



Five Strategies for Making Your Buildings Healthy and Safe:

Indoor Air Quality and COVID-19

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ASHRAE'S MISSION & VISION

MISSION

To serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration and their allied fields.

VISION

A healthy and sustainable built environment for all.

From the C-suite to the facilities manager, indoor air quality (IAQ) is a top priority as organizations navigate reopening safely during the COVID-19 pandemic. The priority is magnified for operators of multi-site organizations contemplating the reopening of hundreds — if not thousands — of buildings.

With research pointing to airborne transmission as one of the ways the virus infects people, building operators are turning their attention to the quality of indoor air. In addition to surface cleaning processes, distancing, and separating and shielding workspaces, building managers must ensure the proper operation of heating, ventilation, and air conditioning (HVAC) systems.

If you are trying to manage IAQ across a large portfolio of building sites, it can be daunting to develop and execute a unified strategy. This white paper provides the owners and managers of multi-site building portfolios with five strategies to improve IAQ and minimize the risk of viral transmission through building HVAC systems.

WHAT IS INDOOR AIR QUALITY ?

Most people recognize that the air we breathe has a large impact on our health, comfort, and well-being, even affecting how well we learn and perform. But ask 10 people to define indoor air quality, and you might get 10 different answers.

Not so with ASHRAE. This international society of engineers for the built environment has long been focused on IAQ as it relates to ventilation and other HVAC systems in buildings. ASHRAE's standards 62.1 (commercial and industrial buildings) and 62.2 (residential buildings) have been the recognized benchmarks for ventilation system design and acceptable IAQ since 1973. Expanded and revised in 2019, both standards specify minimum ventilation rates and other measures to keep building occupants healthy.

“Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled,” ASHRAE says. “Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.”

ASHRAE offers recommendations for reopening and operating buildings during and after the pandemic, as well as operating the HVAC system during shutdown. It has also produced numerous guidelines and other resources, many of which are available online at <https://www.ashrae.org/technical-resources/resources>.

COVID-19 RAISES THE STAKES FOR IAQ

We’re still learning about SARS-CoV-2, the novel virus that causes the coronavirus disease we know as COVID-19. We know that it spreads through direct contact with infected people and contaminated surfaces, and through airborne transmission. Direct contact is easy enough to understand. Transmission through the air is a more complex subject.

You may have seen animations of what happens when someone sneezes, coughs, talks, sings, or shouts. We spray moisture from our mouths in a plume. Some comes out as droplets, some as aerosols.

The World Health Organization (WHO) considers the main means of virus transmission to be respiratory droplets. WHO defines these as particles bigger than five to 10 microns in diameter (10 microns is about one-fifth the width of a human hair). Once they’re launched from a mouth, these droplets fall to the ground close to the infected person. WHO says that’s about three feet; the federal Centers for Disease Control and Prevention (CDC) says it’s six feet. Either way, the key to avoiding droplets is social distancing.

As small as droplets are, aerosols are even smaller. If droplets are parachutes, aerosols are hang gliders. These lighter-than-a-feather particles can float, ride air currents, build up in enclosed spaces, and remain suspended for longer periods. Social distancing doesn’t do much good against aerosols.

You can take straightforward steps to reduce the potential airborne transmission of COVID-19. These include changing the layout and design of a building, rearranging the way we occupy a building, and improving HVAC systems.

Improving HVAC systems alone can’t eliminate airborne transmission, but it can minimize the risks. As part of a larger strategy that includes social distancing, wearing masks, surface cleaning and disinfection, handwashing, and other precautions, building managers have a range of tools to work with. These include improving air filtration, fresh air circulation, humidity, monitoring IAQ metrics, and other technologies such as ultraviolet germicidal irradiation.

Taking these actions for one or two buildings is difficult enough; attempting it across a portfolio of hundreds or thousands of sites compounds the challenges. Companies that leverage cloud-based energy management systems have a distinct advantage when it comes to rolling out these strategies quickly. Many changes can be put into effect remotely, automatically, and at scale.

“ If droplets are parachutes,
aerosols are hang gliders. ”





1 Filter the Air

FIVE STRATEGIES TO IMPROVE IAQ

1. FILTER THE AIR

Filtering the indoor air is more important than ever. While most systems use mechanical filters to scrub the air, it is important to pay attention to filter efficiency.

Filter efficiency is measured on a scale of 1 to 16 MERV, an acronym for Minimum Efficiency Reporting Value. The higher the MERV, the better the filter is at capturing smaller particles, even as low as 0.3 microns. ASHRAE recommends mechanical filter efficiency of at least MERV 13 and preferably MERV 14 or higher to minimize the transmission of infectious aerosols.

There is a trade off between filter efficiency and airflow. Higher efficiency filters require greater air pressure. You should increase central air filtration as high as possible without significantly decreasing design airflow. Verify the HVAC system can handle these filters without unduly affecting temperatures, humidity, and pressures. Finally, inspect filter housings and racks to ensure good filter fit and check for ways to minimize filter bypass.



