HVAC COVID GUIDANCE

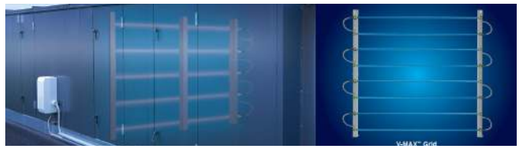
We've all read and watched a lot of information lately about how you can improve your HVAC system to prevent the spread of diseases and viruses, especially SARS-CoV-2. Some of it accurate, and some not so much. We pulled together a panel of our experts at Little to get their insights and recommendations on how to improve existing HVAC systems, and what to consider when designing new systems.

Q: WHAT ARE SOME HVAC OPTIONS TO CONSIDER THAT ARE LOW-COST AND HIGHLY-EFFECTIVE?

If you are looking to kill over 99% of all diseases and viruses in one pass, we recommend adding high-intensity UV-C energy that is emitted from Ultraviolet germicidal irradiation (UVGI) lamps. These lamps can be added in a variety of places within the HVAC system, but we recommend placement just downstream from the coil in the main air handling units, between the coil and the fan. Placing the lamp in this location will kill the viruses in the air that passes through, and provide an added benefit of cleaning the coil and the drain pan.

This typically is the easiest and quickest installation, as long as there is room in the unit. We've seen most vendors provide a magnetic clip for the lamp. The UVGI lamp will need its own power supply, and safety cutoff switch to turn off the bulb when the access panel is opened. If there are any exposed wires or rubber or plastic components, protect them with metal shielding so they don't deteriorate from the UV light.

In-Duct Air Disinfection System
https://www.uvdi.com/



AHU Air Disinfection System
https://www.uvdi.com/

If there isn't room in the air handler, an alternate location would be in the ductwork, though this may require additional labor and cost. Just make sure the duct is not lined. The galvanized metal does a great job reflecting the UV light.

Pricing for this should be reasonable and economies of scale from larger projects should bring that down. Required maintenance is changing the bulb once per year (they are rated for 9,000 hours of continuous runtime, or about 375 days) for less than $100. You could add a control point to the Building Management System (BMS) for runtime hours for the lamp to alert you when it's time to order replacement bulbs.

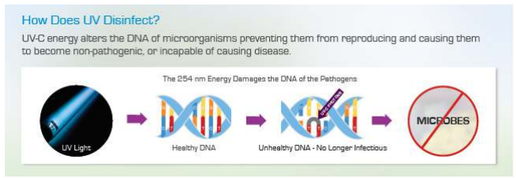
One thing to consider in adding UV-C lamps is who controls the air handling units, you, the tenant, or the building owner/manager? You may have to get permission to add them, and then discuss who is paying for and changing the bulbs.

Q: A RECENT ASHRAE POSITION PAPER RECOMMENDS INCREASING OUTSIDE AIR. WHY?

The purpose of adding fresh outside air is to try to dilute "bad stuff" out of the interior circulating air as much as possible. But outside air is the "most expensive" air since we need to condition it. This is why the energy code requires us to have Demand Control Ventilation (DCV) to monitor carbon dioxide in the densely populated space and only allow in outside air when needed, saving energy. However, during this time of concern about COVID-19, ASHRAE recommends temporarily reducing or disabling DCV to further dilute the air, with the trade-off being increased energy costs. It should be fairly simple for a technician to adjust the programming. Just remember to eventually turn it back on.

Q: IF WE HAVE HIGH-INTENSITY UV-C LIGHTING IN THE HVAC SYSTEM, DO WE ALSO NEED TO INCREASE OUTSIDE AIR?

Our recommendation would be to increase the outside air and add the UV-C. The UV-C removes bacteria and viruses, and the outside air mixing handles the rest. So until we get back to "normal" add more outside air for a healthier environment. Please note that there is a direct correlation between the percentage of Outdoor Air (OA) and the supply air temperature; notably in the cooling season, as the outdoor air percentage is increased so does the supply air temperature. There may be comfort issues with the maximum OA ratios during the cooling seasons.



Ultraviolet Light
https://www.uvdi.com/

Q: CAN INCREASED AIR FILTRATION BE ADDRESSED EASILY?

MERV 13 is the recommended minimum for filters. It's the standard we design to, and aligns with LEED and WELL certification requirements. Normal areas of hospitals, including most patient rooms, use MERV 13.

We like to have a MERV 8 filter to catch the big stuff, and the MERV 13 to catch the small stuff. The higher the MERV number, the smaller the particles that are filtered. MERV goes up to 20 (17-20 overlap with HEPA) and then you get into HEPA filters with special racks found in laboratories and critical areas of hospitals. MERV 13 filters will capture more of the smaller particles, including viruses, but its not the only improvement to make to address COVID-19 concerns.

