



AIRotor Series-R™

AIRotor, LLC®

Rotary Air-to-Air Heat and Water Vapor Exchanger

Product Guide

- Energy Transfer Effectiveness up to 85%
- Non-Sectioned
- Ten Inch Deep Corrugated Aluminum Construction
- Low Pressure Drop
- Practically No Cross-Contamination with Purge Sector
- Factory Installed Variable Speed Drive and Controls



Performance ARI Certified

ETL Listed



Introduction	1
Applications	1
Value	1
Unit Housing	2
The Housing Frame.....	2
Face and Side Panels.....	2
The Rotor	2
Filtration Recommendations.....	3
Leakage/Cross Contamination	3
Desiccant Carryover.....	3
Flow through Wheel Structure.....	4
Direct Rotational Carryover.....	4
Seal Leakage.....	4
Seal System	4
Purge Sector	5
Drives and Control System	6
Drive.....	6
Control.....	6
Multifunction VFD—Standard	6
DDC—Optional	7
Controls, Concept of Operation	8
Frost Control Only—Optional	8
Performance	9
ARI Certified Performance	9
Psychrometric Analysis.....	9
Quantified Volume Analysis.....	10
Selecting a Series–R	11
Ordering Specifications	11
Series–R Configuration Options	12
Horizontal Airflows	12
Vertical Airflows.....	12
Dimensional Specifications	13
General Specification	14
Rotary Air-To-Air Heat Exchanger	14
Enthalpy Recovery Wheel.....	14
Cross Contamination Verification.....	14
ARI Certification.....	14
Unit Housing.....	14
Purge Sector	15
Drive System/Speed Control.....	15
Full Season Operational Control.....	15

Introduction

The Series-R™ heat wheel is a total energy exchanger that transfers both heat and water vapor between airstreams. Because of its construction, it is highly effective yet causes very little pressure drop. When used for ventilation, it can dramatically reduce both the cost of other necessary heating and cooling equipment as well as the operating cost of the ventilation system.

Applications

The Series-R can be used to improve and control indoor air quality in a wide variety of applications. For example, they have been used for years in:

- Auditoriums
- Child Care Facilities
- Churches
- City Halls and Community Facilities
- Commercial and Military Offices
- Conference Centers
- Controlled Climate Factories
- Correctional Facilities
- Healthcare Facilities, Hospitals, and Clinics
- Hotels
- Industrial Process Facilities
- Laboratories
- Libraries
- Low Humidity Industrial Processes
- Maintenance Facilities
- Museums
- Nursing Homes
- Process Manufacturing Facilities
- Recreational and Fitness Centers
- Schools and Universities
- Welding Areas
- Zoos

Value

Payback for the Series-R begins prior to installation. The ability to recover otherwise-wasted energy from exhaust airstreams reduces the load on other mechanical heating and cooling equipment by up to 85%, allowing smaller and less expensive equipment to be used.

- High energy transfer effectiveness, low pressure drop, minimum maintenance, and value-added features such as factory installed controls make the Series-R a unique product among its competitors.
- Our global experience goes back to 1975 when we first developed and began to manufacture thin-sheet aluminum heat wheels to improve indoor air quality for industrial facilities in Sweden.
- ARI Performance Certification™ provides you assurance of product performance.
- The Series-R is ETL tested and listed under the Standard for Heating and Cooling Equipment ANSI-UL-1995, CAN/CSA-22.2 No 236-05, 3rd Edition.
- Non-sectioned wheel construction reduces product and field assembly costs while improving overall performance.
- Highly effective seals, purge system, and non-contaminating desiccant means virtually no cross-contamination, as documented by independent testing.
- The Series-R has a demonstrated record of low failure rate and minimum maintenance requirements.
- Water does not condense on the exchanger's hygroscopic surfaces, so no drain pan is required.
- Series-R can operate up to 150 °F.
- The AIRotor team provides highly responsive service and support.

Unit Housing

The Housing Frame

The rotors in Series-R exchangers are housed in a cabinet suitable for installation in an HVAC system. For models RVB-700 to 1100, the frame of the cabinet is constructed of formed, heavy gauge galvanized steel. For larger models, RXA-1350 to 3000, the frame is constructed of extruded, anodized aluminum.

The heavy duty frame is designed to prevent the torque produced by the airstreams from bending the heat wheel. It is strong enough to limit deflection from static pressure drops to less than 0.03 inches at the wheel's perimeter.



AIRotor Series-R, Model RVB-1100

Face and Side Panels

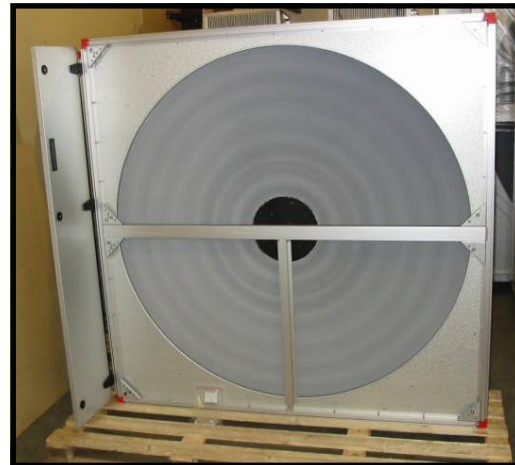
The face shroud panels are constructed of aluminum-zinc plated sheet steel coated with an ALC finish conforming to Corrosion Class C4. The face shroud is reinforced to limit deflection.



AIRotor Series-R, Model RXA-2250

The necessary drive and control components are located in the open cavities inside the frame and are not exposed to either of the airstreams.

These units can also be special ordered with exterior side panels, as shown above. The panels provide clear and easy access to enclosed drive and control components.



AIRotor Series-R, Model RXA-1950

The Rotor

The rotor is assembled from alternate layers of flat and corrugated thin sheet aluminum.

