CELEBRATING 125 YEARS

ASHRAE OVERVIEW

Founded in 1894

200+ Standards and Guidelines

56,000+ Volunteer Members

130+ countries

59 Active Research Projects Total of 907; $76 million

7,400+ Student Members

10+ Regions

190+ Chapters

400+ Student Branches

Industry Classification

Consulting Engineers
Contractors
Manufacturers
Manufacturing Representatives
Government, Health & Education
Design Build
Architects

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ASHRAE Board of Directors

Statement on Operation of HVAC Systems During the COVID-19 Pandemic April 20, 2020

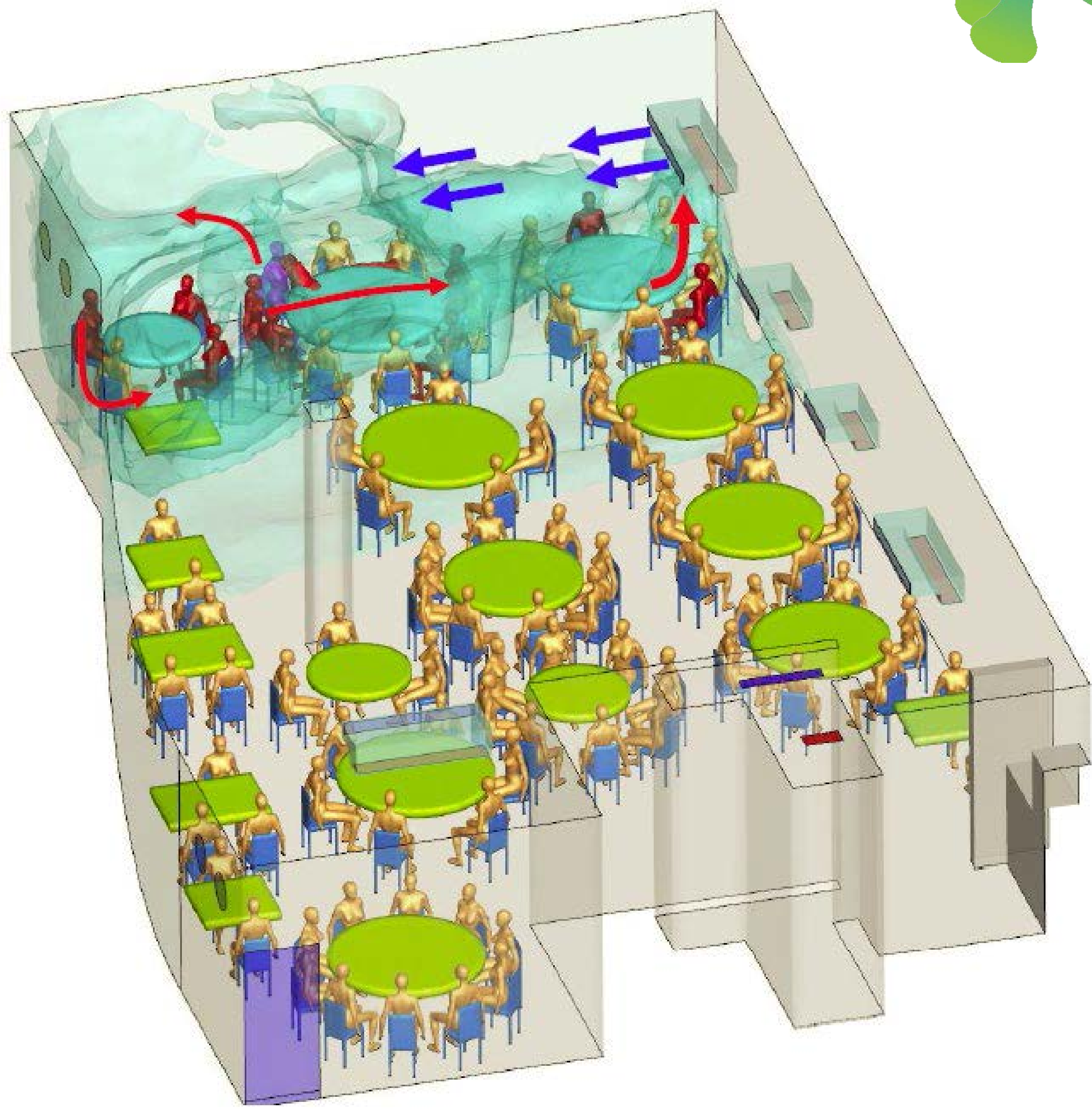
- ASHRAE's position is that "Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning [HVAC] systems, can reduce airborne exposures."
- Airborne transmission of SARS-CoV-2 is significant and should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.

