Quick Answers to Frequently Asked ERV Questions

The FAQ's provide a quick answer to questions we hear most often from the field. They address both general energy recovery topics as well as requests for specific information on the Airxchange wheels used in our ERV's.

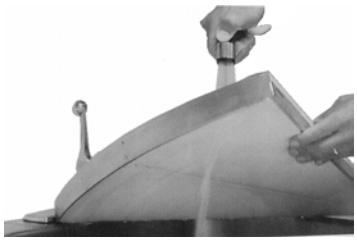
ERV Enthalpy Wheel Design Questions

What are the limits to using the Airxchange wheel or wheels in general?

- The wheel is designed for space conditioning applications and should not be used in process heat recovery where it would be exposed to temperatures in excess of 160 degrees F.
- The wheel can be mounted in any position, vertically, horizontally or on an angle.
- Because wheels always have a small amount of potential leakage between airstreams, they should not be used to recover energy from airstreams containing toxic or noxious fumes, biohazards, etc. – use separate duct systems and a runaround loop for these applications.
- Cold climate applications benefit from the low frost threshold of enthalpy wheels, but frost control must be used where analysis indicates it is required (typically where winter design temperatures are below 0 degrees F).
- Due to the cost of the wheel to handle the larger airflow, unbalanced applications where one airstream is less than 50% of the other tend to be uneconomical.

How often does the wheel have to be cleaned?

- Cleaning the wheel or wheel segments has two functions: one is to remove material that might cause odors (such as tobacco smoke), the other is to restore latent capacity lost when oily deposits block water from entering the desiccant. The frequency of cleaning is determined by the operating environment.



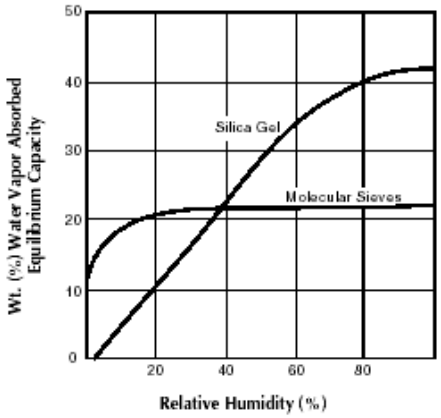
- In a non-smoking environment such as a school or office, yearly inspection (at the time of filter change, for example) is suggested. Washing might be required for maintaining latent capacity after a period of 4-5 years.
- In a heavy smoking exhaust air environment, such as a bar or cocktail lounge, the wheel should be cleaned every 3-6 months. Optimal results are obtained with an overnight soak in detergent or alkaline coil cleaner.
- Industrial exhaust conditions (weld shop for instance) may have special requirements.

How should the wheel be cleaned?

- Materials blocking airflow entry to the energy transfer matrix can readily be removed in the dry state by vacuum while still in the ERV.
- Removal of tar and oil based coatings requires washing with water and alkaline based coil cleaners. Allow the wheel to dry before installing it back into the ERV.

What desiccant does the enthalpy wheel offer?

- Airxchange has standardized on Silica Gel, a sub stance that has preference for the adsorption of water vapor molecules over other chemicals. Silica gel is the best desiccant for comfort ventilation applications because, at typical relative humidities, it transfers two to three times as much water by weight as compared to a Molecular Sieve.



Does Silica Gel wear out?

- Silica Gel is a material that will transfer water vapor at original design levels as long as it's surface is clean and free of oils or other coating agents that will block the free transfer of water vapor molecules. It does not wear out.

Why doesn't the desiccant come off over time?

- Airxchange has a patented and proprietary process that mechanically bonds the desiccant into the polymer energy transfer matrix so that it is permanently fixed. There are no adhesives, which can break down over time. The bond is permanent and lasts the life of the wheel and matrix, even with repeated and periodic washing.

How long will the polymer matrix last?

