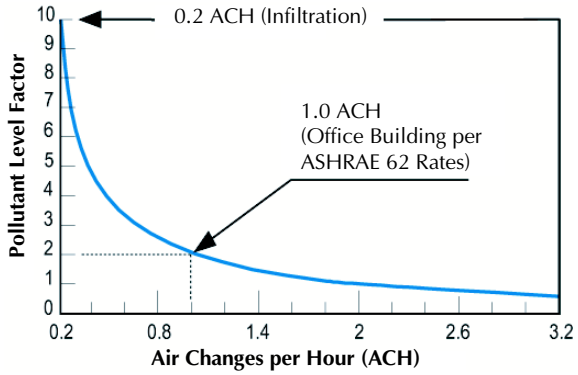
Airxchange Catalog Contents

The Fundamentals

Why Ventilation?

The HVAC community plays a vital role in providing healthful indoor environments in which to live, learn, work, and play. With half of all illnesses attributable to indoor airborne contaminants, the EPA has declared indoor air quality a public health priority. Ventilation with outdoor air is the only strategy that can simultaneously reduce the levels of *all* indoor pollutants. This strategy, in general accordance with the *Dilution Principle*, is shown in the illustration below.



Dilution Principle

Each doubling of the ventilation rate results in a 50% reduction in the concentration of all constant source air pollutants evenly mixed within the space. At 1.0 ACH, pollutant concentrations are reduced by a factor of 5.

National, state and local codes mandate minimum outdoor air ventilation rates based on ASHRAE Standard 62-1999, *Ventilation for Acceptable Indoor Air Quality*. The challenge is to introduce the outdoor air at the levels required by the codes while maintaining indoor comfort and conserving energy.

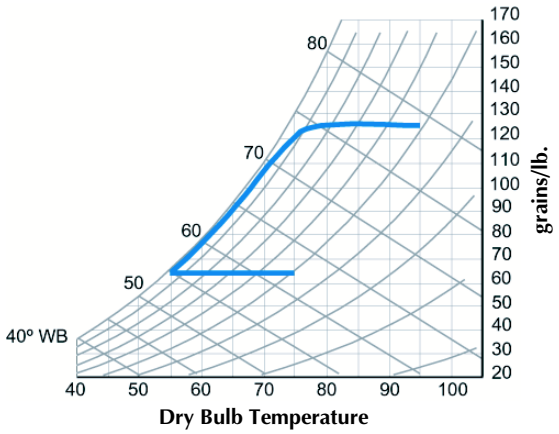
Why *Energy Recovery* Ventilation?

Building Code requirements for increased outdoor air ventilation rates have placed new demands on HVAC equipment and on building operating budgets. At the same time, new refrigerants being deployed to lower atmospheric ozone concerns have reduced equipment capacity and global warming is threatening to place even greater restrictions on our use of energy.

Energy recovery ventilation reduces the load on the system due to outdoor air by taking advantage of the work that has already been done to heat, cool, humidify or dehumidify the space. Instead of exhausting building energy to the outside, it is temporarily captured on the surfaces of the enthalpy wheel heat exchanger and then released to pre-heat, pre-cool, humidify or dehumidify the incoming air. Enthalpy wheels do this with exceptional efficiency and are the leading technology for achieving energy conservation while ventilating for health and comfort.

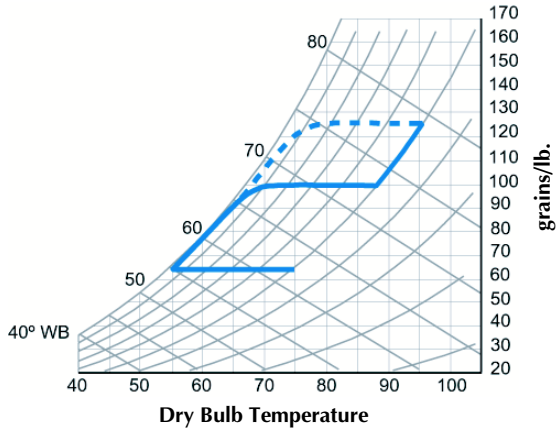
The Power of Enthalpy

The next three figures illustrate the power of enthalpy exchange. The first chart shows the result of just adding the required load from increased ventilation to the normal air conditioning process line.



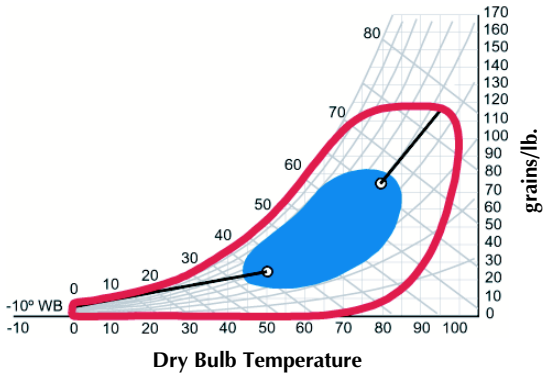
HVAC Conventional System Process Line

The chart below shows the new process line when using enthalpy recovery. As one can see, the cooling load (work) saved is a direct result of the difference in the two enthalpies.



Enthalpy Process Line

As shown below, with the use of an enthalpy recovery device, the conditions entering the coil or the building are in a more advantageous area of the psychrometric chart, and actually reduce the workload on the coil or the system.



Weather Compressor

It is an established fact that commercial buildings use approximately 2.7 quadrillion BTUH/year for cooling, heating, ventilation and refrigeration.

Potential energy savings of 15% total commercial HVAC and R

In a study commissioned by the U.S. Department of Energy and Pacific Northwest National Laboratory, it was determined that "if enthalpy recovery were widely used, 0.4 Quads of energy could be saved annually." This would result in an astounding *15% reduction* of the total energy used in commercial HVAC and R.

Why Airxchange Components?

Airxchange designs have evolved from 20 years of field experience with packaged ventilators, as well as OEM applications and an installed base of over 80,000 wheels.

The Airxchange patented technology comprises a unique set of solutions that are ideally suited for incorporation in a wide range of products.