Statement on Operation of HVAC Systems During the COVID-19 Pandemic April 20, 2020

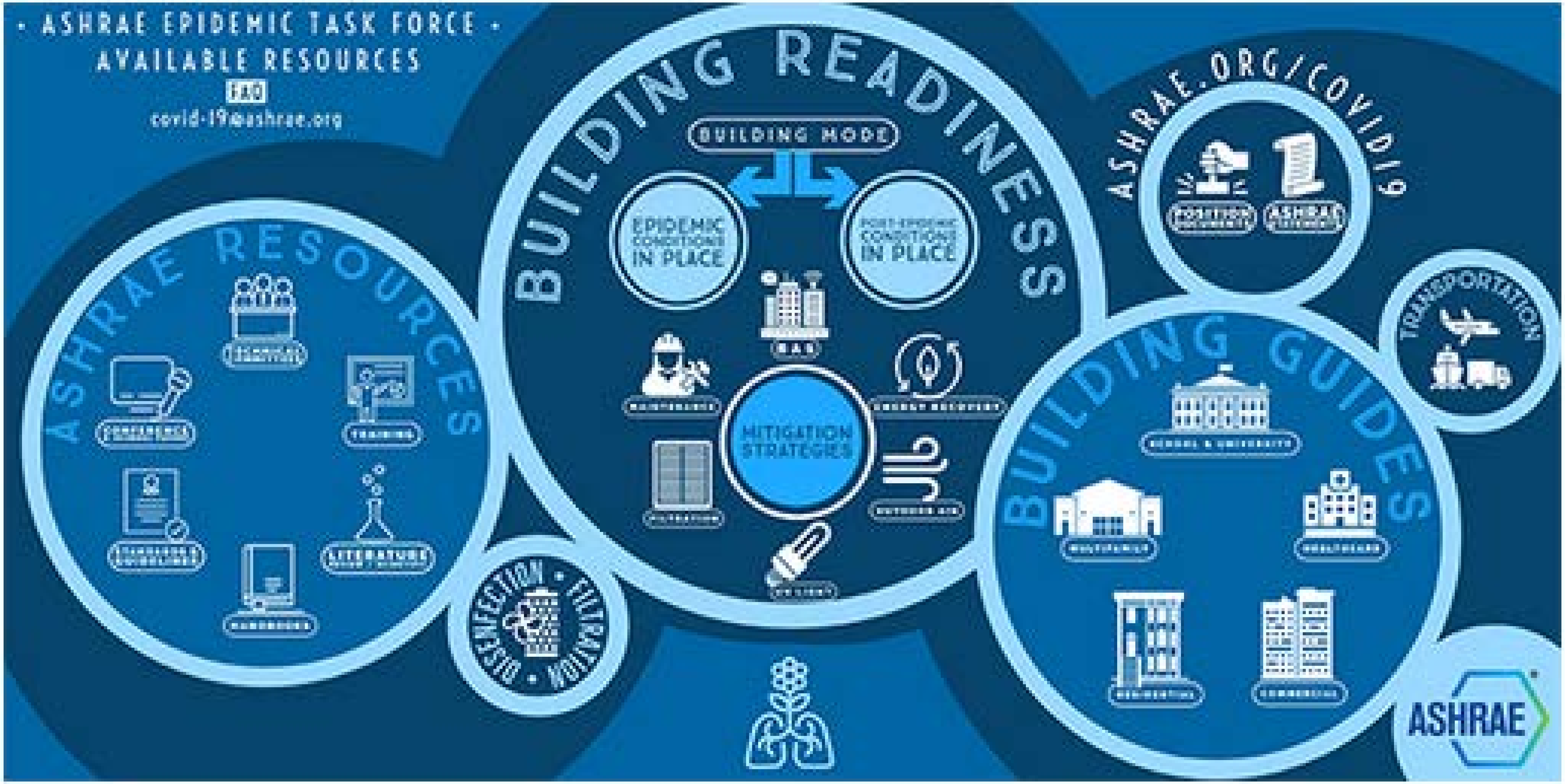
Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus.