- The matrix is designed to last the life of the HVAC system, 20 years or more. It is unaffected by salt, oils or other corrosive elements. It was chosen to be a light and durable energy transfer material that can be easily washed clean. It is one of the few heat exchangers that can be applied in a marine (coastal) environment without special coatings.

How about fire? Doesn't the polymer wheel burn?

- All plastics have a combustion temperature as do all filters, insulation and other materials commonly used in HVAC systems. In recognition of the need for fire safety, building codes reference NFPA standards and UL product safety standards. All Airxchange components are UL listed for mechanical, electrical and fire safety. This UL listing assures that the Airxchange wheel has passed rigid fire safety testing and meets the requirements of NFPA standards and the building codes.

Do the belts wear out?

- Airxchange utilizes stretch belts fabricated of Urethane, a durable synthetic material (also used in automobile timing belts), that is impervious to chemicals and aging that typically attack natural rubber based products. In addition, the stretch belt design eliminates belt tensioners, adjusters and other mechanical devices prone to failure or that may require additional maintenance. The urethane belt is pre-stretched at the factory and designed to last at least 10 years before replacement may be required. As a wear part, a simple to install belt replacement kit is available from the factory.

How long will the wheel drive motor last?

- The wheel drive motor has been selected very conservatively to last on average for the life of the HVAC system. 20 years of field service has shown this to be the case. These motors are oversized for the relatively easy application of turning the wheel. Nevertheless, as with any motor, an occasional premature failure is to be expected.

Do Bearings need service?

- Airxchange wheel shaft bearings are permanently lubricated and sealed at the factory. They have an L10 life of 30 or more years, which means the user should never have to worry about bearing failure. Our field experience with replacement parts bears this out.

How corrosion resistant is the cassette and wheel? Can I use it on seacoast applications?

- Airxchange makes one of the most corrosion resistant cassettes available. The cassette frame is made of G90 galvanized material, the wheel components are stainless and the matrix material is plastic. The Airxchange wheel has superior life when compared to aluminum wheels in seacoast applications or other corrosive environments and does not require any special coatings that might interfere with the desiccant function.

What about swimming pool ventilation?

- Airxchange makes one of the most corrosion resistant cassettes available. The cassette frame is made of G90 galvanized material, the wheel components are stainless and the matrix material is plastic. In addition, especially for pool applications, the cassette frame can be powder coated on a special order basis, which adds further corrosion protection. However, it is not advisable to use a rooftop unit on a swimming pool without having specially treated coils, because of the chlorine. Also, the high humidity generated by swimming pools could be a detriment to the enthalpy wheel. Be very careful of this application.

I don't understand how the wheel controls moisture and humidity.

- Any time that the outside air supply has a higher absolute humidity than the indoor air being exhausted, the desiccant coating will capture moisture from the OA and transfer it to exhaust air, by the process of adsorption and desorption. This process is driven by the partial pressure of the respective water vapor streams, with the desiccant acting as the carrier. When the OA is drier than exhaust air the opposite occurs. OA is then humidified by the transfer of water vapor from the exhaust to supply air stream.
- The contribution of the wheel to better humidity control is to remove the majority of the latent load from either the cooling or the humidification system. For true control of humidity, those systems must be sized properly to either remove remaining excess moisture from the supply air before it enters the building or add required humidity to dry winter air. Independent research has demonstrated that properly designed DX cooling systems combined with enthalpy wheel preconditioning achieve adequate control of indoor humidity in hot-humid climates.

ERV Installation Types – Stand-Alone vs. Unitized

When I apply the ERV to my rooftop unit, what precautions do I need to observe?