2 Manage Airflow and Ventilation



3 Control Indoor Humidity

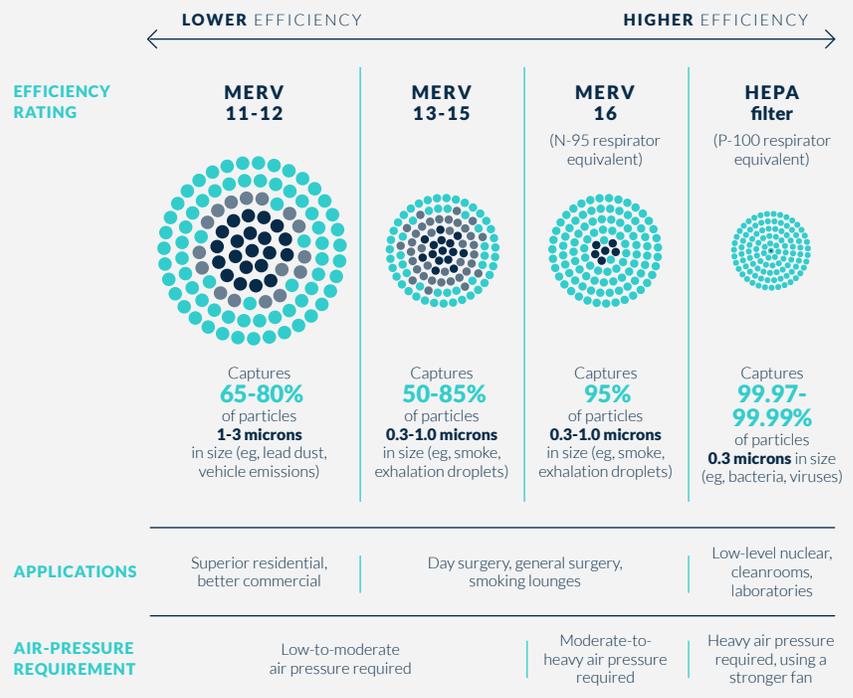


4 Use Ultraviolet Germicidal Irradiation



5 Monitor Air Quality

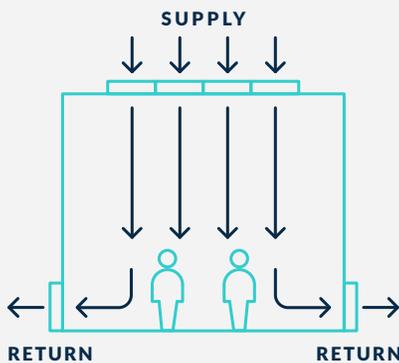
MERV Ratings



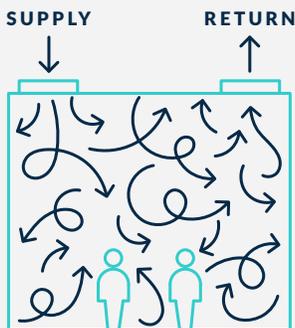
Source: McKinsey & Company, Can HVAC systems help prevent transmission of COVID-19?, July 9, 2020

Vertical Laminar Flow
vs Turbulent Airflow

**VERTICAL
LAMINAR FLOW**



**TURBULENT
AIRFLOW**



2. MANAGE AIRFLOW AND VENTILATION

Is it better to have lots of air moving around or none? While more fresh air is better, an important related question is *how* that air should move.

Hospital operating rooms, high-tech clean rooms, and commercial aircraft cabins have this figured out. They move air at the same speed and in a straight path from ceiling to floor. The technical term for this is vertical laminar flow.

What you don't want is air swirling like dust devils. This so-called turbulent airflow mixes things up even more.

You may need to upgrade the outlets in your HVAC systems or replace outlet covers in order to produce these laminar flows. Adjust airflows to slow, steady speeds. When possible, direct potentially contaminated air out of rooms and away from people.

Place air outlets carefully. Take into consideration the number of occupants, room layout, furniture placement, and other factors that may affect airflow.

In addition to in-room airflows, consider inter-room airflows. Some tools that can keep out unwanted air include air curtains at doorways, air gates at outside doors, and overpressure above suspended ceilings.

FROM AIRFLOW TO VENTILATION

The more people in an indoor environment, the more you need to mix in fresh outdoor air to help reduce the concentration of airborne contaminants, including viruses.

Diluting the air of contaminants lessens the chance for viral spread. This is why ASHRAE standard 62.1 makes dilution of contaminants is an important part of an overall IAQ strategy.

ASHRAE building guidance encourages building operators to increase their system's outdoor air ventilation. The facilities team may have to consider adjusting space-comfort setpoints to increase the system's ability to use more outside air. Use as much outside air as possible without sacrificing comfort.

Set the ventilation schedule across all of the buildings in your portfolio to flush the indoor air before, during and after people are in the building. Hold the flush long enough to reduce the concentration of airborne infectious particles by 95 percent. This might require three changes of outside air. As an alternative to calculating the air-change rate, ASHRAE also recommends flushing the air for two hours before and after occupancy (for a total of four hours).

