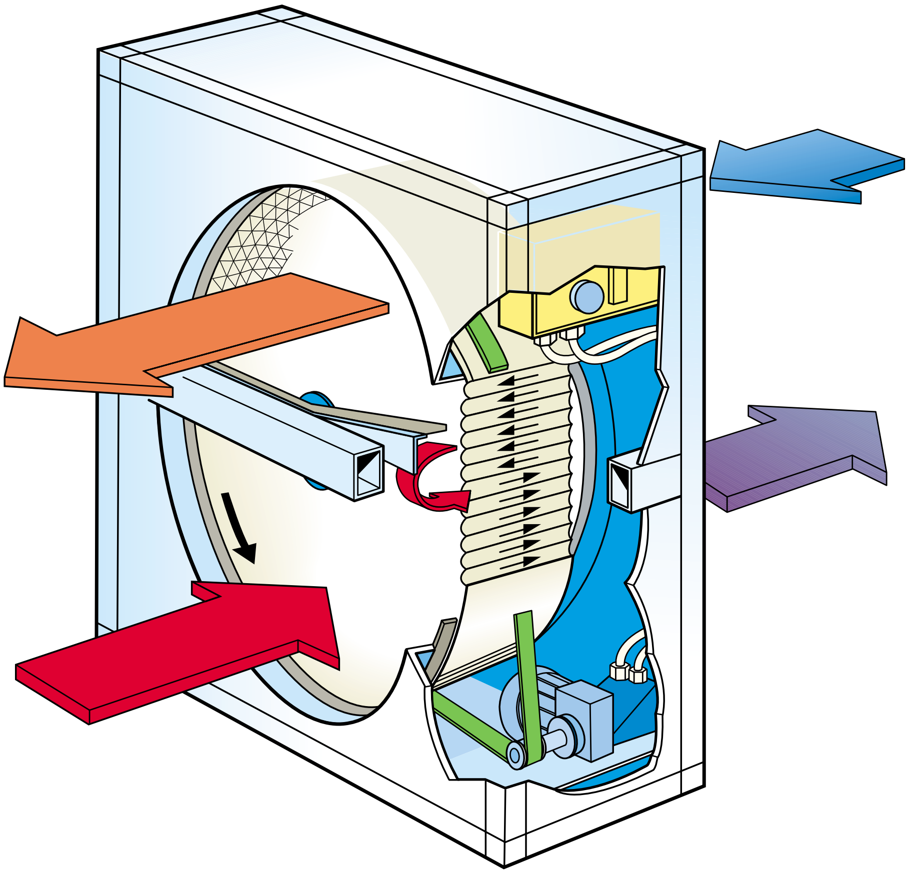
ECONOVENT® – PUM

Rotary heat exchanger
Technical Handbook



FläktWoods

CONTENTS

Design

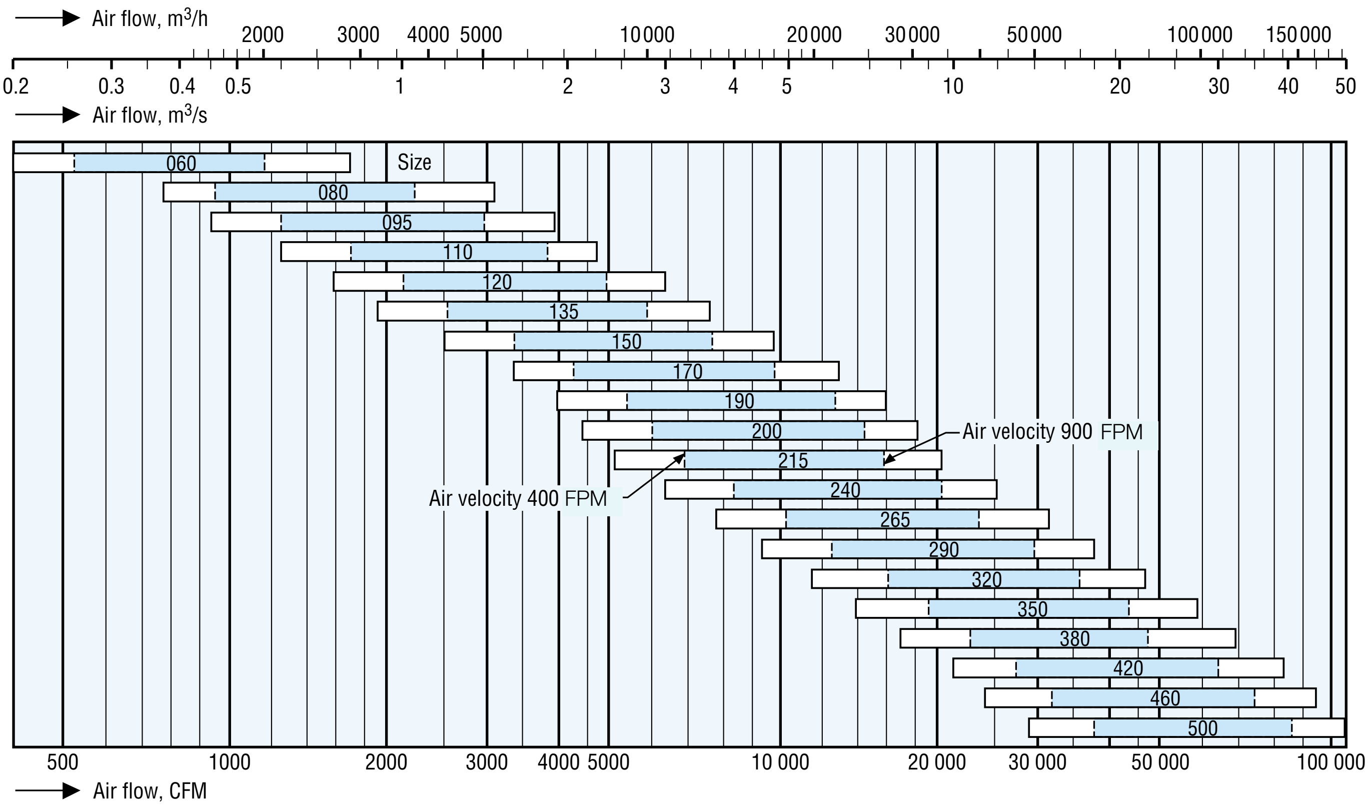
The ECONOVENT unit is a regenerative heat exchanger comprising a rotor which transfers heat and moisture from the exhaust air to the supply air as it rotates.

The supply air flows through one half of the heat exchanger, and the exhaust air flows in counterflow through the other half. Supply air and exhaust air thus flow alternately through small passages in the rotor in opposite directions.

Most important benefits:
Reduced heat demand which, in turn, reduces the size and thus also the investment cost for the boiler station or the connection charge for tariff-linked heat, such as electric power and heat from the district heating system. In addition, the sizes and thus the investment costs for air heaters, pipes and pumps are reduced.

- Reduced heat energy demand, which reduces the operating costs, i.e. the oil consumption or the consumption charge for electrical energy or heat from the district heating system.
- Reduced energy consumption for humidification (hygroscopic rotors) of the air, since moisture is also recovered.
- Reduced cooling power demand (hygroscopic rotors) which reduces the size and thus also the investment cost for the refrigeration system (compressor, cooling tower, etc.), air coolers, pumps and pipes.
- Reduced energy consumption for refrigeration (hygroscopic rotors).
- General reduction in environmental pollutants.

ECONOVENT is a complete product range of rotary heat exchangers for air handling systems in various types of environments and plants. ECONOVENT is available with six different materials for the rotor, and the right material can therefore always be specified to suit most environments.



Specifications are subject to alteration without notice

Design

General

The heat exchanger consists of a casing, a rotor of hygroscopic or non-hygroscopic type, and a rotor drive unit. Adjustable seals are fitted between the casing and the rotor on both sides, in order to minimize the leakage of air. The heat exchanger can be ordered either with or without purging sector.
The purging sector is adjustable and prevents the carry-over of exhaust air to the supply air.
Casing for sizes 060–240
The casing is of single-skin design and is made as one unit. An inspection panel (2 panels for size 190 and larger sizes) is located on the end wall or front (optional) of the casing as shown in Fig. 1. The drive motor and speed controller (for a variable speed unit) are fitted and tested at the factory. Note that a split casing as shown in Fig. 2 is available for size 150 and larger sizes.

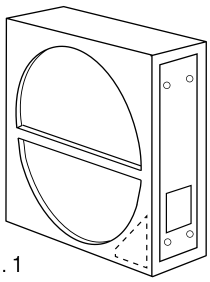


Fig. 1

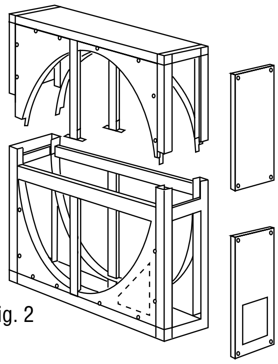


Fig. 2

Inspection panel, optional

Inspection panel standard

Casing for sizes 265–500

The casing is of single-skin design and is delivered split, as shown in Fig. 3. Size 265 and 290 units can also be ordered assembled at the factory. Inspection panels are located on the front or on the end wall (optional) of the heat exchanger as shown in Fig. 3. The drive motor is installed on the inside of the inspection panel. Access panels are provided on the front of the casing for installation of the rotor sector.

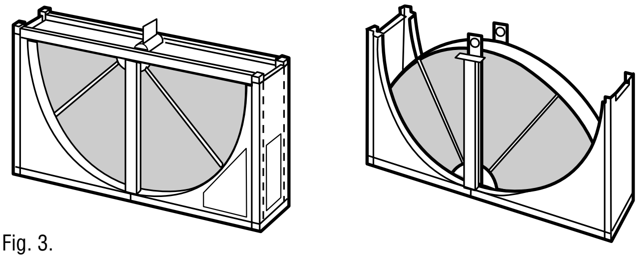


Fig. 3.

Inspection panel standard

Inspection panel, optional

Delivery form in split version.

Delivery

The ECONOVENT PUM(A-F) Heat exchanger is delivered as shown in Table 1.

	One factory-assembled unit			Split casing (2 units)
Size bbb	One-piece rotor 1)	Sectorized rotor	Split casing Sectorized rotor	Sectorized rotor
060	●			
080	●			
095	●	●		
110	●	●		
120	●	●		
135	●	●		
150	●	●	●	●
170	●	●	●	●
190	●	●	●	●
200	●	●	●	●
215	●	●	●	●
240	●	●	●	●
265			●	●
290			●	●
320				●
350				●
380				●
420				●
460				●
500				●

Specifications are subject to alteration without notice

Design - Description - Accessories

Drive system

The drive system consists of an electric motor (constant speed or variable speed) with reduction gear, driving the rotor by means of a jointed V-belt. The V-belt is kept automatically tensioned by the spring-mounted motor bracket.

Temperature limit

The heat exchanger is suitable for use at temperatures up to +165°F.
The temperature in the motor compartment must not exceed +100°F. If the supply or exhaust air temperature exceeds +100°F, see further under Temperature limit on page 19.

Materials and finish

Frame Sizes 060–240: galvanized sheet metal
Sizes 265–500: rotor support steel beams primed with anti-corrosion paint.
Cover panels, inspection panels and purging sector: galvanized sheet metal.
Hub (one-piece rotor): aluminum
Hub (sectorized rotor): steel, primed with anti-corrosion paint.

Rotor material

ALUMINUM ROTORS (A, C and E rotors) are non-hygroscopic, i.e. they recover only sensible heat, as long as condensation does not occur.

ALUMINUM ROTORS (B and D rotors) are hygroscopic and recover both sensible heat and latent heat (on changing moisture content).

COMPOSITE ROTORS (F) rotors are hygroscopic, i.e. they recover both sensible heat and latent heat. The composite material is incombustible and contains no metals, which means that the material cannot corrode.
The material is treated with silica gel-based substances.