- ***Make sure that the rooftop unit has been correctly sized to take into account the load reduction provided by the ERV.*** Without this step, the cooling system may be oversized, leading to short cycling and a loss of control of indoor humidity.
- Be sure that there are no rooftop sources of pollution near the supply air opening. Avoid plumbing vents, exhaust fans and any other source of external air pollution. Minimize the potential for exhaust from the ERV to be reentrained into the supply air. Watch out for the impact of parapets and architectural screens. It may be desirable in some cases to connect a short run of duct to either the supply or the exhaust air stream to avoid rooftop problems.
- Provide easy service access to the ERV. It is important to be able to easily change filters, clean the wheel, adjust fan belts and inspect the unit.
- Unit connections to the HVAC unit should be sealed against leakage.
- Be sure that the ERV is attached securely to the roof in case of a severe storm.
- Be sure that all filters and hoods are installed properly.
- Be sure to have the proper curb height. Some ERVs require taller curbs.

ERV's have been installed in various manners. **What is the best method?**

- ERV's have basically been installed in three ways. They are "stand alone", "stand alone ducted to the a/c return duct", and "unitized" to the a/c unit.
  - Stand-alone ERV's do not attach to the a/c system in any manner. This was the manner that the first ERV's were installed. The disadvantage is they do not take advantage of any refrigeration/heating cycle, and they require an independent duct system, balancing dampers, and diffusers.
  - Stand-alone ducted systems have the exhaust air duct connected to the a/c return duct system. In this manner they take advantage of the refrigeration/heating system of the unit. The disadvantage of the system is that it requires additional ductwork, and balancing dampers for each zone.
  - Unitized systems have the ERV connected directly to the rooftop unit. This system takes advantage of the refrigeration/heating system of the a/c unit. The advantage of the system is that it removes the need for an additional duct system.

Why should I attach the ERV to the rooftop unit, rather than a stand-alone unit?

- By attaching the ERV to the rooftop unit, you take advantage of the preconditioned air entering the rooftop unit. The ERV typically introduces air into the unit that closely matches the ARI design conditions of 87^{o} Fahrenheit and 67% humidity. This becomes a unitized system that allows the unit (1) refrigeration system to operate at close to its optimum conditions, and (2) prevents extremely cold temperatures from entering the unit heat exchanger.

Why is a balancing damper provided to install in the rooftop unit?

- The balancing damper is provided to insure proper balance of the exhaust airflow and the amount of return air that mixes with the fresh air. Without the damper, the a/c unit blower and the exhaust blower "fight" each other for the return air.
- Companies that provide ERV's without balancing dampers force the installing contractor to "tweak" the a/c and the exhaust blower to try to get the specified airflow for each requirement. Most of our competitors do not provide a balancing damper, which is bad for the industry.

How should the rooftop a/c unit that is used with an ERV be sized?

- The a/c load for the conditioned space should be calculated with the required amount of outside air. Then, the performance software should be used to determine the tonnage savings due to the energy recovery. For example, if 1000 cfm of outside air was required, and the calculation called for a 10-ton unit, and the ERV provided a savings of 2.5 tons, then a 7.5-ton a/c unit should be installed with the ERV.

Why are there multiple ERV sizes for each rooftop unit?

- Each job application has different outside air requirements. By offering multiple sizes of ERV's, the best wheel for the application can be utilized, providing the most economical cost per cfm of outside air.

Can an ERV be retrofitted to an installed rooftop unit?

- Yes, but it is important to note the amount of outside air that is being brought into the space. Typically the amount of outside air on installed equipment is not up to ASHRAE 62 guidelines. If the outside air is being increased to get to those guidelines, then the original equipment was not sized for the outside air load.

What is the benefit of the "pivoting" wheel in an ERV?

- An ERV is generally attached to a rooftop a/c unit over the area where the unit's economizer would be installed. Typically the ERV provides 50% or less of the a/c units airflow capability (example: 10-ton unit supplying 2000 cfm of outside air). When the outside air conditions are suitable for economizer operation, standard ERVs cannot provide 100% outside air. Many applications are installed with an economizer in the a/c unit that closes the return damper during economizer operation. This results in the a/c trying to pull all its air through the ERV, which can only provide its rated airflow. This hurts the a/c units blower, because it is operating at less than design airflow.
- The "pivoting wheel" ERV models rotate the wheel out of the airstream during economizer operation, and opens intake dampers. This allows the a/c to supply 100% outside air to the building, providing "***true economizer***" operation.

