated areas. Where portable heaters are provided consideration must be given to the introduction of further hazards i.e., trips caused by trailing cables, fire risk/ overloading electrical systems and sockets, requirements for PAT testing and approved purchase requirements in line with HMPPS policy.

1. **CO2 Monitors**

The use of CO2 monitors does not remove the need for other controls to be in place as identified by risk assessment.

The use of carbon dioxide (CO2) to monitor occupant generated CO2 can only be used to provide an indication of the air quality in a room and/or effectiveness of ventilation in a setting.

CO2 levels are not a direct measure of infection risk and the concentration of CO2 in a space does not give a direct measure of safety from an infection control perspective, it is a means to guide additional actions which may be needed to manage ventilation and occupancy.

All possible controls identified by risk assessment should be considered before the introduction of CO2 monitoring is considered. Please refer to **Annex 2** Hierarchy of Control and **Annex 4** Ventilation Process Flowchart for further information.

The most appropriate portable devices to use in the workplace are non-dispersive infrared (NDIR) CO2 monitors.

3.1Where CO2 monitors will be less effective

CO2 monitors are less effective in areas used by few people, they are also not suitable for use in areas where air cleaning units such as HEPA filtration are used to provide ventilation. This is because filtration units remove contaminants (such as coronavirus) from the air but do not remove CO2.

**Annex 3** provides examples of spaces where monitors may be useful.

3.2 Where to place a CO2 monitor

CO2 levels vary within a space 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.

The accurate use of C02 monitors relies on being placed in the correct place in rooms suited to their use and where other direct mitigations may not sufficiently lower the risk.

Monitors should be positioned;

* Away from windows, doors, or air supply openings.
* At head height standing within occupants breathing zone (consider if occupants will be mainly sitting or standing).
* At least 50cm away from people as their exhaled breath contains CO2. If your monitors are too close, they may give a misleadingly high reading.
* Larger spaces may require more than one sampling location. Specialist advice should be sought when considering where to site monitors in these spaces.

3.3 Measuring the CO2 level

It is important to know how to use the portable monitor correctly, including the time needed to provide a reading.

The room should be set up for use with the CO2 monitor positioned in a suitable location, with the identified controls and occupancy levels identified by risk assessment.

Many factors influence the level of CO2 measured in a space so monitors should be used as a broad guide to the environment rather than to define specific “safe” thresholds.

Instantaneous or ‘snapshot’ CO2 readings can be misleading, multiple readings should be taken for a minimum of one full working day to ensure the readings taken represent normal use and occupancy. A log should be used to record the date, CO2 readings taken, number of occupants and type of ventilation used at the time. An average per day should be calculated to provide a baseline indicator of CO2 levels which will help determine if the control measures in place are working effectively and the space is adequately ventilated.

A copy of the CO2 monitoring undertaken should be attached to the risk assessment.

3.4 Interpreting CO2 monitoring data

The amount of CO2 in the air is measured in parts per million (ppm). If the measurements in an occupied space seem very low ( below 400ppm) or high (over 1500ppm), it’s possible the monitor is in the wrong location and needs to be moved to another location in the space to get a more accurate reading. If CO2 readings don’t change through the course of the day, this could indicate the monitor is not working correctly.

A consistent CO2 value around 800ppm is likely to indicate that a space is well ventilated but does not mean that an environment is risk free of COVID-19 risks.

Readings which vary quite rapidly and extensively over short periods of time are not to be unexpected given the dynamic nature of room use and ventilation and longer term averages of readings are the best determinant of overall ventilation effectiveness.

Sustained high CO2 values over 1500ppm are likely to indicate overcrowding or poor ventilation with further mitigating actions likely to be required. i.e., reduce occupancy, increase ventilation, reduce ,duration of the session, use of face coverings.

**NB** CO2 concentrations will rise in a room even when occupants are wearing face coverings, but the face coverings will reduce the emission of the virus.

 3.5 Review and monitor CO2 Levels

Should changes be made to the identified controls with additional controls implemented or identified controls changed i.e., windows not opened, occupancy increased, change in task, duration of session increased etc a retest (point 3.3) to capture the average CO2 levels should be completed.

You may need to repeat monitoring at different times of the year particularly if your space relies on natural ventilation. As outdoor temperatures change this may affect occupant behaviour i.e. windows and doors may not be opened which could reduce the air exchange. (Refer back to **Annex 2 and 4)**

1. **Air Cleaning Devices**

Air cleaning devices are not a substitute for ventilation and should never be used as a reason not to optimise all available ventilation and utilise other controls, nor to reduce ventilation. All occupied spaces must have some background ventilation to be suitable for occupancy. Ventilation should be assessed, and if possible improved, first before considering whether there is a need to use an air cleaner.

