NY ENGINEERS CORONAVIRUS IMPACT ON CONSTRUCTION

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CORONAVIRUS PREVENTION WITH AIR FILTERS UNDERSTANDING MERV AND HEPA

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Most coronavirus infections seem to occur at short distances, when infected persons sneeze or cough. However, many infections also seem to occur with airborne transmission, when smaller drops (aerosols) with the virus stay suspended in the air. ASHRAE provides many guidelines to help prevent the airborne transmission of coronavirus. One of the recommendations is using air filters with at least a MERV 13 rating, or the superior HEPA rating if possible. This article will briefly describe each filter rating and its applications.

The professional opinion of an HVAC engineer is strongly recommended before attempting to upgrade any air filters. More efficient filters cause a higher pressure drop, and your air handling unit may not have enough capacity. There are three main options to improve air filtering in buildings:

- Upgrading to more efficient filters, while staying within the operating capacity of your ventilation system.
- Upgrading to an even higher filter efficiency, but also upgrading your ventilation system to overcome the additional pressure drop.
- Using portable air cleaners with high efficiency filters. These can complement HVAC filter upgrades, or they can be used as an alternative when an upgrade is not possible.

Air filters are not only a prevention measure against airborne pathogens. They also capture inorganic pollutants like particulate matter, improving your indoor air quality in general. For even better results, filtering can be combined with an air purification method, such as Ultraviolet Germicidal Irradiation (UVGI). Air purification with UVGI not only inactivates viruses, but also bacteria and mold spores.

Air filtering and other indoor air quality measures for coronavirus are intended as a complement for the guidelines provided by health authorities: social distancing, handwashing, personal protective equipment (PPE), etc. These measures cannot be overlooked, even if your building has the best air filtering and disinfection systems in the market.

MERV Filters: Minimum Efficiency Reporting Value

The Minimum Efficiency Reporting Value (MERV) is an effectiveness scale for air filters that was developed by ASHRAE in 1987. The scale goes from 1 to 16, where a larger number indicates a higher filter efficiency and the ability to capture smaller particles. The following table summarizes the average arrestance and applications of filters along the MERV scale, and the typical particle size for which they are used.

MERV	AVG. ARRESTANCE	PARTICLE SIZE RANGE	APPLICATIONS
1-4	60-80%	>10.0 microns	Minimum filtering for: Residential buildings Light commercial buildings Equipment protection
5-8	80-95%	3.0-10.0 microns	Industrial workplaces, Typical commercial buildings Better residential buildings, Paint booths & finishing
9-12	>90-98%	1.0-3.0 microns	Superior residential buildings, Better industrial workplaces, Better commercial buildings, Hospital laboratories
13-16	>95-99%	0.30-1.0 microns	Smoke removal, Hospital inpatient care, General surgery, Superior commercial buildings

The MERV of a filter is determined with laboratory tests according to ASHRAE Standard 52.2. The test uses an aerosol generator and synthetic dust specified by ASHRAE, and particle counts are measured upstream and downstream from the filter. The testing procedure for the MERV rating uses 6 measurements and 12 particle sizes, which results in a total of 72 data points.

- To help prevent coronavirus infections in buildings, ASHRAE recommends upgrading air filters in HVAC systems to at least MERV 13.
- In cases where this is not possible, portable air cleaners with MERV 13 or better filters can be used.
- In residential settings, ASHRAE recommends upgrading typical 1-inch filters to MERV 13, and upgrading 2-inch filters to MERV 16. However, you should double-check with an HVAC engineer before proceeding.
- When using UVGI for in-duct air cleaning, ASHRAE recommends using at least MERV 8 filtering to complement the disinfection system.

Consider that a filter is only effective when air is moving through. For this reason, ASHRAE recommends increasing the operating schedules of ventilation systems, up to 24/7 if possible. More pollutants and germs can be captured simply because more air is moving through the filter.

HEPA Filters: High Efficiency Particulate Air

High Efficiency Particulate Air or HEPA filters outclass even the MERV 16 filter rating. While a MERV 16 filter captures >95% of particles in the entire size range tested (0.3-10.0 microns), a HEPA filter captures 99.97% of particles with a size of 0.3 microns. The filtering efficiency is even higher for particles larger or smaller than 0.3 microns. HEPA filters can capture many airborne germs, and also nonliving pollutants such as fine particulate matter.

Since HEPA filters are so efficient, they cause a higher pressure drop than even MERV 16 filters. Many ventilation systems are not designed for HEPA, but these filters are also available as portable air cleaners or even vacuum cleaners

Given their high efficiency, HEPA filters are recommended for critical healthcare applications like anterooms, isolation wards and COVID-19 patient rooms. When educational institutions reopen after the coronavirus outbreak, ASHRAE also recommends a portable HEPA and UV air cleaner for each classroom, with at least two air rotations per hour.

