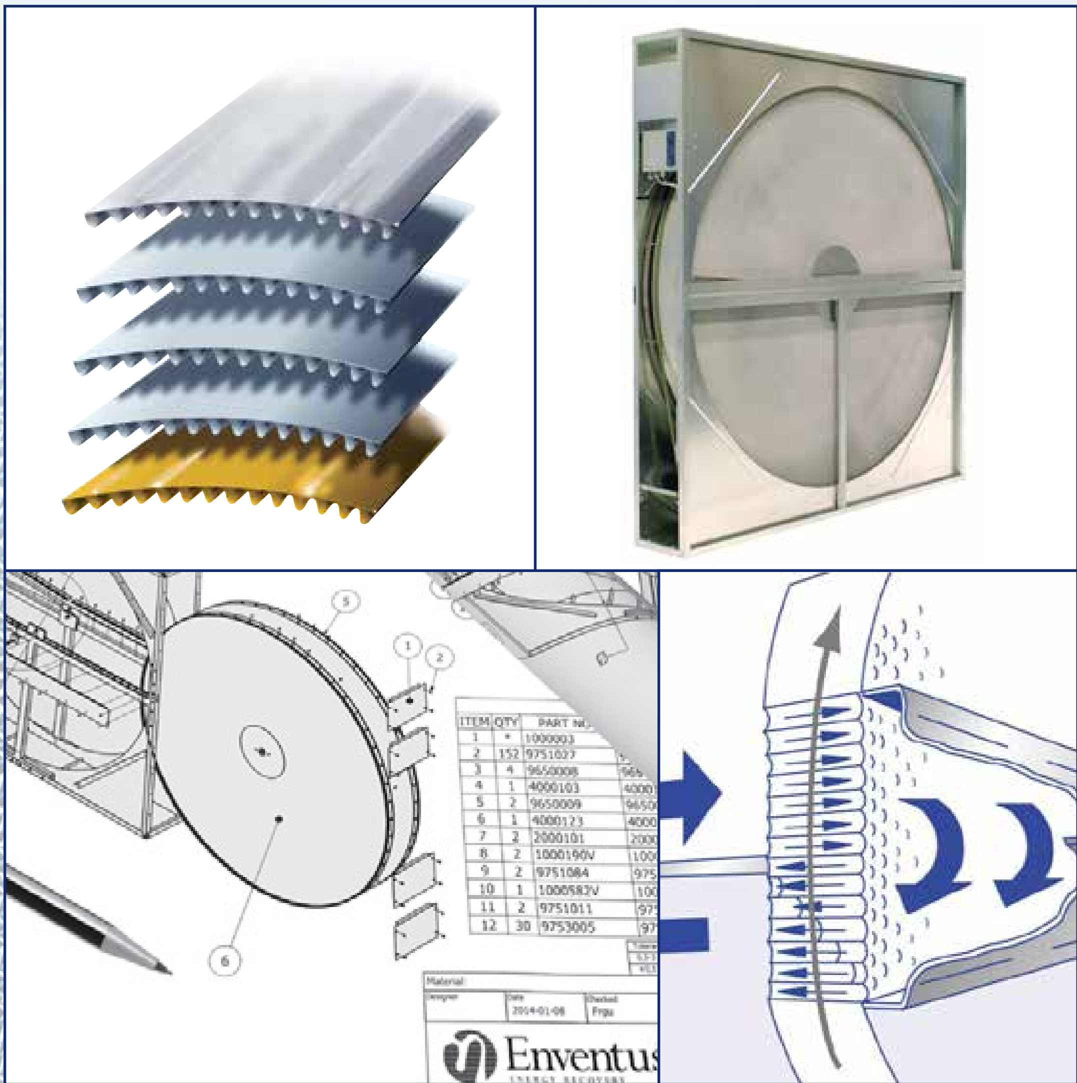
Enventus
ENERGY RECOVERY

Rotary heat exchangers
Product catalogue



Hoval A MEMBER OF THE HOVAL GROUP

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1 Company Presentation

Enventus AB has developed and produced rotary heat exchangers for more than 30 years. Today we are among the industry's global market leaders. Our strengths are a high level of technical competence and trusted partners. Our products are available worldwide via a global network of production facilities, distributors and representatives. This network provides Enventus with a local presence and rapid response times on a global scale.

Since 2014 Enventus is owned by Hoval Aktiengesellschaft, with head office in Liechtenstein.

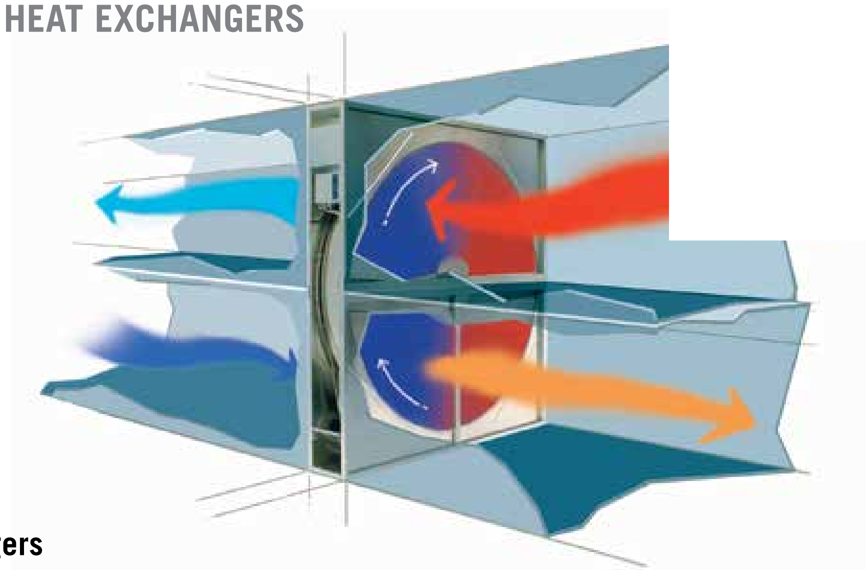
For more information about Hoval: www.hoval.com

1.1 THE ADVANTAGES OF ROTARY HEAT EXCHANGERS

Energy recovery

A combination of engineering proposals, end user requirements, and civil authority regulations has resulted in an increasing use of energy recovery equipment. Investment in energy recovery equipment significantly reduces operating costs and investments in humidifiers and air conditioning.

Enventus energy recovery systems safeguard your return on investment.



General principle of rotary heat exchangers

Rotary heat exchangers belong to the group regenerative heat exchangers. Rotor movement means that exhaust air and supply air pass the rotor medium alternately. A major proportion of the energy in the exhaust air is transferred to the supply air via the rotor medium. Thanks to the alternating airflow direction, the rotor is self cleaning and frost proof to a large extent.

The ability to recover both thermal (sensible) and humidity (latent) energy makes rotary heat exchangers very efficient. Efficiency between 70-90% with a pressure drop under 200 Pa is normal for rotary heat exchangers, and efficiency is easily adjusted by regulating motor rpm.

1.2 CERTIFICATION PROGRAMME AND STANDARDS

Enventus seeks to deliver high-quality customized products at competitive prices.

Enventus rotary heat exchangers and the Hoval CASER program are Eurovent certified. Eurovent certification guarantees a product's performance and provides customers with assurance in their choice of supplier. Eurovent certification is issued when test rotor values correspond to the results reported in the supplier's calculation program. Eurovent certificates are renewed each year following new tests.

Enventus sorption rotors are certified by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI), an American trade association.

Please visit our website at www.enventus.com for copies of these certificates.

The Eurovent programme applies primarily to Europe. The regenerative heat exchanger range is based on EN 308 and AHRI 1060 standards and our own certification procedures.

www.eurovent-certification.com

Enventus sorption rotors are AHRI certified (see Selection Software print out for certified types). AHRI is an American trade association that applies the AHRI 1060 standard for certification.

http://www.ahridirectory.org

TÜV Süd certifies the Enventus Product Selection program (Enventus Calculation) and verifies program changes and algorithms.

http://www.tuev-sued.de

Enventus business operations are certified to ISO 9001 standards.
http://www.enventus.com/products/quality-assurance/

2 Product description

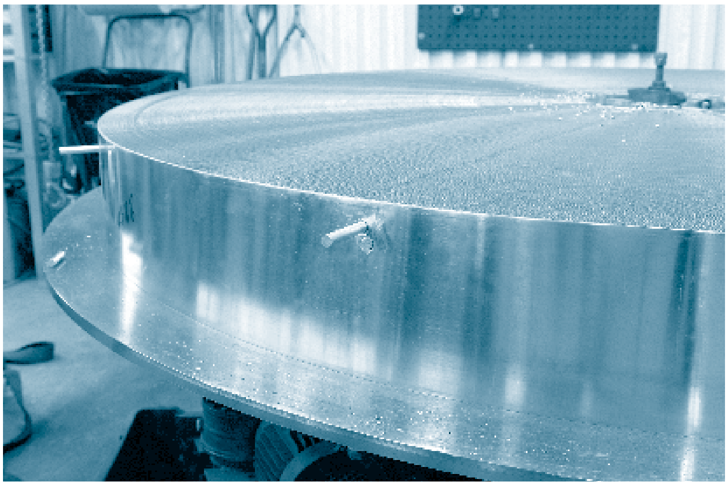
Enventus supplies rotary heat exchangers to producers of air handling units worldwide. Rotary heat exchangers can be used in most types of applications. The three principal areas are comfort ventilation (e.g. homes, offices, hotels and airports); industrial ventilation (e.g. automotive industry) and marine ventilation (cruise liners and coastal environments).

The Enventus production line allows flexible manufacturing according to the customer's requirements. We are able to provide customized rotor diameters, casing dimensions and foils for different applications and performance ranges all with short, reliable delivery times.

Enventus is regarded as a reliable energy recovery partner around the world.

2.1 ROTORS

The rotor matrix is made for laminar airflow using alternating layers of smooth and corrugated foil to provide a structure comprising small, triangular channels.



The picture above shows manufacturing of a one piece rotor.

The rotors are either one piece or sectorized. Sectorized rotors are divided into segments that are assembled when the rotor is installed. One piece rotors are made in diameters between Ø300–2600 mm, while sectorized rotors have diameters of Ø950-5000 mm.

Small rotors up to max Ø650 mm are glued; other rotors are made mechanically stable by internal spokes screwed into a hub and welded around the periphery.

This design allows cleaning with compressed air, steam, hot water or special cleaning agents.

Temperature range -20°C till +70°C.

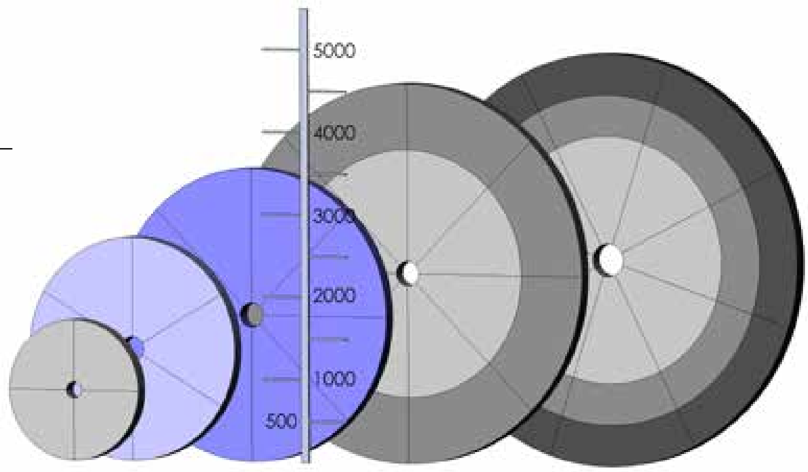
Air speed should be kept low for best efficiency. The stable design allows a pressure drop of 300 Pa across one piece rotors and 400 Pa across sectorized rotors. However, these pressure drops are not recommended as high air speeds result in lower efficiency and higher fan energy consumption.

The rotor may be installed vertical or horizontal (vertical is standard; horizontal is an option). One piece rotors up to Ø2030 mm may be installed horizontally, and sectorized up to Ø3200 mm.

Five different wave heights are available to enable optimization of efficiency and pressure drop.

Rotor type	Wave height	Wave length
Extra Low (X)	1.5 mm	3.0 mm
Special Low (S)	1.65 mm	3.0 mm
Low (L)	1.7 mm	4.0 mm
Normal (N)	2.0 mm	4.0 mm
High (H)	2.7 mm	5.5 mm

Rotor Ø	Number of Segments
400-1699	4
1700-2699	6
2700-3549	8
3550-4599	8+8
4600-5000	8+8+8

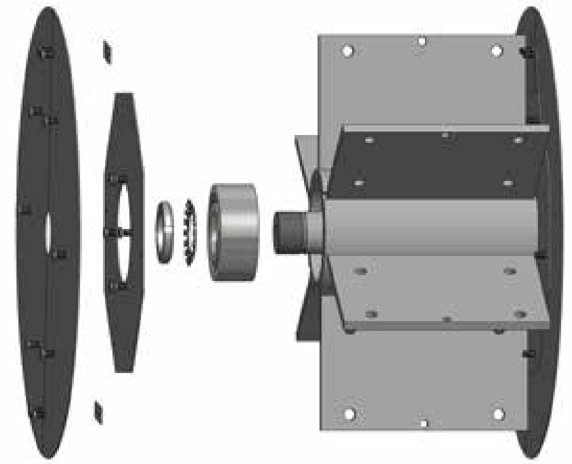


The illustration above shows the number of segments for sectorized rotors of different dimensions.

