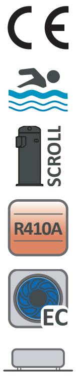
SXH/HP

SWIMMING POOL HEAT PUMP AIR HANDLING UNITS



INTRODUCTION

Public 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 control 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

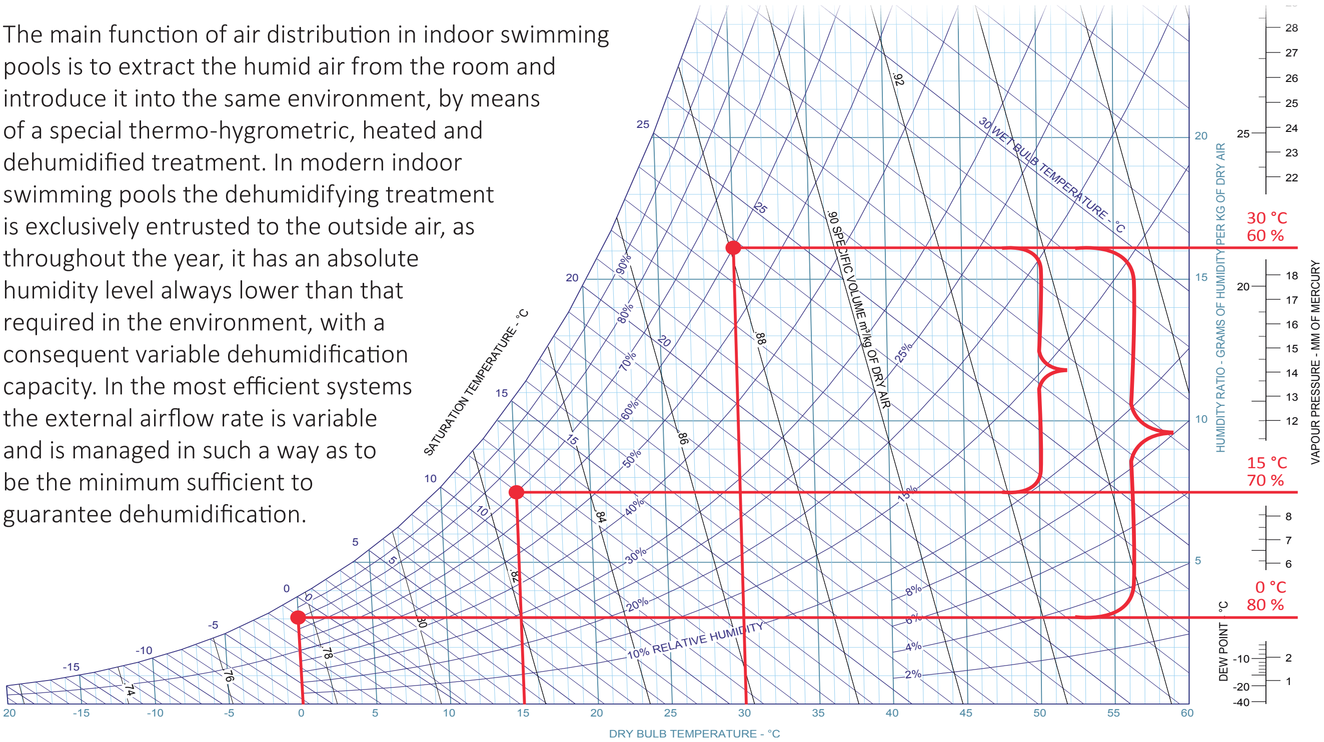
Fresh airflow (VDI 2089 B1-94)	m^3/h	1.365
Fresh airflow (Italian law 16/03)	m^3/h	2.000

= 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		Water temperature		Fresh airflows	
Swimming pool	30- 34 °C	Public pools	28 °C	Hall	5 m^3/hm^2
Locker rooms	22- 28 °C	Leisure pools	28 - 32 °C	Locker rooms	15 m^3/hm^2
Showers	26- 34 °C	Children's pools	32 °C	Infirmary	25 m^3/hm^2
Offices	22- 26 °C	Therapeutic pools	36 °C	WC (unitary)	100 m^3/h
Hall	> 20 °C	Whirlpools	36 °C	Showers (unitary)	220 m^3/h
Connecting area	> 20 °C	Cold water pools	15 °C		

INSTALLATION IN THE POOL

In indoor swimming pools, the correct sizing and positioning of the air diffusers is a fundamental requirement to ensure good comfort for bathers; in particular, the distribution system must remove excess humidity, ensure a uniform temperature and avoid annoying drafts in the passage areas.