CAVEAT –AIR CONDITIONING THAT DOES NOT VENTILATE, FILTER, DOESN'T HELP

- Guangzhou restaurant community spread event
- No active ventilation
- Fan coil unit air-conditioning
- No close range/fomite transfer
- Measured ventilation rate ~0.75 –1 L/s per patron (very low!)
- •*Conclusions: "*Aerosol transmission of SARS-CoV-2 due to poor ventilation may explain the community spread of COVID-19.



Li, et al. (2020) https://doi.org/10.1101/2020.04.16.20067728



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Epidemic Conditions in Place

Simple HVAC Steps to Re-Occupation

- Systems Evaluation
- Extra Outdoor Air
- Higher Efficiency Filters
- Energy Recovery

Epidemic Conditions in Place

Systems Evaluation:

All building facility managers should evaluate their HVAC systems to check that they are operating in proper order (per design conditions or current operational strategies), are capable of being modified to align with disease transmission mitigation strategies, and they have no deficiencies that should be repaired.

This could be viewed as tactical commissioning of the systems to determine risk areas for the building operating in epidemic conditions.

This is not for energy conservation but for Indoor Air Quality.

Epidemic Conditions in Place

Systems Evaluation:

Systems evaluation should include the following steps:

1. Gather and review building and systems documentation, including but not limited to:
    a. Most recent design documents, specifically the HVAC and Plumbing Water systems construction documents
    b. Record documents (as-built, marked up drawings and specifications received from the Contractor at the conclusion of construction)
    c. Original, approved equipment and system submittal documents
    d. Systems manuals or turnover package
    e. Controls and Building Automation System (BAS) drawings and sequences of operation and initial system parameters
    f. Equipment control wiring diagrams and troubleshooting guidelines
    g. Service contracts and maintenance logs
    h. BAS Trend reports and alerts and notifications reports
    i. Most recent Testing, Adjusting and Balancing (TAB) reports
    j. Most recent Commissioning Reports (if available)

Epidemic Conditions in Place

Systems Adjustment:

Systems adjustment should include the following steps:

1. Modify controls to admit more outdoor air:
   a. Review the design documents and equipment submittals
   b. Review the TAB reports
   c. Adjust the HVAC system controls to increase the outdoor air.
      a. Reset the minimum % OA upward
      b. Check the freeze stat or economizer set point for operation
      c. Check the mixing box for stratification spots
      d. Check the mixed air dampers for full stroke and tight shut off.
2. Watch the weather! If you get close to design conditions – return controls to design condition
   a. Keep close eye on the mixed air temperature and the discharge temperature.
   b. Do a trend log on both system and space conditions.

Epidemic Conditions in Place

Increased Ventilation: Summer

One major concern is the ability to maintain space conditions. Hot and humid climates could struggle to keep the space below acceptable temperature and relative humidity for comfort. Cold climates could struggle to keep the space above acceptable space temperature and relative humidity for comfort. It is important to note that research indicates that maintaining the space relative humidity between 40% and 60% decreases the bio-burden of infectious particles in the space and decreases the infectivity of many viruses in the air. The team should consider adjusting the space comfort setpoints to increase the system's ability to use more outside air.

The ability for a coil to provide additional capacity was evaluated using a typical cooling coil at various percent of outside air. This evaluation shows the additional required cooling capacity and gpm required[1] if the same exact coil experiences the different entering air conditions while achieving constant leaving air conditions. The following shows the impact of increasing the percent of outside air:

Percent OA	EAT DB / WB	CHW GPM	Coil Pressure Drop (Ft H2O)	Total Capacity (MBH)	Sensible Capacity (MBH)
20	77.64 / 66.64	73.66	5.04	443.49	282.78
30	78.95 / 68.55	83.4	6.32	510.68	297.83
40	80.26 / 70.39	94.27	7.90	582.09	312.93
50	81.56 / 72.15	104.17	9.49	651.46	327.99
60	82.86 / 73.84	114.6	11.3	720.81	343.1
70	84.15 / 75.47	125.87	13.43	790.57	358.15
80	85.44 / 77.03	135.5	15.37	857.15	373.26
90	86.72 / 78.54	149.73	18.48	929.1	388.3

The unit was selected to be 10,000 cfm with a constant 44°F chilled water supply with a 12°F chilled water rise to make a consistent coil leaving air temperature of 52°F dry-bulb and 51.5°F wet-bulb. This assumes a return air condition of 78°F and 60% RH from the space. The coil was locked in at an 8-row coil with 126 fins per foot that is 20.45 square feet of coil face area.