The air cleaning/filtration units should be appropriate for the size of the area it’s used in to ensure it works in the way it’s intended to.

Carbon dioxide (CO2) monitors are not suitable for use in areas that rely on air cleaning units. This is because air cleaning/filtration units remove contaminants (such as coronavirus) from the air but do not remove CO2.

**5. Prison Dentistry**

5.1 Within dental suites there is an increased risk of airborne aerosols created during aerosol generating procedures (AGP’s) using high speed devices, for example ultrasonic, for example ultrasonic scalers and high-speed drills where high velocity air and water streams are used. These aerosols can remain suspended in the air, may travel over a distance and may cause infection if they are inhaled during the treatment of someone who is suffering from an infectious disease transmitted wholly or partly by the airborne or droplet route.

5.2 UK building regulations recommend whole building ventilation to be 10 l/s/person and current healthcare guidance for new buildings and major refurbishments specifies that a treatment room should have at least 10 air changes per hour (ACH).

5.3 Dental providers must as part of the risk assessment process identify if existing air changes within the treatment room/s meet the requirements of the current UK healthcare guidance and legislation.

5.4 The following stepped process should be followed by dental providers when considering the ventilation characteristics of the prison dental suite.

* Where safe ventilation to an outside space is present and mechanical means of extraction and refresh are known, these should be recorded on the Workplace Risk Assessment along with any deficit according to the required standard noted in the guidelines and advice notes set out in point 5.5.
* Air change rates can be sought from O&M Manuals, Technical Manuals or through Technical Assessment (via the Site Delivery Manager).
* Where information (calculation /assessment) of air change rates is not available then the dental provider should contact the Regional Estates Manager (REM) who will arrange for the information to be provided or for measurement to be calculated.
* Where a deficit in ventilation has been identified and of a review of local management and operational practices have failed to identify a solution which would allow the service to continue; the dental provider should confirm this deficit in writing to the REM.
* The REM will complete an assessment of the deficit utilising the air change calculation, developing options for rectification and confirming the recommended solution *to PMG Senior Management, Governor and the PGD*.
* Following this the REM will complete and submit the necessary business case for the required works and will manage these through the approval process, procurement and delivery.

5.5 COVID guidance for Prison Dentistry including consideration of AGP’s and ventilation requirements has been issued by DHSC, PHE and NHS E and can be found at;

* [Mitigation of Aerosol Generating Procedures in Dentistry – A Rapid Review (PDF)](https://www.sdcep.org.uk/wp-content/uploads/2020/09/SDCEP-Mitigation-of-AGPS-in-Dentistry-Rapid-Review.pdf)
* [SBAR Ventilation, water and environmental cleaning in dental surgeries relating to COVID-19](https://www.scottishdental.org/ventilation-water-and-environmental-cleaning-in-dental-surgeries-relating-to-covid-19/)

The new IPC dental Appendix has been published as UK wide (Government/ public health/ NHS) guidance for NHS, private and independent dental settings and can be found at;

* [https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection- prevention-and-control](https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-%20%20prevention-and-control)

**6.0 Air Conditioning – Portable or Fixed**

6.1 Health and Safety Executive guidance is that the risk of air conditioning spreading coronavirus (COVID-19) in the workplace is extremely low as long as there is an adequate supply of fresh air and ventilation. Further information can be found using the links at point 1.1.

6.2 Air conditioning systems, which have the capacity to recirculate, should have this option switched off.

6.3 There is some suggestion that using fans, as part of a wider strategy to maintain fresh air and also comfortable temperatures, might tend to re-circulate contaminated air in infected environments and so the following guidance should be followed;

6.4 Recirculating fans within Healthcare and Dental Suites

Guidance suggests avoiding the use of recirculating fans within Healthcare and Dental Suite settings. It is therefore important to ensure that where any air movement is mechanically generated, it is matched with an opportunity to drive air out of a room and for fresher air to replace it. (See point 5.5)

6.5 Large Volume (Tactical) Fan use

Tactical fans should be situated in such a way as to induce the ingress of fresh air on their inlet side (locate them near external doors, windows etc.) and to push air along a landing and towards an existing vent point or area.

