XeteX® Series–S™

Rotary Air-to-Air Heat and Water Vapor Exchanger

Product Guide

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

ETL Listed

Introduction

The Series–S™ 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 cost of other necessary heating and cooling equipment as well as the operating cost of the ventilation system.

Applications

The Series–S can be used to improve and control indoor air quality in a wide variety of applications. Typical applications include:

- 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–S 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–S a unique product among its competitors.
- Our global experience in heat wheel manufacturing goes back to 1975. We were among the first to use this technology.
- The sectioned wheel design allows the rotor and case to be assembled on-site making the Series–S easy to transport and install in hard-to-reach areas.
- The Series–S 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.
- Highly effective seals and purge system, minimize cross contamination.
- The Series–S has a demonstrated record of low failure rate and minimum maintenance requirements.
- Water does not condense on the exchanger's surfaces, so no drain pan is required.
- Series–S can operate up to 160 °F.
- The XeteX team provides highly responsive service and support.

Unit Housing

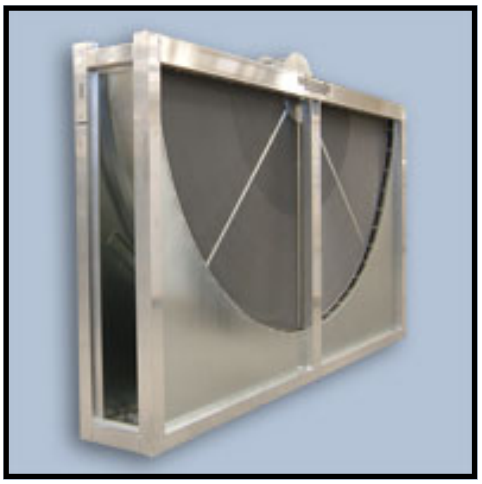
The Housing Frame

Series–S rotors are housed in a cabinet suitable for installation in an HVAC

system. The cabinet frame is made of aluminum profiles (for SXA–2250 – 4000) or steel profiles (for SXA–4250 and larger).

The heavy duty frame is designed to prevent the torque created by the airstreams from bending the heat wheel. It is strong enough to manage the torque produced by static pressure drops of less than 0.9" w.g.

For models SXA–2500 and larger, cases are shipped in two halves as shown below. Cases for smaller models can also be shipped in two parts upon request. As an option, all cases can be further broken down and shipped in as many as six pieces. Their smaller disassembled size makes them easy to install in small, confined spaces.



XeteX Series–S Sectioned Housing

Face and Side Panels

The face shroud panels are constructed of galvanized sheet metal and are reinforced to limit deflection. The necessary drive and control components are located in the cavities inside the frame and are not exposed to either of the air streams.

Standard removable and insulated side panels are also provided to fully enclose the rotor while also allowing access to the drive and control components.

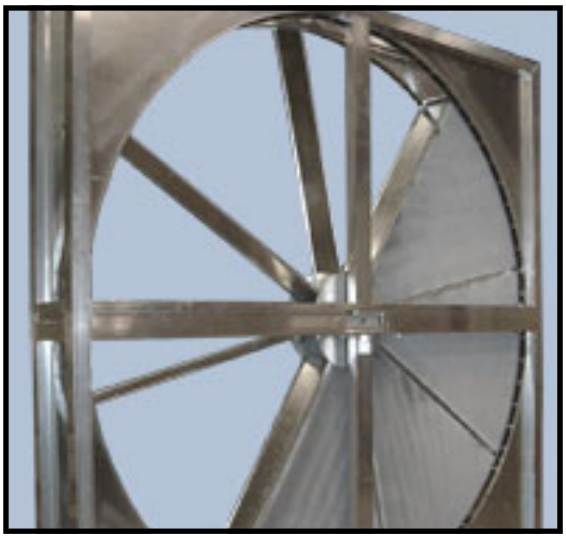
A fully assembled XeteX Series–S heat wheel

The Rotor

The rotor is assembled from alternate layers of flat and corrugated 60 µm-thick aluminum. No adhesives are used to laminate these layers together. This creates smooth channels with very low pressure drop and minimizes the risk of fouling—dry particles up to 900 microns wide can pass freely through the rotor without clogging.

The distinguishing characteristic of the Series–S heat wheel is its sectioned rotor. All Series–S wheels are split into a number of sections, allowing individual portions of the rotor to be removed and, if necessary, replaced. Each section is bound with a galvanized (standard) or stainless steel (optional) sheet metal rim. The number of sections varies with the size of the wheel. Small wheels have only four sections, while the largest ones have up to twelve.

The rotor sections are stabilized with interior spokes threaded at the hub and welded at the rotor periphery for long term stability. These spokes bind the layers of the rotor together and make use of laminating adhesives unnecessary.