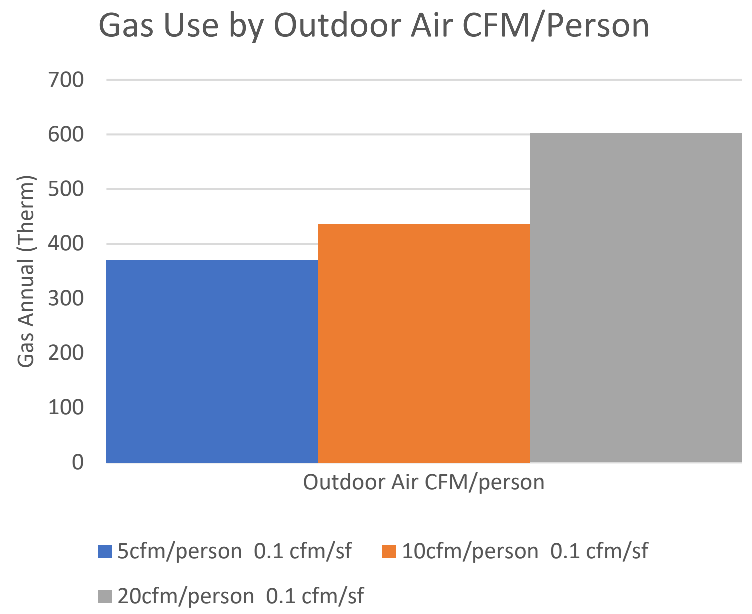
OA at 92/75F.

Epidemic Conditions in Place

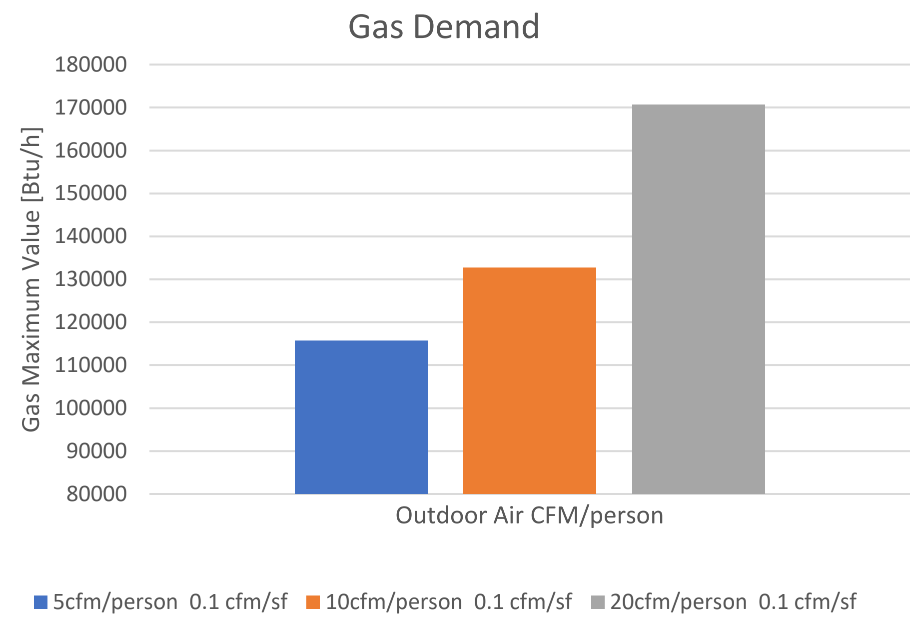
Increased Ventilation: Winter

One major concern is the ability to maintain space conditions. Cold climates generally have heating system designs for the 99% or the 97.5% winter design conditions. Therefore, the heating system will be capable of heating mixed air at minimum outdoor quantities even at such cold ambient temperatures. When the ambient temperature is higher than design, the coils will be able to heat sufficiently at higher outdoor air fractions but will use more energy to do so. The chart below demonstrates the additional annual gas energy use for three outdoor air volume conditions in a 5000 square foot single story office with normal occupancy and schedules in Chicago, ILL.

The ability for a coil to provide additional capacity was evaluated using a typical gas fired heating coil at various outside air cfm/person. This evaluation shows the additional required heating capacity and gas required if the coil experiences the different entering air conditions while achieving constant leaving air conditions. The following shows the impact of increasing the quantity of outside air: 62% increase from 5 to 20 cfm/p in energy and 48% increase in Demand.