Rotors are made in 200 mm depth as standard in all materials, and can also be produced in 100, 150 or 250 mm depths.

Rotors have maintenance-free hubs with life-time lubricated ball or roller bearings in a protected location in the hub. All bearings are sealed to prevent dirt and humidity from entering the bearing.

Bearing lifetime is at least 200,000 h for one piece rotors and at least 60,000 h for sectorized rotors in continuous operation with a maximum rotation of 20 rpm (L_{10}h as per ISO 281:19910).

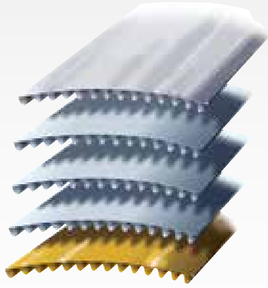


The illustration above shows the components in a hub.

Vertical installation	Depth 100 mm	Depth 150 mm	Depth 200 mm	Depth 250 mm
Glued rotor, Ø (mm)	200-650	200-650	200-650	-
Spoked rotor, one piece, Ø (mm)	300-1500	-	300-2600	300-2600
Spoked rotor, sectorized, Ø (mm)	-	-	950-5000	-

Horizontal installation	Depth 100 mm	Depth 150 mm	Depth 200 mm	Depth 250 mm
Glued rotor, Ø (mm)	200-650	200-650	200-650	-
Spoked rotor, one piece, Ø (mm)	300-1500	-	300-2000	300-1800
Spoked rotor, sectorized, Ø (mm)	-	-	950-3200	-

Foil type



The right foil for the right application, performance and environment
Rotary heat exchangers are classified into three different types; condensation rotors, hygroscopic rotors and sorption rotors. Enventus provides foils for all three types.

Condensation rotors, non-hygroscopic rotors (ST, SC)
The condensation rotor is a cost-efficient solution to recover heat and is suitable for standard applications in comfort ventilation. Humidity is only transferred in cases when the dew point of one of the air streams is reached during winter conditions.

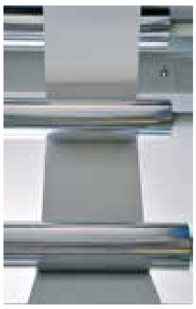
Hygroscopic rotors (SE, SH)
The hydroscopic surface of this rotor class supports humidity transfer. Typically used for standard applications in comfort ventilation systems to recover humidity during winter temperature periods.

Sorption rotor (HM)
The high performance desiccant coatings of the sorption rotor **HM (molecular sieve 3Å)** provide a maximum humidity transfer capacity for minimal Carry Over. The high humidity efficiency is constant throughout all climate conditions. Sorption rotors are especially designed for summer season cooling recovery and dehumidification of supply air. Therewith, it should always be used in humid and hot climates, with dry cooling systems (chilled beams) and when in winter time humidifiers are used. This substantially reduces the cooling and humidification demand of the HVAC system.

Epoxy-coated foil should be used in environments that entail a major risk of corrosion such as in industrial ventilation. Epoxy-coated foil provides effective corrosion protection.

Seawater resistant foil is an alternative to epoxy-coated foil. The foil has a 2.5% magnesium content, which provides good corrosion protection. Seawater resistant foil is recommended for use in cruise liners and coastal environments.

Type	Condensation	Hygroscopic	Sorption	Remarks
ST	x			Untreated aluminium foil
SE		x		Oxidized aluminium foil
SC	x			Epoxy-coated foil
ST2	x			Seawater resistant foil (AlMg), 100 µ.
SH		x		Molecular sieve, 3Å and untreated aluminium foil
HM			x	Molecular sieve, 3Å



2.2 CASINGS

Casings are available for the entire product range – Ø300 mm till Ø5000 mm – and are characterized by flexible, modifiable dimensions suitable for air handling units. The robust design prevents rotor movements that can cause leaks.

Standard casings are made from galvanized sheet steel (Z275), Aluzinc (A150) or stainless steel (EN 1.4301). Casings can also be supplied with powder coatings for extra corrosion protection.

Some units have an aluminium profile (C, CD, DS, D Ø<4251) frame, while larger units have steel profile frames.

Purge sectors can be supplied for all casings in optional sizes of 2,5°, 5° or 10° depending on unit pressure conditions.

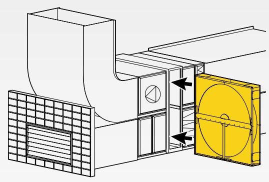
All casings have adjustable brushsealing around the rotor periphery and along the centre beam. Additional seals can be provided for high pressure differentials.

Standard casings are intended for vertical installation, smaller models can be ordered for horizontal installation.

All of our casings can be made to measure to facilitate installation or conversion of existing plant (not adapted for heat recovery).

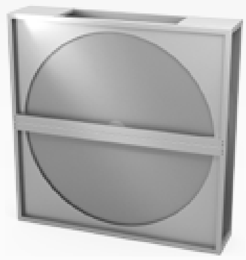
There are two different casing types; the slide-in model and the modular unit.

Slide-in model, (CS, SD, DS)
Slide-in models fit into air handling units (AHU's) thus making a uniform AHU appearance possible. Slide-in casings are always uninsulated and have a large, exposed rotor surface in relation to casing size. Slide-in casings can be provided with one piece (max Ø2600 mm) or sectorized rotors (max Ø5000 mm).



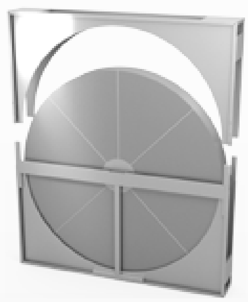
CS type casing:
Slide-in casing for one piece rotors, Ø300-2600 mm.

The casing is made from corrosion-resistant sheet steel. The stable middle beam is made of pressed sheet steel or a coated steel profile on larger units. For units larger than Ø2451 mm, the casing is made from steel profile frame. Rotor suspension allows rotor adjustment. There are adjustable brushsealing around the rotor periphery and along the middle beam. Delivered assembled.



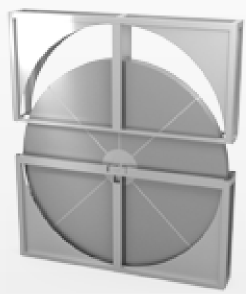
SD type casing:
Slide-in casing for sectorized rotors Ø950 -2800 mm.

The casing is made from corrosion-resistant sheet steel. The stable middle beam is made from coated steel profile. For units larger than Ø2401 mm, the casing is made from steel profile frame. Divided casing (two parts). Rotor suspension allows rotor adjustment. There are adjustable brushsealing around the rotor periphery and along the middle beam. The SD casing is used when the casing must be transported in parts to save space. The rotor segments are delivered in separate packaging. Parts delivered separately, unassembled.

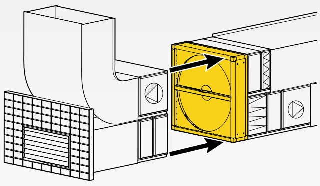


DS type casing:
Slide-in casing for sectorized rotors Ø2451-5000 mm.

Divided casing (two parts). The casing comprises an aluminium profile frame, or galvanized steel profile frame on units larger than Ø4251 mm. The frame profiles are joined without corners to provide a play-free framework. Rotor suspension allows rotor adjustment. There are adjustable brushsealing around the rotor periphery and along the middle beam. The rotor segments are delivered in separate packaging. Parts delivered separately, unassembled.



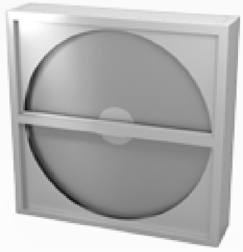
Modular units (C, CD, D)
Complete units for connection to other parts of air handling unit or directly to ducting. The unit is modified so that connection can be carried out using e.g. connection panels or corner connectors. The modules are insulated with 50 kg/m³ mineral wool as standard, but can be delivered with a different density or completely uninsulated. The modular unit can be made with a one piece casing (one piece rotors) up to Ø2600 mm and divided casings (sectorized rotors) up to Ø5000 mm.



Accessories such as inspection window, tubular frame, lighting and condensate trays are available (see section 2.5).

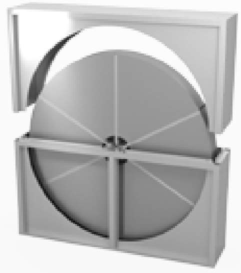
C type casing:
Modular unit for one piece rotors Ø300-2600 mm.

Made from aluminium profiles, galvanized sheet and side hatches. There are adjustable brushsealing around the rotor periphery and along the middle beam. Delivered assembled, complete with removable inspection hatch.



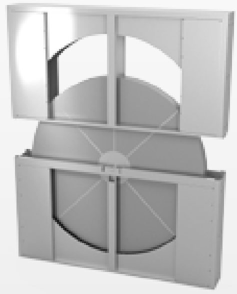
CD type casing:
Modular unit for sectorized rotors Ø950-2450 mm.

Divided casing (two parts). Made from aluminium profiles, galvanized sheet and side hatches. There are adjustable brushsealing around the rotor periphery and along the middle beam. The rotor segments are delivered in separate packaging. Parts delivered separately, unassembled.



D type casing:
Modular unit for sectorized rotors Ø2451-5000 mm.

Divided casing (two parts). The casing comprises an aluminium profile frame, or galvanized steel profile frame on units > Ø4251 mm. The frame profiles are joined without corners to provide a rigid, gap-free framework. Rotor suspension allows rotor adjustment. There are adjustable brushsealing around the rotor periphery and along the middle beam. The casing is fitted with insulated panels and an inspection hatch. The rotor segments are delivered in separate packaging. Parts delivered separately, unassembled.



	Slide-in			Modular unit		
Casing type:	**CS**	**SD**	**DS**	**C**	**CD**	**D**
Diameter Ø (mm)	300-2600	950-2800	2451-5000	300-2600	950-2450	2451-5000
One piece casing	x			x		
Divided casing (2 parts)		x	x		x	x
One piece rotor (W)	W			W		
Sectorized rotor (S)		S	S		S	S
Rotor depth (mm)	100, 200, 250	200	200	200	200	200
Casing depth (mm)	190, 290, 330, 340	290, 330	430	430, 470	430, 470	430

2.3 DIMENSIONS

All casings are dimensioned as required.

Size examples

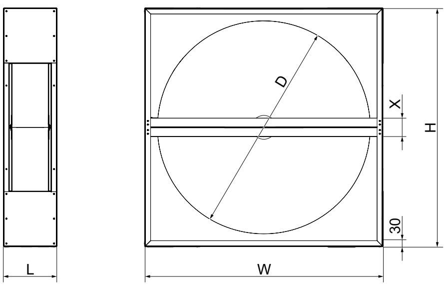
Height (H), width (W) and rotor diameter (D) are dimensioned as required.

Refer to the Hoval CASER program for exact dimensions.

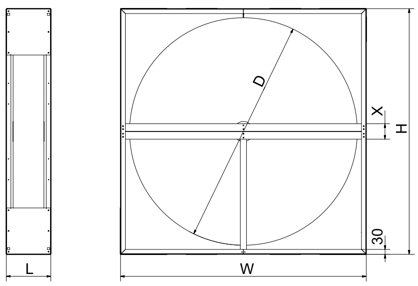
CS type casing

Slide-in casing for one piece rotors, Ø300-2600 mm.

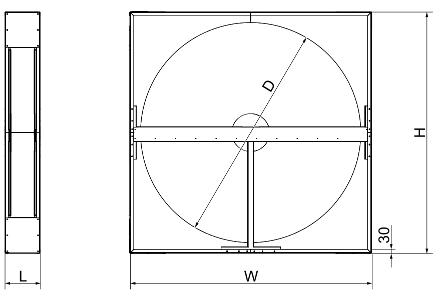
Rotor D (mm)	Casing W x H (mm)	X (mm)	L 100 rotor (mm)	L 150 rotor (mm)	L 200 rotor (mm)	L 250 rotor (mm)	Remarks
300-399	Ø+180	50	190	240	290	340	
400-499	Ø+160	50	190	240	290	340	
500-599	Ø+130	50	190	240	290	340	
600-1499	Ø+100	100	190	240	290	340	
1500-2050	Ø+100	100	-	240	290	340	Ø>1800 = Support leg
2051-2450	Ø+100	100	-	-	290	-	Support leg
2451-2600	Ø+120	100	-	-	330	-	Steel profile frame



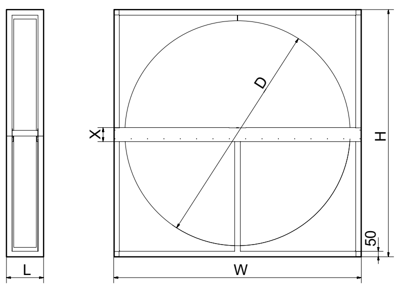
CS Ø 300-1449 mm



CS Ø 1450-1799 mm



CS Ø 1800-2450 mm

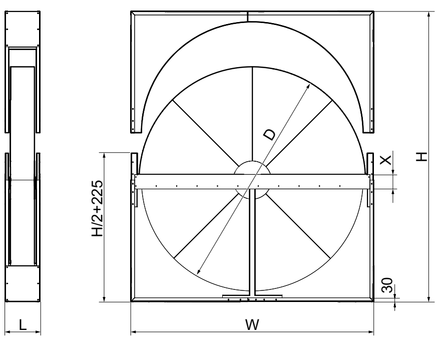


CS Ø 2451-2600 mm

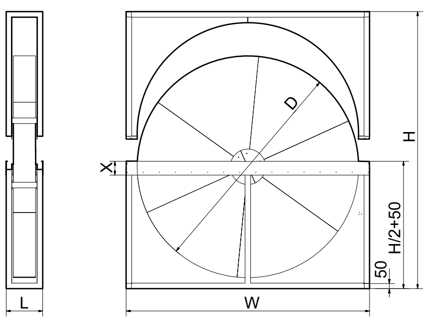
SD type casing

Slide-in casing for sectorized rotors Ø950 -2800 mm.