XeteX Series–S heat wheel with four of eight rotor sectors installed

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 air, steam, water, or a mild detergent.

The Series–S comes standard with a high performance zeolite silica gel permanently bonded to the rotor surface without any adhesives and specifically developed for the selective transfer of water vapor. This coating 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–S wheels can also be custom manufactured with a light-duty micro-sieve desiccant or a silica gel-based, corrosion-prohibiting, non-migrating, adsorbing desiccant, both permanently bonded to the rotor surface without any adhesives and specifically developed for the selective transfer of water vapor. Epoxy coated rotors and sensible-only wheels (with no desiccant) are also available. Sensible, hygroscopic, and epoxy coated rotors can also be made from a special corrosion-resistant aluminum alloy. For further increased performance, a higher density "Plus" rotor can be custom manufactured.

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

Filtration Recommendations

In order to maximize energy transfer and rotor life and to minimize maintenance, XeteX recommends installation of 30/30 filters upstream of the exchanger.

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–S 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–S desiccant, however, uses a chemical process that is optimized for the

transport of water vapor. The result is maximum moisture transfer with little contaminant carryover.

Flow through Wheel Structure

The Series–S 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

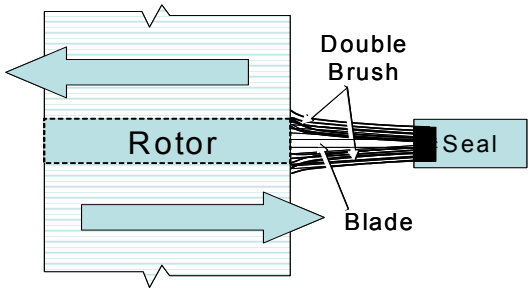
As the wheel rotates, some air from one airstream will be trapped in channels that rotate over to the other airstream. If left unchecked, more air gets carried between airstreams in this way than leaks between airstreams by any other mechanism. Use of a purge sector, however, effectively eliminates this 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–S 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

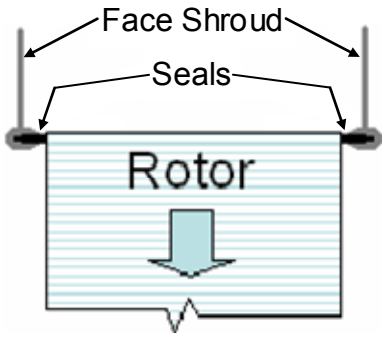
To minimize leakage between airstreams, an adjustable and replaceable double-brush and blade seal system is installed between the airstreams and around the perimeters of the rotor. The smooth rotor surface allows the seals to provide an extremely effective barrier against leakage with very little contact between the rotor and the seal, resulting in extended service life.



Double brush and blade seal between airflows

Around the rotor perimeter, the seals are attached to the face shroud and seal against the flat and smooth face of the rotor.

Brush seals provide inherent flexibility, allowing them to bend under transient conditions that would damage fixed seal systems. Brush seals 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.

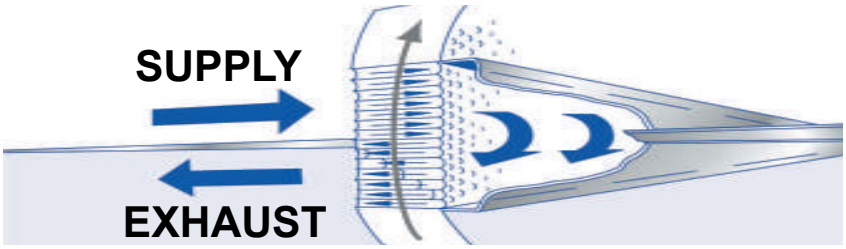


Perimeter Seals attach to the face shroud and operate on the edge of the smooth rotor face.

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

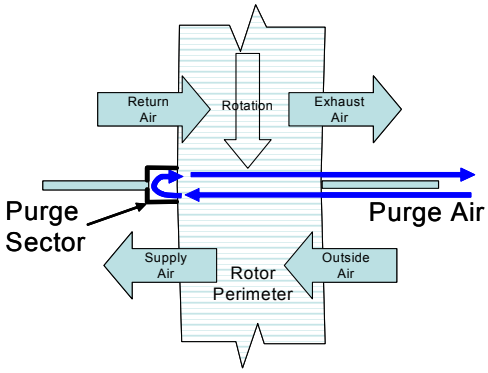
Purge Sector

A double purge sector is provided to prevent carryover contamination. The picture at the top of this page shows how the purge sector operates. As can be seen, when the rotor spins, some of the air caught in its channels is carried from one airstream



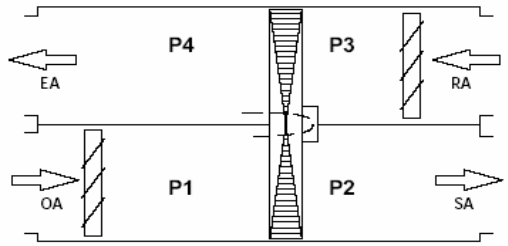
XeteX Series–S Purge Sector. The angle of the purge sector is custom designed according to the specific conditions of each application.

to the other. The purge sector captures all of this crossover air and sends it back into the exhaust airstream. This device virtually eliminates cross-contamination.



