



Heating Ventilation Air Conditioning Systems:

Guide to schools during COVID-19



Heating, Ventilation, and Air Conditioning (HVAC) Systems

HVAC systems are an important part of an overall plan to promote school health, wellness, and safe environments. This information is intended for school staff involved in maintaining, improving, and safe use of heating, ventilation, and air conditioning (HVAC) systems including: administrators, facility managers, custodial staff, supply purchasers, teachers, school nurses and others.

HVAC systems are an integral component to a comprehensive approach to reducing exposure and the spread of airborne particles throughout an indoor space.^{1, 2, 3} Improvements to HVAC systems combined with other protective measures, reduce the risk of getting and spreading the severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) and the illness it causes, coronavirus disease (COVID-19).

Coronavirus and HVAC systems

SARS-Cov-2 virus is small in size, approximately 0.12 micron (μm) and can be spread via droplets and aerosols.⁴ Depending on how these droplets enter the air, (e.g., breathing, talking, singing, coughing, or sneezing), these particles can spread 6 feet or further⁵ and remain in the air for a period of time, and then settle on surfaces.^{6, 7} HVAC systems in combination with cleaning and disinfecting help to remove these particles and represent good building practices.

Air Cleaning and HVAC Systems

HVAC systems maintain indoor air temperature and humidity at healthy and comfortable levels as well as filter particles from the air (Figure 1).⁸ Filtration is a common method for air cleaning. Using high efficiency HVAC filters - Minimum Efficiency Reporting Value (MERV) 13 or higher (Figure 2)^{9, 10, 11, 12} and portable High Efficiency Particulate Air (HEPA) filtration help to capture particles through multiple ways (Figure 3)^{13, 14} and return clean air.

Key Messages

- ❖ HVAC systems are an important part of reducing exposure and spreading of COVID-19.
- ❖ The systems work by increasing air flow of “cleaner” air throughout the space by using “on” or run times for air replacement and filtration for removal of airborne particles.
- ❖ Improvements depend on each system’s capabilities, outdoor environment, health and safety concerns, and costs among other factors.

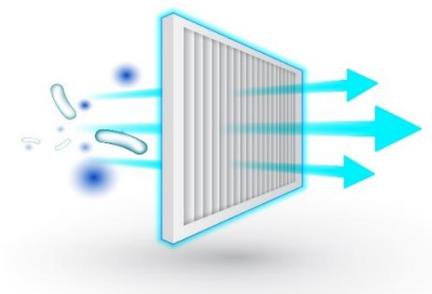


Figure 1. Air filtration

MERV Filters

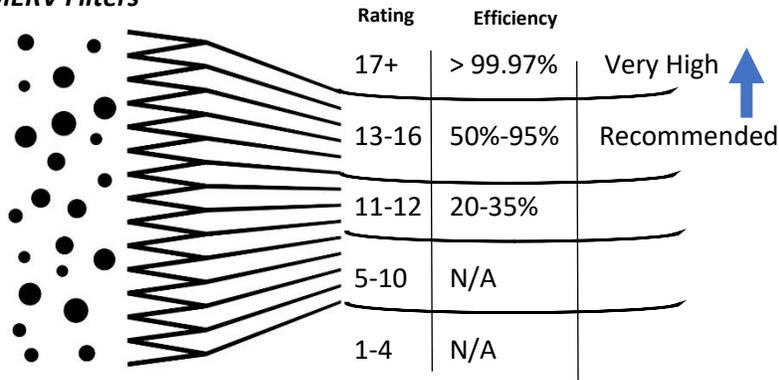


Figure 2. MERV rating and estimated clearance of particles 0.30 – 1.0 microns

Sources: ANSI/ASHRAE Standard 52.2 – 2017; LakeAir, 2021

HEPA Filters

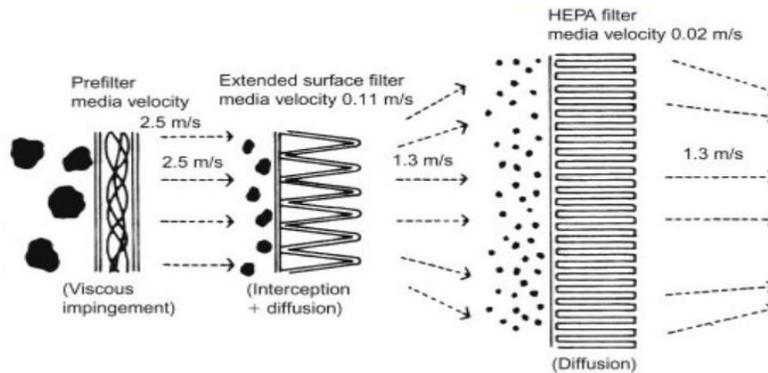


Figure 3. Example of ways a HEPA filter captures particles

Source: Sparks and Chase, 2016

Alternative Methods for Air Cleaning



There are additive and alternative methods for air cleaning such as ultraviolet germicidal irradiation (UVGI) lights (i.e., HVAC systems, upper room, and box), foggers, and other disinfection devices; however, caution is needed.^{15, 16} Prior to purchase, these systems need to be thoroughly reviewed as to effectiveness and protective benefit compared to risks and adverse health conditions, as well as specific products for the device listed in the labeling, safety of the products for occupants, ozone production, lengths of time needed for disinfecting and to clear the air, and costs.

This guidance focuses on the important role HVAC systems can play in improving air quality while reducing the spread of viruses and other particles.