Conclusion

Filtering is a mechanical air purification method, which means it works with living and non-living particles. HEPA filters are the most efficient for residential or commercial use, followed by MERV 13-16 filters. However, the airflow restriction of these filters causes a significant pressure drop. For this reason, the pressure and airflow delivered by the ventilation system must be considered before specifying a filter.

In cases where the ventilation system cannot handle a high-efficiency filter, you can use the highest MERV possible for the system capacity, complemented with a portable air cleaner. Alternatively you can upgrade the ventilation system itself, making it suitable for MERV 13 filters or better.

There are many types of HVAC systems, and each building is unique. To improve indoor air quality and help prevent coronavirus infections, the best starting point is an assessment by a qualified HVAC engineering firm.

THE WHO WARNS AGAINST AIRBORNE COVID: IMPORTANCE OF INDOOR AIR QUALITY

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The airborne transmission of coronavirus has been a widely debated topic among medical professionals and researchers. At first, the prevention guidance focused on avoiding large droplets when infected persons sneeze or cough, while keeping surfaces and objects disinfected. However, there is now scientific evidence that airborne COVID-19 infection is possible, in the form of microscopic particles that are called aerosols. These particles can reach high concentrations in poorly ventilated spaces, increasing the risk of infection.

At first, guidance from the World Health Organization (WHO) focused on preventing infection by large droplets and surfaces, and airborne transmission was not considered a significant risk. However, the latest guidance from the WHO recognizes the threat of COVID-19 infection by exposure to aerosols.

With the risk of airborne COVID-19, indoor air quality becomes critical in buildings. ASHRAE has provided detailed guidance on how to improve IAQ and reduce the risk of infections. Specific guidance is provided for each building type, but in general they focus on:

Increased ventilation with outdoor air, with zero air recirculation when possible.
Upgrading air filters to medical grade, which means MERV 13 or better.
Air and surface disinfection with Ultraviolet Germicidal Irradiation, or UVGI.

ASHRAE GUIDANCE TO CONTROL AIRBORNE COVID-19

The infection mechanisms of the new coronavirus are not fully understood. However, airborne transmission seems more likely in building interiors, especially if they have high occupancy and deficient ventilation.

- When there is a large number of occupants, the chance of having COVID-19 positive persons is higher.
- Deficient ventilation means that viral particles are not removed from the air effectively. Since this increases exposure to the virus, infections are more likely.

Occupancy can be reduced with stay-at-home orders, instructing companies to use teleworking as much as possible. This infection risk is reduced for the simple reason that collaborators are not interacting in person.

Ventilation improvements depend on the existing HVAC installation. Some systems can be easily reconfigured, while others may need component upgrades to provide adequate ventilation. In general, ASHRAE recommends increasing the outdoor air supply as much as possible, while reducing or eliminating air recirculation. Outdoor air does not normally contain coronavirus, and an increased air supply can dilute air pollutants. With reduced recirculation, outdoor air can displace indoor air that has been accumulating viral droplets.

Filter upgrades and UVGI can provide additional protection against COVID-19 infection: medical-grade filters can capture a high percentage of air particles, while UV light can kill germs by destroying their DNA. However, building owners must use the right products: filters should have at least a MERV 13 rating, and UVGI systems must use UV-C light specifically.

FINDING THE BEST AIR QUALITY MEASURES FOR A BUILDING

To improve indoor air quality, the best starting point is a professional assessment of the property. Depending on the type of ventilation system and the HVAC configuration, the most effective measures will vary. For example, HVAC systems that are controlled by a Building Automation System (BAS) can be easily reconfigured, while systems without smart controls will need manual adjustments.

Increasing the outdoor airflow is beneficial for air quality, but this may be limited by weather conditions. For example, if the outdoor air is very hot or cold, a high airflow may overwhelm the air conditioning or space heating system. This may cause indoor temperatures that are unsuitable for extended occupancy.

Upgrading air filters is only recommended after a fan inspection, or you can end up installing filters that restrict airflow. Instead of improving air quality, this will end up having a detrimental effect. Professional guidance is also necessary when deploying UVGI, since ultraviolet light can cause eye or skin damage with incorrect use.

NY STATE NOW REQUIRES AIR FILTERS FOR CORONAVIRUS IN SHOPPING MALLS

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Coronavirus infections seem to occur mostly at short distances when persons interact, and also when touching surfaces with the virus. However, airborne transmission at longer distances is still a debated topic. There is not enough scientific evidence to confirm airborne transmission, but the risk is high enough to justify action. Considering this issue, shopping malls in New York state will be required to have filtering systems that can capture COVID-19.