Generally, the supply air duct should form a "U" around the three sides of the pool, so that the airflow "washes" the perimeter glass surfaces and external walls with drier air. In such a system, the correct airflow on external walls, windows and doors eliminates or minimizes the formation of condensation on cold surfaces.

The air intake grilles are normally placed on the free side and in the upper part of the room where warm and humid air tends to stratify. In general, 4/6 air changes per hour are sufficient to ensure that all these requirements are met.

The materials used for the construction of air distribution ducts must be suitable for humid environments where, among other things, corrosive chemicals contained in the treated air are present.

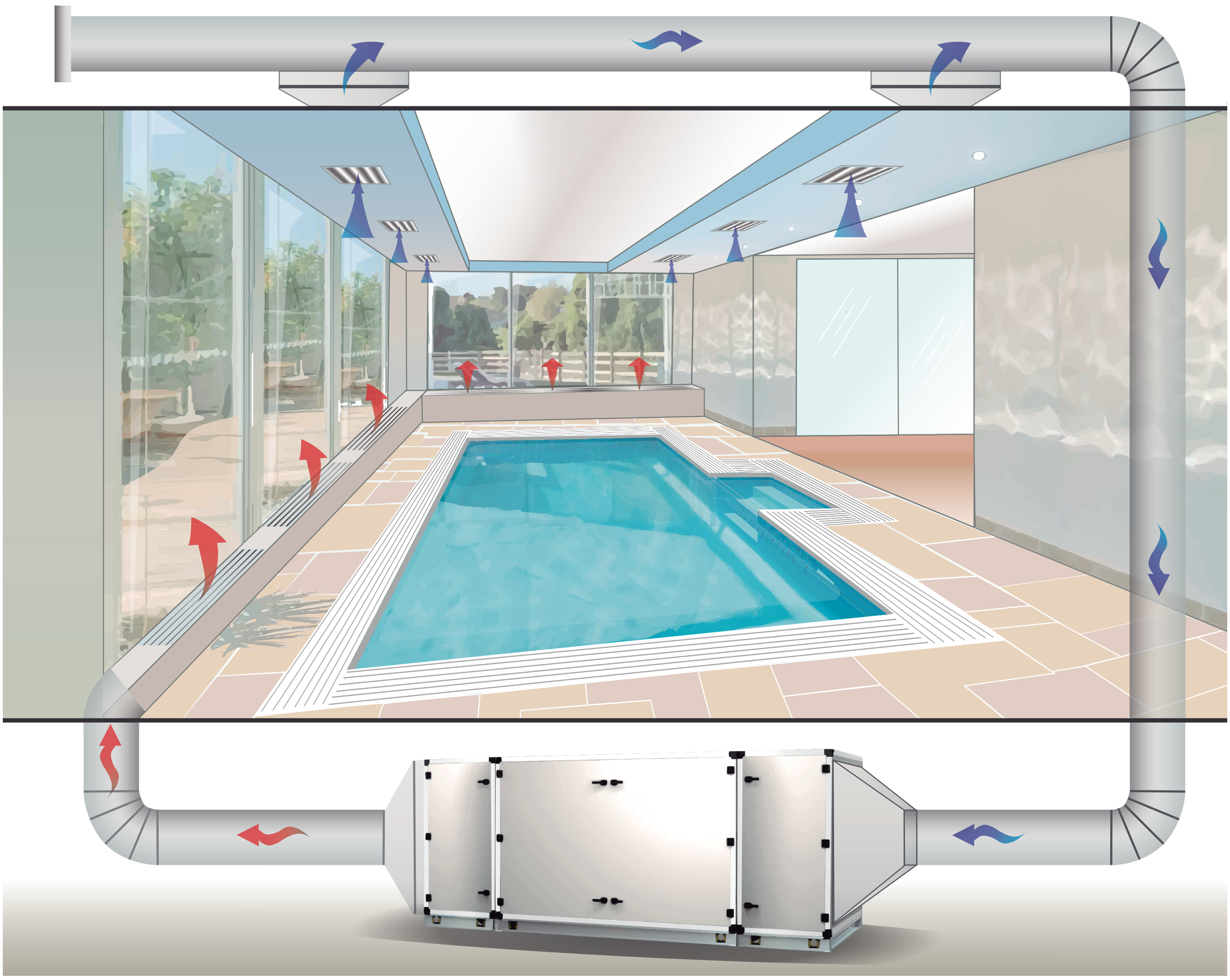
Generally, aluminium and plastic are the preferred materials for grilles, control dampers and diffusers, while the distribution ducts are made of painted steel or aluminium.

