A Union of Professionals

# Ventilation Basics

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As we learn more and more each day about SARS-CoV-2, the AFT continues to adjust recommendations as new science surfaces. We now have evidence that the coronavirus SARS-CoV-2 can travel from an infected person through small airborne particles over significant distances—primarily indoors. Therefore, we recommend enhanced indoor ventilation and filtration as a strategy for mitigating exposure to the virus in education settings.

Ventilation is one of the key mitigation strategies, which include physical distancing of at least 6 feet, wearing cloth face coverings, cleaning and disinfecting surfaces, access to hand-washing facilities and supplies and robust testing protocols. Each of these is important but represents only one piece of a very complicated puzzle, and each piece works best in tandem with the others for optimum exposure protection. All these strategies must remain in place for the foreseeable future even with anticipated vaccine rollout.

School buildings vary in age and construction including the design and operation of ventilation and filtration systems. Therefore, there is no "one size fits all" approach to developing an enhanced ventilation strategy. What follows is a primer for leaders that provides:

1. Background on the importance of ventilation and filtration; and
2. Questions leaders should pose to school administration, including the manager of maintenance and operations and/or principal maintenance contractor(s). **These questions and information may be useful in meetings with key administrators.**

## Why Ventilation and Filtration Are Important

We know that inadequate ventilation and poor indoor air quality have plagued schools long before the COVID-19 pandemic. Research (http://bit.ly/improving-air-quality) has found that increased ventilation rates are associated with increased student performance, improved respiratory health, increased student attendance, and lower risk of transmission of airborne infectious diseases. This is an opportunity for districts to address this issue with the hope and goal of improving conditions for learning and teaching moving forward.

The vast majority of coronavirus transmission occurs indoors during the winter months when people spend more time inside. Ventilation plays a critical role in removing and diluting exhaled virus-laden air, thus lowering the overall concentration and therefore any subsequent dose inhaled by the occupants.

Once the virus is in the air, there are two methods for reducing potential exposure: **bringing in additional fresh air** from the outside to dilute and replace air in the space and remove the virus from the air inside the building through **filtration**. Ventilation can be accomplished by natural means (e.g., opening a window) or mechanical means (e.g., fans or blowers in a heating ventilation and air conditioning system, HVAC).

Another strategy that should be considered in spaces where it is difficult to comply with enhanced outdoor air recommendations and/or filtration improvements is to **limit or reduce the number of people and activities** within those indoor spaces.

## Bringing in Additional Outdoor Air

The general purpose of ventilation—whether through windows or through mechanical means—is to provide healthy air for breathing by both diluting the pollutants originating in the building and removing the pollutants from it. When there is poor indoor ventilation, it means that there is inadequate outdoor air coming in from windows or mechanical systems. When this happens in the case of SARS-CoV-2, virus particles can build up quickly in those spaces. The goal of ventilation is to replace potentially virus-laden air indoors with virus-free air.

### Mechanically Ventilated Spaces

In a mechanically ventilated building, ventilation air is typically provided by a heating, ventilating and air conditioning (HVAC) system. Sometimes, ventilation air is provided by dedicated fans or outdoor air units.

HVAC system control strategies can usually be modified to increase ventilation to a certain extent in the occupied zones, with relatively little additional cost, to reduce the risks of airborne transmission between occupants. However, this is not via a simple "flick of a switch" because HVAC systems are complex and usually designed for individual buildings within standard specific operating parameters. Many requirements need to be considered apart from the ventilation rate, including control of temperature, relative humidity, air flow distribution and direction. (https://bit.ly/indoor-transmission)

Another issue to consider is air recirculation. The recirculation of air is a measure for saving energy, but care must be taken, as it can transport airborne contaminants (including infectious viruses) from one space and distribute them to other spaces connected to the same system, potentially increasing the risk of airborne infection in areas that otherwise would not have been contaminated.

### Questions for school maintenance managers and administrators:

Ask for the following information in writing. If they don't know the answers to these questions, be wary about the space.

1. In buildings where facilities managers are in charge, ask for confirmation that all ventilation equipment is operating according to system manufacturer's specifications and that the amount of outdoor air being brought indoors is being maximized. Confirm also that:
   - Systems have been inspected and controls calibrated; and
   - All supply and return grilles and registers have been inspected to make sure they are open, operating properly and that air is flowing through them when the system fan is on.
2. Ask for data on the following ventilation parameters:
   - **Air exchanges per hour** (the number of times the air inside a building gets replaced with air from outside). There should be at least six air changes per hour. Ten to 12 exchanges per hour are ideal;

- The **grade of the filter** in the air handling unit; and
- The **percentage of fresh air** introduced.

