health
Department:
Health
REPUBLIC OF SOUTH AFRICA

Guidelines for ventilation to prevent the spread of the SARS-CoV-2 virus (version 1: 15 August 2021)

(Document prepared by the Occupational Health and Safety Workstream of the National Department of Health – Covid-19 Response)

Please note: This is an interim guide that may be updated as the outbreak in South Africa unfolds, to guide additional workforce preserving strategies.

INTRODUCTION

The purpose of this guideline is to provide basic guidance on the ventilation of workplaces for the control of SARS-CoV-2 transmission. This document is intended to provide the technical details to the Consolidated Direction of the Department of Employment and Labour[1]. For more detailed guidance refer to the World Health Organisation [1] or SAGE-EMG[2] documents.

SARS-CoV-2 exposure can occur in three principal ways:

(1) touching mucous membranes with hands that have been contaminated either directly by virus-containing respiratory fluids or indirectly by touching virus contaminated surfaces;
(2) deposition of respiratory droplets and particles on exposed mucous membranes in the mouth, nose or eyes by direct splashes and sprays; or
(3) inhalation of very fine respiratory droplets and aerosol particles

The two ways that individuals can inhale the SARS-CoV-2 virus are through:

- Short range infection by large droplets at distances of less than 1.5 meters[3-5].
- ***Long range infection*** by small aerosols at distances of more than 1.5 meters meter and extending across the full extent of a room or vehicle [3].

The focus of this guideline is to understand how to prevent ***long range infection***. However, prevention measures for all for these forms of transmission remain effective and are equally recommended.

The Centres for Disease Control (CDC) in the US [6] further elaborates on the 3 main risk factors for ***long range infection*** by SARS-CoV-2, noting they are:

- **Enclosed spaces with inadequate ventilation or air handling** within which the concentration of exhaled respiratory very fine droplets and aerosol particles, can build-up in the air space. Enclosed spaces include ***rooms*** in a building and ***vehicles*** such as a buses, taxis or cars.

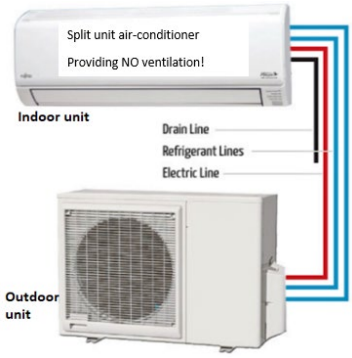
[1] Department of Employment and Labour (DEL) Consolidated COVID-19 Direction on Health and Safety in the Workplace Issued by the Minister in terms of Regulation 4(10) of the National Disaster Regulations, 28 May 2021

- **Increased exhalation** of respiratory fluids if the infectious person is engaged in physical exertion or raises their voice (e.g., exercising, shouting, singing).
- **Prolonged exposure** under these conditions, typically more than 15 minutes.

Our government confirmed this in one of our "family talks". In Feb 2021 President Ramaphosa said *"Research has shown that the risk of transmission of the virus is almost twenty times higher indoors than in outdoor settings*"[7]. Further he shared in July 2021 *"We know that indoor gatherings, particularly in places that have poor ventilation, are the major cause of outbreaks and super spreader events. We must continue wearing our masks at all times when in public, keep our distance from others and always ensure that windows are open and that there is a flow of fresh air"*[8].

VENTILATION

Ventilation is the process by which air is intentionally provided to or extracted from an indoor space for the purposes of diluting and removing indoor contaminants[9]. Ventilation is quantified by the rate of clean or outdoor air supplied into a space.



Ventilation is ***not*** synonymous with air-conditioning, since:

- Air conditioning refers to the ability of the system to heat, cool and dehumidify.
- Air conditioning systems are not automatically ventilation systems.
- Importantly, most split unit aircons ***do not*** have ventilation capability, and must be combined with some sort of ventilation (most commonly natural ventilation).

How much ventilation is required?

Minimum ventilation rates for occupied spaces in South African buildings are prescribed by the compulsory standard SANS 10400-O: 2011. However, in the context of long-range SARS-CoV-2 transmission control, the World Health Organisation recommends that each room is supplied with at least **10 L/s/person** (litres of fresh outdoor air every second per room occupant) [1]. This means that if there are 4 people in a room, then the room must be supplied with at least 40 litres per second of outdoor fresh air. As a general principal in meeting rooms and classrooms, where there is a higher density of people in a room, as well as in rooms where activities such as singing, shouting or speaking occurs, then an increased ventilation rate is needed.

How to determine whether there is adequate ventilation?