ECONOVENT rotor designation	Material	Property	Max temperature - range, °F	Application
A	Aluminum	Non-hygroscopic	165	Heating and cooling energy recovery in air handling systems - without moisture transfer.
B	Aluminum	Hygroscopic	165	Heating and cooling energy recovery in air handling systems - with moisture transfer.
C	Edge-reinforced aluminum	Non-hygroscopic	165	Heating and cooling energy recovery in air handling systems - without moisture transfer in a corrosive environment.
D	Edge-reinforced aluminum	Hygroscopic	165	Heating and cooling energy recovery in air handling systems - with moisture transfer in a corrosive environment.
E	Epoxy-coated aluminum	Non-hygroscopic	165	Heating and cooling energy recovery in air handling systems - without moisture transfer in corrosive environment.
F	Composite	Hygroscopic	165 1)	Heating and cooling energy recovery in air handling systems - with moisture transfer in corrosive, city, marine and coastal environments.

1) Available for a max. temp. of 275°F. Get in touch with Munters International Inc.

Design - Description - Accessories

Accessories

PUMZ-17 Duct connection frames

Slip joint connection, made of galvanized sheet metal and fitted to the heat exchanger at the factory.

PUMZ-20 Speed detector

Used for continuous monitoring of the rotor speed, with automatic alarm if the rotor should stop when heat recovery is needed.
An alarm relay and sensor unit are needed for a constant-speed exchanger. Only the sensor unit is needed for a variable-speed exchanger.

PUMZ-21 Differential thermostat

In cooling energy recovery, used for switching the heat exchanger to maximum speed when the outdoor temperature is higher than the exhaust air temperature. Two sensors are included for fitting in the outdoor air and exhaust air ducts upstream of the heat exchanger.

PUMZ-27 Cleaning equipment

For automatic purging of the air passages in the rotor. With compressed air nozzle which is moved by means of a pneumatically actuated cylinder in a radial direction along the face of the rotor. Nozzle, cylinder and control unit are included.
For assistance in selecting the variant and locating the equipment, please get in touch with Munters International Inc. representative.

PUMZ-28 Condensate tray

For collecting and disposal of the condensate from the rotor.

The process in the psychrometric chart

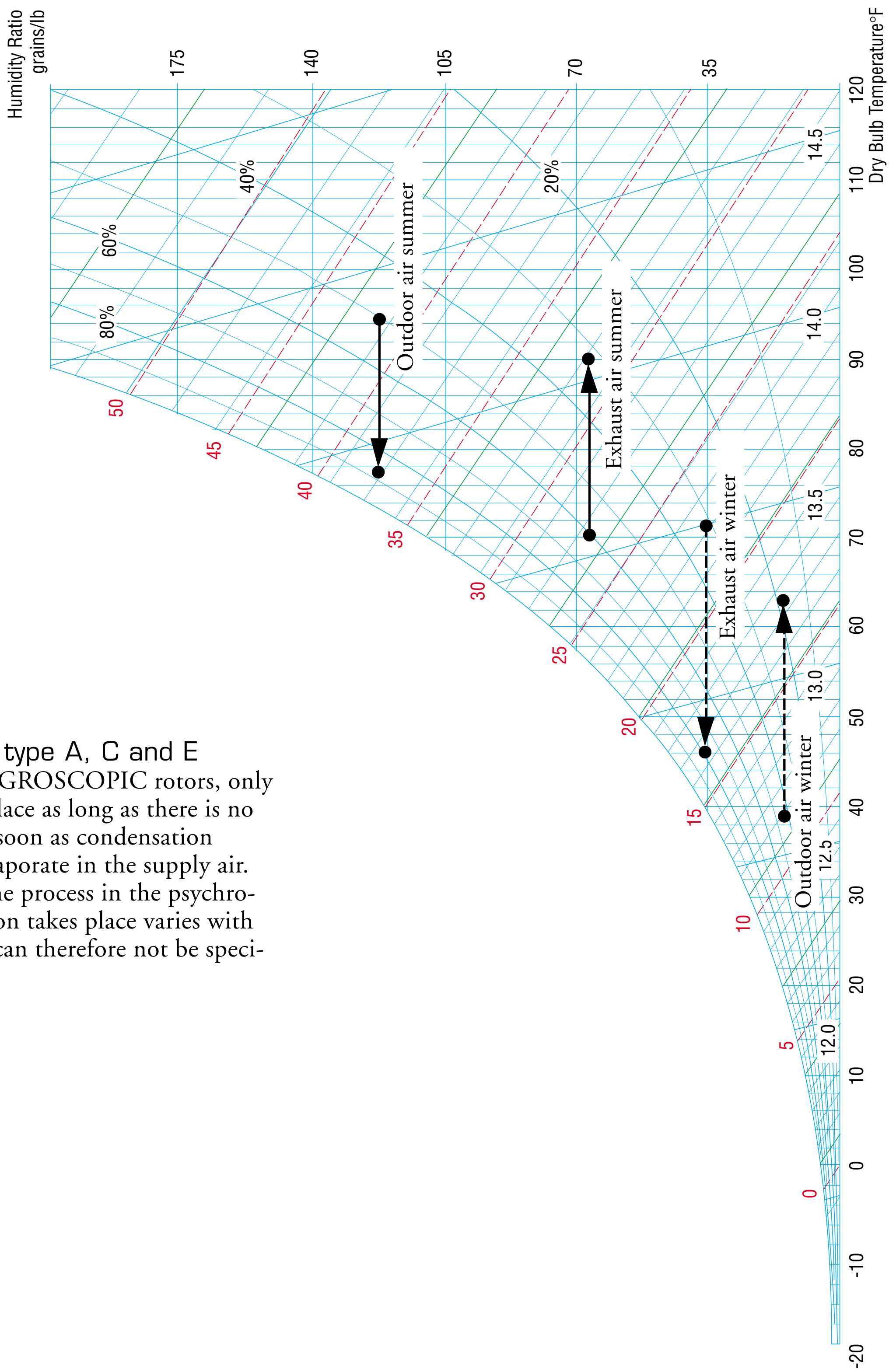


Chart 1

Non-hygroscopic rotors - type A, C and E

In type A, C and E NON-HYGROSCOPIC rotors, only sensible heat exchange takes place as long as there is no condensation in the rotor. As soon as condensation occurs, the condensate will evaporate in the supply air. The graphic presentation of the process in the psychrometric chart when condensation takes place varies with the operating conditions and can therefore not be specified generally.

Specifications are subject to alteration without notice

The Process in the psychrometric chart

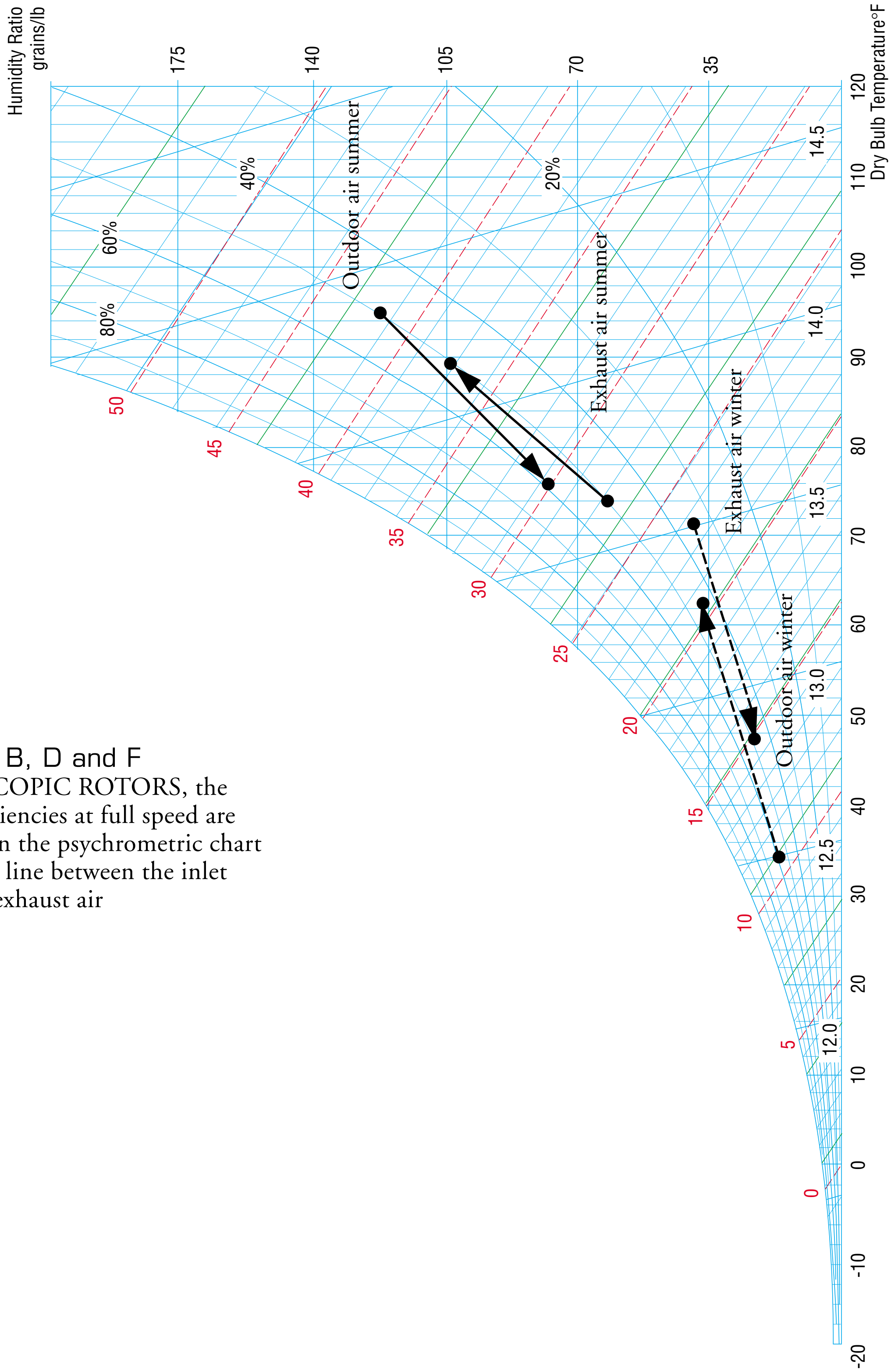


Chart 2

Hygroscopic rotors - type B, D and F

In type B, D and F HYGROSCOPIC ROTORS, the moisture and temperature efficiencies at full speed are equal. As a result, the process in the psychrometric chart runs along the interconnecting line between the inlet conditions for the supply and exhaust air

The Process in the psychrometric chart

Summer operation

Charts 1 and 2 show summer conditions in which the outdoor air is warmer and more humid than the exhaust air. The hygroscopic rotor (Chart 2) lowers both the moisture content and the temperature to the vicinity of the exhaust air conditions, and gives an enthalpy efficiency of 75%. The nonhygroscopic exchanger (Chart 1) lowers the temperature by the same amount, but does not change the moisture content. In this case the supply air enthalpy efficiency will be only about 25%. The example illustrates the significance of the high moisture efficiency of the hygroscopic rotor, above all in humid, warm climates.

Winter operation

Charts 1 and 2 show a winter case with moderately low outdoor temperatures. No condensation takes place in the nonhygroscopic rotor, (Chart 1) which therefore does not contribute to the moisture content of the supply air. On the other hand, the hygroscopic rotor (Chart 2) raises the moisture content of the supply air by almost 11 Gr/lb of air, which usually offers welcome humidification of the supply air. The nonhygroscopic rotor can operate without risk of freezing even when condensation takes place at temperatures below 32°F.

