



**Rotary heat exchangers**  
for Heat Recovery in Ventilation Systems

**Hoval**

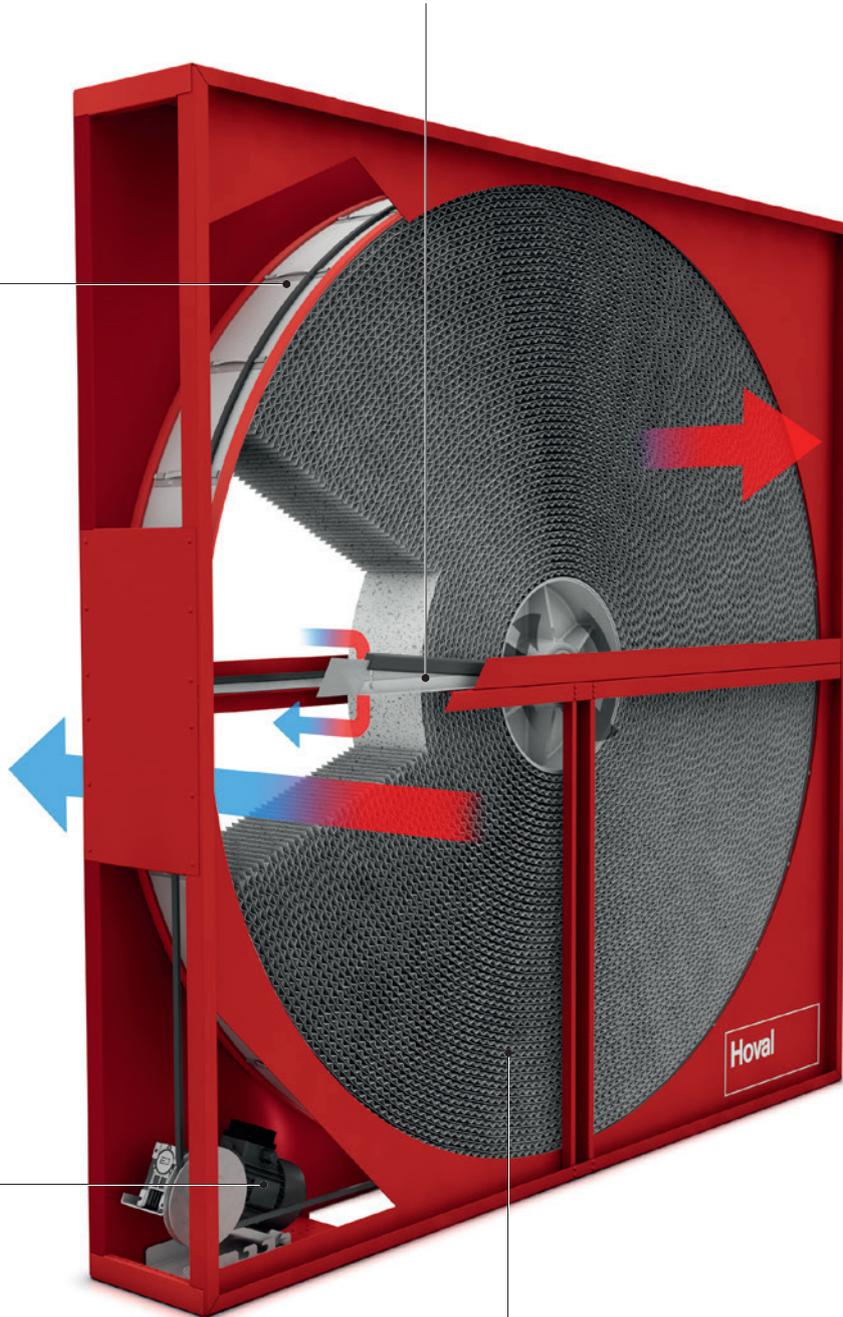
**Handbook for Design, Installation and Operation**

**Peripheral slide seal**

Constant-force springs permanently press the abrasion-resistant ring seal against the casing. The patented system permanently minimises leakage and allows the unit to be sized for smaller air flow rates.

**Adjustable purge sector**

The size of the purge sector can be adjusted to suit requirements. The device (patent pending) prevents contamination of the supply air by the extract air and at the same time minimises purge and energy loss.



**Drive motor**

The 3-phase gear motor with belt pulley and v-belt is installed on a rocker in the corner of the casing. The speed of rotation is infinitely adjustable.

**Storage mass**

Hoval supplies the storage mass in three types of material: for condensation, enthalpy and sorption wheels. The sorption coating guarantees a consistently high degree of humidity efficiency, even under summer conditions.

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# 1 Principle and Operation

Hoval rotary heat exchangers are regenerators with rotating heat accumulators (category 3) in accordance with the guidelines for heat recovery (e.g. VDI 2071).

The heat-dissipating and heat-absorbing air flows heat or cool the rotating, air-permeable storage accumulator. Depending on the air conditions and the surface of the accumulator material, humidity may also be transferred in the process. Supply and exhaust air must therefore be brought together and flow through the heat exchanger.

The storage mass consists of triangular, axially arranged small ducts made of thin metal foil. The depth of the storage mass (viewed in the direction air flow) is generally 200 mm; the airway height is normally 1.4 – 1.9 mm, depending on the application. With these dimensions the storage mass generates a laminar flow in the wheel ducts.

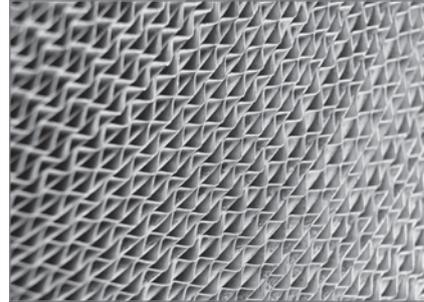


Fig. 2: Geometry of storage mass

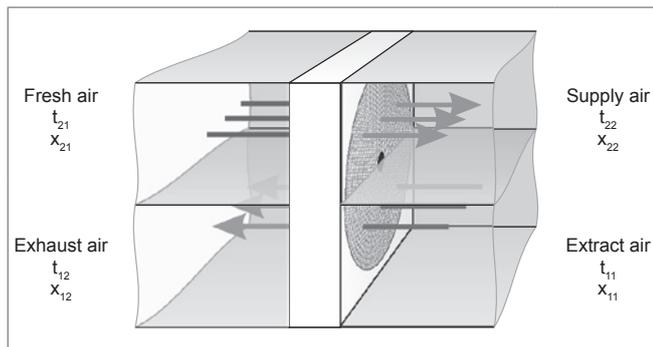


Fig. 1: Function diagram and air conditions

## 1.1 Heat transmission

The wheel with its axially arranged, smooth ducts acts as a storage mass, half of which is heated by the warm air and the other half of which is cooled by the counter-flow of cold air. The temperature of the storage mass therefore depends on the axis coordinates (wheel depth) and the angle of rotation.

The function is easy to understand by following the status of a wheel duct through one revolution (see Fig. 3). The following can be recognised with reference to the heat transfer from this process:

- The air temperature after the exchanger varies; it depends on the location on the wheel.
- The heat recovery efficiency can be varied by varying the speed.
- The heat recovery efficiency can be changed with the storage mass. This can be done with different cross-sections of the wheel ducts, different thickness of the storage material or by changing the wheel depth. However, in all cases this varies the pressure drop.
- The specific heat output depends on the temperature difference between warm air and cold air. The rotary heat exchanger is therefore suitable for heat and cool recovery, i.e. for winter and summer operation.

### Definition of key data according to Eurovent

Temperature efficiency  $\eta_t = \frac{t_{22} - t_{21}}{t_{11} - t_{21}}$

Humidity efficiency  $\eta_x = \frac{x_{22} - x_{21}}{x_{11} - x_{21}}$

Legend: t = Temperature [K; °C]  
x = Absolute humidity [g/kg]

Index: ...<sub>11</sub> Extract air  
...<sub>21</sub> Fresh air  
...<sub>12</sub> Exhaust air  
...<sub>22</sub> Supply air

**1 Warm air entry**

The rotation of the storage mass has moved the wheel duct from the cold air to the warm air. The storage material is cooled almost to the temperature of the cold air. This applies particularly to the entry side of the cold air (= exit side of the warm air). The warm air now flows through the duct with reference to the temperature in the counter-flow and is cooled greatly. The storage mass is therefore heated. The local temperature efficiency, i.e. directly at the inlet to the warm air, is very high. Condensation can also occur very easily.

