Q1. What filters are recommended for HVAC systems?

A: Our current recommendation is to use a filter with a Minimum Efficiency Reporting Value (MERV) of 13, but a MERV 14 (or better) filter Is preferred. Of course, the ultimate choice needs to take the capabilities of the HVAC systems into consideration. Generally, increasing filter efficiency leads to increased pressure drop which can lead to reduced air flow through the HVAC system, more energy use for the fan to compensate for the increased resistance, or both. If a MERV 13 filter cannot be accommodated in the system, then use the highest MERV rating you can.

Appropriate filters tested under the ISO 16890 Standard can also be used. The table below provides approximate relationships between ratings under the ASHRAE MERV and ISO 16890 test methods. The current recommendations would suggest using a filter with an ePM1 rating under ISO 16890.

Approximate Equivalent Ratings for Filters Tested Under ASHRAE Standard 52.2 (MERV) and ISO 16890	
ASHRAE MERV* (Standard 52.2)	**ISO 16890 Rating**
1-6	ISO Coarse
7-8	ISO Coarse >95%
9-10	ePM_{10}
11-12	$ePM_{2.5}$
13-16	ePM_{1}

*MERV-A will give closer results between the two standards. Charged media filters usually show a drop-off in efficiency with use. ISO 16890 captures this with an IPA condition step. ASHRAE 52.2 can capture this drop if the test is done with the optional Appendix J which gives the MERV-A. Thus the MERV and the ePM ratings do not reflect the same testing. For charged media, the MERV will likely make the filter appear more efficient than the ePM rating.

Q2: How often should HVAC filters be changed?

A: Please refer to current ASHRAE guidance on HVAC System Maintenance and Filter Replacement during the COVID-19 Pandemic.

Filters in HVAC systems should be changed according to the typical schedule or even left in place longer than normal. Extending the time between filter changes is a strategy being employed during the current COVID-19 pandemic. If lower rated filters were upgraded to meet ASHRAE recommendations of at least

a MERV 13 filter, there was likely an increase in airflow resistance (increased pressure drop) when the new filters were installed. However, the upgraded filters may be capable of holding more dust than the lower rated filters without a substantial additional increase in air flow resistance. Thus, extending the time between filter changes may be beneficial. Either way, the risks from not changing filters right on time are small. The filters may load more than normal, which could lead to slight reductions in air flow. The secondary impact of that depends on the type of building and building occupancy (among others).

Q3: What is the size of the SARS-CoV-2 virus, and can it be captured by ventilation filters?

A: Research has shown that the particle size of the SARS-CoV-2 virus is around 0.1 µm (micrometer). However, the virus does not travel through the air by itself. Since it is human generated, the virus is trapped in respiratory droplets and droplet nuclei (dried respiratory droplets) that are predominantly 1 µm in size and larger.

ASHRAE currently recommends using a minimum MERV 13 filter, which is at least 85% efficient at capturing particles in 1 µm to 3 µm size range. A MERV 14 filter is at least 90% efficient at capturing those same particles. Thus, the recommended filters are significantly more efficient at capturing the particles of concern that a typical MERV 8 filter which is only around 20% efficient in the 1 µm to 3 µm size range. Filters with MERV ratings higher than 14 would capture an even higher percentage of the particles of concern. High-efficiency particulate air (HEPA) filters are even more efficient at filtering human-generated infectious aerosols. By definition, a HEPA filter must be at least 99.97% efficient at capturing particles 0.3 µm in size. This 0.3 µm particle approximates the most penetrating particle size (MPPS) through the filter. HEPA filters are even more efficient at capturing particles larger AND smaller than the MPPS. Thus, HEPA filters are more that 99.97% efficient at capturing airborne viral particles associated with SARS-CoV-2.

Q4: Should HVAC system maintenance, including filter changes, be postponed during the pandemic?

A: Please refer to current ASHRAE guidance on HVAC System Maintenance and Filter Replacement during the COVID-19 Pandemic.

It is not necessary to suspend HVAC system maintenance and/or filter changes during the COVID-19 pandemic, but some additional safety precautions are warranted.

At this time little is known about the penetration of SARS-CoV-2 into HVAC systems. The task force is developing a research work statement to study just that. Neither ASHRAE nor CDC has posted guidance on the decontamination of HVAC systems (to include air filtration systems) potentially exposed to SARS-CoV2. The survival time of SARS-CoV-2 in air has been estimated at several hours and survival on surfaces is, at most, several days. There is no evidence to date that SARS-CoV-2 penetrates to a significant extent through central air-handling units to cause risk in spaces where infectors are not present. Should HVAC systems actually become contaminated with viable virus, the most likely scenario for disinfection is that the virus would lose its viability naturally within hours-to-days, and thus, there is no guidance advocating proactive system shutdown for decontamination and/or filter replacement.