Airxchange is dedicated to the OEM component market. The components are the choice of leading HVAC manufacturers for the following applications:

- Commercial ventilators
- Unit ventilators and accessories for packaged unitary heating and air conditioning products
- Packaged HVAC units with integrated energy recovery
- Standard, semi-custom and custom air handlers

Airxchange Technology at Work

ERV systems have found application in a wide variety of building environments, including:

- Animal Shelters
- Bars and Clubs
- Bingo Halls
- Casinos
- Churches
- Clinics
- Day Care Facilities
- Dormitories
- Exercise Facilities
- Function Halls
- Hair Salons
- Houses
- Hospitals
- Ice Rinks
- Locker Rooms
- Manufactured Homes
- Manufacturing Plants
- Mobile Offices
- Modular Classrooms
- Modular Homes
- Mortuaries
- Nail Salons
- Nursing Homes
- Office Buildings
- Photo Processing
- Pools
- Printing Shops
- Prisons
- Restaurants
- Schools
- Smoking Lounges
- Supermarkets
- Veterinary Hospitals

Common Features

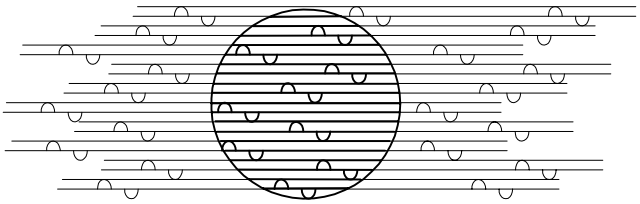
All Airxchange Energy Recovery Ventilation (ERV) components utilize a unique parallel plate energy transfer matrix design that optimizes the energy recovery surface area for a given diameter and depth of a rotary heat exchanger. In addition, a polymer film matrix offers ideal properties that limit counterproductive axial conduction of heat. This combination achieves the required performance in a thin, light weight configuration.

All Airxchange desiccant-coated enthalpy wheels are corrosion resistant. They are washable due to patented and proprietary processes that secure the desiccant to the matrix substrate with a permanent mechanical bond without the use of adhesives.

Recognizing the different needs of the unitary packaged and air handling segments of commercial space conditioning equipment, Airxchange components are available in Standard Matrix and Channel Matrix configurations.

Standard Matrix

The standard construction employs a series of small conical internal dimples (standoffs) to separate the film layers and define the geometry of the matrix.



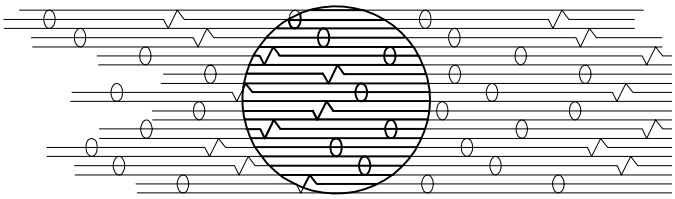
Standard Matrix

The standard construction is always suitable for ventilation in comfort applications and is generally specified for:

- Stand-alone ERVs
- Accessories, or integration into packaged unitary HVAC equipment

Channel Matrix with Mechanical Purge

Airxchange 3-inch depth components are available in the Channel Matrix configuration with an optional adjustable mechanical purge sector. Channel matrix wheels employ the same ideal parallel plate geometry as the standard configuration, however, the internal standoffs are axial ridges that separate intake and exhaust air streams while determining the matrix geometry.



Channel Matrix

With the channel matrix configuration, a mechanical purge sector may be required to control the amount of exhaust air that transfers to the supply air stream by the carryover mechanism. Using an adjustable purge sector, carryover can be reduced to less than 1% while limiting excess fan energy to less than 10%. This configuration is ideal for air handlers and other high pressure applications where the Standard Matrix might allow higher carryover or excessive fan energy losses. It is also responsive to applications and engineering specifications in which it is necessary to limit the recirculation of exhaust air.

Custom Designs

The Airxchange approach to the design and production of ERV components provides unique flexibility and capability. Custom wheels and segments can be produced in a wide variety of geometries to optimize the tradeoffs between *size, effectiveness* and *pressure loss*.

For your specific needs, please contact the factory.

If our catalog offerings do not meet your needs, we can engineer components to satisfy your specific requirements.

The *Fresh* Approach to Energy Recovery

Optimized Design

Airxchange achieves optimum performance through the use of polymer film material that is spirally wound into a parallel plate energy transfer matrix. Low thermal conductivity of the polymer material minimizes axial heat flow, thus permitting the design of thinner, light weight wheels ranging in thickness from 1″ to 3″.

All wheels consist of a welded assembly of hubs, spokes and rim. For wheels larger than 30″ in diameter, the spokes form pockets for retention of energy transfer segments that are removable without the use of tools. Under 30″ diameter, the wheel is permanently embedded in a monolithic, spirally wound energy recovery matrix.

Energy transfer matrixes are cut and framed into either 6, 8, or 16 pie-shaped segments depending on the size of the wheel. Segments are sized for ease of handling during installation, removal, and cleaning.

Silica Gel Desiccant

The Airxchange silica gel desiccant has superior moisture handling capacity in the working range above 30% R.H., the range concern for all standard space conditioning environments and outdoor air design conditions.

Flexible Performance

Airxchange technology provides a wide range of performance characteristics in a given wheel size. This results in flexibility of component selection for a wide assortment of outdoor air ventilation applications. Wheels are available in desiccant coated (enthalpy wheel) and uncoated (sensible wheel) configurations.

Mechanical Considerations

The Airxchange wheel matrix is resistant to mechanical damage and the polymer film is not subject to corrosion in coastal locations or swimming pool areas. The combination of a replaceable polymer matrix with an all-welded stainless steel hub, spoke and rim assembly provides an infinite design life. This results in a reliable heat exchanger for a wide variety of applications.

Airxchange ERV components have a life expectancy that matches or exceeds that of a complete heating and air conditioning system. Additional reliability considerations include:

- Bearings with a rated L-10 life in excess of 400,000 hours
- Urethane stretch wheel drive belts designed and tested specifically for this application
- Motors selected from highly respected industry suppliers

Serviceability

Serviceability was the basic consideration of Airxchange leading to designs of small monolithic and patented segmentation of large energy transfer matrixes.

Removable segments offer easy cleaning and replacement

Removable segments make wheel cleaning and replacement both possible and convenient. All wheels larger than 30" in diameter are made in patented segments that are removable without the use of tools. Thus, the wheels are easy to handle in the plant and in the field.

