SXV/Hi

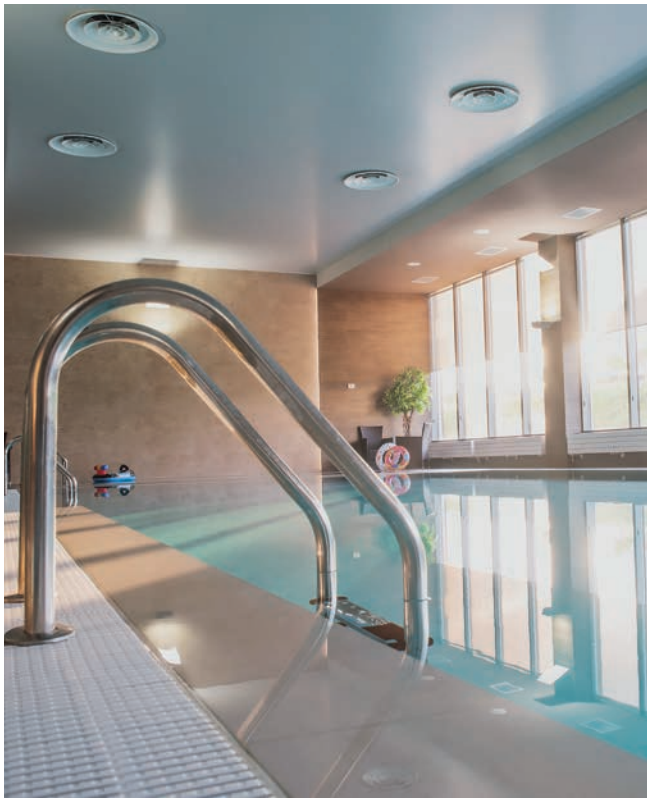
SWIMMING POOL HEAT PUMP AIR HANDLING UNITS

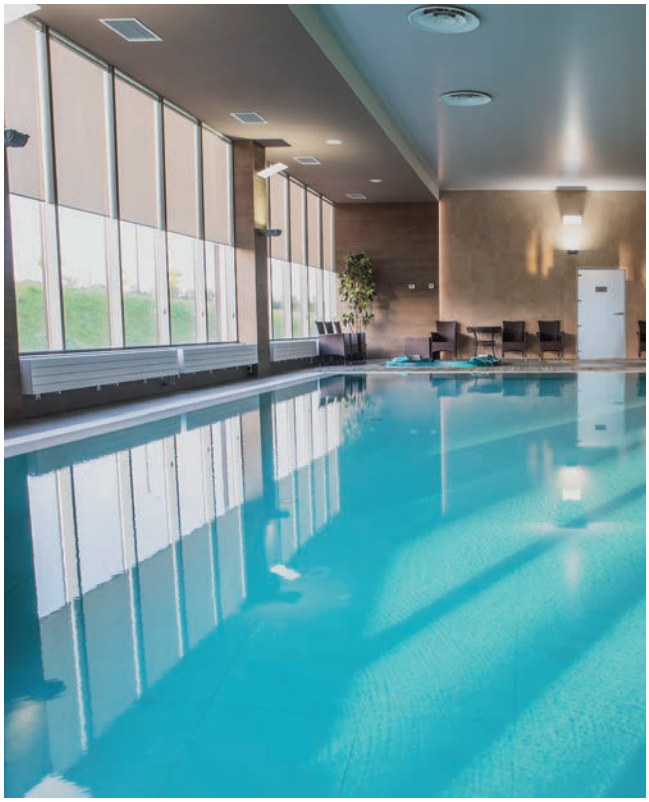
INTRODUCTION

Indoor swimming pools are generally characterised by an air temperature between 28 °C and 33 °C, in order to offer bathers a comfortable environment. In principle, the air temperature in the pool rooms is almost always warmer than the outside air.

