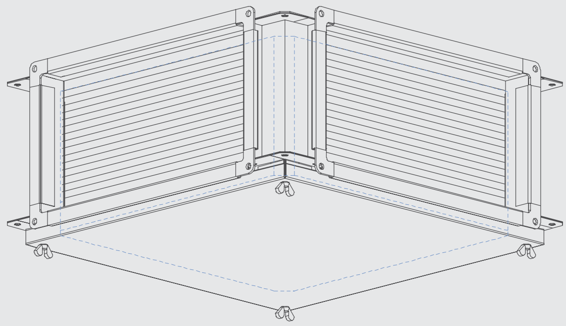
Technical Information

Figure 1 - Cross-airflow heat exchanger



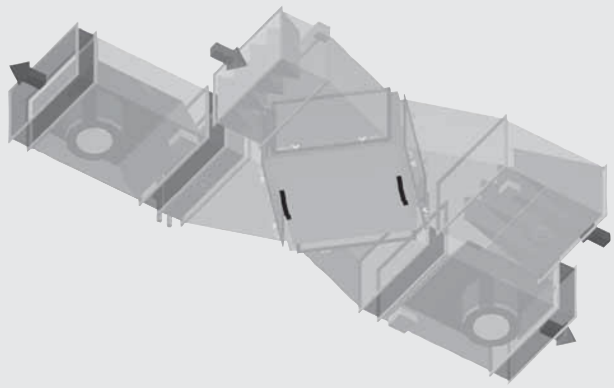
Application

HRV cross-airflow plate heat exchangers are used to recover heat energy from the outlet air coming from an air-conditioned room, especially in applications which are highly demanding for heating or cooling of the inlet air.

Operating Conditions and Position

Inlet and outlet air must be without solid, fibrous, sticky, aggressive and explosive impurities.
The heat exchanger is designed to be installed into the air-handling system, into a parallel, perpendicular or 45° aslant air inlet/outlet duct line, or their various combinations.
The layout variability of the heat exchanger is provided by special connecting elbows OBL.../45. The number of elbows must be specified in the project, depending on the intended layout.
The SKX mixing section can be connected directly to the heat exchanger via elbows for the parallel air outlet. The HRV heat exchanger even without elbows has the standard connecting dimensions of the Vento System. The HRV heat exchanger can be operated either in the horizontal or vertical position. However, condensate draining from the outlet air duct behind the heat exchanger must be ensured. When planning the air-handling system, it is necessary to consider requirements for the servicing space to enable the replacement of heat-exchange inserts

Figure 2 – location in the air-handling assembly



Materials and Design

The external casing and connecting flanges of HRV plate heat exchangers are made of galvanized steel sheets. The heat exchanger is equipped with a heat-exchange insert made of thin aluminium fins (sheets). The air-tightness of the inlet and outlet air separation within the heat-exchange insert is ensured by capping the fins and sheets and sealing the connections with polyester resins.

Dimensional and Type Range

HRV plate heat exchangers are a part of the Vento air-handling modular system. They are manufactured in eight dimensional rages, from HRV 40-20 to HRV 90-50. In these eight dimensional rages, corresponding OBL.../45 elbows are also manufactured.

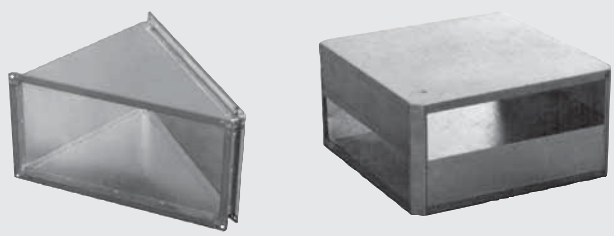
Figure 3 - Heat exchanger designation

HRV 60 - 30

- 30 – Flange connection B dimension (cm)
- 60 – Flange connection A dimension (cm)
- HRV – Heat exchanger designation

