

Decentralised Indoor Climate Systems

Argumentation

Hoval

Responsibility for energy and environment



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Responsibility for energy and environment

Efficient and economical

Efficiency

- Minimal loss of energy and ideal air supply and distribution
- Ventilation and connection of recirculation units optimised according to requirements
- Needs-based ventilation with "Air quality" operating mode
- Needs-based night cooling with adapted air volume
- Excessive cooling and overheating protection in Standby mode

Saving energy

- High level of comfort due to ideal air supply and distribution
- Duct-free system without energy loss due to ducts
- Heat recovery from Hoval Enventus with superior performance and optimised control concept

Clean and ecological

Clean air at all times

- Cleanly separated air streams in heat recovery
- No contamination of supply air due to air ducts that are hard to clean

Ecological

- Naturally ecological room cooling with adiabatic systems
- Use of highly efficient heat recovery
- Use of renewable energy sources

Decentralised and modular

Flexible

- Diverse range of coordinated units for flexible mixed systems
- Completely decentralised system
- Easy to plan and to expand due to modular design
- For a wide range of diverse applications
- Specific unit versions for special applications and process extract air

Quick to install, easy to maintain

- Ready-to-connect solution with prefabricated cable harnesses and connections
- Clear interfaces for external connections
- Units that are ready for operation with matching accessories
- Easy to maintain without interrupting operation

Competent and reliable

Customer care

- Support over the entire system life cycle
- One contact person for the entire system
- Units supplied with control systems and CE certification
- Local contacts

Safety

- Independent unit response to alarm messages
- Alarm messages by e-mail
- Simple and clearly defined operating modes
- Simplex operation possible even without commissioning

Systematic control

- Patented control algorithm with specialist expertise

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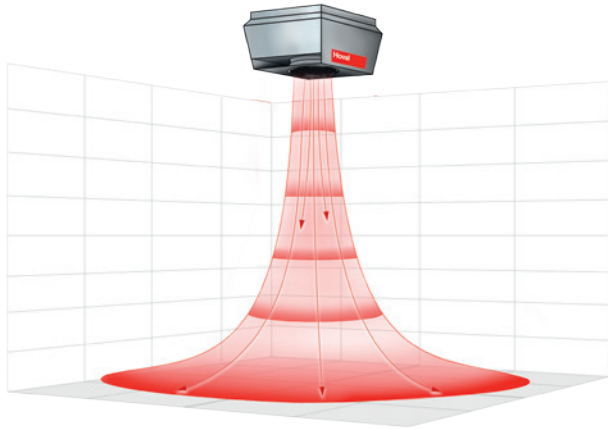


Efficient and
economical

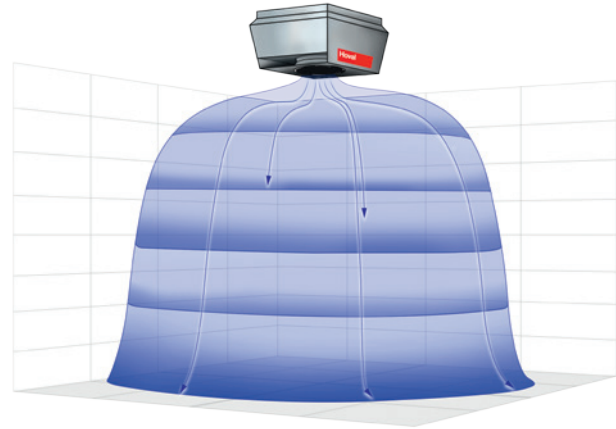
Clean and ecological

Decentralised and
modular

Competent and
reliable



Heating: the supply air is warmer and thus lighter than the room air, causing it to flow upwards. The vertical air supply ensures that the heat reaches the areas where it is needed.



Cooling: the air flowing in is colder than the room air and therefore sinks. To avoid draughts, it is injected horizontally.

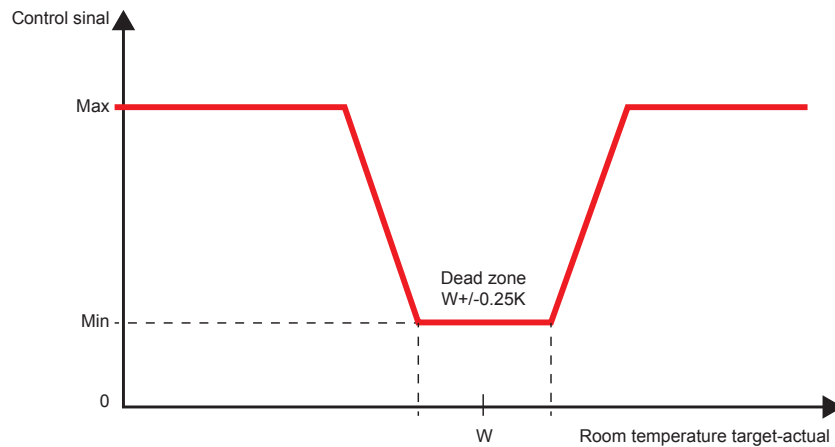
Minimal loss of energy and ideal air supply and distribution



Hoval indoor climate systems are an easy and efficient solution. The patented air supply and distribution system helps reduce temperature stratification in the halls. Therefore, the difference between the room temperature under the roof and the outside temperature remains as small as possible and only a minimal amount of energy is lost through the roof.



