MEMORANDUM

To: Our Clients and Design Colleagues

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Subject: Covid 19 Pandemic – Building Design and Construction Industry Suggested Modifications

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The COVID-19 Pandemic has affected the building design and construction industry. Construction sites are shut down. Owners are experiencing potential delays in project schedules while government agencies may not be able to authorize building and process permits. As an industry, architects and engineers have been able to adjust how we work with minimal visits to the job site.

With the known mechanisms of transmission of corona viruses, specifically Covid-19, we here at AHA are willing to provide on-site inspection of HVAC systems to identify maintenance issues and recommend features to add to the systems to promote healthier indoor air. We have found that the following features may offer benefits in the improvement of the interior air:

- Proper Filtration
- Ventilation Rates and Methods
- Space Relative Humidity
- UVC Treatment

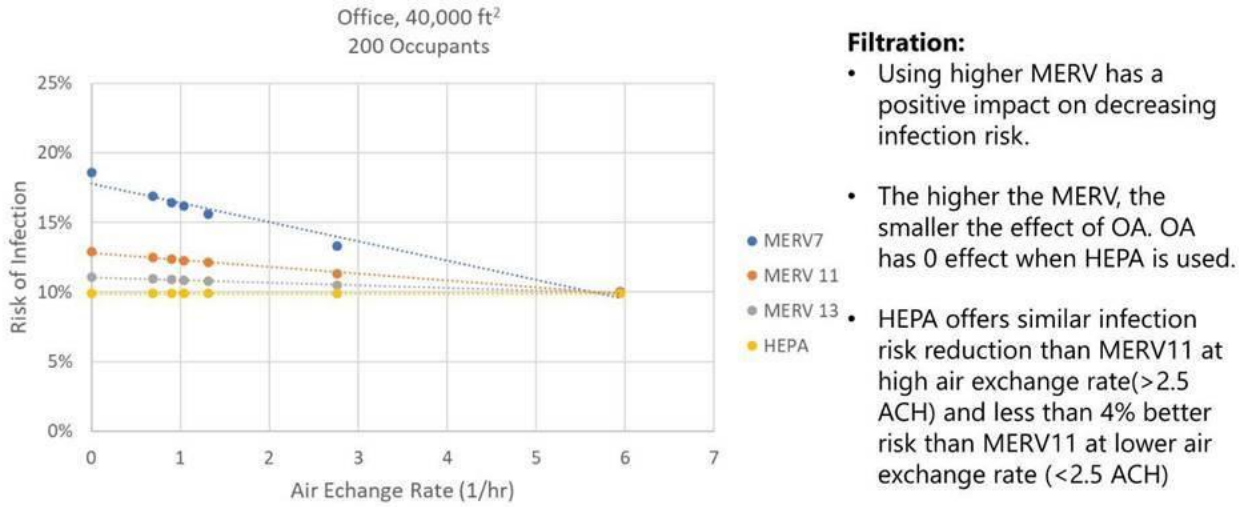
Filtration and Ventilation

High efficiency filters at the central air handler can reduce the spread of pathogens in the circulated air. Recommendations indicate a minimum MERV 13 filtration. HEPA filtration provides improvement over MERV 13 but at a substantial increase in operating costs. Good filtration provides more benefit than increasing the percentage of outdoor air (OA). Research carried out by the Harvard School of Public Health indicates an association between increases in particulate matter concentration and mortality rates due to COVID-19. Increasing OA in existing HVAC systems can cause other problems such as higher operating costs in general and problems with heating and cooling capacities in existing systems.

Existing filters and filter seals should be inspected before deciding to replace the existing filters with higher efficiency ones. In many systems, the filters are not well sealed and a noticeable amount of air may bypass the filters. Increasing the efficiency of the filters without addressing leaky seals will increase the amount of air bypassing the filters. Fan and fan motor capacities may be affected by the decrease in system pressure when some high efficiency filters are used, requiring an assessment of the system on a whole. Indoor recirculating filtration units with high efficiency filters may be added inside the building to circulate interior air.

Ventilation rates and discharge patterns need to be considered with respect to occupants. Air delivery should be such that a fast moving air stream is not directed to occupants where it can transport a pathogen across a room, either aerosolized or contained in a droplet.

This diagram compares the relative benefit of improvements in increasing filter efficiency vs increasing OA. As you can see, filters such as MERV 13 and sometimes MERV 11, can be almost effective as HEPA.



Filtration:

- Using higher MERV has a positive impact on decreasing infection risk.
- The higher the MERV, the smaller the effect of OA. OA has 0 effect when HEPA is used.
- HEPA offers similar infection risk reduction than MERV11 at high air exchange rate(>2.5 ACH) and less than 4% better risk than MERV11 at lower air exchange rate (<2.5 ACH)