MERV RATING CHART

Standard 52.5 Minimum Efficiency Reporting Value	Dust Spot Efficiency	Arrestance	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
16	n/a	n/a	.30-1.0 pm Particle Size	General Surgery	**Bag Filter-** Non supported microfine fiberglass or synthetic media, 12-36 in. deep, 6-12 pockets. **Box Filter-** Rigid Style Cartridge Filters 6 to 12" deep may use lofted or paper media.
15	>95%	n/a	All Bacteria	Hospital Inpatient Care	
14	90-95%	>98%	Most Tobacco Smoke	Smoking Lounges	
13	89-90%	>98%	Droplet Nuceli (Sneeze)	Superior Commercial Buildings	
12	70-75%	>95%	1.0-3.0 pm Particle Size Legionella	Superior Residential	**Bag Filter-** Non-supported microfine fiberglass or synthetic media, 12-36 in. deep, 6-12 pockets. **Box Filter-** Rigid Style Cartridge Filters 6 to 12" deep may use lofted or paper media.
11	60-65%	>95%	Humidifier Dust Lead Dust	Better Commercial Buildings	
10	50-55%	>95%	Milled Flour Auto Emissions	Hospital Laboratories	
9	40-45%	>90%	Welding Fumes		
8	30-35%	>90%	3.0-10.0 pm Particle Size	Commercial Buildings	**Pleated Filters-** Disposable, extended surface area, thick with cotton-polyester blend media, cardboard frame. **Cartridge Filters-** Graded density viscous coated cube or pocket filters, synthetic media. **Throwaway-** Disposable synthetic panel filter.

Most HVAC systems will take an upgrade to a MERV 13 filter, though we recommend having a mechanical engineer review the system and see if an analysis needs to be done to prevent any pressure drop issues. A deeper filter rack might be needed – a small one-time cost. The filters may also have to be replaced more often, if the HVAC system becomes less tolerant of clogged filters, which would slightly increase maintenance costs. Making the change at the big air handling units would be fairly straightforward.

In order to switch to HEPA level filters, fan filter units and different housing racks would be needed, and would be significantly more costly than a switch to MERV 13 filters. If the system has a lot of smaller fan coil units, water source heat pumps, VRF units, it would be more costly to upgrade filters. Adding a ceiling-mounted HEPA filtration system would be another expensive option, and we only see these used in extreme situations.

Q: ARE THERE OTHER HVAC CONSIDERATIONS THAT AREN'T AS OBVIOUS?

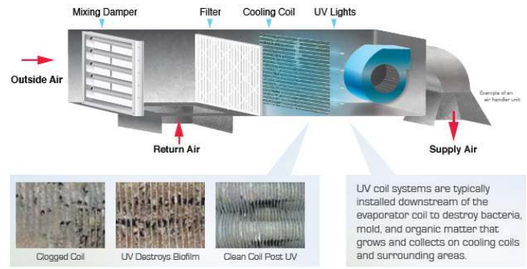
A temporary option might be a free-standing UV air cleaner, if you have the floor space, a place to plug it in, don't mind how it looks, and don't mind spending at least $1,000.

Direct humidity control is another option, but only for new construction or complete renovations. ASHRAE studies suggest if you can maintain 40%-60% relative humidity in a space, your body is more resistant to viruses, and the virus particles drop out of the air faster. Usually this is only found in hospitals or clean rooms. It would take a lot of work to retrofit a system, as it requires adding a water line and a drain line, possibly needing to purify the water, and possibly reworking ductwork. It would add to energy costs, and it would add a lot to maintenance. Our best guess on cost is $20,000-$30,000 per office floor.

Baseline specifications should always call for anti-microbial ductwork, but due to the cost it's almost always replaced with standard ductwork. Virus concerns may change that going forward.

Q: I'VE HEARD A LITTLE ABOUT BI-POLAR IONIZATION. CAN YOU TELL ME MORE?

We believe the jury is still out, at least in terms of the effectiveness of this technology with removing viruses. The basics of the process is particles receive a charge as they go through the HVAC units and when they get out into the open space, they find the "bad particles" in the air, clump together, and drop out of the air.



Coil Cleaning
https://www.uvdi.com/

ASHRAE is not backing it for the purposes of killing airborne aerosols or microbes, LEED and WELL are not accepting the technology either. We believe it's due to the larger particulates that fall out of the air and become surface contamination, rather than simply eliminating it from the air in the first place (like filters or UV-C lights would do.) LEED used to accept it to allow for the reduction of outside air, but not any more.

There are situations where this technology can be beneficial, such as if you need to remove VOCs or odors, but not for the purposes of virus removal.

