RenewAire®
Energy Recovery Ventilation

USE OF RENEWAIRE ERVS DURING THE SARS-COV-2 PANDEMIC

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Ventilation is one of the important strategies in combatting airborne transmission of infectious diseases, as is recognized by ASHRAE[1, 2] and the Federation of European Heating, Ventilation and Air Conditioning Associates (REHVA)[3]. Nonetheless, during the SARS-CoV-2 pandemic, it is reasonable to ask whether the ventilation system in one's home, office or other facility is safe to operate.

In almost all cases, the answer is yes[4, 5]. However, both ASHRAE[6] and REHVA[7] have suggested ways to improve ventilation systems to mitigate viral transmission, including evaluation of Energy Recovery Ventilators (ERV) to ensure they are operating safely.

In order to make their own judgements about the safety of their ventilation system, homeowners and facilities managers need information about how ERVs interact with the HVAC system, and how airborne transmission is thought to occur. The most detailed advice is found in ASHRAE's **TC5.5 Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems**[8].

RenewAire's EV Premium L Energy Recovery Ventilator (ERV)

This white paper, which draws heavily on the "TC5.5 Practical Guidance…" addresses the use of RenewAire ERVs only. To address this in context, we first discuss the key point of concern: **Aerosol Transmission.** We then speak to the mechanism by which **Aerosol Transfer** could occur in ventilation systems. One possible mechanism for aerosol transfer is exhaust air transfer in ERVs, and this is discussed in more detail in **Mechanics of exhaust air transfer in ERVs.** The first concerns for homeowners are addressed in **Simple Advice for RenewAire owners in single-family homes.** Since upgrading filters can be helpful in mitigating risk, we briefly address this topic in **Upgrading Filters.**

Good maintenance of ERVs is always advisable, and if there is a special reason to worry about airborne transmission in a specific installation, an inspection of the unit can be performed and measurements can be made to evaluate whether changes are needed. Please contact us and ask for separate document **RenewAire ERVs EAT Inspection Form 20200629.**

Aerosol Transmission

It is critical to understand that the primary mode of airborne transmission of coronaviruses in general is by relatively large water droplets expelled by an infectious person. Since droplets of this size fall out of the air rapidly, "six-foot distancing" is recommended and is thought to be effective[9, 10, 11]. These droplets do not enter ventilation systems. A secondary mode of airborne transmission is by so-called aerosols – very small droplets that *can* be transported by HVAC systems. "**Aerosol transmission**" means the infection of a healthy person by means of virus carried from an infectious person in these tiny airborne water droplets. It has not been established that aerosol transmission of SARS-CoV-2 occurs; however, aerosol transmission did occur with earlier SARS-CoV-1 and MERS coronaviruses. For that reason authorities such as ASHRAE recommend that it be assumed aerosol transmission can occur, and that HVAC systems can be operated to reduce risk in epidemic conditions[12]. (For a very different view, see Taylor Engineering's Covid-19 White Paper[13].)

1 ASHRAE, 2020. Guidance for Building Operations During COVID-19 Pandemic. https://www.ashrae.org/news/ashraejournal/guidance-for-building-operations-during-the-covid-19-pandemic (May 8, 2020)
2 ASHRAE, April 14, 2020, ASHRAE Position Document on Infectious Aerosols, https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf (July 21, 2020)
3 REHVA, April 3, 2020, REHVA COVID-19 guidance document, April 3, 2020 downloadable at https://www.rehva.eu/activities/covid-19-guidance (May 8, 2020)
4 ASHRAE, 2020. Guidance for Building Operations During COVID-19 Pandemic. https://www.ashrae.org/news/ashraejournal/guidance-for-building-operations-during-the-covid-19-pandemic (May 8, 2020)
5 ASHRAE, June 9, 2020, TC5.5 Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems, https://www.ashrae.org/file%20library/technical%20resources/covid-19/practical-guidance-for-epidemic-operation-of-ervs.pdf (June 17, 2020)
6 ASHRAE, April 14, 2020, ASHRAE Position Document on Infectious Aerosols, https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf (July 21, 2020)
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9 ASHRAE, April 14, 2020, ASHRAE Position Document on Infectious Aerosols, https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf (July 21, 2020)
10 CDC. 2020. Coronavirus Disease 2019 Frequently Asked Questions, How COVID-19 Spreads, https://www.cdc.gov/coronavirus/2019-ncov/faq.html#How-COVID-19-Spreads (May 8, 2020)
11 REHVA, April 3, 2020, REHVA COVID-19 guidance document, April 3, 2020 downloadable at https://www.rehva.eu/activities/covid-19-guidance (May 8, 2020)
12 ASHRAE, April 14, 2020, ASHRAE Position Document on Infectious Aerosols, https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf (July 21, 2020)
13 Taylor Engineering Covid-19 White Paper, June 2, 2020, https://taylorengineers.com/taylor-engineering-covid-19-whitepaper (July 21, 2020)