Why are "pivoting" wheel ERVs offered for some units, but not others?

- The a/c unit's design determines whether a "pivoting" wheel ERV is available. The wheel must pivot in a horizontal plane. Units that have the economizer intake above the exhaust air outlet can have a pivoting wheel ERV. Units that have the intake air and the exhaust air side-by-side cannot have a pivoting wheel ERV.
- On ERVs of 550 cfm and smaller the added cost of making a pivoting wheel ERV is not practical on a payback basis.

Can all rooftop a/c units have an ERV attached directly to them?

- ***No!*** The a/c unit must have the ability to have a balancing damper installed inside the unit. This damper must be accessible for adjustment. Many small packaged units are designed for both residential and commercial applications. This may limit the access to the return compartment.
- ***No!*** The a/c unit must be designed to allow enough airflow for exhaust air and intake air. The balancing damper on some a/c equipment would block the evaporator coil, thereby limiting the amount of exhaust air.

ERV Application Considerations

What happens if the a/c unit is not downsized when an ERV is utilized?

- The a/c unit will be oversized, which will result in less runtime. This will prevent the system from fully controlling the humidity conditions in the space.

How do we get a Mechanical Engineer to compare our ERV recovery to the competition?

- An engineer can only get a true comparison by reviewing the performance information provided by the software of each manufacturer. The critical information is the entering (supply) air conditions from the ERV.

Can the ERV be used to provide make-up air for a restaurant?

- For the ERV to provide the energy recovery it must have exhaust air across the wheel. Most make air systems are supplying air to "make-up" for exhaust air generated by kitchen hoods. These applications do not provide enough exhaust air across the wheel to allow them to pre-treat the outside air, therefore making them unacceptable for this application.

Why would a wheel be better than a plate in the winter?

- The very advantage claimed by most plate manufacturers- no moving parts – is also the downfall of the design. By rotating between a warm and a cold air stream the energy transfer matrix of the wheel can remove water from the exhaust, depressing the dewpoint and operating successfully too much lower temperatures.
- The frosting threshold of the wheel is typically over 20 degrees lower than that of the plate. This means many climates requiring frost control with a plate do not need it with a wheel. With a wheel operating at typical space conditions, the frosting threshold is around 0 degrees F and there is no condensate to drain.

When should frost control be considered?

- With a wheel operating at typical space conditions, the frosting threshold is around 0^{o} F and there is no condensate to drain. Low ambient controls are options on the ERV.

Why not use a fixed core (fixed plate) exchanger and avoid the moving parts?

- Plate type heat exchangers are good heat transfer devices and typically poor water vapor transfer devices. Even permeable membrane plates that transfer some water do not approach the latent effectiveness of a comparable wheel. If the application is a heating only application, a properly sized fixed plate exchanger can be successful. The one drawback to the fixed core exchanger in cold climates is the need for frost control any time the OA temp is below ~22 degrees F. This lowers the potential recovery efficiency of the exchanger, may interrupt ventilation and creates the need for defrost and a means of handling the condensate.

What is the difference between Standard and Channel Matrix wheels?

- Airxchange wheels have two energy transfer matrix options. The standard matrix is commonly used for balanced comfort and unitary applications. These are the typical applications that rooftop equipment is designed for.

- The channel matrix was designed for applications that require mechanical purge. This would only be used where no cross leakage can be allowed. This would be used in applications with contaminated exhaust situations. The channel matrix wheels are special order items.

When should "purge" be used?

- A purge sector minimizes the carry over cross leakage from the exhaust air into the supply (outside air) air stream by shunting a portion of the supply air back into the exhaust air stream. This is required when the cross leakage must be minimized due to contaminated exhaust air.

When should "purge" not be used?

