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HEALTH & SAFETY SIMPLIFIED

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Info Bulletin

Subject:	**COVID-19 Guidelines for HVAC Systems in Schools**	Revision No. 001
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California school districts are required to comply with the School Accountability Report Card (SARC) to keep students safe on school grounds by providing an environment that is clean, safe, and functional. Executive Environmental (EE) provides advice to school administrators regarding potential health hazards.

On February 11, 2020 the World Health Organization announced an official name for the disease that was causing the 2019 novel coronavirus outbreak, first identified in Wuhan China, but which is now spread throughout the world. The new name of this disease is Coronavirus Disease 2019, abbreviated as COVID-19. In COVID-19, 'CO' stands for 'corona', 'VI' for 'virus', and 'D' for disease. COVID-19 is caused by a coronavirus called SARS-CoV-2. Older adults and people who have severe underlying medical conditions like heart or lung disease or diabetes seem to be at higher risk for developing more serious complications from COVID-19 illness. COVID-19 symptoms can range from mild (or no symptoms) to severe illness or death. You can become infected by coming into close contact (about 6 feet or two arm lengths) with a person who has COVID-19. COVID-19 is primarily spread from person-to-person. Recent research indicates that SARS-CoV-2 is resilient in aerosol form and may be a more important exposure pathway than previously considered.

The Centers for Disease Control (CDC) has determined the virus primarily spreads from person-to-person in close contact with one another or through respiratory droplets produced when an infected person talks, coughs, or sneezes. The droplets may come into contact with the eyes, nose or mouth or be inhaled by a healthy person nearby. A healthy person can also become infected by touching a surface where the expelled droplets recently settled, and then proceeding to touch their eyes, nose or mouth. The virus itself is very small, roughly 0.16 microns in diameter, and is contained within these respiratory droplets. Studies indicate droplets typically expelled by those suffering from respiratory infections range from the visible droplets we are all able to see, to those too small for our eyes. The invisible droplets range from 0.5 micron to a high of approximately 15 microns with most in the lower size ranges. Studies of other common viruses suggest droplets of 1.0 micron can carry enough virus to cause infections. The size of the droplet, the quantity of virus it contains, the time it remains suspended in the airstream, even the temperature and relative humidity are all critical variables when considering the likelihood of airborne contamination.

From a filtration point of view, the droplet is the particle that must be removed from the air. Recognized authorities have recommended filters with Minimum Efficiency Reporting Value (MERV) ratings of MERV-13 or higher (see below). An air filter is a single component within a larger and more complex Heating, Ventilation and Air Conditioning (HVAC) system designed to accomplish the proper ventilation of a building. Increasing particle capture efficiency is not necessarily a singular solution to lowering the risk of infection. Air filters with higher capture

efficiency ratings often have higher pressure drops which may reduce air changes per hour (ACH) and influence humidity as well. These filters may also be physically larger than lower rated filters, therefore it is important to verify that the HVAC system is equipped with the frames necessary to ensure an airtight seal and that the fan can overcome the added resistance of the filter without damaging the equipment or accelerating the useable equipment life.

Current guidelines from the CDC and American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) have some general recommendations in place. Their main intent appears to be to reduce disease transmission from airborne particles by increasing outdoor air ventilation and filtration efficiency. The general consensus from both CDC and ASHRAE appears to be that increasing both ventilation and filtration can reduce the risk of COVID-19 airborne transmission. While some of these recommendations may be able to be implemented with little to no effect on the current HVAC systems, it is important for a School District's Facility Maintenance management team to fully understand the effects these recommendations may have on their specific systems before implementing them.

All filters have specific pressure drops associated with them, which varies depending upon the type of the filter itself as well as the quantity of airflow across it. Pressure drops across the filter also increase as the filters become dirty. Installing a higher efficiency filter may work fine initially while the filter is clean but may not when the filter gets dirty, as the Air Handling Unit (AHU) fan may then be outside its performance range, resulting in a decrease in total airflow and equipment useable life. Therefore, one needs to analyze the AHU system to determine if the system can accommodate a higher efficiency filter as recommended by the CDC or ASHRAE.

It is important to have each system evaluated by a licensed mechanical engineer or vendor familiar with such systems before any changes to the systems are made. This may include verifying the AHU system performance by a licensed test and balance or mechanical contractor to assure the system is performing in accordance with its intended design standards — and also to verify what, if any, excess capacity the respective systems have before making temporary or permanent changes to their current operation.