Rotor D (mm)	Casing W x H (mm)	X (mm)	L 200 rotor (mm)	Remarks
950-2400	Ø+140	100	290	
2401-2800	Ø+170	100	330	Steel profile frame



SD Ø 950-2400 mm

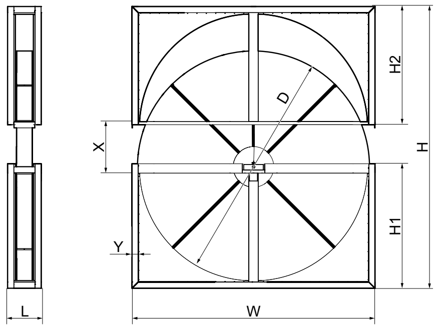


SD Ø 2401-2800 mm

DS type casing

Slide-in casing for sectorized rotors Ø2451-5000 mm.

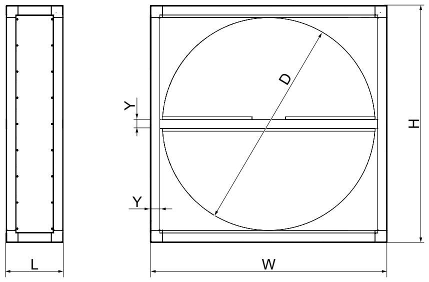
Rotor D (mm)	Casing W x H (mm)	X (mm)	H1 (mm)	H2 (mm)	L (mm)	Y (mm)
2451-5000	Ø+200	160	H/2+40	H/2-40	430	80



C type casing

Modular unit for one piece rotors Ø300-2600 mm.

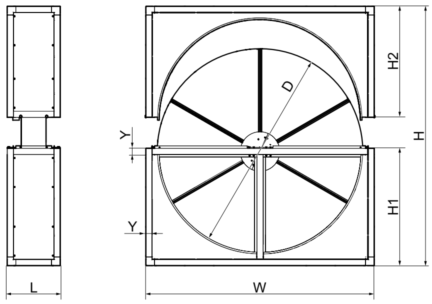
Rotor D (mm)	Casing W x H (mm)	Y (mm)	L (mm)
300-1999	Ø+200	50	430
2000-2600	Ø+220	70	470



CD type casing

Modular unit for sectorized rotors Ø950-2450 mm.

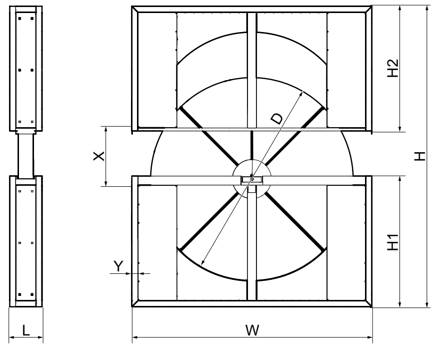
Rotor D (mm)	Casing W x H (mm)	Y (mm)	H1 (mm)	H2 (mm)	L (mm)
950-1999	Ø+220	50	H/2+25	H/2-25	430
2000-2450	Ø+220	70	H/2+35	H/2-35	470



D type casing

Modular unit for sectorized rotors Ø2451-5000 mm.

Rotor D (mm)	Casing W x H (mm)	X (mm)	H1 (mm)	H2 (mm)	L (mm)	Y (mm)
2451-5000	Ø+230	160	H/2+40	H/2-40	430	80



2.4 DRIVE EQUIPMENT

Enventus provides easy, operationally reliable drive equipment for both constant and variable speed operation.

Rotors are driven by a motor mounted on a bracket inside the casing. All rotors are driven by the motor via a belt to the rotor periphery. Rotors Ø<1400 mm are driven by round belts and rotors Ø>1400 are driven by V-belts.

All motors are 4-pole with integrated thermo-switches that monitor winding temperatures. Enventus provides both three-phase and single-phase motors.

Belt pulley size and/or gearing are dimensioned to achieve optimum rotor rpm. Optimum rotor speed for heat recovery is 12 rpm, and for moisture recovery (sorption rotors) 20 rpm.

Constant drive

Constant drive means that rotor speed remains constant during operation, or is switched off to remain stationary – so called on/off drive.

Induction motors with reduction gearing are available in three-phase and single-phase versions. These are mainly used in small units and are available with outputs of 6W, 25W and 40W. The motors have class B insulation and IP54 protection ratings. The reduction gear is life-time lubricated and maintenance-free.

Asynchronous motors with worm gears are available in three-phase and single-phase versions. They are available with outputs between 90W and 750W. The motors have class F insulation and IP55 protection ratings. The worm gears are life-time lubricated and maintenance-free.

Enventus Drive Equipment and Technical Specification

1-phase 50 Hz

Drive motor		**SPG6-1**	**SPG25-1**	**SPG40-1**	**AP56E-1**	**AP63E-1**	**AP71E-1**	**AP80E-1**
Voltage	V	1x230	1x230	1x230	1x230	1x230	1x230	1x230
Frequency	Hz	50	50	50	50	50	50	50
Engine power	kW	0,006	0,025	0,04	0,09	0,18	0,37	0,75
Electricity	A	0,07	0,26	0,36	0,90	1,60	3,20	5,60
Weight	kg	1,0	1,8	3,4	4,7	6,2	10,3	15,0

3-phase 50 Hz

Drive motor		**SPG40-3**	**SPG40-3**	**AP56-3**	**AP63-3**	**AP71-3**	**AP80-3**
Voltage	V	3x230	3x400	3x230/400	3x230/400	3x230/400	3x230/400
Frequency	Hz	50	50	50	50	50	50
Engine power	kW	0,04	0,04	0,09	0,18	0,37	0,75
Electricity	A	0,39	0,21	0,74/0,43	1,17/0,68	1,92/1,11	3,08/1,78
Weight	kg	3,4	3,4	4,3	5,4	8,1	14

3-phase 60 Hz

Drive motor		**SPG40-3**	**SPG40-3**	**AP56-3-60**	**AP63-3-60**	**AP71-3-60**	**AP80-3-60**
Voltage	V	3x230	3x400	3x230/400	3x230/400	3x230/400	3x230/400
Frequency	Hz	60	60	60	60	60	60
Engine power	kW	0,04	0,04	0,09	0,18	0,37	0,75
Electricity	A	0,33	0,19	0,74/0,43	1,17/0,68	1,92/1,11	3,08/1,78
Weight	kg	3,4	3,4	4,3	5,4	8,1	14

Variable drive

Variable drive enables rotor speed regulation and thus optimal control throughout the year.

The drive unit consists of a motor and control unit that regulates motor rpm in relation to an input signal.

MicroMax

Micromax is a standardized, user-friendly control unit with all necessary functions.

Micromax is controlled by 0-10 V input signals.

Rotor speed is proportional to the control unit input signal. If the input signal drops below a set threshold value, the motor will stop.

Micromax is connected to 4-pole induction motors with reduction gears or 4-pole asynchronous motors with worm gears. All motors are three-phase versions equipped with thermo-switches.

Minimax

Minimax is a standardized, user-friendly control unit with all necessary functions.

Minimax is controlled by all available input signals.

Rotor speed is proportional to the control unit input signal. If the input signal drops below a set threshold value, the motor will stop.

Minimax is available in one model and can drive rotors < Ø 3500 mm.

Emotron Control units

Emotron control units were specially developed for regulating rotary heat exchanger rpm. They provide full control across a broad range of rpm and ensure reliable operation. Emotron rotor speed control is linear, i.e. the command signal is proportional to rotor efficiency, which provides precise control across the entire temperature range.

Emotron has an integrated rotation guard (Not EMX-P).

EMX™ -P

EMX™ -P is a control unit for rotors Ø <1000 mm. The unit is connected to a single-phase motor max output 40W, which communicates with the control unit by means of a tachometer.

EMX™-R

EMX-R is a speed-controlled drive system using SR motors (SR=Switched Reluctance) that make it possible to drive rotors < Ø 3500 mm without gears. The direction of rotation is set using a DIP switch. The control unit is available in two versions, S (Standard) and E (Extended). The E version includes extended functionality.

EMX™-D

EMX™-D is a speed-controlled drive system for rotors Ø >3500 with selectable direction of rotation. All functions can be controlled by means of an integrated display.

CONTROL UNITS, SUMMARY

	MicroMax	Minimax	EMX-P	EMX-R	EMX-D
Connection voltage	1x230V ±15%	1x230V +6–10%	1x230V ±15%	1x230V ±15%	1x230V ±15%
Connection frequency	50-60Hz	50-60Hz	50-60Hz	50-60Hz	50-60Hz
Motor type	Asynchronous	Asynchronous	Induction	Reluctance	Asynchronous
Safety class	IP 54	IP 54	IP 54	IP 54	IP 54
Ambient temperature	-20 – +45°C	-20 – +45°C	-30 – +40 °C	-30 – +40 °C	-30 – +40 °C
Direction of rotation	Fixed	Fixed	Fixed	Optional	Optional
Input signals (control signals)	0-10V	0-5V, 0-10V, 0-20V 0-20mA 4-20mA"	0-10V 0-20mA, 4-20mA"	0-10V 0-20mA, 4-20mA"	0-10V 0-20mA, 4-20mA"
Lowest constant rpm	4 Hz	4 Hz	2% of max rpm	2% of max rpm	4% of max rpm
Rotation guard	Magnetic sensor	Magnetic sensor	Magnetic sensor	Magnetic sensor, via motor (E)	Magnetic sensor, via motor
Purge function	10s (every 30 min)	10s (every 30 min)	30° (every 10 min)	30° (every 10 min)	15° (every 10 min)
Defrost function	Integrated function	Integrated function	Integrated function	Integrated function	Integrated function
Symbol	Operational status	Operational status	Operational status	Operational status	Operational status
	Alarm	Alarm	Alarm	Alarm, rotor rpm (E)	Alarm, rotor rpm (E)
Max rotor diameter	Ø≤5000	Ø≤3500	Ø≤1000	Ø≤3500	Ø≤5000
Built-in display	No	No	No	No Yes (E)	Yes

2.5 ACCESSORIES

Reinforced edges
The rotor matrix can be fitted with edge reinforcement to improve corrosion protection. The reinforcement protects the foil edges against corrosion and is suitable for use in environments subject to heightened corrosion risk.

Enhanced seals
Enhanced seals consist of an extra layer of brushsealing on the middle beam and around the rotor periphery. They are recommended in installations with high pressure differentials between the supply and exhaust ducts.

Inspection window, handles
An inspection window and/or handles may be selected for C and D casings.

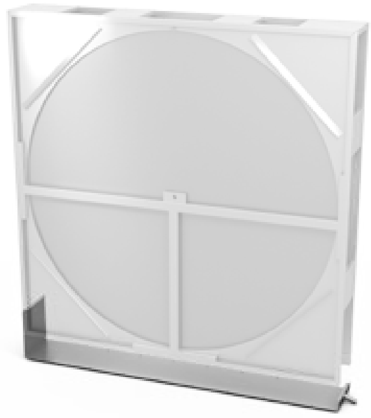
Flat panels and triangular inspection hatch
The slide-in casing can be fitted with flat panels on the sides. We recommend ordering a triangular inspection hatch to facilitate motor and drive belt inspections when flat panels are installed. The triangular inspection hatch is advisable when it is not possible to reach the rotor and drive unit from the inspection side.

Cable bushings
Bushings for power and signal cables are available as accessories. Standard cable bush fittings are installed.

Powder coated casing
All of our casings can be powder coated to order. The standard colour is Light Grey, RAL 9006. Powder coating enhances the casing's corrosion protection. Special colours are available on request

Condensate trays

All casings can be fitted with condensate trays and pipe fittings in aluminium, corrosion-protected steel sheet or stainless steel sheet. For exact detail per casing, please contact us.



Tubular frames

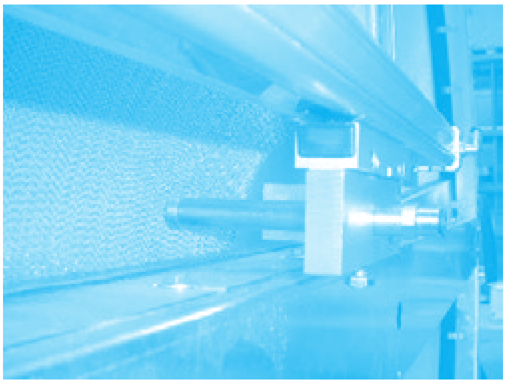
Modular units can be fitted with tubular frames made from galvanised steel tubing. Dimensions made to order.

Lifting Accessory

Extra details to lift the casings can be ordered. Will be delivered separate in a box inside the casing at delivery.

E-Clean 16, Pneumatic cleaning equipment

E-Clean 16 is an automatic pneumatic device for cleaning away fouling adhering to the rotor surface. It consists of a pneumatically controlled cylinder, sled, nozzle and control box. The control box is used to control single or twin rotors and manual operation. Dimensions made to order.



3 Product selection and performance calculations

Enventus has developed a series of calculation programs. The software allows any user to make a selection out of our products.

The programs are free of charge, easy to use and can be installed on most standard PC's.

