Building System Ventilation and Filtration Recommendations
Seattle University Facilities Services
September 09, 2021

Summary
This document provides background information and additional documentation for the ventilation and filtration recommendations Facilities Services is implementing at Seattle University in response to COVID-19. Our primary source of guidance for mechanical systems has been the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) recommendations specific to COVID-19. These recommendations are updated as new information is being developed and we will revise our response plans accordingly.

We have defined three levels of existing building systems in regard to their ability to implement the ASHRAE recommendations:

Campus Building Ventilation and Filtration Tier Ratings	
Tier 1	HVAC system is capable of introducing three or more air changes per hour of any combination of outside air or recirculated MERV13 filtered air.
Tier 2	HVAC system is capable of introducing three or more air changes per hour from any source.
Tier 3	HVAC system does not provide three or more air changes per hour, or no mechanical ventilation is present.

†Meets all Tier 1 HVAC requirements with addition of portable filtration unit.

Appendix E1 provides a detailed list of Tier Ratings by Building and Room number for many spaces on campus. Appendix E.1, on the Seattle University Physical Plant COVID-19 Response Plan website, can be found here: https://www.seattleu.edu/facilities/physical-plant-covid19-response-plan/.

Please contact Rich Cota, Director of Maintenance and Operations (rcota@seattleu.edu) with any questions about the Tier ratings or specific space on campus.

Our basic response includes the following where building mechanical systems are capable:

- Pre-occupancy building flush each day of three air changes with 100% outside air.
- Introduce increased levels of fresh air until space comfort or system operation is adversely affected. Our Tier 1 baseline is three or more air changes per hour.
- Use MERV 13 filtration if the system can support the added air pressure.

Ventilation and Filtration Guidelines
Both of the following operating conditions apply to the HVAC (Heating, Ventilation, and Air Conditioning) systems in our instructional spaces to minimize COVID-19 exposure:

- Introduce three or more air changes to the space, calculated using the volume of the space (ft^3) and the system's airflow value (Cubic Feet per Minute)
- Provide a MERV (Minimum Efficiency Reporting Value) air filtration level of MERV13 or greater

Facilities Services has upgraded all instructional spaces and conference rooms in use for Fall 2021 term to "Tier 1"—meaning they have at least three air changes per hour of outside air or MERV-13 filtered air. In some spaces with HVAC systems not capable of providing three air changes—

including classrooms as well as work-spaces that serve large numbers of students, faculty and staff—portable filtration units are being deployed to meet Tier 1 criteria. Healthcare and K-12 settings where masks are required for all individuals per local Public Health and CDC guidance will meet or exceed Tier 1 conditions.

What is MERV-13 (Reference 1)?

Minimum Efficiency Reporting Values, or MERVs, report a filter's ability to capture particles

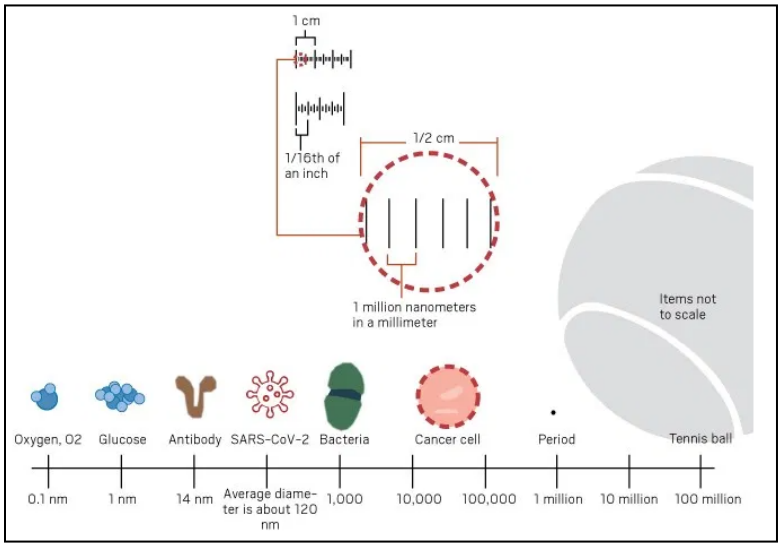
- This value is helpful in comparing the performance of different filters.
- The rating is derived from a test method developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) [see www.ashrae.org].
- The higher the MERV rating the better the filter is at trapping specific types of particles.

What Size particles will a MERV 13 filter remove (Reference 2)?

MERV 13 air filters provide close to:

- 90% efficiency for filtering particles between 3 and 10 microns in size (such as mold spores, dusting aids, and cement dust).
- 80% and 85% efficiency for filtering particles between 1 and 3 microns in size (such as legionella, lead dust, humidifier dust, coal dust, and nebulizer droplets).
- 35% and 50% efficiency for filtering particles between 0.30 and 1 micron in size (such as bacteria, most smoke, sneeze nuclei, insecticide dust, copier toner, and face powder).

How Big is Corona Virus (Reference 3)?



From USA Today (Reference 4):
"The COVID-19 particle is indeed around 0.1 microns in size, but it is always bonded to something larger. There is never a naked virus floating in the air or released by people," said Linsey Marr, a professor of civil and environmental engineering at Virginia Tech who specializes in airborne transmission of viruses.