The package unit was selected to be 4818 cfm with a fuel fired heating coil in Chicago, Illinois. (99% 1.0F design) Outdoor air is modeled at 5, 10 and 20 minimum cfm/person with a fixed dry-bulb economizer.



ASHRAE

Epidemic Conditions in Place

Upgrading & Improving Filtration:

- ASHRAE recommends that mechanical filter efficiency be at least MERV 13 and preferable MERV 14 or better to help mitigate the transmission of infectious aerosols.
- While MERV 13 and greater filters are better at removing particles in the 0.3 micron to 1 micron diameter size (the size of many virus particles) the higher efficiency does not come without a penalty.
- Higher efficiency filters require greater air pressures to drive or force air through the filter. Care must be taken when increasing the filter efficiency in an HVAC system to verify that the capacity of the HVAC system is sufficient to accommodate the better filters without adversely affecting the system's ability to maintain the owner's required indoor temperature and humidity conditions and space pressure relationships.

Epidemic Conditions in Place

Calculation Approach to Increase MERV in an AHU Continued:

Filter Level	Supply Airflow CFM	Fan RPM	Static Pressure Fan (in. w.g.)	Fan Brake Horsepower	Fan Motor NamePlate Horsepower
MERV 8	23,000	2,216	5.3 Dirty	5.36	7.5
MERV 14	23,000	2,395	5.8 Dirty	6.7	7.5

Discussion on the findings of the Calculated Approach:

1. Assuming the unit is under a constant discharge duct pressure control, a static pressure profile of the unit should show a nearly constant pressure in the supply plenum and a gradually increasing negative pressure in the mixing box, filter array and coils on the inlet side of the fan.
2. Energy saving strategies such as reducing the discharge pressure of the unit to serve the VAV box with the greatest air demand should and could still be employed and continued.
3. There is commercially available software that evaluates the costs of material and labor for filter change out intervals. Good testing instrumentation should be available to trend and chart (and it desired record) filter pressure drops.
4. This is only an example. There are potential issues in maintaining airflow at design by increasing fan speeds.
   a. Fan speed cannot be upgraded because of the limits of that fan construction class is an example. In this case, manufacturers data indicate that the fan maximum rpm is 3125. Check with the fan manufacturer.
   b. If changing the motor would necessitate an electrical system upgrade, this solution may be cost prohibitive. In this case the owner may choose to operate the system at a reduced air flow. Reduced airflow in this example would be approximately 22,200 cfm.
   c. Filter bypass is a potential problem. If possible, conduct a light test to determine if there are any major cracks needing closure.
   d. Cabinet negative pressure leakage is also a potential problem. Check with the manufacturer as they will be following AHRI standards.

Epidemic Conditions in Place

ERV Systems with Intentional Recirculation

If the ERV exchanger is installed in a system where the outdoor air portion of the total system airflow is being processed through the ERV, but a portion of the return air is being recirculated back to the space as shown in Figure 1 (as are most conventional packaged systems) then turning off the wheel would do little to improve the supply air quality since the EATR associated with the wheel could be small compared to the recirculation rate.