During cleaning and disinfection of the pool water, by-products are formed which flow into the pool air. A further task of the air distribution system is to prevent the concentration of these substances so that they do not reach dangerous concentrations for bathers.

The most widely used product for the disinfection of swimming pool water is chlorine. If used correctly, it allows an excellent control of the value of microorganisms and bacteria, however, decomposing into hypochlorus acids and hypochloryte ions also reacts with sweat, skin cells, urine and other organic compounds present in the water creating disinfectant by-products such as trichloramine and cyanogen chloride.

These by-products transported by the air stream can be hazardous to health and must be properly removed.

Chloramines are compounds that irritate the eyes, lungs and skin of swimmers and occupants. They are also responsible for the typical "pool smell" which is often confused with "chlorine smell". In fact, "pool smell" is a symptom of insufficient chlorination.



MAIN CHARACTERISTICS

STRUCTURE AND PANELS

The structure of the units can be realized in two versions:

VERSION 1:
Profiles 50 x 50 mm in self-supporting extruded anodized 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 in pre-painted RAL 9010 galvanized sheet steel with interposed insulation made of polyurethane foam with a density of 40 kg/m^3.
This structure has a seal class L1 while the thermal transmittance and the thermal bridge characteristic is class T3/TB4 according to EN1886.

VERSION 2:
Thermal break profiles 60 x 60 mm in self-supporting extruded anodized aluminium, with mechanical strength requirements in accordance with EN 1886: D1 (M). 63 mm thermal break sandwich-type double-walled sandwich-type panels with both exterior and interior side in pre-painted RAL 9010 galvanized sheet steel with interposed insulation made of polyurethane foam with a density of 40 kg/m^3.

This structure has a seal class L1 while the thermal transmittance and the thermal bridge characteristic is class T2/TB2 according to EN1886.

AIR FILTERS

The filter sections on the return and fresh air are supplied with bag filters class 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 thus ensuring, according to the needs of the system, that the correct operation of the unit is maintained with consequent saving of the energy absorbed by the unit.

COMPRESSORS

The compressors are scroll type with electric heater incorporated in the crankcase and thermal overload protections incorporated in the motor windings. They are mounted on rubber anti-vibration dampers.

REFRIGERANT CIRCUIT

The refrigerant circuit is of direct expansion type loaded with R410a refrigerant. Each refrigerant circuit is factory tested both in terms of tightness (pressure test) and functionality.

CONTROLS

The unit is equipped with a microprocessor control system, able to manage the different operating modes, ensuring maximum energy saving in all conditions of use.
The electronic controls, according to the needs of the environment, can operate in different modes such as:
- dehumidification with external air;
- dehumidification with Alpha cycle;
- heating with external air;
- recirculation heating;
- activation of pool water heat recovery.

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 remote control panel (optional).

VORTICE INDUSTRIAL

TECHNICAL DATA

MODEL		021	031	041	061	081
Nominal airflow rate	m^3/h	2000	3000	4500	6000	8000
External air flow	%	0 ÷ 100	0 ÷ 100	0 ÷ 100	0 ÷ 100	0 ÷ 100
Thermal efficiency recovery (1)	%	79,5	78,9	79,9	79,7	79,4
Thermal power recovery (1)	kW	16,3	24,4	37,1	49,6	65,9
Thermal power of refrigerant circuit (1)	kW	8,5	14,2	20,0	28,1	34,3
Total thermal power of unit (1)	kW	24,8	38,6	57,1	77,7	100,2
Electrical power absorbed of compressor (1)	kW	1,2	1,7	2,0	3,5	4,7
Electrical power absorbed of supply fans	kW	0,65	0,94	1,44	1,93	2,70
Electrical power absorbed of return fans	kW	0,57	0,85	1,31	1,74	2,44
Total electrical power absorbed (1)	kW	2,42	3,49	4,75	7,17	9,84
COP refrigerant circuit (1)	W/W	4,4	4,3	4,3	4,4	4,2
SFP factor (3)	W/(l/s)	1,54	1,56	1,68	1,67	1,76
Supply fan available static pressure	Pa	350	350	350	350	350
Return fan available static pressure	Pa	300	300	300	300	300
Thermal power of water coil (1) (2)	kW	23,6	35,1	49,3	67,1	90,2
Number of compressors: inverter	n°	1	1	1	1	1
Number of refrigerant circuits	n°	1	1	1	1	1
Type of refrigerant		R410A				
Energy classification filters		ePM1 65% (F7) | ePM10 65% (M5)				
Power supply	V/ph/Hz	400/3/ 50				