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COVID-19 HVAC SELECTIONS

HVAC SYSTEM	HOW DOES IT WORK?	HEALTH	ENERGY	WATER	INSTALLATION	RETROFIT	ESTIMATED COST	NOTES AND RESOURCES
UV-C HIGH INTENSITY LAMPS	UV-C is short-wave electromagnetic radiation (most effective UV wavelength for germicidal control). UV-C disrupts the DNA of microorganisms, making them harmless. These lamps are used in air ducts and air handling units to reduce the transmission of contaminants	Kills 99% of all disease and viruses using UV-C light	Additional energy costs due to increased air temperature and electricity from the light may be associated, but are minimal.	NA	» Simple retrofit for existing systems. » Recommended placement: downstream from the coil in the main air handling units in a metallic section to avoid damage to other components » Alternate placement: in duct systems as standalone unit (increases installation cost)	YES	**$**	» Replace lamps annually or as recommended by manufacturer » Read more: https://www.ashrae.org/technical-resources/filtration-disinfection
INCREASED OUTSIDE AIR, ADJUST OR DISABLE DEMAND CONTROL VENTILATION	Reduces amount of recirculated air and introduces additional fresh air from outside, diluting the amount of air that has already been exposed to occupants.	Increased outside air recommended by ASHRAE	Demand Control Ventilation (DCV) monitors carbon dioxide in the space and only allows more than code minimum outside air when needed. Temporarily disabling DCV will increase energy costs but further dilute the internal air by bringing in more outside air.	NA	» Technician to adjust programming for DCV » HVAC tech to adjust outside air damper if not controllable	YES	**$$**	» Cost is mostly due to increased energy conditioning outside air. During shoulder seasons when conditions are favorable, cost increase is minimal. In extreme conditions, cost may be higher.
IMPROVE FILTRATION	MERV filters range from up to 20, the higher the MERV the more efficient at capturing airborne particulate Minimum Efficiency Reporting Value (MERV), a rating system for filtration. High Efficiency Particula Air (HEPA) filters are more efficient than MERV 16. HEPA filters, while better at capturing small particles usually require specialized systems and not normally used outside of surgical and clean room laboratories.	MERV 8 prefilter and MERV 13 final filter are recommended minimum and is Little's standard BOD Recommend changing filters when loaded, quarterly at most.	Minimal additional energy costs may occur from the HVAC system working slightly harder to pull air through higher filters. Generally increased filter efficiency = increased pressure drop Can investigate feasibility of deeper filters as they have more surface area and can reduce pressure drop.	NA	» Potential for retrofit but could lead to installation of deeper filter rack to offset pressure drop	YES	**$$$**	» May have to change filters more often, as HVAC system may be more sensitive to airflow restrictions from higher filters that are collecting more particulate matter » Ensure system can handle filter upgrades **» Most HVAC systems will take an upgrade to a MERV 13 filter, though we recommend having a mechanical engineer review the system and see if an analysis needs to be done to prevent any pressure drop issues.**
INCREASED HUMIDIFICATION IN WINTER	Helps occupant immune response and limits airborne virus' ability to travel via air by maintaining space relative humidity between 40-60%	Increased immune response of occupants Decreased travel by viral particulates	Little to no increased cost to HVAC, as the system would only run as needed being tied to the controls.	Increased use of potable water	Requires domestic water, sanitary sewer, electrical, and controls connections.	NO	**$$$$**	» Most critical in winter, when air is dry and further dried out by heating systems. » Requires retrofit of controls to operate humidifier.
WALL MOUNTED HUMIDIFIER TO INCREASE HUMIDITY IN WINTER	Self-contained humidifer that operates similar to the AHU (air handling unit) mounted humidifer.	Increased immune response of occupants Decreased travel by viral particulates Potential for health issues if water basin is not cleaned and maintained.	Potential for wasted energy, as system not connected to main controls or AHU system	Increased use of potable water		YES	**$$**	
STAND ALONE AIR UVC PURIFIER	Self-contained UV-C lamp that operates similarly to AHU/duct mounted unit.	Kills 99% of all disease and viruses using UV-C light	Minimal additional energy costs from running the unit	NA	Potential for small spaces	YES	**$$**	» May not be pleasing to the eye » Loss of floor space
BI-POLAR IONIZATION	Creates oxygen ions to react with airborne organic compounds, causing the particulate to aggregate and fall out of the air				Not recommended for removing virus contaminants	NO	**$$**	» Has the potential to create larger particulates that fall out of the air and become surface contamination. » Potential to react with cleaning products, creating harmful compounds like formaldehyde » Not compliant with LEED and WELL » Better application would be if you have VOCs or odor issues, not for removing particulates in the air » Some systems may emit excess ozone

Additional Resources
https://www.ashrae.org/technical-resources/filtration-disinfection