- Purge sectors should not be used in typical space conditioning applications. Typically, in these applications most of the return air from the space is being re-circulated into the space. The ERV is pre-treating the outside air that is required to meet building code requirements. In applications that have a small amount of contaminants (toilet exhaust for example) in the exhaust, the amount of intake air can be increased above the amount of exhaust to lower the cross leakage in the wheel. A purge sector results in increased velocity across the wheel exhaust which results in lower effectiveness, thereby increasing the operating cost of the ERV.

I am worried about the transfer of air from exhaust to supply of ERV. What can I do?

- First, if the exhaust air has toxic or noxious chemicals, then the use of a wheel should be questioned. A run around loop may be the better choice to isolate the exhaust.
- If it is a comfort conditioning application with some toilet exhaust, then the wheel can safely and successfully be used.
- All wheels have seals that act to prevent the direct transfer of air from one air stream to the other. The two common transfer mechanisms are (1) leakage driven by pressure differences between air streams which the seals address and (2) the air carried over by the matrix and 'pumped' by rotation from supply to exhaust and exhaust to supply.
- Airxchange wheels are the narrowest offered which minimizes the effect of carryover and limits the transfer in comfort applications where the pressures are balanced between supply and exhaust air streams to 3-5% total, well inside safe limits for comfort applications. Seal leakage can be managed by pressure differentials.
- In hospital or industrial applications and for high pressure air handlers, where adjustable mechanical purge may be required to minimize any leakage (less than 1%) while minimizing fan size, purge is available in Airxchange "Channel Matrix" components for air handling applications.

How do I use the Airxchange performance software in my load calculation software?

- The performance software provides dry bulb and wet bulb ***supply air*** conditions. This is the condition of the air entering the a/c unit. Therefore, these conditions would be entered into the load software as the entering ***fresh air*** conditions.

ERV "Option" Questions

When should frost control be considered?

- With a wheel operating at typical space conditions, the frosting threshold is around 0° F and there is no condensate to drain. The low ambient control option should be used when the ERV will operate at these conditions.

Frost Threshold Temperatures

Indoor Air R.H. %	Indoor Air Dry Bulb Temperature			
	70° F	72° F	75° F	80° F
20	−14	−13	−11	−8
30	−3	−2	−1	3
40	5	7	9	11
50	12	13	15	18
60	18	19	21	26

How does the low ambient control work?

- The low ambient control functions by de-energizing the intake blower when the discharge air temperature falls below a field selectable temperature setting. In this manner the warm exhaust air removes any frost. The intake blower resumes operation after the discharge air temperature rises above the adjustable temperature differential. If the optional motorized outside air damper is installed, it closes during low ambient operation.

When should electric heat frost control be used?

- Electric heat (preheat) frost control should be used only in those applications that operate at extreme cold conditions. Bin data, such as provided by ASHRAE or Airxchange performance software, can be used to qualify daytime applications in cold climate conditions. Most applications do not require preheat. Preheat has a high cost of operation, and offsets the electrical savings of the ERV.

How can a service technician know how much intake air and exhaust air is crossing the wheel?

- The ERV is provided with test ports so the static can be measured across the wheel in both the intake and exhaust sections. By measuring the static, the airflow can be verified for each wheel size.
- The Pressure Sensor option provides a continuous readout of the static of the intake air. The static pressure chart gives the cross-reference for the cfm of the ERV.

What is the benefit of the Stop-Start-Jog option on an ERV?

- The Stop-Start-Jog (SSJ) option is used to rotate the wheel on a preset timer to prevent contamination of the wheel during occupied operation when energy recovery is not desired. Many companies define this as the economizer option, when actually only a portion of the a/c units cfm capability is entering through the ERV. In this manner, the wheel rotates momentarily helping to keep the wheel clean. This option is not required on pivoting wheel models that provide "true economizer" operation.

ARI Certification Questions

ARI has certified the ratings of the ERV component. What does this mean?