The fast discharge velocity of the Air-Injector leads to high induction and a “carry-along” effect for secondary air – the supply air mixes quickly with the room air and therefore reduces the difference in temperature over the hall height. Due to the low temperature difference over the entire hall height, the room temperature is also lower directly under the building’s roof. This reduces the loss of heat through the roof. Our calculation tool determines the possible energy savings quickly and easily.



Control diagram for adjusting the air quantity: if the room temperature drops below or exceeds the set value by 0.25 K, the quantity of air is adjusted accordingly.

Ventilation and connection of recirculation units optimised according to requirements



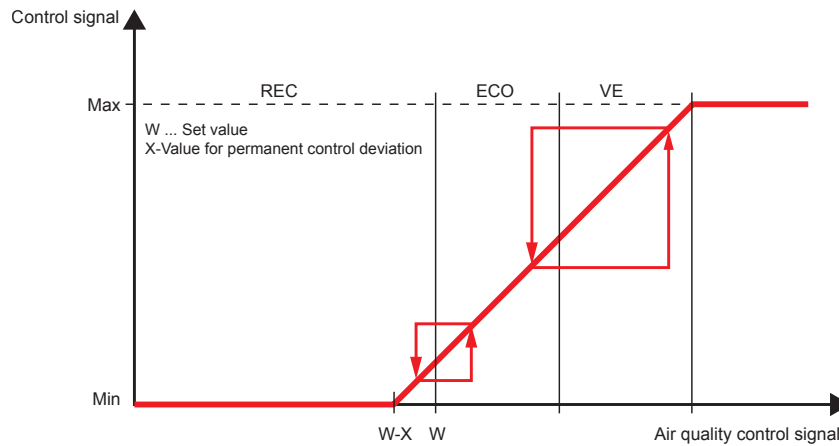
Hoval indoor climate systems operate with minimal energy consumption, as they only supply the amount of air required to reach the set room temperature. In the case of mixed systems, recirculation units are only connected if the heating or cooling capacity of the fresh air air units is no longer sufficient.



The supplied air quantity is controlled between a minimum and maximum value depending on the room temperature set value deviation. If the set value deviation is high, the air quantity increases to the maximum value.

- The minimum value is adjustable according to customer requirements. Yet, depending on the mounting height a certain air quantity is always required to ensure that the air stream penetrates down to the occupied area.
- The maximum value corresponds to the nominal air quantity of the units.

The switch-on and switch-off points of recirculation units are always optimised. They are determined via a time-temperature integral depending on the extent and duration of the temperature deviation.



Sequence control diagram: depending on the room air quality the operating mode and the quantity of air are adjusted accordingly.

Needs-based ventilation with “Air quality” operating mode



The “Air quality” operating mode supplies and conditions ¹⁾ precisely the quantity of fresh air that is necessary to reach and maintain the air quality set values – and no more. This minimises energy consumption.



In the “Air quality” (AQ) operating mode, the units are switched between recirculation operation, eco operation (specifically defined mixed air operation with 50% fresh air and 50% recirculated air) and ventilation depending on the air quality.

¹⁾ *Conditioning ... heating/cooling*

Needs-based night cooling with adapted air volume



Hoval indoor climate systems are more efficient because their operation can be easily tailored to specific customer requirements.

During night cooling, the air quantity can be adapted to customer requirements.



The air quantity for night cooling can be adapted to specific parameters, such as switch-on and switch-off times, on a project-specific basis.

Code	Operating mode	Description
ST	Standby The unit is normally switched off. The following functions remain active:	
CPR	<ul style="list-style-type: none"> Excessive cooling protection: If the room temperature drops below the set value for excessive cooling protection, the unit heats up the room in recirculation operation. 	Supply air fan MAX Exhaust air fan off Energy recovery 0 % Extract air damper closed Recirculation damper open Heating/cooling on
OPR	<ul style="list-style-type: none"> Overheating protection: If the room temperature rises above the set value for overheating protection, the unit cools down the room in recirculation operation. If the temperatures also permit fresh air cooling, the unit automatically switches to night cooling (NCS) to save energy. 	
NCS	<ul style="list-style-type: none"> Night cooling: If the room temperature exceeds the set value for night cooling and the current fresh air temperature permits it, the unit blows cool fresh air into the room and extracts warmer room air. 	Supply air fan MAX Exhaust air fan MAX Energy recovery 0 % Extract air damper open Recirculation damper closed Heating/cooling off



Excessive cooling and overheating protection are defined in the Standby operating mode.