HVAC System Upgrade Considerations

Prior to enhancements, HVAC professionals should be consulted and equipment designs reviewed to determine the system's capacity to work well with any upgrades and deliver the best results.¹⁷ HVAC professionals and facility staff should inspect, clean, and maintain the system.¹⁸

These systems require filter changes, and scheduled checks for leaks, condensation, etc., or the system could potentially worsen the spread of the virus by recirculating contaminated air, and/or create indoor conditions (temperature and humidity) that support survival of the virus.² A maintenance schedule should be driven by need (e.g., impeded air flow or lack of exhaust ventilation) and a routine schedule such as:^{2, 19}

- visual inspections of filters and water distribution system monthly
- filter changes quarterly or more frequently, if needed
- professional inspection and service annually

While maintenance and upgrades to HVAC systems have a cost, the expenditures are often offset by the gained efficiencies in health and productivity.^{20, 21} By adhering to checks, changes, cleaning and maintenance schedules (e.g., filter changes, scheduled checks for leaks, condensation, mold, etc.) prevents the potential for spreading the virus. The following recommendations are compiled from a variety of sources including the national standards from the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. ([ASHRAE](#)), and are intended as guides and should be adapted to meet your system, school, and state requirements.

Recommendations

- Prior to enhancements, conduct an assessment of the HVAC system to determine capacity for improvements including proper installation of new filters.²² Monitor temperature, relative humidity, carbon dioxide, pressure drops, and other information to promptly take corrective action.^{2, 3}
- Air filtration should be medium to high efficiency using filters with a MERV 13 or higher.^{2, 7, 23} The level of efficiency selected should take into consideration the system capacity, expected number of occupants, and the size of the space being used. Recirculation modes should be as low as possible.
- Filters should be inspected monthly and changed quarterly or more frequently if visible debris. The duct systems should be cleaned when there is visible debris in ductwork, debris being blown out of vents, or there are moisture issues and possible fungal growth.^{24, 25} Workers performing maintenance or replacing filters should wear personal protective equipment (PPE) (e.g., mask, eye protection, disposable gloves, shoe covers, etc.).²⁶
- Ensure filter rack is sealed to prevent bypass (i.e., air going around the filter).^{2, 7}

- Consider using portable air purifiers with HEPA filters.^{2, 7, 13, 27}
- Ensure proper separation (minimum of 10 feet) between outdoor air intakes and exhaust discharge outlets to prevent/limit re-entrainment of potentially contaminated exhaust air.³ Bypass energy recovery ventilation systems that leak potentially contaminated exhaust air back into the outdoor air supply.²
- Facilities should have ventilation of as many air exchanges per hour as possible (i.e., room air replaced), preferably 6 or more, for mechanically-ventilated areas. Aerosol generating areas such as [music and band rooms](#), [nurse's offices](#) and [respiratory condition treatment areas](#) should take precautions and use portable HEPA filters to mitigate risk.
- Exhaust fans in restrooms and other locations such as kitchens and locker rooms by-pass the HVAC systems when they pull “contaminated air” directly from indoor spaces and exhausts to the outside. Exhaust fans should be operating at full capacity continuously when the building is occupied.³
- Adjust temperature in classrooms (72 F in winter and 75 F in summer) with relative humidity (40% to 60%) to reduce virus survival, prevent mold colonization, and at 50% may help to reduce dust mites and mold.^{2, 28}
- Disable demand-control ventilation controls because “demand control” means the system runs only when needed and not continuous. Set to “on” for continuous fresh air intake when occupied taking into consideration the outdoor climate. If relative humidity exceeds 60%-65%, return to original settings and consult with HVAC operator on system changes to address issue.¹⁷
- HVAC systems should operate at maximum outside air for 2 hours prior and after occupied, and continuously when occupied.¹
- Make sure there is adequate ventilation (air flow) when using chemical products for cleaning and disinfecting.²⁹
- If the building has been shut-down or unoccupied and in non-use for period of time, review [ASHRAE](#) checklist, [CDC](#), and [EPA](#) guidance and recommendations before reopening.
- Table or pedestal fans are safe in single occupancy rooms but should be avoided in spaces with several people. Maintenance staff should adjust ceiling fans to pull air up rather than down.

- Consider having licensed and insured HVAC technicians install variable speed fan motors or variable air volume (VAV) boxes closer to termination points to control airflow for various occupancies and levels of activity.²

These recommendations from a variety of sources represent best practices, but should be tailored and implemented to specific circumstances and environmental conditions, as well as local, state, and federal regulations.

The Pediatric Environmental Health Specialty Units (PEHSUs)

The PEHSUs are a federally sponsored network of interdisciplinary pediatric environmental health specialists based at academic medical centers around the country. The Healthy Schools Program, led by environmental hygienists, has been working for 15 years to assist school districts and childcare organizations in developing effective strategies for long-term improvement of indoor environmental conditions in school and childcare facilities. Together, we are working hard to provide the most up-to-date guidance around maintaining healthy school environments during the COVID pandemic as well as beyond. Please note that through this service we are not providing medical advice, but general guidance and recommendations based on our areas of expertise – environmental hygiene (best practice standards around building health), environmental health, and public health. Please reach out to us through either the [Children’s Mercy \(CM\) Kansas City School Health Portal](#) or by email to the [CM Healthy Schools/PEHSU Collaborative Service](#) staff. Of note, all our schools’ inquiries are anonymized and made public through the portal. Please use the portal as a resource to find answers to your questions as well. Thank you so much to all the schools for reaching out to us, whether through the CMH School Health Portal, or by email.

Glossary

Air Filtration: The process of removing airborne particles from the air.

Contaminant: An unwanted airborne particle with the potential to reduce the acceptability and quality of the air.

Demand-controlled Ventilation: Any means by which the outdoor air flow can be varied to the occupied spaces based on the number of occupants or ventilation requirements.

Relative Humidity: The amount of water vapor actually in the air, expressed as a percentage of the maximum amount of water vapor the air can hold at the same temperature.

Ventilation: The process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity, or temperature within the space

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