ASHRAE recommends filters with a MERV rating of 13 or higher, in a scale from 1 to 16. MERV stands for Minimum Efficiency Reporting Value, a measurement scale that was first introduced by ASHRAE in 1987. High Efficiency Particulate Air filters (HEPA) are even more effective than MERV 16, and NASA has tested HEPA filters with particles as small as 0.01 microns (one micron is 1/1000 of a millimeter).

AIR FILTER UPGRADE: TIPS FROM PROFESSIONAL ENGINEERS

Upgrading air filters may seem like a simple and straightforward procedure. However, simply replacing filters with the most efficient units available is not recommended by HVAC experts.

- Air filters add resistance to airflow, and more efficient filters have a greater resistance.
- When higher efficiency filters are installed, the ventilation system must produce more air pressure to reach the same airflow.
- If fans lack enough capacity for the new filters, the airflow will drop and the building may not get enough ventilation.

To ensure that shopping malls get enough ventilation after a filter upgrade, the best recommendation is contacting a qualified HVAC engineering firm. This way building owners can optimize their fan capacities and filter ratings, to achieve COVID-19 filtering at an optimal cost.

Property managers must be aware that air quality measures are not intended to replace the guidance from health authorities. In other words, social distancing and face masks are required, even if a building has excellent air quality.

Assuming that coronavirus is airborne is much smarter than assuming the opposite. Reaching a conclusion would require time and many experiments, and having too much protection is better than not having enough.

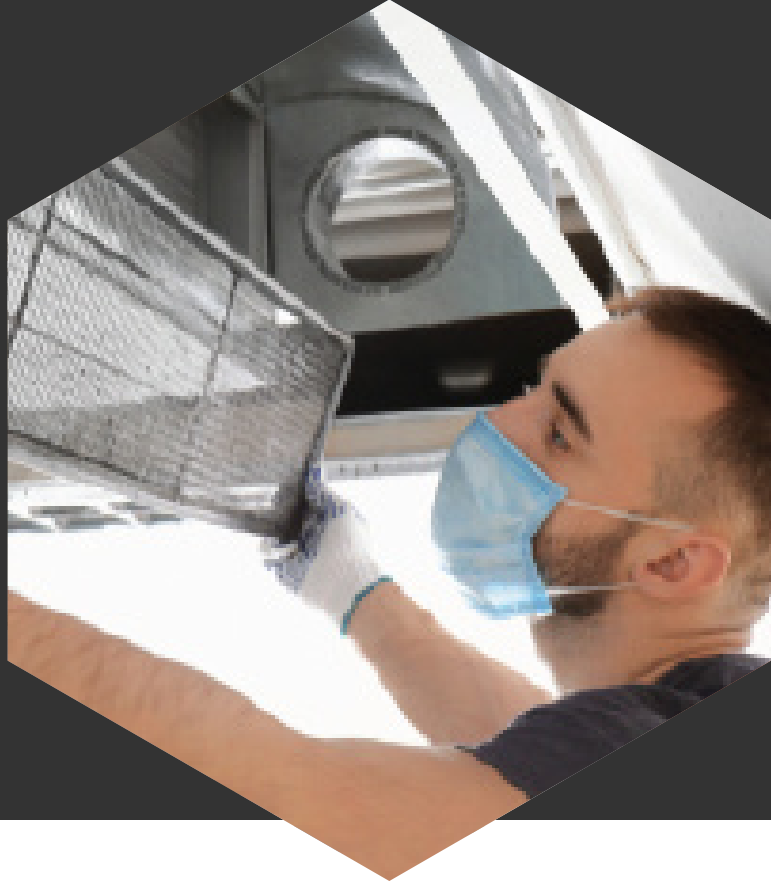
ADDITIONAL AIR QUALITY MEASURES FOR MALLS IN NY

Air filters that are capable of capturing coronavirus will be mandatory for NY malls. However, this can be combined with other measures recommended by ASHRAE, further reducing the risk of COVID-19. The ASHRAE recommendations also include a higher outdoor air ventilation, and adding ultraviolet germicidal irradiation systems (UVGI).

Many ventilation systems have smart controls that optimize airflow according to occupancy, and this concept is called demand controlled ventilation (DCV). However, during the coronavirus emergency and its aftermath, the best recommendation is disabling DCV and setting the outdoor airflow as high as possible.

With respect to UVGI, the highest germicidal effect is achieved with UV-C radiation, which has a wavelength below 280 nanometers. However, the UVGI systems must also be ozone-free, since ozone can severely irritate the respiratory system.