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

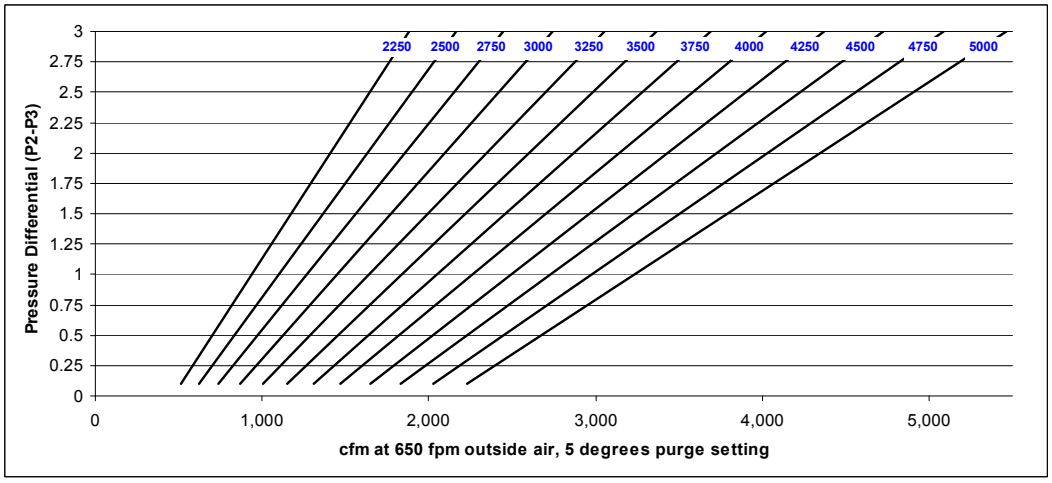
A detail of the purge sector is shown above. For units that contain wheels with purge sectors, the fans should be selected and located so that the pressures in airstreams passing through the wheel, as shown in the figure to the right, act to prevent cross-contamination (P1 > P4 and P2 > P3).



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.

The purge angle is factory set according to the conditions of each specific application. Based on the design air velocity, a purge angle of 0, 2.5, or 5 degrees is selected in order to supply just enough purge air to clear all rotor air channels before they turn into the supply airstream but without consuming more outdoor air than necessary.



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 XeteX 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 and 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 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 1/3 to 1 hp gear reduced motor with soft-start requires no maintenance as all components are pre-lubricated and sealed.

Control

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

Multifunction VFD—Standard

The Series–S 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 XeteX 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 over-ride—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 XeteX DDC controller or is provided by others (i.e. the BMS supplier).

DDC—Optional

For more sophisticated controls, the XeteX 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 total control by sensing airflow conditions and making on-the-fly adjustments to wheel speed.

XeteX 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.

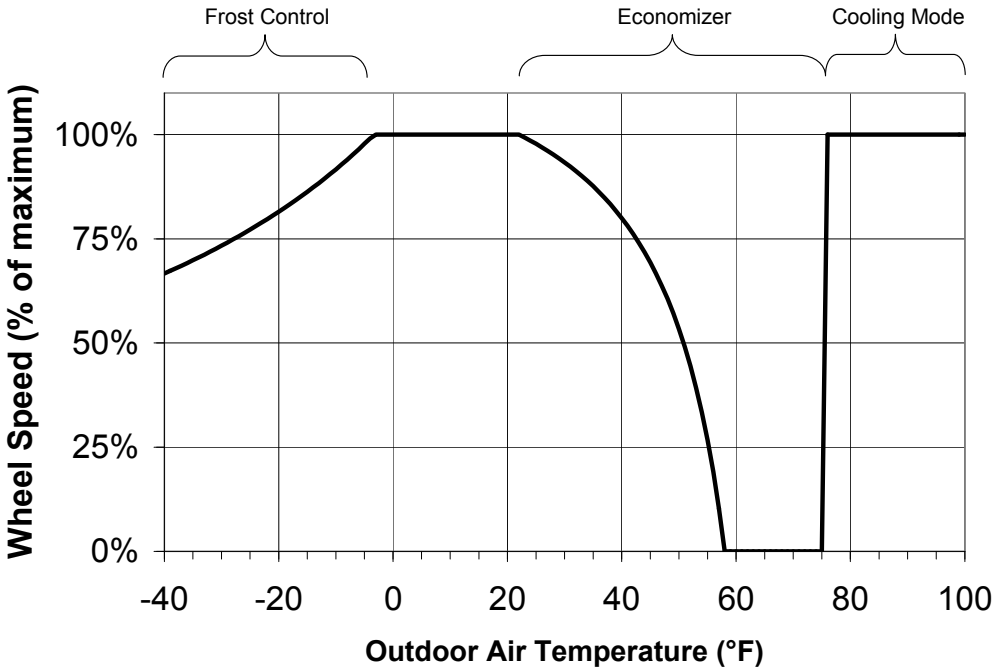
When providing direct air to a large area (e.g. gymnasium or large hall), the pre-set point can be adjusted to suit the target indoor design temperature.