These rooms are also characterised by a high degree of water evaporation which leads to a high level of humidity and an unpleasant feeling of oppressive heat. If humidity is not controlled, not only is the time spent in an indoor pool perceived as unpleasant, but the climate that forms in the environment can also cause real discomfort to the users and the public present. In addition, there is a risk that the moisture contained in the water vapour condenses on colder surfaces, such as metal components, external walls or glass surfaces.

This can lead to the formation of mould and can cause corrosion. If all this were to occur, the building would suffer considerable damage over time, which would lead to costly renovation work, accompanied by business interruptions and economic losses for the site manager. In these applications, room ventilation is mandatory and is strictly regulated by specific international regulations. Ventilation, however, involves considerable energy consumption, and good heat recovery systems combined with advanced controls systems must be used to manage it. The most important aspect of ventilation systems in a public indoor swimming pool are not the investment costs, but the operating costs, for this reason the correct choice of the air handling unit can lead to very important savings in the long term and a recovery of costs in a very short time.





SELECTION PRINCIPLES

The water surface and the use of the pool are key factors in calculating the evaporation of the pool water. Evaporation is as high as the difference in pressure between the saturation water vapour at the pool water temperature and the partial water vapour pressure in the pool air. Based on these factors, the mass of evaporated water can be determined.

EXAMPLE OF CALCULATION OF DEHUMIDIFICATION AND FRESH AIRFLOW IN INDOOR SWIMMING POOLS

SWIMMING POOL DATA

Room volume	m3	1.0
Pool surface	m2	100.0
Pool water temperature	°C	28.0
Vapour pressure: Water 100% R.H.	mbar	37.79
Room temperature	°C	30.0
Relative humidity	%	60.0
Vapour pressure: Air	mbar	25.45
Full operation factor:		1.0
Stand-by factor:		0.5

EVAPORATION CALCULATION

Max. evaporation:	kg/h	11.03
Max. evaporation:	kg/24h	264.79
Min. evaporation:	kg/h	5.52
Min. evaporation:	kg/24h	132.40

FRESH AIRFLOW RATE CALCULATION

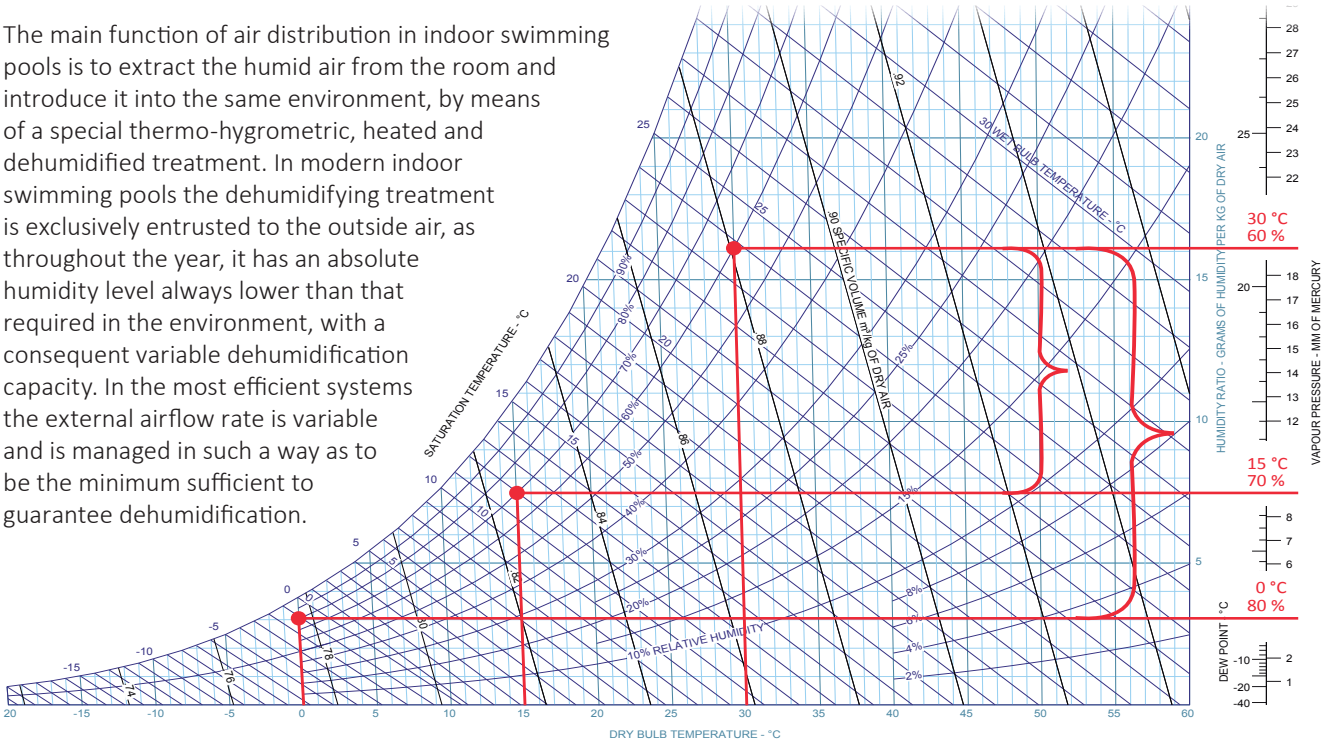
Fresh airflow (VDI 2089 B1-94)	m3/h	1.365
Fresh airflow (Italian law 16/03)	m3/h	2.000