3. Ask for confirmation that the system fan is on and air is being moved through the HVAC system whenever people are present, even when the thermostats are not calling for heating or cooling. HVAC systems, if possible, should be kept running longer hours, up to 24/7 if possible, and at least two hours before occupants arrive and the last person leaves the building.
4. Confirm that air is not being recirculated as far as practically possible, to avoid the dissemination of virus-laden particles throughout the indoor environment. For central air handling units at a building level or serving multiple zones, recirculation should be avoided, and the system operated on 100 percent outdoor air if possible. It is possible to increase the fraction of recirculated air if the air handler has efficient filters that remove the aerosol. At a minimum, the outdoor air intakes or controls should be set to the maximum level of fresh outdoor air the system is capable of handling or providing. (This usually depends on weather, season, operating costs, etc.)
5. Ask if the system is equipped with a humidifier. If so, ask for assurances that the humidifier is clean, operating properly and providing an in-room relative humidity of about 40-60 percent. Ask how conditions are being monitored to ensure they are within the desired ranges for humidity and temperature.
6. Request documentation from the ventilation system equipment manufacturer, which will state the highest level of filtration on the Minimum Efficiency Reporting Value (MERV) scale, which are defined in the ASHRAE 2017b standard. A MERV rating of 13 or higher is recommended to reduce airborne infection potential.
7. Ask if portable room air cleaners with HEPA or high-MERV filters are being provided in areas where there is high occupant load or areas that have poor ventilation. If so, find out where these are being used.

Finally, be aware that older buildings may not have mechanical ventilation or the system may be in disrepair. These buildings are very difficult to make safe.

## Natural Ventilation

If ventilation is provided using window openings (aeration) or other means (fixed openings, e.g., natural ventilation), an estimation of the possible outdoor flow rate can be made. However, the outdoor air flow rate that is achieved is strongly dependent on the specific local conditions (opening sizes, relative positions, building pressurization, climatic and weather conditions, etc.) and should be estimated case by case; it can easily range from two up to 50 air changes per hour or more.

For naturally ventilated spaces, particularly in cold climates, other challenges will arise, but these can also be addressed to reduce the risk of airborne infection transmission. It may be necessary to provide additional heating in some buildings to maintain thermal comfort, particularly where the occupants are vulnerable. (https://bit.ly/indoor-transmission)

### Questions for school maintenance managers and administrators:

1. Weather permitting, are windows and doors to the outside being opened to allow clean outdoor air into the building to dilute the air already inside?
2. Is airflow direction going from cleaner air to less clean air? For example, fans should not be blowing directionally from one person to another.
3. Are bathroom and kitchen exhaust fans running continuously to help bring in more outdoor air if these fans exhaust directly to the outside and there is a source of outdoor air, such as an open window?

# Filtration

Filtration is an important part of the ventilation system. Filters are rated for how well they remove particles from the air. The rating system seen most often is called Minimum Efficiency Reporting Values. In a nutshell, the higher the MERV rating, the more efficient the filter is in removing the smaller particles.

- MERV 1 to 4 filters only catch relatively large particles to keep them from clogging the heating/cooling coils and ductwork in the ventilation system.
- MERV 5 to 7 filters also remove midsize particles like pollen and mold spores.
- MERV 8 to 13 filters are good to excellent at removing fine particulate, including smoke and bacteria and viruses attached to small particles.

## Questions for school maintenance managers and administrators:

1. It is important to ask the people who service your system if it is powerful enough for high MERV filters before using them.
2. Is the district using the highest MERV filter your system can accommodate?
3. Air filters must be properly installed, fit tightly so air doesn't go around instead of through them, and be replaced at least several times a year. Ask for documentation that this is happening.
4. High MERV filters must be replaced every 60 to 90 days. What is the schedule for replacement of filters in your building?

# Limiting People and Activities

This measure is self-explanatory in the context of the need to lower the concentration of airborne virus-carrying particles, and reduce the number of people who can be exposed at any time. The fewer people, the less chance someone is exhaling the virus. There is no one specific value for a number of people who could share the same space during pandemics, and this measure should be considered in conjunction with the engineering measures discussed above, and particularly in relation to the ventilation parameters of the space.

Ventilation issues can at times be daunting and technical. There are several organizations that issue guidance on ventilation (see below). AFT Health Issues can assist with more detailed information and checklists for leaders to evaluate building ventilation in their districts.

### *Technical references*


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