The smooth channels result in a very low pressure drop and minimize the risk of fouling by dirt or dust—dry particles up to 900 microns wide can pass freely through the rotor without clogging.



The Series-R is constructed of alternate layers of corrugated and flat sheet aluminum.

The rotor is also self-cleaning; debris caught on the wheel surface will be blown off when the wheel rotates to the other side of the exchanger and encounters the airstream blowing in the opposite direction.

If additional cleaning is necessary, the rotor face can be cleaned with compressed air, a vacuum cleaner, water, low pressure steam, or a mild detergent.

The Series-R comes standard with a hygroscopic Micro-Sieve™ desiccant that provides both sensible (heat) and latent (water vapor) energy transfer. Moisture is transferred between airstreams in the vapor state so the exchanger surfaces remain dry and no drain pan is required.

Series-R wheels can also be custom manufactured as sensible-only (with no desiccant). For increased energy exchange performance, a higher density “Plus” rotor can be custom manufactured as well.

The rotor, which may be removed from the frame, is journaled on a heavy-duty hub and shaft with industrial quality, sealed and lubricated ball bearings. The bearings can be serviced or replaced without removing the rotor completely from the case.

Pull-room equal to the wheel diameter less fifteen inches is required to remove the rotor and recommended to improve accessibility and serviceability.

Filtration Recommendations

In order to maximize energy transfer and rotor life and to minimize maintenance, installation of 30/30 filters in each airstream upstream of the exchanger is recommended.

Leakage/Cross Contamination

The moving surfaces characteristic of all heat wheels will inevitably lead to some amount of leakage or cross contamination between the outside/supply airstream and the return/exhaust airstream. In general, there are four ways leakage can occur:

- Desiccant carryover (small amount)
- Flow through internal wheel structure (moderate amount)
- Direct rotational carryover (moderate amount).
- Seal leakage (large amount)

The Series-R is designed to eliminate or minimize each of these leakage types.

Desiccant Carryover

Some hydroscopic wheels transfer more than just moisture between airstreams. The Series-R Micro-Sieve desiccant, however, uses a chemical process that is designed to adsorb and transport only water. There are no pores or other transfer mechanisms that carry or become clogged with other types of

particles. The result is highly-effective moisture transfer that does not degrade over time, but practically no contaminant transfer. This performance has been independently verified by labs at the University of Minnesota.

Flow through Wheel Structure

The Series-R wheel has separate and distinct sealed air channels that do not allow air to move radially through the wheel from one airstream to the other.

Direct Rotational Carryover

As the wheel rotates, some air from one airstream will be trapped in channels that rotate over to the other airstream. If left unchecked, more air gets carried between airstreams in this way than leaks between airstreams by any other mechanism. Use of a purge sector, however, effectively eliminates this direct rotational carryover. This method works so well that, at recommended rotational speeds, carried-over air results in only a trivial component of overall net leakage.

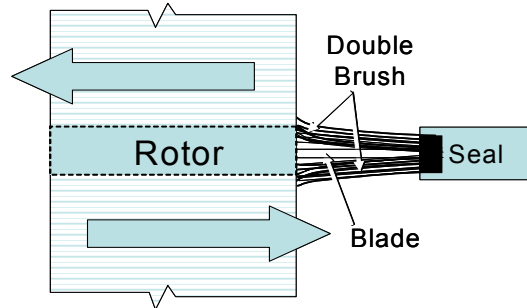
Seal Leakage

For wheels with a purge sector, most leakage can be attributed to the seals. This is simply the result of an exchanger that has parts which move between airstreams. The Series-R provides the best possible seal system. Instead of a labyrinth system which leaves a gap between airstreams, it uses a double brush and blade seal that provides a physical barrier to leakage.

Seal System

To minimize leakage between airstreams, an adjustable and replaceable double-brush and blade seal system is installed between the airstreams and around the perimeters of the rotor. The smooth rotor surface allows the seals to provide an extremely effective

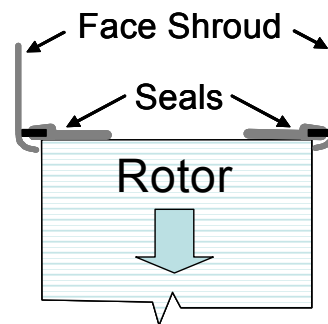
barrier against leakage with very little contact between the rotor and the seal, resulting in extended service life.



Double brush and blade seal between airstreams

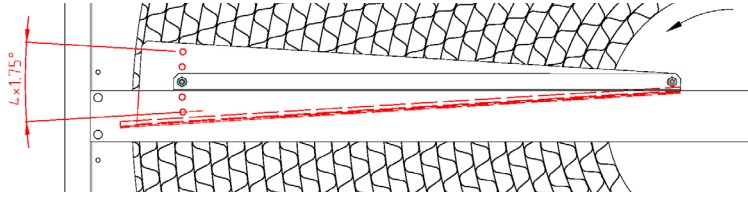
Around the rotor perimeter, the seals are attached to the wheel and seal against the surface of the face shroud. For model RXA wheels, the shroud is beveled to further reduce leakage.

Brush seals provide inherent flexibility, allowing them to bend under transient conditions that would damage fixed seal systems. They therefore offer better performance. And because contact with the surfaces across which they move does not cause wear or increased leakage over time, brush seals are able to sustain this high level of performance.



Perimeter Seals are attached to the outside of the wheel and (for model RXA wheels) operate inside the beveled flanges of the face shroud.