3.1 HOVAL CASER DESIGN PROGRAM

During the spring of 2016, work is ongoing to combine Hoval CASER and Enventus Calculation. Until this work is finished each program will work independently of each other. Find the latest information on our websites: www.hoval.com and www.enventus.com.

The Hoval CASER design program is available for fast and accurate design of Hoval rotary heat exchangers (= Computer Aided Selection of Energy Recovery). It runs under Microsoft® Windows and offers the following applications:

- Secure planning with Eurovent and TÜV-certified data
- Accurate calculation of a specific Hoval rotary heat exchanger
- Calculation of all applicable rotary heat exchangers for a specific project
- Calculation of the efficiency class in accordance with EN 13053
- Calculation of leakage in accordance with Eurovent
- Price calculation for the selected rotary heat exchangers

Notice

You can download the Hoval CASER design program free of charge from our home page (hrs.hoval.com).

The program is also available as a Windows DLL file and can therefore be integrated into other spreadsheet programs (on request).

3.2 INSTALLATION AND MOTOR POSITION

Rotary heat exchangers can be installed in units in several different ways. Enventus has two different casing types independent of rotor size. The choice of slide-in or modular unit depends mainly on the air handling unit's design and desired technical performance.

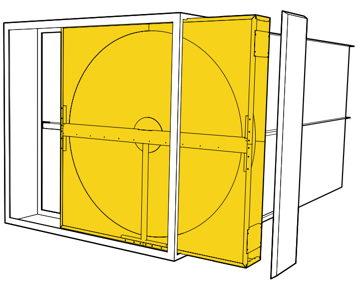
Enventus has different types of slide-in casing for units for incorporation into air handling units, depending on the size requested. Further information about rotor and casing designs is available in section 2.

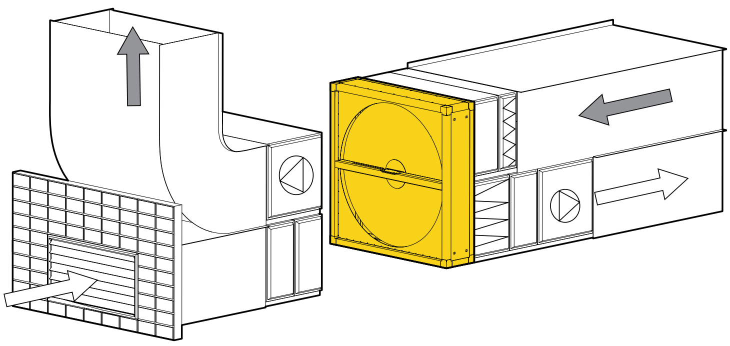
Modular units are available when the customer wants to connect the rotor directly to the unit or ducting. This design allows a rotor larger than the unit in order to maximize technical performance. The way in which the rotor assembly is connected to unit components is determined by the customer. Connection parts are not supplied by Enventus.

Rotors for both versions can also be supplied for horizontal installations <Ø3200mm. Correct function is ensured by following the installation instructions available on our website.

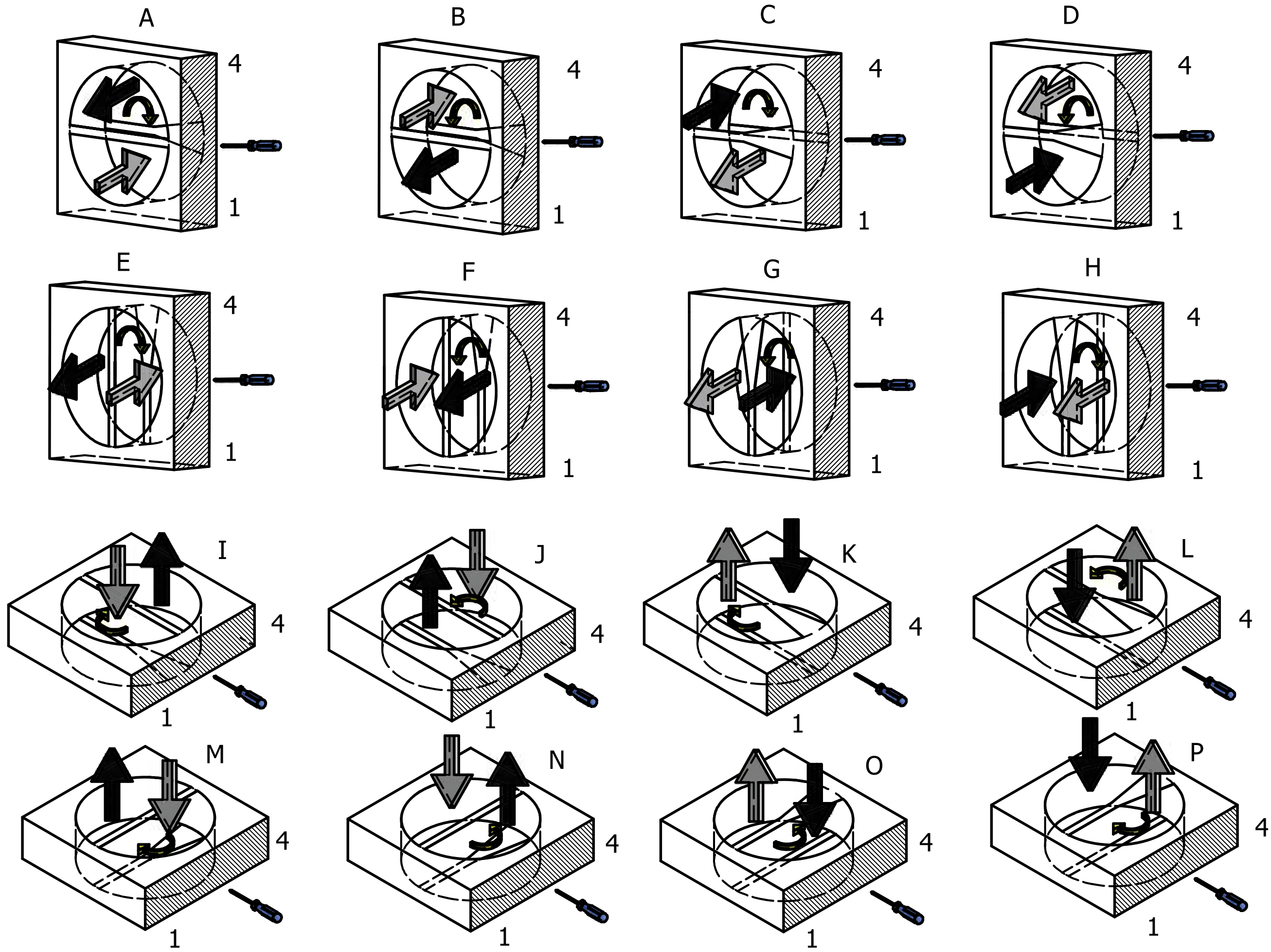
When dimensioning heat exchangers in Hoval CASER, units are shown in the standard version with a purge sector. In order to locate the purge sector correctly, it is necessary to know unit set-up in regard to exhaust air, supply air and the inspection side.

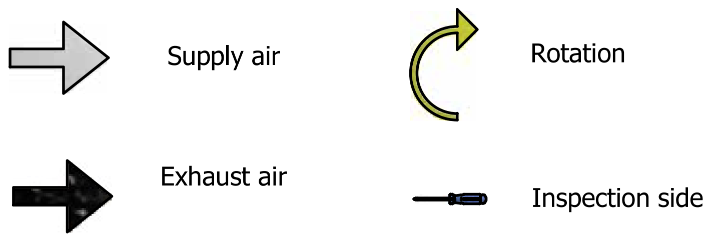
On the following page there is a sketch showing installation type and motor position.





Enventus installation type and motor position





3.3 REPLACEMENT ROTORS

Enventus rotary heat exchangers can be used to replace most makes on the market.

When replacing a rotor it is often possible to use the existing rotor casing. Bearings on all Enventus rotors are installed in the rotor, and this solution is very beneficial. We need the following information to make a replacement rotor.

- Shaft dimensions and design
- Precise rotor diameter

If the rotor does not run properly it is necessary to find the cause. Was the initial choice of material wrong, or has the operation in the environment changed? The new rotor may possibly need a different specification compared to the original. If there is a lack of space, a fully wound rotor can be replaced by a sectorized rotor. Because a sectorized rotor adds 60 mm to the diameter due to the design, it is important to check that there is space enough in the rotor casing.

A rotary heat exchanger can also replace other heat recovery system types. It is important to consider the following:

- What are the maximum dimensions (height, width and depth)?
- Can a slide-in casing be used?
- What kind of environment is it; is a rotor suitable?

3.4 ORDERING PRODUCTS

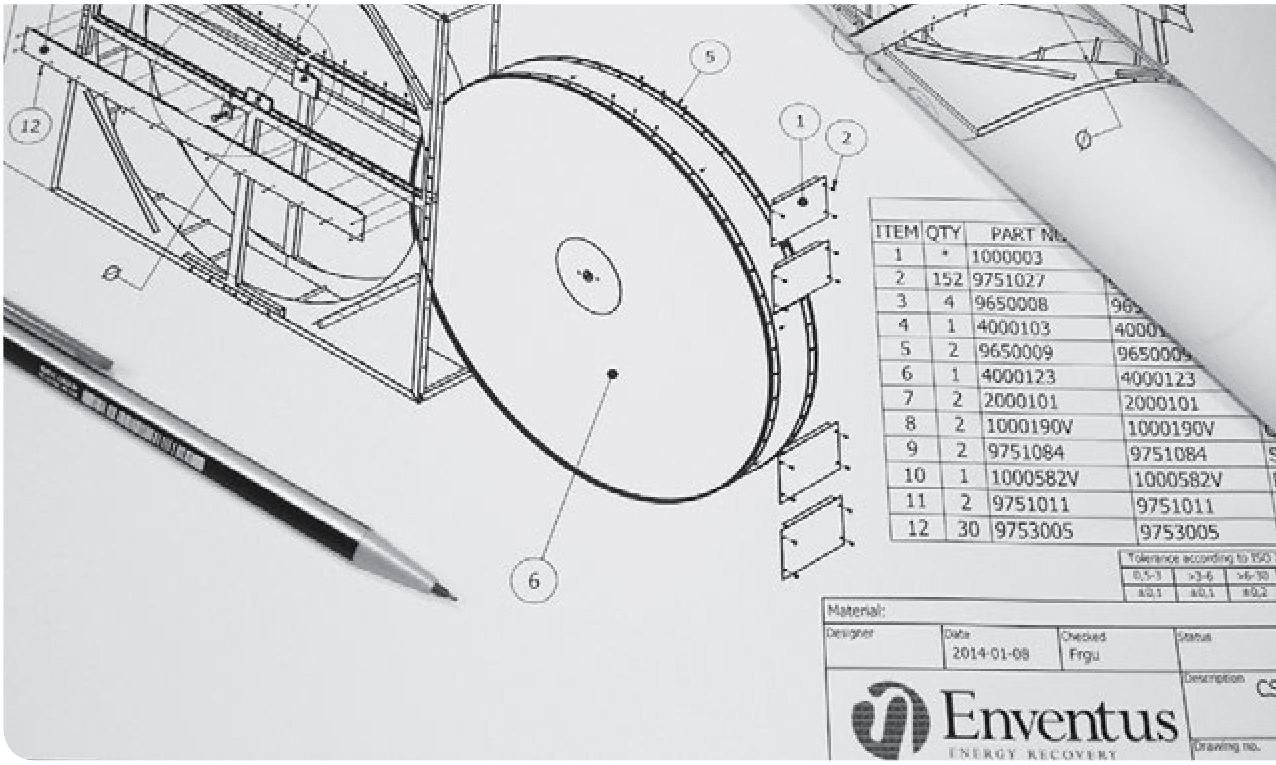
Enventus products can be ordered in a number of ways. We recommend a written order via email to info@enventus.com, or by fax to +46 (0)36 375668.

To avoid misunderstanding, we need the following information:

- Company information
- Delivery address
- Invoice address
- Product specification
- Rotor diameter and foil type
- Casing type and dimensions
- Type of drive equipment
- Motor position
- Purge sector
- Any accessories

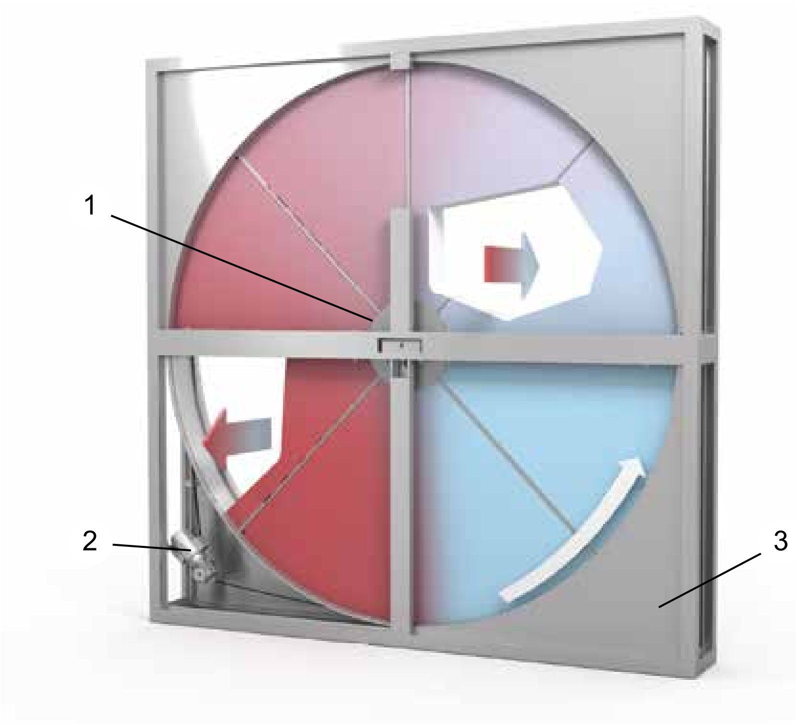
The product specification can be prepared in Hoval CASER or by means of this catalogue. You can also call us and ask for a quotation.