Cleanability

All Airxchange energy transfer matrixes are washable. Airxchange utilizes proprietary technology to permanently bond the silica gel desiccant to the surfaces of the patented heat exchange matrix without adhesives — the desiccant cannot be removed by washing.

Latent heat transfer effectiveness is restored by cleaning

What Airxchange Brings to the OEM

Invention and Cost Effectiveness

Airxchange has changed the energy recovery ventilation market with its new and unique approach to design and manufacture of heat wheels. Through the use of new materials, patented designs, and innovative manufacturing techniques, Airxchange has responded to the market challenge making energy recovery ventilation practical for all HVAC systems.

Cassettes and Components

Airxchange patented cassettes are complete ERV components consisting of a stainless steel wheel, washable energy transfer matrix, bearings, structural support beams, seals, motor, and drivetrain. The cassette is a UL recognized component. Airxchange UL and ARI certification support your engineering, manufacturing, sales, and marketing efforts.

Technology Benefits

- Reduced loads at design allow significant downsizing of the heating and cooling plant
- Energy efficient ventilation reduces operating costs
- Reduced design loads and operating costs combine for rapid payback
- Increased ventilation improves indoor air quality
- Greater efficiency permits raising the outdoor air quantity without increasing the heating/cooling plant. This makes it ideal for retrofit applications as well as new systems.

Product Features and Benefits

- Completely welded, stainless steel wheel structures for corrosion resistance and long service life
- Removable energy transfer segments for easy cleaning or replacement
- A spare set of energy transfer segments that can facilitate maintenance, reduce service time and minimize downtime in smoking and other high maintenance applications
- Washable energy transfer matrix for long life and sustained effectiveness
- UL recognized component for quick approvals
- Permanently bonded silica gel desiccant for long life
- ARI Certified performance for engineering confidence

Desiccant Process

Airxchange desiccant wheels are coated using a patented and proprietary process that permanently bonds the silica gel to the surface of the polymer substrate without adhesives. Even after years of operation and repeated washings, the Airxchange desiccant remains in place doing its job.

Optimized for Ventilation

The Airxchange wheel is optimized for the ventilation of conditioned space and should not be confused with heat regenerated wheels used in dehumidification and desiccant cooling. A silica gel desiccant is used for its superior sorption characteristics in the working range above 30% R.H., precisely the range encountered in heating and air conditioning applications.

Flexibility by Design

Flexibility is inherent in Airxchange designs. The same cassette dimensions and wheel diameters can be produced with a variety of different airflow and efficiency characteristics. This results in a wide variety of design choices for the OEM HVAC equipment manufacturer and greater flexibility in both production and field applications.

Getting Longer Life from Your Ventilation Unit

Materials are selected for durability using stainless steel welded wheel construction and patented polymer energy transfer matrixes. No special coatings are required in marine environments or swimming pool applications. Design life is in excess of 25 years, except for motors and belts.

Time-Tested Products

Airxchange energy recovery ventilation components are proven products with more than theoretical benefits. They have been time-tested during more than 20 years of use.

ARI Certification

About ARI

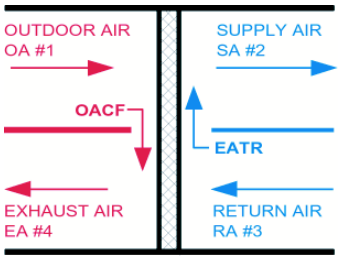
The *Air Conditioning and Refrigeration Institute* (ARI) is an association of at least 90% of the manufacturers involved in the HVAC & R industry. ARI establishes equipment standards for performance and administers certification programs to ensure compliance to those standards. By providing equipment bearing the ARI seal, the end user is assured of repeatable performance from a credible and reliable manufacturer.

The ARI seal signifies repeatable performance from a reliable manufacturer.

ARI Standard 1060-2000

ARI Standard 1060-2000 was established to rate the performance of factory-made air-to-air energy heat exchangers for use in Energy Recovery Ventilation equipment. The standard uses the *ASHRAE 84 Method of Testing Air-to-Air Heat Exchangers* as the test reference. The ARI standard outlines the performance parameters to be reported in any literature.

It is important to understand what the parameters mean to the overall equipment performance. The air stream measuring convention that is the basis for the discussion in this catalog is detailed in this figure.



Cassette Airflow Convention (Summer Condition)

The Effectiveness Equation

The effectiveness, ε, of air-to-air heat exchangers is measured in terms of:

- Sensible energy (heat) transfer: dry-bulb temperature
- Latent energy (water vapor or moisture) transfer: humidity ratio
- Total energy (heat and moisture) transfer: enthalpy

$$\varepsilon = \frac{m_s(x_1-x_2)}{m_{min}(x_1-x_3)}$$

Where:

ε = *Effectiveness: Sensible, Latent or Total*

X = *Dry bulb temperature, humidity ratio, or enthalpy*

m_s = *Supply (or outside) airflow*

m_{min} = *The lesser (minimum) of the two airflows, usually the exhaust*

For ARI balanced flow conditions, $m_s/m_{min} = 1$; supply and exhaust airflows are equal. On page 20, there is a discussion of the effect of unequal flows on effectiveness.

Air Transfer between Exhaust and Supply

Standard 1060-2000 has developed definitions for air transfer from one stream to another, as follows:

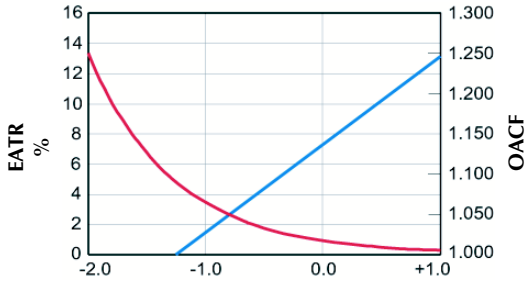
- Outdoor Air Correction Factor (OACF) = Difference in airflow (CFM) measured between OA and SA, presented as a ratio.

  OACF = OA flow/SA flow

  The OACF includes air lost through purge and seal leakage from the OA supply to the exhaust air stream.

- Exhaust Air Transfer Ratio (EATR) = Percentage of supply airflow that originated as return air (measured using tracer gas).

The sample curve below shows the typical relationship between EATR, OACF, and static pressure. The ARI ratings include data characterizing EATR and OACF for each component.