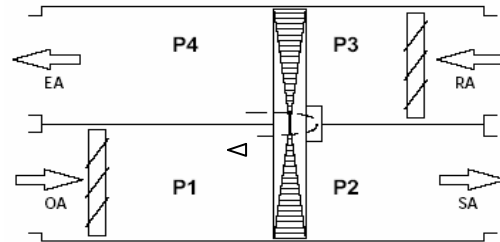
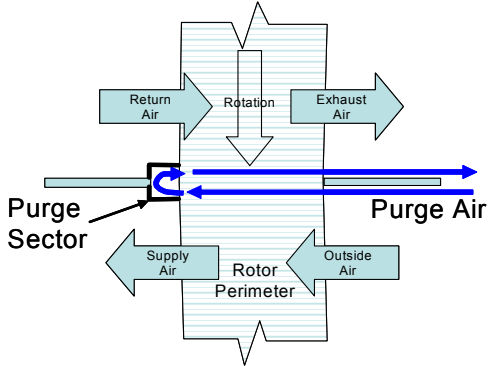
For applications involving pressure differentials over 2.5" w.g., see the High Pressure Differential Addendum.



Purge Sector

An adjustable purge sector is provided to prevent carryover contamination. As described above, when the rotor spins, some of the air caught in its channels is carried from one airstream to the other. The purge sector captures all of this crossover air and sends it back into the exhaust airstream. This device virtually eliminates direct rotational carryover cross-contamination.

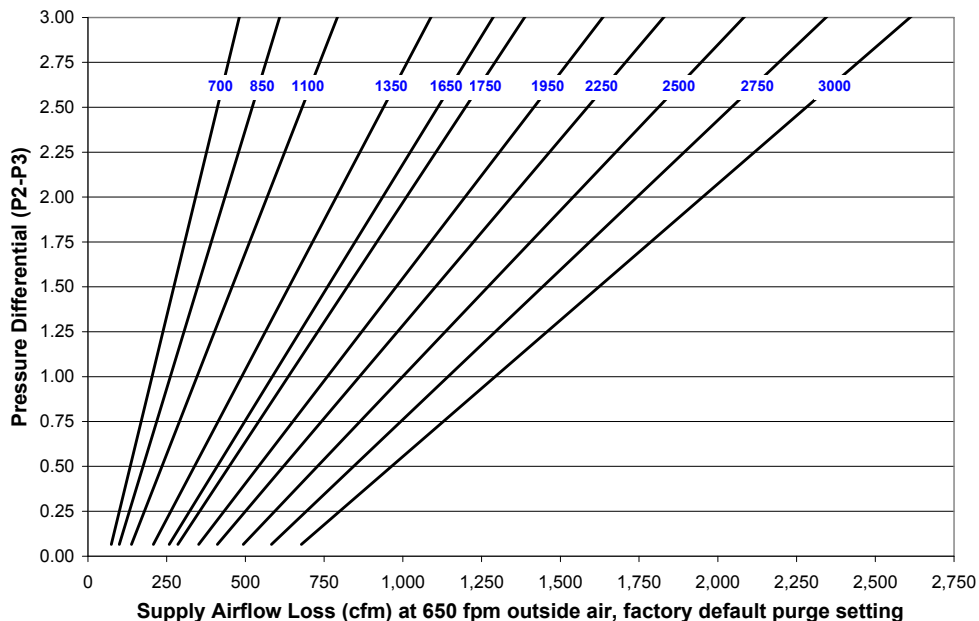
A detail of the purge sector is shown above. For units that contain wheels with purge sectors, the fans should be selected and located so that the pressures in airstreams passing through the wheel, as shown in the figure below, act to prevent cross-contamination ($P1 > P4$ and $P2 > P3$).



The purge air and purge sector use a small amount of outside air to blow-out or purge the carryover return air.

To ensure virtually no cross contamination, pressure should be higher in P1 (OA) than in P4 (EA) and higher in P2 (SA) than in P3 (RA).

Purge air volume is determined by outdoor air velocity and seal leakage by pressure differential. The chart below shows the sum of purge and leakage air for different AIRotor models (with standard seals) at different pressure differentials.



Drives and Control System

Controls contractors do not often work with heat wheel drives and controls. These components therefore often become complicating factors in field installation.

The AIRotor drives and controls are factory installed and tested to ensure minimal complications. Our standard configuration includes the drive motor system and multifunction VFD. We also offer a frost-control-only option or fully-integrated, BACnet-compliant DDC controls—all adaptable to your specific needs.

Drive

The drive system is specifically designed for heat wheel applications and consists of a perimeter belt and a worm gear motor sized from 1/8 to 1/2 hp. The worm gear drive includes pre-lubricated and sealed bearings and a gearbox designed for long duty life. The high-torque, soft start (and stop), 3-phase, variable speed motor reduces wear-and-tear on equipment.



A 1/8 to 1/2 hp gear reduced motor with soft-start requires no maintenance as all components are pre-lubricated and sealed.

Control

With AIRotor, all controls are factory installed and tested. This reduces field installation costs and prevents common installation errors.

Multifunction VFD—Standard

The Series-R comes standard with an advanced technology, feature-rich control system with all functions necessary to control a rotating heat exchanger. This system is flexible, interfacing with all types of control speed reference signals.

The speed of the wheel (and, therefore, its effectiveness) is controlled by the VFD so that the speed of the rotor is proportional to the input signal from the central control system. This configuration prevents frost without need for a preheating coil and controls heat recovery capacity by modulating the rotor speed from maximum down to an adjustable minimum of 1/20 rpm.



The AIRotor VFD, uncovered

The multifunction VFD provides the following functions:

- Self Cleaning—When the rotor has been still for 30 minutes the cleaning function engages and the rotor will rotate for 10 seconds at the minimum speed. This ensures that no air channels spend prolonged periods in the stagnant zone between airstreams.