= input data = output data

USE FACTORS:

0.3 = swimming pools not in function (with cover)
0.6 = swimming pools not in function (without cover)
1.0 = private swimming pools
1.5 = hotel swimming pools
2.0 / 2.5 = public swimming pools (2.2 average factor)
2.7 = wave pools, children's slides
3.0 = whirlpools, waterfalls or other attractions

The main function of air distribution in indoor swimming pools is to extract the humid air from the room and introduce it into the same environment, by means of a special thermo-hygrometric, heated and dehumidified treatment. In modern indoor swimming pools the dehumidifying treatment is exclusively entrusted to the outside air, as throughout the year, it has an absolute humidity level always lower than that required in the environment, with a consequent variable dehumidification capacity. In the most efficient systems the external airflow rate is variable and is managed in such a way as to be the minimum sufficient to guarantee dehumidification.



The design parameters normally used in the various environments are shown in the following table:

Air temperature

Swimming pool	30- 34 °C
Locker rooms	22- 28 °C
Showers	26- 34 °C
Offices	22- 26 °C
Hall	> 20 °C
Connecting area	> 20 °C

Water temperature

Public pools	28 °C
Leisure pools	28 - 32 °C
Children's pools	32 °C
Therapeutic pools	36 °C
Whirlpools	36 °C
Cold water pools	15 °C

Fresh airflows

Hall	5 m3/hm2
Locker rooms	15 m3/hm2
Infirmary	25 m3/hm2
WC (unitary)	100 m3/h
Showers (unitary)	220 m3/h

OPERATING MODE

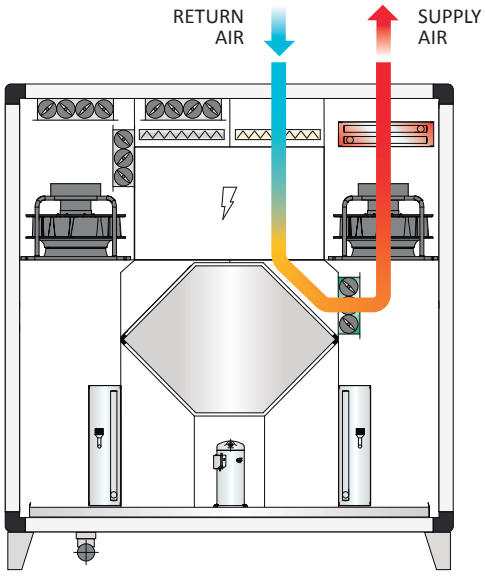
• RECIRCULATION 100%

The unit operates in 100% recirculation mode with no fresh air inlet.