OACF and EATR

OACF and EATR are reported at three selected pressure conditions and the resultant purge angle (if a purge is provided) at which these values were determined.

For actual ARI certified ratings at the ARI test conditions, see the section entitled, Performance Data beginning on page 24. This data is provided in a table similar to the table below.

ARI Data

Nominal Airflow (scfm)	
Net Airflow (scfm)	

Effectiveness

SCFM	Effectiveness (%)			Δ P (in.w.c.)
	S	L	T	
Heating Conditions				
100%				
75%				
Cooling Conditions				
100%				
75%				

Net Effectiveness

Heating Conditions				
100%				
Cooling Conditions				
100%				

Delta P	EATR	OACF	Purge Angle
-1.00			
0.00			
1.00			

The tabularized ARI Certified Rating information allows ARI and OEMs to periodically check the validity of manufacturer data. All other data is tabulated under *Application Ratings*. This is data that is specified at other than standard conditions.

Airxchange Performance Selection Software is available to determine actual design parameters. Further information on this software is provided in Performance Selection and Calculations beginning on page 21.

Certifying Your OEM Product

The ARI Certified Products Directory for Air-to-Air Energy Recovery Ventilation Equipment lists packaged products that incorporate certified components. ERVs, accessories, unitary equipment and air handlers that incorporate Airxchange components are eligible to bear the ARI Standard 1060-2000 certification seal, at no cost to the OEM. Airxchange is happy to assist engineers and product managers listing units in the ARI Certified Products Directory and will also provide electronic files of the required data submittal sheets.

Design Considerations

Guidelines

Energy recovery cassettes can be incorporated within the design of packaged rooftop units and accessories, airhandlers, energy recovery ventilators, or site-built air handling systems.

The guidelines include: accessibility, orientation, lifting and support, diameter seal adjustment, and wheel drive motor characteristics. For overall dimensions refer to the section entitled Physical Data beginning on page 44.

Accessibility

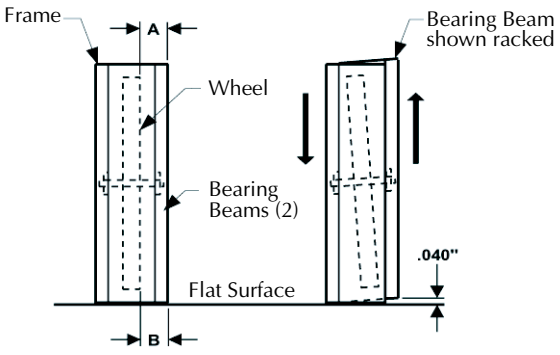
The cassette and all its operative parts including motor, belt, pulley, bearings, seals and energy transfer segments must be accessible for service and maintenance. The most practical design to allow complete access is one in which the motor side of the cassette can slide at least half way out of the cabinet or ductwork for service. This design requires that adequate clearance be provided outside of the installed cabinet.

Where cassettes are permanently installed in a cabinet, access to both faces of the cassette must be provided. Internal partitions that separate air streams must allow access for bearing removal.

Orientation, Lifting and Support

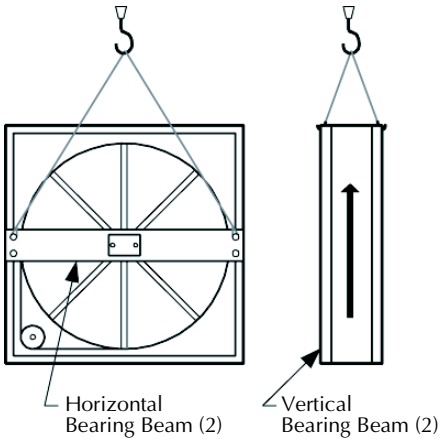
The Energy Recovery Cassette may be mounted in any orientation. However, care must be taken to make certain that the cassette frame remains flat and the bearing beams are not racked. After installation, be sure that the distance between wheel rim and bearing beam is the same at each end of one bearing beam to within ¼". A small amount of racking can be compensated for by adjusting the diameter seals. If dimensions **A** and **B** in the following figure differ by more than ¼", racking must be corrected to ensure that the drive belt will not disengage from the wheel.

Bearing beam racking of as little as .040″ on a 74" diameter wheel causes the wheel to tilt 3/16″ at the rim.



Avoid Racking of Cassette Frame

When lifting larger cassettes, ensure the provided lifting holes in the bearing beams are used as shown in the figure below.



Lifting Hole Locations

Diameter Seals

Diameter seals are adjusted at the factory when the wheel is in the vertical position. Cassettes installed at angles greater than 30° from vertical may require seal readjustment.

A final check of seal adjustment is recommended for all designs.

Wheel Drive Motor

Cassettes provided with single phase PSC wheel drive motors include the capacitor. Single phase motors may be pre-wired at the factory with a three pin Amp connector. The motor is designed to rotate clockwise when viewed from the pulley side.

Three phase wheel drive motors are provided with a junction box and optional 208/230 V or 460/480 V wiring. Motors may be pre-wired at the factory upon request. Wiring diagrams are provided with each motor. When wired according to the wiring diagram, the motor rotates clockwise when viewed from the pulley side.

3-phase motors must be wired according to the wiring diagram to assure clockwise rotation or the wheel when viewed from the pulley side.

Frost Control

Frost control is required in extremely cold climates to preserve performance and assure the continuous supply of outdoor air. Enthalpy wheel frost control strategies take advantage of inherently low frosting thresholds.

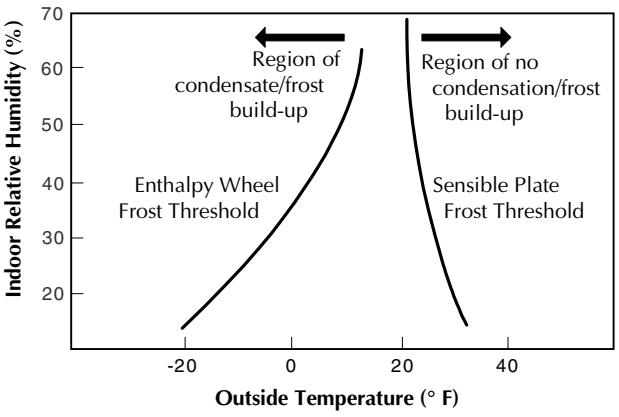
Enthalpy wheels have inherently low frosting thresholds.