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–S is a high performing energy recovery wheel. Our performance has been certified by Eurovent under one of the most rigorous standards in the world.

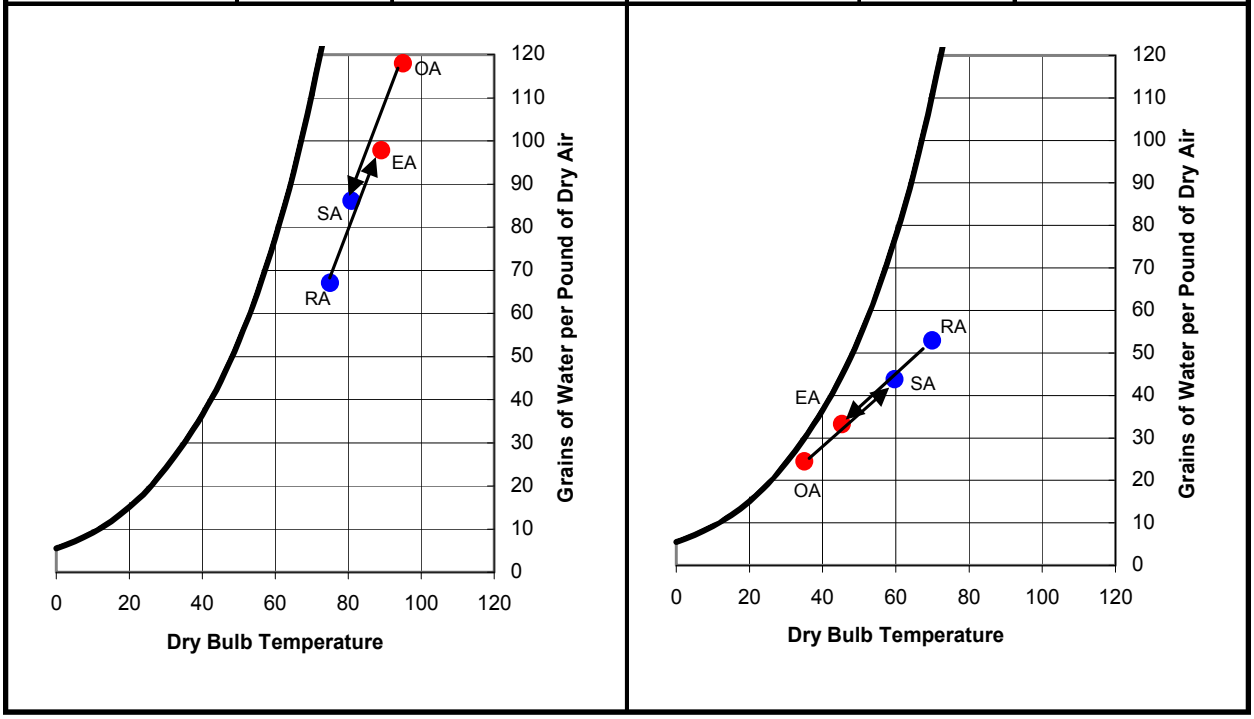
Performance claims can be manipulated to show almost any desired effectiveness, but such claims do not then represent realistic situations. It is best to evaluate performance using your actual operating conditions. You can then compare case-specific effectiveness results.

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

Psychrometric Analysis

The charts below show actual XeteX performance data in psychrometric format for standard conditions.