COVID-19 RESILIENT BUILDING: INDOOR AIR QUALITY HVAC REPORT



WHY IS A BUILDING AIR QUALITY CHECK IMPORTANT?

According to the World Health Organization (WHO) and other health authorities, the 2019 coronavirus (SARS-CoV-2) is transmitted mostly within short distances. When infected persons sneeze or cough, they release large droplets that contain the virus, which normally fall within six feet. These viral particles can also be released when speaking loudly or yelling, Other persons can get infected with direct exposure to these droplets, or when they touch an infected surface and then touch their eyes, nose or mouth.

However, coronavirus also appears to be transmitted by smaller droplets called aerosols, which stay suspended in the air for longer. Aerosols can travel longer distances than large droplets, especially when carried by air currents or HVAC ducts. Considering these risks, ASHRAE has provided detailed guidance on how to prevent airborne transmission of coronavirus. Each building and its systems are unique, but there are general principles that can be applied to prevent airborne transmission of COVID-19:

- Increasing ventilation with outdoor air, while reducing indoor air recirculation.
- Replacing air filters with more efficient units, such as MERV 13 or higher.
- Using Ultraviolet Germicidal Irradiation (UVGI) to complement air filtering.
- Keeping relative humidity between 40% and 60%, since this range minimizes the transmission of viruses and bacteria.
- Inspecting HVAC systems and ensuring they work optimally before reopening a building.

ASHRAE also warns about the Legionella bacteria, which proliferates in warm and stagnant water. Building owners should detect and eliminate any Legionella risks before a building resumes operation. Hot water piping and cooling towers are likely spots for Legionella growth. This bacteria can cause severe pneumonia, similar to coronavirus infection.

Before reopening a building after the coronavirus outbreak, a deep inspection by professional HVAC engineers is strongly recommended. Even if your building has not stopped completely, an indoor air quality assessment can help you prevent coronavirus infections.

HVAC design measures can help prevent the spread of coronavirus, but they cannot prevent infections by themselves. Building owners should make sure that occupants use personal protective equipment (PPE) whenever necessary while practicing social distancing and following all the guidelines provided by health authorities. NY Engineers can analyze your HVAC system and other key equipment, identifying measures to make your building more resilient against COVID-19.

COVID-19 PREVENTION WITH INCREASED OUTDOOR AIR SUPPLY

Many ventilation systems are designed to optimize the outdoor air supply: the outdoor ventilation rate is increased during high occupancy and reduced during low occupancy. This concept is called demand-controlled ventilation (DCV), and it saves fan power while reducing the workload on space heating and cooling systems. However, in response to the coronavirus emergency, ASHRAE recommends keeping the highest possible airflow in buildings, for as long as possible (even 24/7).

In other words, building owners should disable their DCV systems temporarily, and set the outdoor air supply as high as possible. ASHRAE is aware that keeping 100% outdoor air 24/7 is not possible in some climates, or when outdoor pollution is high. However, they recommend increasing outdoor air as much as possible under the operating conditions of each building.

The building should also reduce or eliminate air recirculation by HVAC systems, and also unwanted air movement between building areas. Indoor air should be exhausted without recirculation whenever possible, and replaced with 100% outdoor air.

Positive pressurization can be used to keep air outside of a specific area. This is achieved by setting the air supply higher than the air exhaust.
On the other hand, negative pressurization is used to prevent air leakage from a specific area. This is achieved by setting the air exhaust higher than the air supply.

For example, a place where important supplies are stored can be kept at positive pressure to keep air pollutants out. On the other hand, a room where coronavirus could be released should be at negative pressure, keeping the virus away from other building areas.

ENERGY EFFICIENCY MEASURES FOR OUTDOOR AIR VENTILATION

An increased outdoor airflow leads to a higher workload for heating and cooling equipment, since more air must be conditioned. This increases energy consumption, but there are two ways to compensate for this:

• In some climate zones, an airside economizer can increase outdoor airflow to achieve the same effect as air conditioning. This provides the higher ventilation suggested by ASHRAE, while saving on air conditioning. Keep in mind that the effectiveness of an economizer depends on the local climate, so you should ask a qualified HVAC engineer before purchasing one.
• An energy recovery ventilator (ERV) can exchange heat and humidity between the outdoor air supply and the exhaust air, reducing the workload on HVAC equipment. However, the ERV must be in optimal condition to prevent mixing between both airstreams. Viral particles and other pollutants in the exhaust air must be prevented from reaching the supply air. A well-designed ERV system can operate with only 1-3% air mixing between the supply and exhaust. This metric is called the Exhaust Air Transfer Ratio or EATR.