MODEL		101	132	172	242
Nominal airflow rate	m^3/h	10000	13000	17000	24000
External air flow	%	0 ÷ 100	0 ÷ 100	0 ÷ 100	0 ÷ 100
Thermal efficiency recovery (1)	%	79,3	80,0	79,5	78,3
Thermal power recovery (1)	kW	81,5	106,0	140,6	181,6
Thermal power of refrigerant circuit (1)	kW	43,2	64,1	80,7	104,0
Total thermal power of unit (1)	kW	124,7	170,1	221,3	285,6
Electrical power absorbed of compressor (1)	kW	5,8	8,2	9,5	16,0
Electrical power absorbed of supply fans	kW	3,29	4,03	5,51	8,14
Electrical power absorbed of return fans	kW	2,92	3,65	4,98	7,45
Total electrical power absorbed (1)	kW	12,01	15,88	19,99	31,59
COP refrigerant circuit (1)	W/W	4,3	4,5	4,4	4,5
SFP factor (3)	W/(l/s)	1,68	1,61	1,69	1,84
Supply fan available static pressure	Pa	350	350	350	350
Return fan available static pressure	Pa	300	300	300	300
Thermal power of water coil (1) (2)	kW	113,5	136,1	183,3	248,0
Number of compressors: inverter + On/Off	n°	1	1 + 2	1 + 2	1 + 2
Number of refrigerant circuits	n°	1	2	2	2
Type of refrigerant		R410A			
Energy classification filters		ePM1 65% (F7) | ePM10 65% (M5)			
Power supply	V/ph/Hz	400/3/50			

(1) 100% external air flow, external air conditions 0°C / 80% R.H. ambient air conditions 30°C / 60% R.H.