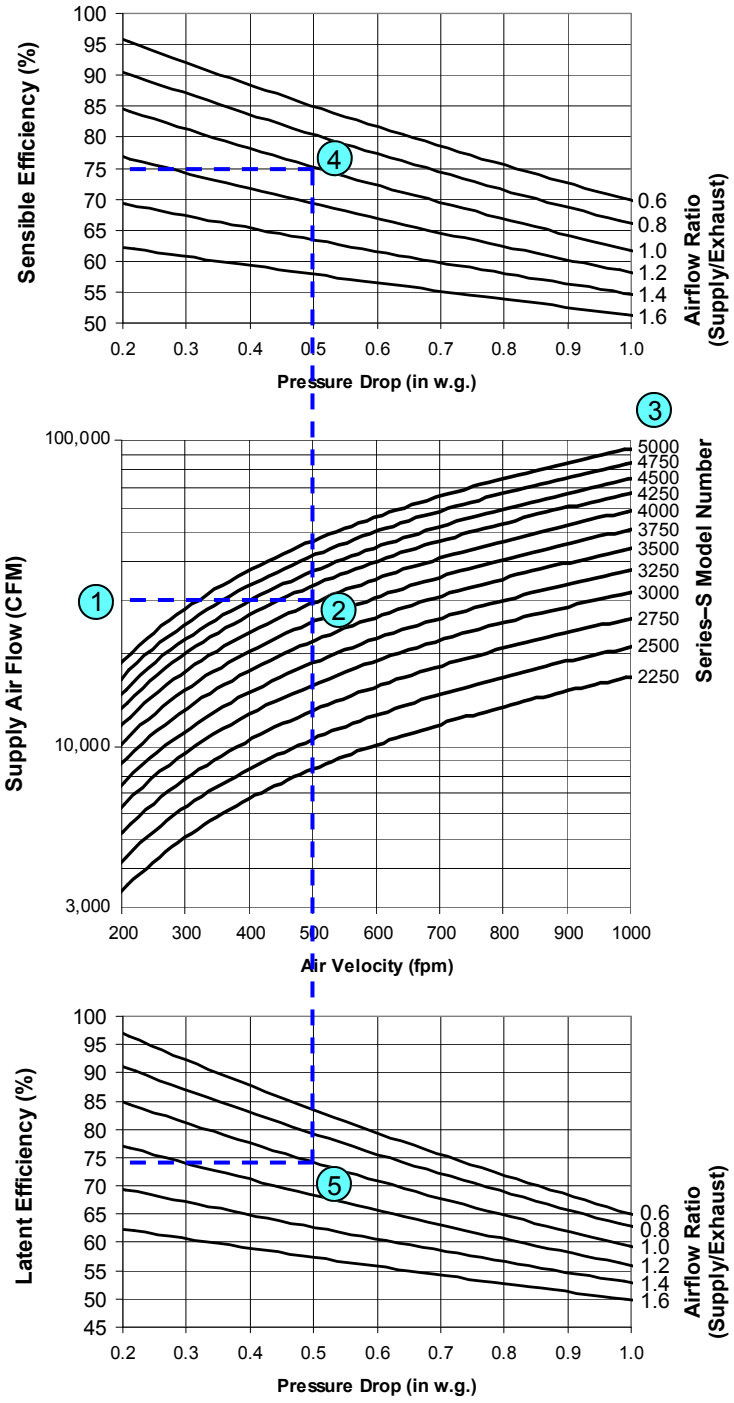
Summer	*DB (F)*	*w (grains/lb)*	*Winter*	*DB (F)*	*w (grains/lb)*
Outdoor:	95.0	118.0	Outdoor:	35.0	24.5
Return:	75.0	67.1	Return:	70.0	52.9
Supply:	80.9	86.1	Supply:	59.7	43.8
Exhaust:	89.1	97.8	Exhaust:	45.3	33.2



Psychrometric performance of the Series–S wheel for normal operating conditions.

Quantified Volume Analysis

The charts on this page show sensible and latent efficiencies, pressure drop, and air velocity for the entire Series–S line across a wide rage of flow rates. Using this data, you can make a rough wheel selection and estimate performance.



In this example, the supply and exhaust airflows are both 30,000 cfm and the maximum pressure drop is 0.5 inches w.g. To make a rough wheel selection, first locate the supply airflow on the vertical axis of the middle chart (1). Then find the maximum allowable pressure drop on the horizontal axis of the top (or bottom) chart. The desired operating point is located on the middle chart at the intersection of these two parameters (2). The line on this chart that comes closest to touching this point represents the wheel that will be selected. In this example, the line representing Model SXA–4000 (3) comes closest.

Now the efficiencies can be determined. A vertical line is drawn through the point on the middle chart where the SXA–4000 line intersects the 30,000 cfm supply airflow rate. The airflow ratio for this example is 1.0 (since the supply and exhaust airflow rates are equal). The intersections on the top and bottom charts of the vertical line and the 1.0 airflow ratio lines indicate a sensible efficiency of 75% (4), and a latent efficiency of 74% (5).

For more accurate calculations, use the XeteX Series–S selection program.

Note: Air flow capacity can be doubled by installing two rotors in parallel (side-by-side).

$$\text{Where:}\quad \text{Efficiency} = \text{Effectiveness} \times \frac{\text{The smaller flow rate (supply or return) (cfm)}}{\text{Supply flow rate (cfm)}}$$

Selecting a Series–S

Selections of the Series–S exchangers are available through your XeteX Sales Representative, through the XeteX 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 XeteX for a copy of the software on CD ROM.

