

AIVC Webinar, 11/20/2020
COVID-19 Ventilation Related Guidance by ASHRAE and REHVA

ASHRAE's Ventilation Recommendations for COVID-19 Risk Mitigation

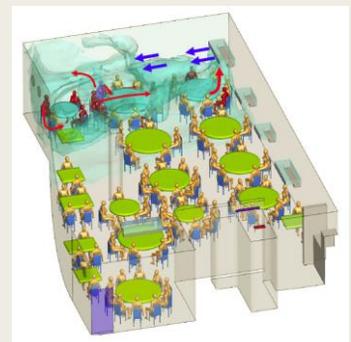
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Chair, ASHRAE Epidemic Tasks



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Covid-19 Transmission Characteristics

- Covid-19 transmission
 - *Can be transmitted by airborne route indoors*
 - *Super-spreading incidents with observed or suspected low outdoor air exchange rates*
 - *Evidence of impact on transmission by in-room recirculation when outdoor air exchange is inadequate*
 - *No clear evidence of room to room transmission through ventilation systems (system level recirculation)*



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Scope of ASHRAE Guidance

(Some still under development)

- Residential (Detached, Multi-unit)
- Commercial/Retail
- Schools (K-12, Universities)
- Communities of Faith
- Laboratories
- Healthcare (Hospitals/Clinics, Alternate Care Facilities, Nursing homes)
- Transportation
- Intended to be adaptable to any system type
- Not climate zone-specific
 - *Members in more than 130 countries*
 - *More than 20% of members outside North America*
 - *US includes 8 of 9 climate zones*

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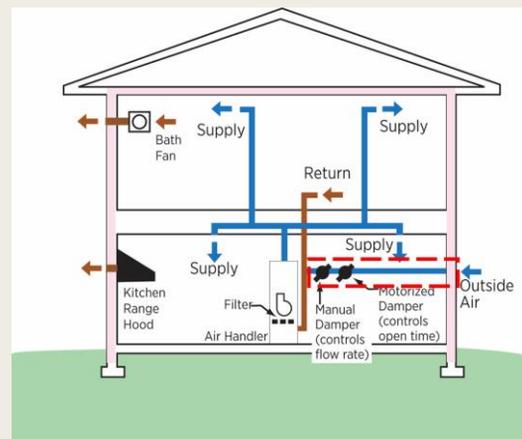
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Typical Residential Forced Air System

- Constant volume recirculating system
- Furnace/DX air conditioner or heat pump
- Older homes likely to have no outdoor air supply
- Newer homes may have energy recovery ventilators



<https://www.energy.gov/eere/buildings/downloads/building-america-top-innovations-hall-fame-profile-low-cost-ventilation>

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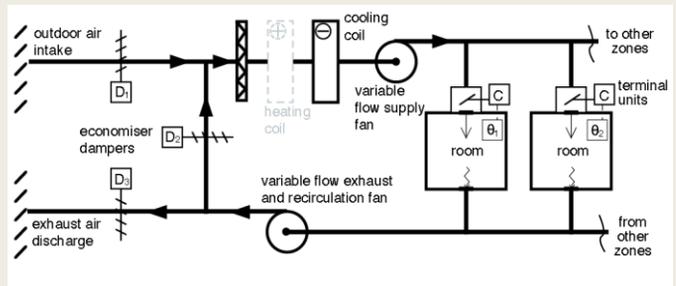
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Typical Variable Air Volume (VAV) System

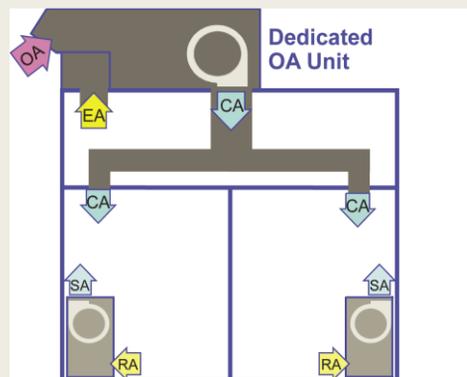
- Most air supply is recirculated
- Economizer controls permit up to 100% outdoor air to save energy
- Maximum possible outdoor air depends on weather
- Filters normally located in central supply air path
- More outdoor air → less recirculation through filters



<https://www.cibsejournal.com/cpd/modules/2019-04-vav/>

Typical Dedicated Outdoor Air (DOAS) System

- 100% outdoor air system with energy recovery
- Normally sized for no more than ventilation requirement
- Limited or no ability to increase outdoor air flow rate
- Often serve spaces without operable windows.
- Filters in DOAS do not clean indoor air



Core Principles for Ventilation and Air Distribution

- Provide *at least* design minimum outdoor air when building is occupied (e.g., compliant with ASHRAE Standard 62.1)
- Provide filter and air cleaner performance equivalent to *at least* MERV 13 (~ePM1 50%) for recirculated air streams (MERV 13 filters if possible)
- Operate system for a time required to achieve three equivalent air changes of outdoor air before first daily occupancy and between occupied periods, if needed
- Prefer mixing without strong air currents that could increase direct person to person transmission
- Use combinations of outdoor air, filters, and air cleaners that provide desired exposure control while minimizing energy penalties

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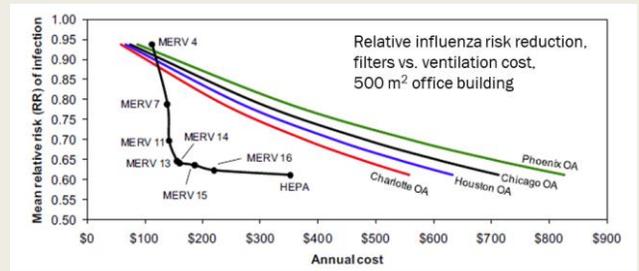
Why minimum required outdoor air and not as much as possible?