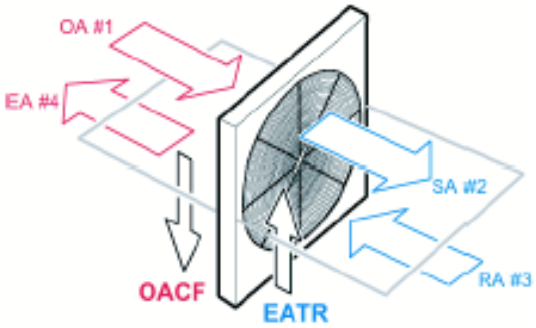
- The ERV utilizes an Airxchange enthalpy wheel, and the wheel is the "component". The wheel itself has been certified to ARI Standard 1060 conditions. The ERV itself must carry the following label:
  "Energy recovery COMPONENT rated in accordance with ARI Standard 1060-2000 and certified to ARI. Actual performance in packaged equipment may vary."
- ARI Standard 1070 has been proposed to certify the complete ERV, but the completion date for such a standard has not been set.

What benefits did ARI certification bring to the industry?

- ARI has given credibility to the product. In the past there were many questions regarding how companies rated their wheels. ARI provides an independent test.

What changes did ARI certification bring to the testing procedure?

- Traditionally the enthalpy wheel was rated by the application (measured) "effectiveness". This effectiveness was based on the supply (outside air leaving the wheel) air as a comparison to the difference of the exhaust air as it entered the wheel and the outside air before entering the wheel. Any cross leakage of the exhaust air to the supply air was not considered.
- ARI established the "net effectiveness" terminology that rated the wheel with all exhaust leakage removed. This was done in the testing laboratory by the use of a colored tracer gas. Net effectiveness cannot be measured in the field.
- ARI established the "outdoor air correction factor (OACF)" and the "exhaust air transfer ratio (EATR) definitions for leakage of airflow.
  - OACF is the difference in airflow measured between the outside air and the supply air, measured as a ratio.
  - EATR is composed of carryover leakage resulting from the rotation of the wheel from the return air to the supply air of the ERV. It is shown as a percentage.



Airflow Configuration Convention

Why do the ARI ratings for enthalpy wheels vary for each manufacturer?

- Each wheel manufacturer submits their product to ARI for certification. The manufacturer specifies to ARI at what cfm rate to certify the wheel. If the wheel range is 1500 – 3000 cfm, and the manufacturer specifies that the wheel be rate at 2000 cfm, then the performance would be higher than if they had specified 3000 cfm due to lower velocities across the wheel. Many wheel manufacturer use this approach to make their performance appear higher.
- Each wheel manufacturer has different type of media that does the energy recovery.
- The size of the wheel and velocity of the air across the wheel varies by manufacturer.

Has ARI certification placed every manufacturer on a level playing field?

- ***No!*** Unfortunately not all manufacturers of wheels have allowed ARI to test their product.
- ***No!*** Unfortunately some manufacturers have certified their product at lower airflows than the typical application for the product. This makes the ARI rating higher due to the lower velocity across the wheel. This is misleading without actually analyzing each wheel at the application cfm. All Airxchange enthalpy wheels are rated at or near the top normal range for their application.

Have all enthalpy wheel manufacturers had their wheels certified?

- ***No!*** In fact a limited number of manufacturers have submitted to certification. Some state in their literature and on their web site that their product "has been tested in accordance with ARI Standard 1060". This gives the impression that the wheel performance is ARI certified, when it is not. Without the ability to test for net effectiveness with a tracer gas, as ARI's lab does, it cannot be tested "in accordance with".

How can we determine who has ARI certification on their enthalpy wheels?

- The ARI web site provides a directory of all certified products by manufacturer. The site is www.ari.org/directories/erv. The prime directory has all the component manufacturers listed. The supplemental directory contains the manufacturers of package ERV's that utilize the certified components. The supplemental directory is where our ERV listings are found.