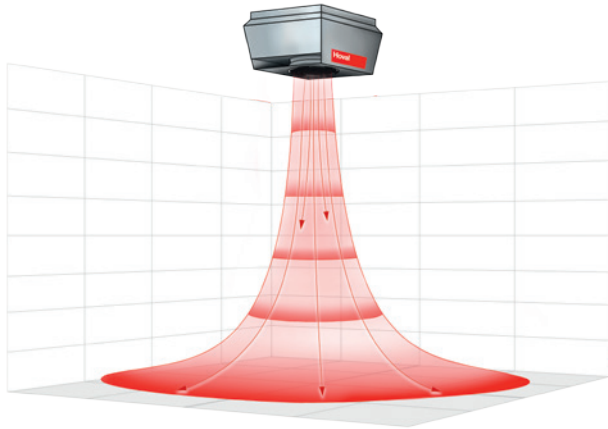
Excessive cooling and overheating protection in Standby mode




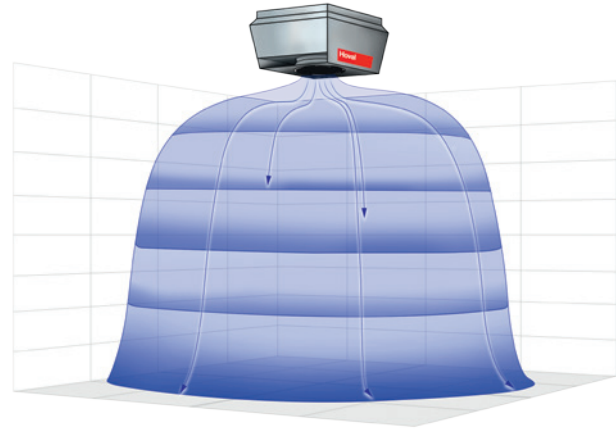
Due to their excessive cooling and overheating protection options, Hoval indoor climate systems save energy even during periods of downtime, such as plant holidays or weekends.




The building can be kept within a defined room temperature range with the excessive cooling and overheating protection, which prevents the building from overheating or cooling down.



 Heating: the supply air is warmer and thus lighter than the room air, causing it to flow upwards. The vertical air supply ensures that the heat reaches the areas where it is needed.



 Cooling: the air flowing in is colder than the room air and therefore sinks. To avoid draughts, it is injected horizontally.

High level of comfort due to ideal air supply and distribution



The automatically adjustable Air-Injector vortex air distributor ensures a high degree of comfort for the building users. Regardless of whether the building is being heated or cooled: there are no draughts.

Due to their efficient air distribution, the units cover a large area. This means that fewer units are required.



Due to the high induction and the air being mixed, the speed of the supply air flow is quickly reduced.

The air supply is steplessly controlled between horizontal and vertical supply based on the difference between the room temperature and the supply air temperature. This is a fully automatic process which is carried out via adjustable vanes.

In the case of horizontal air supply, the Coanda effect results in a stable horizontal flow. The very large area subjected to the flow enables a small number of units while ensuring uniform air distribution. Due to stable flows, the area remains the same size for heating and cooling.

		4x RoofVent RH-9C/R1	1x Centralised unit
Nominal air flow rate	m³/h	8000	32 000
Pressure drop on supply air side	Pa	560	411
Pressure drop on extract air side	Pa	360	468
Pressure drop of duct system ¹	Pa	-	600
Static fan efficiency	%	63	65
Specific fan power per ventilation unit	W/(m³/s)	1460	2275
Specific fan power of duct system	W/(m³/s)	-	923
Specific fan power of the entire system	W/(m³/s)	5841	3198
Power consumption of the entire system	W	12 981	28 431
Fan power saving	%	54	
Cost of electricity for air handling ²	EUR/a	6090	13 340
Cost savings	EUR/a	-7249	

¹ Assumed pressure drop of duct system on supply air and extract air side

² Calculation of operating costs under the following conditions:

- Specific cost of electricity 0.17 EUR/kWh
- Operating hours per day 12h/d
- Working days per year 230 d/a
- Operating hours per year 2760h/a



The example calculation demonstrates the basic energy problem in duct systems.