- Minimum outdoor air *by itself* is not sufficient, but “as much as possible” has inconsistent, sometimes adverse consequences
 - *DOAS – does not change operation or reduce risk*
 - *VAV or other all-air system*
 - Possibly large risk reduction
 - Large energy use increase
 - Potential operational problems
 - Reduces filter effectiveness
- Minimum outdoor air + upgraded filters can achieve similar outcome with lower energy use and cost

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Why MERV 13 filters and not HEPA for HVAC equipment?

- Existing air handling units and some terminal units *may* accept MERV 13, but definitely not HEPA
- Lack of room to room transmission suggests near 100% single pass efficiency is not essential
- Removal rate and not single pass efficiency is most important – high flow with moderate efficiency



Azimi and Stephens, Building and Environment 70 (2013) 150-160

Why is recirculation not a concern?

- It **is** a concern within spaces when there is poor ventilation and filtration
- It **is** a concern for energy wheels, which should be checked
- Within systems, lack of space-to-space infection transmission evidence suggests dilution makes risk low
- Eliminating recirculation in all-air systems like typical VAV trades off with central filtration performance
- High recirculation rates through efficient filters is the basic approach to infection control in healthcare facilities

ASHRAE Standard 170-2017

Infection control is an objective

- Patient room minimum, requirements
 - Outdoor air: 2 ACH
 - Total supply air: 4 ACH
 - Pre-filter: MERV 7
 - Final filter: MERV 14
 - Exhaust all room air outdoors - no
- Protective environment
 - Outdoor air: 2 ACH
 - Total supply air: 12 ACH
 - Pre-filter: MERV 7
 - Final filter: HEPA
 - Exhaust all room air outdoors - yes



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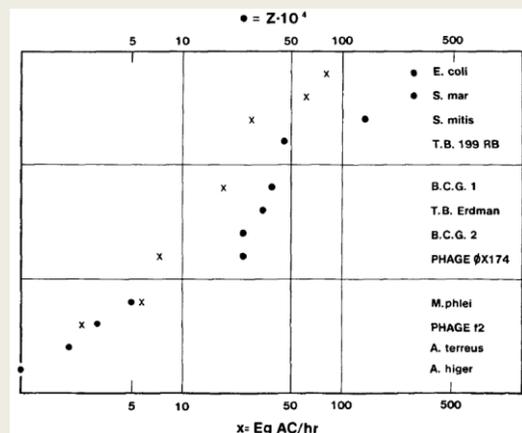
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What is the role of air cleaners?

- Supplement outdoor air and mechanical filtration to achieve exposure targets
- May be central or in-room
- Recommended
 - Standalone HEPA filtration
 - Germicidal ultraviolet
 - Upper room most effective
 - Air-handler/in-duct may be lower cost, but less effective
- Others
 - Mostly technologies that produce reactive species
 - Caveat emptor!

Upper Room UVGI Equivalent Air Changes



Riley, R. and Nardell, E., 1989. Clearing the air. *Am Rev Respir Dis*, 139, pp.1286-94.

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Why prefer mixing when stratification is “known” to give better IAQ?

“...the general air distribution system in many cases creates a fully mixed concentration, which to some extent protects people from a high exposure from the source person.”

Nielsen, P., et al. 2008. ASHRAE Transactions 114: 632.

“Based on the available data and our understanding at present, ... we do not recommend the use of displacement ventilation...for control of exhaled substances or any harmful infectious aerosols.”

Li, Y, et al. 2011 ASHRAE Journal, 53(6), pp.86-89.



In most existing buildings, revision of air distribution in the short term is not an option

What is “desired exposure control”

- Targets for exposure control
 - Growing acceptance and use of “equivalent clean air supply” approaches to Covid-19 risk management
 - Typically based on Wells-Riley model analysis
 - ASHRAE has not made recommendations, but others have
 - Multiple risk estimating tools are available
- This approach allows optimization of with respect to cost and operational constraints
- Results are somewhat comparable to healthcare ventilation requirements

Summary

- ASHRAE recommendations provide a minimum baseline that may require supplementation
- Emphasis is on feasibility of implementation with some consideration for energy use
- Allowance of multiple controls and use of equivalent clean air approach allows owner/operator to tailor effective strategies to local conditions
- Better understanding of total air exchange requirements is needed

Thank you!

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ASHRAE Covid-19 resources
ashrae.org/covid19



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