Figure 4

Figure 5 - Heat exchanger accessories



Technical Information

Figure 6 - Important dimensions of heat exchangers

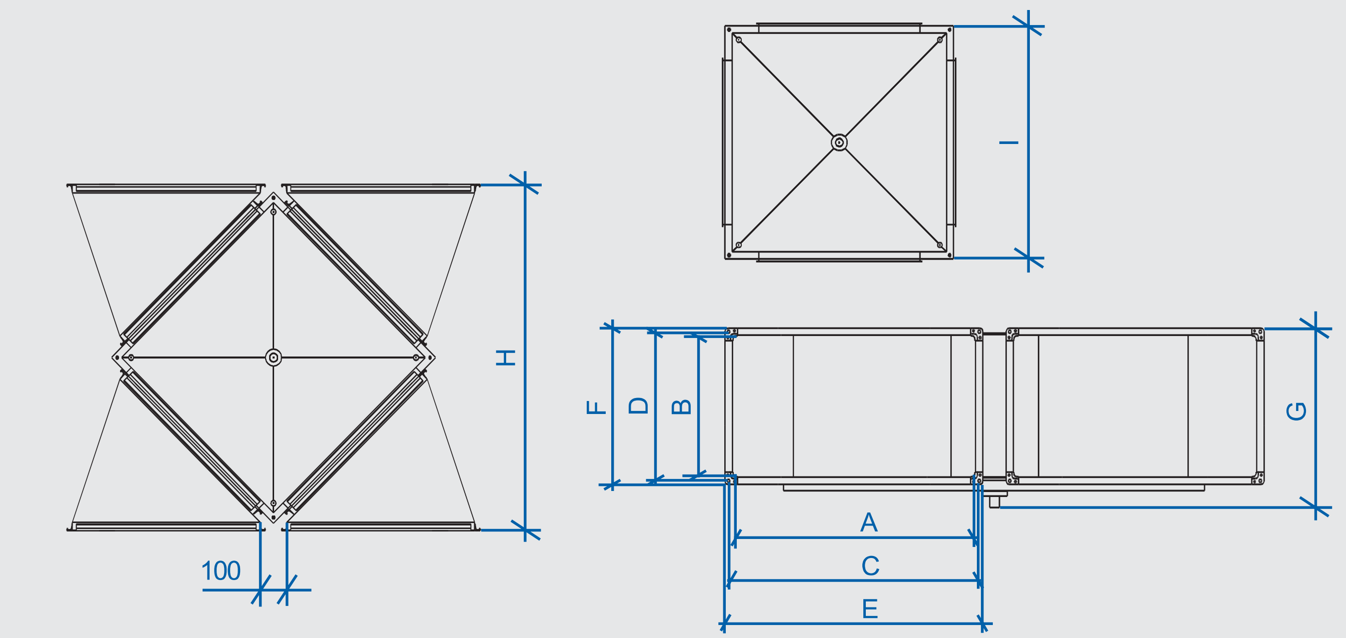


Table 1 - Dimensions and weights of heat exchangers

Heat Exchanger	Dimensions (mm)									Weight
	A	B	C	D	E	F	G	H	I	m [kg]
HRV 40-20	400	200	420	220	440	240	250	845	561	19
HRV 50-25	500	250	520	270	540	290	300	985	661	21
HRV 50-30	500	300	520	320	540	340	350	985	661	23
HRV 60-30	600	300	620	320	640	340	400	1130	761	36
HRV 60-35	600	350	620	370	640	390	450	1130	761	37
HRV 70-40	700	400	720	420	740	440	500	1270	861	39
HRV 80-50	800	500	820	520	840	540	550	1410	961	53
HRV 90-50	900	500	930	530	960	560	600	1590	1107	94

Figure 7 - Example of elbow designation

OBL 60 - 30 / 45

- 45 – Angle between the elbow inlet and outlet flanges (45°)*
- 30 – Flange connection B dimension (cm)
- 60 – Flange connection A dimension (cm)
- OBL – Type designation OBL

* REMAK a.s. does not deliver elbows with other angles

Figure 8 - Example of the summer insert designation

LV 60 - 30

- 30 – Flange connection B dimension (cm)
- 60 – Flange connection A dimension (cm)
- LV – Type designation LV

A PVC outlet is included in the delivery of the heat exchanger to drain condensate which may be created in the heat-exchange insert. It must be connected to the lowest point of the heat exchanger lid, which serves as a tray, to drain the condensate from the heat exchanger (if the heat exchanger is suspended under the ceiling with the lid directed downwards), see figures #9 and # 11 on page 216.