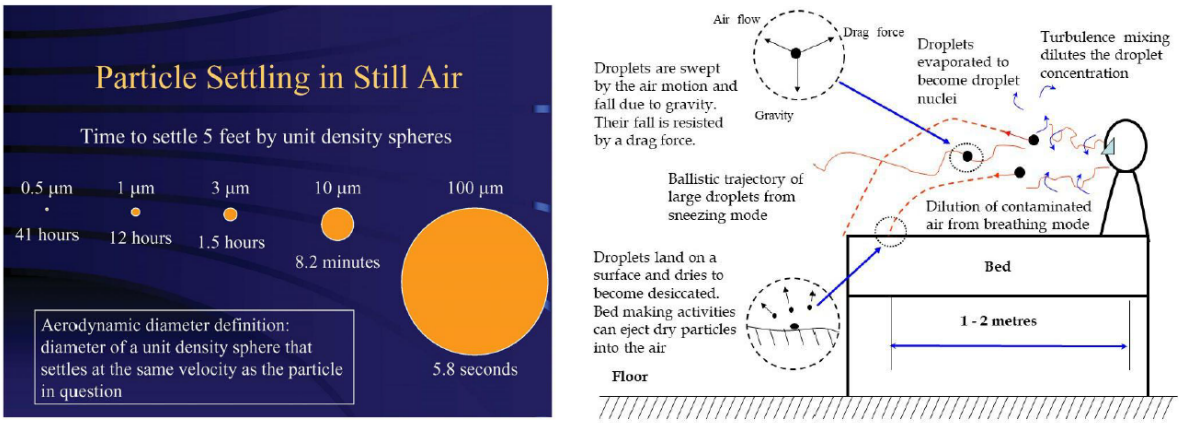
The virus attaches to water droplets or aerosols (i.e. really small droplets) that are generated by breathing, talking, coughing, etc. These consist of water, mucus protein and other biological material and are all larger than 1 micron (μ) Note: (1 μ = 1000 nm). "Breathing and talking generate particles around 1 micron in size, which will be collected by N95 respirator filters with very high efficiency," said Lisa Brosseau, a retired professor of environmental and occupational health sciences who spent her career researching respiratory protection.

What does ASHRAE Recommend (Reference 3, Page 15)?

1) Outside air for ventilation should be increased to as much as the HVAC system can accommodate. If there are significant energy impacts, use minimum outside air as required by Std 62.1 with MERV-13 filter minimum.
2) Evaluate building occupied hours, adjust as necessary (have building hours extended to encourage physical distancing).
3) Flushing sequence or mode should be implemented to operate the HVAC system with maximum outside air flow for two hours before and after occupied times, or, achieve 3 air changes of outside air in the space.

How does the virus spread in air (Reference 6)?

From the ASHRAE Position Document on Infectious Aerosols the virus can become an aerosol as droplets dry. The aerosols can be suspended in still air from 1.5 to 12 hours depending on the size. The mechanical ventilation helps draw the aerosols out of the area.



(a) (b)

Figure 1 (a) Comparative settling times by particle diameter for particles settling in still air (Baron n.d.) and (b) theoretical aerobiology of transmission of droplets and small airborne particles produced by an infected patient with an acute infection (courtesy Yuguo Li).

Why three air changes an hour (Reference 7, page 8)?

A study was conducted on the effectiveness of vaccination versus ventilation for the influenza virus. The study concluded in part that three air changes an hour will "almost completely eliminate" aerosol-based outbreaks.

> **"**In pure droplet-based transmission models, vaccination is a powerful strategy to mitigate the spread of an infectious disease. When transmission can also be aerosol-based, increasing ventilation is an additional way to curb the spread of disease. We therefore compared the effect of ventilation to traditional vaccination strategies. According to the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), good ventilation in classrooms corresponds to 3 air changes per hour. Most classrooms, however, have poor ventilation at rates around 0.5 air changes per hour (see Methods for more details). In the pure aerosol-based model, bringing all rooms to the recommended ventilation rate would almost completely eliminate the chance of an outbreak."

More questions on filtration? See Reference 8.

Tier Ratings by Building and Room Number?
See Appendix E.2 on the Seattle University Physical Plant COVID-19 Response Plan website here:
https://www.seattleu.edu/facilities/physical-plant-covid19-response-plan/

For other general questions please reach out to:

Rich Cota, Director of Maintenance and Operations (rcota@seattleu.edu)
Robert Schwartz, AVP Facilities Services (schwartr@seattleu.edu)

References:

1) https://www.epa.gov/indoor-air-quality-iaq/what-merv-rating-1

2) https://www.grainger.com/search/hvac-and-refrigeration/air-filters?attrs=Performance%20Rating|MERV%2013&filters=attrs&cm_sp=CM-Shop-_-inline-text-_-kh-what-is-merv-rating-air-filter-rating-chart-_-2020-02

3) https://www.ocregister.com/2020/04/10/coronavirus-heres-how-small-the-enemy-is-and-how-it-attacks/

4) https://www.usatoday.com/story/news/factcheck/2020/06/11/fact-check-n-95-filters-not-too-large-stop-covid-19-particles/5343537002/

5) https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-commercial-c19-guidance--08-17-20-.pdf

6) https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf

7) Assessing the Dynamics and Control of Droplet- and Aerosol-Transmitted Influenza Using an Indoor Positioning System (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6379436/)

8) https://www.nafahq.org/covid-19-corona-virus-and-air-filtration-frequently-asked-questions-faqs/