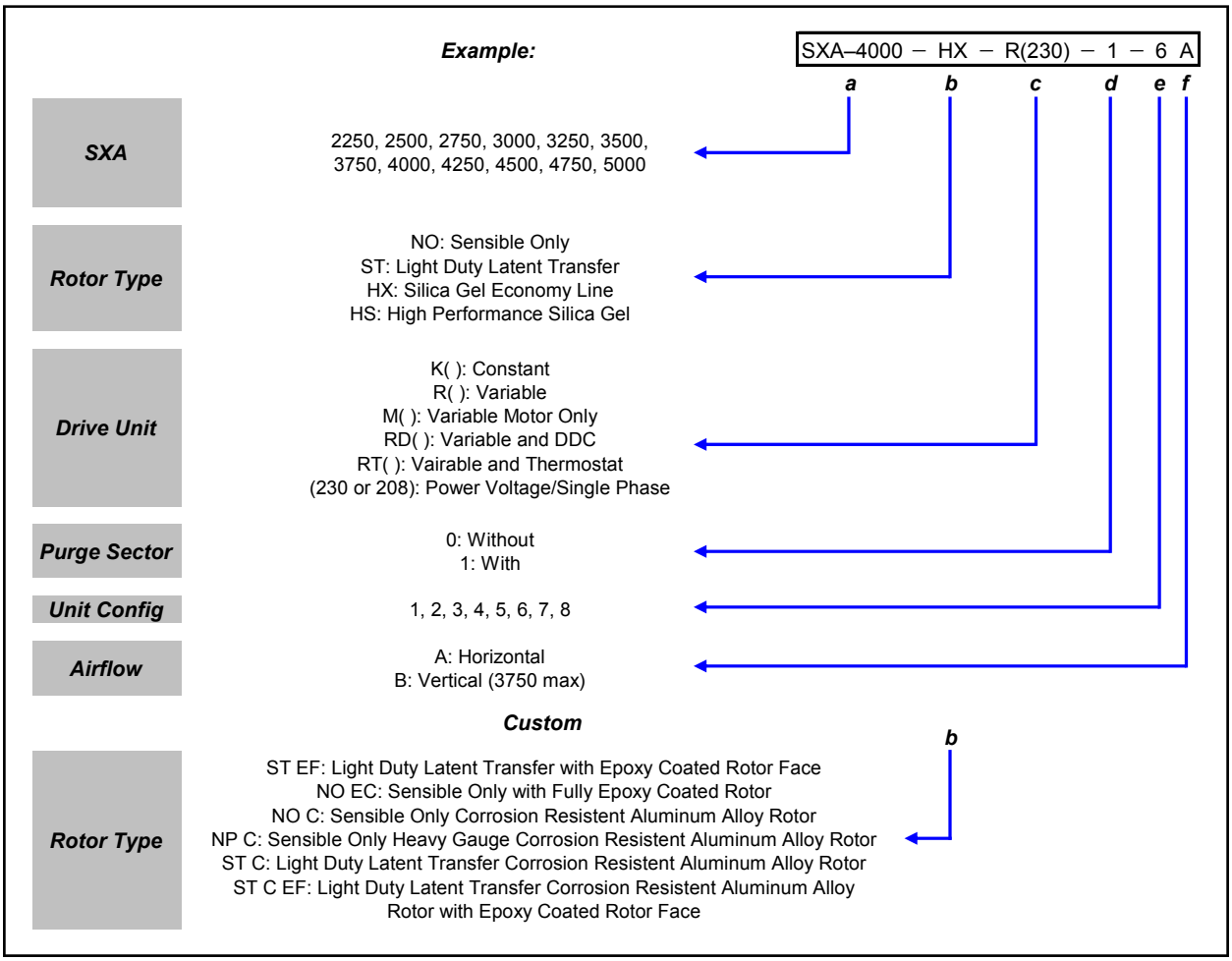
Installation of this program requires a unique password which can be obtained from your XeteX Sales Representative or the XeteX support staff.