- Adjustable Signal Threshold—If the signal is under the adjusted threshold value the rotor will stop.
- Rotation Monitor—If a problem occurs, the rotation monitor will stop the drive and signal an alarm indicating possible drive belt failure or similar disorder.
- Thermal Contact and Protection—An over or under current or open thermal contact will stop the drive and signal an alarm.
- Input Power Flexibility—The standard input is 230V, 1-phase power, but 208V, 1-phase is optional without additional components. For all other input powers, a transformer is provided.
- Manual high and low speed test override—These buttons aid in tuning and troubleshooting.
- Multiple Building Management System (BMS) control interface options—Eight DIP switches set the VFD to be controlled by 0–5V, 0–10V, 1–5V, 2–10V, 5–10V 10–0V 10–2V, 10–5V, 0–20V Phase Cut, 0–20mA, or 4–20mA input signals.

It also comes with the following features:

- On/Off operation, BMS controlled
- Remote reset of alarm
- Alarm relay
- Operational Indicators for power present, run, rotation, alarm conditions
- Fuse
- Automatic restart after power failure or disconnect

More advanced, year-round automatic temperature control and operation is accomplished with the optional AIRotor DDC controller or is provided by others (i.e. the BMS supplier).

DDC—Optional

For more sophisticated controls, the AIRotor DDC (Direct Digital Control) compliments the VFD. The DDC is a native BACnet, pre-programmed and adjustable controller tuned for a wide variety of application-specific conditions. It provides complete control by sensing airflow conditions and making on-the-fly adjustments to wheel speed.



AIRotor DDC controller (right) alongside MiniMax multifunction heat wheel VFD (left)

This control automatically modulates rotor speed to prevent frost build-up (frost control), reduce heat recovery to prevent overheating the space (economizer), and switch to maximum recovery during warm weather (cooling mode). An LCD Display provides an interface for setup and tuning.

The DDC control system includes the following components:

- Factory installed and tested integral controller
- Four field installed, plenum/duct mounted temperature sensors (optional outdoor mounted)
- Field installed digital temperature readout and keypad

Controls, Concept of Operation

Frost Control—In the winter, heat from the exhaust airstream is transferred to the supply airstream. If no preventative steps are taken, moisture in the cooled exhaust air can condense on the wheel surface and eventually form frost. Frost control is provided by monitoring the temperature of the exhaust air leaving the exchanger. The wheel rotational speed is then modulated to prevent the exhaust air temperature from dropping below an adjustable, pre-set point of 15 °F.

Economizer—Economizer control monitors the supply discharge temperature and modulates rotor speed to prevent it from rising above an adjustable pre-set point of 58 °F (this is the recommended minimum).

This pre-set point is established to compliment indirect air systems, where other distribution and terminal equipment (e.g. heat-pumps or variable air volume units) and controls regulate the final supply air temperature.

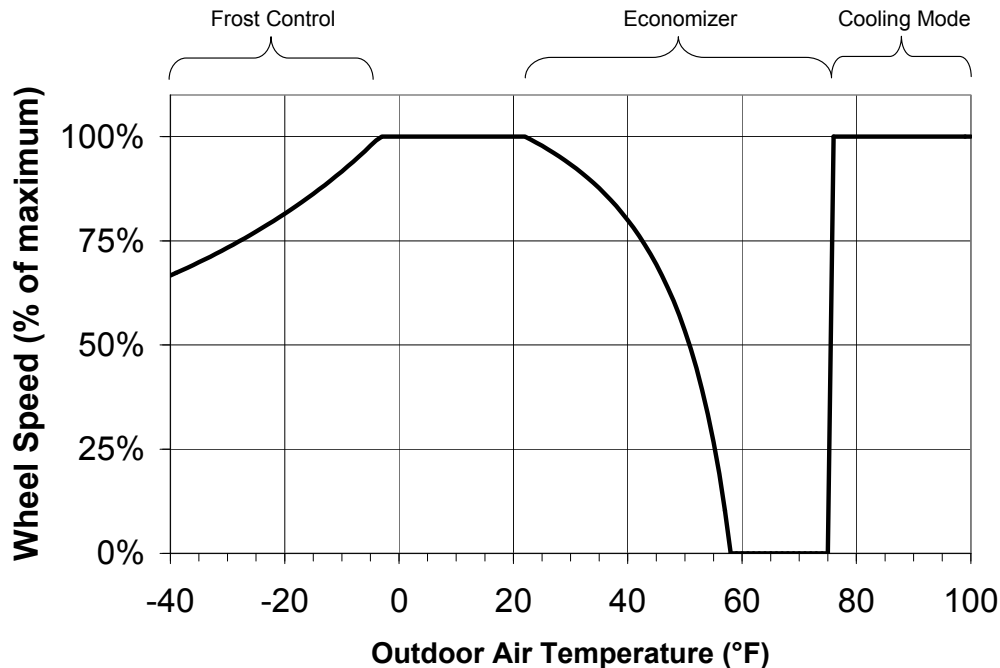
When providing direct air to a large area (e.g. gymnasium or large hall), the pre-set point can be adjusted to suit the target indoor design temperature.

Cooling Mode—Under summer conditions, when the outdoor air is warmer than the indoor air, maximum energy recovery is always beneficial. The Cooling Mode control monitors the outdoor air and return air temperatures to modulate the rotor to maximum recovery speed when summer conditions are detected.

The diagram below shows how these different controls affect wheel speed at different outdoor air temperatures.

Frost Control Only—Optional

The Frost Control Only control option is a simplified version of full DDC controls. It uses an adjustable thermostat and a single temperature sensor in the exhaust air stream to prevent frost from building up on the wheel.



Rotor speed is modulated based on conditions of the exhaust air for Frost Control, supply air for the Economizer, and outdoor air and return air for Cooling Mode.

Performance

The Series-R is a high performing energy recovery wheel. Our performance has been verified by several rigorous certification programs including: ARI, Eurovent, TUV, as well as independent testing conducted by the University of Minnesota, Mechanical Engineering Laboratory for Heat Transfer Practice.