Frosting - Defrosting

Rotor temperatures below 32°F need not necessarily cause frosting in the rotor. Moisture transfer then takes place by the moisture, which has been deposited as frost on the rotor surface, being evaporated on the supply air side. For frosting to occur, there must also be excess water in the rotor. This will take place if the supply air is not capable of absorbing the moisture that has condensed out of the exhaust air.

The frosting process, which causes an increase in pressure drop across the rotor, normally takes many hours. The frosting problem is therefore often relieved by the outdoor temperature varying over a 24 hour period, or because the heat exchanger is in operation during only part of the 24-hour period.

Frosting limit

Frosting will occur if excess water should occur, at the same time as the supply air inlet temperature is below 14ºF. This temperature applies with relatively good accuracy at different airflow rates, full speed and typical exhaust air temperatures occurring in comfort ventilation systems.

Excess water will occur in the hygroscopic rotor as soon as the interconnecting line between the inlet conditions for the two air streams intersects the saturation line in the psychometric chart (see Chart 3).

In the case of a nonhygroscopic rotor, excess water will form when the interconnecting line between the supply air condition and the exhaust air dewpoint plus approximately 7ºF, as shown in Chart 4, intersects the saturation line in the psychometric chart.

Frosting time

As an example, it will take about 8 hours for the pressure drop to increase by 50% if the saturation curve is intersected as shown in Chart 3, and about 4 hours if the saturation curve is intersected as shown in Chart 4.
Note that the frosting time will be as above if the temperature and moisture conditions are constant throughout the frosting time. But since the temperature often varies, the frosting time may be appreciably longer. As a result of factors such as operating time and supply air temperature variations, experience shows that a minor intersection of the saturation curve is permissible without significant frosting occurring, even if the design outdoor temperature is below 14°F.

Defrosting - avoidance of frosting

Frosting can be totally avoided by preheating the outdoor air to a temperature so that the line connecting indoor and outdoor conditions in the psychometric chart falls below the saturation line. Heating to 14ºF is normally adequate. The rotor can be defrosted, normally within 5–10 minutes, in several ways.

- By reducing the rotor speed to around 0.5 r/min (see example 5 page 22).
- By preheating the incoming outdoor air to around 23°F.
- By bypassing a sufficient amount of supply air across the rotor so that the outlet temperature on the exhaust air side will be at least around 41°F. As an example, the supply air flow rate would have to be reduced to around half for defrosting to take place at the normal exhaust air temperature, at a 75% temperature efficiency and an outdoor temperature of about –4°F.

All three methods can be used for a variable speed rotor drive, while the last two can be used with constant speed drive.around half for defrosting to take place at the normal exhaust air temperature, around 75% temperature efficiency and an outdoor temperature of about –4°F.
All three methods can be used for a variable-speed rotor, while the last two can be used at constant speed.

The process in the psychrometric chart

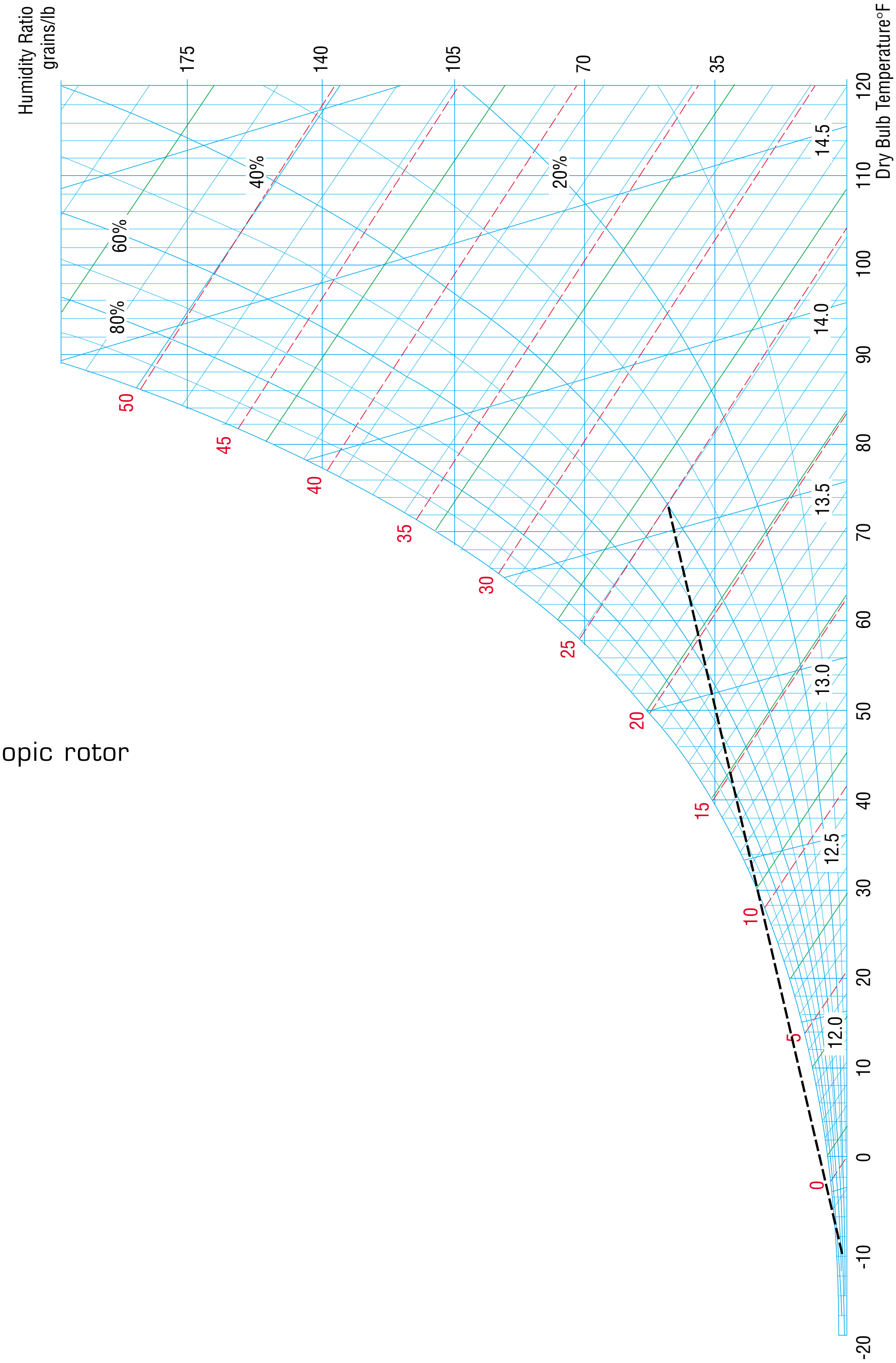


Chart 3

Frosting in a hygroscopic rotor

The process in the psychrometric chart

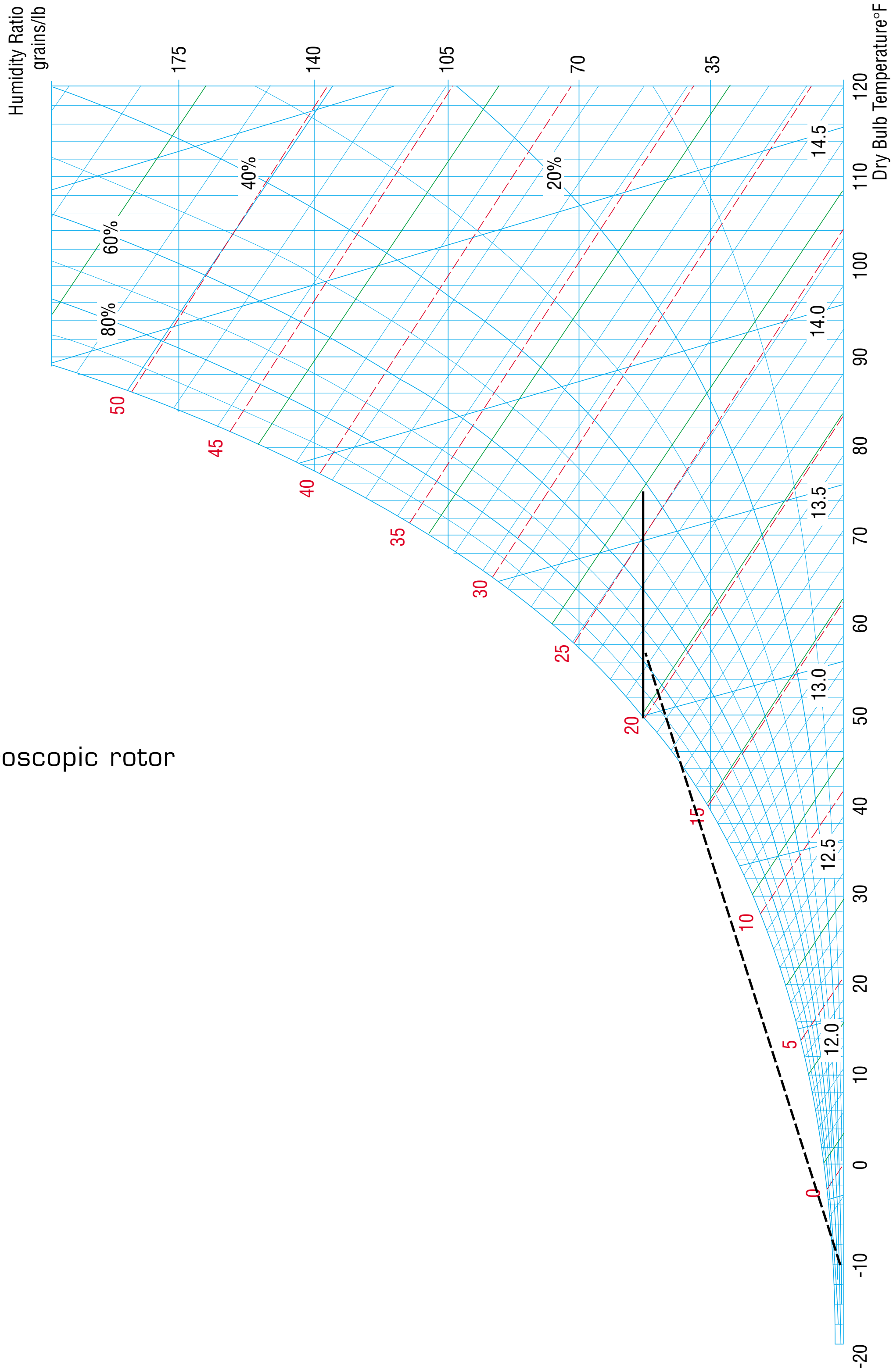


Chart 4

Frosting in a non-hygroscopic rotor

Rotor selection

Selection of the rotor material to suit the application.
Take great care to select the right material for every environment.
If in doubt, consult Munters International.

Key to markings

- Light grey = Right choice
- Dark grey = Satisfactory
- Hatched = Not recommended

Rotor material	Aluminum		Edge-reinforced aluminum		Epoxy-coated aluminum	Composite
Application \ Rotor version	PUMA	PUMB	PUMC	PUMD	PUME	PUMF
Non-hygroscopic (recovery of heat)	Right choice	Not recommended	Right choice	Not recommended	Right choice	Not recommended
Hygroscopic (recovery of heat + moisture)	Not recommended	Right choice	Not recommended	Right choice	Not recommended	Right choice
Marine - coastal	Not recommended	Not recommended	Right choice	Right choice	Right choice	Right choice
Inland	Right choice	Right choice	Satisfactory	Satisfactory	Not recommended	Not recommended
Heavy industry	Not recommended	Not recommended	Satisfactory	Satisfactory	Right choice	Right choice
Light industry	Satisfactory	Satisfactory	Right choice	Right choice	Not recommended	Not recommended
Urban	Satisfactory	Satisfactory	Right choice	Right choice	Satisfactory	Satisfactory
Rural / Landsbygd	Right choice	Right choice	Satisfactory	Satisfactory	Not recommended	Not recommended

Selection of heat exchanger type and size

Selection of heat exchanger

No moisture transfer required

1.Systems intended for:
comfort air handling
exhaust air with solvents or
exhaust air with dry, granular dust.
Select the ECONOVENT with A rotor or possibly C rotor.