This results in minimized energy use and maximized design load reductions.

Frost Threshold

Frost formation causes reduction of airflow through the heat exchanger. Without frost control, energy recovery and airflow may be significantly reduced.

The *frost threshold temperature* is the point at which frost begins to accumulate on heat exchanger surfaces. It is a function of both outside temperature and indoor relative humidity. The following figure compares the frost threshold of a plate-type sensible heat exchanger with that of an enthalpy wheel.



Frost Thresholds:
Enthalpy Wheels vs. Plate-type Heat Exchangers

Note that while frost forms at between 22° F and 30° F in a plate-type exchanger, frost thresholds for enthalpy wheels are generally 20 to 30 degrees lower. This is because the enthalpy wheel removes water from the exhaust air stream, effectively lowering the dewpoint of the exhaust. The water removed is subsequently picked up through desorption, re-evaporation or sublimation by the entering outdoor air.

Economic Impact of Enthalpy Recovery

Depending on the indoor R.H. in areas where winter outside temperatures are between −5° F and 22° F, enthalpy wheel components have a significant *advantage* over sensible plate type units because...

No added cost for frost control is required.

Even in colder areas, in most cases, enthalpy wheel systems for schools and office buildings can be designed *without* frost control because most of the frosting hours are at night when the building is unoccupied. Bin data, such as that provided by ASHRAE or AIRX ERC performance modeling software, can be consulted to qualify daytime applications in cold climates for frost-free operation.

The following table lists typical frost threshold temperatures for Airxchange ERV wheels over a wide range of indoor air temperatures and relative humidities. Frost control is not required until outdoor air temperatures are below the threshold.

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

Frost Control Designs

In regions of extreme winter temperatures, Airxchange ERV components are utilized effectively with specific frost control techniques, such as:

- *Preheat* frost control, a universally applicable strategy which meets all design requirements.
- *Variable effectiveness with bypass,* which can be used to advantage in a limited number of applications. Speed control is generally *not* recommended.
- *On/Off.*
- Exhaust Only.

These topics are discussed in detail in the *Tech Frost* technical note on the Airxchange CD accompanying this catalog.

Enthalpy Wheel Cleaning

Over time, build up of material on energy transfer surfaces reduces latent energy transfer and airflow. Because of this, periodic cleaning is generally required to maintain building moisture control and to supply required ventilation rates. This topic is discussed in greater detail in the *Techcln* technical note on the Airxchange CD accompanying this catalog.

Cleaning Needs

Tar and oil based aerosols condensing on desiccant surfaces eventually closes off micron-sized pores, reducing the efficiency with which the desiccant can transfer moisture. This material, which does not adversely affect sensible heat transfer, can only be removed by washing with water and a detergent.

"Sticky" material that builds up on the face of the parallel plate energy transfer matrix, can bridge the narrow opening between the parallel plates so as to reduce airflow. This material can be removed with a brush, vacuum or flat bladed scraper.

Self-Cleaning

Particles small enough to enter the energy transfer matrix will pass through. Larger particles attempting to enter are blown clear as the wheel rotates into the counter-flowing airstream.

Cleaning Frequency

Because of the self cleaning characteristics for dry particles, the presence of oil and tar based aerosols in the air being supplied or exhausted will be the major factor determining the need and frequency for cleaning. Other factors are climate and operating schedule.

Desiccant is not lost in the washing process.

Use the following guidelines and initial annual inspections to establish an appropriate cleaning schedule.

- *In normal indoor environments* of schools, office buildings, or homes, reductions in airflow or effectiveness may not occur for five to ten years.
- *In commercial, institutional, and residential applications* with moderate occupant smoking, measurable changes in latent energy (water vapor) transfer and some loss of airflow can occur in less than five years.
- *In applications of unusually high levels of occupant smoking,* such as lounges, nightclubs, bars and restaurants, latent effectiveness may be severely reduced in less than one year without loss of airflow.
- *In industrial applications*, such as welding and machine, which ventilate high levels of smoke or oil-based aerosols, a three to six month washing cycle may be required.
- In all applications, loss of indoor moisture control during the cooling season could indicate the need to clean enthalpy wheels.

Cleaning and Performance

Airflow

Materials blocking airflow entry to the energy transfer matrix can readily be removed in the dry state by vacuum or by scraping with a flat blade while the energy transfer matrixes remain in the wheel within the air moving cabinet. However, removal of oil and tar based coatings requires washing with water and alkaline based coil cleaners.

Moisture Transfer

Restoration of latent effectiveness to near original performance only requires soaking in a water and detergent solution to loosen deposited tars and oils, followed by a rinse. Because removal of desiccant during the cleaning process would cause permanent loss of latent effectiveness, Airxchange wheels feature silica gel desiccant ***permanently*** bonded to the heat exchange surface without adhesives. The ***permanent*** nature of the bond between the substrate and desiccant is readily demonstrated by the inability to rinse, soak, scrub or otherwise remove desiccant from its substrate.

Removable Segments

To facilitate washing, all energy transfer wheels larger than 30" in diameter are made with energy transfer segments that are removable in minutes without the use of tools. Depending on wheel size, individual segments weigh between 4 and 23 pounds. Easily handled, removed segments and small wheels can be washed on site or at a remote location.

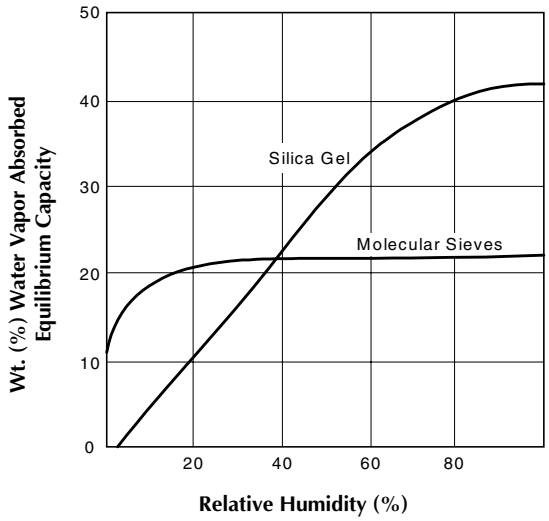
Silica Gel Desiccant

What is it?