Relative Humidity

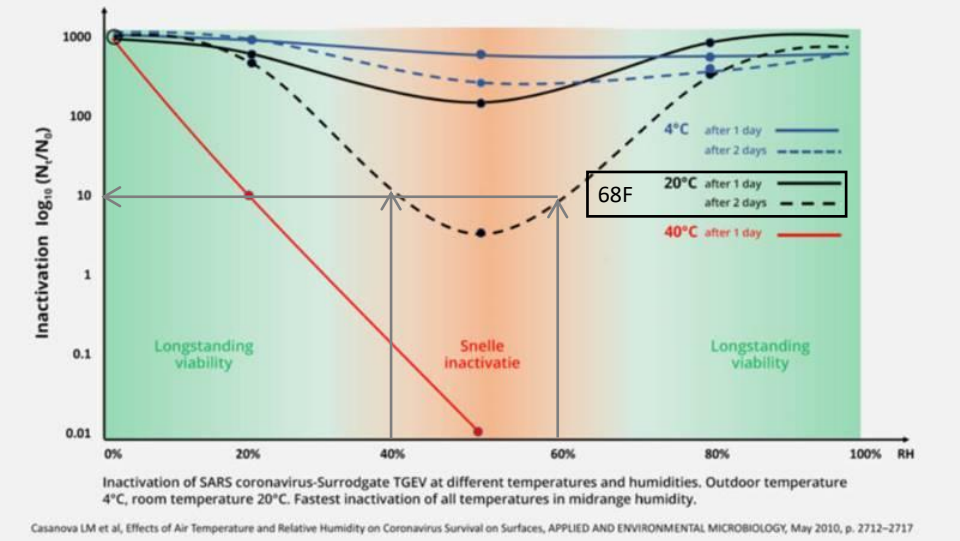
Research on the effect of Relative Humidity (RH) on viruses goes back to SARS and has shown that the risk of serious illness is significantly reduced with RH between 40 and 60%. The RH range of 40-60% affects both virus lifespan and the human immune response. There is some benefit based on indoor temperature also, but RH is much more important at the typical indoor temperatures specified for the indoor environment. Indoor RH levels during mechanical cooling are typically between 40 and 60%, so that is good news. In cold environments, when the outdoor temperatures can be 30F or below, indoor RH levels can be 20% or less. Humidification is needed to raise the RH to the recommended range. Humidification can be more easily added to new systems than added to existing buildings. Adding humidification to existing HVAC systems can be difficult to locate, expensive and maintenance intensive. Adding separate indoor humidification is an option. Relative humidity can make a difference in controlling the spread of pathogens and in maintaining a strong immunity . Reducing the OA amount can reduce the need for humidification, but this is not always possible. We have had a lot of success in

reducing OA by deploying the enVerid HLR in new and existing facilities. Research at Yale University has shown that low humidity hinders the immune response and leads to more severe symptoms.

From Research at the Harvard Medical School:

- First, when RH is in this optimal range, infectious aerosols released from a sick person quickly settle out of the air and can be wiped away from surfaces.
- Second, many viruses and bacteria, carried in droplets, are less infectious in this midrange RH zone. Conversely, when indoor air is dry, their infectivity is higher. This goes against many people's intuition!
- Third, RH between 40-60% is the range that optimizes the ability of our immune system to fight viral and bacterial infections. When indoor RH is lower, our respiratory immune system is less able to protect us from infectious microbes, even when we maintain perfect hand and surface hygiene.

This diagram shows effects of RH on the SARS coronavirus. It is a logarithmic scale so the impact is actually more pronounced than it looks.



Inactivation of SARS coronavirus-Surrodgate TGEV at different temperatures and humidities. Outdoor temperature 4°C, room temperature 20°C. Fastest inactivation of all temperatures in midrange humidity.

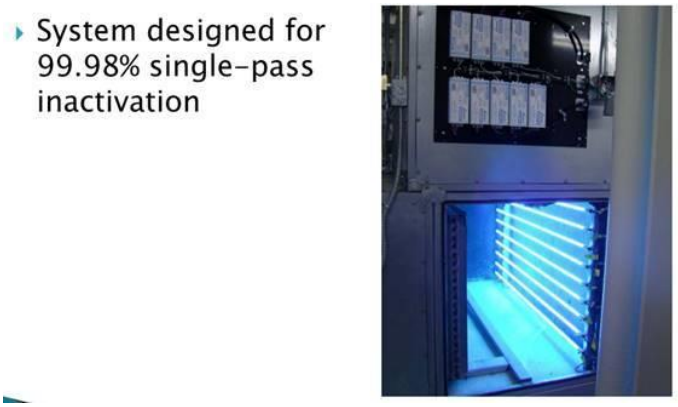
Casanova LM et al, Effects of Air Temperature and Relative Humidity on Coronavirus Survival on Surfaces, APPLIED AND ENVIRONMENTAL MICROBIOLOGY, May 2010, p. 2712–2717

UV Treatment

UV-C is effective in eliminating bacteria and virus. This requires the proper design and installation of UV units. The most effective wavelength appears to be 254nm. UV can be installed in air handling units, ducts and in the occupied space. UV systems are sized based on the target organism, level of exposure, and exposure time. Output efficiency of the lamps installed in cool supply air after a cooling coil may be less than in the 75F return air upstream of the coil. However, installing on the downstream side of the cooling coil provides the additional benefit of keeping the coil free of fouling.

In-room systems can operate continuously or at specific times. Upper-room systems consist of a series of lamps above the occupied zone. The UV rays should be directed away from people because UV can cause a burn similar to a sunburn or damage to eyes, and can also damage some materials.

An installation at the coil discharge:



Typical in-duct installation:

As a fast recap:

- Filtration – MERV 13 filters are nearly as effective as HEPA, except for critical spaces. Filter bypass must be minimized.
- Ventilation – OA is important along with good filtration. Equipment capacities need to be considered before increasing OA quantities.
- Space Relative Humidity – RH can make a big difference in pathogen lifespan and human immune-response. Recommended RH levels range between 40 and 60%.
- UVC treatment – Effective in eliminating bacteria and virus. Systems must be designed and installed correctly.

Please let us know how we can help you improve your facilities and operations.