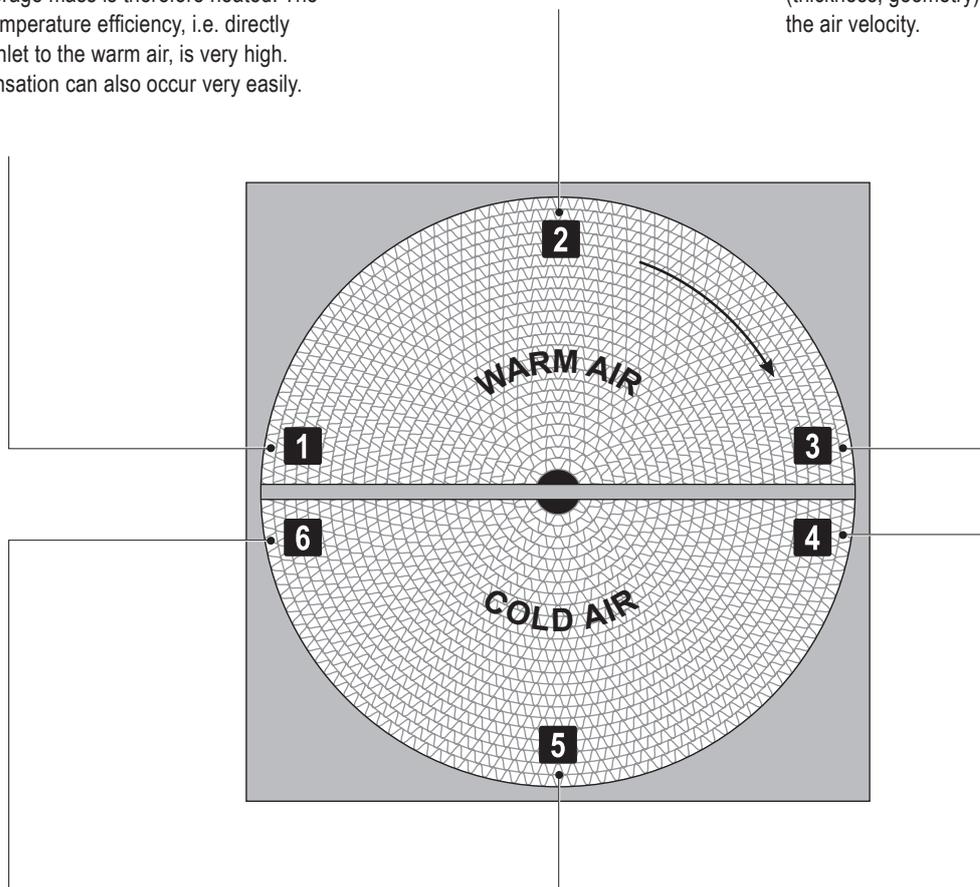
**2 Mid warm air**

The wheel duct now has passed half of its time in the warm air. The storage mass has been heated by the flowing warm air; therefore, the warm air is not cooled down as much as in entry inlet zone. The wall temperature at the entry and exit is approximately the same. Condensation occurs only with large humidity differences.

**3 Warm air exit**

The wheel duct is now shortly before entry to the cold air. It has virtually reached the temperature of the extract air at the entry side. The transferred performance is still only low.

The dwell time in the warm air and in the cold air, i.e. the speed of rotation, is decisive for the performance of the rotary heat exchanger. It depends on the storage mass (thickness, geometry), the heat transfer and the air velocity.



**6 Cold air exit**

The wheel duct has passed through the cold-air section. The storage mass has greatly cooled, almost down to the cold-air temperature in the entry section. After crossover to the warm air side, the cycle starts anew.

**5 Mid cold air**

Half of the dwell time in the cold air is past. The storage mass has already cooled significantly. The temperatures at the entry and exit are approximately equal.

**4 Cold air entry**

After the transition from the warm air to the cold air, the wheel duct now has cold air flowing through in the opposite direction (referring to the temperature). With the high temperature difference the transferred performance is very high, i.e. the cold air is very strongly heated; in reverse the storage mass is strongly cooled. Any condensate formed on the exchanger surface is (partially) absorbed by the heated cold air.

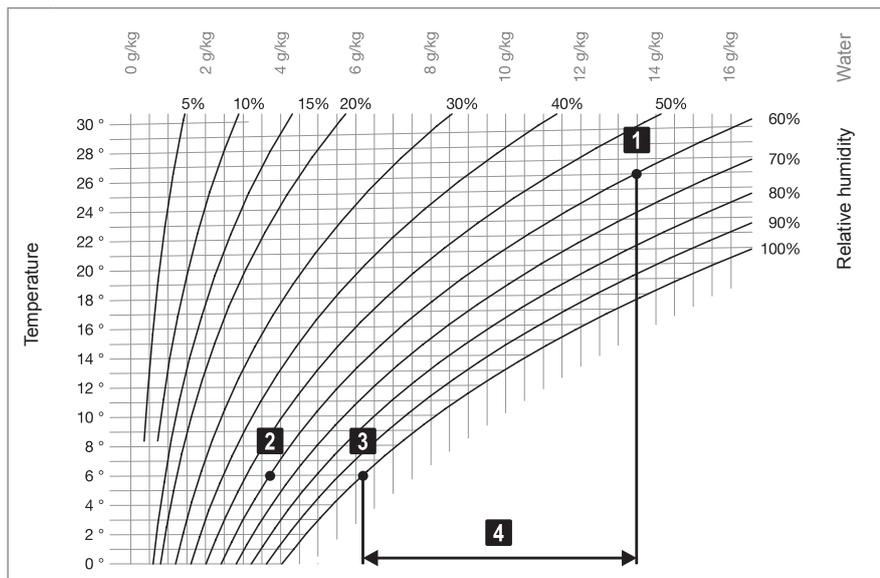
Fig. 3: States depending on the turning angle

### 1.2 Humidity transmission

In addition to heat, humidity can also be transported with rotary heat exchangers. The decisive factor here is the material and/or the surface of the storage mass. Characteristic features for different designs have been developed with detailed measurements of wheels from different manufacturers by the building technology test centre of the University of Lucerne. The reference factor for the humidity efficiency is the condensation potential; that is the humidity difference between warm-air humidity and the saturation humidity of the cold air (see Fig. 4).

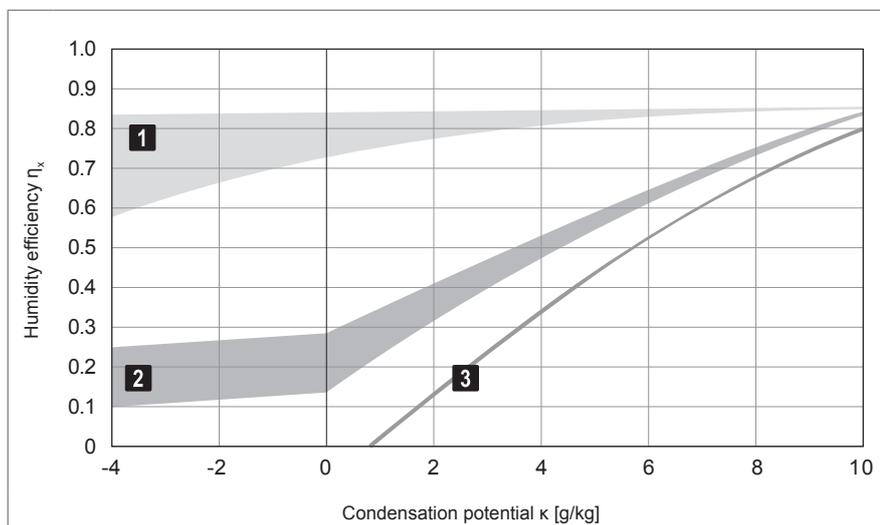
The following must be noted:

- The greater the condensation potential the greater the volume of condensate that can be expected at the warm air side.
- If the condensation potential is zero or negative, no condensation can take place. Humidity transmission is therefore only possible by sorption.
- The derived characteristics reflect typical values of 1 : 1 for the mass-flow ratio and the pressure drop of approx. 130 Pa at an airway height of 1.9 mm.
- The area of application of reference magnitude  $\kappa$ , i.e. the condensation potential, is restricted to the standard conditions of ventilation technology. The temperature efficiency must be at least 70 %. The humidity transmission must not be restricted by the saturation curve (e.g. with very low outside temperatures).



- 1** Warm air entry
- 2** Cold air entry
- 3** Saturated cold air
- 4** Condensation potential of warm air  $\kappa$

Fig. 4: Definition of condensation potential  $\kappa$



- 1** Sorption wheel
- 2** Enthalpy wheel
- 3** Condensation wheel

Fig. 5: Typical course of humidity efficiencies of various wheels depending on the condensation potential

There are 3 different designs:

**Condensation wheel**

The storage mass consists of smooth, untreated aluminium, which only transmits humidity if condensation occurs on the warm-air side and it is picked up by the cold air (partially). Humidity efficiency rates greater than 80 % can be reached if the temperature difference is high.

The use of condensation wheels for heat and humidity transmission is recommended primarily for ventilation systems without mechanical cooling, i.e. for winter operation.

**Enthalpy wheel (hygroscopic wheel)**

The metallic storage mass has been treated to form a capillary surface structure. The humidity is transmitted by sorption and condensation, with the sorption component being very low. Humidity transmission in summer operation ( $\kappa < 0$ ) is also very low.

**Sorption wheel**

The storage mass in this case has a surface that transmits humidity by pure sorption (i.e. without condensation). The humidity efficiency is therefore virtually independent of the condensation potential. The low decrease can be explained with the simultaneous reduction of the temperature difference.

Sorption wheels are recommended particularly in systems with mechanical cooling. The high humidity efficiency, even under summer conditions, dries the fresh air. This requires less cooling capacity and reduces energy costs for cooling up to 50%.

1.3 Leakage of rotary heat exchangers

Rotary heat exchangers transfer heat and humidity via a rotating storage mass that alternates between the exhaust air and supply air flows. This functional principle delivers extremely efficient energy recovery, but it does also entail a certain leakage: the exhaust air and supply air flows cannot be completely separated from one another. The seals are not able to withstand the existing differential pressure with 100 percent effectiveness. The rotating storage mass transfers a small quantity of air from one air flow to the other on every rotation (carryover).

The effects of the leakage must be taken into account during planning and configuration of air handling systems. The draft standard EN 13779:2014 consequently defines the calculation method for the leakage. It describes the following two values:

- Exhaust air transfer ratio EATR  
This is the quantity of exhaust air that enters the supply air due to carryover and seal leakage.
- Outdoor air correction factor OACF  
This is the ratio between the quantity of the fresh air and supply air flows.