The pool room air is recirculated and heated by the water coil within the unit and supplied by an external energy source (e.g. boiler or heat pump).

The unit's heat pump circuit is stopped and the fans operate at a constant flow rate in modulation mode to minimise the unit's power consumption.

This mode is used during the unit start-up or night operation.

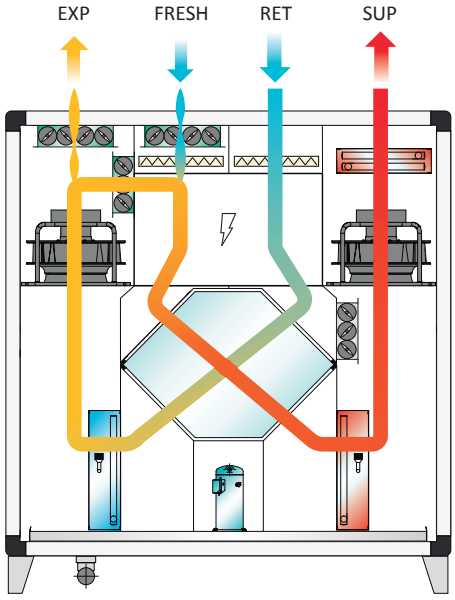


• "ALPHA" CYCLE

In certain climatic conditions or when it is energy-efficient, the unit reduces the amount of fresh air to a minimum and activates the heat pump circuit.

Part of the air taken in from the room is recirculated down-stream of the evaporator, where the recovery of the latent and sensible load takes place (thus dehumidifying the air), and then sent to the condenser, thus delivering warm dehumidified air into the room with very high energy efficiency.

A (variable) percentage of the air flow is however expelled and reintegrated with fresh air, guaranteeing the hygienic requirements of the pool room. In the event that the air temperature is still not warm enough, integration with the heating water coil takes place.



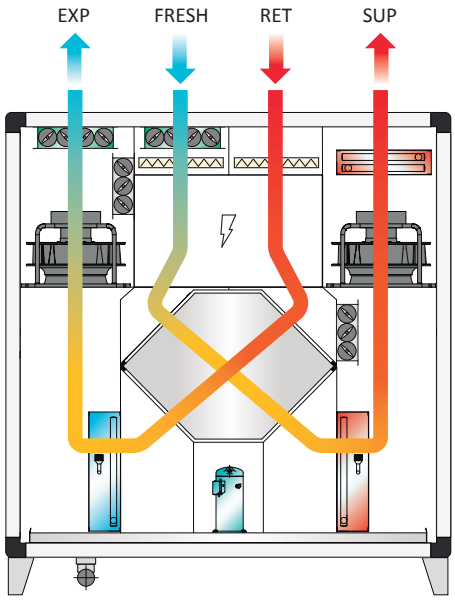
• FRESH AIR 100%

When outdoor and room conditions are convenient, the unit operates with 100% fresh air.

The by-pass damper of the heat recovery is closed and dehumidification takes place using the thermo-hygrometric conditions of the fresh air.

In this mode, the heat pump circuit is used as a second system to recover the energy expelled from the room, recovering the sensible and latent load in the evaporator and then transferring it to the condenser, thus delivering warm dehumidified air into the room with very high energy efficiency.

In the event that the air temperature is still not warm enough, integration with the heating water coil takes place.



MAIN CHARACTERISTICS

STRUCTURE AND PANELS

Profiles 50x50 mm in self-supporting extruded painted RAL 9010 aluminium, with mechanical strength requirements in accordance with EN 1886: D1 (M).
50 mm thick double-wall sandwich type paneling with both exterior and interior side painted RAL 9010 galvanized sheet steel with interposed insulation made of polyurethane foam with a density of 40 kg/m^3 or mineral wool (90 kg/m^3). This structure has a seal class L1 while the thermal transmittance and the thermal bridge characteristic is class T3/TB3 according to EN1886.

AIR FILTERS

The filter sections on the return and fresh air are supplied with panel filters class ePM$_{10}$ 60% (M5) and ePM$_1$ 55% (F7) in accordance with international norms.