Performance claims can be manipulated to show almost any desired effectiveness, but such claims do not then represent realistic situations. It is best to evaluate performance using your actual operating conditions. You can then compare case-specific effectiveness results.

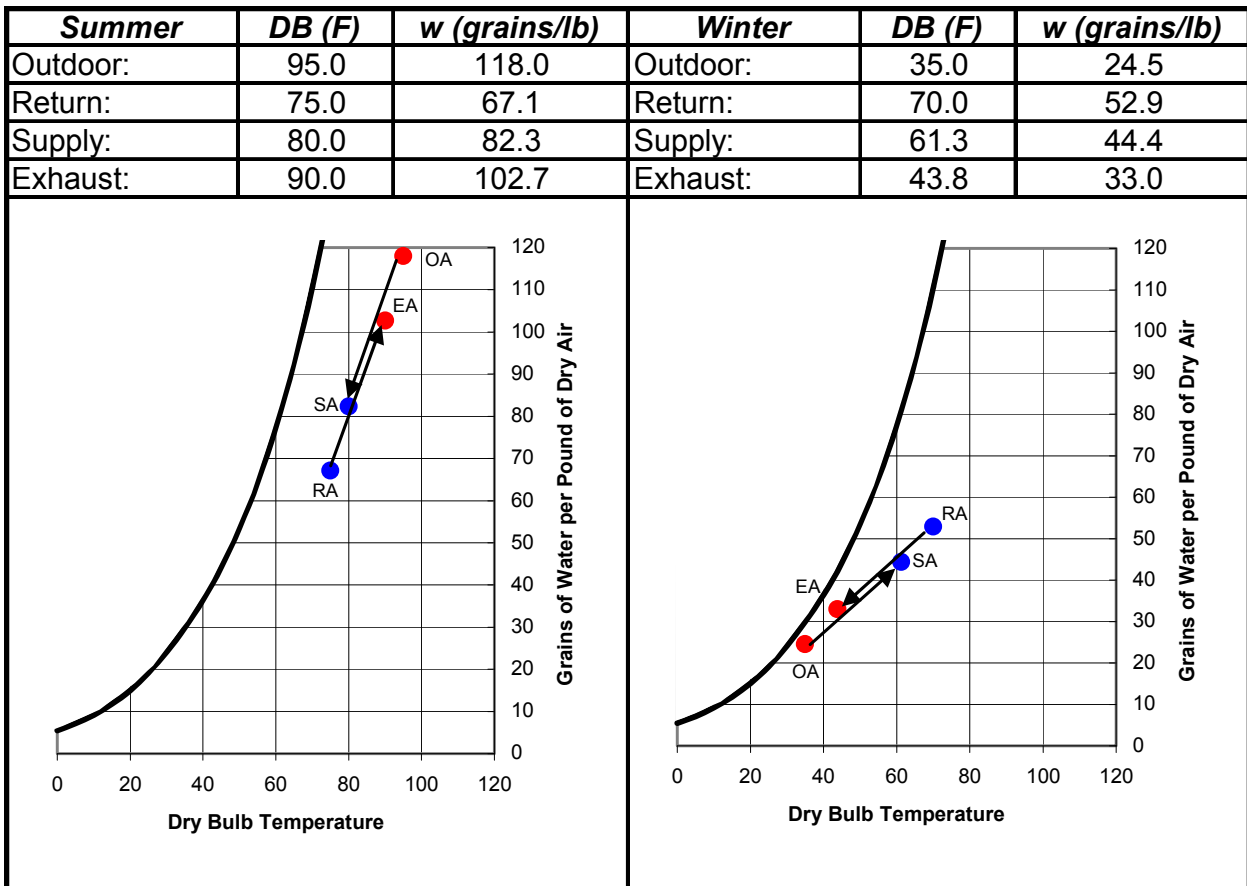
Our selection program automates this process, making it easy to select wheels and accurately calculate performance.

ARI Certified Performance

The AIRotor, Series-R is ARI certified under the 84-1991 ASHRAE Standard (testing rotary air-to-air heat exchangers) and ARI Standard 1060 (rotary air-to-air energy recovery equipment).

Psychrometric Analysis

The charts below show actual AIRotor performance data in psychrometric format for the standard ARI testing conditions.