These two values are calculated using the design program for a differential pressure to be specified between the supply air and extract air ( $\Delta p_{22-11}$ ). From April 2015, this calculation will be mandatory for Eurovent-certified rotary heat exchangers.

Based on the calculated leakage values, it is possible to take suitable measures according to the application. The following must be noted:

- The transfer from exhaust air to supply air can be significantly reduced or even completely eliminated by taking the following measures:
  - Using a purge sector
  - Suitable arrangement of fans (supply air pushes, exhaust air sucks)
- The OACF value is decisive for setting the dimensions of the fans:
  - An OACF value greater than 1 means that fresh air gets to the exhaust air side (due to seal leakage and/or purge air). The size of the supply air fan will have to be increased accordingly to ensure that the required air volume is supplied to the building. This means more energy is required for pumping the air.
  - An OACF value less than 1 means air is moving in the opposite direction, i.e. there is a proportion of recirculated air in the supply air.

**Definition of leakage according to EN 13779:2014 (draft)**

**Exhaust air transfer ratio:**

$$EATR = \frac{a_{22} - a_{21}}{a_{11}} \quad (\text{Exhaust Air Transfer Ratio})$$

- $a_{22}$  ..... Concentration in supply air
- $a_{21}$  ..... Concentration in fresh air
- $a_{11}$  ..... Concentration in extract air

**Outdoor air correction factor:**

$$OACF = \frac{q_{m\ 21}}{q_{m\ 22}} \quad (\text{Outdoor Air Correction Factor})$$

- $q_{m\ 21}$  ..... Mass flow of fresh air
- $q_{m\ 22}$  ..... Mass flow of supply air

### 1.4 Frost limit

If the warm extract air stream is very strongly cooled condensate can be formed and it may even freeze. The fresh air temperature at which this starts is referred to as the frost limit.

- Condensation wheel, enthalpy wheel: The condensate generated by cooling the extract air may freeze at low outside temperatures. There is a frost hazard at equivalent mass flows for exhaust air and fresh air if the average inlet temperature of the two air streams is less than 5 °C.

$$t_m = \frac{t_{11} + t_{21}}{2} < 5 \text{ °C}$$

- Sorption wheel: The gaseous humidity transmission by sorption generally prevents condensation; the frost hazard is reduced.

### 1.5 Temperature efficiency

Appropriate design and serial layout allows virtually any temperature efficiency to be reached. The 'correct' temperature efficiency depends on the applicable regulations and the economy calculations, i.e. the operating data such as energy price, service life, operation time, temperatures, maintenance requirements, interest etc. Even minor changes (a few percent lower temperature efficiency, a few pascals more pressure drop) can mean significantly poorer results for capital value and amortisation period.

### 1.6 Pressure drop

Heat recovery units cause pressure drop on the extract and supply air sides and as a result operating costs. With current general conditions the economical values for wheels are between 80 Pa and 130 Pa. However, to reduce costs, more and more heat recovery units whose pressure drops are above these economically reasonable values are being installed. This affects the feasibility of the system.

### 1.7 Pressure difference

A distinction is made between internal pressure difference (between exhaust air and supply air) and external pressure difference (between the exchanger and the environment).

#### Internal pressure difference:

The internal leakage between the two air streams depends greatly on the pressure difference. Hoval rotary heat exchangers with high tightness seal compared with other designs are certainly very leak-proof, but the following information should be taken into account in the design:

- The pressure difference in the rotary heat exchanger should be as low as possible.

- In applications that involve the danger of odours the pressure gradients and therefore possible leakage from the fresh air to the exhaust air must be considered. However, the internal pressure difference may also cause deformation of the casing; a pressure difference of more than 2000 Pa is not permitted.

**i Notice**  
The pressure difference depends on the layout of the fans. Overpressure on one side and underpressure on the other side add up.

#### External pressure difference:

This is a major factor for the external leakage of the heat exchanger. If a duct system is correctly and carefully installed, this effect can be ignored.

### 1.8 Hygiene

Hoval rotary heat exchangers with high tightness seal have been tested for conformity with hygiene requirements at the Institute for Air Hygiene in Berlin. The test criteria were the requirements relevant to hygiene for applications in general building ventilation and in hospital applications. All hygiene requirements were met.

**i Notice**  
Hoval rotary heat exchangers are tested and certified for operation in hospitals in accordance with DIN 1946-4. Install rotary heat exchangers with the 'coated casing' option for such applications.



Fig. 6: Certificate of hygiene conformity test (valid for Hoval rotary heat exchangers with high tightness seal)

### 1.9 Reliable data

Hoval rotary heat exchangers are always tested by independent test organisations (e.g. at the building technology testing laboratory of the University of Lucerne). All technical data are based on these measurements. This means that they are reliable data for planners, installers and operators.



## 2 Performance control

The Hoval rotary heat exchanger always operates as a temperature rectifier between the two air streams. The flow direction of the heat is irrelevant in this context, i.e. depending on the temperature gradients between extract air and fresh air either heat or cold is harvested. Therefore, regulation of the output of the Hoval rotary heat exchanger is not necessary if the extract air temperature is identical to the setpoint temperature. In this case, the fresh air is always either heated or cooled in the direction of the set temperature by the heat exchanger.

However, in most cases there are heat sources in the ventilated rooms (people, machines, lighting, solar radiation, processing systems) that increase the room temperature, i.e. the extract air temperature is higher than the setpoint temperature. In this case, check the outside temperature from which the system is heated at full performance of the rotary heat exchanger and – if this cannot be tolerated – the performance of the heat exchanger must be controlled.

It is very simple and economical to reduce the performance of the rotary heat exchanger for heating and also for humidity transmission by reducing the speed of rotation. All Hoval rotary heat exchangers can therefore be supplied with speed-controlled drives.

There is also the option of diverting one or both air streams past the wheel by a bypass. The method – used primarily in process technology and at various air flow rates – must be installed by the customer.

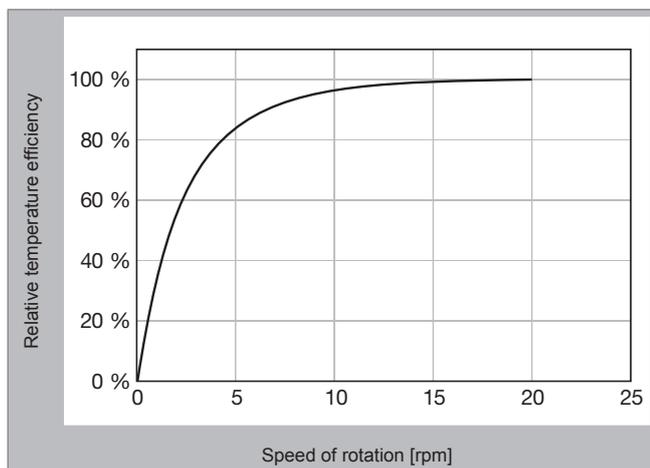


Fig. 7: Dependency of the temperature efficiency on the rotational speed

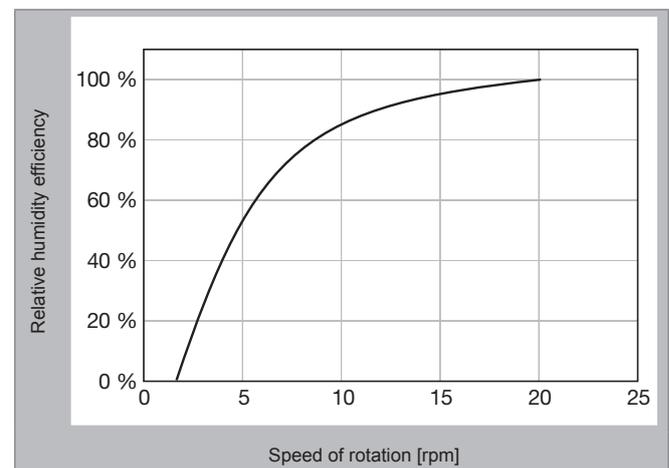


Fig. 8: Dependency of the humidity efficiency on the rotational speed

## 3 Structure

A functional rotary heat exchanger consists of the wheel, the casing and the drive.

### 3.1 Wheel

#### Storage mass

A corrugated and a smooth metal foil are wound together as the storage mass. This forms triangular, axial ducts. The material is 60 µm thick.

The surface treatment also depends on the use; there are 3 series:

- Series A: condensation wheel, consisting of high-quality aluminium.
- Series E: enthalpy wheel, consisting of aluminium with enthalpic coating.
- Series S: sorption wheel, consisting of an aluminium substrate foil coated with a sorption substance (e.g. silica gel) for humidity transmission. This transmits humidity in the form of a gas without condensation.

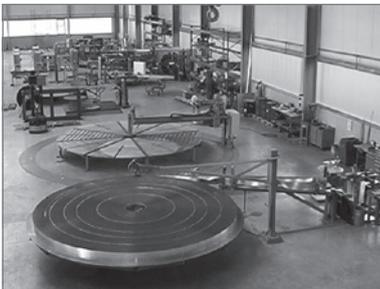


Fig. 9: A corrugated and a smooth metal foil are wound around each other.

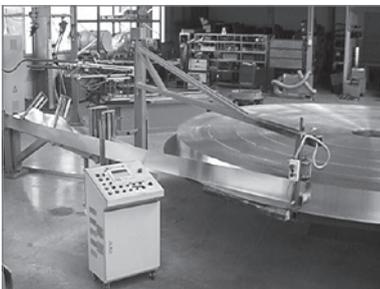


Fig. 10: Production on state-of-the-art machines ensures consistently high quality.