All units are equipped with differential pressure switches to monitor the air side pressure drops of the filtering sections.

FANS

The units are equipped with high efficiency plug-fan type fans with built-in brushless EC motor.

In this way it is possible to guarantee an accurate control of the airflow both in the supply and extract section, ensuring that all regulatory requirements such as SFP are met.

The airflow rate of the fan is managed through the integrated electronic control system.

HEAT RECOVERY

The units are equipped with a high-efficiency counter-flow heat exchanger made of aluminium treated for chlorinated environments.
The heat exchanger participates to the **Eurovent Certification** program and it is sized according to the **ECO Design** specification.

AIR DAMPERS KIT

The units are supplied complete with 4 regulation air dampers, each equipped with a specific actuator.
The dampers manage the air flows within the unit and control the various operating modes. They are managed directly by the microprocessor control.

HOT WATER COIL KIT

The units are supplied complete with hot water coil kit with modulating 3-way valve and water pipe kit, managed directly by the microprocessor control.

REFRIGERANT CIRCUIT

The thermodynamic and energy efficiency of the unit is further improved thanks to the refrigeration circuit in heat pump.
The refrigerant circuit is of direct expansion type loaded with refrigerant R32, it is tested at the factory with reference to both its tightness (pressure test) and its functionality.

The main components are: finned pack heat exchangers, solid cartridge acid filters, high and low refrigerant pressure switches, liquid/humidity indicator light, possible high pressure safety valve.

The circuit is also equipped with an electronic expansion valve managed in such a way as to guarantee the correct overheating of the refrigerant that reaches the refrigeration compressor in the various operating modes.

COMPRESSORS

The refrigerant circuit is equipped with rotary compressors with a brushless DC motor suitable to be managed by an inverter, for a continuous control of the refrigeration capacity. The compressor is complete with thermal protection, crankcase heating and vibration dampers suitable for isolating vibrations.

DIRECT EXPANSION COILS

The evaporative-condensing coils consist of internally and mechanically expanded striped copper tubes and epoxy painted aluminium fins, that guarantees rapid drainage of condensation and reduced drag effects as well as increased corrosion resistance due to chlorine products in the treated air. The galvanised painted condensate drain pan with ductable outlet complies with ASHRAE 62-89 self-draining standards.

CONTROLS

The unit is managed by a microprocessor electronic board with dedicated software and external LCD display as user interface. Through the external or remote LCD display it is possible to set all the working set-points of the unit and display the operating status and any alarm conditions present.
Through the values acquired by the room temperature probe and the supply air, the thermoregulation will be managed by activating the compressor with reference to the set-points.

The unit can manage the automatic change of operating modes by comparing the temperature and humidity of the outside and room air.
The thermal capacity delivered by the heat pump unit will be continuously modulated through the speed variation of the refrigeration compressor.
This characteristic allows the operation at partial loads with a much higher energy saving compared to a traditional system equipped with ON/OFF compressors.

The microprocessor also activates and modulates all the dampers of the unit and optimizes all the operating parameters of the refrigerant circuit.
The RS485 interface is standard (MODBUS protocol) to be used for connection to remote supervision and control systems.
The control can also be supplied with a second remotable control panel (optional).