4 Technical function



Enventus rotary heat exchangers are classified as regenerative air-to-air energy recovery units. The primary function of a regenerative air-to-air energy recovery unit is the transfer of sensible (temperature) and latent (humidity) energy between exhaust and supply airflows. Regenerative energy recovery units are very important for energy conservation in ventilation installations that treat outside air to ensure good indoor climate and air quality.

4.1 FUNCTIONAL DESCRIPTION



The regenerative system consists mainly of the following components:

1. Rotor matrix (hub, bearings and foil)
2. Drive equipment (motor, control unit and belt)
3. Casing (structure, purge sector and seals)

The rotary heat exchangers is connected on the exhaust side to the outlet and supply ducts and on the supply side to the supply and exhaust ducts. In this way the air streams pass the rotor matrix in opposite directions, which provides the largest degree of recovery compared to cross or parallel-flow operation.

Both air streams pass the rotor simultaneously and continuously, and the rotor is heated and cooled within one revolution. Energy from exhaust air is transferred to the rotor matrix and then from the rotor matrix to outside air.

The rotor matrix consists of many small, sinusoidal channels made from thin aluminium foil. Depending on the desired level of recovery, wave height varies between 1.5 and 2.7 mm. The rotor matrix is between 100 and 250 mm deep; 200 mm is suitable for most installations. Regenerative systems are very attractive due to their high continuous recovery rates and minimal installation depths.

Untreated aluminium foil is used for sensible heat recovery. Epoxy-coated aluminium or seawater resistant foil with higher magnesium content is best suited in installations in aggressive environments such as industrial or maritime locations. Sensible rotors only transfer humidity during the winter when exhaust air condenses in the rotor matrix and is taken up by the supply air stream.

Hygroscopic or sorption-treated rotors transfer airborne humidity (latent energy) year round. The aluminium foil in hygroscopic rotors is oxidized to create a surface that transfers humidity. Sorption rotor foil is permanently coated with sorption material of the type 3Å molecular sieve, which has an extremely high humidity transfer capacity.

4.2 HEAT AND HUMIDITY RECOVERY

Heat recovery

According to the fundamental laws of thermodynamics, heat energy is transported from the warmer to the cooler substance. Similarly, during the winter, sensible heat energy in exhaust air is transferred to the rotor matrix, and from the rotor matrix to the cooler supply air. The amount of heat transfer is generally specified by the temperature efficiency.

The temperature efficiency of rotary heat exchangers in contra-flow operations is usually between 70–90% and for the supply air side is calculated according to the following equation:

$$\eta_t = (t_{22} - t_{21}) / (t_{11} - t_{21})$$

Temperature efficiency can be determined relatively easily in terms of both measurement and theory. It is largely dependent on the size of the heat transfer surface area, rotor material, air speed through the rotor matrix channels and rotation speed.

Heat transfer surface area is in turn a function of the structure's wave height and design. A simple rule of thumb is that reducing wave height increases the heat transfer surface area and thus temperature efficiency.

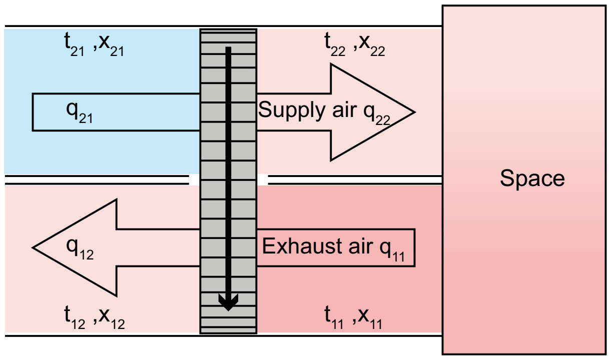


Figure 4.2.1 Temperature and humidity designation

Rotor type	Wave height	Wave length
Extra Low (X)	1.5 mm	3.0 mm
Special Low (S)	1.65 mm	3.0 mm
Low (L)	1.7 mm	4.0 mm
Normal (N)	2.0 mm	4.0 mm
High (H)	2.7 mm	5.5 mm

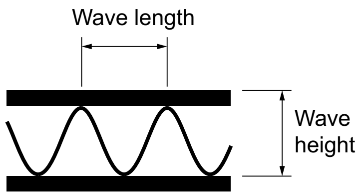


Figure 4.2.2 Wave height and length

An important parameter that affects temperature efficiency is airflow and the resultant face velocity on the rotor surface. The Reynold number in the rotor matrix is very low, which results in laminar airflow. The adjacent diagram shows temperature efficiency depending on airflow. In face velocity ranges of 5 down to 1.5 m/s, temperature efficiency increase is almost linear and reaches maximum at around 1.2 m/s. At lower face velocities, temperature efficiency falls again.

The larger the outside airflow is in relation to exhaust airflow, the lower the temperature efficiency, and vice versa. Furthermore, rotor speed should be around 12 rounds per minute for optimal heat recovery. If rpm is reduced, temperature efficiency drops.

Furthermore, temperature efficiency is not dependant on the relationship to air temperature, which makes it easier to calculate the recovery rate for varying air temperatures.

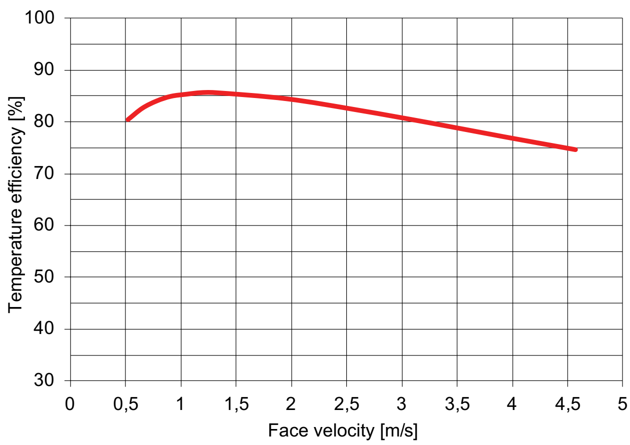


Figure 4.2.3 Temperature efficiency depending on face velocity

Humidity recovery

Humidity efficiency depends on temperature and humidity content in outside and exhaust air and is thus not as easy to calculate as temperature efficiency. Humidity efficiency is defined by the following equation:

$$\eta_x = (x_{22} - x_{21}) / (x_{11} - x_{21})$$

In general, there are two humidity transfer principles:

- Humidity transfer via condensation and evaporation in condensation rotors
- Humidity transfer via physical adsorption and desorption through hygroscopic or sorption rotors

The following table provides an overview of general rotor types and their humidity recovery capabilities:

Type of rotor	Condensation rotor (ST)	Hygroscopic rotor (SE, SH)	Sorption rotor (HM)
Rotor matrix	Polished or epoxy-coated aluminium	Oxidized aluminium surface with hygroscopic capacity	Surface with sorption coating (3Å) molecular sieve)
Humidity transfer principle	Humidity transfer when condensation is present	Small humidity transfer via adsorption and when condensation is present	Large humidity transfer via adsorption
Eurovent classification (no condensation)	No humidity efficiency	Humidity efficiency < 70% of temperature efficiency	Humidity efficiency ≥ 70% of temperature efficiency

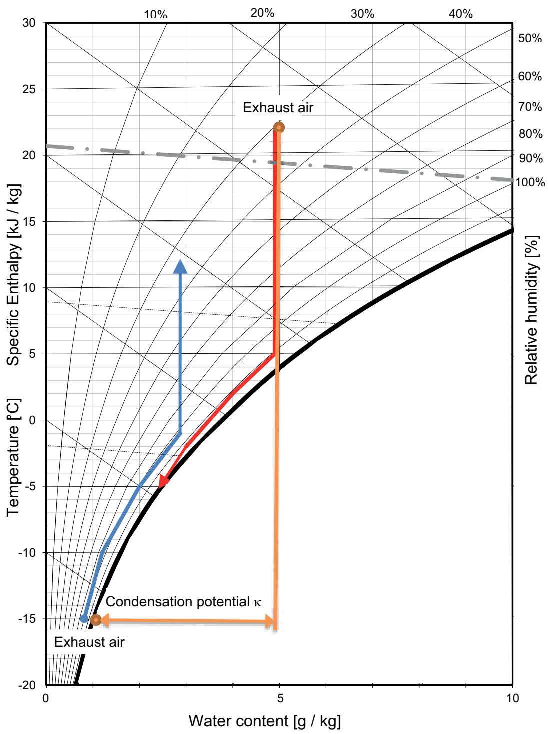


Figure 4.2.4 Condensation potential

Humidity transfer by condensation

Condensation rotors transfer humidity only when condensation occurs on the exhaust side which is taken up through evaporation by the supply side. Thus humidity efficiency is directly dependent on the amount of condensation on the exhaust side and the amount of humidity taken up on the supply side. The maximum humidity-transfer potential is the difference between exhaust air humidity content and the outside air temperature dew point, also known as condensation potential κ.

The condensation potential is independent of air temperature and is a direct measurement of humidity transfer due to condensation. The greater the condensation potential, the larger the amount of condensate on the exhaust side, and thus the larger the humidity efficiency. If the condensation potential is 0, no humidity transfer via condensation can take place. Negative condensation potential describes the summer case and humidity transfer only takes place via physical adsorption.

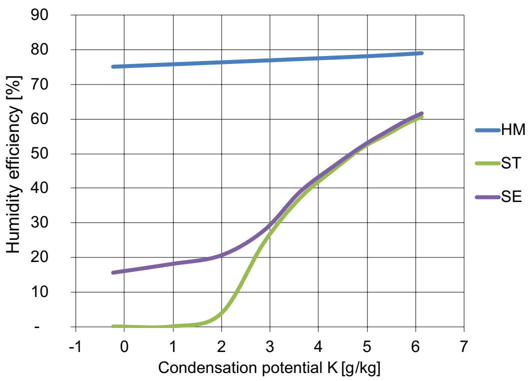


Figure 4.2.5 Humidity efficiency depending on condensation potential

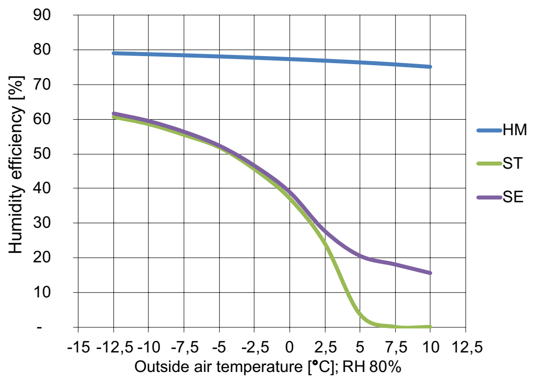


Figure 4.2.6 Humidity efficiency depending on outside air temperature

Humidity transfer by hygroscopy

The rotor matrix of a hygroscopic rotor is treated by oxidation to create the capillary surface structure with adsorption properties. Up until the 1990s it was thought that hygroscopic rotors transfer humidity solely via adsorption and desorption, and therefore humidity efficiency was almost constant and not dependent on condensation potential. Today it is known that hygroscopic rotors reach their best humidity efficiency at low outside air temperatures where humidity is also transferred via condensation.

Compared to condensation rotors, hygroscopic rotors transfer a smaller proportion of humidity without condensation occuring (summer time).

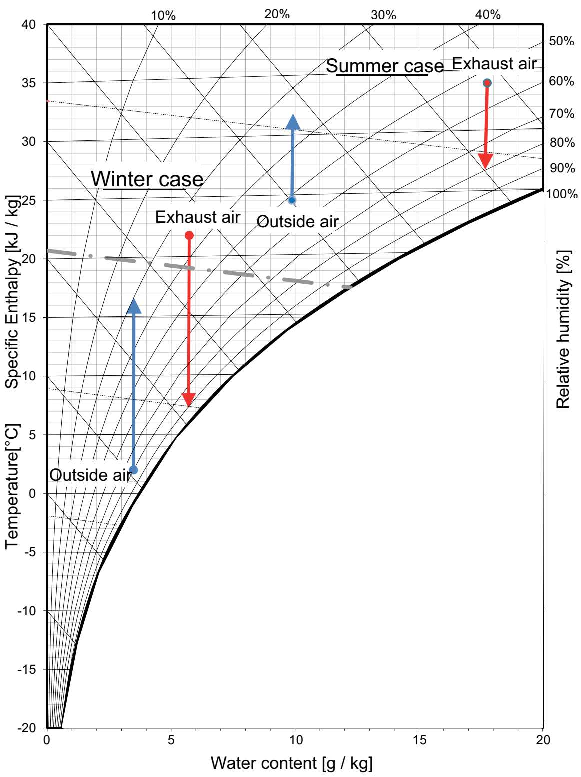


Figure 4.3.1 Process of condensation rotor

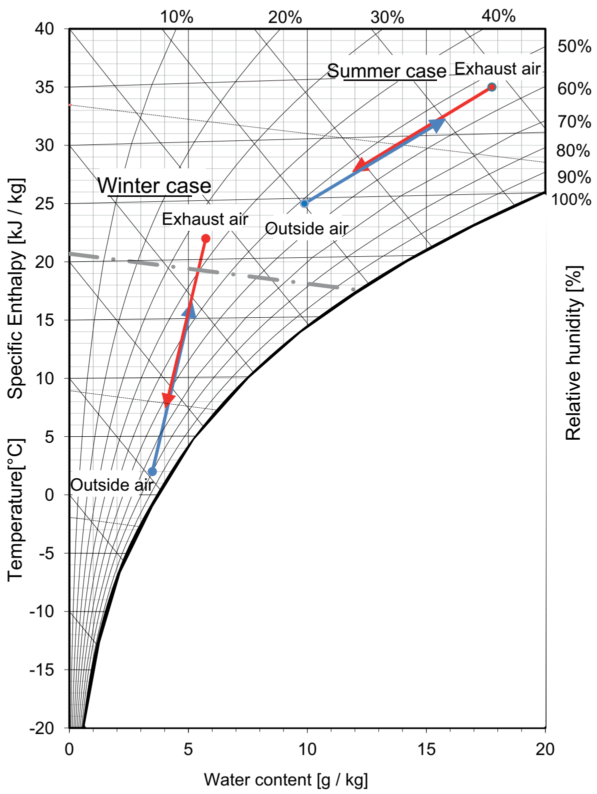


Figure 4.3.2 Process of sorption rotor

Humidity transfer by sorption

Sorption rotors have a special coating that consists of a 3Å molecular sieve, and humidity transfer takes place solely through adsorption and desorption. Humidity efficiency depends on sorption layer coating thickness, adsorption capacity, polarity and air temperature differential. Adsorption kinetics, which is the speed of the adsorption and desorption process as absorbed and released sorption energy, also plays an important part.