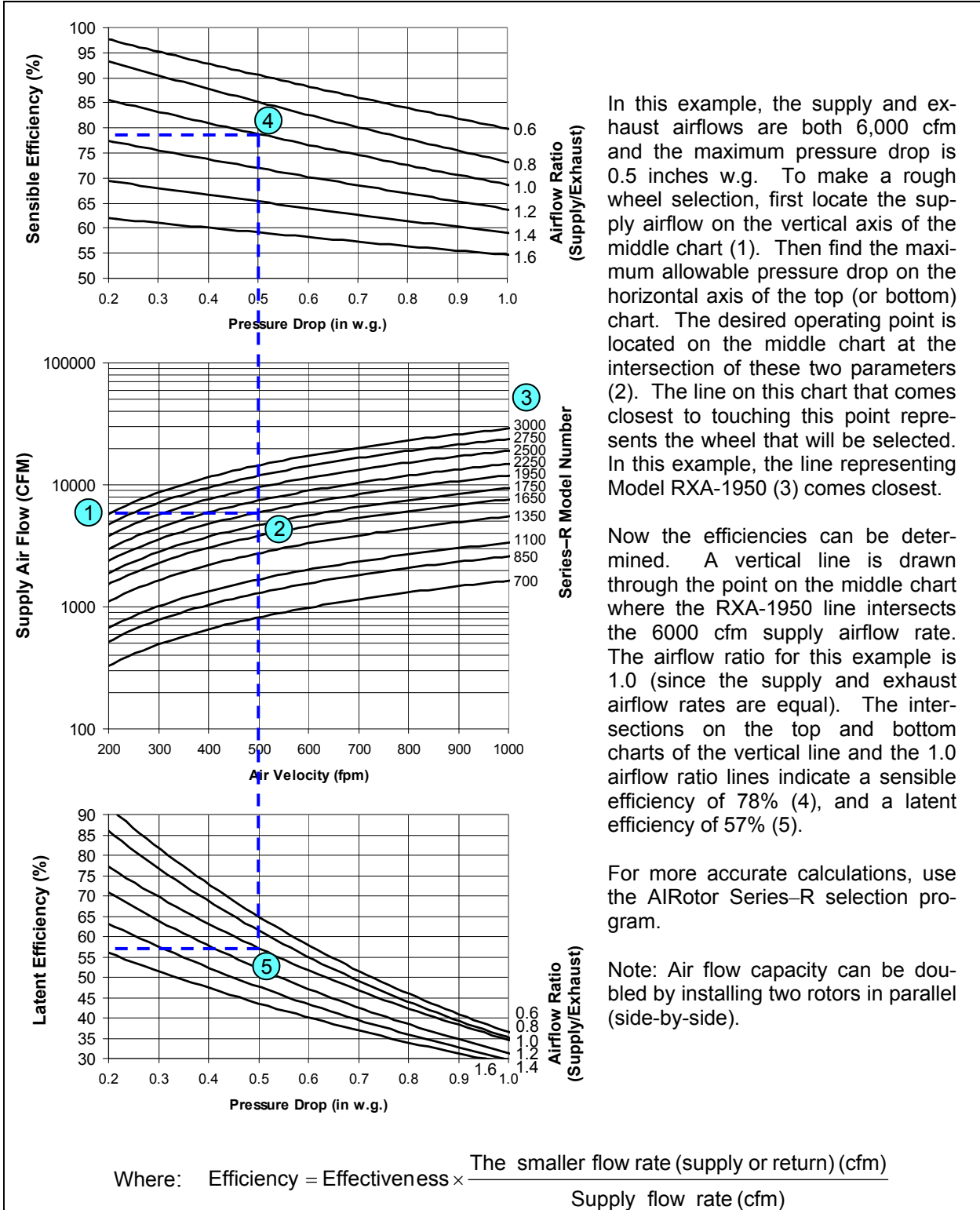


Nominal performance for balanced air flows is 75% sensible effectiveness and 70% latent.

Quantified Volume Analysis

The charts on this page show sensible and latent efficiencies, pressure drop, and air

velocity for the entire Series-R line across a wide range of flow rates. Using this data, you can make a rough wheel selection and estimate performance.



Selecting a Series-R

Selections of the Series-R exchangers are available through your AIRotor Sales Representative, through the AIRotor support staff, or through our automated software selection program.

The program is downloadable from the internet. Due to its size, a high speed connection is recommended. If you do not have a high speed connection, contact AIRotor for a copy of the software on CD ROM.

Installation of this program requires a unique password which can be obtained

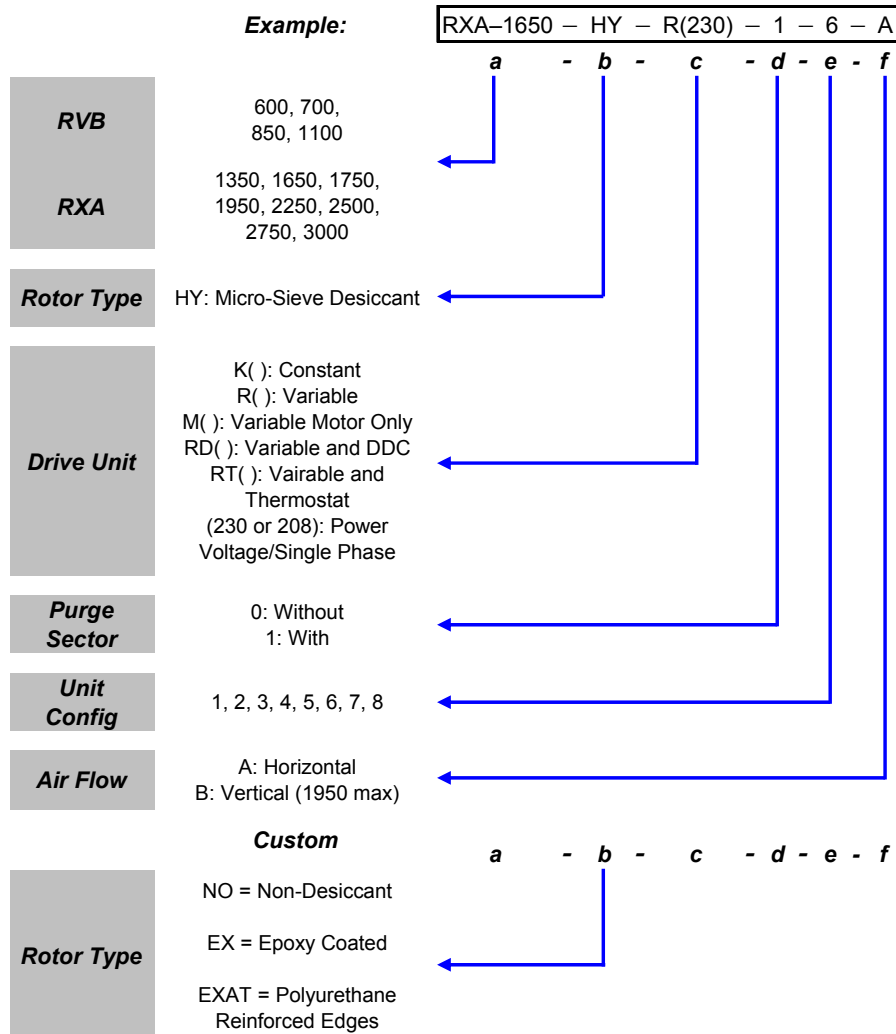
from your AIRotor Sales Representative or the AIRotor support staff.