Silica gel is a highly porous solid adsorbent material that structurally resembles a rigid sponge. It has a very large internal surface composed of myriad microscopic cavities and a vast system of capillary channels that provide pathways connecting the internal microscopic cavities to the outside surface of the sponge. Silica gel enthalpy wheels transfer water by rotating between two air streams of different vapor pressures. The vapor pressure differential drives water molecules into/from these cavities to transfer moisture from the more humid air stream to the drier air stream.

Adsorption: Silica Gel vs. Molecular Sieve

The following figure shows the characteristic curve for adsorption of water on silica gel. It shows the percent weight adsorbed versus relative humidity of the air stream in contact with the silica gel. The amount of water adsorbed rises linearly with increasing relative humidity until R.H. reaches near 60%. It then plateaus at above 40% adsorbed as relative humidity approaches 100%. For contrast, the curve for molecular sieves rises rapidly to plateau at about 20% adsorbed at 20% R.H.



Effect of Relative Humidity on Desiccant Capacity

The graph explains the following application considerations:

- Molecular sieves are preferred for regenerated applications such as desiccant cooling and dehumidification systems that must reduce processed air streams to *very low* relative humidities.
- Silica gel has superior characteristics for recovering space conditioning energy from exhaust air and handling high relative humidity outside conditions. Another key point is that the transfer of water by sorption/desorption is not dependent on temperature. Thus, the silica gel enthalpy wheel works to reduce latent load at difficult part-load conditions.

Purge

Purge removes exhaust air that would be otherwise carried to the supply air stream by the rotating wheel matrix. Outdoor air is used to clean or *purge* the wheel matrix before it rotates from the exhaust air stream to the supply air stream. The driving force for the purge stream is the pressure differential between the outdoor air and return air compartments adjacent to the wheel. Purge is accomplished by utilizing the wheel matrix or by mechanical means.

Two Choices of Purge Technology

Airxchange offers two distinct technologies to support the purge process.

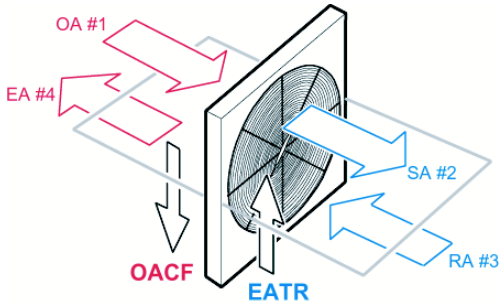
- *Through-Matrix Purge* using Standard Matrix components
- *Channel Matrix* with optional Mechanical Purge

Design Considerations

If purge is desired, the design considerations include:

- Use of outdoor air to flush carryover through the open matrix
- Adjusting fans and pressures so that any seal leakage is from supply to exhaust
- Ensuring that pressures are not excessive resulting in wasted fan energy

The following diagram defines the terminology of airflow for consideration of purge.



Airflow Configuration Convention

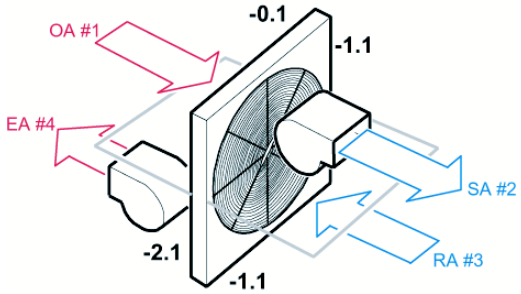
- EATR (%) is composed of carryover leakage resulting from the rotation of the wheel from Return air to Supply air and any seal leakage in that direction, minus the impact of purge. Purge airflow removes return air from the wheel volume before it enters the supply side of the component.
- Outdoor Air Correction Factor (OACF) is the difference in airflow measured between OA and SA, presented as a ratio. The OACF includes air lost through purge and leakage from the outdoor air stream to the exhaust stream. Accordingly, OACF is used to size the fans.

Through-Matrix Purge

This technology employs the Airxchange standard energy transfer matrix. It is well suited for comfort applications where EATR values of 4% to 6% are acceptable.

The performance of through-matrix purge is competitive with mechanical purge sectors supplied with fluted wheels, however, through-matrix purge is less expensive and simpler for most field applications. *Effective* purge yielding an EATR of 1% or less can be achieved with through-matrix technology whenever static pressure differences are positive from supply to exhaust on *both* sides of the wheel. By making best use of system characteristics and fan placement, EATR (cross-leakage) can be held to 1% or less.

For example, in the draw-thru, draw-thru configuration shown below, where all static pressures are negative, nominal wheel delta P is 1" on both sides.



Compartment Pressures to Achieve Effective Purge

Typical data for standard wheels with through-matrix purge is given in the following table which indicates that in order to obtain less than 1% EATR, as much as 14% of the flow entering the outdoor air hood will be used to purge the matrix and seals into the exhaust compartment. To achieve this, the exhaust fan must be sized to result in 114% of normal flow.

OA to EA *(Delta P in. w.g.)*	*SA to RA (Delta P in. w.g.)*	OACF Ratio	EATR %
1.0	-1.0	1	6.5
1.5	-0.5	1.06	3.2
2.0	0.0	1.14	0.6
2.5	0.5	1.20	0.1
3.0	1.0	1.24	0
4.0	2.0	1.32	0

The values shown in the table above and the next table (mechanical purge) differ slightly from wheel size to wheel size due to wheel geometry. In general, larger wheels and thinner wheels will see smaller leakage as a percentage of design flow. Data for specific wheels is located in Performance Data beginning on page 24.

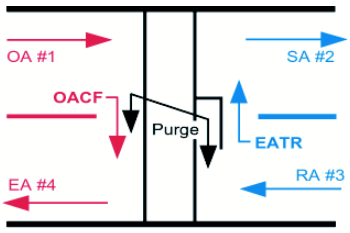
Channel Matrix with Mechanical Purge

Airxchange channel matrix technology is the option of choice to limit excessive leakage of air in critical higher pressure applications. Channel technology results in greater energy savings throughout the system. These designs *require* a mechanical purge if it is necessary to minimize the impact of carryover of exhaust air. This is a wedge-shaped sector that captures and redirects the supply air to the exhaust side.