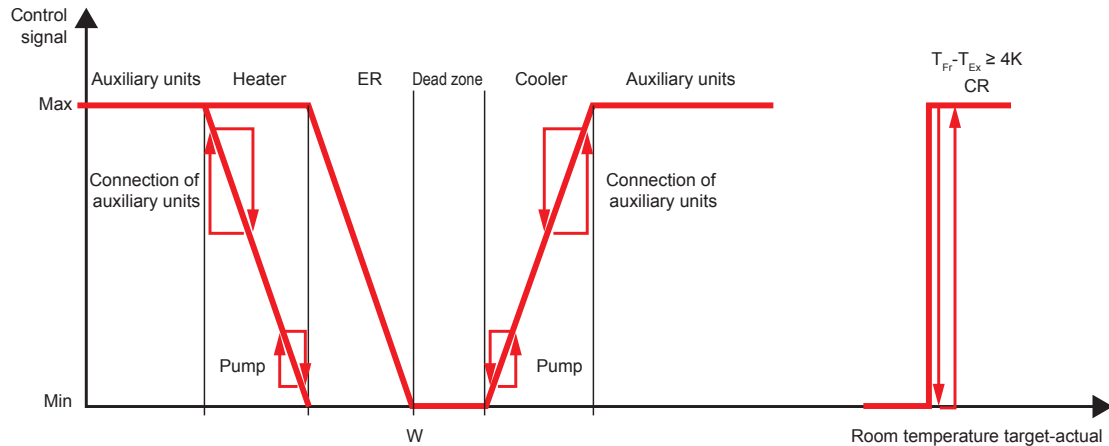
Duct-free system without energy loss due to ducts



Pressure drops occur in all ducted ventilation systems and lead to energy loss. Hoval indoor climate systems are completely duct-free, thereby preventing unnecessary loss of energy.



Pressure drops in ducts are cubed when calculating the electrical power consumption. This means that reducing pressure drops results in a much lower electrical power consumption and very high energy savings compared to a unit with a duct system. Due to the air leak rate, conventional duct systems have to constantly supply more air in order to provide the required air quantity at the air outlets. Hoval indoor climate systems save energy by their very nature, since they operate without ducts. The calculation tool determines the energy savings quickly and easily.



The temperature control of the units is divided into sequences.

Heating operation (sequence based on increasing heat output):

- Heat recovery
- Heating coil

Cooling operation (sequence based on increasing cooling output):

- Cooling coil
- Cooling recovery as described above only after $\Delta T \geq 4\text{ K}$ – parallel to the cooling coil

Heat recovery from Hoval Enventus with superior performance and optimised control concept



With 40 years of experience, significant expertise and its own production facilities, Hoval Enventus gives a unique performance in terms of energy recovery.

The control concept for energy recovery reliably ensures that a minimum amount of energy is consumed.



Through Hoval Enventus' own product development and production, the heat recovery system is always ideally designed for every unit and application.

The optimised control algorithm enables heat or cooling recovery depending on the temperature ratio between the extract air and the fresh air. Cooling recovery is only activated when the difference between the fresh air temperature and extract air temperature is ≥ 4 K, when it is sensible in energetic terms.

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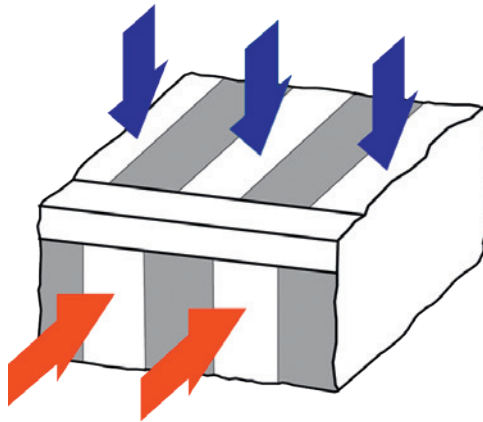


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The air streams in the plate heat exchangers are separated by thin plates and pass each other in cross-flow.

Cleanly separated air streams in heat recovery



Hoval indoor climate systems always ensure clean air. By guiding the air streams separately in the plate heat exchanger, there is no contamination and odours are not transferred from the extract air to the fresh supply air. Indirect free cooling or indirect adiabatic cooling via plate heat exchangers prevents the room air from humidifying, thereby protecting the units and equipment from excessive moisture and preserving the comfort in the room.



The streams of extract/exhaust air and fresh/supply air are hermetically separated from each other in the plate heat exchanger by a thin metal sheet with a double seam and sealing putty. Separating the air streams enables indirect free cooling and indirect adiabatic cooling and provides constant relative humidity in the room.

Nominal air quantity of the ventilation system	m³/h	32 000
Hall height	m	8
Air change rate		1.5 times
Floor area of the hall	m²	2 660
Dimensions	m x m	53 x 50
Air outlets	Units	9
Air duct connections horizontal	m	3 x 40
Air duct connections vertical	m	1 x 38
Branch ducts down to air ducts	m	9 x 3
Total length of supply air ducts	m	185
Total length of extract air ducts	m	158
Total length of air ducts	m	343
Specific cleaning costs ¹	EUR/m	15
Number of cleanings ²	a	1
Total cost for cleaning the air ducts	EUR/a	1 715
Specific cost for cleaning the air ducts	EUR/m²	0.64

¹ Guide value for end user price in Germany

² VDI 6022 with normal dirt level and normal application (no process extract air)



The table shows a sample calculation of the duct network length and a cost estimation for duct cleaning.