Aerosol Transfer in Ventilation Systems

Once it is accepted that aerosol transmission of SARS-CoV-2 or other viruses is possible, the next and key question is *whether a specific ventilation system can transfer aerosols generated by infectious people to spaces with uninfected humans*.

There are at least four ways in which aerosols from a space with an infectious person could be carried to a space with healthy people by this ventilation system: **recirculation, re-entrainment, duct leakage** and **exhaust air transfer** in the ERV.

In many HVAC systems air from the space is deliberately **recirculated** into the Zone Supply Air to the space so that the required heating and cooling can be provided. When HVAC systems include Recirculated Air, that typically is the dominant way in which potentially virus-laden aerosols are reintroduced into the building.

Air exhausted from the building can be pulled back into the Outdoor air intakes through **Re-entrainment**. This occurs in most building design and can range from near-zero to as high as 20%, depending on building and system layout, with great moment-to-moment variability depending on wind speed and direction.[14]

Duct leakage occurs to some extent in virtually all systems. If ducts are at higher static pressure than the surrounding space, some exhaust air will leak into the space; if at lower static pressure, some space air will leak into the duct. For ERVs located inside the building, the supply duct from outside to the ERV is usually at lower static than the space; conversely, the exhaust duct from the ERV to the outside will be at higher static than the space. So air being exhausted could leak from the duct to the space: not a problem if it is the same space from which the air is being exhausted, but perhaps a problem if the air is being exhausted from another space with infectious people.

Leakage from the exhaust airstream to the supply airstream, if it occurs within the energy exchanger portion of the ventilation system, is referred to as **Exhaust Air Transfer** (EAT). The rate of EAT into the Supply Air is called the Exhaust Air Transfer Rate (EATR). For manufacturers, like RenewAire, who participate in AHRI 1060, EAT/EATR is an independently certified performance rating for the exchanger. RenewAire's exchanger has very low EATR ratings, but as in any ERV[15] there are potential leak paths in the unit. For more details, see section **Mechanics of Exhaust Air Transfer in ERVs**.

Considering all the above, we recommend that when evaluating potential for aerosol transfer in a specific ventilation system, the entire system should be considered, not just the ERV.

Simple Advice for RenewAire owners in single-family homes

1. If no resident of the house is self-quarantining from other members of the household, continue to operate the ERV. Consider operating the home's exhaust fans (if any) as well.
2. If a resident IS self-quarantining from other members of the household, the HVAC system needs to be modified such that no air from the quarantine space should be returning to the ERV or the air handler. This can be done by blocking off return registers in the quarantine space and improvising a system to exhaust air directly from the space to the outside but make sure to consult with your HVAC installer for best results.
3. Continue to maintain your HVAC system, including your ERV as usual. For useful guidance on what to expect from an HVAC technician working in your home, see **The NEWS**, March 24, 2020, **Comprehensive Guide: HVAC Service Calls During COVID-19**[16].

Mechanics of Exhaust Air Transfer in ERVs

The key driving force for leakage in ERVs are the differences in static pressures between adjacent compartment. Without static pressure differences, air will not flow through the leak paths. Air flows through leak paths from higher static pressure to lower. Only if the exhaust air compartments are at higher static pressure than the fresh air supply compartments will exhaust air leak into the supply air, resulting in Exhaust Air Transfer. Otherwise, any leakage is from the outside air compartments into the exhaust air compartments.

The volume or "amount" of leakage in an ERV is a function of both the magnitude of the static pressure differentials and also the "size" of the leak paths. In general, plate exchangers have significantly "smaller" leak paths than energy wheels.

ERVs using energy wheels typically are designed so that the leakage direction is from the outside air compartments into the exhaust air compartments. This means that a portion of the outside air[17] is used to minimize EAT. When the application is critical, ERVs using energy wheels must be carefully commissioned to maintain low EAT.