To make a selection using this software, you will need to know:

- The quantity of Supply and Return airflow in cfm.
- The indoor and outdoor air conditions: Dry Bulb and Wet Bulb temperatures.

Ordering Specifications

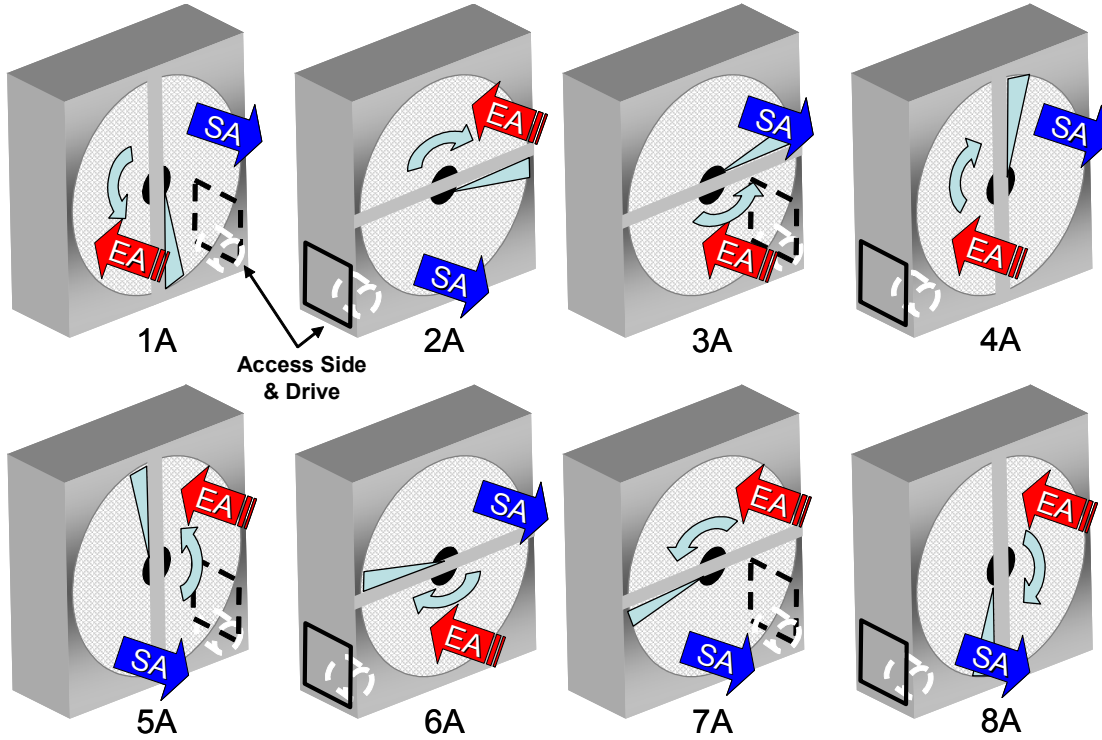
The following diagram depicts the ordering specification and complete part number designation for the Series-R. Unit Configuration options are described on the next page.



Series-R Configuration Options

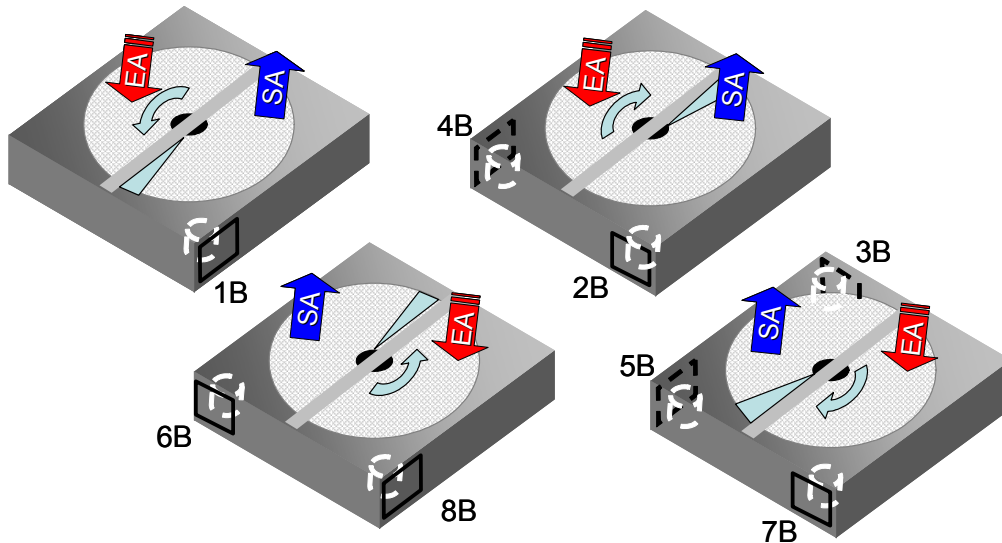
Horizontal Airflows

Horizontal airflow wheels are available in over-under and side-by-side configurations.

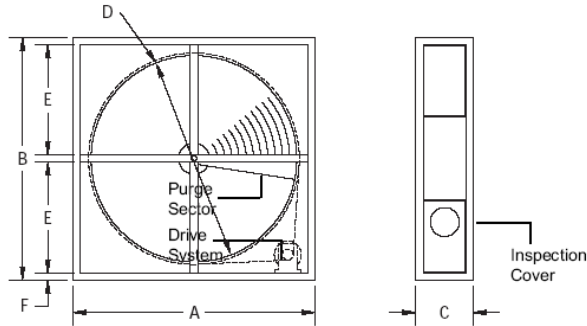


Vertical Airflows

Vertical airflow configuration is only available for sizes RXA-1950 and below.