In summary, channel matrix designs:

- Limit excessive leakage of air and limit resulting additional fan energy requirements in high differential pressure applications
- With adjustable purge, limit EATR (exhaust air transfer, or cross-leakage) to less than 1% in sensitive applications over a wide range of pressure differentials

The following diagram defines airflows and delta P:



Airflows with Mechanical Purge

The driving forces for OACF and purge are provided by the plenum pressures in the wheel compartment and adjusted by system and component pressure loss and fan placement.

EATR of 1% or lower can be provided whenever pressures are *positive* from supply to exhaust on both sides of the wheel. The table below represents sample application performance data based on tracer gas testing and airflow measurements obtained in laboratory testing. Purge Angles for EATR < 1% and minimum OACF are shown in the following table.

OA to EA *(Delta P in. w.g.)*	*SA to RA (Delta P in. w.g.)*	Purge Angle	OACF Ratio	EATR %
1	−1	15°	1	>>1
1.5	−0.5	15°	1.06	1.60
2.0	0.0	3.3°	1.055	0.996
2.5	0.5	1.8°	1.073	0.991
3.0	1.0	1.1°	1.086	0.991
4.0	2.0	0.4°	1.107	0.994

Equations for Energy Recovery System Design

Fan capacity and the various ratios can be calculated manually using the following equations, or by using the Airxchange Performance Modeling Software. For definitions of the terminology used in these equations, refer to the Airflows with Mechanical Purge figure on the previous page of this catalog.

- To size a draw-thru fan at location #2:

  Required Fan CFM =
  Desired Outdoor Air CFM (1 + EATR)

- To size a blow-thru fan at location #1:

  Required Fan CFM =
  Desired Outdoor Air CFM (1 + EATR) (OACF)

- To size a draw-thru fan at location #4:

  Required Fan CFM =
  Desired Exhaust CFM +
  Required CFM at location #1 – Desired CFM at #2

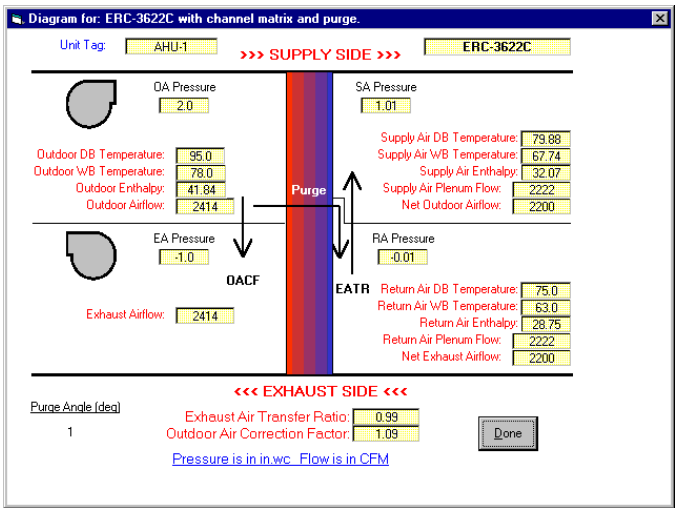
- To correct the outdoor airflow measurement at the outdoor air hood (all arrangements):

  Measured Outdoor Air CFM =
  Desired Outdoor Air CFM (1 + EATR) (OACF)

Performance Modeling Software

Airxchange software models the purge system parameters to simplify the design process. For any desired outdoor airflow and set of operating pressures, airflows in all four plenums, EATR, and OACF are provided by the model. Fan size can now be calculated using this information.

An example of a Purge System Diagram developed from the modeling software is shown here.



Purge System Diagram

Fungal Growth and Moisture Transfer

Water Transfer

In Airxchange silica gel-based desiccant wheels, the water molecules are individually transferred by sorption to and from the silica gel surfaces. Water is present on the wheel in a molecular layer only, and condensation does not occur. Thus, these wheels experience *dry* moisture transfer. There is no bulk liquid water present that could support fungal growth or dissolve other chemical species. Water transfer to and from the wheel's desiccant surfaces occurs in the vapor phase. There are no wet surfaces and liquid water does not enter the air stream. Silica gel is also highly selective for water, based on the strong preference of the gel surface for the dipolar water molecule over other compounds.

The sensible, non-desiccant coated Airxchange wheel can transfer water through a mechanism of condensation and re-evaporation. However, there is no accumulation of water, unless the frost threshold is violated through misapplication of the component. In this case, the water is in the form of frost or ice, which does not support fungal growth. Sensible, uncoated wheels from all manufacturers are identical in this regard.

Field Experience

Airxchange has over 80,000 wheels in the field, including both desiccant and sensible varieties in a broad range of applications, without a single reported instance of mold or fungal growth on the wheel. Airxchange enthalpy wheels play a primary role for the control of moisture in buildings. In many cases, Airxchange wheels and ERV units have been installed successfully for the purpose of correcting mold and fungal growth problems resulting from inadequate ventilation and excessive humidity levels.

Airxchange enthalpy wheels play a primary role in the control of moisture in buildings.

Fire and Electrical Safety

All Airxchange products have bourne the UL label since first manufactured in 1981. Currently Airxchange energy recovery cassettes are UL Recognized Components under UL Standard 1812, Ducted Heat Recovery Ventilators. UL's follow up services program assists our ongoing compliance with these standards.

Part of the UL investigation for listing under Standards 1812 involves an evaluation of the fire safety of the heat wheel matrix. Airxchange wheels are subjected to the UL 900 fire test for air filter units. This test evaluates both flammability and smoke density under operating conditions simulating actual use in an air stream. Airxchange wheels easily surpass the criteria established for widely used Class 2 filters. Therefore, Airxchange products are accepted for installation in accordance with NFPA 90A by virtue of their UL listing for safety and their UL 900 test results for flammability and smoke density.

Copies of the Airxchange UL Listing Card are available on request.