6.6 Local and Individual Fan Use

The use of fans both portable-handheld and small mains powered “desk fans” is an acceptable means of providing some air circulation and also cooling where required in localised areas but are subject to the following restrictions:

* Desk or ceiling fans should not be used in poorly ventilated areas.
* Set up to ensure the best possible movement of air within the area by being directed towards an extraction vent or window and being placed near to an opening from which fresh air can be drawn in from.
* Not used in designated healthcare units including healthcare residential/ward units.
* Not used in communal living areas where shielding, isolating or known cases are sharing those common living areas
* Used in cells in which occupants are isolating so long as they are switched off before the door is opened (in line with any relevant SOP) and air movement has settled.
* Used in cells in which occupants are shielding so long as they are switched off before the door is opened (in line with any relevant SOP) and air movement has settled.
* Used in RCU cells so long as they are switched off before the door is opened (in line with any relevant SOP) and air movement has settled.

**7. Dilution and Mechanical Ventilation and Air Conditioning.**

The varied nature of the prison and community estate in terms of building positions, layouts, design and construction is such that individual systems require local management and control. However, it is possible to make the following statements:

All prison and approved premises have designed capacity to ensure that stale air is removed and replaced by fresh air at a specified rate by a combination of natural (dilution) and mechanically assisted ventilation.

Stale air is removed at vents and via various openings via mechanical extraction and natural convection and pressure differential designs. External fresh air is drawn into the building via ducts, grilles and natural openings.

In cellular accommodation, air is extracted mechanically via vents and ducts and discharged into the air usually at or above roof level. Replacement air is drawn in via incidental openings such as windows, doors and trickle vents and by designated ventilation grilles and ducts.

In general, this results in movement of ingress air horizontally along a landing, upward and into cells to windows and or extraction vents. These systems are designed so that the speed of air going through the system and differential pressures in different zones (e.g., where separated by doors) do not create uncomfortable drafts or make the opening doors, for example difficult or dangerous.

Such systems neither create high air speeds, which might have the potential to dislodge settled infective particles, nor do they re-circulate air in such a way that risks gradual increase of potential viral concentrations.

There is therefore no general requirement for such a system to be switched off or have its operating capacity reduced other than in a situation where public health experts have good evidence to suggest the ventilation system may be a significant causal factor for sustained transmission. The risks of reduced ventilation must then be weighed against those of infection risk and order and control.

Those in charge of premises should seek to optimise the intake of fresh air and the venting of “used” air as much as possible within the following parameters.

* Maintaining physical safety and security.
* Accommodating the needs of building users
* Maintaining cleanliness
* Maintaining infection control and hygiene standards

**8. Additional consideration during hot summer months**

Concern has been expressed about the need to keep prisoners, offenders and staff as comfortable as possible when outside temperatures and relative humidity are increasing and while Regime restrictions are in place.

The risks to prisoners and offenders confined for substantial periods in hot and humid conditions are both physiological and psychological. The former range in seriousness from discomfort through increasing dehydration to heat exhaustion and heat stroke, referred to as hyperthermia.

Psychological effects exacerbated by sustained discomfort, and the inability to rectify it, may range from loss of concentration, stress, confusion, anger and potentially violence and aggression.

For those who are vulnerable by having pre-existing mental and or physical health conditions, these effects may be quicker acting and more severe.

The avoidance of dehydration is a core aspect of avoiding these effects at the more severe end of this spectrum of physical effects. Ongoing loss of body fluids via sweating leads to loss of electrolytes in the body, which if not reversed, leads to a potentially rapid decline in functioning and the risk of loss of consciousness, seizures and potentially, death. Proactive plans should be in place to check at suitable intervals on the most vulnerable

It is therefore important to make sure that all occupants are aware of the need to keep themselves well hydrated at such times and to identify and respond to the early symptoms of dehydration such as thirst, headache, loss of concentration etc. both in themselves and others.

Staff on patrol and making visits to cells can look for and ask about welfare and encourage more hydration if appropriate.