If a facility uses a Building Automation System (BAS), it can be reconfigured according to the ASHRAE guidance for COVID-19. For example, the BAS can be reprogrammed from minimal outdoor airflow to maximum ventilation with outdoor air.

Regardless of the system configuration, building owners must make sure that all HVAC components are working properly before reopening. There is evidence that people are more susceptible to coronavirus under thermal discomfort, or when relative humidity falls outside the 40-60% range recommended by ASHRAE. Energy savings should not be achieved at the expense of health and comfort, especially during a health emergency like the coronavirus outbreak.

USING AIR FILTERING METHODS AGAINST COVID-19

An increased outdoor air supply helps remove viruses and other air pollutants, by diluting them and removing them from indoor spaces before they spread. This can be complemented with filtering and disinfection, which have the goal of removing pollutants from the air. Filtering is a mechanical method that applies for organic and inorganic particles, while disinfection kills harmful organisms like viruses, bacteria, and fungi.

- Among its COVID-19 guidelines, ASHRAE recommends upgrading all filters to MERV 13 or better.
- The acronym MERV stands for Minimum Efficiency Reporting Value, and the scale goes from 1 to 16.
- A higher MERV means that the filter handles smaller particles, and filters in the range of MERV 13 to 16 are typically used for particles that measure 0.3 to 1.0 microns.

Consider that more efficient filters also create a larger pressure drop in air distribution systems. Before upgrading filters to MERV 13 or higher, you must ensure the HVAC system can handle the extra pressure drop. Simply upgrading to the highest MERV available is not recommended, since this can have a negative effect on ventilation. By having your system inspected by HVAC experts, you can use the optimal filter ratings.

High-Efficiency Particulate Air or HEPA filters are even more efficient than MERV 16, capturing 99.97% of particles with a diameter of 0.3 microns. However, HEPA filters create an even larger pressure drop than MERV 16. For this reason, HEPA filters are not suitable for many HVAC systems, but you can also find them as portable air cleaners.

USING ULTRAVIOLET RADIATION AGAINST COVID-19

Ultraviolet Germicidal Irradiation or UVGI can complement high-efficiency filters. While filtering captures harmful particles like viruses and bacteria, UVGI kills them by destroying their DNA. Ultraviolet radiation with a wavelength of 200 to 280 nm is called UV-C, and it is the most effective against viruses and bacteria. The germicidal effect is maximum at 265 nm, and most UVGI systems use 253.7 nm, which is close to the optimal value.

UVGI disinfection technology can be classified into four main types. The basic principle is the same - killing pathogens with UV-C radiation - but the application method changes:

- In-duct air disinfection
- Upper-air disinfection
- In-duct surface disinfection
- Portable room decontamination

More than one method may be viable for your HVAC system, and NY Engineers can help you find the best option.

In-duct air disinfection uses arrays of UV lamps in HVAC equipment or air ducts, which apply a high dose of UV-C as the air passes by. They are normally designed for an airspeed of 500 fpm, with a minimum irradiance zone of 2 feet and an exposure time of 0.25 seconds. According to ASHRAE, this type of UVGI should be coupled with at least MERV 8 filtration.

Upper-air disinfection is normally used in occupied spaces at least 7 feet tall, where the walls and ceilings have a low UV reflectivity. The ventilation system should maximize air mixing to make this method more effective, and supplemental fans are used when the existing ventilation is not enough.

In-duct surface disinfection is similar to the first method, but UV lamps are installed along ducts, drain pans, cooling coils, and other wetted surfaces. This method has a longer exposure time than the in-duct air disinfection rate, which means it can use a lower UV irradiance.

Portable room decontamination is typically used for surfaces since the unit is portable and fully automated. These UVGI systems are very effective, and they have been used successfully against pathogens more resistant than the 2019 coronavirus.

PREVENTING LEGIONELLA BACTERIA IN HYDRONIC SYSTEMS

Health authorities have found no evidence of coronavirus infection through water distribution systems. However, when a building has not been used for a long time, another dangerous pathogen can proliferate in stagnant water - the Legionella bacteria. This bacteria has one thing in common with the 2019 coronavirus: both germs can cause severe pneumonia.