Figure 9 - PVC outlet

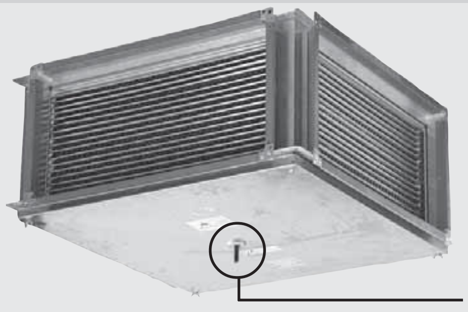
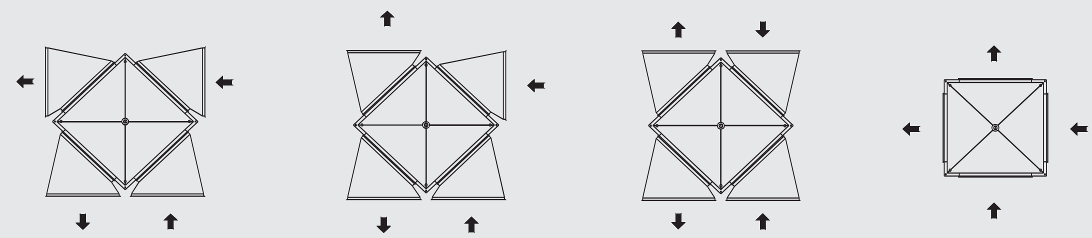


Figure 10 - heat exchanger layout arrangements in the ducting depending on the orientation OBL elbows. /45



Heat Exchanger Dimensioning

Accessories

The following optional accessories can be ordered with HRV heat exchangers:

- OBL …/45 elbows to make the heat exchanger's installation in different layouts of ducting easy.
- LV summer insert (built-in assembly) .... For summer operation of the heat exchanger, the heat-exchange insert can be replaced with so-the called "summer insert". The summer insert avoids unwanted heat exchange, while the pressure loss is decreased by approximately 10% (this is advisable if a heat exchanger without a bypass is used in the inlet branch, respectively for air-handling systems without cooling).

Heat Exchanger Dimensioning, Parameters

On page 215 you will find correlation graphs of efficiency and pressure losses related to the air flow rate for each heat exchanger. The heat exchanger's efficiency is defined by the following relationship:

$$\Phi = (t_{p2} - t_{p1}) / (t_{o1} - t_{p1})$$

kde

t_{o1} is the outlet air temperature in the entry to the heat exchanger.

t_{p1} is the inlet air temperature in the entry to the heat exchanger.

t_{p2} is the inlet air temperature in the exit from the heat exchanger.

From this relationship and the known heat exchanger's efficiency, the required inlet air temperature tp2 in the heat exchanger's exit can be determined using the following relationship:

$$t_{p2} = \Phi \cdot (t_{o1} - t_{p1}) + t_{p1}$$

As the heat exchanger's efficiency is significantly dependent on the relative humidity of the outlet air (i.e. the higher the relative humidity, the higher the heat exchanger's efficiency), two curves, the so-called "dry" (minimum) and "wet" (maximum) efficiency, are included in each graph. The value of relative humidity at which a significant change in the heat exchanger's efficiency was manifested was always selected as the relative humidity for the "dry" efficiency. The value of the "wet" efficiency was determined at 100% air relative humidity.

The temperature of the outlet air exhausted from the ventilated room and the temperature of the inlet (outdoor) air are further parameters selected for the structure of the graphs. The outlet air temperature was selected as t_{o1} = 25°C, and the inlet air temperature was in all cases selected as t_{p1} = -10°C. However, the dependency of the heat exchanger's efficiency on these values is not too significant; therefore, if needed, the outlet air temperature behind the heat exchanger for other t_{o1} and t_{p1} temperatures can also be determined with decent accuracy using the following graphs and above-mentioned relationship. If the calculated outdoor air temperature is lower than -10°C it is advisable, in relation to the outdoor air humidity, to consider installation of an air preheater situated in front of the heat exchanger which would raise the air temperature at the entrance to the heat exchanger, or consider installation of active antifreeze protection. Otherwise, there is the risk of the heat exchanger freezing, which would cause malfunction of the entire air-handling system (for details, refer to the section "Heat Exchanger Bypass and Antifreeze Protection"). Conditions in which the risk of frosting exists can be precisely determined by the calculation using AeroCAD program