2.Systems with risk of corrosion and intended for:
comfort air handling
exhaust air with corrosive solvents
exhaust air with corrosive dust.
Select the ECONOVENT with E rotor.

Moisture transfer required.

3.Systems with humidification or dehumidification of the supply air and intended for:
comfort air handling,
light industry inland.
Select the ECONOVENT with B rotor or possibly D rotor.

4. Systems with humidification or dehumidification of the supply air and intended for:
comfort air handling
heavy industry in a coastal environment or
corrosive urban environment.
Select the ECONOVENT with D rotor or possibly F rotor.

5. Systems with high risk of corrosion and intended for:
comfort air handling
heavy industry in a coastal environment or
corrosive urban environment
Select the ECONOVENT with F rotor

For a non-hygroscopic rotor (A, C and E rotor):

The temperature efficiency can be obtained from the design chart on page 16. At maximum speed and for equal supply and exhaust air flow rates

Definitions, see page 15

$$\eta_{tt} = \eta_{tf}$$

The procedure for calculating the temperature efficiency at different air flow rates is given in the design chart on page 16. If the rotor size and the supply and exhaust air flows are given, the temperature efficiency is independent of the conditions of the supply and exhaust air.

A non-hygroscopic rotor recovers only heat as long as condensation does not occur in the rotor. There is no generally applicable formula for calculating the moisture content of the supply air downstream of the rotor when condensation takes place. If the rotor speed is reduced, the supply and exhaust air temperature efficiencies will decrease. This phenomenon is used for controlling the supply air temperature downstream of the heat exchanger.

The temperature efficiency is the same for all rotor types at a given face velocity.

Efficiency

For a hygroscopic rotor (B, D and F rotor):

The temperature efficiency for a given rotor size and a given supply air flow is obtained from the design chart on page 16. At maximum speed and for equal supply and exhaust air flow rates:

$$\eta_{tt} = \eta_{tf}$$

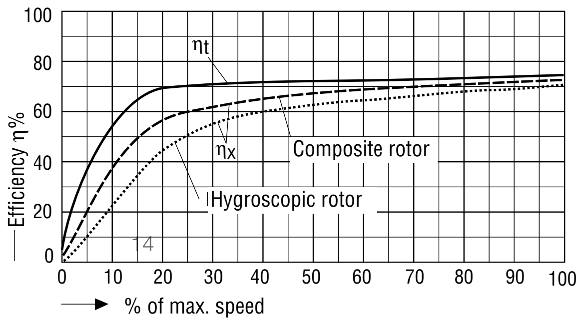
where
η_{tt} = supply air temperature efficiency and
η_{tf} = exhaust air temperature efficiency.

At maximum speed and at different supply and exhaust air flow rates, the supply air efficiencies are linked, and so are those of the exhaust air.

$$\eta_{tt} \approx \eta_{xt} \quad \eta_{tf} \approx \eta_{xf}$$

How the temperature efficiency changes at different flow rates is shown in the design chart on page 16.

Chart 3
Temperature and moisture efficiencies at different rotor speeds



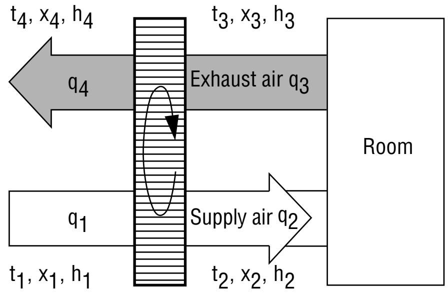


Fig. 4

Temperature and moisture recovery

The temperature efficiency ht and the moisture efficiency hx at different rotor speeds are shown in Chart 3. The chart is valid for normal changes in condition in climate systems and at an air velocity v = 3 m/s through the rotor.

Definitions:

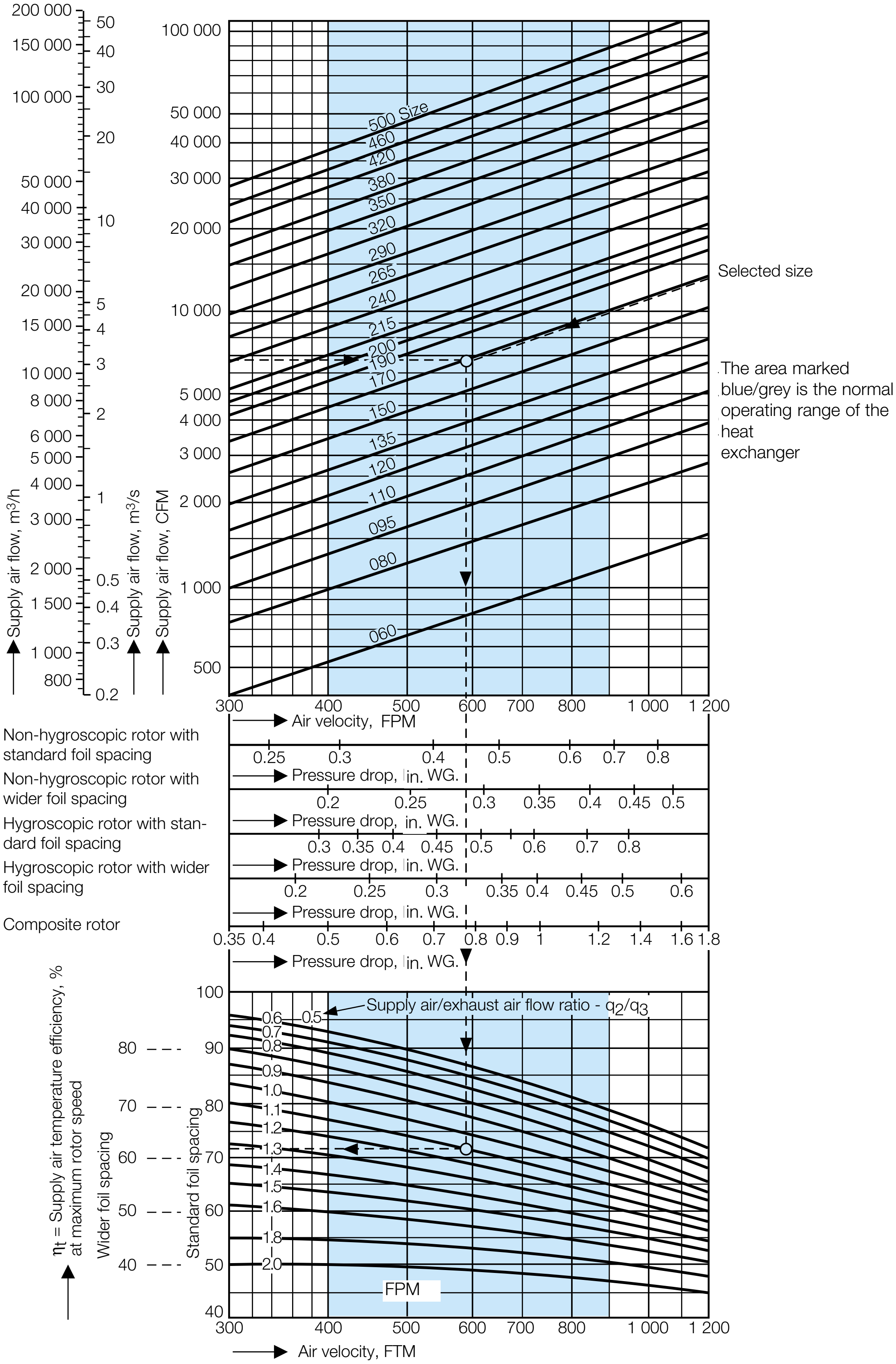
	Efficiency
Supply air temperature efficiency	$\eta_{tt} = \frac{t_2-t_1}{t_3-t_1}$
Supply air moisture efficiency	$\eta_{xt} = \frac{x_2-x_1}{x_3-x_1}$
Supply air enthalpy efficiency	$\eta_{ht} = \frac{h_2-h_1}{h_3-h_1}$
Exhaust air temperature efficiency	$\eta_{tf} = \frac{t_3-t_4}{t_3-t_1}$
Exhaust air moisture efficiency	$\eta_{xf} = \frac{x_3-x_4}{x_3-x_1}$
Exhaust air enthalpy efficiency	$\eta_{hf} = \frac{h_3-h_4}{h_3-h_1}$

t = temperature (°F)
x = water content per lb of dry air (gr)
h = enthalpy (Btu/lb)

A common feature of all hygroscopic aluminium rotors is that when the rotor speed is reduced, the moisture efficiency also drops below the temperature efficiency. However, with the ECONOVENT F rotor of composite material, the difference between the two efficiencies on a drop in speed is appreciably smaller.

Design chart

Chart 4



Project design advice

Leakage flow rates and fan sizing

Leakage between the supply and exhaust air sides cannot be entirely eliminated in a rotary heat exchanger. But by locating the fans as shown in Fig. 5, the carry-over of exhaust air to the supply air can be eliminated. The pressure differential between the supply and exhaust air ducts on both sides of the exchanger should be such that p1 > p4 and p2 > p3. If necessary, an adjusting damper is installed as shown in Fig. 5 to achieve this.
Leakage at the seals can be minimized by the pressure differential between the supply and exhaust air ducts being as small as possible. Chart 5 shows the leakage flow across the seal as a function of pressure differential p1 - p3.

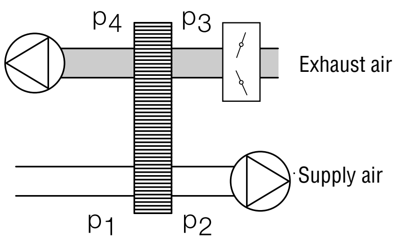


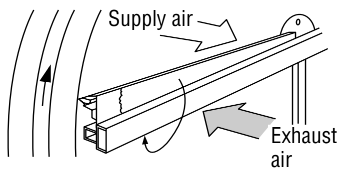
Fig. 5. Heat exchanger on the suction side of both fans

Purging sector – carry-over flow

The purging sector is located on the supply air outlet side, at the point where the rotor passes from the exhaust air flow path to the supply air flow path. The sector, which is adjustable between 0 and 6°, should be set to suit the pressure differential p1 - p3 in the system (see table below).
If the purging sector of the heat exchanger is set to 0°, a certain volume of exhaust air will always be transferred to the supply air, and a certain volume of supply air will always be transferred to the exhaust air by carry-over. However, these volumes are equal and cancel one another out. If the purging sector is correctly adjusted to suit the prevailing pressure conditions (see the table), complete purging of the rotor will take place without any air being lost. However, a certain amount of supply air will be transferred to the exhaust air by carry-over. This takes place at the point where the rotor moves from the supply air duct to the exhaust air duct as it rotates.