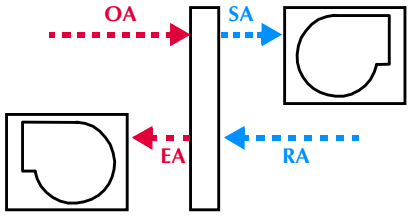
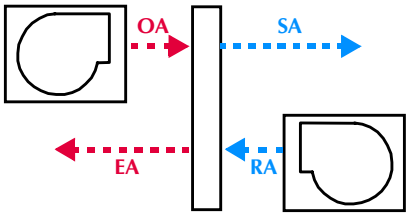
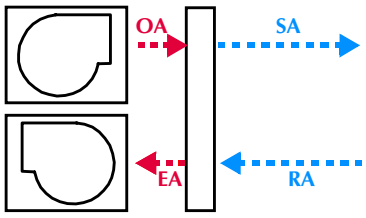
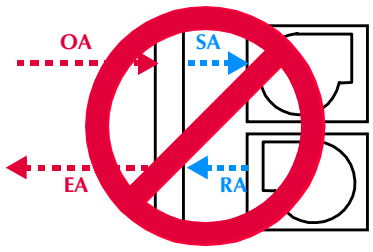
Application Considerations

As a supplier of ERV components to OEM HVAC manufacturers,
Airxchange cites the following application considerations for the engineer.

Industrial Processes	• Cross-transfer of pollutants from exhaust to supply air. • Operational temperature range required. • Ability to clean the pollutants from the exhaust air stream that deposit on the wheel. • Do not use energy recovery from fume hood exhaust.
Print Shops	• Do not use energy recovery from the print head exhaust. • An ERV may require supplementary heating and dehumidification to control the space humidity to tolerances required for paper based products. • Regular cleaning to keep latent performance at factory original levels is suggested.
Swimming Pools	• A properly sized pool dehumidifier in addition to a sensible or latent recovery wheel is required to control indoor relative humidity in pool spaces. • The exhaust air contains chlorine molecules that will combine with condensate on cool surfaces to create mild solutions of hydrochloric acid. Metal parts should be coated or chosen for resistance to corrosion. • Pools must be ventilated to at least ASHRAE minimums 24 hours a day to avoid chlorine buildup. • Frost control for low temperature operation at higher humidities should be considered. ASHRAE design conditions for the pool deck are 80° F and 60% R.H.
Ice Rinks	• Ventilation air must be dried and pretreated to keep indoor relative humidity below the dewpoints at ice levels on the rink. • Enthalpy wheels are recommended for controlling the introduction of humidity from the outdoor air. • Ventilation can be staged for occupancy, but allowance must be made for the operation of gas-fired Zamboni ice machines during low occupancy. • Frost control is rarely required due to the dry nature of exhaust air.
Hospitals	• Enthalpy recovery wheels are acceptable for ventilation in common use areas such as patient rooms, waiting areas, and hallways. • Operating rooms and labs may need to avoid the possibility of even the slightest cross-transfer of exhaust to supply. Most hospital ventilation codes require final filters and separation of intake and exhaust. • Wheels must be regularly cleaned and maintained to assure the highest supply air quality. • Ventilation is a 24/7 requirement, so provision for low temperature operation (frost control) must be considered in cold climates.
Nursing Homes	• Odor generation mandates ventilation rates at or above the minimums listed in Table 2 of ASHRAE Standard 62-1999. • Enthalpy recovery assists with humidity control, which is important for occupant comfort and health. • Frost control is required in many cold climates. • Special laboratory or infectious disease areas should have dedicated exhausts.

Correctional Facilities	• Odor generation mandates ventilation rates at or above the minimums listed in Table 2 of ASHRAE Standard 62-1999. • 24/7 operation requires low temperature (frost) operational controls in many cold climates. • The possible need to control infectious disease, particularly tuberculosis, requires applications care and may require final filters.
Toilet Exhaust	• Odor control is rarely an issue when toilet exhaust is provided at ASHRAE Standard 62-1999 Table 2 minimums. Consider additional exhaust to balance flows when using energy recovery. • Make-up air for toilet exhaust is generally provided by transfer air from surrounding spaces. • The mixing of toilet exhaust with space ventilation exhaust is acceptable for systems where cross-transfer is limited to 10% or less of the exhaust air stream.
Hospitality/Smoking	• Control and separation of smoking and non-smoking areas presents design challenges as does kitchen ventilation from grills, fryers, and ovens. • Where smoking is allowed and exhausted through an enthalpy recovery wheel, thorough cleaning every 90 days is highly recommended to avoid buildup of tars and nicotine on the surface of the wheel. • Supply air coming through a wheel that has smoking room exhaust must always be supplied back to the smoking space. It should not be supplied to non-smoking areas due to concerns for odor transfer. Space conditioning should be provided separately, as well.
Retail	• Retail ventilation is important to minimize the concentration of chemicals in the space due to clothing dyes, paint, and formaldehyde from products and furnishings. • Significant savings in ventilation costs are available due to long hours of operation. • Cross-transfer of pollutants is not an issue, nor is the mixing of toilet and space exhaust for recovery purposes. • Frost control should be considered in the colder climates.
General	• Observe care in siting the supply air intake of the energy recovery ventilator. Avoid the possibility of direct transfer of exhaust air back into the space. • Avoid placing plumbing and bathroom vents near supply air intakes. • Avoid placing kitchen exhaust near outdoor air supply intakes. • Never use rotary enthalpy recovery on contaminated exhausts from laboratory hoods. • Never use rotary enthalpy wheels on paint booth exhaust. • Never use rotary enthalpy wheels on direct exhaust of automobile engines, or diesel exhausts.

Fan Placement

Configuration	Description
	**Draw-Thru Supply/Draw-Thru Exhaust** **Advantage** • Good airflow distribution across the wheel • Minimal cross-transfer • Most energy efficient use of fans **Cautions** • Cross-transfer direction depends on delta P **Remedy** • Design the system so static pressure in both chambers is nearly equal
	**Blow-Thru Supply/Blow-Thru Exhaust** **Advantage** • Minimal cross-transfer **Cautions** • Cross-transfer direction depends on delta P • Turbulence between fan and wheel increases energy use over draw-thru configurations **Remedy** • Design the system so static pressure in both chambers is nearly equal
	**Blow-Thru Supply/Draw-Thru Exhaust** **Advantage** • Good for minimizing cross-transfer between exhaust and supply **Cautions** • OACF will be higher with standard matrix wheels **Remedy** • Design the system to keep the delta P(s) low, or utilize channel matrix wheels
	**Draw-Thru Supply/Blow-Thru Exhaust** **Advantage** • **None — DO NOT USE** **Cautions** • Significant transfer of exhaust air • Significant waste of fan energy **Remedy** • **None**