ryan soames engineering

HVAC AND COVID-19

WHAT CAN ENGINEERS, DESIGNERS AND CONTRACTORS DO TO ASSIST IN THE FIGHT AGAINST THIS VIRUS?

WE NORMALLY TURN TO THE CODE BOOK BUT HAS THIS BEEN WRITTEN YET?

ASHRAE being our trusted resource for years has developed guidance to help address concerns with respect to operation and maintenance of HVAC systems:

Interim Guidance for Businesses and Employers to Plan and Respond to Coronavirus Disease 2019 (COVID-19)

- Plan, Prepare and Respond to Coronavirus Disease 2019

ASHRAE INTERIM GUIDANCE >

The main changes to the guidance are:

- Updated cleaning and disinfection guidance
- Updated best practices for conducting social distancing
- Updated strategies and recommendations that can be implemented now to respond to COVID-19

ASHRAE have also created a new epidemic task force:

ASHRAE EPIDEMIC TASKFORCE >

In addition to ASHRAE, OSHA has provided their own guidance for preparing workplaces:

OSHA GUIDANCE >

The CDC has also provided separate guidance for Healthcare:

CDC GUIDANCE >

Much of the OSHA and CDC Guidance has been put into effect involving social distancing and personal health and hygiene but what else can be done?

Maintaining a healthy work environment

The CDC recommends the following:

- Improving the engineering controls using the building ventilation system
- Increase ventilation rates
- Increase the percentage of outdoor air that circulates into the system

This is where the HVAC community can aid. There is a role to play for HVAC systems in the transmission of COVID-19, how HVAC systems work, and the practical HVAC operational measures that can be considered along with possible design changes to reduce the likelihood of the virus spreading.

It is believed that the virus can be transmitted from person-to-person, most likely through close contact with an infectious person, or contact with droplets of fluid from an infected person's cough or sneeze. It is also believed that transmission can occur by touching surfaces that have droplets from an infected person, and then touching the mouth or face. It is believed that the virus may survive for up to 9 days on some surfaces in the right conditions

When a person infected with an illness coughs or sneezes, pathogens can be encapsulated within droplets of fluid and discharged into the air. Different illnesses are known to result in differing droplet sizes. It is not yet certain what size droplets are produced by people infected with COVID-19.

It is known that large droplets (>60 μm) normally are too large to remain suspended in the air and usually fall and land on surfaces. In some instances, some of the fluid can evaporate and the large droplets can transform into smaller particles called droplet nuclei and these can remain suspended in air. Droplet nuclei (2.5 to 10 μm) are believed to be able to remain suspended in air for hours and therefore be entrained into HVAC systems.

Heating Ventilating and Air Conditioning (HVAC) systems exist in many formats. It is fundamentally a recirculating system with a portion of outside air added continually while a similar portion is exhausted. The outside air rate can be varied in many systems. Air is filtered before recirculation and moved around the system using fans. Heating and cooling are typically provided by finned coils.

The journey that a virally infected droplet would experience to arrive back in an occupied space would typically include extended ducted air pathways, multiple changes in direction and air velocity, and multiple impacting surfaces including air filters, fans, dampers and grilles. There is a good likelihood that a particle would impact, entrain and dry on a surface.

While published research on healthcare ventilation systems and scenarios suggests that the transmission of droplets containing viral material is theoretically possible in these situations, it is thought to be less likely in a well-designed and properly maintained typical HVAC system in a public setting.

There are a number of practical HVAC operational measures that can be addressed along with possible system changes to reduce the likelihood of a virus spreading including the following:

- Maintenance regimes and essential safety measures
- Cleaning and disinfection
- System commissioning and operation, and outside air rates
- Air filtration and cleaning options

Maintenance regimes and essential safety measures

The continued application of good housekeeping and preventative maintenance regimes are imperative. HVAC maintenance should be carried out as prescribed by the recognized standards and maintenance procedures should be adhered to.

It is important to remember that in the majority of modern buildings, operating HVAC systems form part of the essential safety measures and are therefore required for occupancy. The scheduled statutory maintenance of these systems along with fire protection and other essential systems is mandatory.

While facilities may scale down operations and occupancy as the COVID-19 situation evolves, generally these essential safety systems must continue to be maintained in accordance with regulations to ensure the ongoing compliance of the buildings.