Fig. 11: Large wheels are cut into several segments.

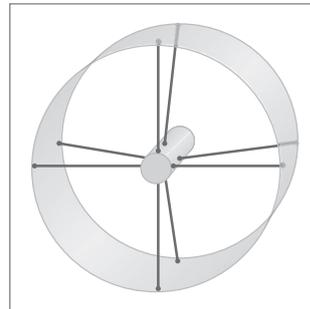


Fig. 12: The wheel is permanently stabilised by internal welded double spokes.

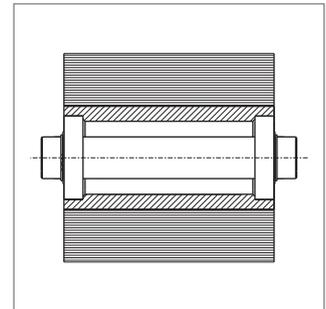


Fig. 13: Hub with long-life, permanently lubricated inner bearing

#### Design

The depth of the wheel is 200 mm. The wheel is stabilised by double spokes, screwed (and welded) to the hub and welded to the wheel mantle (see Fig. 12). This guarantees a long service life.

For stability and performance large-diameter wheels must be made in a segmented design. The diameter of the wheel can be freely selected in 10-mm steps.

The outside of the wheel is held together by an aluminium jacket plate (welded). This guarantees uninterrupted radial runout and enables maximum usage of the wheel surface.

#### Hub with inner bearing

The hub, whose size depends on the wheel diameter, is fixed to the axle with 2 internal ball bearings. It is fastened to the crossbars of the casing. This design has the following advantages:

- The internal bearings are protected against contamination and require little space.
- The axial lock with circlips makes installation and removal quick and simple.
- Both bearings are integrated into the hub, i.e. in the same component. This ensures that they mesh together perfectly (in contrast to external bearings). This does not reduce the service life of the bearings.
- The position of the axle, hub and wheel is precisely fixed by the fastening of the internal ball bearings by the hub and the circlips.
- The fixed axles connects the two crossbars of the casing. This greatly increases its stability.

### 3.2 Casing

There are different casing designs, depending on the wheel diameter and whether the wheel is 1-piece or segmented.

#### Sheet-metal casing

Self-supporting aluzinc sheet steel casing are standard for 1-piece wheels with diameters up to 2620 mm. The sheet-metal casing is strengthened with galvanised steel profiles from wheel diameters of 1800 mm.

#### Profile casing

A profile design of aluminium is used for wheels above 1500 mm diameter. The casing is extremely stable and the dimensions are flexible. The plate covers can be removed and replaced quickly and easily, a factor which is important for installation of segmented wheels. The height and width of the profile casing is limited to 4.2 m. Larger casings (welded construction, galvanised) are available customised for specific systems.

The casings are designed for installation in a ventilation unit. Therefore, the sides are open; this allows inspection and maintenance as required.

#### Casing types

Different types of casing are also available for adaptation to different installation situations (see also Section 4 'Options'):

- **Special size:**  
Height and width of the casing can be selected as required (for example for adjustment to the internal cross-section of a ventilation unit). The hub can also be placed away from centre.



#### Notice

The casing design may be different for special sizes compared to Table 1.

- **Duct design:**  
The side walls of the casing are closed (for the duct connection).

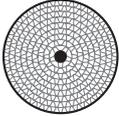
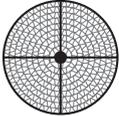
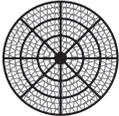
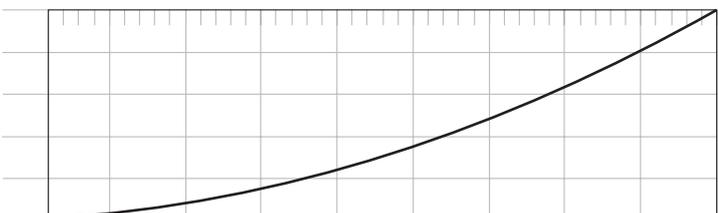
Wheel diameter (in mm)		600	1500	2500	2620	3800	5000
Wheel 1-piece Sheet-metal casing  (Delivery assembled)		[Hatched area]		[Hatched area]			
Wheel 4-piece Profile casing  (Delivery in parts)			[Hatched area]	[Hatched area]			
Wheel 8-piece Profile casing  (Delivery in parts)			[Hatched area]				
Required torque	500 Nm 400 Nm 300 Nm 200 Nm 100 Nm 0 Nm						

Table 1: Overview of designs and wheel dimensions (for standard casing)

### 3.3 Peripheral slide seal

#### High tightness seal

- In rotary heat exchangers with sheet-metal casing automatically adjustable constant-force springs are mounted on the wheel mantle; they press the abrasion-resistant slide seal against the casing. The patented system permanently minimises leakage and allows the unit to be sized for smaller air flow rates.
- In the profile casing a ring seal with externally accessible double springs is used. They press the seal to the casing and to the wheel.

#### Basic tightness seal

- In rotary heat exchangers with sheet-metal casing, sealing strips are mounted on the wheel mantle (e.g. brushes). These guarantee the minimal sealing effect for the air flows that is usual for devices on the market.

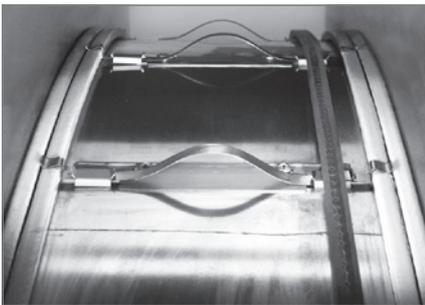


Fig. 14:  
High tightness seal

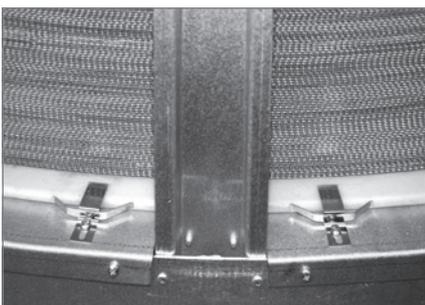


Fig. 15: Peripheral slide seal in profile casing

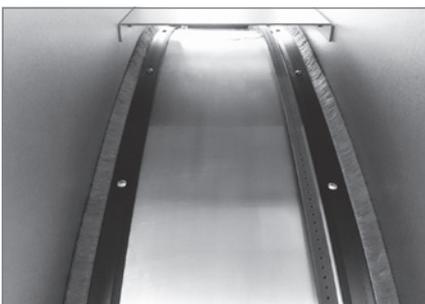


Fig. 16:  
Basic tightness seal

### 3.4 Transverse seal

The transverse seal between the two air streams consists of adjustable aluzinc sheet steel with a triple rubber-lip seal.

### 3.5 Drive

The wheel is driven by an electric motor and belt. The motor is generally fastened on the left or right on a rocker in the casing. Because manufacturers of ventilation units and installers sometimes install their own drive, Hoval offers this component as an option.

2 versions are available:

#### Constant rotational speed

The motor is switched on and off by a single switch or contact. Output regulation (i.e. changing the temperature efficiency or humidity efficiency) is not possible.

#### Controllable rotational speed

The drive motor is controlled by a control unit. A frequency converter (FU) is generally used. Common additional functions are speed monitoring (by inductive sensors) and intermittent operation. If heat recovery is not required, the wheel is moved slightly at intervals to prevent dirt build-up. The control unit and as a result the wheel are normally actuated by the room temperature controller, for which the rotary heat exchanger is perceived as an energy resource for both heating and cooling, which forms part of the cascade control concept.

## 4 Options

### 4.1 Drive

The wheels are driven by a worm gear or a spur-gear drive motor using a v-belt; the type and size of the motor depends on the wheel diameter:

- Drive Y  
for direct drive by mains power. On/Off operation at constant speed only.
- Drive A  
The motor speed and therefore the performance of the rotary heat exchanger can be controlled. A control unit (option R) is required.

Motor designation		A 60	A 250	A 370	A 750
Motor power	kW	0.06	0.25	0.37	0.75
Output shaft	mm	18 x 34	20 x 55	20 x 65	25 x 60
Current Y (direct operation by mains power)	A	0.25	0.83	1.09	1.92
Current Δ (with control unit)	A	0.30	1.44	1.90	3.40
Protection rating	Drive Y	–	IP 44	IP 55	IP 55
	Drive A	–	IP 54	IP 55	IP 55
Motor nominal speed $n_1$	min <sup>-1</sup>	1600	1320	1380	1400
Output speed $n_2$ at 50 Hz	min <sup>-1</sup>	100	132	138	140
Motor nominal torque $m_1$	Nm	0.5	1.81	2.60	5.10
Output torque $m_2$	Nm	6.1	14	21	45
Rotor diameter	mm	up to 1300	up to 1800	up to 2620	up to 3800
Control unit	Type	R / 370	R / 370	R / 370	R / 750

Table 2: Data sheet for rotary drives

## 4.2 Control unit

### Structure

A frequency converter with a modular design is used as the control unit; it can adjust the speed of three-phase motors infinitely. Protection rating IP 54 is required for installation in the ventilation unit. The power unit is protected from under-voltage, overvoltage or non-approved converter temperature. The aluminium casing and the standard input and output filters increase the immunity to interference. Error messages can be read out directly at a flashing LED.

The control unit is delivered ready for operation with the factory-set parameters. Various settings can be changed with an optionally available operating unit.