ASHRAE discusses some alternative methods of HVAC disinfection. Ultraviolet (UV) air cleaning systems installed in air handlers can control biofouling of cooling coils. These systems are generally not likely to eradicate virus in the airstream unless designed to deliver the necessary dose during the available exposure time. Such systems require a much higher UV output.

With regard to UV-C Disinfecting Lighting, upper air UV light fixture can eradicate airborne virus; would not impact droplets settling on surfaces so there is limited impact on overall virus transmission. Most direct UV lights are harmful to occupants and furnishings, so there are very limited applications.

SPECIFIC RECOMMENDED GUIDELINES:

Centers for Disease Control (CDC)

"*Interim Guidance for Businesses and Employers Responding to Coronavirus Disease 2019 (COVID-19)*", updated 6/6/20

Consider improving the engineering controls using the building ventilation system. This may include some or all of the following activities:

- Increase ventilation rates.

- Ensure ventilation systems operate properly and provide acceptable indoor air quality for the current occupancy level for each space.
- Increase outdoor air ventilation, using caution in highly polluted areas. With a lower occupancy level in the building, this increases the effective dilution ventilation per person.
- Disable demand-controlled ventilation (DCV).
- Further open minimum outdoor air dampers (as high as 100%) to reduce or eliminate recirculation. In mild weather, this will not likely affect thermal comfort or humidity. However, this may be difficult to do in cold or hot weather.
- Improve central air filtration to the **MERV-13** or the highest compatible with the filter rack, and seal edges of the filter to limit bypass.
- Check filters to ensure they are within service life and appropriately installed.
- Keep systems running longer hours, 24/7 if possible, to enhance air exchanges in the building space.

https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html

California Department of Education (CDE)

"*Stronger Together: A Guidebook for the Safe Reopening of California's Public Schools*", updated 6/8/20
CDE Health & Safety Checklist, LEA Checklist for Physically Reopening Campuses for Students,
Section 8e(i) – Cleaning and Disinfecting:
Make a Plan for Adequate Outdoor Air Circulation

i. In accordance with CDC guidance, ensure that ventilation systems and fans operate properly and increase circulation of outdoor air as much as possible by opening windows and doors and other methods. Do not open windows and doors if doing so poses a safety or health risk to children using the facility (for example, allowing pollen in or exacerbating asthma symptoms). Maximize central air filtration for heating, ventilation, and air conditioning (HVAC) systems (targeted filter rating of at least **MERV 13**).

https://www.cde.ca.gov/ls/he/hn/documents/strongertogether.pdf

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

"*ASHRAE Epidemic Task Force Filtration and Disinfection*", updated 5/27/20
Mechanical Air Filters:
"The fraction of particles removed from air passing through a filter is termed "filter efficiency" and is provided by the Minimum Efficiency Reporting Value (MERV) under standard conditions. −MERV ranges from 1 to 16; higher MERV = higher efficiency; **MERV ≥13** (or ISO ePM1) are efficient at capturing airborne viruses."

"Increased filter efficiency generally results in increased pressure drop through the filter. Ensure HVAC systems can handle filter upgrades without negative impacts to pressure differentials and/or air flow rates prior to changing filters."

https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-filtration_disinfection-c19-guidance.pdf

According to a March 31, 2020 news article, ASHRAE has established an epidemic task force to respond to the global COVID-19 pandemic. As of April 15, 2020, the following statement from the ASHRAE Epidemic Task Force was posted on their website:

- On the recommendation of the ASHRAE Epidemic Task Force, ASHRAE leadership has approved the following two statements regarding transmission of SARS-CoV-2 and the operation of HVAC systems during the COVID-19 pandemic:
    1. Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.
    2. Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus.

DISCUSSION:

It is important to recognize that these are recommendations and are not required by regulation or statute. The intended purpose is to supplement the primary control techniques employed in the District and not to replace frequent hand washing, social distancing or the appropriate use of masks. Nevertheless, the absence of regulation or statute will not change how the public perceives the issue as to how well students, staff and faculty are protected by the District or in the court of public opinion. It seems that the three organizations CDE, CDC, and ASHRAE are essentially recommending that:

1. The quantity of fresh outside air is increased to achieve potential dilution of the virus in the ambient air;
2. The ventilation system is run for longer periods of time to achieve potential dilution of the virus in the ambient air; and
3. Implementation of increased filtering of the air to potentially remove the virus from the ambient air.