Legionella bacteria tend to grow in stagnant water, especially when warm. To keep these bacteria under control, ASHRAE recommends setting hot water systems at 140°F and never letting them drop below 120°F. These temperatures are high enough to cause burns, but this is solved by mixing cold water before the point of use. However, when a building has been empty, stagnant water could have been left at favorable temperatures for Legionella. The following HVAC components are some likely places to find Legionella if no precautions were taken:

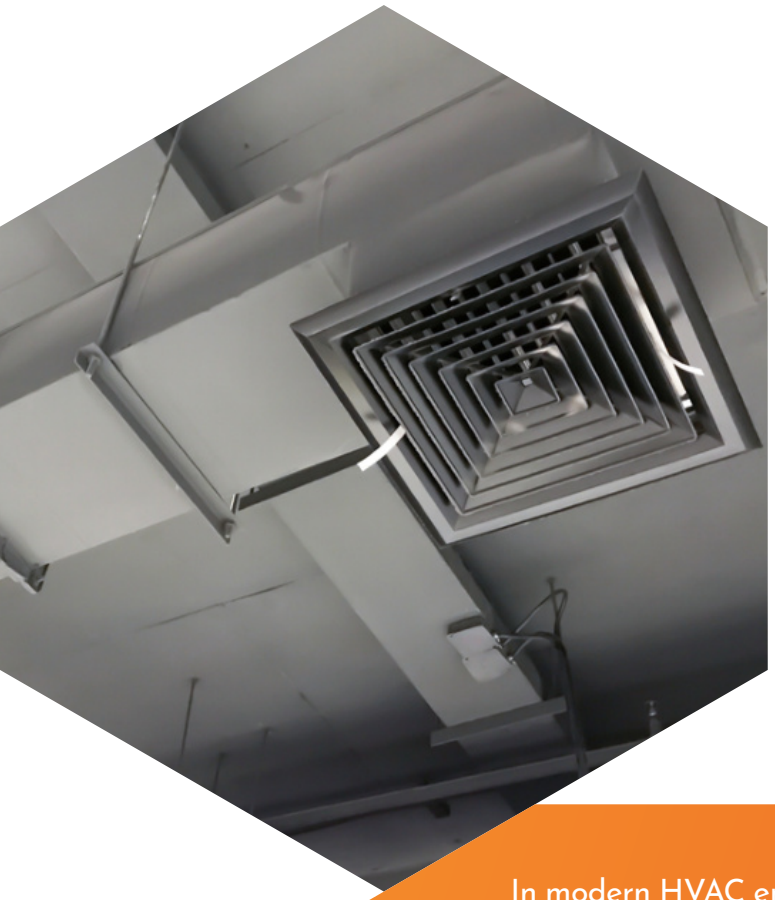
- Domestic hot water and hydronic piping, especially in dead legs.
- Cooling towers.
- Condensate pans.

Since Legionella is a very dangerous pathogen, building owners must make sure it is detected and eliminated before occupancy. Building systems that use water may need to be flushed and disinfected completely if they simply stopped without precautions. Contractors and maintenance departments should provide full PPE for their personnel before working with HVAC components that may contain pathogens.

IMPORTANCE OF HAVING A COVID-19 HVAC PLAN AND GOOD COMMUNICATION

Even if you install the best air filters and purification systems, you must have a COVID-19 plan for your building, and you must ensure effective communication. As previously mentioned, HVAC measures cannot prevent coronavirus inspections by themselves, and you must ensure that all occupants follow the guidelines from health authorities. Teleworking and remote collaboration are strongly advised while the emergency lasts.

A COVID-19 resilient building requires good communication, especially among managers, maintenance departments, and contractors. You must make sure that all occupants get the information they need to help prevent coronavirus infections in your building.



CORONAVIRUS PREVENTION ASHRAE GUIDELINES FOR BUILDING VENTILATION

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In modern HVAC engineering, ventilation systems are often designed to reduce their outdoor air supply when the full capacity is not needed. Outdoor air is not conditioned, and an increased airflow also increases the workload on space heating or cooling systems, depending on the time of the year. The energy cost of using more outdoor air is especially high on the hottest summer days and the coldest winter days.

However, ASHRAE recommends a different approach to prevent coronavirus infections in your building during the emergency and after. The outdoor air supply should be increased as much as possible, to avoid spreading the virus with indoor air recirculation. If possible, a building should sustain maximum outdoor airflow 24/7.

- There is a limit to how much outdoor air can be supplied when the outdoor temperature reaches extreme values, since the capacity of heating and cooling units may be exceeded.
- The same applies when the outdoor air is too dry or too humid, since the relative humidity may fall outside the range of 40% to 60% recommended by ASHRAE.

The recommendation is providing as much outdoor air as possible, subject to these constraints. An increased outdoor airflow helps prevent the spread of viruses and bacteria, by removing their concentration in indoor air, and by removing them without recirculation to other areas. Increased outdoor ventilation can be complemented with a filter upgrade to at least MERV 13, and the use of Ultraviolet Germicidal Irradiation. We will discuss these methods in the following blog posts.

ASHRAE is aware that more outdoor air comes with an extra energy cost. This can be mitigated by adding an airside economizer, if the local climate allows it. Another option is using an energy recovery ventilator to exchange heat and humidity between the supply air and the exhaust air. Both options help compensate for the increased energy burden of a higher outdoor air supply.