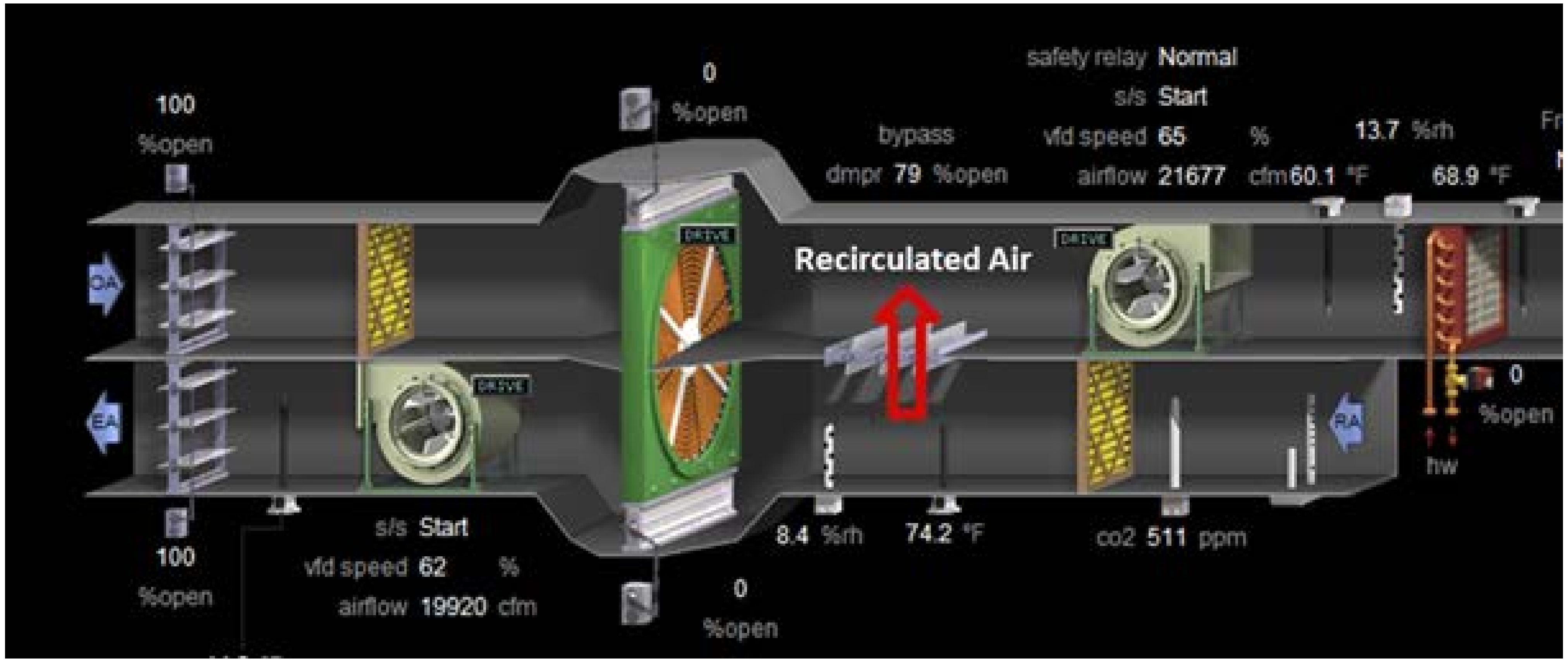


Figure 1 AHU Configuration with Recirculated Air and Energy Recovery Wheel Heat Exchanger

Epidemic Conditions in Place

UVGI SYSTEMS

There is a lot of ASHRAE (and others) guidance on ultraviolet (UV) technology for the built environment.

Please refer to some of the documentation to determine the best application for your building or systems:

- Filtration and Disinfection Guidance on the ASHRAE COVID-19 site
- Chapters in ASHRAE Handbook
  - 2019 Applications - Chapter 62: ULTRAVIOLET AIR AND SURFACE TREATMENT
  - 2016 Systems and Equipment - Chapter 17: ULTRAVIOLET LAMP SYSTEMS
- ASHRAE Journal article: Ultraviolet Germicidal Irradiation - Current Best Practices (2008, Martin et al)
- For upper room systems – NIOSH guidelines (2009)

Core Recommendations

1. Public Health Guidance –
   a) Follow all regulatory and statutory requirements and recommendations for social distancing, wearing of masks and other PPE, administrative measures, circulation of occupants, reduced occupancy, hygiene, and sanitation.
2. Ventilation, Filtration, Air Cleaning
   a) Provide and maintain at least required minimum outdoor airflow rates for ventilation as specified by applicable codes and standards.
   b) Use combinations of filters and air cleaners that achieve MERV 13 or better levels of performance for air recirculated by HVAC systems.
   c) Only use air cleaners for which evidence of effectiveness and safety is clear.
   d) Select control options, including standalone filters and air cleaners, that provide desired exposure reduction while minimizing associated energy penalties.

Core Recommendations

3. Air Distribution
    a) Where directional airflow is not specifically required, or not recommended as the result of a risk assessment, promote mixing of space air without causing strong air currents that increase direct transmission from person-to-person.
4. HVAC System Operation
    a) Maintain temperature and humidity design set points.
    b) Maintain equivalent clean air supply required for design occupancy whenever anyone is present in the space served by a system.
    c) When necessary to flush spaces between occupied periods, operate systems for a time required to achieve three air changes of equivalent clean air supply.
    d) Limit re-entry of contaminated air that may re-enter the building from energy recovery devices, outdoor air, and other sources to acceptable levels
5. System Commissioning – Verify that HVAC systems are functioning as designed.

Disclaimer

Regarding Responses to Questions about COVID-19:

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www.ashrae.org/covid19