ERVs using plate exchangers, like RenewAire's, are inherently "less leaky" but as in any ERV, proper static pressure differential can be used to minimize or eliminate Exhaust Air Transfer.

The above discussion of leakage and static pressure differentials is necessarily brief and simplistic. The reader is encouraged again to consult **ASHRAE's TC5.5 Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems** for a more rigorous discussion.

[14] ASHRAE RP 1635 and ASHRAE 62.1 Normative Appendix B provide guidance on how to calculate separation distances and dilution factors for specific job sites or applications.

[15] ASHRAE, June 9, 2020, TC5.5 Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems, https://www.ashrae.org/file%20library/technical%20resources/covid-19/practical-guidance-for-epidemic-operation-of-ervs.pdf (June 17, 2020)

[16] The NEWS. March 24, 2020. Comprehensive Guide: HVAC Service Calls During COVID-19. https://www.achrnews.com/articles/142890-comprehensive-guide-hvac-service-calls-during-covid-19 (July 21, 2020)

[17] The amount of outside air used for this purpose is characterized by the Outside Air Correction Factor (OACF) specific to device in that application, see AHRI 1060.

Upgrading Filters

For many occupied buildings, once social distancing and enhanced hygiene measures are enacted, upgraded air filtration is recommended in pandemic condition by ASHRAE[18, 19], the National Air Filtration Association[20], REHVA[21] and Taylor Engineering[22].

For most applications upgrades to MERV 13 or MERV 14 are recommended, while full HEPA filtration is recommended for exhaust from full-blown infectious disease containment rooms or for supply to immune-compromised wards.

RenewAire does not intend to provide advice about the relative merits of different filtration approaches and refers the reader to the reference sources. We also note that **properly** deployed UL light systems are thought to be effective by ASHRAE[23] among others.

Following are recommendations for those who do want to upgrade filtration in their ventilation systems that use RenewAire ERVs.

Merv 13 Multi-Residential Filters

- MERV 13 filters are now available as optional accessories from RenewAire for the **supply side** of our residential models built starting in January 2020. These are fitted at the outside air inlet face of the exchanger. (Residential units built before January 2020 do not accept these filters.)
- MERV 13 filters are available from RenewAire for our commercial models, and are intended for installation in the supply airstream. These are fitted at the outside air inlet of the exchanger (they also can be fitted at the return air inlet faces of the exchanger, but this is not generally recommended).

In some systems there may be better places to install upgraded filters:

- If the goal is to reduce aerosol content in the air exhausted from a sub-space, consider installing the filter in the return duct from the space. This has a collateral benefit of increasing the static pressure differential at the exchanger. This location may also be more convenient for change-out.
- If the goal is to reduce aerosol content in **supply air**, the upgraded filtration should be applied where it can filter all the supply air to the space, and that might be downstream of the point where the ERV connects to the air-handling system.

Higher-effectiveness filters tend to have higher static pressure drop, therefore:

1. Airflow rates are somewhat decreased, requiring re-balancing of the system with somewhat increased blower power input.
2. Static pressure differentials (SPD) may be increased or decreased depending on filter location. EAT might or might not change depending changes from a negative to positive value or vice versa. Assuming airflow is re-adjusted to original levels, the following small changes in SPD can be expected:
    a. Added or upgraded filter in return duct between space and ERV: increased SPD; except in HE1.5X where there is no effect.
    b. Return filter in ERV upgraded from MERV 8 to MERV 13: increased SPD; except in HE1.5X where there is no effect.
    c. Upgraded filter in supply duct between ERV and space or ventilation system: no effect in except in HE1.5X, in which static pressure differential is increased.
    d. Supply air filter in ERV upgraded from MERV 8 to MERV 13: decreased SPD; except in HE1.5X where there is no effect.

Conclusion

The mission of a RenewAire ERV is to provide ventilation. They are inherently resistant to exhaust air recapture when in good operating condition. During times of pandemic concern they should be kept in normal or even increased operation in virtually all applications. Where our ERVs are used to exhaust air from infectious spaces and supply air to non-infectious spaces, it is prudent to confirm proper operating of the ERV and to consider other steps such as upgraded filtration.

To better make your own judgement, you are encouraged to look at the source documents in the citations, in addition to the **Bibliography** section.

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