DISABLING DEMAND CONTROLLED VENTILATION FOR COVID-19 PREVENTION

Modern ventilation systems have automatic controls that reduce the outdoor air supply in response to occupancy. In other words, the maximum outdoor airflow is only used when the building is at full occupancy. This concept is called demand controlled ventilation, or DCV. However, ASHRAE recommends disabling DCV systems in response to the coronavirus emergency. This allows a high outdoor airflow regardless of occupancy.

DCV is very effective as an energy efficiency measure, since it optimizes the workload on all HVAC components - air handlers, air conditioning units, and space heating systems. However, during the coronavirus emergency, preventing infections in building interiors has a higher priority than saving energy.

Buildings with a Building Automation System (BAS) or Building Management System (BMS) can be reconfigured more easily to following ASHRAE guidelines for coronavirus prevention. The DCV control can be paused temporarily, and replaced with a program that maximizes the outdoor air supplied to the building, regardless of occupancy.

INSPECTING VENTILATION SYSTEMS BEFORE REOPENING A BUILDING

Since ventilation plays an important role in coronavirus prevention, you should make sure the system is in optimal operating conditions. If your building has been on pause due to the lockdown orders, checking the ventilation system is very important before letting occupants in. There are two main issues that must be checked before reopening a building:

- Technical issues: Are all HVAC components working correctly?
- Health hazards: Are all HVAC components free of pathogens and fungi?

The 2019 coronavirus (SARS-CoV-2) is a new threat, but other air pollutants have existed for long. In particular, mold and Legionella bacteria can proliferate in HVAC components when no prevention measures are taken. Mold spores can irritate the respiratory system, and patients with allergic rhinitis and asthma are especially vulnerable. On the other hand, Legionella bacteria can cause a severe type of pneumonia called Legionnaires' disease.

Mold is a very resilient organism, and it can grow almost everywhere when relative humidity is above 60%. It can be controlled in most building areas by keeping humidity within the ASHRAE recommended range of 40-60%. However, humidity is unavoidable in some components, such as cooling coils and condensation pans. In these cases, mold can be inactivated with Ultraviolet Germicidal Irradiation, or UVGI. Mold growth in HVAC components is an issue that requires quick attention, since spores can be easily spread to other building areas using air ducts. Some components that are susceptible to mold growth include air filters, insulation, cooling coils and ducts.

Legionella bacteria tends to grow in stagnant water at warm temperatures. Some likely places to find this bacteria are hot water piping, condensation pans and cooling towers. Since Legionella can produce severe pneumonia, building owners must make sure it is detected and eliminated before returning to normal occupancy. Water droplets contaminated with Legionella can cause an infection if they are inhaled.

UV GERMICIDAL IRRADIATION
CAN ULTRAVIOLET LIGHT KILL COVID-19?

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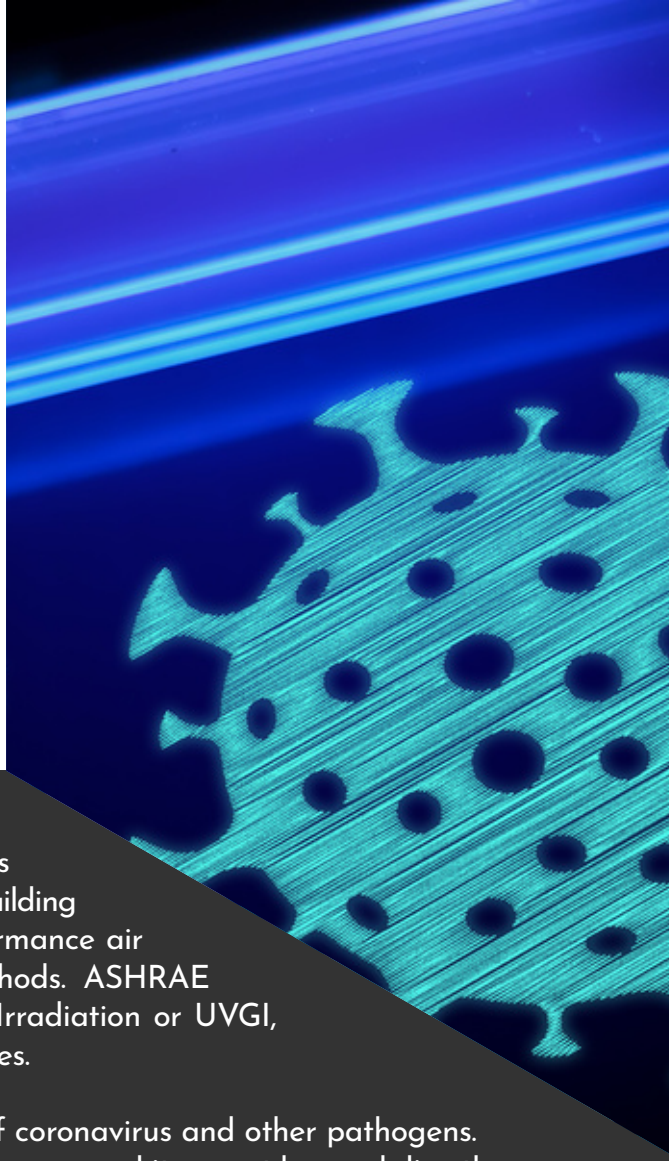
Jahnavi Sajip