TECHNICAL DATA

MODEL		011	015	021	031
Nominal airflow rate	m^3/h	1000	1500	2000	3000
External air flow	%	0 ÷ 100	0 ÷ 100	0 ÷ 100	0 ÷ 100
Dehumidification capacity (1)	kg/h	16,9	25,4	33,8	48,0
Dehumidification capacity (2)	kg/h	3,8	5,5	7,1	10,9
Nominal electric power absorbed (1)	kW	1,02	1,65	1,73	2,78
Max electrical power absorbed	kW	4,05	4,45	4,45	6,80
Max electrical current absorbed	A	10,4	10,4	12,4	13,0
Type of heat recovery system (HRS)	type/n°	static counter-flow / 1			
Thermal efficiency recovery (1)	%	89,1	89,1	89,0	88,6
Thermal power recovery (1)	kW	10,5	15,7	21,0	31,4
Thermal power of refrigerant circuit (1)	kW	3,25	5,00	5,14	7,87
Total thermal power of unit (1)	kW	20,4	29,7	38,5	55,6
COP refrigerant circuit (1)	W/W	5,80	5,81	6,27	6,25
Compressors / Refrigerant circuits	n°	1 /1	1 /1	1 /1	1 /1
Type of refrigerant / GWP		R32 / 675			
Hot water coil heating capacity (1) (3)	kW	6,27	8,60	10,90	16,30
Heating coil waterflow (1) (3)	l/h	550	750	1000	1430
Hot water coil + valve kit water pressure drops (1) (3)	kPa	15	20	26	35
Type of fans	type/n°	EC / 2	EC / 2	EC / 2	EC / 2
Supply fan available static pressure	Pa	150	150	150	150
Return fan available static pressure	Pa	150	150	150	150
Max. external / internal leakage percentage	%	max 3,5 % at -400 Pa | max 5,0 % at +250 Pa			
Energy classification filters		ePM1 55% (F7) | ePM10 60% (M5)			
Filters pressure switch		present			
Sound power level L_{WA} (4)	dB(A)	79	78	82	85
Sound pressure level (5)	dB(A)	64	62	67	69
Power supply	V/ph/Hz	230/1/50	400/3/50		

(1) 100% external air flow, external air conditions -5°C / 80% R.H. ambient air conditions 30°C / 60% R.H.

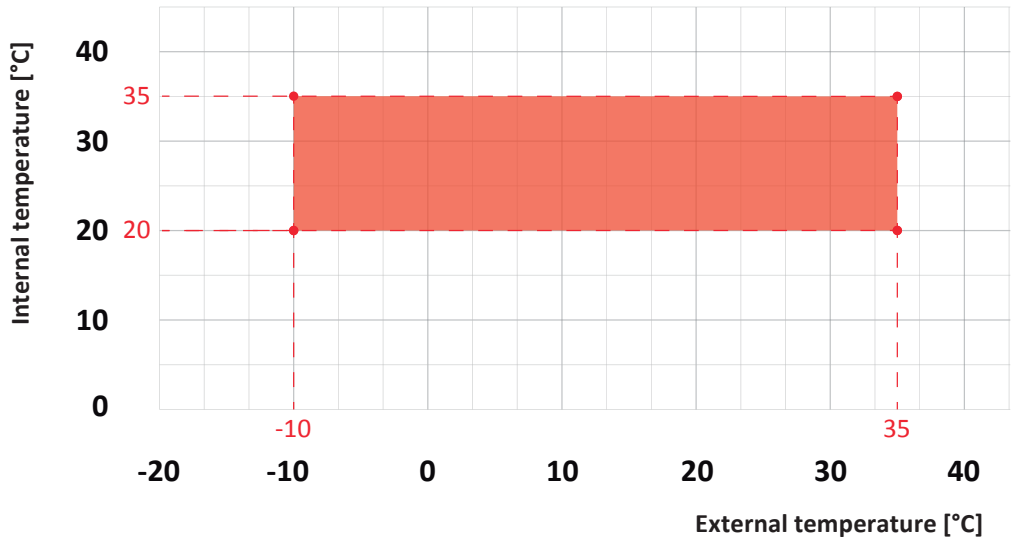
(2) ambient air conditions 30°C / 60% R.H. all recirculation

(3) inlet/outlet water temperature 70/60°C

(4) sound power level calculated in accordance with EN 3744

(5) sound pressure level measured at 1 m free field distance, ducted unit, in accordance with EN 3744