Changing temperatures, humidities, airflows, and ventilation can affect comfort levels. In hot and humid climates, keeping the indoor space cool and comfortable can be challenging. In colder climates, the challenge is keeping the space warm enough.

Bringing in more outside air can also make a big impact on energy use. But during a pandemic, saving lives trumps saving energy.

Fortunately, it's not an either-or proposition. A building can be comfortable, safe, and energy-efficient. If your HVAC systems are antiquated, this could be an ideal time for a retrofit. Upgrading to a more efficient HVAC system and using automated smart technology can reduce energy usage and improve IAQ at the same time.

3. CONTROL INDOOR HUMIDITY

Relative humidity (Rh) can make a surprising difference in the ability of airborne viral particles to stay aloft or sink. This is where it's important to understand the relationship between humidity and temperature.

A Yale University scientific review of how respiratory illnesses are transmitted confirms the importance of monitoring and adjusting indoor humidity levels.

“Ninety percent of our lives in the developed world are spent indoors in close proximity to each other,” said Yale immunobiologist and senior review author Akiko Iwasaki. “What has not been talked about is the relationship of temperature and humidity in the air indoors and outdoors and aerial transmission of the virus.”

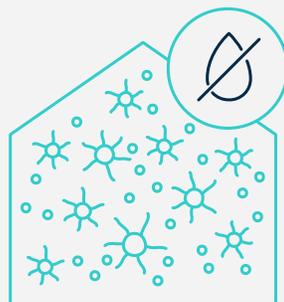
If you remember your high school science, Rh measures the saturation of air with water vapor. Rh is inversely proportional with heat: The higher the temperature, the lower the Rh, and vice versa.

When cold, dry air enters a building and is warmed, the Rh can fall 20 percent. If the air is not re-humidified, the warmer, now drier air makes it easier for the virus particles to stick around in the air longer. Making matters worse, immune systems are less able to defend themselves in drier air, and the hair-like projections on cells lining the airways are less able to expel viral particles.

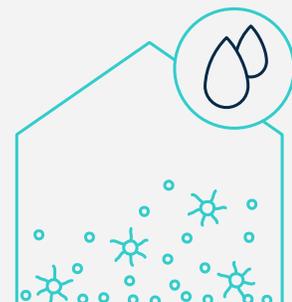
Research shows that the optimal Rh range is 40 to 60 percent. Within this sweet spot, more viral particles drop to the ground faster and immune systems work better. The fewer viral particles in the air and the healthier our immune systems, the less chance of transmission.

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40–60%

Within this sweet spot, more viral particles drop to the ground faster and immune systems work better



Rh ↓
= LOWER HUMIDITY



Rh ↑
= HIGHER HUMIDITY

“ If you can measure it, you can control it. ”



4. USE ULTRAVIOLET GERMICIDAL IRRADIATION

Another tool building managers can use is ultraviolet germicidal irradiation (UVGI). The National Institutes of Health (NIH) recommends UVGI for killing harmful pathogens, including those from COVID-19.

The UV spectrum ranges from 100 to 400 nanometers (nm). The most effective UV light for disinfecting is approximately 254nm, known as UVC. UVC light deactivates microorganisms, preventing viruses from replicating and spreading. If you want to try this solution, make sure you hire a contractor that can provide proper design, installation, and maintenance. They will know how to place UVC light fixtures for safe operation. The installation design must consider airflow, installation location, and climatic location to maximize effectiveness.

Other strategies for killing the harmful particles include thermal sterilization, bipolar ionization, and ozone generators.

5. MONITOR AIR QUALITY

If you can measure it, you can control it. That’s a good reason for installing sensors. The data produced by monitoring sensors are valuable and provide real-time actionable information. Sensors are purpose-built and offer specific details to drive better business and public health decisions.

Building energy systems suppliers like ENTOUCH use sensors to monitor IAQ metrics by measuring the total volatile organic compounds (TVOC), CO, CO2, particulates, and allergens. The system can be programmed to provide alerts or make remote adjustments to correct dangerous indoor air quality levels.

It is highly recommended to install sensors and monitor IAQ to round out a clean air strategy. While sensors cannot detect the coronavirus specifically, they bring in more data to analyze and layer with other building data to ensure optimal building performance.

CONCLUSION: EASING THE TRANSITION BACK TO THE WORKPLACE

We are still learning about the transmission of the virus and ways to mitigate it. Strategies need to be fluid to adapt to the changing guidance, and building managers must be vigilant in enforcing new means and methods. Along with more stringent and frequent cleaning processes, multi-site organizations may be able to reduce the spread of COVID-19 so that they may return to a new normal in onsite operations.

Changes to air filtration, ventilation systems, humidity levels, air quality monitoring, and technologies such as ultraviolet germicidal irradiation will help ease the transition back to a safe work environment. Using a centralized EMS will help to fast-track changes across the portfolio while monitoring building performance through a unified IAQ strategy.

Consult ASHRAE, the Building Owners and Managers Association, the CDC, ENTOUCH, and other trusted resources for further information and details on protecting your people and properties from the COVID-19 pandemic.



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To learn more about protecting your building occupants’ health, building energy efficiency, and smart building technology, **contact us** today.

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