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

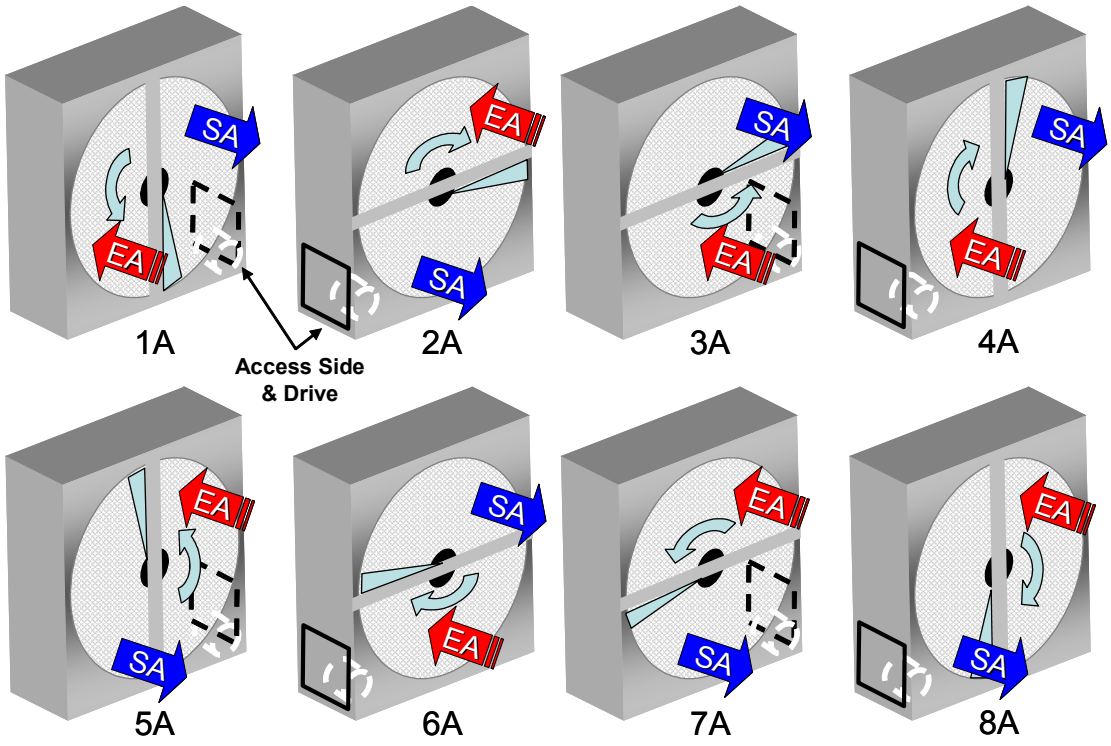
The following diagram depicts the ordering specification and complete part number designation for the Series–S. Unit Configuration options are described on the next page. (Note: even though only discrete model sizes are shown, wheels of any size diameter can be custom ordered.)



Series–S Configuration Options

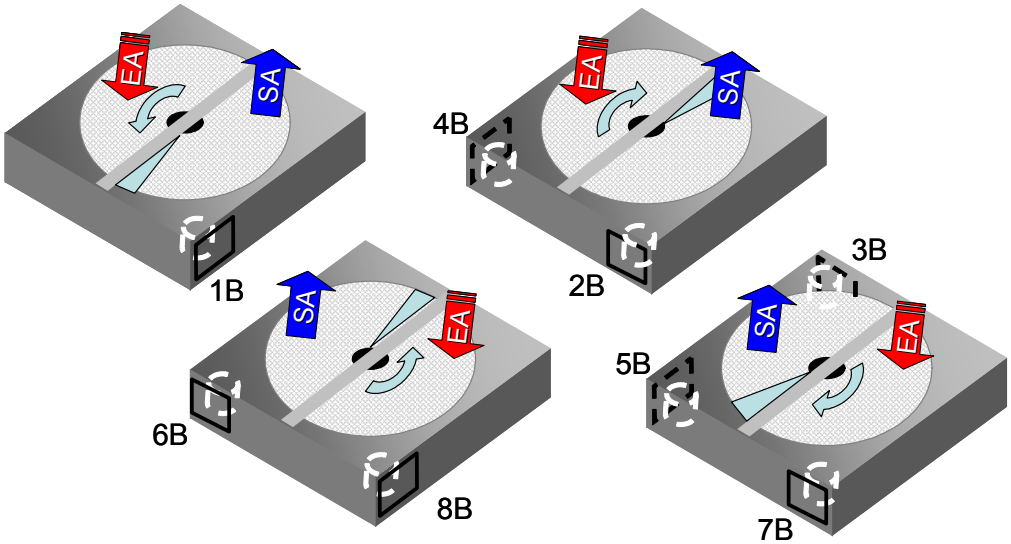
Horizontal Airflows

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

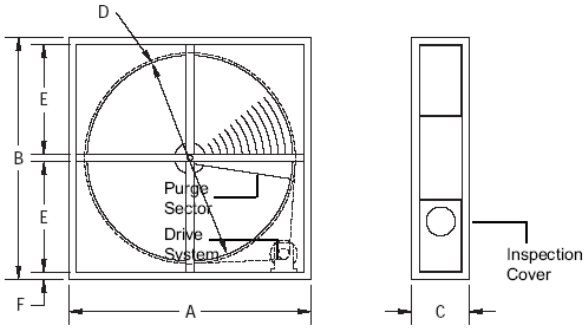


Vertical Airflows

Vertical airflow configuration is only available for sizes SXA–3750 and smaller.



