KOHLER&LEWIS
Mechanical Engineering

COVID-19 Mechanical Engineering Recommendations for Specific HVAC System Types

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Medium and Long Term Actions

The general report and Short Term Actions report have sections numbered 1, 2 and 3, so this report begins with an introduction, and then section 4.

Introduction

This report takes the general ventilation design principles of my report "COVID-19 Mechanical Engineering Recommendations for School Buildings" and applies them to form recommended specific actions for the medium-term (before cold weather commences in late October), and long term (next summer, and subsequent years.)

This report applies to buildings with Unit Ventilators (UVs), Air Handling Units (AHUs), Roof Top Units (RTUs), Energy Recovery Ventilators (ERVs), and Exhaust Fans (EFs), and for pneumatic, electric and Direct Digital Control (DDC) control systems.

Please note that following the recommendations of this report will NOT guarantee complete safety. There is no guaranteed level of safety except for complete quarantine.

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4 Medium Term Actions

4.1 All HVAC System Types

4.1.1 Be sure that all Short Term Actions have been completed.

4.2 Unit Ventilators

4.2.1 For DDC systems without CO2 control, consider adding a CO2 sensor for each UV: Vaisala GMW86P.

4.2.2 For DDC systems with CO2 control: with the advent of cold weather, it is time to reduce the UV outside air amount (which has been set at 100%). Via the DDC system, adjust the minimum outside air setting to 10%, and adjust the normal CO2 setpoint to 700 ppm.

4.2.3 For DDC systems, provide a minor software change to go to 100% outside air for all rooms that are used for meal time, when occupants will not be wearing masks. Implement the 100% outside air either via pushing the override button on the room temperature sensor (which would go to 100% outside air for one hour, or another selectable amount of time), or via preprogrammed time schedule – this choice should be made district-wide.

4.2.4 For electric or pneumatic controls, and for DDC systems without CO2 sensors, set the minimum outside air damper position to 2/3 open (during occupied hours for DDC systems). Unless you have a pneumatic pilot positioner at each UV, you may have to make this a manual positioning of the damper. The 2/3 setting is of course an approximation. If you are having other balancing work done in the school, consider having the balancer determine a more exact damper position to deliver 30 cfm/person of outside air. The balancer can use the mixed air temperature method (which requires an outside air temperature of 40F or below for best accuracy). Test a representative sample of UVs if the number of UVs is large. You can also use a portable CO2 meter in a fully-occupied room to

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help set or check the ventilation rate, but this would be time-consuming. Consider a CO2 reading in the range of 700-800 ppm to be satisfactory.

4.2.5 If there are variable-speed relief air fans for the UV rooms, set the fans to run at a partial speed to match the fresh air cfm. If there is not an exact match, it is better to have the building at a slight negative air pressure. Set all relief air fans to run on the same time schedule as that for the UVs.

4.2.6 Install MERV-13 filters in all unit ventilators, which will now be partially recirculating room air. This will slightly reduce airflow and increase noise.

4.3 AHUs and RTUs with Outside Air (OA) and Return Air (RA)

4.3.1 For units serving multiple rooms: check the engineering data for each AHU/RTU to see whether an OA damper position of 100% will allow the heating coil to provide adequate heat on the coldest design day. “Adequate” would be 70F leaving air temperature if the AHU/RTU service area has independent heating in each room, or 90F if the AHU/RTU provides the room heating. If needed, reduce the maximum outside air damper position accordingly. This maximum OA damper position may be reduced by other recommendations.

4.3.2 Examine the room-by-room outside air ventilation levels compared to the room occupancy and determine if more fresh airflow is needed to achieve the 30 cfm per person goal through the winter when opening windows is not an option on most days. Determine whether AHU/RTU total airflow can be increased, and then provide the needed balancing adjustments both at the AHU/RTU and at the branch ducts. [Same as 4.4.2.]

4.3.3 Where you determine that there will be occupied rooms with fresh air ventilation rates less than the recommended 30 cfm/person, consider adding a portable HEPA air filter unit to each room to make up the difference. For example, if a 20-person room has an OA rate of 400 cfm (20 cfm/person), add a minimum of 200 cfm (10 cfm/person) of portable filtration. Operate the portable unit(s) on the same time schedule as that for the room’s ventilation system. Use the unit’s

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built-in time clock, or use a digital plug-in time switch. See Note 5 for recommended air filter selection criteria and sample units. [Same as 4.4.3.]

4.3.4 For AHUs and RTUs that serve a single room, follow the recommendations for Unit Ventilators.

4.4 Energy Recovery Ventilators

4.4.1 For cold weather, it is time to reduce any excess outside air amount for variable-speed ERVs with CO2 control. Via the DDC system adjust the CO2 setpoint to 700 ppm.

4.4.2 Examine the room-by-room outside air ventilation levels compared to the room occupancy and determine if more fresh airflow is needed to achieve the 30 cfm per person goal through the winter when opening windows is not an option on most days. Determine whether ERV total airflow can be increased, and then provide the needed balancing adjustments both at the ERV and at the branch ducts. [Same as 4.3.2.]