OPERATING LIMITS



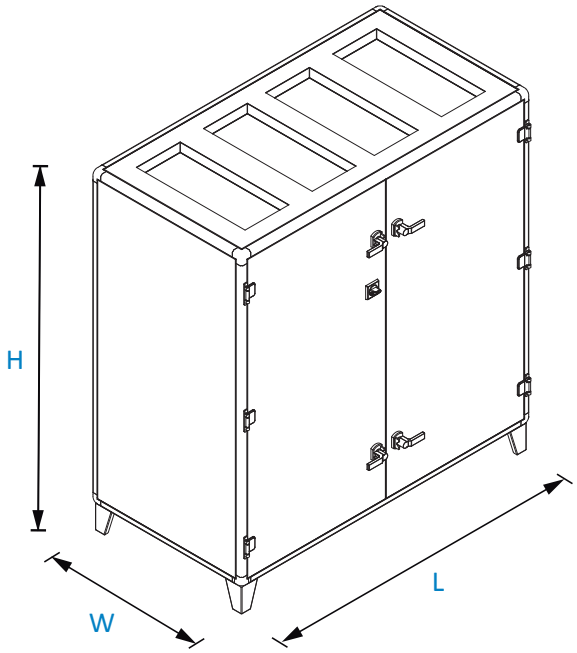
ACCESSORIES

MODEL	011	015	021	031
RAL 9010 painted frame	■	■	■	■
Supply and return EC fans	■	■	■	■
Filters differential pressure switches on return / supply air	■	■	■	■
Counter-flow plate heat recovery	■	■	■	■
ePM_{10} 60% (M5) + ePM_1 55% (F7) filter on return / supply air	■	■	■	■
Hot water coil with 3 way modulating valve	■	■	■	■
Dampers with actuators (4 pcs)	■	■	■	■
Microprocessor control system + remotable control panel with LCD display	■	■	■	■
Refrigerant circuit with DC inverter compressor	■	■	■	■
RS485 serial interface Modbus protocol	■	■	■	■
Door lock mainswitch	■	■	■	■
50 mm frame with 40 kg/m^3 polyurethane panels insulation	□	□	□	□
50 mm frame with 90 kg/m^3 mineral wool panels insulation	□	□	□	□
TCP/IP ethernet and modbus port	□	□	□	□
BACnet and ethernet port	□	□	□	□
Second remotable control panel with LCD display	□	□	□	□
Flexible joints kit for duct connections (4 pcs) [1]	□	□	□	□

[1] supplied loose

■ Standard □ Optional – Not available

DIMENSIONAL DRAWING

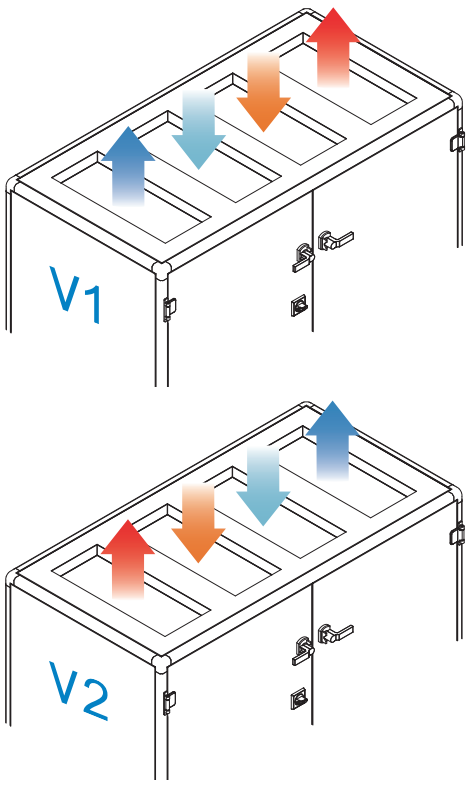


DIMENSIONS AND WEIGHTS

MODEL	011	015	021	031
L (mm)	1560	1560	1860	1860
W (mm)	660	810	810	960
H (mm)	1690	1690	1840	1840
Weight (kg)	283	332	432	512

Dimensions and weights referred to the standard configuration

CONFIGURATIONS



RETURN AIR
EXHAUST AIR
FRESH AIR INLET
SUPPLY AIR