There are no published laboratory studies showing whether the SARS-CoV-2 virus can be re-aerosolized from ventilation air filters or other HVAC surfaces. Laboratory studies indicate that re-aerosolization of viable mycobacteria, which are of similar size to viral particles, from filter material is not probable under normal conditions. However, the risks associated with handling filters or performing other maintenance activities inside HVAC systems potentially contaminated with coronaviruses under field-use conditions have not been evaluated. Therefore, it is recommended that workers performing maintenance and replacing filters on any ventilation system with the potential for viral contamination wear a properly fitted respirator (N95 or higher), eye protection, and gloves. The HVAC systems should be turned off prior to entry for any maintenance activity. When feasible, filters can be disinfected by spraying them with a 10% bleach solution or another appropriate disinfectant, approved for use against human coronaviruses (see EPA List N), before removal and disposal. Disinfectants should not be used on ventilation filters prior to continued use of the filters inside ventilation systems. The effects of the disinfectants on filter performance are unknown. Filters should only be sprayed with disinfectants if they are to be removed from service and discarded. Whether disinfected or not, filters removed from HVAC systems with suspected coronavirus contamination can be placed into a regular trash bag (do not bend, tear or crush the filters) and disposed of as normal trash. There are no special bagging/tagging requirements or waste processing steps necessary, outside of the normal waste processing procedures. When maintenance tasks are completed, maintenance personnel should immediately wash their hands with soap and water or use an alcohol-based hand sanitizer.

Q5: Are there recommended procedures for disinfecting HVAC equipment?

A: Neither ASHRAE nor CDC has posted guidance on the decontamination of HVAC systems (to include air filtration systems) potentially exposed to SARS-CoV2. To date, there has not been compelling evidence to demonstrate that viable virus is contaminating these systems. Should such systems actually become contaminated with viable virus, the most likely scenario is believed to be that the virus would lose its viability naturally within hours-to-days, and thus, there is no guidance advocating proactive system shutdown for decontamination and/or filter exchange.

If you choose to use chemical disinfectants, it is important to use them properly. There are no disinfectants approved specifically for use inside ventilation systems. However, there are hundreds of EPA-registered disinfectants that are effective at killing human coronaviruses (see EPA List N). A good fact sheet on the use of disinfectants to control the COVID-19 virus from the National Pesticide Information Center can also be found here. It provides some tips for proper disinfectant usage, including surface types, understanding the label, and proper dwell or contact times. It is important to remember that most of these disinfectants, while effective at killing coronaviruses, do not continue killing long after they are applied. So, while they are effective at killing viruses on HVAC surfaces, they will not continue killing into the future. They would need to be reapplied.

If chemical disinfectants are used, they should only be applied with the HVAC system powered off. Also, disinfectants should not be applied to ventilation filters prior to continued use of the filters inside ventilation systems. The effects of the disinfectants on filter performance are unknown. Filters should only be treated with disinfectants if they are to be removed from service and discarded.

Q6: Is ultraviolet energy (UV-C, ultraviolet germicidal irradiation, germicidal ultraviolet) effective against the SARS-CoV-2 virus?

A: Ultraviolet energy (ultraviolet germicidal irradiation or germicidal ultraviolet) could be a powerful tool in the fight against COVID-19. ASHRAE's position on UVC is expressed in the Position Document on Airborne Infectious Diseases: UVC air and surface disinfection is used in many different settings – residential, commercial, schools, as well as healthcare. Germicidal light (particularly 254 nm UVC produced by low pressure mercury vapor lamps, which operate near the most effective wavelength of ~265 nm) has not, to our knowledge, been tested on SARS-CoV-2, but it has been tested on an airborne coronavirus (Walker 2007). The sensitivity of that coronavirus to 254 nm was high enough that it seems like a good candidate for UV disinfection.

While UV systems are quite effective at maintaining cleanliness of HVAC coils, drain pans and other wetted surfaces, properly designed systems can be quite effective at on-the-fly inactivation of microorganisms in moving airstreams. These systems generally require more lamps so they can provide significant UV doses in a short period of time. A typical single pass inactivation efficiency is 85%, much like a good particulate filter, but systems can be designed for over 99.9% inactivation as well. Plus, a well-designed UV air disinfection system inside an HVAC system, and located by the cooling coils, can also provide the surface disinfection benefits mentioned above.

Another way to install UV is in an "upper-air" configuration. Specially designed fixtures mounted on the wall create an irradiated zone above the occupant and disinfect air in the space as air circulates naturally, mechanically or by means of the HVAC system. This sort of system has been approved for use in control of tuberculosis by CDC for nearly 20 years and there is a NIOSH guideline on how to design them.

Finally, mobile UV systems are frequently used for terminal cleaning and surface disinfection in healthcare and other spaces. Systems such as these are typically used in unoccupied spaces due to concerns of occupant exposure. All three system types may be relevant, depending on the building type and individual spaces within the building.

The design and sizing of effective ultraviolet disinfection systems can be a complex process because of the need to determine the dose delivered to a moving air stream or to an irradiated region of a room. In-duct systems are further complicated by the air handling unit and ductwork configuration and reflections from surfaces that can help achieve higher irradiance levels. Upper-air systems require adequate air mixing to work properly while paying close attention to reflective surfaces that could result in room occupants being overexposed to the UV energy. Reputable manufacturers and system designers can assist by doing the necessary calculations and designing systems specific to individual spaces.

For basic information on ultraviolet disinfection, we suggest that you consult some of the references listed on the ASHRAE COVID-19 resources page (ashrae.org/covid19).

Q7: Do I need to seal my filter in place after I put it in the filter slot?

A: A filter needs to be installed so that all the air goes through the filter. If this doesn't happen, the air that goes around the filter will not get cleaned. This can be the same as using a lower MERV filter. Sealing filters to prevent bypass can be accomplished in many ways. For a residential filter in a slot that is a bit loose, a simple piece of tape can be used hold it in place and allow the airflow to push the filter forward to engage the flat surface in front of it. Commercial building filters with rigid frames may be clamped in place. Gasketing can be added to most filters, either to the installation location or to the frame of the filter. HEPA filters need much better sealing as even a tiny 0.3% leak will give 10x as much penetration.