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

(3) in compliance with EN 13779

ACCESSORIES

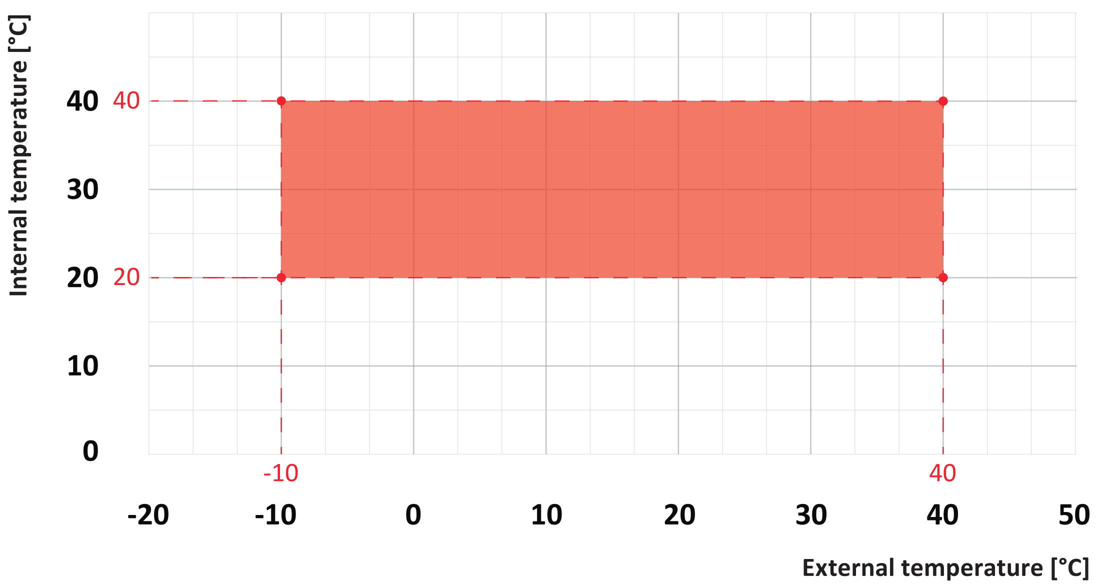
MODEL	021	031	041	061	081	101	132	172	242
RAL 9010 painted frame	■	■	■	■	■	■	■	■	■
Supply and return EC fans	■	■	■	■	■	■	■	■	■
Counter-flow plate heat recovery	■	■	■	■	■	■	■	■	■
ePM_{10} 50% (G4) + ePM_1 55% (F7) supply filter	■	■	■	■	■	■	■	■	■
ePM_{10} 50% (G4) + ePM_1 55% (F7) return filter	■	■	■	■	■	■	■	■	■
Hot water coil with 3 way modulating valve	■	■	■	■	■	■	■	■	■
Filters differential pressure switches	■	■	■	■	■	■	■	■	■
Fans differential pressure transducers	■	■	■	■	■	■	■	■	■
Dampers with actuators	■	■	■	■	■	■	■	■	■
Microprocessor control system with display	■	■	■	■	■	■	■	■	■
Refrigerant circuit with scroll compressor	■	■	■	■	■	■	■	■	■
RS-485 serial port Modbus protocol	■	■	■	■	■	■	■	■	■
50 mm frame	□	□	□	□	□	□	□	□	□
60 mm thermal break frame	□	□	□	□	□	□	□	□	□
40 kg/m^3 polyurethane panels thermal insulation	□	□	□	□	□	□	□	□	□
80 kg/m^3 mineral wool panels thermal insulation	□	□	□	□	□	□	□	□	□
Electric frost coil pre-heater	□	□	□	□	□	□	□	□	□
Circular duct flanges (4 pcs.)	□	□	□	□	□	□	□	□	□
Sound attenuator (1)	□	□	□	□	□	□	□	□	□
Roof for outdoor installation	□	□	□	□	□	□	□	□	□
45° hoods with bird trap (2 pcs.)	□	□	□	□	□	□	□	□	□
Flexible joints for duct connections (4 pcs.)	□	□	□	□	□	□	□	□	□
Remote control panel (2)	□	□	□	□	□	□	□	□	□