Dimensional Specifications



Model #	Dimensions (in)						Weight (lbs)	Drive Power (hp)
	A	B	C	D	E	F		
RVB-700 *	31.00	31.00	14.50	26.57	14.10	0.70	75	1/8
RVB-850 *	36.14	36.14	14.50	33.07	16.67	0.70	110	1/8
RVB-1100 *	43.62	43.62	14.50	37.40	20.40	0.70	220	1/8
RXA-1350 *	54.72	54.72	14.96	50.40	24.99	1.18	370	1/4
RXA-1650 *	63.23	63.23	14.96	58.86	29.25	1.18	450	1/4
RXA-1750 *	68.90	68.90	14.96	62.99	32.05	1.18	462	1/4
RXA-1950 *	77.95	77.95	14.96	73.43	36.61	1.18	650	1/3
RXA-2250	88.58	88.58	17.32	81.10	39.57	2.36	880	1/3
RXA-2500	98.43	98.43	17.32	90.94	44.49	2.36	1,035	1/2
RXA-2750	108.27	108.27	17.32	100.79	49.41	2.36	1,210	1/2
RXA-3000	118.11	118.11	17.32	110.63	54.33	2.36	1,386	1/2

* For side-by-side configurations, dimension A will be the height and dimensions B and E will be widths.



The AIRotor Series-R production facility



Stock AIRotor Series-R wheels ready for orders. Final assembly includes finishing sheet metal work, attaching seals, and configuring the purge sector, drive, and control systems. The complete system is tuned and factory tested prior to shipment.

General Specification

Rotary Air-To-Air Heat Exchanger

Furnish a “Series-R” rotary air-to-air heat exchanger manufactured by AIRotor, LLC, certified by the Air-Conditioning and Refrigeration Institute (ARI), ETL Listed, and verified for cross contamination. Exchanger shall be hygroscopic, mounted in housing with purge sector, variable speed drive, multifunction control system, and optional full season operational control.

Enthalpy Recovery Wheel

Exchanger shall be 10” deep and constructed of alternate layers of corrugated and flat aluminum sheet material. Both sides of the exchanger shall be completely smooth with less than 0.005” variation between alternate layers to allow for optimum sealing surface for brush seals. The rotor shall have smooth air channels to ensure laminar airflow for low pressure drops. Dry particles up to 900 microns shall pass freely through the rotor without clogging the media. The rotor media shall be capable of being cleaned with low pressure steam without degrading unit performance. The rotor media must be made of aluminum coated with a corrosion-prohibiting, non-migrating adsorbent specifically developed for the selective transfer of water vapor.

Cross Contamination Verification

Verification in writing must be presented from independent laboratory evaluations confirming that the desiccant adsorbent surface freely transmits water vapor without detectable gaseous cross-contamination. The specially formulated “Micro-Sieve” shall be permanently bonded to the aluminum media and provide a water vapor selective adsorbent desiccant.

ARI Certification

Sensible and latent recovery performance and leakage must be clearly measured and certified through ARI in accordance with the 1060 Standard.

Performance should not be derived by manipulated testing procedures that result in equal sensible and latent recovery effectiveness.

Unit Housing

The rotor housing shall be constructed using a heavy-duty extruded and anodized aluminum tube frame. Models RVB-1100 and smaller shall have a heavy duty galvanized frame. Adjustable brush seals must be provided along the periphery of the rotor and between the inlet and outlet air passages to effectively prevent air leakage and cross-contamination between airflows. Total contamination leakage (Exhaust Air Transfer Ratio) shall be less than 2.0% at 0.00” w.g. differential pressure between airflows as measured and certified by ARI.

Rotor and casing shall be reinforced to prevent deflection from differential pressures to less than 0.03 inches. All rotors shall be mounted on sealed, pre-lubricated, spherical bearings. All rotors over 80” diameter must have flanged or pillow block bearings that can be serviced or replaced without complete removal of the rotor from the case.

Purge Sector

The unit must be provided with a factory set, field adjustable purge sector. The purge sector shall be designed such that, as measured according to ARI Standard 1060, the Outdoor Air Correction Factor is less than 1.11 at a differential pressure of 0.00” w.g. This performance shall be certified and published by ARI.

Drive System/Speed Control

The rotor drive system shall consist of an adjustable belt around the rotor perimeter driven by an AC motor with gear reduction. The variable speed drive shall be specifically designed for heat wheel applications and include: an AC inverter, soft start/stop, rotation detection w/alarm contacts, automatic self cleaning function, and self testing capability.

The speed controller shall be capable of accepting a potentiometer, VDC, or mA control signal.

Full Season Operational Control

The full season operational control system shall consist of an integral, preprogrammed, native BACnet DDC control panel with remote temperature sensors mounted in each of the four airstreams to monitor exchanger performance. The controller shall modulate rotor speed to (1) prevent frost build-up, (2) control heat recovery for economizer mode, and (3) switch to maximum heat recovery when outdoor temperature is higher than indoor temperature. A digital display keypad for monitoring temperatures and changing set points shall be included.

Refer to independent performance tests of XeteX AIRotor Total Energy Recovery Wheels conducted, evaluated, and verified for specified characteristics by research assistants from the Department of Mechanical Engineering, University of Minnesota. Detailed Technical Reports that certify Thermal Effectiveness and Cross-Contamination performance are available upon request.



Rotary Air-to-Air Energy Recovery
ARI Certified and ETL Listed

AIRotor, LLC
Minneapolis, MN
Phone: 612-724-3101
Fax: 612-724-3372



www.airotor.com