Dusty or germ-laden air duct systems provide an ideal breeding ground for bacteria, viruses, legionella, parasites, mites, moulds and pollen.

No contamination of supply air due to air ducts that are hard to clean



Dirty air ducts can lead to health problems as they allow germs to form (sick building syndrome).

This does not occur with Hoval indoor climate systems because the air outlets are located directly on the units. This eliminates the time and cost of maintaining and cleaning air ducts that are often difficult to reach. And, most importantly, the supply air cannot be contaminated due to the system's design.



The design of the Hoval indoor climate system eliminates the need for maintaining and cleaning the air ducts. In Germany, maintaining and cleaning the air ducts is mandatory according to standard VDI 6022 and must be performed by the operator. The total costs saved can be determined quickly and easily using the calculation tool.

Sick building syndrome: describes a range of health problems experienced by people who spend a long time in certain buildings. The symptoms disappear very quickly after leaving the building. Therefore, they are caused by the building and can be attributed to pollutants in the room air.

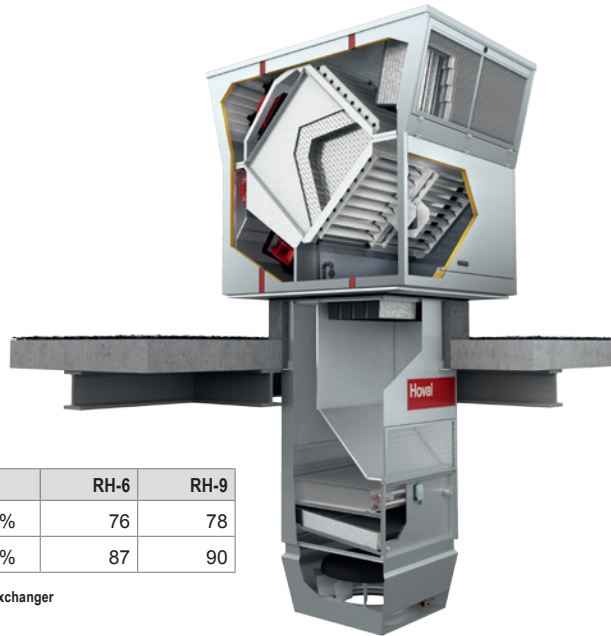
Naturally ecological room cooling with adiabatic systems



The adiabatic cooling process in Hoval indoor climate systems is sensible both in economic and ecological terms. Dispensing with mechanical refrigeration not only reduces operating costs, but also helps the environment due to the absence of refrigerant.



The adiabatic cooling process in Hoval indoor climate systems involves wetting a plate heat exchanger. The water evaporates and absorbs the evaporation energy, thereby cooling the air stream.



Unit type		RH-6	RH-9
Temperature efficiency, dry	%	76	78
Temperature efficiency, wet	%	87	90

Table: Thermal transfer level of the plate heat exchanger



The table shows the thermal transfer level of the plate heat exchanger in the RoofVent® unit.

Use of highly efficient heat recovery



Hoval indoor climate systems are highly efficient heat recovery systems. This saves both investment and operating costs – and it reduces CO₂ emissions.



Due to the highly efficient heat recovery, heat and cooling generation units can be designed in smaller versions.



Decentralised indoor climate units with heat pump

Use of renewable energy sources



Hoval indoor climate systems can use renewable energy sources. In Germany, this counts towards compliance with the requirements of the EEWärmeG (German Renewable Energy Sources Act) and the EnEV (German Energy Saving Ordinance).



Our indoor climate systems are designed to be completely decentralised. Each unit can easily be combined with Hoval heat pumps.

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Decentralised and modular





The decentralised indoor climate system guarantees maximum adaptability.

Diverse range of coordinated units for flexible mixed systems



The diverse range of coordinated units makes it very easy to design the entire system so that it operates efficiently. The number of fresh air units can be precisely matched to the required quantity of fresh air, which reduces investment and energy costs.



Depending on the requirements, the number of fresh air and recirculation units can vary in the Hoval indoor climate system.

- The required quantity of fresh air which has to be conditioned determines the number of fresh air units,
- while recirculation units cover the remaining load – i.e. the remaining transmission heat requirements and transmission sensible gains.

Completely decentralised system



The Hoval indoor climate system is designed to be completely decentralised, which offers the following key advantages:

- Quick and easy planning
- Low investment costs as a pipe network for heating and cooling supply is not required
- Reliable system operation due to redundancy in case of unit failure



When using completely decentralised systems (units with heat pump), it is not necessary to adapt the heating and cooling supply or the pipe network.