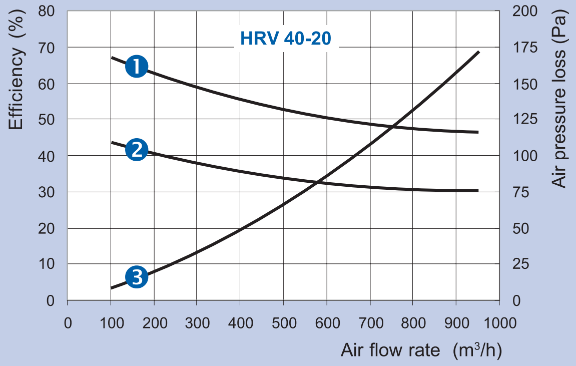
On the basis of these data or relationships, all necessary final parameters of the heat exchangers can be obtained from the required default data:

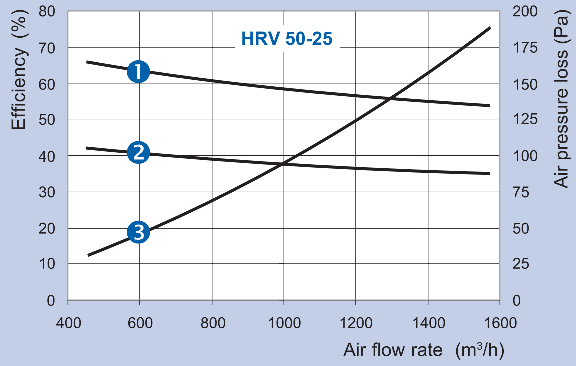
- **Required default parameters**
  - Selected heat exchanger's size
  - Air flow rate (velocity in the cross-section)
  - Relative outlet air humidity
- **Determined final parameters**
  - Outlet air temperature behind the heat exchanger
  - Heat exchanger's pressure loss

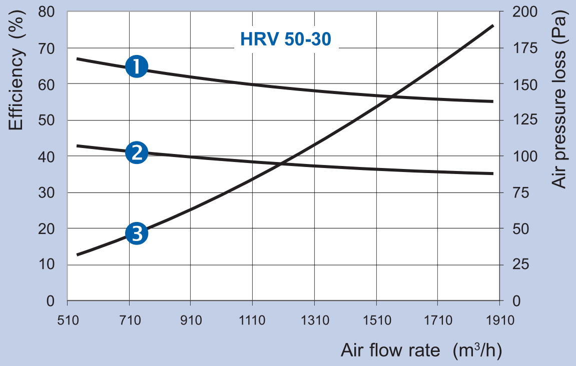
Heat Exchanger Dimensioning Procedure

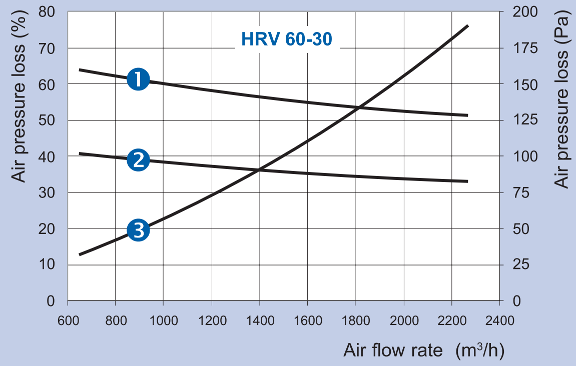
- Dry" or "wet" efficiency of the heat exchanger for the required values of the air flow rate can be determined from the graph. If the expected relative humidity value of the outlet air lies in the area between the "dry" and "wet" efficiency curves, the efficiency can be estimated within the range between these limit curves.
- The observed efficiency of the heat exchanger and expected air temperatures, i.e. the inlet air temperature behind the heat exchanger and the temperature of the air exhausted from the room, are put into the following relationship $t_{p2} = \Phi \cdot (t_{o1} - t_{p1}) + t_{p1}$
- The heat exchanger's pressure loss at the given air flow rate for calculation of the assembly pressure loss balance needed for the fan selection can be obtained from the graph. Condensation of the air humidity can significantly increase the heat exchanger's pressure loss; it can be in the range from 20% to 50%. If the outlet air humidity value lies within the range above the "dry" efficiency curve, it is advisable for pressure loss balance purposes to increase the value derived from the graph by at least 30%.
- The calculated air temperature tp2 will be used to dimension the water heater as the inlet air temperature.