Because humidity transfer depends solely on sorption, the condensation potential does not effect the humidity efficiency. The humidity efficiency graph for sorption rotors shows a slight reduction with reduced temperature differential between outside and exhaust air. This is because temperature differential forms an important part of the parameters behind the adsorption and desorption process.

4.3 PROCESS IN MOLLIER DIAGRAM

Condensation rotors

Condensation rotors only transfer sensible energy and no airborne humidity if no condensation is present. In the Mollier diagram the process graphs are vertical as air temperature alone is changed through the rotor.

Hygroscopic and sorption rotors

Hygroscopic and sorption rotors transfer sensible and latent energy. The process graphs run at an angle through the diagram as temperature and humidity content change. Humidity efficiency for sorption rotors is larger than that of hygroscopic rotors.

4.4 PRESSURE DROP

Airflow through the rotor matrix channels causes a pressure drop, which is the pressure difference between air flowing in and out.

The magnitude of the pressure drop depends on air speed through the rotor, air density and rotor matrix wave height. Pressure increases with lower wave height or increasing air flow.

Depending on the fan arrangement, air can be drawn or blown through the rotor matrix. Draw through fans result in a more even flow than blow through fans.

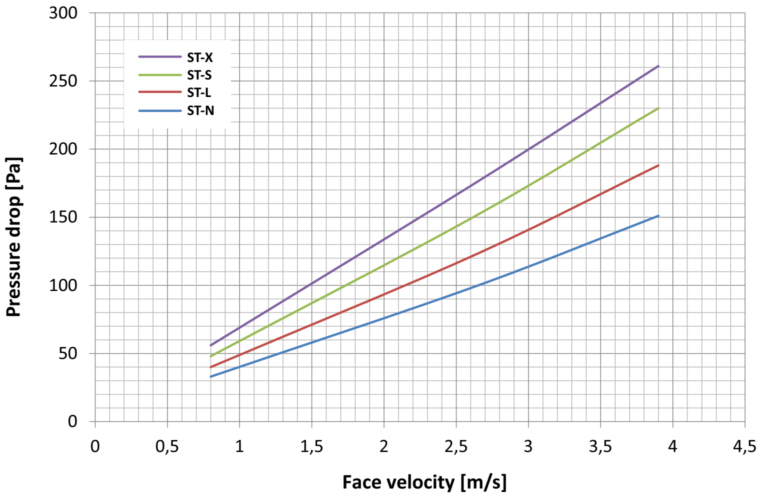


Figure 4.4.1 Pressure drop depending on face velocity

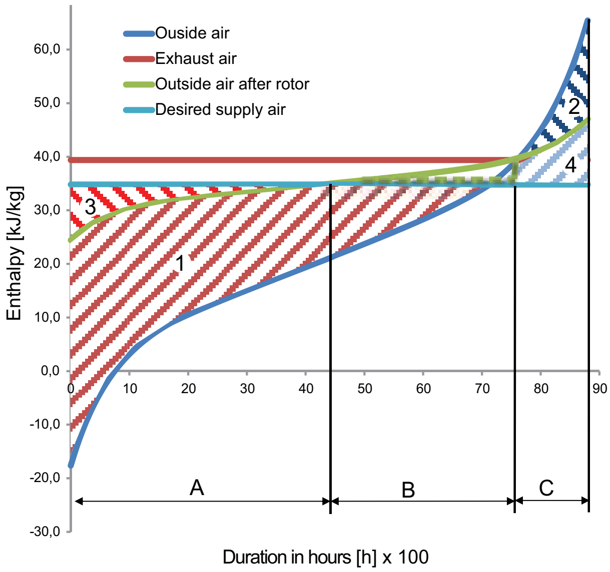
4.5 PERFORMANCE CONTROL

The amount of energy recovered by a rotary heat exchanger depends on the condition of outside air and exhaust air. Outside air temperature and humidity content change daily, and over a year the differences can be very large.

Air temperature is expressed over a full year by means of the duration graph. Areas 1 and 2 show heat exchange by the rotor. Areas 3 and 4 show necessary external heat and cooling requirement to reach the required supply air temperature.

Time period A shows winter and time interval C describes summer. During these periods, the rotor is driven at maximum rpm for maximum energy recovery. Time period B shows the intermediate months during spring and autumn. During these periods rotor speed is adjusted downwards, which means maximum efficiency is not exploited to reach the required supply air temperature.

When rotor rpm decreases in relation to maximum rpm, temperature efficiency and humidity efficiency are reduced. Temperature efficiency is reduced significantly from 5 rpm and lower. Humidity efficiency is reduced more constantly than temperature efficiency as a function of rpm.



1 Heat recovery
2 Cooling recovery
3 Re-heating
4 Re-cooling

A Maximum rpm
B Regulated rpm
C Maximum rpm

Figure 4.5.1 Control of rotary heat exchanger

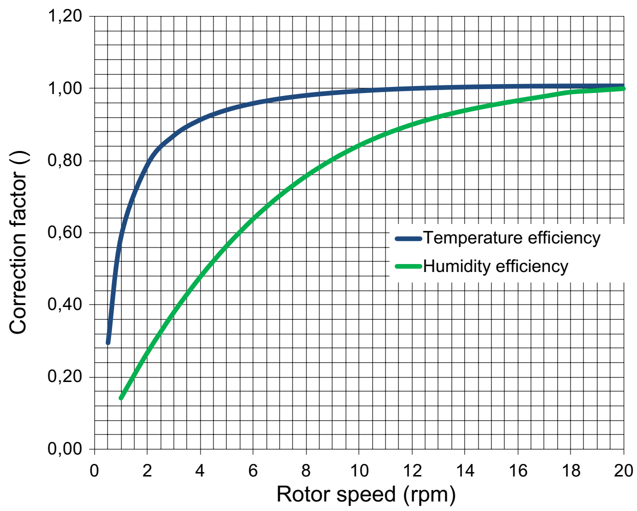


Figure 4.5.2 Temperature- and humidity efficiency depending on rotor speed

4.6 PURGE SECTOR

Carry over

The heat exchanger matrix rotates between two contra-flowing air streams. When the rotor passes the separating floor between the air streams, the air trapped in the matrix is transferred from one duct to the other. This phenomenon is called carry over.

If no action is taken, trapped air will be constantly transferred between the air streams. In this way, a small part of the exhaust air can get mixed with the supply air.

The degree of transfer, which is proportional to rotation speed and matrix thickness, can be calculated using the following formula.

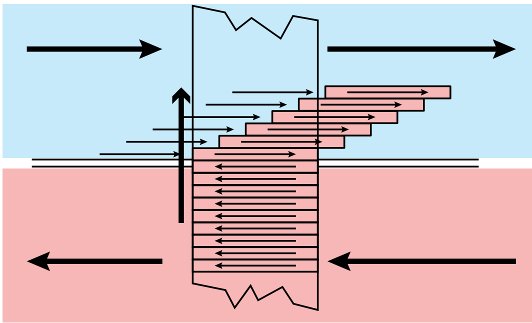


Figure 4.6.1 Carry over effect

$$c = \frac{r^2 \cdot \pi \cdot l \cdot f \cdot n}{120 \cdot q} \cdot 100\ \%$$

c *carry over (no purge) [%]*
r *radius of rotor [m]*
l *length of rotor [m]*
n *rotational speed [min^{-1}]*
q *nominal supply airflow [m^3/s]*
f *rotor porosity » 0,95 [-]*

Purge sector

To prevent exhaust air mixing with supply air by carry over, a purge sector can be installed. Its function is to flush the rotor matrix with outside air before it rotates into the supply air duct. In this way only outside air is present in the matrix and no carry over of exhaust air to supply air is possible. The purge sector is located on the supply side of the supply air duct. No purge sector is installed on the opposite side, where the matrix leaves the supply air duct, as transfer of outside air to outlet air does not impair supply air quality.

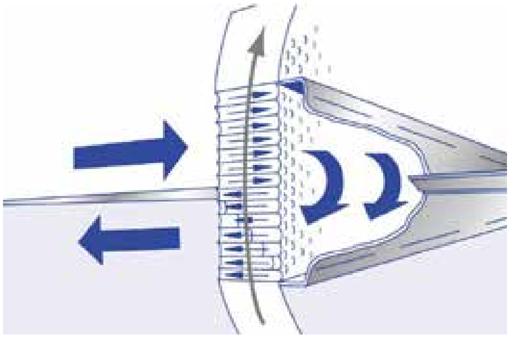


Figure 4.6.2 Function of purge sector

The purge process is ensured by allowing sufficient air to flow through the rotor matrix as it passes the purge sector, so that all trapped air is replaced by outside air. Two different purge sector angles, a = 2.5° and 5.0°, are available as standard. The size of the purge sector angle depends on air speed in the sector and rotation speed.

$$\alpha = (l \cdot n \cdot 6)/v$$

a *Purge sector angle*
l *Rotor depth [m]*
n *rpm [min^{-1}]*
v *Airvelocity through purge [m/s]*

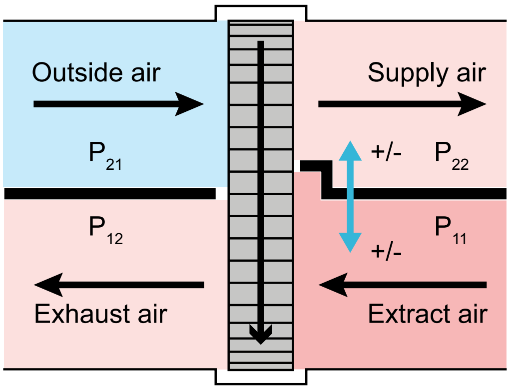
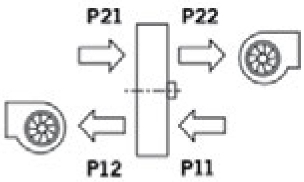
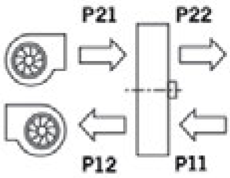
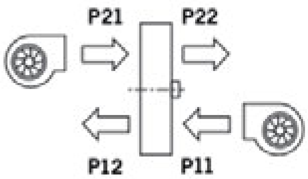
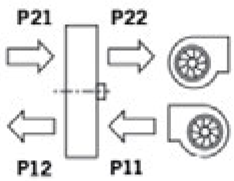


Figure 4.6.3 Difference pressure $p_{22\text{-}11}$

The most important parameter is the air speed through the purge sector, which in turn is dependent on static pressure conditions around the rotor.

The table below provides guidelines for purge angles, which should be chosen depending on static pressure conditions on the supply air side $p_{22\text{-}11}$, which is the pressure differential between supply air and exhaust air.

Fan location	$P_{22\text{-}11}$ < 0 Pa	$P_{22\text{-}11}$ 0 – 250 Pa	$P_{22\text{-}11}$ 250 – 500 Pa	$P_{22\text{-}11}$ > 500 Pa
	No purge sector recommended	5° angle	2.5° angle	No purge sector recommended
	No purge sector recommended	5° angle	2.5° angle	No purge sector recommended
	No purge sector recommended	5° angle	2.5° angle	No purge sector recommended
	No purge sector (backpressure from purge sector)			

P_{21} = Static pressure, outside air *P_{22} = Static pressure, supply air*
P_{11} = Static pressure, exhaust air *P_{12} = Static pressure, outlet air*
$P_{22\text{-}11}$ = Pressure differential $P_{22} - P_{11}$

4.7 PURGE FLOW AND EFFECT OF PERFORMANCE

The magnitude of the purge flow depends on rotor diameter, purge sector angle and the pressure differential between supply and exhaust air and outside and exhaust air respectively.

In theory, purge flow affects technical performance such as temperature efficiency and humidity efficiency only marginally and has no practical significance.

The Hoval CASER product selection software provides the ability to calculate purge flow and air leakage.

4.8 AIR LEAKAGE

A sealing system is installed between the rotor matrix and casing parts to provide the best possible air seal. Because the rotor matrix is movable, a small amount of leakage between the air ducts may occur. The magnitude and direction of leakage flow depends on the static pressure relationship between the supply and exhaust ducts.