The decentralised system design ensures high system reliability – if one unit fails, the other units continue to work. In the event of a failure in systems with centralised units, the fresh air supply fails completely. In contrast, the decentralised Hoval indoor climate systems ensure at least a partial supply of fresh air through unit redundancy.



The Veith plant in Öhringen (Germany)

Easy to plan and to expand due to modular design



Hoval indoor climate systems facilitate a quick and easy planning process. They can be perfectly integrated into a uniform roof structure, and they do not require any special designs for extremely high loads. It is also possible to extend existing systems at any time with a small number of adaptations and low investment costs.



Finished units simplify planning, and the large selection of units makes it easy to adapt every system according to the operator's requirements. Existing systems can easily be expanded by incorporating additional units. Unlike conventional systems, the supply air duct network does not need to be adapted. Distributing the weight over the entire roof is a great advantage in terms of statics. There are no large point loads which are typical for central units.



You can find our references on our homepage or in our reference manual.

For a wide range of diverse applications



Hoval indoor climate systems can be used for a wide range of applications: manufacturing halls, multipurpose halls, high-bay warehouses, logistics centres, shipyard halls or other halls up to 25 m in height.



Distributing air with the Air-Injector is possible in halls up to 25 m high. The same unit can be used for all kinds of applications and uses. It is very easy to convert or modify the units according to the application.

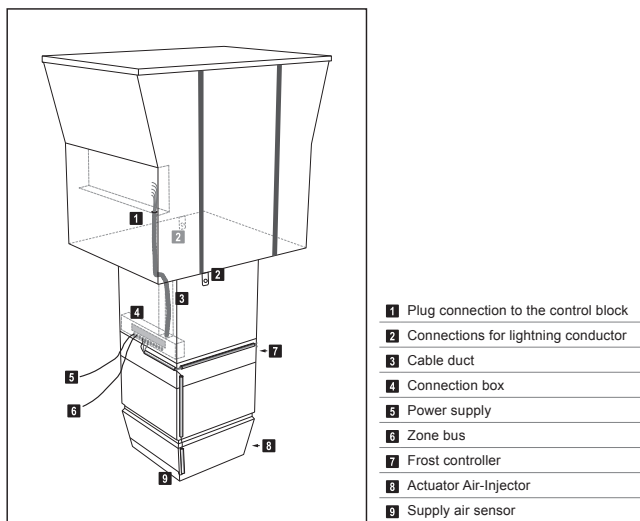
Specific unit versions for special applications and process extract air



For special fields of application, Hoval offers specially developed unit versions for maximum functional reliability.



- Hoval supplies RoofVent® units in an oil-proof design or ProcessVent units for process extract air.
- Corrosive extract air can be treated with RoofVent® supply and extract air handling units in a corrosion-protected design.
- For high extract air humidity, Hoval also offers an adapted design for the RoofVent® supply and extract air handling units.
- Hoval solutions are also the first choice for swimming pools impacted by high extract air humidity that require a corrosion-protected design.



The systems are installed very quickly
due to our ready-to-connect solution.

Ready-to-connect solution with prefabricated cable harnesses and connections



The system is delivered as a ready-to-connect solution, ensuring a quick and easy installation process. Furthermore, the precise specifications concerning the predefined hydraulic and electric connection points also simplify planning. All costs and expenses for additional roof openings for cable feedthrough are not required for RoofVent® supply and extract air handling units.



The unit is completely wired on delivery. Plug connections between the roof unit and the below-roof unit enable quick and easy assembly.

There is a predefined connection point, which can be easily integrated into the planning process, for all electrical connections. The interface between the components and the trades responsible for them is clearly defined.

The connection point for the entire electrical system is located on the below-roof unit. The electrical supply for the roof unit is integrated and tested at the factory.



You can find the technical data for the indoor climate units in the respective design handbook.

Clear interfaces for external connections



Hoval indoor climate systems minimise the need for clarifying interfaces, as the possibilities for external connections are clearly defined.



There are defined connections for special functions, external signals and much more. Clear descriptions are available in the design handbooks.

Units that are ready for operation with matching accessories



All units are supplied as ready for operation from the factory. The system is easy and safe to commission. The coordinated accessories simplify planning, as there is no need to configure additional components.



All unit functions are tested at the factory before delivery. Prefabricated hydraulic assemblies and mixing valves that are adapted to the units reduce the work for system designers.

Easy to maintain without interrupting operation



With Hoval indoor climate systems, operation does not need to be interrupted to maintain the units. Therefore, maintenance does not incur any additional costs.



It is possible to maintain individual units during normal operating times, as operation is continued by the remaining units.
In the case of conventional central units, on the other hand, the entire system has to be taken out of service and no fresh air is supplied – maintenance is therefore only possible outside normal operating times.

Competent and reliable



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Support over the entire system life cycle



A single contact person provides expert support for the entire indoor climate system over the entire product life cycle – from planning to disposal.