Building operators should confer with service providers if measures are being considered to preclude or restrict maintenance technicians from accessing buildings.

Air filters should be replaced as scheduled or more often as required. PPE (Personal Protective Equipment) including P2 mask or appropriately rated respirator, coveralls and gloves and should be worn by trained technicians when servicing dirty filters.

After turning off the air handling unit, filters should be carefully removed to avoid dust or other particles being released into the air, and the dirty filters should be bagged and tied, and the bag disposed of in an appropriate waste disposal process.

Surfaces should be cleaned to remove any residual particles. Service of washable air filters should be carried out with similar approved procedures and use of PPE.

Cleaning and disinfection

Standard HVAC systems are typically very difficult to clean and disinfect effectively because of the lack of access to many of the system components and ductwork. Some systems in acute care health facilities or laboratories are designed to provide adequate access and other features to facilitate regular and effective cleaning.

In commercial HVAC systems, air filters can be readily changed, and cooling and heating coil surfaces can be cleaned and disinfected using approved methods and chemicals. Most other features and surfaces in HVAC systems typically cannot be readily cleaned physically.

In HVAC systems that include wall mounted or console type induction type units or chilled beams it is practical to clean these units if required.

Fogging or fumigating using approved methods and chemicals for disinfection can be applied in facilities and HVAC systems that are designed for this treatment. Typically, these are in laboratories and some acute care areas. Fogging or fumigating is not recommended for normal facilities and standard HVAC systems that are not specifically designed for this treatment. It is very likely to be ineffective and may be hazardous in these situations.

System commissioning and operation, and outside air rates

It is important to ensure that HVAC systems have been properly commissioned and are operating correctly. Commercial HVAC systems are typically designed to produce internal conditions with a relative humidity of 40 – 60 per cent. Published research suggests that this humidity range may have a positive impact on virus deactivation, human susceptibility to virus's and cross infection rates.

Minimum statutory outside air rates should be in place as a basic requirement. Increased ventilation (circulation) rates can assist in diluting contaminants in room air and potentially reduce the likelihood of infections. In systems with modulating outside air systems, or where adjustment is possible, increasing outside air rates may be possible. This will also require increasing the system's exhaust air rate and will help dilute any contaminants in the circulating air.

It should be noted that increasing outside air rates and or ventilation rates will generally result in increased energy usage and in some circumstances may result in difficulties in the system maintaining the desired internal temperature and humidity conditions.

Air filtration and air cleaning options

Filtration in building HVAC systems can be a part of an overall risk mitigation approach but is not generally regarded as solution by itself. There is no direct scientific evidence of benefit, but some reduced exposure can reasonably be inferred based on the ability of some filters to remove relevant-sized particles and droplets.

In order for air filters to have any impact on infectious disease transmission, transmission has to occur through the airborne route, filters have to be properly installed and maintained in appropriate systems to treat recirculated air, and filters have to be appropriately designed for the building in which they are used.

More importantly, in most buildings and situations, filters may not be as effective as other infection control measures, including social distancing, isolation of known cases, and handwashing.

High-efficiency filters may be appropriate for your building, but they can also be counterproductive. A high-efficiency filter may have a high initial pressure drop and/or accumulate dust and particles very quickly, thus requiring frequent filter changes.

A high pressure drop filter (either because it is that way when it is new or because it is heavily loaded with dust) can also cause more air to bypass the filter if it is not properly installed and well-sealed. Depending on the design of your system, a high pressure drop filter can also diminish the amount of air supplied into the environment, making the filter less effective as well as causing other problems with other parts of the HVAC system.

Most importantly, in many residential and some light commercial systems, the fan in the system does not run very often, and the efficiency of the filter may not be as important as it could be.

Air filtration typically installed in standard HVAC systems will not be effective in filtering droplet nuclei or viruses, should these reach the filters. The addition of increased efficiency particle filtration is likely to reduce the airborne load of infectious particles.

HEPA (High Efficiency Particulate Arresters) filtration systems filter 99.999 per cent of dust particles and airborne contaminants such as viruses and bacteria. These filters are typically used in hospital operating rooms, acute care areas and clean rooms. HEPA filters are unlikely to be a practical option for most existing HVAC systems due to their high pressure drop. Additionally, HEPA filters require specific housings and cannot be retrofitted as a direct replacement for traditional filter media.