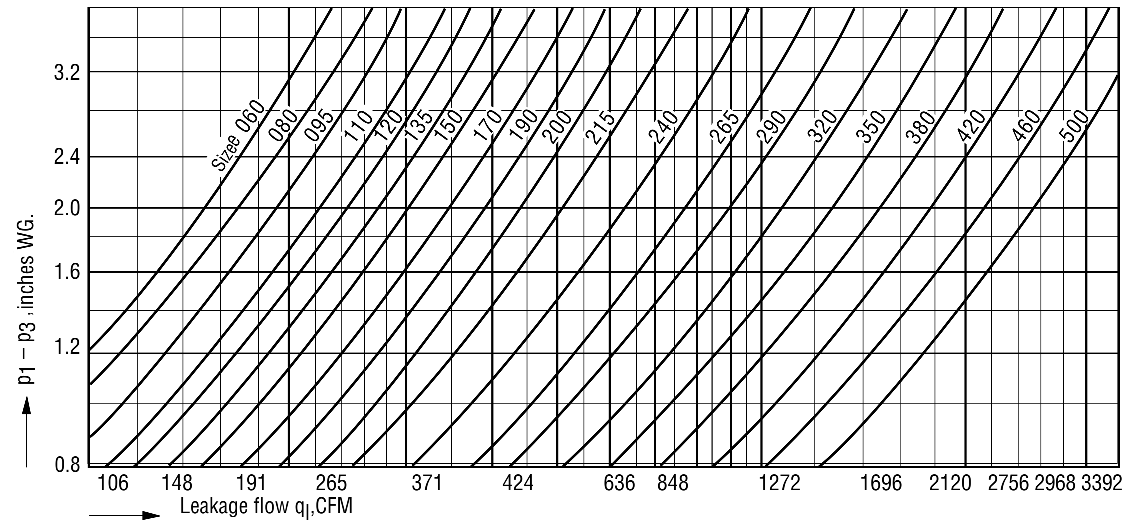
The volume carried over is approximately 3% of the supply air flow at p1-p3 = 0.4 in. WG, and approximately 1.5% at p1-p3 = 0.8 in. WG, regardless of the heat exchanger size (rotor speed = 10 RPM).

Fig. 6.
Purging sector



		Angle, degrees 1°– 6°					
		1	2	3	4	5	6
Pressure differential, p_1-p_3, in WG	Standard foil spacing	4,8	2,0	1,3	0,9	0,7	0,6
	Wider foil spacing	2,8	1,0	0,6	0,4	0,4	0,3

Chart 5
Leakage flow q_1



Project design advice

Symbols used:

Rotor pressure drop on the supply air side, Δp_{1-2}, inches.WG

Pressure differential across the purging sector, $p_1 - p_3$, inches.WG

Supply air flow downstream of the heat exchanger, q_2, CFM

Exhaust air flow upstream of the heat exchanger, q_3, CFM

Exhaust fan air flow q_4

Leakage flow, q_l, CFM

Carry-over flow, q_m, CFM

Rating factor for exhaust air $= f$

$$f = \frac{q_3 + q_1 + q_m}{q_3}$$

$$q_4 = f * q_3$$

Calculation example:

Given: PUMB-240 installed as shown in Fig. 5
$q_2 = q_3 = 18\ 000$ CFM
$\Delta p = 0.66$ in.WG
$p_1 - p_3 = 1.6$ in.WG
From Chart 5, $q_l = 540$ CFM

From the previous page, the carry-over air flow would amount to approximately 2% of the supply air flow, q_2 (3% at 0.4 inches WG; 1.5% at 0.8 inches WG.

The exhaust air fan thus operates at a flow which is around 5% higher than the exhaust air flow rate from the room (q_3).

$$f = \frac{18000 + 540 + 0.02*18000}{18000} = 1.05$$

$$q_4 = 1.05 * 18000 = 18900 \text{ CFM}$$

Location of the fan

Question: Is air recirculation permissible?

If air is recirculated, the fans can be located in any position. If air recirculation is not permissible, the fans should be installed as shown in Fig. 7 or Fig. 8 if particularly high purging pressure is required.

Note that the installation shown in Fig. 7 may cause negativ pressure in the building during the winter. This is the most common location of the fans. The pressure can be lowered by installing an adjusting damper in the exhaust air duct upstream of the heat recovery unit.

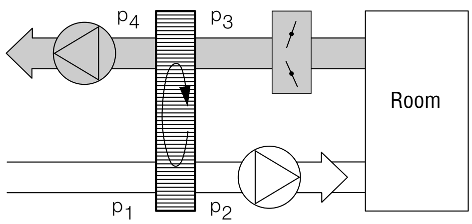


Fig. 7

Question: Is maximum cooling energy recovery desirable?

If the fans are installed as shown in Fig. 8, all of the losses in the motor and the exhaust air fan and almost all of the losses in the motor and the supply air fan will be discharged with the exhaust air.

These locations give constant pressure conditions in the building throughout the year.

Maximum cooling energy recovery will be achieved if the fans are located so that the heat in the outdoor air and the fan-generated heat are both transferred to the exhaust air. This location is also suitable for premises in which high air cleanliness is demanded.

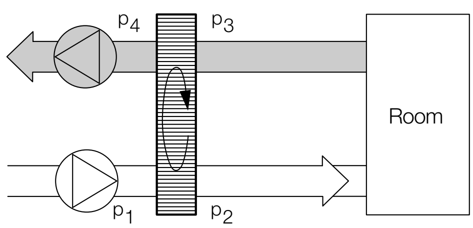


Fig. 8

Project design advice

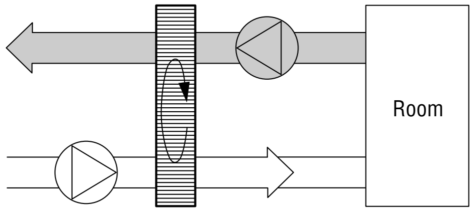


Fig. 9

The fan locations shown in Fig. 9 may give rise to problems, since it may be difficult to achieve correct pressure balance.

Question: Is maximum heat recovery desirable?

If the fans are installed as shown in Fig. 10, all of the power supplied to the exhaust air fan motor and almost all of the power supplied to the exhaust air fan motor will be utilized.

The location provides constant pressure conditions in the building throughout the year.
Maximum heat recovery will be obtained if the fans are installed so that the heat from the exhaust air fan is utilized (Fig. 10). This fan location can be used only in systems in which air recirculation is permissible.

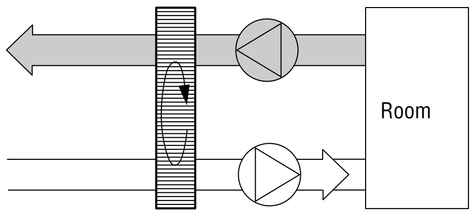


Fig. 10

In cases where the exhaust air is polluted and return air cannot be used, a correct pressure balance must be obtained on both sides of the rotor.

Pressure conditions: $p_1 > p_4$, $p_2 > p_3$.

INSERTION LOSS ΔL_W, dB

Rotor version	Insertion loss ΔL_W, dB							
	Octave band, mid-frequency, Hz							
	63	125	250	500	1000	2000	4000	8000
Non-hygroscopic rotor, aluminium	3	4	4	3	4	5	6	9
Hygroscopic rotor, aluminium	3	2	3	4	5	6	7	9
Composite rotor	3	3	3	4	5	6	10	14

Filters

Experience has shown that the ECONOVENT rotor is very insensitive to clogging during operation, in spite of the dense structure of passages. This is due to the fact that the direction of air flow through the rotor is continually reversing, which has an excellent self-cleaning effect. The laminar flow through the rotor is also a contributory factor to the very rare occurrence of clogging of the rotor.
If either of the air streams has a high dust content, the particles usually adhere to the rotor surface, and very rarely settle inside the passages. As a result, the particles are blown away from the rotor surface when the direction of air flow reverses.

In many installations, the rotor is stationary during parts of the year. To protect the rotor from deposits and clogging, the supply air filter of the system should be located upstream of the rotor.

If the rotor should become clogged, it can normally easily be cleaned by vacuum cleaning. Compressed air, low-pressure steam and certain types of grease solvents can also be used.

Clogging problems may nevertheless occasionally occur in practice. In the event of doubt, it is therefore better to fit a filter rather than determine at a later date that a filter is needed (see Fig. 11).

In order to prevent fouling and clogging of the rotor during the construction period, the regular filters should be in position, and the rotor should always be rotating when the fans in the system are running.

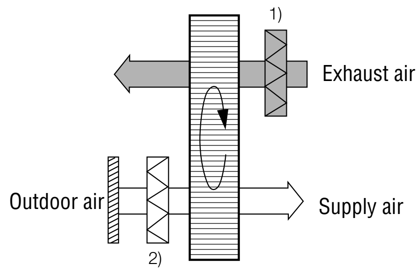


Fig. 11

1) A basic filter should preferably be installed, particularly if the dust consists of large particles, or of oily, tacky or adhering particles. If a filter is not installed, space should be left for installing a filter at a later date.

2) The filter class should be selected to suit the requirements of the premises.

Inspection facilities

An inspection section or a duct with inspection cover should be connected to the heat recovery unit to enable the rotor to be inspected and serviced. However, if unit sections with good access facilities are connected directly to the heat recovery unit, these may be used for inspection.

Project design advice

If the air is admitted at an angle to the rotor face

In systems in which the air impinges on the rotor face at an angle as shown in Fig. 12, the rotor could start to turn because of this inclined angle of flow. This may cause undesirable heat recovery due to the rotor rotating even when the heat exchanger is shut down.

In such installations, guide vanes should be fitted at the rotor inlet in order to deflect the air so that it will flow at right angles to the rotor face.

If the heat exchanger is located on the delivery side of the fan, a space should always be provided between the fan outlet and the rotor to enable the air leaving the fan outlet to distribute itself evenly over the whole of the rotor area.

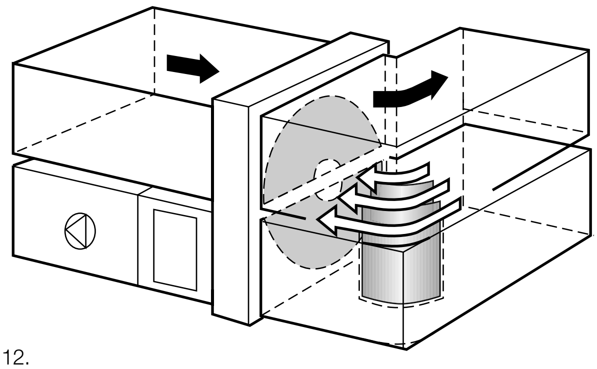


Fig. 12.

Control Systems

Control of rotary heat exchangers

Either on/off or continuously variable control can be employed for controlling the rotor speed.

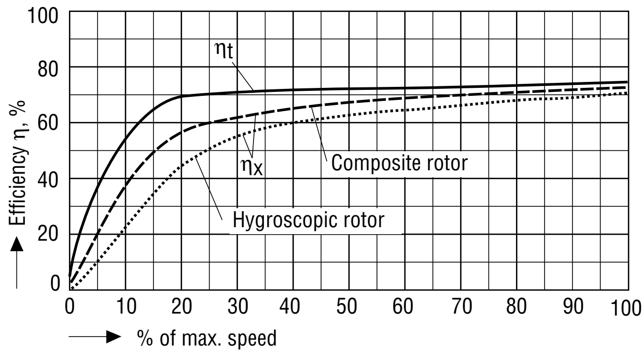
If on/off control is employed, the temperature efficiency will be either zero or a maximum.

In continuously variable control, the rotor speed is varied from rest to maximum speed in a continuous manner. The temperature and moisture efficiencies as a function of the rotor speed are shown in Chart 6.

During periods when no heat recovery is required, the rotor speed will be so low that the efficiency will be close to zero, although the rotor will still be purged.

For particulars of selecting the drive equipment for on/off or continuously variable speed, refer to separate instructions from Munters International Inc.

Chart 6



Example. Heat recovery - Variable speed

The heat exchanger rotor speed is controlled steplessly by temperature sensors for constant supply air temperature, constant room temperature or constant exhaust air temperature.