■ Standard □ Optional – Not available

(1) mounted in a separated box

(2) supplied loose

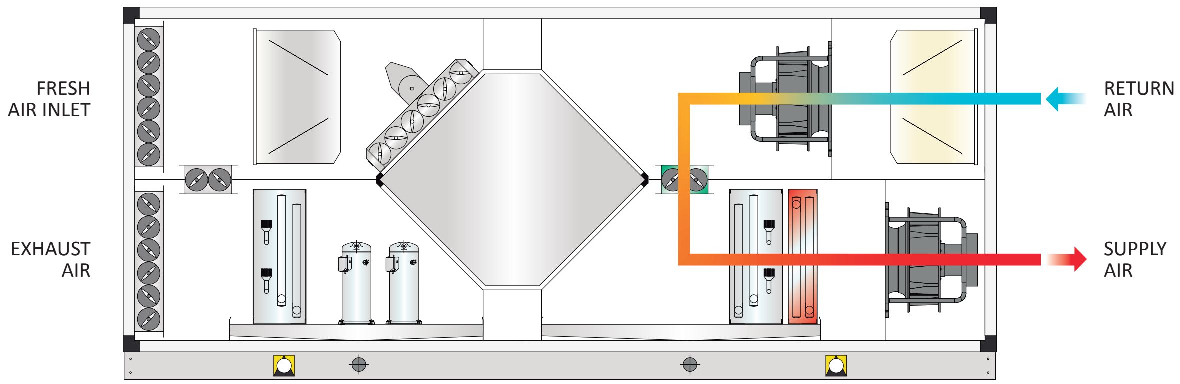
OPERATING LIMITS



OPERATING MODE

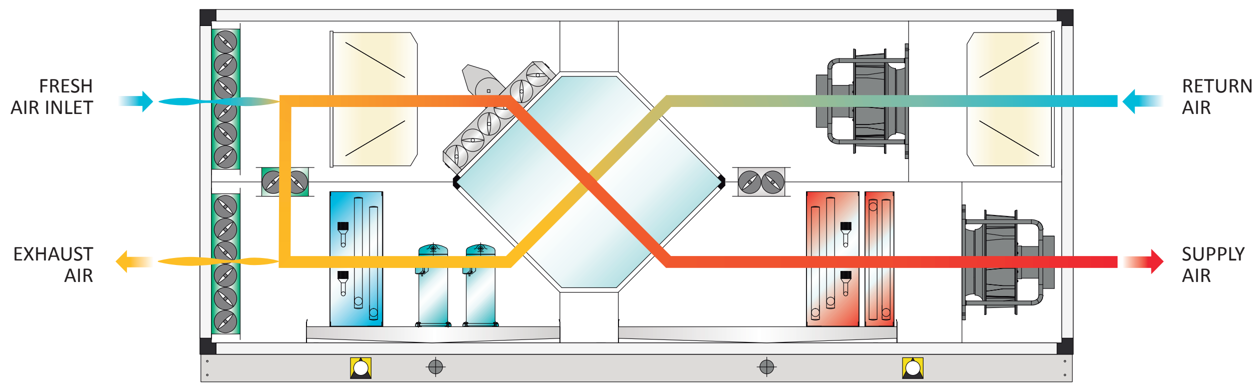
• START-UP MODE OR NIGHT HEATING MODE

The unit operates in 100% recirculation mode without external air supply. The air in the pool room is recirculated and heated by the water coil in the unit and supplied by an external energy source (e.g. boiler). The heat pump circuit is in stand-by. The fans operate in flow modulation to minimize the power consumption of the unit.



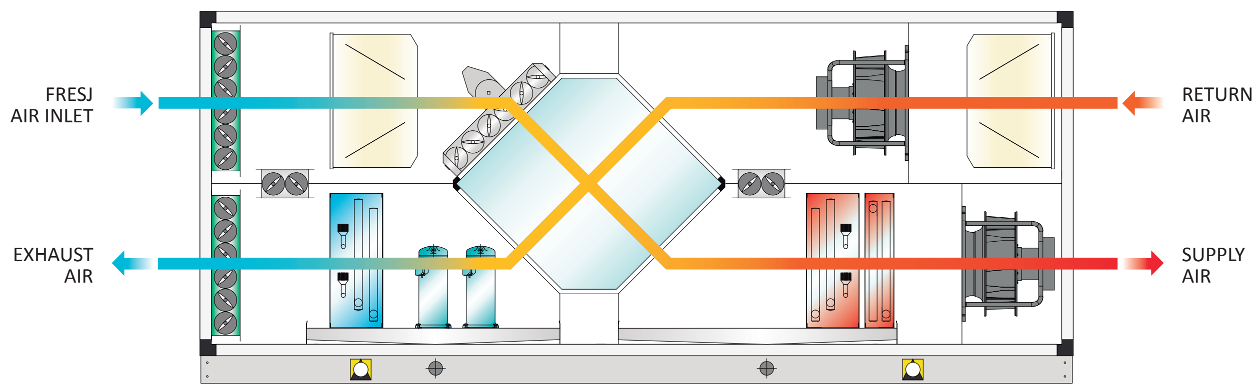
• DEHUMIDIFICATION MODE WITH "ALPHA" CYCLE

The unit operates with the minimum amount of fresh air to ensure the hygiene requirements of the pool room. In this mode, the fresh air is sufficient to ensure adequate dehumidification of the room, if this is not sufficient, part of the air downstream of the heat pump evaporator (dehumidified) is recirculated to supplement the dehumidification. In this way a percentage (variable) of the airflow is expelled, fully integrated with fresh air. The fresh air is pre-heated in the heat recovery and then in the condenser of the heat pump; in case the temperature is not yet warm enough, it will be integrated with the hot water coil.