### Function

- The control unit can be used for condensation, enthalpy and sorption wheels that require speed control. All standard control signals are accepted.
- A quadratic (standard) or linear implementation of the setpoint into the rotary field frequency based on the maximum frequency of the selected parameter set is used.
- As soon as the input signal is below the defined threshold value, the wheel stops rotating. After an adjustable holding time intermittent operation is started and the wheel rotates at the defined speed for a few seconds.
- An inductive sensor can be connected for speed monitoring (option D).
- Readiness for operation and any fault messages can be output via a relay.

### System design

- The control unit is not designed for outside installation.
- The control unit is normally installed in the side wall of the casing.
- The normal installation position is vertical. Sufficient ventilation for heat dissipation is essential.

## Installation



### Caution

All work for transport, installation and commissioning as well as maintenance is conducted by qualified technicians (note IEC 364 and VENELEC HD 384 or DIN VDE 0100 and IEC Report 664 or DIN VDE 0110 and national occupational health and safety regulations or VGB 4).

Qualified technicians as defined by the basic safety instructions are persons who are familiar with the setup, installation, commissioning and operation of the product and are appropriately qualified for their activities (defined in IEC 364 or DIN VDE 0105).

### Commissioning

- Before commissioning the control unit the rotary heat exchanger must be operating correctly.
- The direction of rotation of the wheel can be changed by reversing 2 phases of the motor.
- A green LED lights when the unit is operating without faults.
- Causes of faults are displayed on the control unit.



Fig. 17: Control unit R



#### 4.3 Operating unit

The control unit settings can be customised with the operating unit. Parameters can be configured quickly and easily with the LCD graphical display, the menu structure in German or English and the parameters displayed in plain text.



Fig. 18: Operating unit

#### 4.4 Rotational speed monitoring

The speed of rotation of the wheel can be monitored with an inductive sensor. Stoppages, e.g. caused by a broken v-belt, can be detected quickly and the cause can be corrected.

#### 4.5 Inspection cover

The motor and the v-belt can be inspected through inspection covers on both sides. This is recommended if inspection from the side is not possible.



#### Notice

Inspection covers cannot always be installed in small casing dimensions. If applicable, this is shown in the Hoval CASER design program. Detailed information can be obtained from Hoval's application consulting service.

#### 4.6 Purge sector

When correctly laid out, the purge sector reduces the transmission of extract air to the supply air. The size can be configured individually to reduce the purge and energy loss to a minimum.

Instructions for the optimum settings can be found in Section '7.6 Using and setting the purge sector'.

Factory setting: 3°

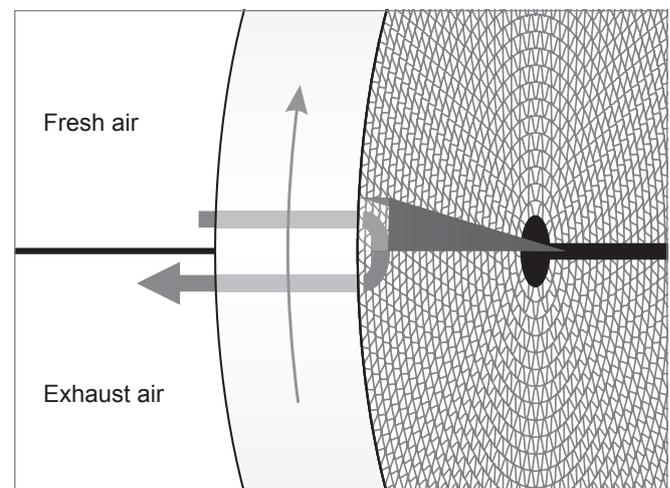


Fig. 19: Purge sector

#### 4.7 Duct design

The side walls of the casings in Hoval rotary heat exchangers with ducts are enclosed. This makes them suitable for the duct connection.

#### 4.8 Coated casing

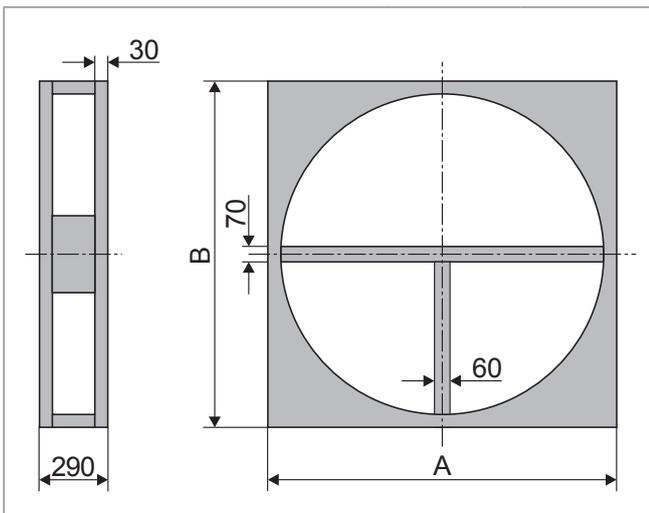
Hoval rotary heat exchangers with coated casings are available for applications with very high hygiene requirements (e.g. hospitals): powder-coated red (RAL 3000).

#### 4.9 Offset wheel position

The hub can be offset for optimum adjustment to the installation situation (such as installation in a ventilation unit).

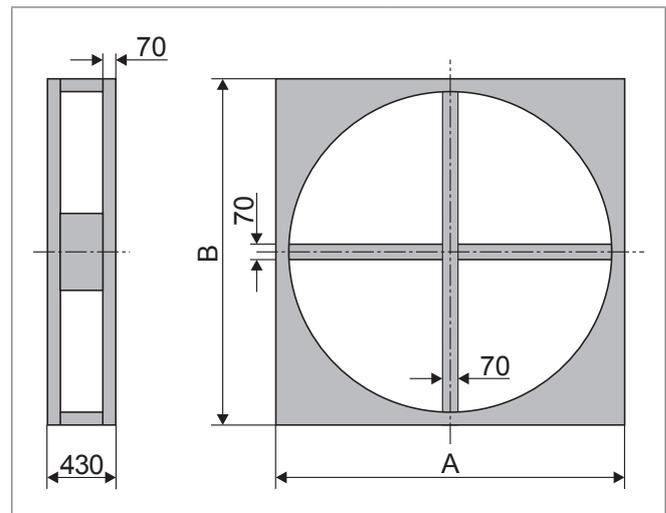
## 5 Dimensions of the exchangers

The minimum size of the casing depends on the wheel diameter. The external dimensions can be individually adjusted.



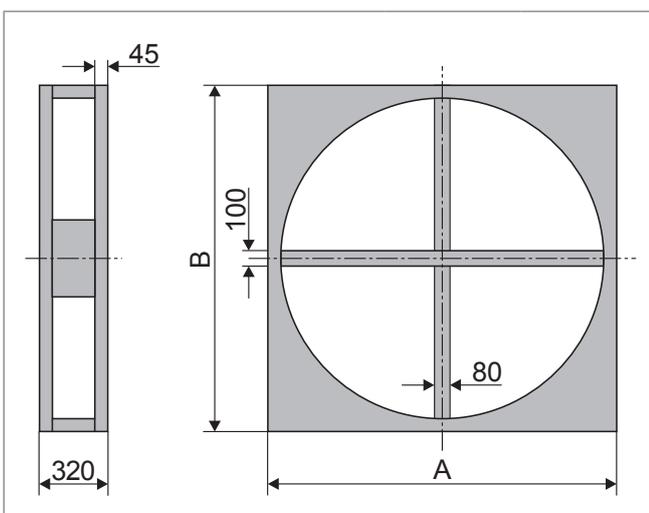
Casing dimensions	min.	max.
Dimension A	$\text{Ø} + 80$	1350
Dimension B	$\text{Ø} + 80$	1350

Table 5: Dimensional drawing for small sheet-metal casing (dimensions in mm)



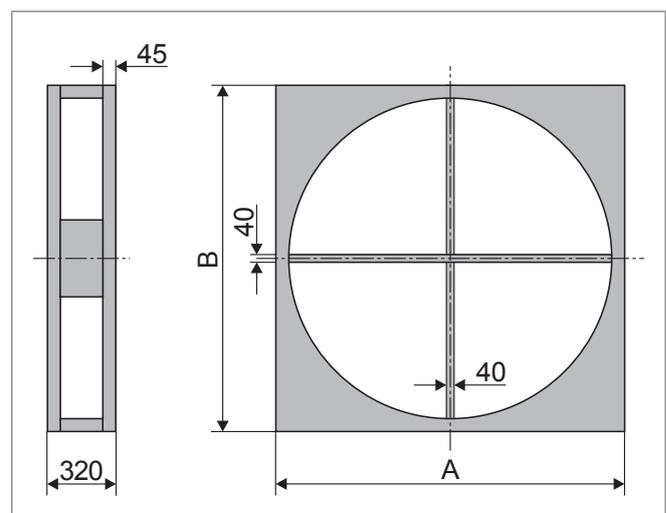
Casing dimensions	min.	max.
Dimension A	$\text{Ø} + 200$	4200
Dimension B	$\text{Ø} + 200$	4200

Table 7: Dimensional drawing for profile casing (dimensions in mm)



Casing dimensions	min.	max.
Dimension A	$\text{Ø} + 80$	2850
Dimension B	$\text{Ø} + 80$	2700

Table 6: Dimensional drawing for large sheet-metal casing, wheel diameter up to 1800 mm (dimensions in mm)



Casing dimensions	min.	max.
Dimension A	$\text{Ø} + 80$	2850
Dimension B	$\text{Ø} + 80$	2700