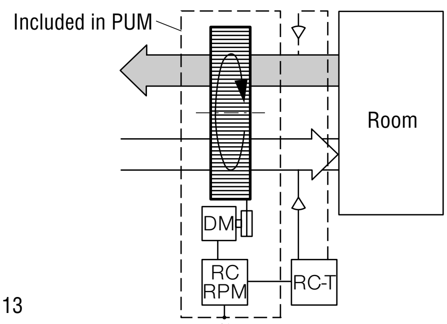


Fig. 13

RC RPM	= Speed controller	ST	= Temperature sensor
RC T	= Temperature control unit		= Proportional thermostat
DM	= Heat exchanger drive motor	DT	= Differential thermostat
SV	= Damper motor	K	= Contactor

Control

Example 2. Heating and cooling energy recovery

The temperature sensor ⑤ maintains the exhaust air temperature or room temperature constant via the control unit ④ which, on a drop in outdoor air temperature, begins by reducing the cooling output. If the sensor ② senses a higher temperature than sensor ③, the rotor will run at maximum speed, which is known as summer case control. If no cooling is carried out and the temperature drops further, the rotor speed will increase. At maximum speed and increased heat demand, the supply air temperature is controlled by means of the reheater.

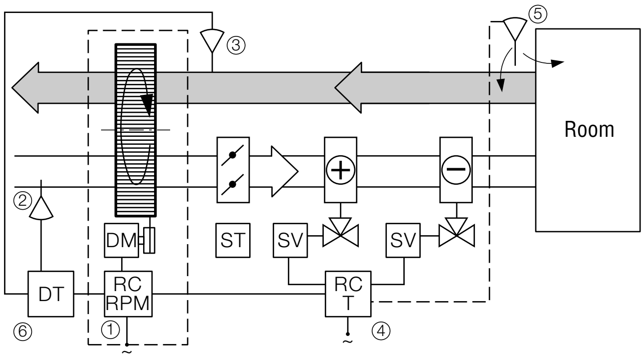
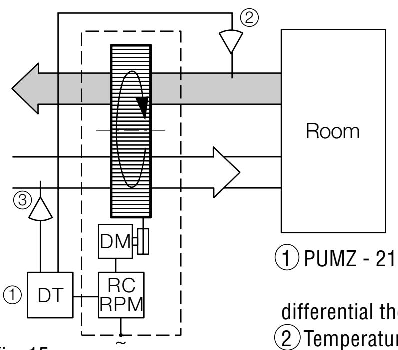


Fig. 14

① Speed controller
② Temperature sensor } are included in ⑥
③ Temperature sensor
④ Control unit of a make available on the market
⑤ Temperature sensor
⑥ PUMZ - 21 or equivalent differential thermostat

Example 3. Cooling energy recovery - maximum speed

If the temperature sensors ② and ③ of the differential thermostat sense that the supply air temperature is higher than the exhaust air temperature, the motor will run at maximum speed for cooling energy recovery.



① PUMZ - 21 } are included in ①

differential thermostat
② Temperature sensor
③ Temperature sensor

Fig. 15

Example 4. Speed detector

Variable speed: The speed detector monitors the rotor speed. An alarm will be initiated if the rotor speed is lower than that demanded by the speed controller. The magnet, magnetic sensor and mounting bracket are included in the supply.

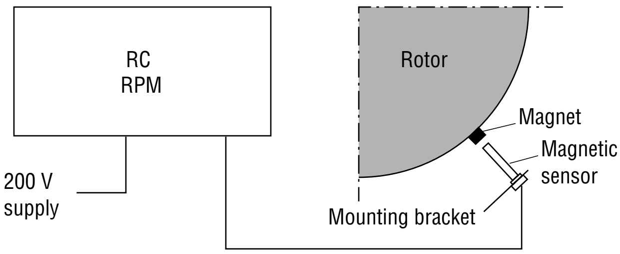


Fig. 16a

Constant speed: The speed detector consists of a magnet, a magnetic sensor and an alarm relay. The alarm relay is preset for an alarm delay time of 120 seconds. This time corresponds to the lowest rotor speed of approximately 0.25 rpm. In order to avoid an alarm when the rotor is intended to be stationary, the alarm relay should be wired so that an alarm can be initiated only when the system requires heating or cooling energy recovery (see the instructions).

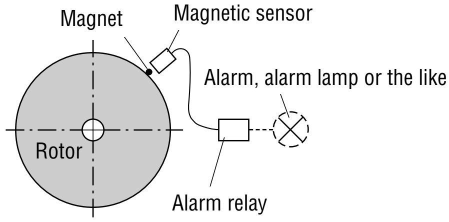


Fig. 16b

Control

Example 5. Frosting monitor

Variable speed: The frosting monitor is used for indicating frosting in the rotor at very low outdoor temperatures and high humidity of the exhaust air. If the pressure drop across the rotor exceeds the value preset on differential pressure switch 2, the rotor speed will be reduced if the heat exchanger is running at variable speed.

Constant speed: In the case of a constant-speed heat exchanger, the rotor is defrosted by the supply air being by-passed across the rotor via a damper or by the supply air fan being stopped. The differential pressure switch indicates when the damper should be opened or when the fan should be stopped.

Caution. No frosting is permissible in a composite rotor.

1 Speed controller
2 Differential pressure switch.
3 Control signal

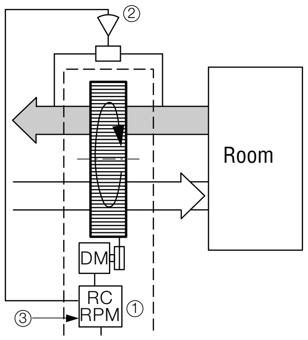
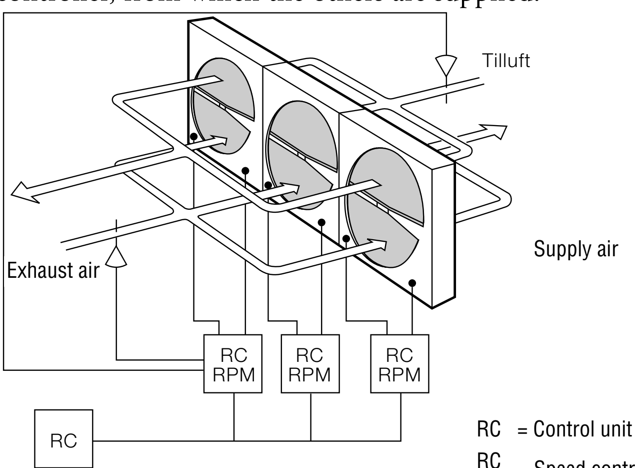


Fig. 17

Example 6. Parallel operation

If several rotary heat exchangers are included in a given air handling system and are thus to be controlled simultaneously, each heat exchanger must have its own speed controller and sensor for the speed detector. On the other hand, the control signals from the control unit (RC) and summer case sensors can be connected to only one speed controller, from which the others are supplied.



RC = Control unit
RC RPM = Speed controller

Fig. 18

Example 7. Purging operation

Purging operation should be employed when the heat exchanger rotor is stationary for an extended period of time in an environment in which the supply or exhaust air contains dust that may cause clogging.

For the ECONOVENT with variable speed, no time-switch need be employed. Purging operation is integrated into the speed controller. The function is switched on automatically when the rotor is stationary. A timeswitch (SU) with 24-hour dial is used for the ECONOVENT with constant speed, and this starts the rotor and runs it at maximum speed for 0.5–1 hour per 24 hours. Any dust that may have settled in the rotor passages will then be blown away by the air flow which is continually reversed through the rotor. A filter should always be installed in systems in which the dust is likely to cause deposits (see page 16).

Variable speed Constant speed

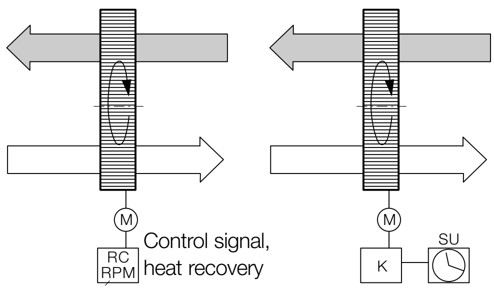


Fig. 19

Temperature limit for the drive motor

To ensure effective cooling of the drive motor located inside the casing, the temperature in the motor compartment should always be lower than +100 °F.

In systems in which the supply or exhaust air is at a higher temperature than +100 °F, the heat exchanger should be installed so that the leakage flow is from the cooler air stream to the warmer air stream. This is achieved by p1 > p2 and p2 > p4 as shown in Fig. 20 below. If the supply and exhaust air are both at temperatures above +100 °F, the motor compartment should be cooled by means of a separate fan.

As an alternative, the heat exchanger can be supplied with the drive motor located outside the casing.

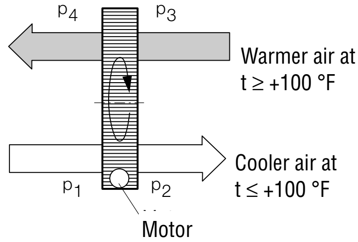
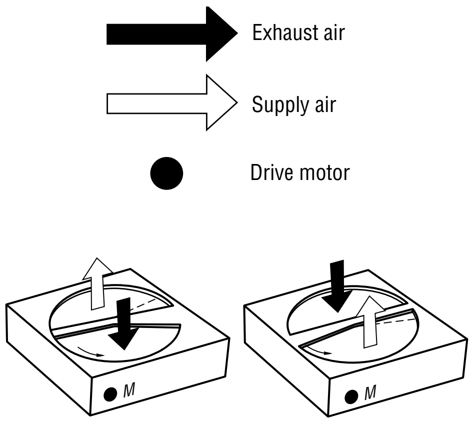


Fig. 20

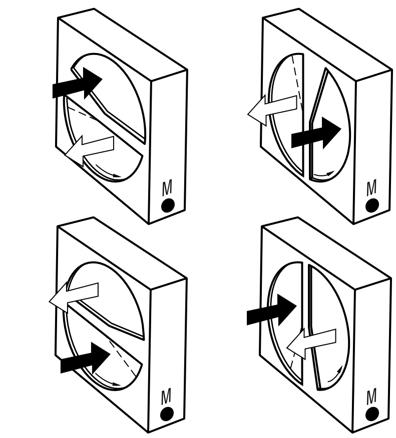
Installation

Rotary heat exchangers can be supplied for installation in air handling units, in the ducting or in a plant room. All variants and sizes can be installed either horizontally or vertically.



1. Horizontal installation

Fig. 21



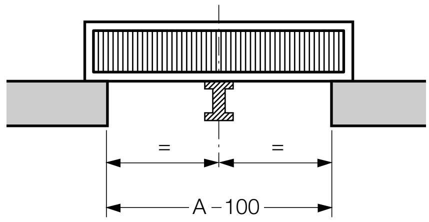
2. Vertical installation - horizontally split

3. Vertical installation - vertically split

Fig. 22

The heat exchanger should rest on a flat supporting surface. If other components, such as a duct or unit section, are connected to the top of the heat exchanger, they must not rest on the exchanger.

A supporting center beam must be provided for size 200 and larger units. The maximum permissible deflection of the load-bearing centre beam when supporting the weight of the heat exchanger and any other components is 0.04 inches.



For dimension A, see page 24.