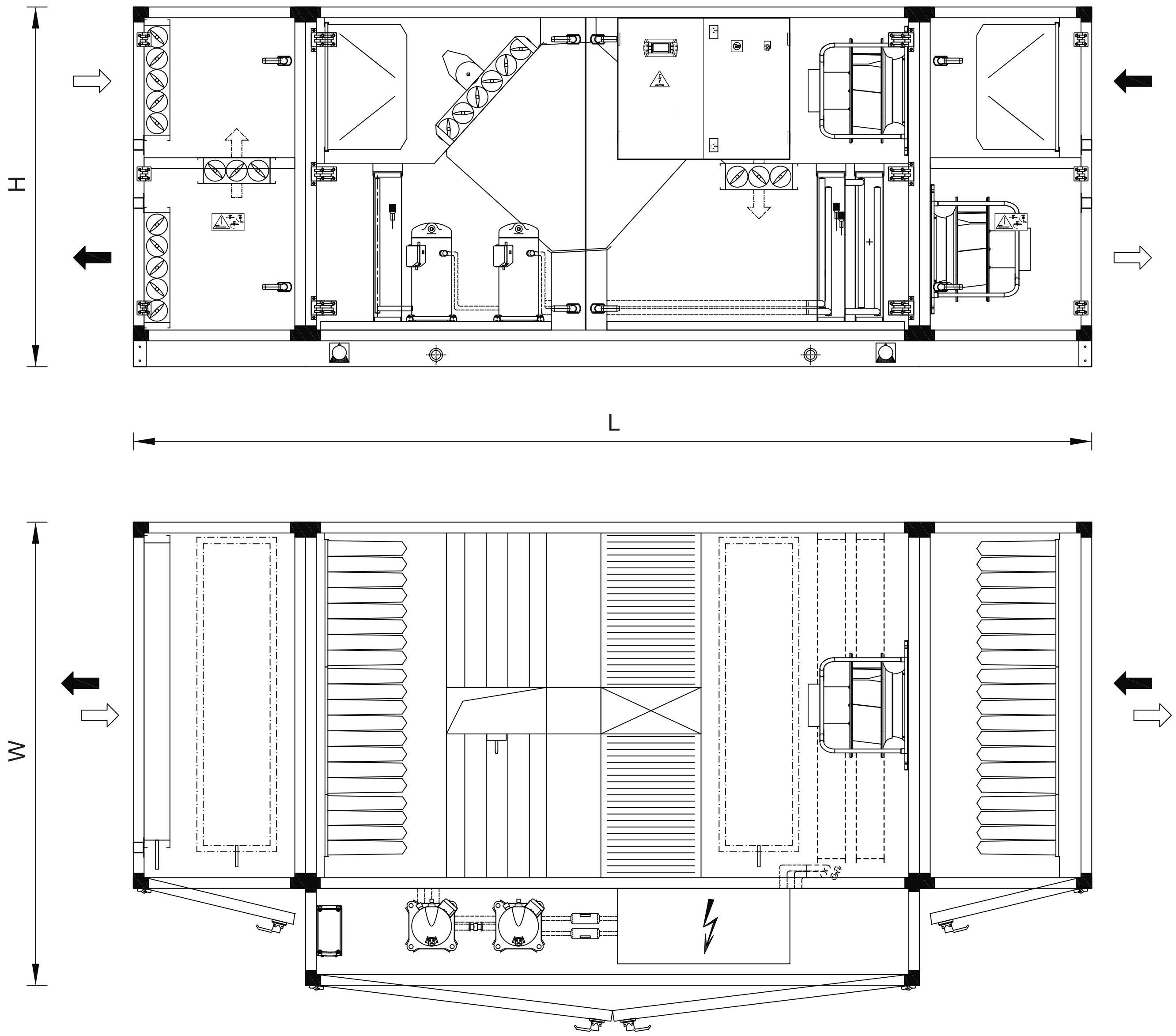


• DEHUMIDIFICATION MODE WITH FRESH AIR

The unit operates with 100% fresh air. The by-pass damper on the heat recovery pack of the cross-flow heat recovery is closed and the unit operates by heating all the fresh air. Dehumidification takes place using fresh air. The heat pump circuit recovers the energy expelled from the room and heats the supply air.



DIMENSIONAL DRAWING



DIMENSIONS AND WEIGHTS

MODEL	021	031	041	061	081	101	132	172	242
L (mm)	3500	3900	4400	4400	4700	4800	5250	5900	6300
W (mm)	1350	1500	1650	1900	2150	2250	2280	2380	2380
H (mm)	1270	1300	1550	1700	1700	1820	2220	2550	2750
Weight (kg)	510	639	785	1022	1147	1276	1512	1876	2125

Dimensions and weights referred to the standard configuration