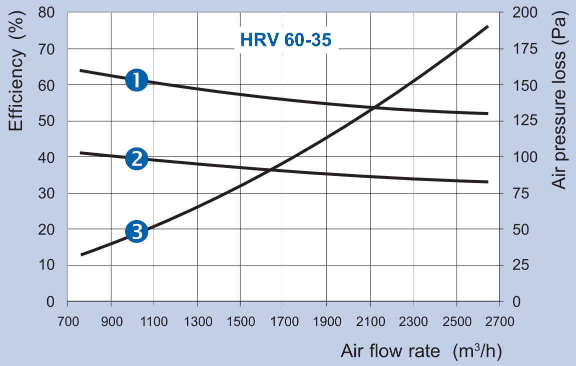
Heat Exchanger Working Characteristics

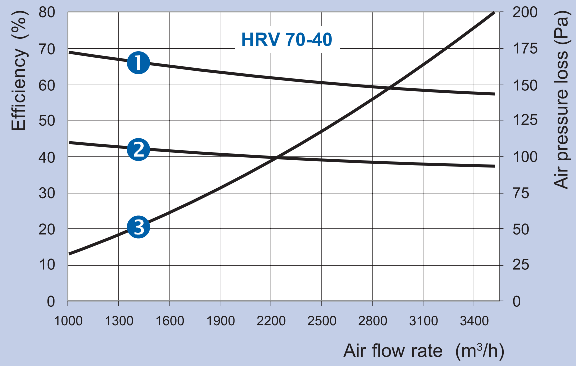


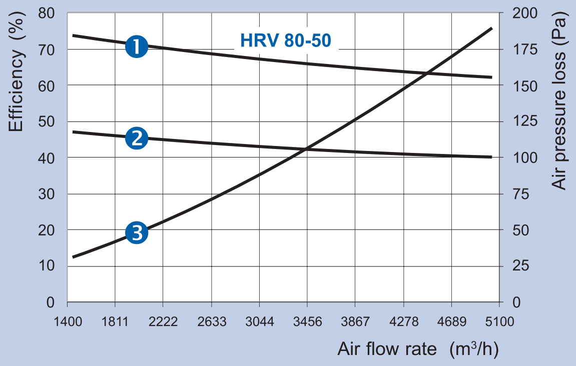












1. Correlation of "wet" efficiency [%] and pressure loss [Pa] related to the air flow rate [m³/h] through the heat exchanger
2. Correlation of "dry" efficiency [%] related to the air flow rate [m³/h] through the heat exchanger without condensation (applicable for outlet air relative humidity from 0 % to 25 %)
3. Correlation of pressure loss [Pa] related to the air flow rate [m³/h] through the heat exchanger

Efficiency of heat exchangers

		Inlet (outdoor air)	Outlet (indoor air)
Temperature	°C	-15	20
Relative air humidity for "dry" efficiency [1]	%	It does not affect the result	max. 25
Relative air humidity for "wet" efficiency [1]	%		min. 65
Air flow	m³/h	**1400 – 5100** (Ratio inlet/outlet = 1:1)	
Altitude	m	250	

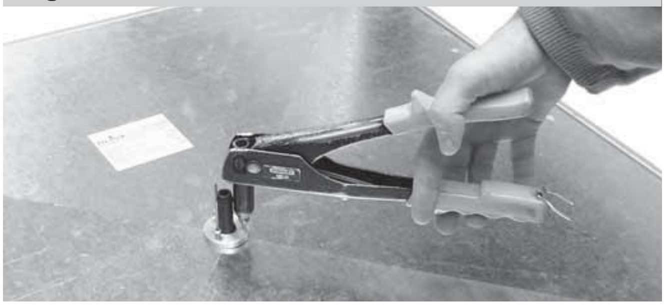
[1] If the outlet air relative humidity is within the range from 25% to 65%, the efficiency curve will lie proportionally between the "dry" and "wet" efficiency curves. The precise values for any operating conditions can be calculated using the AeroCAD design program.