Table 8: Dimensional drawing for large sheet-metal casing, wheel diameter from 1800 mm (dimensions in mm)

## 6 Unit type reference

A V - A 1 - 0600 / 1.4 / A0680B0680 / S001 / A1, RN, B, D, SR, I3, K, AX1234BX1234

### Air flow

Case A, B, C or D

### Installation position

V Vertical to 20% inclination  
H Horizontal

### Peripheral slide seal

- High tightness seal  
B Basic tightness seal

### Rotor model

A Condensation wheel of aluminium  
E Enthalpy wheel with enthalpy coating  
S Sorption wheel with sorption coating

### Wheel construction and casing design

1 Wheel 1-piece, sheet-metal casing, supplied assembled  
4 Wheel 4-piece, profile casing, supplied unassembled  
8 Wheel 8-piece, profile casing, supplied unassembled

### Wheel diameter (in mm)

Any required size in steps of 10 mm

### Airway height

1.4 mm  
1.6 mm  
1.9 mm  
2.9 mm

### Casing size in mm

Dimension A x dimension B  
Any required size in steps of 1 mm

### Special code

---- Standard

A V - A 1 - 0600 / 1.4 / A0680B0680 / S001 / A1, RN, B, D, SR, I3, K, AX1234BX1234

#### Drive

- Without drive
- A Drive controllable
- Y Drive for constant speed of rotation (direct drive from mains power)
  - 1...3 Specifies the position

#### Control unit

- Without control unit
- RN Control unit, supplied uninstalled

#### Operating unit

- Without operating unit
- B Operating unit in German
- O Operating unit in English

#### Rotational speed monitoring

- Without rotational speed monitoring
- D Rotational speed monitoring

#### Purge sector

- Without purge sector
- SR Purge sector, mounted in position for clockwise direction of rotation
- SL Purge sector, mounted in position for anticlockwise direction of rotation
- SN Purge sector, supplied uninstalled

#### Inspection cover

- Without inspection cover
- I Inspection cover
  - 1...3 Specifies the position

#### Casing model

- Standard
- K Duct design
- C Coated casing

#### Offset

- Standard
- AX Distance of casing edge to wheel axle in dimension A
- BX Distance of casing edge to wheel axle in dimension B

## 7 System design

### 7.1 Hoval CASER design program

The Hoval CASER design program is available for fast and accurate design of Hoval rotary heat exchangers (= **C**omputer **A**ided **S**election of **E**nergy **R**ecovery). It runs under Microsoft® Windows and offers the following applications:

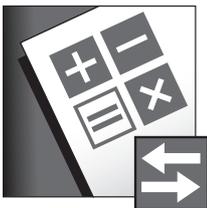
- Secure planning with Eurovent and TÜV-certified data
- Accurate calculation of a specific Hoval rotary heat exchanger
- Calculation of all applicable rotary heat exchangers for a specific project
- Calculation of the efficiency class in accordance with EN 13053
- Calculation of leakage in accordance 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](http://hrs.hoval.com)).

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



### Hoval CASER

### 7.2 Design data

As with all design, achieving the setpoint values depends on the correct starting data. This often causes problems, particularly in ventilation applications. The reason is the dependence of the temperature of the specific density and the specific heat. Water vapour in the air is also very important for the design. This is why the data available on entry to the exchanger are essential for accurate calculation of a heat exchanger.

<b>Exhaust air stream</b>	Extract air flowrate	$V_{11}$ [m³/s]
	Extract air temperature	$t_{11}$ [°C]
	Extract air rel. humidity	$RH_{11}$ [%]
<b>Supply air stream</b>	Fresh air flowrate	$V_{21}$ [m³/s]
	Fresh air temperature	$t_{21}$ [°C]
	Fresh air rel. humidity	$RH_{21}$ [%]

Table 9: Design data

The following errors must be avoided with data recording:

- Volume flow is not equal to mass flow. The mass flows of supply air and exhaust air must be known for correct design.
- The humidity in the extract air is generally estimated too high, particularly for winter operation. (Where does the humidity come from?)
- Are the temperatures (fresh air, extract air) really as stated in practice (or are they wishful thinking)?

### 7.3 Local conditions, installation position

- Where should the heat recovery unit be installed?
- Which is the optimum air path?
- What dimensions are approved?



**Notice**

Please note that the wheel must be accessible for maintenance and cleaning. Hoval therefore recommends to provide 600 mm free space in front of and behind the wheel (= width of an inspection door).

### 7.4 Wheel type

The wheel type must be selected depending on the application. The following are recommended:

- The condensation or enthalpy wheel is suitable for ventilation systems without mechanical cooling and without humidity control.
- Sorption wheels are recommended for ventilation systems with mechanical cooling. The high humidity efficiency, even under summer conditions, dries the fresh air. This requires less cooling capacity and reduces energy costs for cooling up to 50%.

7.5 Performance control

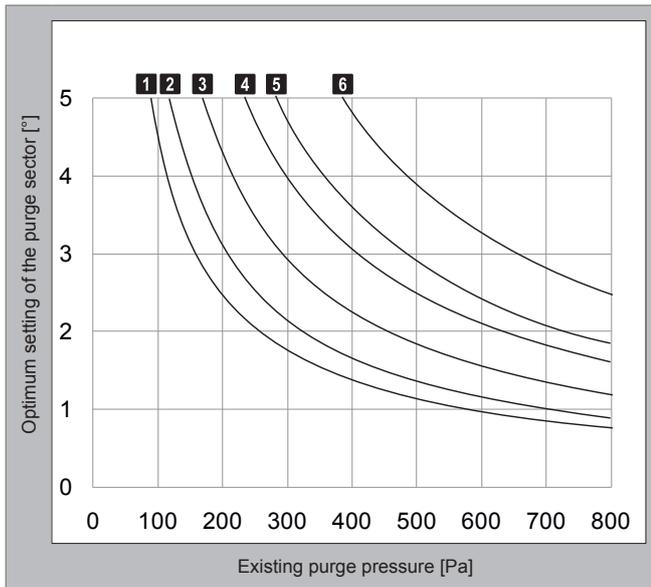
Check which internal heat sources are available in the hall. If the extract air temperature is expected to be significantly higher than the set value, speed control should be planned.

7.6 Using and setting the purge sector

The purge sector reduces transmission of extract air to supply air. It virtually bypasses the fresh air through the wheel to the exhaust air. To avoid deterioration of the temperature efficiency the purge sector must not be too large.

The size of the purge sector in Hoval rotary heat exchangers can be individually adjusted to reduce the energy loss to a minimum. The optimum size of the purge sector depends on:

- the wheel type,
- the existing purge pressure,
- the airway height of the storage mass.



- 1 Condensation/enthalpy wheel airway height 1.9 mm
- 2 Condensation/enthalpy wheel airway height 1.6 mm
- 3 Condensation/enthalpy wheel airway height 1.4 mm
- 4 Sorption wheel airway height 1.9 mm
- 5 Sorption wheel airway height 1.6 mm
- 6 Sorption wheel airway height 1.4 mm

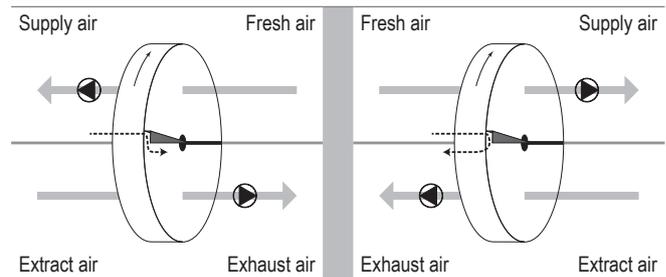
Diagram 1: Purge sector configuration diagram

The required purge pressure  $\Delta p_p$  depends on the layout of the fans:

$$\Delta p_p = p_{\text{supply air}} - p_{\text{exhaust air}} \qquad \Delta p_p = p_{\text{fresh air}} - p_{\text{extract air}}$$

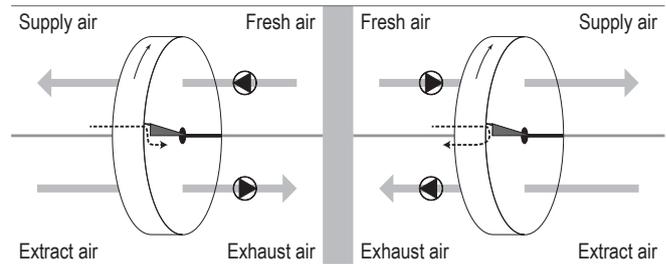
**Both fans suction side:**

A minimum purge pressure of 100 Pa is required.



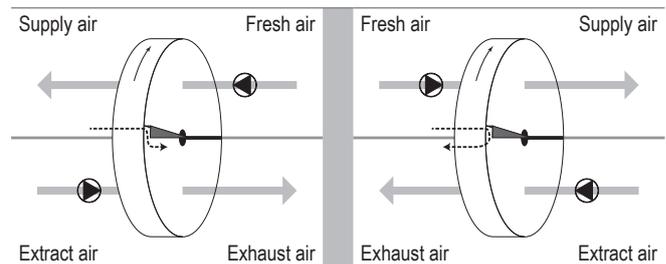
**Exhaust air suction side, fresh air pressure side**

Keep the purge pressure as low as possible to minimise the air flow rate through the purge sector and thus the energy loss. A purge pressure > 800 Pa must be avoided.