Before

- Support in designing and configuring new systems
- Advice for renovating existing systems

During

- Support whilst installing the equipment
- Connecting individual system components
- Commissioning the system
- Training the operating personnel

After

- Safe, reliable system as a result of regular maintenance
- Unit cleaning and hygiene inspection in line with applicable legislation

One contact person for the entire system



With Hoval indoor climate systems, you are provided with a single contact person, and the project responsibilities are clearly assigned. Hoval is your partner for the entire system, and you do not have to discuss responsibilities with other companies or subcontractors.



Hoval is a system supplier for heat generation, climate technology, hydraulic systems and control systems. Customer needs are fulfilled with a complete system from a single source.

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With the CE marking, Hoval declares that the product is in conformity with the applicable requirements set out in the European Union's harmonization legislation providing for its affixing.

Units supplied with control systems and CE certification



Hoval handles the entire CE certification process for Hoval indoor climate systems. The plant engineer (the distributing company) does not have to provide any certification for the units and therefore does not assume any responsibility for this. The planner can therefore be sure that the unit consistently conforms to CE requirements.



Hoval supplies units with control systems (complete machines according to the Machinery Directive as well as the Ecodesign Directive for Energy-Related Products) and the corresponding CE certification. In the case of conventional central units that are supplied without control system, the plant engineer only receives a declaration of incorporation from the manufacturer. The plant engineer must then draw up the declaration of conformity and is therefore also responsible for ensuring that the unit is designed and operated according to the Machinery Directive and the Ecodesign Directive for Energy-Related Products.



Head office of the Hoval Group – Vaduz, Principality of Liechtenstein
16 international companies within the group
Exporting to over 50 countries

Local contacts



Expert local contacts are available at short notice and can be at your site in no time. They speak your language and ensure mutual understanding.



Local Hoval contacts are available and nearby in every country.

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Independent unit response to alarm messages



Even in the event of faults, Hoval indoor climate systems allow safe system operation and reliable temperature control with the recirculation operating mode.



Hoval indoor climate systems offer a protection mode when alarm messages occur: they switch to the recirculation operating mode.

Alarm messages by e-mail



Unit alarms are detected immediately, which allows for faster resolution of the problem.



The system alarm messages can be forwarded by e-mail to a group of recipients that can be defined freely.

Code	Operating mode	Description
VE	Ventilation The unit blows fresh air into the room and exhausts polluted room air. The room temperature set value day is active. Depending on the temperature conditions, the system controls: <ul style="list-style-type: none"> the energy recovery the heating/cooling the supply air/exhaust air volume (between the adjustable minimum and maximum values) 	Supply air fan.....MAX Exhaust air fan.....MAX Energy recovery.....0-100 % Extract air damper.....open Recirculation damper.....closed Heating/cooling.....0 - 100%
VEL	Ventilation (reduced) As VE, but the unit only operates with the set minimum values for the supply and exhaust air volumes	Supply air fan.....MIN Exhaust air fan.....MIN Energy recovery.....0 - 100 % Extract air damper.....open Recirculation damper.....closed Heating/cooling.....0 - 100%
AQ	Air quality This is the operating mode for demand-controlled ventilation of the room. The room temperature set value day is active. Depending on the current room air quality and temperature conditions, the system operates in one of the following operating states:	
AQ_REC	<ul style="list-style-type: none"> Air quality Recirculation: When air quality is good, the unit heats or cools in recirculation operation. 	Like REC
AQ_ECO	<ul style="list-style-type: none"> Air quality Mixed air: When ventilation requirements are medium, the unit heats or cools in mixed air operation. The supply/exhaust air volume is based on the air quality. 	Supply air fan.....MIN-MAX Exhaust air fan.....MIN-MAX Energy recovery.....0-100 % Extract air damper.....50 % Recirculation damper.....50 % Heating/cooling.....0 - 100%
AQ_VE	<ul style="list-style-type: none"> Air quality Ventilation: When ventilation requirements are high, the unit heats or cools in pure ventilation operation. The supply/exhaust air volume is based on the air quality. 	Supply air fan.....MIN-MAX Exhaust air fan.....MIN-MAX Energy recovery.....0-100 % Extract air damper.....open Recirculation damper.....closed Heating/cooling.....0 - 100%