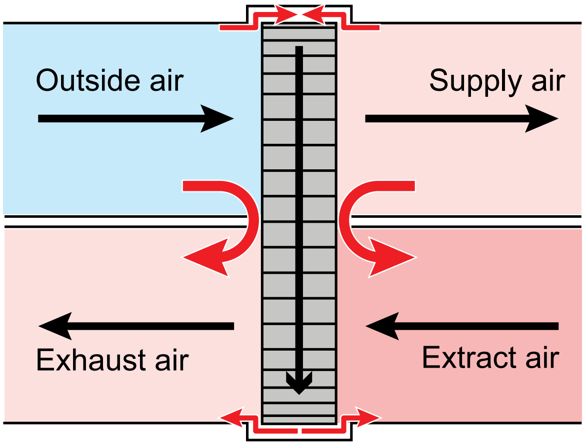


Figure 4.8.1 Possible air leakage ways

The larger the pressure differential between exhaust air and supply air, the larger the leakage. It is preferable for the air pressure on the supply side to be a little larger than the exhaust side in order that air leakage is directed toward exhaust air to avoid contaminating supply air.

The relationship between total seal length and rotor surface is not linear. Leakage in smaller rotors is proportionally larger than in large rotors, as leakage flow is related to supply airflow.

Leakage rate and average pressure

Leakage and purge flow can be calculated in Enventus Calculation. Leakage flow rate is expressed as a percentage of supply airflow.

The average pressure differential is the difference between outside air and outlet air pressure differential, and that of supply and exhaust air. An increase in average pressure differential will result in increased leakage flow.

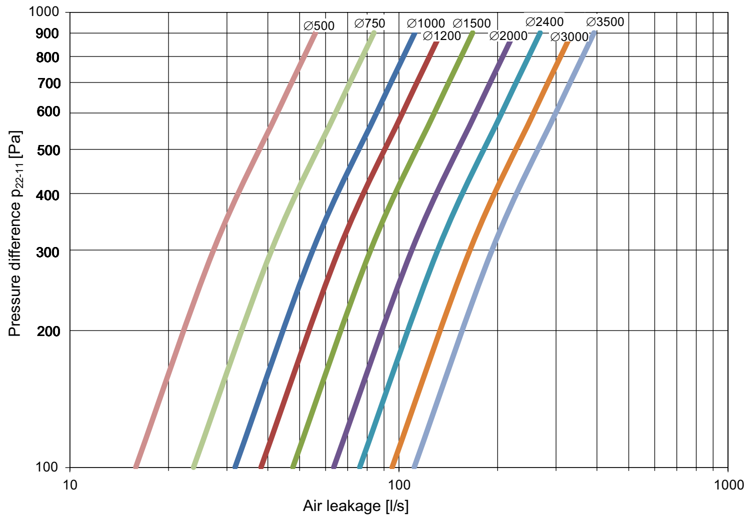


Figure 4.8.2 Air leakage depending on pressure difference $P_{22\text{-}11}$ at 3m/s face velocity

4.9 FROST PROTECTION

At low outdoor air temperatures the humidity of the return air can condensate inside the rotor matrix. When outside air temperature decreases, condensate remains inside the rotor matrix. The condensate is drained from the rotor with the airflow, given that average surface temperature of the rotor matrix during one round is above 0°C. If the average surface temperature of the rotor matrix during one round is below 0°C, a layer of frost will form.

However, this occurs very rarely as exhaust air humidity content during the winter is often very low, and outside air temperature varies over 24 hours which is the reason why condensate evaporates and is taken up by supply air or drained away in most applications.

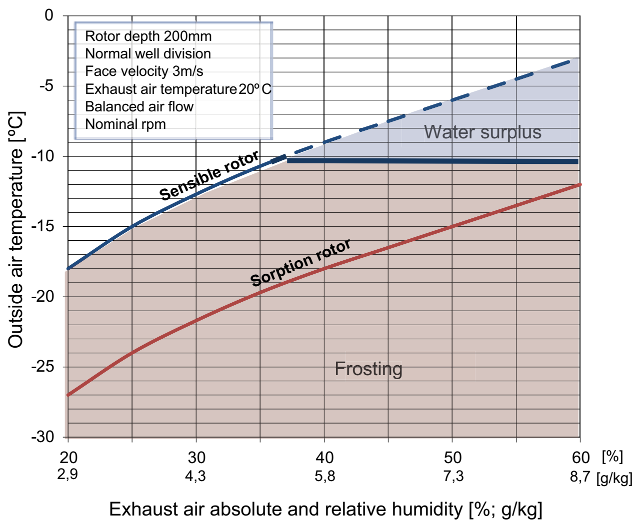


Figure 4.9.1 Frost threshold depending on outside air temperature and return air humidity

Frost threshold

The frost threshold depends on rotor type, exhaust air temperature, humidity content and outside air temperature. The following diagram shows general frost thresholds for condensation rotors and sorption rotors.

A sorption rotor transfers humidity through the entire matrix sorption layer. This principle constantly reduces exhaust air humidity content. Thus a sorption rotor can operate at around 10°C lower outside air temperature compared to a condensation rotor, without the occurrence of frosting.

Defrosting

An effective way to prevent frosting or to defrost a rotor is to pre-heat the outside air to -8°C.

Another method is to reduce rotor speed to 0.5 min^{-1} which results in a reduction of temperature efficiency and humidity efficiency to a minimum allowing exhaust air to thaw the layer of frost on the rotor.

It is also possible to reduce the outdoor airflow by installing bypass dampers or speed-controlled fans.

4.10 CONTAMINATION OF SUPPLY AIR WITH EXHAUST AIR

Supply air can be contaminated with exhaust air in three different ways:

1. Air leakage through sealing due to unfavourable pressure set-ups
2. Carry over in the absence of a purge sector
3. Through a hygroscopic or sorption coating (matrix borne carry over)

Carry over and leakage flow

When the supply air duct has a larger static pressure than the exhaust air duct, leakage from exhaust air to supply air is excluded. Furthermore, proper purge sector function is ensured, preventing supply air contamination by exhaust air through carry over (refer to previous section).

Matrix Borne Carry Over (MBCO)

Sorption rotors with conventional sorption technology transfer volatile organic compounds (VOCs). The degree of carry over is defined by MBCO and depends on the type of sorption coating.

$$MBCO = T_{VOC,SA} - T_{VOC,OA} / T_{VOC,RA} - T_{VOC,OA}$$

Enventus uses a 3Å molecular sieve as a sorption coating, which in comparison to conventional sorption coatings has a selective adsorption capability ≤ 3 Å, i.e. airborne humidity (H_2O = water molecule = 2.7 Å). Installations and tests show that a 3Å molecular sieve is the best choice for reducing the risk of odour transfer via the sorption coating. The MBCO rate for HM 3Å molecular sieves is very low.

Many conventional sorption coatings do not only transfer humidity, but also organic gases in the exhaust air, which are then transferred to supply air. Measurements show that MBCO from conventional sorption coatings can reach 20-40%. As a result, air quality is impaired and there are often odour problems, e.g. when the air has great concentrations of cooking smells from kitchens.

A high MBCO rate can increase VOC concentration in room air through constant recirculation. To counteract this effect, an increased ventilation rate would be required which requires larger fan energy consumption.

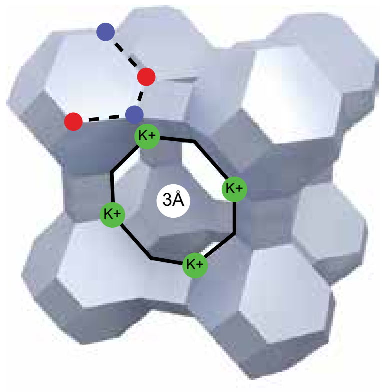


Figure 4.10.1 Molecular Sieve 3Å

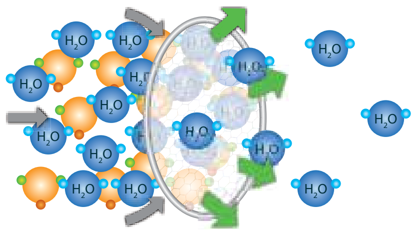


Figure 4.10.2 Selective adsorption capability

4.11 PROJECT PLANNING ADVICE

Recommended installation

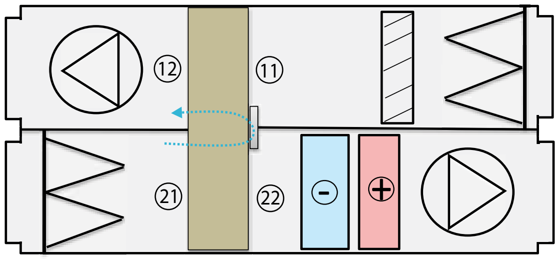


Figure 4.11.1 Draw through fan set up

The best flow conditions are achieved when supply and exhaust air fans are installed on the suction side of the regenerative heat recovery unit. A reasonable pressure difference between the supply air and exhaust air ducts $p_{22\text{-}11}$ is obtained in almost all installations.

Alternatively, the outside airflow fan can be located in the direction of flow upstream of the rotor. This variation is often found in hospital installations where the entire supply air section is run at overpressure. The risk of supply air contamination is thus eliminated.

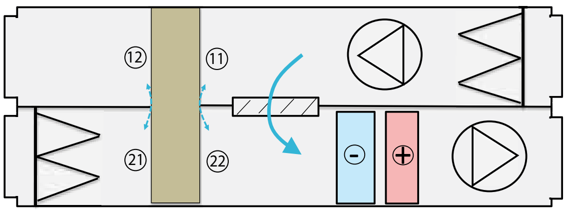


Figure 4.11.2 Blow through exhaust fan set up

Constant pressure and recirculating air

Blow through exhaust air fans and draw through outside air fans are typical in installations with a recirculating air function, or in installations where constant duct pressure is necessary.

The system leads to a negative pressure differential between $p_{22\text{-}11}$ and because a purge sector is unable to function correctly, it should not be installed. Therefore blow through exhaust air fans should only be used in systems where recirculating air is allowed.

Inspection

It is important when installing rotors to consider service, maintenance and cleaning. Hatches are necessary on the inspection side to allow access to control equipment, motors, drive belts and brushsealings.

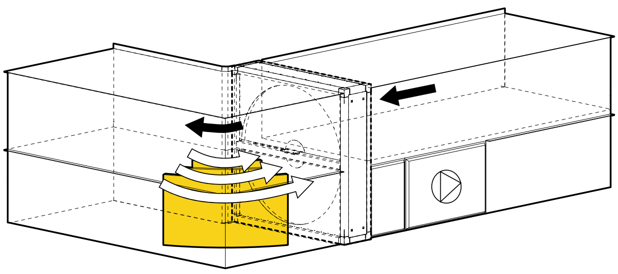


Figure 4.11.3 Airflow disturbance

Airflow disturbance

Rotor performance calculations are based on undisturbed airflows in and out. Because very uneven airflow speed profiles have a negative effect on rotor performance, component location should be carefully planned in a ventilation installation.

If the rotor is e.g. installed in direct connection to a right-angle duct, guides should be installed in the duct so that air speed is evened out as far as possible. When installing a radial fan on the pressure side of the rotor, and air diffuser should be fitted.

Distance to components

Generally speaking, air handling components should not be placed too close to the rotor in order to prevent in- and outflow disturbances to the rotor.

Air containing particulates

Experience shows that the rotor can be run with a moderate amount of particulates in the air. Due to the laminar airflow inside the rotormatrix a self-cleaning effect is achieved when the rotor switches airflow directions between outside and exhaust air. If particulates does remain on the outer surface of the rotor these can be vacuum cleaned or washed away. It is always recommended to install an air filter in the direction of airflow upstream of the rotor in order to protect the rotor from contamination. It is advisable to install an exhaust air oil filter in installations with kitchen exhaust air.

4.12 ENERGY RECOVERY

Sorption rotors

Enventus Molecular Sieve 3Å HM rotors provide exceptionally high humidity efficiency up to 85%. Sorption rotors provide an excellent method of cooling and de-humidifying outside air before it reaches the air handling unit cooling coil.

- Direct investment pay off
- Lower investment cost in cooling capacity
- Lower energy consumption in cooling period
- Better indoor air quality
  - Minimum Carry Over
  - Increased humidity in winter season
- Lower investment and running costs for humidification
- Better performance for dry cooling systems
- Increase cooling capacity in existing systems
- 5-10 °C lower temperature for freezing protection

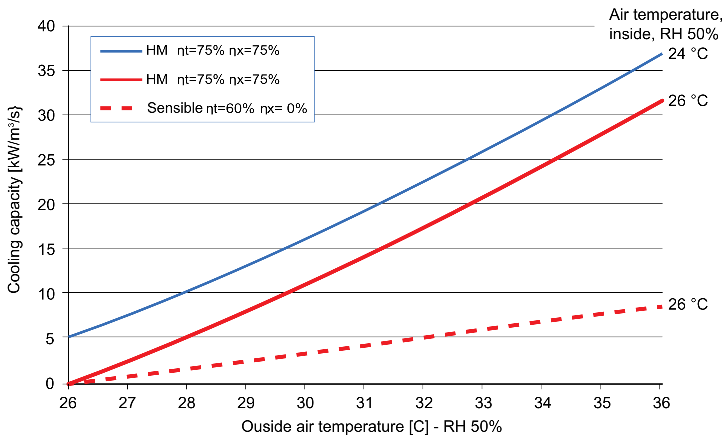


Figure 4.12.1 Cooling capacity saving

Advantages of 3Å molecular sieves

The Enventus HM Molecular Sieve 3Å provides high selectivity for water molecule absorption (2.7Å size).