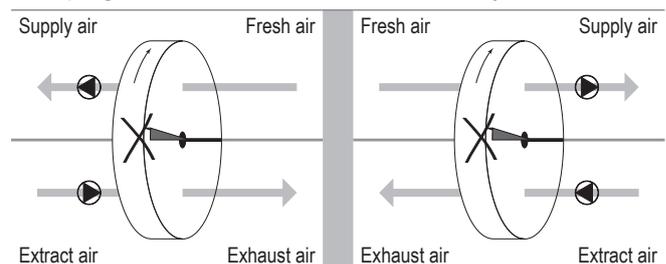
**Both fans pressure side:**

A minimum purge pressure of 100 Pa is required.



**Extract air pressure side, supply air suction side:**

The purge sector cannot be used with this layout.



## 7.7 Mixing of the air streams

Generally a mixing of the air streams must be expected with wheels. Without special precautions VDI 6022 must be observed: 'Regenerators with wheels are to be used only if for hygienic reasons recirculation could also be used.'

Causes for mixing of the air streams include:

- Carryover  
A specific volume of air (depending on the speed of rotation, air velocity and wheel geometry) is rotated in the other direction by an air stream.
  - Leakage  
Leakage through the radial and transverse seals according to the pressure gradients and the seal quality.
  - Extract air transmission  
Because the storage mass is alternately in both air streams, they each influence the other. For example, odours can be transmitted with the smallest particles (e.g. cigarette smoke).
  - Substance transmission  
Wheels also transmit gaseous substances. The amount transmitted depends on the wheel type and the substance itself. Unfortunately, few measurements are available in this field, and on the other hand it is known in practice that this is not a problem for standard VAC systems.
- In rare cases odourants from the extract air may be 'collected' in the wheel and under extreme fresh-air conditions (very high relative humidity) may be emitted again. This can cause odour problems. In general, this problem can be prevented by special adjustments of the cleaning mode or with a minimum speed of rotation.



### Notice

The high tightness seal in Hoval rotary exchangers minimises leakage. They are even certified for operation in hospitals.

## 7.8 Supply air humidification

The humidification downstream from the wheel must be dimensioned to ensure that the desired setpoint value is reached even with minimum fresh-air humidity. Because the wheel speed is generally controlled by the supply air temperature, the corresponding humidity content must be considered when dimensioning the humidifier.

## 7.9 Corrosion

Hoval rotary heat exchangers have proven to be very durable in VAC systems. The Hoval application consulting service can provide information on what equipment to use for applications where corrosion is potential danger, such as in kitchens or specific industrial applications etc.

## 7.10 Application limits

Before selecting the rotary heat exchanger check that application limits are not exceeded during operation:

Temperature	-40...70°C
Pressure difference	max. 2000 Pa
Pressure difference to outside	max. 2000 Pa
Pressure drop	Recommended 80 Pa to 130 Pa

Table 10: Application limits

## 7.11 Danger or contamination

In 'normal' ventilation systems the air streams are generally cleaned with coarse filters. This ensures that there is no danger of dirt build-up on the rotary heat exchanger. If this is a potential problem with specialised applications, this must be considered in the design:

- Install the exchanger so it can be cleaned in its installed position.
- Provide inspection openings before and after the rotary heat exchanger.
- If possible, clean the air stream by filtering to prevent dirt built-up or the cleaning intervals are extended.

In practice it has been demonstrated that the danger of dirt build-up is much less than expected. Clear statements can only be made on the basis of experience. The Hoval application consulting service can also provide information.

## 7.12 Condensation in the warm air stream

If more water condenses from the warm air than the (heated) cold air can absorb, condensate is formed. Because this phenomenon primarily occurs in the first third of the warm wheel side primarily because of the thermodynamic function, some of it is removed by the warm-air stream. This must be considered for downstream components. In general, condensate drip trays should be installed on the warm-air and cold-air side. The following must also be checked or implemented:

- How is the condensate drained off?
- Is there an icing hazard?

## 8 Transport and installation

The following checks must be performed before installation:

- Has the rotary heat exchanger been damaged during transport (visual inspection of casing and wheel)?
- Has the correct model been supplied (type, series, size, options)?
- How must the exchanger be mounted (purge sector)? (Note labels!)

### 8.1 Transport

- The wheel should always be vertical during transport.
- The rotary heat exchanger should be attached to the crossbars of the casing. The pulling direction should be vertical to prevent damage.
- The following general items are applicable: Do not lift the exchanger at a single point but always suspend it by a crane beam (Fig. 20).

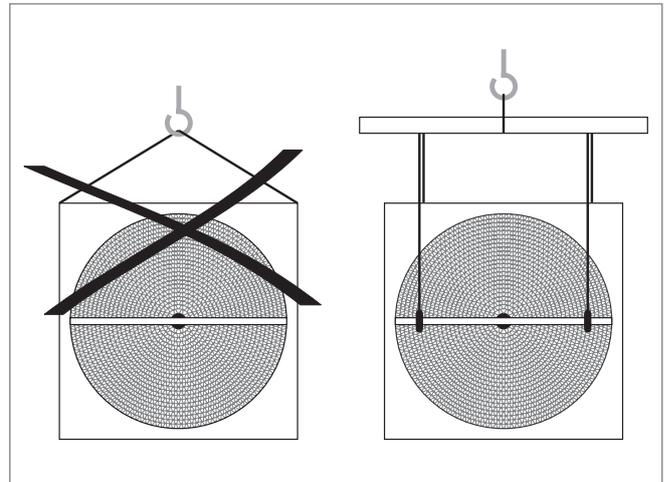


Fig. 20: Recommended attachment

### 8.2 Mechanical installation

- The casing for duct connection can be bolted or riveted at the face area up to 4 cm from the outer frame (Fig. 21).



**Caution**

The wheel casing cannot take any additional load (e.g. ducts).

- When installing the wheel in a ventilation unit, the casing should be reasonably adapted to the unit size (Fig. 22).
- If necessary, baffle plates can be installed to adapt the casing to the unit cross-section.



**Caution**

Ensure that the wheel is not drilled or blocked and the sealings are not damaged during installation.

- Hoval rotary heat exchangers are designed for vertical installation (max. tilt 20°).



**Notice**

Rotary heat exchangers for horizontal installation are available on request. In this case the casing must be supported at the bearings.

- After installation check that the wheel runs smoothly.

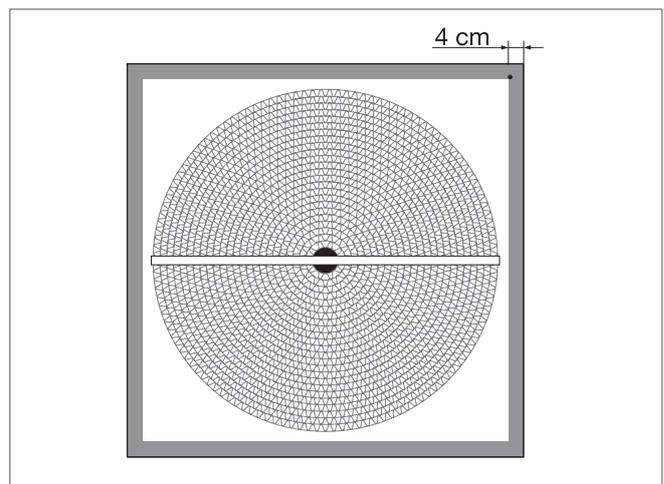


Fig. 21: Drill area

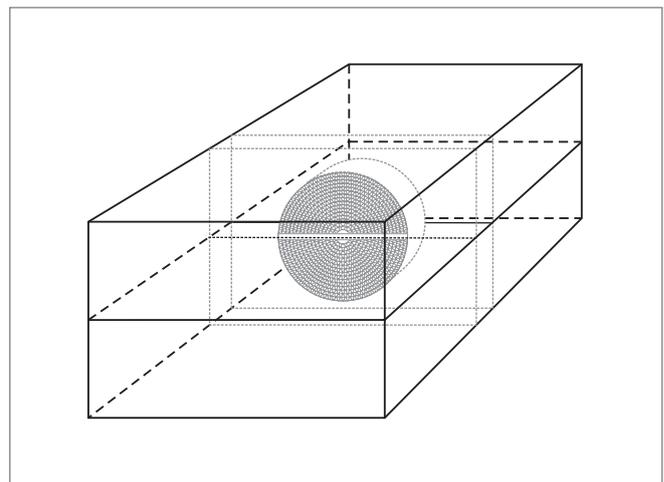


Fig. 22: Casing dimensions adjusted for unit

### 8.3 Installation of sensors

If, for example, temperature sensors are installed, the function of the unit must not be affected.

## 8.4 Electrical installation

### Constant drive

The drive motor is electrically connected at the factory (in Y-circuit). The motor must be correctly fused. The direction of rotation can be reversed by exchanging the phases.

### Variable-speed drive

The control unit is supplied with the unit. The motor must be wired to the control unit and the control unit must be connected during installation.

## 8.5 Assembly of segmented rotary heat exchangers

The installation manual for segmented wheels can be downloaded from the internet. To ensure correct function the installation supervision by a Hoval technician or an authorised supplier is recommended.

## 8.6 Storage

- Rotary heat exchangers with motors must be stored in a dry, dust-free area which is free of vibrations.
- Long periods of standstill can impair the function of gear motors because after some time the bearings lose their lubrication and the seals may become leaky. Too long storage periods must therefore be avoided.

If a rotary heat exchanger is not installed and commissioned within 9 months from the date of delivery it must be put into operation for minimum 5 minutes in order to ensure the reliable operation of the motor.