Fig. 24

Installing the speed controller

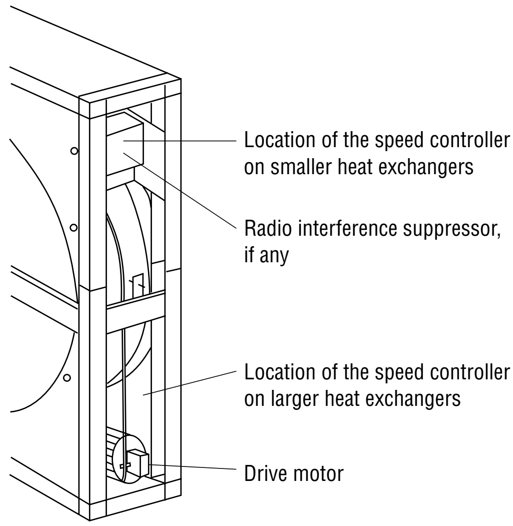


Fig. 23

Specifications are subject to alteration without notice

Installation

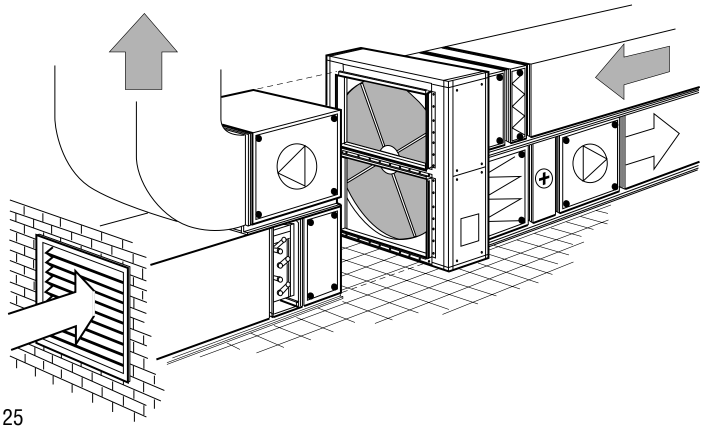


Fig. 25

Connection to other unit sections

A rotary heat exchanger with casing is best connected to the air handling unit or the ducting by means of slip clamps. The slip-clamp system should be fitted by the unit manufacturer or installation contractor to suit the connection openings on the unit or ducts.

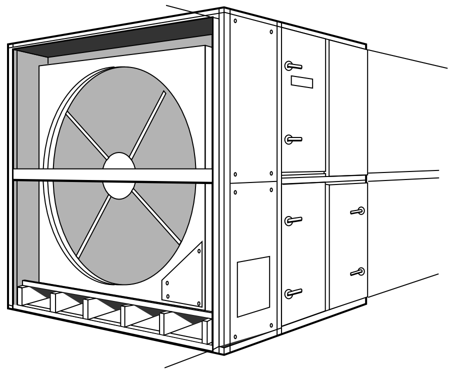


Fig. 27

Installation in a modular unit

The rotary heat exchanger with casing is mounted inside a unit casing or is connected by means of connection frames.

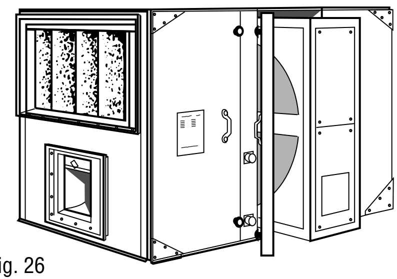


Fig. 26

Installation in compact units

The rotary heat exchanger with casing is pushed into the unit which is provided with seals designed to avoid air leakage.

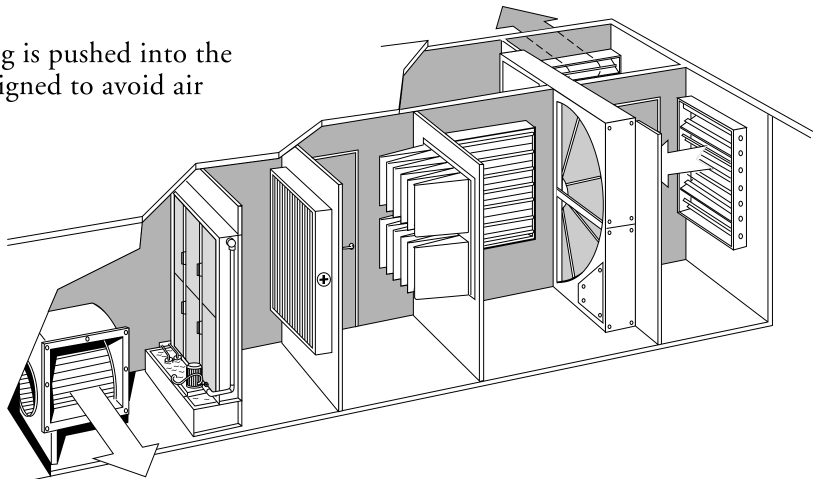


Fig. 28

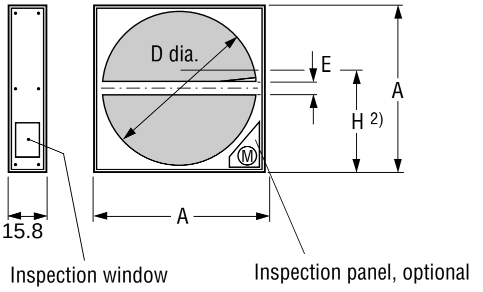
Installation in a plant room

The rotary heat exchangers can be installed directly on the floor or in a wall. This is a common installation alternative in systems with larger heat exchangers.

Dimensions and weights

All dimensions in inches

Size 060 - 240

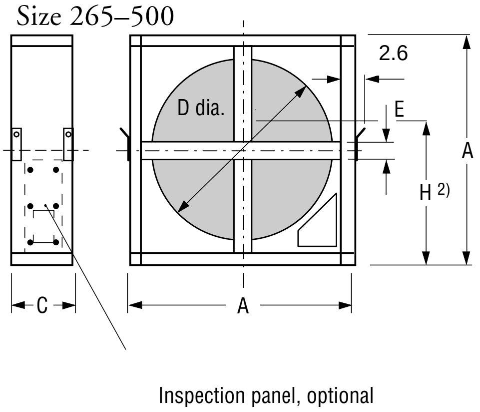


2) Height H is the dimension for a split heat exchanger.

Size	A	D	E	H	Weight, Lbs. Standard foil spacing	Weight, Lbs. Wider foil spacing	Weight, Lbs. Standard foil spacing industrial version
060	37.8	23.6	2.4	–	210	199	–
080	43.3	31.5	2.4	–	287	276	–
095	47.2	37.4	2.4	–	320	309	442
110	55.1	43.3	4.1	–	364	353	530
120	59.1	47.2	4.1	–	464	430	596
135	63.0	53.1	4.1	–	475	442	640
150	66.9	59.1	4.1	39.0	585	541	773
170	74.8	66.9	4.1	42.9	673	607	872
190	82.7	74.8	4.1	46.9	795	740	1104
200	86.6	78.7	4.1	48.8	916	784	1214
215	94.5	84.6	4.1	52.8	949	872	1325
240	103.9	94.5	4.1	57.5	1170	1060	1634

All dimensions in inches

Size 265–500

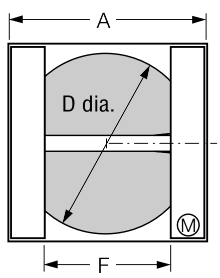


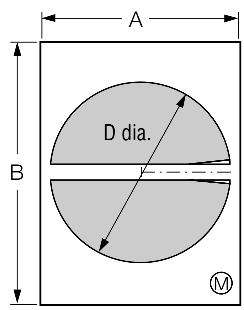
Size	A	C	D	E	H	Weight, Lbs Standard foil spacing	Weight, Lbs Wider foil spacing	Weight, Lbs Standard foil spacing Industrial version composite rotor
265	114.2	16.9	104.3	4.7	70.9	1920	1700	2141
290	122.0	16.9	114.2	4.7	74.8	2141	1920	2428
320	139.9	16.9	126.0	4.7	80.7	2649	2318	2980
350	144.1	16.9	136.2	4.7	85.8	2870	2474	3200
380	157.5	16.9	149.6	4.7	92.5	3311	2980	3753
420	177.2	16.9	165.4	4.7	102.4	3974	3532	4415
460	192.9	18.5	181.1	7.3	110.2	6400	5960	7726
500	212.6	18.5	196.9	7.3	120.1	7726	7064	8389

1) Removable lifting lugs for sizes 265 to 500 inclusive.
2) Height H is the dimension for a split heat exchanger.

Rectangular casing and baffle plates

A rectangular heat exchanger casing can be produced, and the heat exchanger can be provided with baffle plates as shown in the figure below. In such cases, always specify the required dimensions A, B and F.





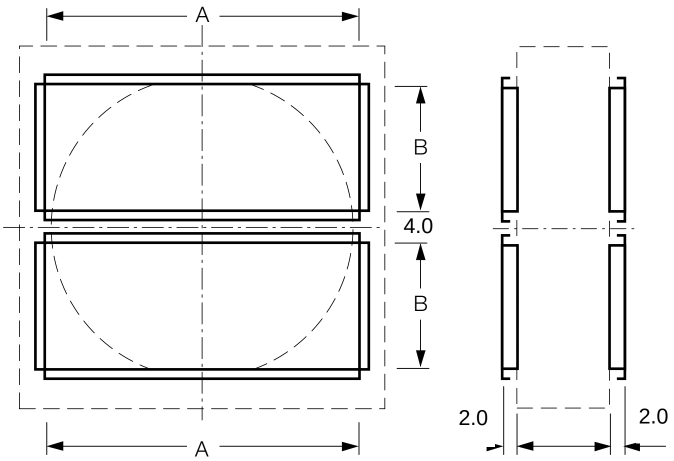
Specifications are subject to alteration without notice

Dimensions and weights - Accessories

All dimensions in inches

Duct connection frame PUMZ-17-bbb-2-0

Type for slip joint

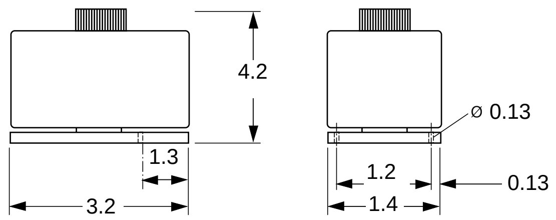


Size	PG / joint	
-bbb-	A	B
060	23.6	11.8
080	31.5	15.7
095	39.4	19.7
110	47.2	19.7
120	47.2	23.6
135	55.1	23.6
150	55.1	27.6
170	63.0	31.5
190	70.9	35.4
200	78.7	39.4
215	86.6	89.4
240	94.5	47.2
265	10.4	52.8
290	1173	56.7
320	129.1	62.6
350	139.4	67.7
380	152.8	74.4

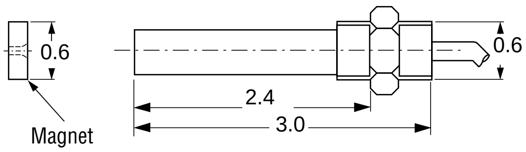
Speed detector

An alarm relay and speed detector are needed for a constant speed heat exchanger, and only a speed detector for a variable speed heat exchanger (EMS).