There are three main ways to get rid of airborne pathogens in building interiors. Pathogens can be expelled from the building with exhaust fans, they can be captured with high-performance air filters, or they can be killed with air purification methods. ASHRAE strongly recommends the use of Ultraviolet Germicidal Irradiation or UVGI, which is effective against viruses, bacteria and mold spores.

Ultraviolet radiation is capable of destroying the DNA of coronavirus and other pathogens. Unfortunately, this type of radiation is also harmful for humans, and it cannot be used directly on patients. However, UV rays can be used safely to purify the air, water, surfaces and inanimate objects. This technology should be handled by trained technicians, since direct exposure to UV radiation can damage the eyes and skin. A qualified HVAC engineering firm can help you select the best measures to help protect your building from COVID-19.

HOW UV RADIATION CAN KILL PATHOGENS

Ultraviolet radiation has wavelengths that range from 100 to 400 nanometers (nm), and it is classified into three bands depending on the wavelength:

- UV-A, from 315 to 400 nm
- UV-B, from 280 to 315 nm
- UV-C, from 100 to 280 nm

UV-C radiation carries the most energy, and this makes it the most effective for killing germs. According to ASHRAE, the optimal range is 200 to 280 nm, and the highest germicidal effect is achieved at 265 nm. Most UVGI air purification systems use a wavelength of 253.7 nm, which is close to the optimal value.

UV radiation with a wavelength below 200 nm forms ozone, and for this reason it is not recommended for air purification

The ozone in the upper atmosphere protects us from harmful space radiation, but ozone at ground level is considered a pollutant. Ozone causes respiratory irritation and chest pain, and asthma patients are especially vulnerable.

Ozone also has a germicidal effect, but the concentrations required for this are also harmful for humans. For this reason, ozone-based air purification is not recommended for occupied spaces. Before installing an UVGI system, make sure it meets UL Standard 2998 Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners.

TYPES OF UVGI SYSTEMS

There are many types of UVGI systems, which use the same basic principle but different application methods. With a professional inspection, an HVAC engineering firm can help you select the best option for building:

- In-duct air disinfection
- Upper-air disinfection
- In-duct surface disinfection
- Portable room decontamination

In-duct air disinfection consists of using banks of UV lamps inside HVAC equipment or air ducts. These lamps intercept the airflow directly, and they release a high dose of UV-C radiation as the air passes by. According to ASHRAE, they are typically designed for 500 fpm air speed, with a minimum irradiance zone of 2 feet and UV exposure time of 0.25 seconds. The ASHRAE recommendation is using in-duct air disinfection coupled with at least MERV 8 filtration.

Upper-air disinfection is a method typically used for occupied spaces at least 7 feet tall, where the walls and ceilings have a low UV reflectivity. This method is more effective when the ventilation system maximizes air mixing, and additional fans may be needed to achieve enough disinfection.

In-duct air surface disinfection is similar to the first method, but UV lamps are parallel to the airflow instead of perpendicular. Since this layout increases the exposure time, the UV irradiance can be lower. In-duct surface disinfection can also be used for cooling coils, drain pans, and other surfaces that may accumulate moisture

Portable room decontamination uses a movable device, as its name implies. This method can be easily used for objects and surfaces, unlike the other three. Portable UVGI devices have been used to kill pathogens that are more resilient than coronaviruses..

UV-C radiation is normally produced with low pressure mercury lamps. LED versions are under development, but they are not cost effective at the moment. Consider that LED lighting is normally used to save energy, and UVGI requires a high enough energy output to kill germs. For an equal UVGI output, current LEDs are much more expensive than low pressure mercury lamps. However, this could change in the future.

UVGI has the advantage of dealing with three health hazards at once: viruses, bacteria and fungal growth. The media is currently focused on the 2019 coronavirus (SARS-CoV-2), but Legionella bacteria can also cause severe pneumonia, and they can spread in poorly serviced HVAC installations.

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