Installation, Service and Maintenance

Mounting and Installation

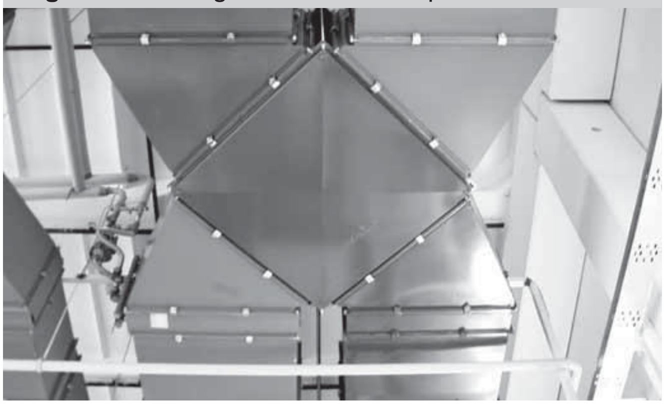
■ Installation of the heat exchanger can be performed in a way similar to installation of other Vento components. The flange dimensions are compatible with Vento components. The casing of the heat exchanger is provided with holes in its corners. These holes can be used to suspend the heat exchanger on M8 threaded rods.
■ Before installation, paste self-adhesive sealing onto the connecting flange faces.
■ It is necessary to ensure conductive connection of the flange using fan-washers placed on both sides, at least on one flange connection.
■ Condensate can form on individual vanes (heat exchange surfaces); therefore, the heat-exchange insert is always situated inside the heat exchanger casing with the side marked with the VRCH (TOP) label up. This along with the shape of the vane surfaces minimizes the possibility of accumulation of condensate on individual layers, and thus continuous draining of condensate drops from the vane surfaces is ensured.

Figure 11 - PVC outlet



As the inlet and outlet air line branches intersect within the heat exchanger, the actual air flow cross-section is approx. half of its entire cross-section, and the air flow speed is doubled. Due to the actual air flow speed, condensate drops can be carried from the vanes down the air duct. In installations where this can happen, it is necessary to slope the duct behind the heat exchanger down, solder the joints, and provide the lowest duct point with a condensate draining outlet. The distance the condensate drops fall extends with increasing air flow speed. Depending on the air flow speed, this distance can be 1-3 m behind the heat exchanger.
A PVC outlet is included in the delivery of the heat exchanger to drain condensate which may form in the heat-exchange insert. It must be connected to the lowest point of the heat exchanger, which serves as a collecting tray (if the heat exchanger is suspended with the lid directed downwards) - see figures #9 and # 11.
If the HRV heat exchanger is installed on the floor with its lid up, the condensate draining outlet is installed only in the following air duct. Therefore, all condensate runs out from the heat exchanger into the duct.

Figure 12 - Flange bar screw clamps

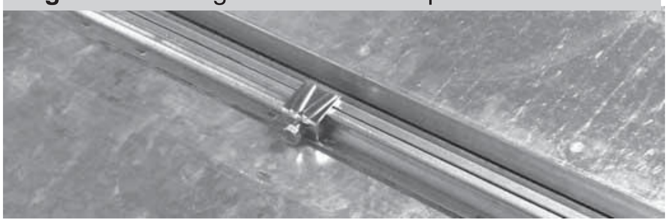


Recommendations:
■ Air filters must be installed in front of the cold and hot air inlets to avoid fouling of the heat-exchange surfaces, gradual reduction of the heat exchange effectiveness, and increasing pressure losses.
■ To brace flanges with a side longer than 40 cm, it is advisable to connect them in the middle with another screw clamp which prevents flange bar gapping (see figures # 15 and # 13).