Alarm relay PUMZ-20-2-1



Speed detector PUMZ-20-b-c

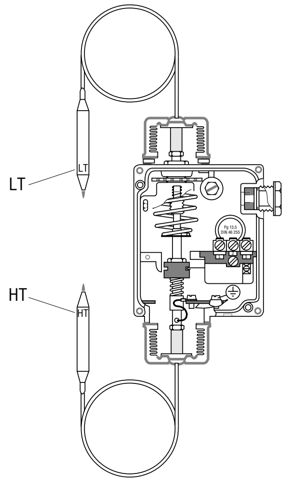


Differential thermostat PUMZ-21

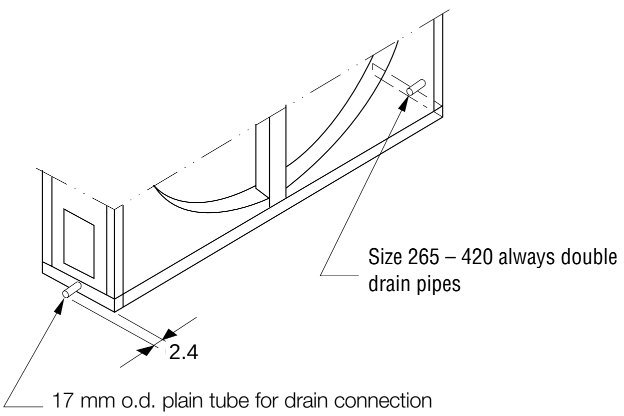
Danfoss type RT 270
2 m length of capillary tube

LT bulb
= For the lower air temperature

HT bulb
= For the higher air temperature



Condensate tray PUMZ-28-bbb



Ordering key

ECONOVENT **PUM(A-F)-a-bbb-cc-d-e-1**
Rotary heat exchanger

Rotor material
A = non-hygroscopic aluminium
B = hygroscopic aluminium
C = edge-reinforced, non-hygroscopic aluminium
D = edge-reinforced, hygroscopic aluminium
E = epoxy-coated aluminium (for a = 1, 2, 5 och 6)
F = composite (for a = 2 and bbb ≤ 420)

Rotor **(a)**
1 = wound, with standard foil spacing
2 = sectorized, with standard foil spacing
3 = wound, with standard foil spacing, industrial grade, aluminium
4 = sectorized, with standard foil spacing, industrial grade, aluminium
5 = wound, with wider foil spacing
6 = sectorized, with wider foil spacing
7 = wound, with wider foil spacing, industrial grade, aluminium
8 = sectorized, with wider foil spacing, industrial grade, aluminium

Size **(bbb)**
060 1), 080 1), 095, 110, 120, 135, 150, 170, 190, 200, 215, 240, 265, 290, 320, 350, 380, 420, 460, 500

1) Only wound rotor

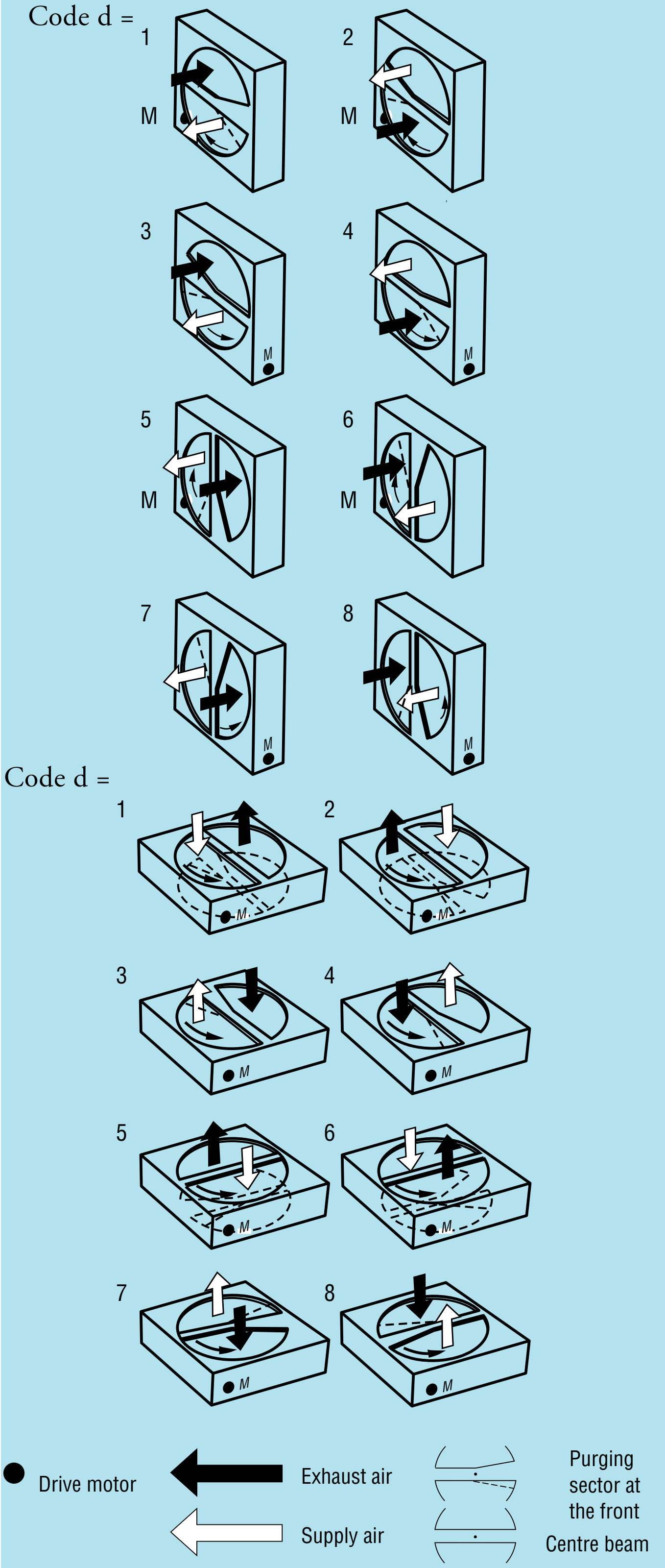
Drive equipment **(cc)**
00 = without drive equipment
01 = with constant speed drive equipment (ABM), heat recovery
04 = with variable speed size 350 - 500, (EMS MASTER)
07 = with variable speed drive size 060-320, (EMS Standard)
08 = with variable speed drive size 060-320, (EMS Extra)
11= with constant speed equipment (ABM) cool recovery

Installation alternative **(d)**
1–8 as shown in figure

Delivery form **(e)**
1 = factory-assembled unit with purging sector, sizes 060–240
2 = dismantled casing, two units, with purging sector, sizes 150–500
3 = factory-assembled unit, split casing with purging sector, sizes 150–290
4 = factory-assembled unit without purging sector, sizes 060–240
5 = dismantled casing, two units, without purging sector, sizes 150–500
6 = factory-assembled unit, split casing, without purging sector, sizes 150–290

Design figure

Installation alternatives



Orderingkey - Accessories

Duct connection frame **PUMZ-17-bbb-2-d**

Size **(bbb)**

060	215
080	240
095	265
110	290
120	320
135	350
150	380
170	420
190	460
200	500

Version **2**

Connection type **(d)**
0 = slip joint
1 = flanged connections

Alarm relay for constant speed **PUMZ-19**

Speed detector for constant and variable speeds **PUMZ-20-b-c-d**

Make **(b)**
4 = for sizes 095 - 240
5 = for sizes 265 - 500

Delivery condition **(c)**
1 = delivered in unmounted condition
2 = factory-mounted

Material **(d)**
1 = galvanized
2 = stainless

Differential thermostat **PUMZ-21**

Cleaning equipment **PUMZ-27-bbb-1**
(ECONOMATIC 95)

Size **(bbb)**

060	170	320
080	190	350
095	200	380
110	215	420
120	240	460
135	265	500
150	290	

Version **(c)**
1 = for compressed air

Condensate tray **PUMZ-28-bbb-c**

Size **(bbb)**

060	170	320
080	190	350
095	200	380
110	215	420
120	240	460
135	265	500
150	290	

Material **(c)**
1 = galvanized
2 = stainless

Specifications are subject to alteration without notice

Sample Specification

ECONOVENT Rotary Heat Exchanger type PUM(A-F), manufactured by Fläkt Woods, distributed by MUNTERS INTERNATIONAL, INC.. The Manufacturer shall be ISO 9001 certified.

WHEEL (**rotor**) - The wheel shall be made of layers of corrugated and alternating flat composite material or aluminum foil of uniform width to ensure a smooth surface. This wheel material is bonded together to form a rigid transfer medium forming a multitude of narrow channels thus ensuring a laminar flow. The wheels shall be of proven design (available on the market for at least 15 years). Corrosion protected wheels shall be able to withstand environments such as marine/coastal climates or industrial applications.

Type A: Non-hygroscopic aluminum wheel for recovering principally sensible heat.

Type B: Hygroscopic aluminum wheel for recovering sensible and latent heat.

Type C: Edge-reinforced non-hygroscopic aluminum wheel for recovering principally sensible heat.

Type D: Edge-reinforced hygroscopic aluminum wheel for recovering sensible and latent heat.

Type E: Epoxy-treated aluminum wheel for recovering principally sensible heat.

Type F: Hygroscopic composite material wheel with high corrosion resistance for recovering sensible and latent heat.

The wheel can be fully wound or, on larger units, Sectorized, i.e. assembled in segments. In the latter case, the segments are assembled between rigid spokes thus ensuring structural longevity and allowing replacement of one or specific segments only; or all of the segments can be replaced without having to remove any spokes. The wheel shall be cleanable by spraying its face surface with compressed air, low temperature steam or hot water or by vacuum-cleaning (on type F wheels: compressed air or vacuum-cleaning only) without affecting its latent heat recovery properties.

The wheels shall be tested in accordance with ASHRAE 84-78 method of testing air-to-air heat exchangers.
The wheels shall meet test conditions for European standard and ARI 1060-97. Development and manufacture shall meet all quality assurance criteria specified in BS EN ISO 9001.

Sample Specification

CASING - The casing shall be constructed as a single-skin, self-supporting, galvanized sheet steel structure and include rotary wheel support beams and a purging sector. The casing shall be supplied with access panels to facilitate inspection and service. Size 215 and larger shall be in two sections to facilitate shipping and handling. The smaller sizes can be delivered in a two-piece special version.

SEALS - The casing shall be equipped with adjustable brush seals which minimize carryover to max. 0.05 - 0.2 %.

HUB and SPOKES - On one-piece rotor: Aluminum. On Sectorized rotor: Hub made of steel, painted with anti-corrosion paint, galvanized sheet steel spokes.

DRIVE - The wheel shall be belt-driven along its perimeter. A constant speed or variable speed, fractional hp drive motor shall be used. The motor shall be mounted on a self-adjusting base to provide correct belt tension. The variable-speed motor shall be specially manufactured for rotary heat exchangers and provide constant torque throughout the speed range. Moreover it shall include a slow-start feature and automatically index the wheel to keep it clean while the AHU is down or energy recovery isn't required. The drive unit shall be available with a differential thermostat for summer/winter changeover, a speed detector with alarm function and an interface for a central energy management control system and be able to accept all common control signals.

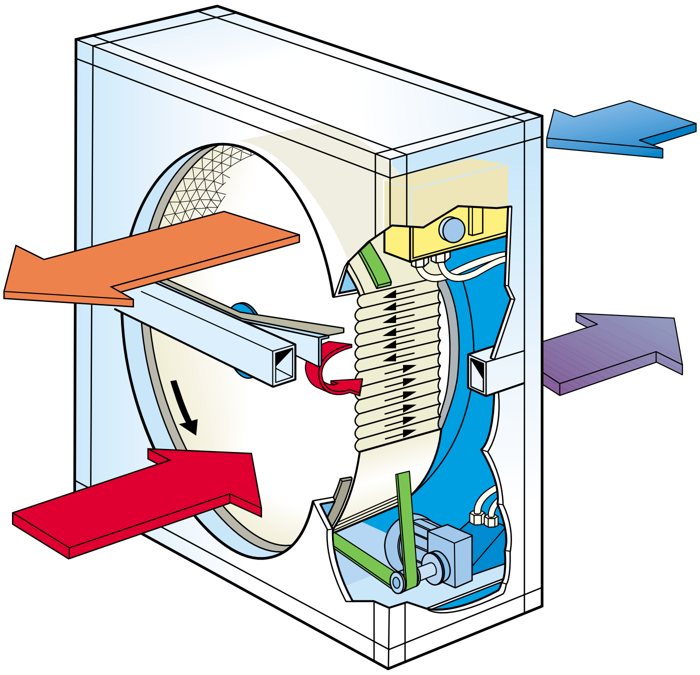
For a quotation of your project please contact MUNTERS INTERNATIONAL Inc. with the following information:

• Supply air flow rate	CFM	
• Outside air temperature	db °F	summer and winter conditions
• Outside air temperature	wb °F	summer and winter conditions

• Return air flow rate	CFM	
• Return air temperature	db °F	summer and winter conditions
• Return air temperature	wb °F	summer and winter conditions

• Expected efficiency
• Size limitations
• Environmental conditions (corrosion concerns)
• Fixed or variable speed drive system
• Maximum pressure drop through the heat exchanger inches WG

Specifications are subject to alteration without notice



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