- Performance of 3Å technology is proven in several international and independent studies
- It is recommended in cases where cross contamination needs to be minimized
- Minimized Carry Over of VOC's from exhaust air to supply air

Lower Investment costs in cooling capacity both in AHU's and cooling system

- The cooling capacity saving is 20 – 50%
- The required cooling capacity will decrease by 10- 25 kW/m3/s air flow compared to sensible energy recovery systems
- Smaller compressors, condensers or cooling towers or higher evaporation and lower condensing temperatures
- Smaller electrical connection costs and power consumption in cooling system
- Lower water flows to cooling coils and smaller pipe works and valves
- Savings in cooling equipment investments are higher than additional cost of sorption treatment of the rotor

Lower investment cost in supply air humidification

- Supply air humidification equipment will be smaller, due to high rate of humidity recovery from the exhaust air

Lower running costs of ventilation, cooling and humidification

- Cooling recovery in summer time
- Humidity recovery in winter time

Better working conditions for dry cooling systems (chilled ceilings or beams)

- Almost constant humidity efficiency provides effective dehumidification of outside air in extreme summer conditions
- Smaller requirement for raised water temperature to unit

Better indoor air quality during winter

- High humidity recovery from exhaust air during winter season

To download our product sheet please see: www.enventus.com

Double Wheel Concept

In regions with high air temperature and humidity or buildings with dry cooling systems (chilled beams, chilled ceilings), the supply air needs to be cooled and dehumidified. Traditionally air dehumidification has been done by cooling the air to condense the humidity from the air and reheating it to the requested air temperature.

Compared to traditional systems the Double Wheel Concept is cooling, dehumidifying and reheating the supply air more energy effective.

The Double Wheel Concept comprises the following components and functions:

1. **HM Sorption rotor:** The HM rotor dehumidifies and cools warm outside air very efficiently.
2. **Cooling coil:** Outside air is further dehumidified by the cooling coil until the preferred temperature is reached.
3. **ST Condensation rotor**: The condensation rotors warms the air to the required supply air temperature.
4. At the same time, exhaust air is cooled which means the HM rotor works more efficiently.

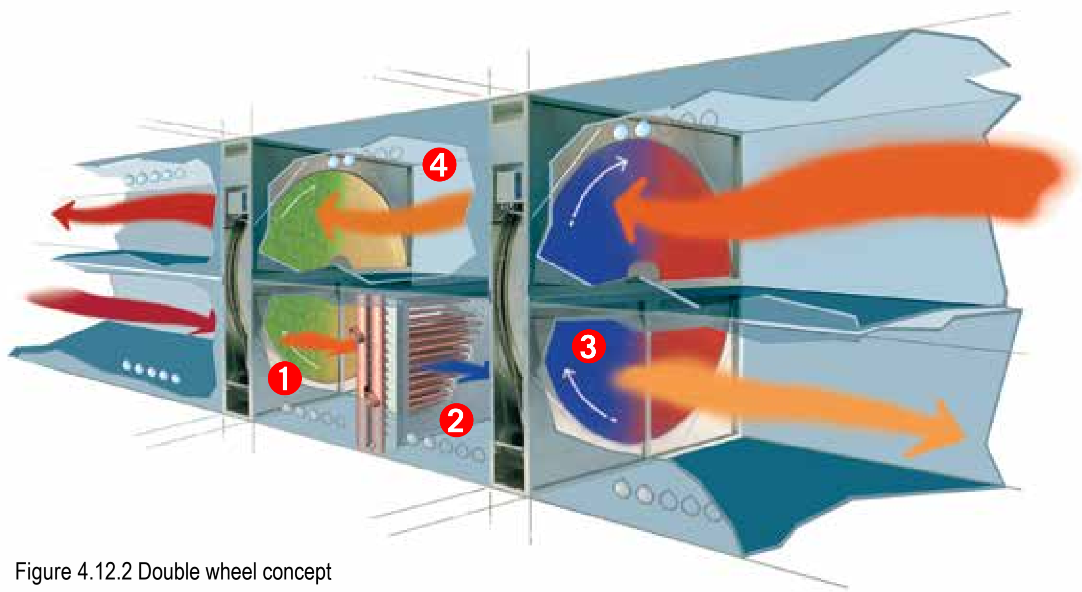


Figure 4.12.2 Double wheel concept

The Enventus Double Wheel Concept saves up to 60% of the total cooling capacity and requires lower investment and running costs compared to traditional systems. As rule of thumb, the additional cost of the sensible wheel can be saved in the lower investment compared to traditional system components, coils, chillers, cold and hot water piping installation, pumps, valves, controls and electric power supply costs. Accurate total investment costs analyze of the complete installation will show major savings in initial costs. Both cooling and heating energy savings will be additional profit of the investment.

To download our product sheet please see: www.enventus.com

4.13 MATERIALS SELECTION

Different environments demand different materials. Enventus offers materials that are suitable for most environments.

Low to normal corrosion risk

Galvanized or Aluzinc coated sheet steel is usually used in areas with low to normal corrosion risk. Frames are made from aluminium. All of our rotor materials are ideally suited for their purposes. All bearings are life-time lubricated and sealed for extended life.

High corrosion risk

Great care should be taken when choosing materials in areas where there is a high risk of corrosion such as industrial use.

All casing parts can be powder coated to enhance corrosion resistance, or a stainless steel (EN 1.4301) casing can be selected. All bearings are life-time lubricated and extra sealed for extended life. Vital parts such as shaft are coated with tectyl for enhanced corrosion resistance.

Epoxy-coated foil (SC) should be selected. Epoxy-coated foil provides extremely effective protection against corrosion. Seawater-resistant foil (ST2) with a 2.5% magnesium content is available; an alternative to epoxy-coated foil, it provides excellent corrosion protection.

Marine ventilation

In maritime environments all sheet metal parts should be in stainless steel of suitable quality. All bearings are life-time lubricated and extra sealed for extended life. Vital parts such as bearings are coated with tectyl for enhanced corrosion resistance.

Seawater corrosion resistant foil is recommended for use in maritime environments. Seawater corrosion resistant foil (ST2) has a 2.5% magnesium content, which provides good corrosion protection.

4.14 SOUND ATTENUATION

The following values can be used as standards for sound attenuation of the rotor:

Insertion silencing ΔLw [dB]								
Frequency [Hz]	63	125	250	500	1000	2000	4000	8000
Condensation rotors	3	3	4	3	4	5	6	10
Hygroscopic rotors	3	3	4	3	4	5	6	10
Sorption rotors	3	3	4	4	5	6	7	11

5 Transport

Enventus delivers goods worldwide by land, sea and air.

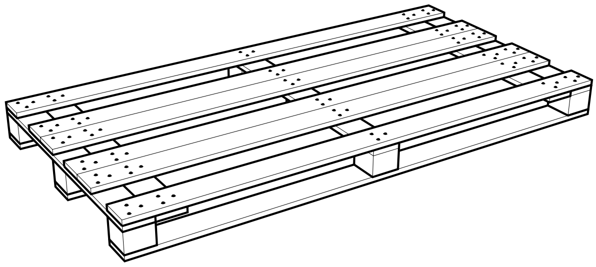
5.1 PACKAGING

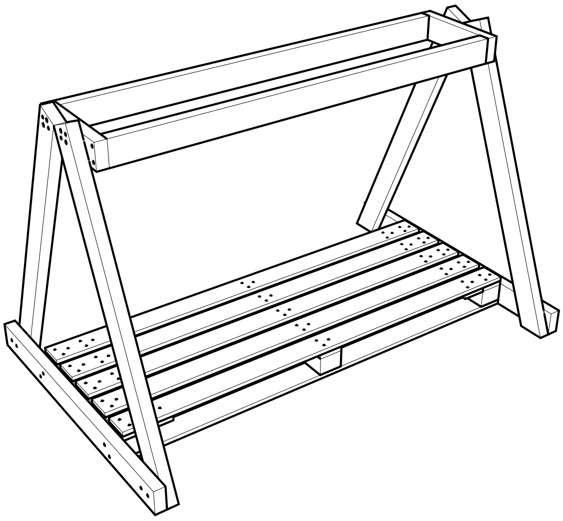
Our packaging is ideally suited for the transportation of heat exchangers by land, sea (including containers) or air. We pack onto pallets or in wooden crates or boxes depending on the type of product, the destination and requirements. All packaging is heat treated and stamped ISPM 15 (in accordance with UN FAO international standards). Packaging is made with 2-way or 4-way pallet bases and can be handled by fork lift.

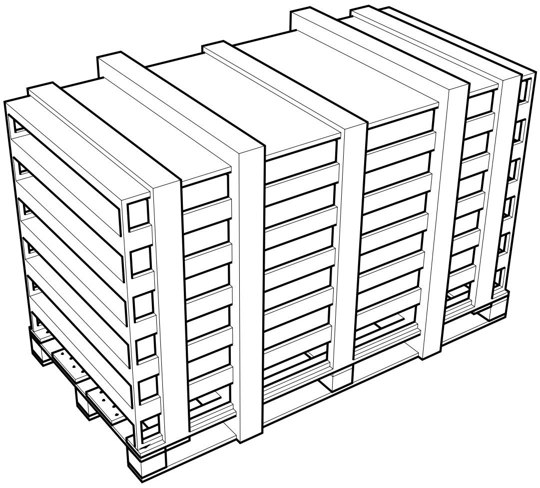
We recommend that goods be inspected on arrival to ensure no damage occurred during transport. If they are to be stored, the goods should be kept in their original packaging and stored on a flat surface and in a dry place.

We can also provide lifting eyes on some casing types to facilitate installation.

Contact us for further information.







6 Commissioning and Maintenance

Correct installation and maintenance is important for ensuring product performance. Enventus provides various aids to ensure efficient, hassle-free commissioning and long product service life.

6.1 COMMISSIONING

In order to ensure effective, hassle-free commissioning, it should be performed according to the commissioning protocol (BL036) included in delivery. This protocol is also available for download at the Enventus website.

The Enventus product warranty is conditional upon presentation of a completed commissioning record.

For other manuals, installation, and installation instructions, refer to our website www.enventus.com.

6.2 MAINTENANCE

Rotor

The rotor surface must be inspected regularly. Rotor fouling is affected by air quality, filter type, filter condition and air leakage etc. Base inspection frequency on the above factors. Enventus recommends that inspections be carried out at least once per year.

Cleaning rotor surfaces

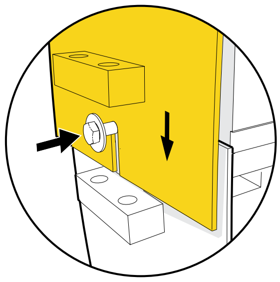
See Section 6.3.

Sectorized rotors

Check all periphery plate fasteners. Re-tighten fasteners. Tightening torque 50Nm.

Check that the periphery plates overlap correctly; see illustration.

Enventus recommends that inspections be carried out at least once per year.



Other rotor checks

Check:

- that the rotor sits square in the casing. Adjust vertical and horizontal alignment as necessary.
- that the rotor spins freely. Adjust brushsealing to ensure contact with the rotor or side plates.

Enventus recommends that inspections be carried out at least once per year.

Wear parts

Seals and drive belts are classed as wear parts and should be checked regularly. Enventus recommends that inspections be carried out at least once per year.

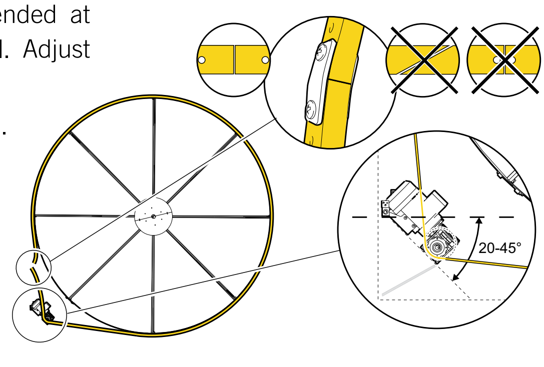
Seals

Check that brushsealing seal against the rotor or side plates. Adjust as necessary. This should be done for the first time 2-3 weeks after commissioning. Replace the seals when needed, normally 2-5 years intervals.

Drive belt, hanging motor bracket

Check:

- that the motor bracket is suspended at a 20-45° angle to the horizontal. Adjust drive belt length as necessary.
- belt locks and drive belt condition.



Drive belt, fixed motor bracket

Check:

- that the round belt does not slip.
- belt joint and condition.

6.3 CLEANING

If the rotor is dirty, clean it using:

- a vacuum cleaner, if fouling is light
- compressed air if fouling is heavy but not stuck too fast
- hot water and mild degreasing cleanser if fouling is heavy and also stuck fast (applies to spoked rotors)

Wash glued rotors with hot water.

Where rotors must be cleaned often, an automatic pneumatic device may be integrated.

If air contains large quantities of dirt, the rotor can be fitted with e.g.

- E-CLEAN 16, compressed air cleaning equipment, 6-8 bar.

6.4 SPARE PARTS

Enventus provides a large range of spare parts and accessories such as drive equipment (motors and control units), drive belts and brushsealing, independent of the type or manufacture or rotating heat exchangers.

We recommend the use of our original parts when replacing heat exchangers that come originally from us.

Most spare parts are in stock for immediate delivery.

Our spare parts price list can be found on our website at www.enventus.com

Please contact us if you have any questions. Our experience will help you make the right choice.

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