Conventional air filters with an improved Minimum Efficiency Reporting Value (MERV) between 13 and 15 (F7 to F9) can reduce levels of droplet nuclei but are not likely to be effective at stopping any unattached virus particles. These filters could assist in reducing the likelihood of droplet nuclei from spreading and may be within the fan capabilities of existing systems.

Generally, efficient filters have higher pressure drops which can increase energy consumption, though advancements in technology mean this is not always true.

Similar to building filtration, there is no direct clinical evidence of the benefit of portable air cleaners for reducing infectious disease risk, but some benefit can be reasonably inferred for portable HEPA filters, provided they are appropriately sized (i.e., their removal rate is appropriate for the size of the room), maintained, and operated. As with building filtration, the details are important, such as the efficiency and airflow rate of the air cleaner, sizing, and placement within the space, maintenance, and filter change, and the nature of space that is being cleaned. As with building filtration, they are only likely to be effective in concert with other measures.

Another practical method of air cleaning is Ultraviolet Germicidal Irradiation (UVGI). UVGI technology involves the production of short wavelength light which is capable of disrupting the DNA of microorganisms including viruses. The effectiveness of ultraviolet radiation depends on the intensity of the light and the time period that a given pathogen is exposed to the light. Units are available as in-duct devices that are installed in ductwork or air handling units.

A properly designed and maintained UV system, often in concert with filtration, humidity control, and airflow management, has been shown to reduce infections from other viruses.

However, the details of the system are very important (e.g., design of fixtures, lamp type, lamp placement, airflow amount and mixing, etc.). Simply adding UV to an existing system without consideration of these factors has not been demonstrated to have a benefit.

ASHRAE, the global organization that publishes standards and guidelines for HVAC, recommends UVGI use in hospitals, schools, and military installations, but application in the United States has been limited. Not only is there the initial expense and need for professional installation, but these specialized systems require additional ongoing maintenance.

Another filtration technology that has been growing in popularity in adoption is Bipolar Ionization. Bipolar Ionization technology produces a natural bio-climate rich in positive and negative oxygen ions. The negative ions contain an extra electron while the positive ions are missing an electron resulting in an unstable condition. In an effort to restabilize, these bipolar ions seek out atoms and molecules in the air to trade electrons with, effectively neutralizing particulate matter, bacteria and virus cells, odorous gases and aerosols, and VOCs.

One advantage of this technology is the low energy use. The ion generators use just a watt of 2 in most installations. This is an advantage over systems that use an enhanced filter media. Also, the ionization of the air causes the existing filters in the system to more evenly load up reducing fan energy in the long run so there is actually an energy savings on fan energy through their use.

Another advantage of this technology is the range of HVAC systems that they can be installed in. In addition to unit for every air handler size from small residential air handlers to 30,000 CFM central plants there are options for installation in terminal units. There are ionizers that can be installed in fan coils, PTAC, as well as VRF ductless split systems.

Bipolar Ionization is so effective in reducing contaminants from the air that it is recognized in ASHRAE Indoor Air Quality Procedure from Standard 62.1. Installation of a bipolar ionization will allow building operators to reduce the minimum outdoor air supplied to the space which provides large energy savings. The reduced outdoor air requirements can also be of use when changing use or occupancy of a space during renovation. In systems where it is not an option to increase the minimum outdoor air to meet the new code requirements without significant alterations of the HVAC system the addition of bipolar ionization allows you to meet code while keeping the existing HVAC system in place unaltered.

The biggest selling point for many building operators is the maintenance cost of bipolar ionization. There is no additional maintenance required from this system. The fact that this system causes the filters to load more evenly and reduces the required min outdoor air will extend the time between required filter changes. Filter changes are the primary maintenance item in most air handling systems.

Closing

It is clear that further guidance will be required and indeed provided in the coming months on the subject but in the interim, Ryan Soames Engineering has already been dealing with requests from Clients to review existing conditions and provide recommendations for new and improved and retrofitted HVAC and filtration systems.

Our workplaces have already changed and will continue to do so.

If you would like to speak to us specifically about your needs or for further general information please feel free to reach out.

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