# 9 Commissioning and maintenance

## 9.1 Commissioning

- Check the correct direction of rotation of the wheel; it is marked by arrows on the casing.
- Check the function of the control unit.
- Ensure that the air streams of the rotary heat exchanger can flow through without obstacles.
- Check that the installation is correct and whether application limits (temperatures, differential pressure, material, etc.) could be exceeded.
- Check the tension of the drive belt and the fastening of the motor.
- Inspect the sealings on the wheel. When making adjustments, ensure that the wheel rotates smoothly and is not blocked. The drive torques listed in Table 1 must not be exceeded.

## 9.2 Maintenance

Maintenance is restricted to regular visual inspections. Inspections should be initially carried out about every 3 months and then after trouble-free operation can be extended to 12 months. The following must be checked:

- Tension of drive belt
- Sealing of gear motor
- Quality of bearings (assess by bearing noise)
- Function of slide seal
- Function of transverse seal
- Condition of casing
- Condition of wheel

Long experience shows that clogging of heat exchangers is not expected in normal cooling and air-conditioning systems. However, if deposits accumulate on the exchanger when used for special applications, it can be cleaned as follows:

- Remove dust and fibres with a soft brush or vacuum cleaner. Use caution when blowing dirt out with compressed air to avoid damage to the wheel. Keep at a distance!
- Oils, solvents etc. can be removed with hot water (max. 70 °C) or grease-removing solvents or immersion. Cleaning with pressure cleaners is possible if the following is observed:
  - a flat 40° nozzle is used (type WEG40/04)
  - max. water pressure 100 bar



### Attention

Do not damage the exchanger mechanically or chemically during cleaning:

- Select compatible cleansing agents.
- Clean carefully. The thickness of the material is less than 0.1 mm!

## 10 Specification texts

### 10.1 Condensation wheel

Rotary heat exchanger for heat transmission consisting of wheel and casing; suitable for optimum dimensioning in accordance with VDI Directive 3803 Page 5.

#### Wheel

The storage mass consists of corrugated and smooth, corrosion-resistant, blank aluminium foil. The result is small, axially arranged, smooth ducts for laminar flow of air. The outside of the storage mass is supported by the wheel mantle; the hub is inside with the permanently lubricated, maintenance-free roller bearings and the axle. The wheel is permanently stabilised by internal spokes between the wheel mantle and hub.

#### Casing

- Sheet-metal casing (for one-piece wheels):  
Self-supporting construction of aluzinc sheet steel, suitable for installation in ventilation units. The automatically adjusted, abrasion-resistant slide seal with constant-force springs (Hoval high tightness seal) reduces internal leakage to a minimum. A lip seal is used as the transverse seal. The motor for the wheel drive can be installed in the casing.
- Profile casing (for multi-component wheels):  
Construction of aluminium extruded sections with aluzinc sheet steel panels, suitable for installation in ventilation units. The high-quality ring seal on both sides in the double-acting support springs reduces internal leakage to a minimum. A lip seal is used as the transverse seal. The motor for the wheel drive can be installed in the casing.

#### Options

- Drive: 3-phase gear motor with belt pulley and v-belt.
- Control unit: for infinite control of speed of rotation; insulation class IP 54. The software includes the speed monitoring and intermittent operation for cleaning.
- Operating unit: for modification of the control program and manual operation (plugged into the control unit).
- Speed monitoring: by sensor and an inductive sensor on the rim of the wheel.
- Purge sector: prevents rotation of the extract to the supply air in the event of pressure gradients between supply air and exhaust air, adjustable to minimise purge and energy loss.
- Inspection cover (on both sides): allows visual inspection of motor and belt.
- Duct design: casing with enclosed side walls for duct connection.
- Coated casing: for applications with very high hygiene requirements (powder-coated red RAL 3000).
- Offset wheel position: for optimum adjustment to the installation situation.

### 10.2 Enthalpy wheel

Rotary heat exchanger for heat and humidity transmission consisting of wheel and casing; suitable for optimum dimensioning in accordance with VDI Directive 3803 Page 5.

#### Wheel

The storage mass consists of corrugated and smooth corrosion-resistant aluminium foil with enthalpy coating for low humidity transmission. The result is small, axially arranged, smooth ducts for laminar flow of air. The outside of the storage mass is supported by the wheel mantle; the hub is inside with the permanently lubricated, maintenance-free roller bearings and the axle. The wheel is permanently stabilised by internal spokes between the wheel mantle and hub.

#### Casing

- Sheet-metal casing (for one-piece wheels):  
Self-supporting construction of aluzinc sheet steel, suitable for installation in ventilation units. The automatically adjusted, abrasion-resistant slide seal with constant-force springs (Hoval high tightness seal) reduces internal leakage to a minimum. A lip seal is used as the transverse seal. The motor for the wheel drive can be installed in the casing.
- Profile casing (for multi-component wheels):  
Construction of aluminium extruded sections with aluzinc sheet steel panels, suitable for installation in ventilation units. The high-quality ring seal on both sides in the double-acting support springs reduces internal leakage to a minimum. A lip seal is used as the transverse seal. The motor for the wheel drive can be installed in the casing.

#### Options

- Drive: 3-phase gear motor with belt pulley and v-belt.
- Control unit: for infinite control of speed of rotation; insulation class IP 54. The software includes the speed monitoring and intermittent operation for cleaning.
- Operating unit: for modification of the control program and manual operation (plugged into the control unit).
- Speed monitoring: by sensor and an inductive sensor on the rim of the wheel.
- Purge sector: prevents rotation of the extract to the supply air in the event of pressure gradients between supply air and exhaust air, adjustable to minimise purge and energy loss.
- Inspection cover (on both sides): allows visual inspection of motor and belt.
- Duct design: casing with enclosed side walls for duct connection.
- Coated casing: for applications with very high hygiene requirements (powder-coated red RAL 3000).
- Offset wheel position: for optimum adjustment to the installation situation.

### 10.3 Sorption wheel

Rotary heat exchanger for heat and humidity transmission consisting of wheel and casing; suitable for optimum dimensioning in accordance with VDI Directive 3803 Page 5.

#### Wheel

The storage mass consists of corrugated and smooth corrosion-resistant aluminium foil with highly effective sorption coating for humidity transmission. Silica gel is used as sorption material, ensuring ideal humidity transmission. The result is small, axially arranged, smooth ducts for laminar flow of air. The outside of the storage mass is supported by the wheel mantle; the hub is inside with the permanently lubricated, maintenance-free roller bearings and the axle. The wheel is permanently stabilised by internal spokes between the wheel mantle and hub.

#### Casing

- Sheet-metal casing (for one-piece wheels):  
Self-supporting construction of aluzinc sheet steel, suitable for installation in ventilation units. The automatically adjusted, abrasion-resistant slide seal with constant-force springs (Hoval high tightness seal) reduces internal leakage to a minimum. A lip seal is used as the transverse seal. The motor for the wheel drive can be installed in the casing.
- Profile casing (for multi-component wheels):  
Construction of aluminium extruded sections with aluzinc sheet steel panels, suitable for installation in ventilation units. The high-quality ring seal on both sides in the double-acting support springs reduces internal leakage to a minimum. A lip seal is used as the transverse seal. The motor for the wheel drive can be installed in the casing.

#### Options

- Drive: 3-phase gear motor with belt pulley and v-belt.
- Control unit: for infinite control of speed of rotation; insulation class IP 54. The software includes the speed monitoring and intermittent operation for cleaning.
- Operating unit: for modification of the control program and manual operation (plugged into the control unit).
- Speed monitoring: by sensor and an inductive sensor on the rim of the wheel.
- Purge sector: prevents rotation of the extract to the supply air in the event of pressure gradients between supply air and exhaust air, adjustable to minimise purge and energy loss.
- Inspection cover (on both sides): allows visual inspection of motor and belt.
- Duct design: casing with enclosed side walls for duct connection.
- Coated casing: for applications with very high hygiene requirements (powder-coated red RAL 3000).
- Offset wheel position: for optimum adjustment to the installation situation.



## Responsibility for energy and environment

The Hoval brand is internationally known as one of the leading suppliers of indoor climate control solutions. More than 65 years of experience have given us the necessary capabilities and motivation to continuously develop exceptional solutions and technically advanced equipment. Maximising energy efficiency and thus protecting the environment are both our commitment and our incentive. Hoval has established itself as an expert provider of intelligent heating and ventilation systems that are exported to over 50 countries worldwide.

### International

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### Hoval heating technology

As a full range supplier Hoval helps its customers to select innovative system solutions for a wide range of energy sources, such as heat pumps, biomass, solar energy, gas, oil and district heating. Services range from small commercial to large-scale industrial projects.



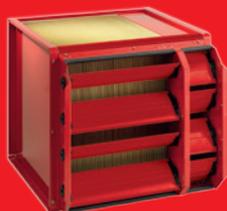
### Hoval comfort ventilation

Increased comfort and more efficient use of energy from private housing to business premises: our comfort ventilation products provide fresh, clean air for living and working space. Our innovative system for a healthy room climate uses heat and moisture recovery, while at the same time protecting energy resources and providing a healthier environment.



### Hoval indoor climate systems

Indoor climate systems ensure top air quality and economical usability. Hoval has been installing decentralised systems for many years. The key is to use combinations of multiple air-conditioning units, even those of different types, that can be controlled separately or together as a single system. This enables Hoval to respond flexibly to a wide range of requirements for heating, cooling and ventilation.



### Hoval heat recovery

Efficient use of energy due to heat recovery. Hoval offers two different solutions: plate heat exchangers as a recuperative system and rotary heat exchangers as a regenerative system.