4.4.3 Where you determine that there will be occupied rooms with fresh air ventilation rates less than the recommended 30 cfm/person, consider adding a portable HEPA air filter unit to each room to make up the difference. For example, if a 20-person room has an OA rate of 400 cfm (20 cfm/person), add a minimum of 200 cfm (10 cfm/person) of portable filtration. Operate the portable unit(s) on the same time schedule as that for the room's ventilation system. Use the unit's built-in time clock, or use a digital plug-in time switch. See Note 5 for recommended air filter selection criteria and sample units. [Same as 4.3.3.]

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5 **Long Term Actions.**

5.1 If new fresh air ventilation standards are updated, and are more stringent than those followed herein, make revisions as needed for full compliance. More stringent would be higher than 30 cfm/person, or lower than 750 ppm of CO2.

5.2 Replace all ventilation equipment more than 35 years old, in order to provide reliable fresh air ventilation and in the proper amounts.

5.3 If UVs lack DDC controls, replace all UVs (no matter their age) with DDC-ready units, and provide a DDC system for them.

5.4 If not already present, install a DDC system for the entire facility, including CO2 measurement for all rooms with code occupancies of eight or more people (except CO2 measurement is not needed for restrooms, kitchens, and similar rooms where exhaust air rates exceed 60 cfm/person.)

5.5 Replace any DDC system more than 20 years old, or one that lacks a web browser user interface.

5.6 Provide complete duct cleaning every 20 years. Note that Personal Protective Equipment may be needed for work on exhaust ducts, which might contain COVID-19 virus particles – comply with applicable regulations.

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Footnotes

(Notes 1-4 are used in the earlier reports)

(5) HEPA Air filtration Unit Selection Guide

The COVID-19 pandemic has made air filtration units very popular, with some models hard to get. And it has led to a confusing cacophony of products and claims. Here is a simple guide to sensible selection of filtration units. While the guide is simple, the selection of the units is not simple, due to many misleading claims and unnecessary bells and whistles.

We suggest four criteria:

(1) Be big enough – 100 cfm minimum.

(2) Have true HEPA filtration.

(3) Be quiet enough for a classroom.

(4) Be a mechanical filter only – no snake oil.

1. Be Big Enough – 100 cfm Minimum

Manufacturers misleadingly claim large airflow rates that are possible only with noise levels comparable to those of a window air conditioner. And the actual airflow rates at lower fan speeds are usually not listed and not available. A rule of thumb is to assume that the actual usable airflow rate is a third to a half of the advertised rate.

Unless you are getting a unit for a small office, a flow rate of 100 cfm is a good minimum. If first cost is paramount, then you may find that multiple 100-cfm units will have the lowest cost.

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2. **Have True HEPA Filtration**

HEPA (High Efficiency Particulate Air) filtration removes at least 99.9% of airborne particles of a wide range of sizes (0.01 – 10 microns, a range that includes the size of COVID-19 viruses). Lesser filtration efficiency also would be acceptable, but HEPA filtration is such a popular standard that more filtration units are available with it than without it.

3. **Be Quiet Enough for a Classroom**

We suggest a maximum noise level of 45 dBA. For most brands, compliance with this criterion is difficult to pin down prior to purchasing a filtration unit, due to the lack of published data. (However, see our Recommended Selections, below.) An ideal classroom will have even lower noise levels of 40 dBA or less, but this level is not achievable with HEPA filtration units except at very high cost per cfm, and background noise levels may be this high anyway.

4. **Be A Mechanical Filter Only – No Snake Oil**

With a 99.9% efficient filter, why would you need anything more? Answer: you don't. You don't need an air ionizer – or if your selected unit comes with one, just turn it off. Be aware that some units do not let you turn it off, so avoid these units. You don't need Microban, silver nano-particles, or any other anti-bacterial treatment of the filters or any part of the unit. (The federal government rightly is discouraging the use of this class of products.) They have no effect on viruses in any case. You don't need ultraviolet light, or photo electrochemical oxidation, or plasmawave technology, etc. You don't need an "air quality sensor" measuring particles or Volatile Organic Compounds.

A carbon prefilter is fine – this removes gaseous organic chemicals, including odors.

Recommended Selections

Here are recommended selections that meet all four criteria. All of them have been widely available lately, and current shipping estimates are shown below.

- Honeywell HPA300, 100 cfm (our measurement) at 45 dBA (our measurement at 3 feet) on “Germ” (lowest speed), about $300, Energy Star Rated. (Ships in 7 days at Amazon)
- Blueair Classic 205, 140 cfm at 44 dBA on medium speed, about $400, Energy Star Rated. (Ships in 7 days at Amazon)
- Blueair Classic 605, 275 cfm at 44 dBA on medium speed, about $850, Energy Star Rated. (Ships in 5 days at Amazon)

Choice of Fan Speed

Use the selected quiet speed during normal operation. During mealtimes, when most masks are off, and the room is already noisy, run the unit at maximum speed = maximum airflow. (Notes on masks: KN95 masks offer much better protection than cloth or fabric face coverings, and we have heard from teachers who keep their masks on while the students are eating.)

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