Bypass and Antifreeze Protection

Installation of the plate heat exchanger without the bypass is advisable only for applications where condensate ice accretion on the heat exchanger fins cannot form and the heat exchanger location and operating and maintenance schedule enable easy access and prompt operator intervention. In air-handling systems without cooling, this installation requires seasonal replacement of the heat-exchange insert by the "summer insert" to avoid unwanted heat exchange during the summer season. If the air-handling system is equipped with cooling (respectively, if the room is cooled in another way) it is possible and convenient to use the heat-exchange insert during both winter and summer seasons.
The heat exchanger's bypass can be installed using dampers and a duct bypass connected to the inlet branch to provide the heat exchanger with antifreeze protection, or to enable automatic cut out of the heat exchanger in air-handling systems without cooling. The bypass control depends on the bypass's function (antifreeze protection, summer bypass, or both), and using a suitable sensor (a surface temperature sensor or a differential pressure sensor - best equipped with an adjustable hysteresis) the bypass control can be autonomous or ensured in cooperation with a control unit. The cross-section of the bypass duct should be dimensioned at 40% of the cross-section1) of the heat exchanger connecting flanges.

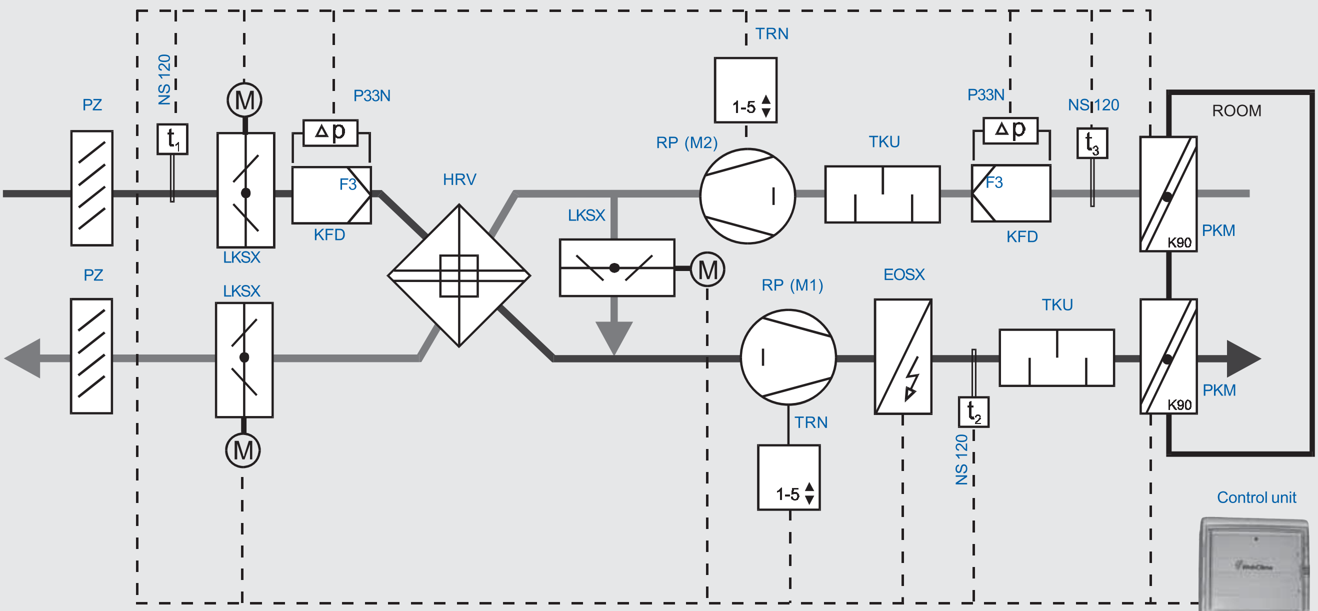
Figure 13 - Flange bar screw clamps



1) The bypass duct must be dimensioned, respectively regulated, so that the air pressure loss in the duct bypass will be approximately the same as the air pressure loss in the heat exchanger. Otherwise, the parameters of the air-handling system could be changed; respectively the working point of the supply fan could be shifted into the non-working (forbidden) area. Therefore, the supply current of the fan must be checked during heat exchange mode as well as during bypass mode.