Dimensional Specifications



Model #	Dimensions (inches)						Drive Power (hp)	Weight (lbs)
	A	B	C	D	E	F		
SXA-2250	88.58	88.58	16.93	79.53	37.99	3.15	1/4	1074
SXA-2500	98.43	98.43	16.93	89.37	42.91	3.15	1/2	1258
SXA-2750	108.27	108.27	16.93	99.21	47.83	3.15	1/2	1445
SXA-3000	118.11	118.11	16.93	109.06	52.76	3.15	1/2	1643
SXA-3250	127.95	127.95	16.93	118.90	57.68	3.15	1/2	1905
SXA-3500	137.80	137.80	16.93	128.74	62.60	3.15	1/2	2145
SXA-3750	147.64	147.64	16.93	138.58	67.52	3.15	1	2512
SXA-4000	157.48	157.48	16.93	148.43	72.44	3.15	1	2768
SXA-4250	167.32	167.32	18.50	158.27	77.36	3.15	1	3034
SXA-4500	177.17	177.17	18.50	168.11	82.28	3.15	1	3313
SXA-4750	187.01	187.01	18.50	177.95	87.20	3.15	1	3602
SXA-5000	196.85	196.85	18.50	187.80	92.13	3.15	1	3904

Note: Although only certain discrete model sizes appear here, wheels of any size can be ordered.
Also note: For side-by-side configurations, dimension E will be a width.

The XeteX Series–S production facility

Stock XeteX 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

Air-to-air rotary heat exchanger shall be a "Series–S" rotary air-to-air heat exchanger manufactured by XeteX, Inc. Exchanger shall be ETL Listed and verified for cross contamination. The exchanger rotor shall be hygroscopic and constructed out of individually removable sections. It shall be mounted in housing with purge sector, variable speed drive, multifunction control system, and optional full season operational control.

Enthalpy Recovery Wheel

Exchanger shall be constructed of alternate layers of corrugated and flat aluminum sheet material. Both sides of the exchanger shall be completely smooth to allow for optimum sealing surface for brush seals. The rotor shall have smooth air channels to ensure laminar airflow for low-pressure drop. 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 air without degrading unit performance or, after consultation with XeteX, with water, low or high pressure steam, or special chemicals.

The rotor media must be made of 60 µm-thick aluminum and constructed in separate sections to be delivered loose. Rotor sections shall be stabilized with interior spokes threaded at the hub and welded at the rotor periphery for long term form stability. No adhesive shall be used to bond the layers of aluminum together. Rotors shall be capable of horizontal or vertical installation and have a maximum operating temperature of 160 °F.

[Sensible only rotor: The rotor media shall be bare aluminum. No desiccant or moisture-transporting coating shall be applied to the rotor material. Moisture may condense on the rotor surface and subsequently be carried between airstreams, but primary energy transfer shall be sensible only.]

[Light duty latent transfer rotor: The rotor media shall be coated with a corrosion-prohibiting, non-migrating, and permanently-bonded adsorbent specifically developed for the selective transfer of water vapor.]

[Silica gel economy line rotor: The rotor media shall be coated with a combination of a corrosion-prohibiting and non-migrating adsorbent and a zeolite silica gel desiccant both permanently bonded to the rotor surface without any adhesives and specifically developed for the selective transfer of water vapor.]

[High performance silica gel rotor: The rotor media shall be coated with a zeolite silica gel desiccant permanently bonded to the rotor surface without any adhesives and specifically developed for the selective transfer of water vapor.]

Unit Housing

The rotor housing shall be constructed using [aluminum profiles (for sizes SXA–2250 – 4000 wheels); or galvanized steel profiles (for size SXA–4250 wheels and larger)] with galvanized sheet metal plates. [Housing shall be delivered in two sections (for models 2500 and larger), or

housing shall be delivered in one or two sections (for models smaller than 2500)] and rotor shall be delivered in sectors for easy assembly on site. As an option, all cases can be further broken down and shipped in as many as six pieces.

Adjustable brush seals shall be provided for installation in the housing on the face shroud along the periphery of the wheel and along the central beam between the supply and exhaust air channels to effectively prevent air leakage and cross contamination between airstreams. Total contamination leakage shall be less than 2.0% at 0.0" w.g. differential pressure between airflows. Rotor and casing shall be reinforced to prevent deflection from differential pressures to less than 0.03 inches.

The rotor hub shall require no maintenance and shall be equipped with permanently-lubricated ball bearings or roller bearings, mounted and installed in a protected position within the hub. Bearings shall be serviceable or replaceable without complete removal of the rotor from the case.

Purge Sector
The unit must be provided with a factory-set, double purge sector designed to limit cross contamination at qualified appropriate design conditions to less than 0.04 percent of the exhaust air stream concentration.

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.

XeteX® Series–S

Rotary Air-to-Air Energy Recovery
ETL Listed

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