There is inadequate ventilation if:

- The room or vehicle feels stuffy, the air smells stale or you can smell the body odour of other people in the room.
- If the room has only an air-conditioner, with closed windows and doors.
- Any vehicle with closed windows.
- The carbon dioxide (CO_2) level is above 800 parts per million (ppm)[2].
    - People breathe in oxygen and breathe out CO_2 - where there is poor ventilation there will be high levels of CO_2. With good ventilation CO_2 levels can be lowered[10, 11]. CO_2 concentrations can be measured using a CO_2 meter, which can be set to trigger an alarm at a specified level, indicating that the level of exhaled air has exceeded the safe threshold, and opening windows or doors is needed. In an enclosed space that is poorly ventilated, increasing occupancy levels are associated with increasing CO_2 concentrations [12].

How to deliver ventilation?

Adequate ventilation may be accomplished by either natural or mechanical means.

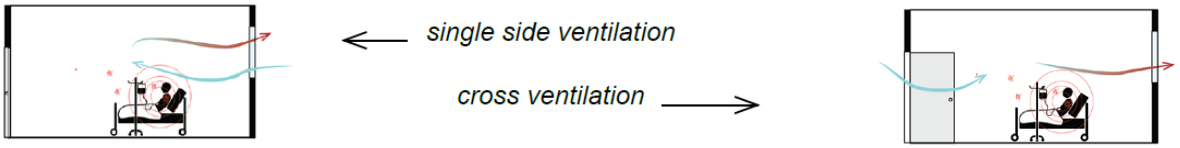
The two broad categories of ventilation systems are:

- *Natural ventilation, which* refers to fresh air delivery via openings such as windows and doors. Windows and doors are the most widely used apertures (openings) for fresh air delivery.
- *Mechanical ventilation, which* refers to ventilation driven by artificial means, such as an extractor fan installed in a window or door, or an HVAC ("Heating, Ventilation and Air Conditioning") system.

NATURAL VENTILATION[1]

Does the ventilation rate meet the minimum requirement? - If NOT, then:

- Assess the location of the opening in the surface, considering introducing potential new openings.
    - The distance between any internal wall and nearest ventilation aperture should not exceed 2.5 times the floor to ceiling height.
    - The total openable size of natural ventilation apertures should not be less than 5% of the floor area[13].
- Promote cross ventilation by ensuring there is an open aperture on the opposite side of the room to allow the air coming in one side to exit on the opposite side. The key principle is to enable lots of fresh air to pass through the occupied space.



In a ***vehicle*** ensure the recirculate function of the air-conditioning system is switched off and it should be set to take in outdoor air. Additionally, open all windows at least 5 cm and keep them open for the full duration of the journey.

Does the facility have periods of low to no occupancy?

Open the windows to allow proper ventilation before and after occupied times. Windows should be opened for approximately 15 minutes beforehand when entering the room (especially when the room was occupied by others).

MECHANICAL VENTILATION[1]

Does the ventilation rate meet the minimum requirement? - If NOT, then:

- Before adjusting your mechanical ventilation system, ensure that you have reduced your occupancy sufficiently to meet the physical distancing requirements.
- If the mechanical ventilation system does not allow for increasing the outdoor air rate to at least the recommended minimum per-person requirement, consider reducing the maximum room occupancy to meet the 10 L/s/person standard.
- You will need to consult with a ventilation technician or engineer to understand the current ventilation balance and capacity of your building. You will also need to determine whether and by how much the fresh-air ventilation rate can be increased.
- If the increased mechanical ventilation rate and reduced occupancy cannot yield at least 10 L/s/ person, consider maximizing ventilation by using natural ventilation through opening windows, by consulting a ventilation technician or engineer to design a method for running your HVAC systems concurrently with natural ventilation. (see natural ventilation section for more strategies) [10].
- The risk of SARS-CoV-2 passing through the air handling unit and the filters, and infecting someone in an adjacent space is considered to be low[14].

- SANS 1424:2008 / EN779:2012 F8 or ISO 16890 ePM1 70-80% filtration, should be sufficient for mechanical ventilation systems. Filtration can reduce viral concentrations in environments where air recirculation takes place, either within a stand-alone unit (e.g. in-room air conditioner) or as part of the building mechanical system.
- In general, to completely remove particles and viruses from the return air, HEPA filters are needed. However, due to a higher pressure drop (across the filter) and special required filter frames, HEPA filters are usually not easy to install in existing systems[15]. It follows that HEPA filtration should only be considered by a ventilation technician or engineer for spaces with high-risk operations and a very high proportion of recirculated air that cannot be adjusted to provide fresh air for operational reasons[2].
- If none of these strategies can be adopted, consider using a standalone air cleaner with a sufficient Clean Air Delivery Rate (CADR) capacity to make up for the ventilation shortfall. CADR should be classified according to ANSI/AHAM AC-1 as amended.

Does the facility have periods of no occupancy?

Operate the HVAC system with maximum outside airflow for 2 hours at normal speed before and after occupied times.

Does the facility have demand control ventilation?

Consider increasing the minimum ventilation capacity to meet the adjusted per person ventilation requirements and ensure that the run-on times recommended above are adhered to.

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