Code	Operating mode	Description
REC	Recirculation On/Off recirculation operation with TempTronic algorithm: During heat or cool demand, the unit draws in room air, heats or cools it and blows it back into the room. The room temperature set value day is active.	Supply air fan.....0 / 50 / 100 % *) Exhaust air fan.....off Energy recovery.....0 % Extract air damper.....closed Recirculation damper.....open Heating/cooling.....on *) *) Depending on heat or cool demand
EA	Exhaust air The unit extracts spent room air. There is no room temperature control. Unfiltered fresh air enters the room through open windows and doors or another system provides air supply.	Supply air fan.....off Exhaust air fan.....on *) Energy recovery.....0 % Extract air damper.....open Recirculation damper.....closed Heating/cooling.....off *) Adjustable flow rate
SA	Supply air The unit blows fresh air into the room. The room temperature set value day is active. Depending on the temperature conditions, the system controls the heating/cooling. Spent room air passes through open windows and doors or another system provides extraction.	Supply air fan.....on *) Exhaust air fan.....off Energy recovery.....0 % **) Extract air damper.....open Recirculation damper.....closed Heating/cooling.....0-100 % *) Adjustable flow rate **) Fresh air and bypass dampers are open



Table describing the operating modes taken from the RoofVent® design handbook

Simple and clearly defined operating modes



The function of the individual operating modes is clearly defined in the planning phase. Commissioning is carried out quickly and without any problems, resulting in safe operation.



Hoval indoor climate systems feature predefined operating modes with precisely defined monitoring and control functions for each operating mode. The operating modes were rigorously tested during the development phase of the control system. In comparison, conventional central units that are supplied without control system are in many cases programmed specifically and cannot be tested in detail in advance.

Simplex operation possible even without commissioning



Immediately after the system has been connected by an electrician, it can be run in simplex operation to heat the hall during the construction phase. This saves costs that would otherwise be spent on a separate heating system. The electrician can activate simplex operation by means of a simple electrical adaptation according to the wiring diagram. It is not necessary to commission a service technician for this purpose.



Even without commissioning, it is possible to use the units for heating without a control function. The unit simply requires a power supply.

- Recirculation units: operate automatically when they are connected to a power supply
- Supply and extract air handling units: operate via a wire jumper in the unit control box

In contrast, conventional central units must mostly be wired internally and commissioned manually after installation.

Patented control algorithm with specialist expertise



The **patented control algorithm** for Hoval indoor climate systems offers many benefits: The room climate control adapts to different areas of use in the building in terms of operating times and temperature requirements. It is therefore very easy to subsequently adapt the control to converted or extended systems.



Hoval indoor climate systems are designed to be completely decentralised; the control system is based on the **concept of zoning**. Units that are supposed to operate according to the same specifications can be grouped together and zone-relevant parameters (set values, etc.) are defined for the control zone. However, the individual units are still controlled autonomously. The units can be flexibly assigned to different control zones.



The control results in **uniform air distribution and reduces temperature stratification** in the room, which saves energy.



The **Air-Injector** air distribution control is based on a highly sophisticated patented algorithm.



The **optimised heat recovery** ensures energy-efficient unit operation and results in cost savings. Full heat recovery can be used in the case of dry extract air. If the extract air is humid, the system prevents the plate heat exchanger from freezing, which would otherwise result in higher pressure drops and energy losses from the fans.



The control algorithm includes anti-ice protection for the plate heat exchanger which involves monitoring the exhaust air temperature. The anti-ice protection is automatically activated when the extract air is humid. The system limits the quantity of fresh air passing via the bypass to the amount required to prevent freezing.



The **energy monitoring** system meticulously records the plate heat exchanger energy savings per day, per week, per month and per year.



It also logs the energy quantity which is saved by heat recovery during the operating times. The quantity is calculated from the temperature difference between the plate heat exchanger's fresh air side and the supply air side.

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reliable



The units can be **started up reliably** at any time, by quickly settling the supply air temperature and ensuring fast, precise control.



The **soft start-up function** is activated as of an adjustable fresh air temperature. During the pre-heating phase, the heating coil is brought to the right temperature while the mixing valve is open 100%. The opening of the ER damper is set to 100% heat recovery. The fan starts via an acceleration ramp and with the mixing valve opening reduced to 50%. The mixing valve closes slowly depending on the time. The supply air temperature control then takes over the control of the mixing valve.



When the units are switched to **day operating modes**, they are started with the minimum required unit operating time, depending on external conditions. This means maximum energy efficiency.



The **start time optimisation** is an automatic and “learning” algorithm for switching from standby mode to other operating modes. Depending on the outside air temperature, the unit switches on automatically early enough to heat the room temperature to the required set value at the beginning of the required operating mode. The run time is adapted and optimised according to the conditions while the unit is operating.



The **recirculation units are operated** in a highly energy-efficient manner due to the special control algorithm.



The **optimised room temperature control** of the recirculation units offers two-stage on/off operation based on fuzzy logic. A temperature-time integral controls the switch-on/switch-off points. It takes into account the size and the time of the set value deviation. The supply air temperature is regulated via adjustable minimum and maximum values.



Operation is very simple, as the set values must only be entered once and can be transferred to other control zones via the **master-slave system**. It is therefore not necessary to adjust every individual zone.



The **master-slave control** adopts all set values for subordinate zones from the master zone.

Efficient and economical

Clean and ecological

Decentralised and modular

Competent and reliable