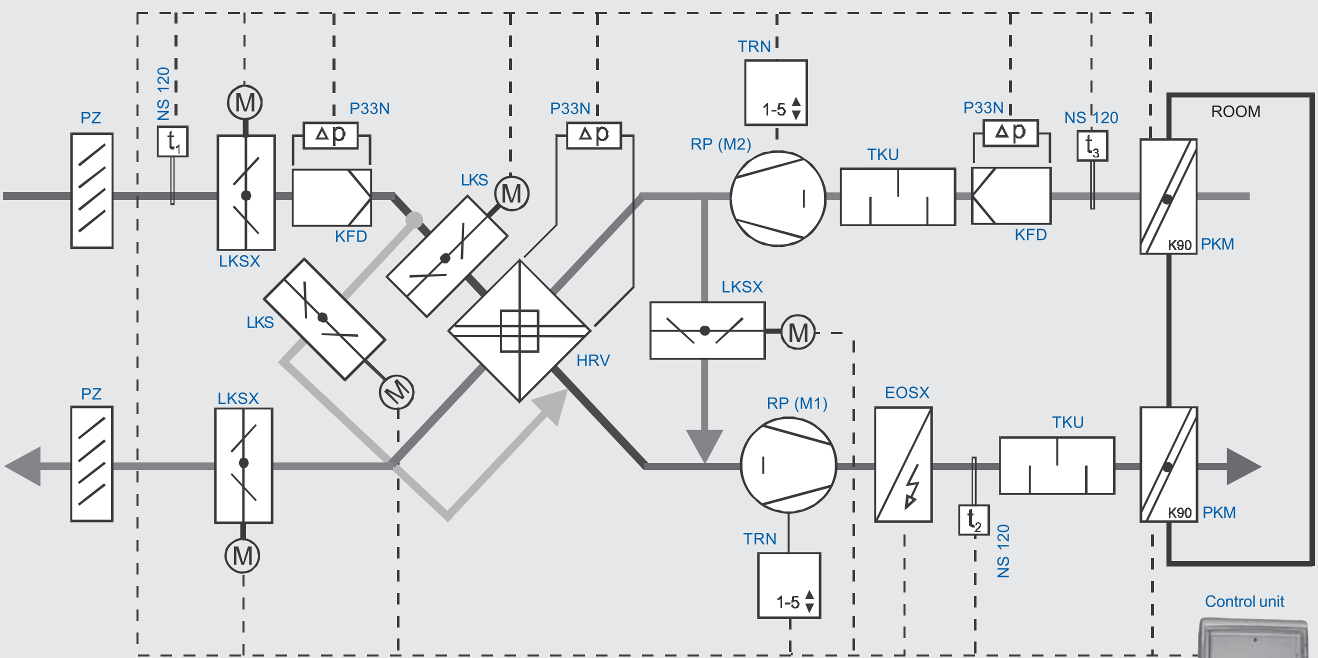
Installation Examples

Figure 14 - Heat exchanger without a bypass



Installation without the heat exchanger's bypass
An example of the heat exchanger installation in an air-handling system without a bypass. This figure shows an example of the ventilation system including air heating using an electric heater, a heat exchanger and a mixing section. If exclusion of the heat exchange during the summer season is required, it is necessary to install the LV summer insert.

Figure 15 - Heat exchanger with a bypass



Installation with the heat exchanger's bypass
An example of the heat exchanger installation in an air-handling system with a bypass. This figure shows the same example as the previous figure completed with a heat exchanger bypass and two inversely working (one closes - the second opens) LKS dampers as a part of the antifreeze protection. This application does not require replacement of the heat-exchange insert by the summer insert. Unwanted air heat exchange can be eliminated by the control of dampers.

Installation, Service and Maintenance

Operation and Maintenance

HRV heat exchangers, when used in accordance with the chapter "Operating Conditions and Position", do not require special maintenance. Recommended checks (e.g. cleaning and checking the insert for damage) are included in the service manual, and are usually performed when changing the winter assembly for the summer one, and vice-versa. To avoid condensation problems, it is necessary to keep the condensate drainage free. The replacement of the block shaped heat-exchange insert (resp. summer insert) can be performed after removing the four wing screws from the bottom lid of the heat exchanger. The block is secured inside the heat exchanger by movable locking pieces. After loosening the securing screws, the locking pieces can be shifted aside (see fig. #16) and the heat exchange insert can be removed from the casing. If the heat exchanger is installed using suspensions, first it will be necessary to push (lift) the heat-exchange insert to release the locking pieces.
Fouling can be carefully removed from the fins of the heat-exchange insert by washing it out with a detergent solution.

Figure 16 - Securing screw