**Annex 1**

**EMG: Role of ventilation in controlling SARS-CoV-2 transmission**



**Further details can be found at;**

[**https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\_data/file/928720/S0789\_EMG\_Role\_of\_Ventilation\_in\_Controlling\_SARS-CoV-2\_Transmission.pdf**](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/928720/S0789_EMG_Role_of_Ventilation_in_Controlling_SARS-CoV-2_Transmission.pdf)

**Ventilation Hierarchy of Control - Checklist Annex 2**

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| **What is the occupancy?** | **Summary of Findings** |
| Number of people who will use the space, allowing for physical distancing measures applicable to local COVID risk? |  |
| Pattern of occupancy - is the space occupied for short durations ? **i.e**. Duration; Short (30mins), Medium (3 Hrs), Long (6 Hrs) |  |
| How many breaks and of what duration can be introduced to allow air exchange through occupancy movement in /out of the space ? |  |
| **How is the space ventilated?** |  |
| Natural ventilation, are there windows, doors (does not include fire doors), air vents which can be opened? |  |
| Are there frequent movements in and out of the space to aid air exchange? |  |
| Is there an impact on thermal comfort, security, fire precautions should the windows /doors be opened? |  |
| Is there any mechanical ventilation installed, is it working effectively, is it controlled locally or centrally? |  |
| Does mechanical ventilation which recirculates air have a fresh air inlet and outlet?  |  |
| If ventilation is considered to be an issue has Facility Management been requested to provide information on the room ventilation and air exchange. i.e., very limited/no natural ventilation (windows/doors/air vents) or a lack of known mechanical ventilation /air exchange? |  |
| Has FM completed reactive work to ensure mechanical ventilation is working at its optimum rate and any remedial action to enable i.e., windows painted over to open/vents unblocked been completed? |  |
| **Have you optimised other related controls?** |  |
| Regular cleaning and disinfection of surfaces, touched often. |  |
| Regular hand washing/ use of hand sanitiser  |  |
| Physical distancing measures applicable to local COVID risk |  |
| Promoting good personal hygiene when sneezing/coughing i.e., Catch it, bin it, kill it. |  |
| Pattern and duration of occupancy – can this be changed to aid air exchange i.e., take breaks/shorten sessions to air the room? |  |
| Using natural ventilation wherever possible to increase air exchange i.e., can windows/doors (not fire doors unless fitted with an approved release device) be opened? |  |
| Consideration, where applicable, of likely covid test and/or vaccine status of room occupants.  |  |
| COVID Face Mask Strategies for staff and prisoners and safe operating procedure guidance in respect of face coverings/FRSM use? |  |

**Annex 3**

**Suitability of CO2 monitoring in different types of space**

| **Characteristics of space** | **Examples** | **Suitability of CO2 monitor** |
| --- | --- | --- |
| Small spaces up to 50 square metres floor area.Occupied by a consistent number of people for more than an hour | Small offices and meeting rooms | Can be used, but results should be treated carefully as concentrations can be affected by the differences between individual breathing rates. |
| Small spaces up to 50 square metres.Occupancy varies over short periods | Changing rooms and small retail premises | Unlikely to give reliable measurements |
| Mid-sized spaces of 50-320 square metres.Occupied by a consistent number of people for more than an hour | Larger office and meeting rooms, classrooms, restaurants/bars, and some indoor sports (low aerobic activity) | Often well suited to monitoring as the higher number of occupants provides more reliable values |
| Mid-sized spaces of 50-320 square metres.Occupancy varies over short periods | Larger office and meeting rooms, classrooms, restaurants/bars, and some indoor sports (low aerobic activity) | Often well suited to monitoring as the higher numbers of occupants provides more reliable values |
| Mid-sized spaces of 50-320 square metres.Occupancy varies over short periods | Some retail spaces | Can be used, but results should be treated carefully as concentrations may be affected by variations in occupancy levels |
| Large spaces over 320 square metres.Occupied by a consistent number of people for a longer period of time | Indoor concert venues, large places of worship and airport concourses | Can be appropriate for monitoring in occupied areas, but might require multiple sensors to provide meaningful measurements |
| Large spaces over 320 square metres.Occupancy varies over short periods | Rail concourses and shopping malls | Unlikely to give reliable measurements |
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**Ventilation Process Flowchart Annex 4**

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**Annex 5**

**COVID 19 Transmission Routes**

COVID-19 spreads when an infected person breathes out droplets and very small particles that contain the virus. These droplets and particles can be breathed in by other people or land on their eyes, noses, or mouth. In some circumstances, they may contaminate surfaces they touch. People who are closer than 6 feet from the infected person are most likely to get infected.

**COVID-19 is spread in three main ways:**

* Breathing in air when close to an infected person who is exhaling small droplets and particles that contain the virus.
* Having these small droplets and particles that contain virus land on the eyes, nose, or mouth, especially through splashes and sprays like a cough or sneeze.
* Hand contact with surfaces or objects on which the virus has been deposited by droplet deposition or other hand contact, followed by touching eyes, nose or mouth without washing hands.