There is no doubt that the implementation of increased outside air, running the system longer and increasing the filtering compacity of the filters will have a likely positive impact on reducing a disease that is passed through the ambient air from person to person. However, the implementation of these items are not as simple as it seems and can result in additional considerations:

1) Increasing fresh outside air either through opening the air dampers, decreasing the percent of recirculated air, and opening the doors and windows can:
    a) Increasing fresh air can accelerate the end-of-life of the HVAC System and Filters by causing more air to be moved or treated by the HVAC system.
    b) Increased fresh air increases the system effect on maintaining a comfortable thermal environment and productive learning environment.
    c) Increased fresh air causes a higher energy cost to heat and cool the additional air to comfortable thermal conditions.
    d) Increased air may not be efficiently handled by the HVAC system as designed and may require redesign and additional AHU's to achieve the original parameters of the design criteria.
    e) Open doors and windows create a potential security issue on a daily basis and during lockdown situations.

f) Open doors and windows with the HVAC system running increases the quantity of air that the HVAC system must climatize to achieve thermal comfort for the occupants. A greater quantity of air climatized will required increased maintenance and in increase the operating cost. Simply put, increased climatized air equal higher costs.
g) Open doors and windows with the HVAC system running is typically not a design criterion considered in the design of most existing system. This can result in failure of the system to maintain, and in some cases, achieve thermal comfort.

2) Running the system for longer periods of time or running the HVAC 24/7 can:
   a) Running the system 24/7 increases the quantity of air moved by the HVAC system, thereby increasing the operating and maintenance cost, accelerates the end of life of filters, and was not considered in the design criterion of the system.

3) Increasing the filter rating:
   a) Typically, systems are designed to handle a standard range of filters, usefully MERV 8, 9. or 10. A higher rated filter will inevitably require a re-design of the system to achieve the same thermal comfort.
   b) Higher rated filters increase the back pressure/pressure drop by decreasing the flow of air across the filter due to denser filtering material. This back pressure/pressure drop puts a greater strain on the HVAC system, thereby increasing the operating and maintenance cost, accelerating the end of life of filters and system, and was not considered in the original design criterion of the system.
   c) Many manufacturers of higher rated filters claim to have filter service life of one year versus the MERV 8-10 filters typically used, which have a service life of 3-4 months depending on field use and original design criterion. If the higher rated filters are used, the District will have to monitor the filter's performance to determine how long they can be used, establish a change-out program, and determine if the system needs further re-deign.
   d) Higher rated filters may immediately require modification of the existing filter holder to accommodate a thicker filter. Typically, the thickness of the filter increases from one inch with the MERV 8-10 filter to approximately 2 inches with MERV 13 to 14. Most existing systems designed for MERV 8-10 filter will need to be modified to handle higher rated filters.

Despite these recommended guidelines by the three organizations, the District should ensure the following before re-opening of school:

A. Ensure the HVAC system is operational with all maintenance and filter change out complete.
B. Air out the system and spaces served by running the system for 24 hours for 7 days.
C. The fresh air damper is open and operational if it is an economizer. As a rule of thumb, the damper should allow 20% recirculated air in non-science classrooms and spaces.
D. Ensure that the system is programed to follow required lead (start) and lag (end) time. The lead time is a system starting one hour (or two hours following a closure of two or more days) before the start of the contractual day and continue through the lag time which is one hour after the end of the contractual day.
E. The fan is on continuously throughout the day regardless of the need for heating and cooling.
F. All climatized spaces have a programable thermostat or District remotely controlled system, with the thermosets and remote system properly programed. A manual thermostat or a rheostat-controlled system may be problematic for the District because it requires a staff

member or faculty to turn the system on. Typically, these systems that still exist are set by the morning custodian when they arrive.

G. If the system is serviced by a central cooling tower, clean the cooling tower, and inspect for signs of legionella if the cooling tower was not maintained during the closure.

CONCLUSIONS:

Implementing these recommended guidelines or elements thereof will be very challenging for the Districts. Consider switching to MERV-13 filters, if feasible, in your District's HVAC system. Have each system evaluated by a licensed mechanical engineer or vendor familiar with such systems **before** any changes to the HVAC systems are made. Further open minimum outdoor air dampers to reduce recirculation and increase fresh air within the classrooms. Ensure ventilation systems operate properly and provide acceptable indoor air quality for each space.

Where feasible and practicable, consider installing a UV-C light in the common return mixing plenum in lieu of a higher rated filter or in combination with a higher rated filter. If this option is pursued, it needs to be evaluated by a Certified Industrial Hygienist in Comprehensive Practice because there will be specific training, posting, maintenance, regulatory, safety and safety interlocks requirements.

We hope this info bulletin proves useful to you. Please contact us if we can provide assistance with your health and safety needs.

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