TITAN Sky

30÷200 kW

General
Chiller and reversible heat pumps with full inverter reciprocating compressors and plate heat exchangers. Extended range, versatile applications.

Configurations
Hi: chiller with inverter compressor

Hi HP: Reversible heat pump version, with inverter compressor

/SLN: super low noise version

/DS: execution featuring a desuperheater

/DC: execution with recovery condenser

Strengths
- Refrigerant R290 - GWP=3.The refrigerant is a pure natural fluid.
- Reduced refrigerant charge
- Eurovent Certification
- High efficiency and compact dimensions

Chiller version:
- Versatile application: water temperature from -15°C up to 20°C. Operation in a wide range of environmental conditions

Reversible heat pump version:
- High outlet water temperature: up to +63°C
- Down to -20°C ambient temperature with outlet water up to +50°C

BlueBox by Swegon

Titan SKY R0

Titan SKY is a large range of high efficiency chillers and reversible heat pumps featuring with full inverter reciprocating compressors and an air source, suitable for both comfort and process applications. Chiller versions can produce chilled water from -15 ° C up to 20 ° C, with external temperatures from -15 ° C up to + 52 ° C. Heat pump versions are designed for the production of hot water up to63°C, with outside temperature down to -20°C. Units mount variable speed inverter compressors in order to maximize the seasonal efficiency and achieve stable thermodynamic regulation in any load condition. The whole range is characterized by compactness and low refrigerant charge.

REFRIGERANT

Titan Sky units are available with R290 refrigerant.

The use of R290 refrigerant is indicated by acronym "R0", which indicates a GWP level close to 0.

Refrigerant R290 GWP(Global Warming Potential)=3*

ODP (Ozone Depletion Potential) 0

The refrigerant is a pure natural fluid.

R290 is classified as group 1 fluid according to PED.

It is also classified as A3 according to ASHRAE standard 34:

- non-toxic;
- Highly flammable.

The excellent GWP value may be an advantage in projects where:

- min. targets are adopted for the containment of the environmental footprint;
- it is possible to receive incentives or other benefits that are applicable in some countries or are connected to specific plant design criteria.

(*) GWP (AR5), pursuant to IPCC V, evaluated over a span of 100 years.

STRUCTURE

The structure of the unit is made of galvanized sheet-iron coated with polyester powder in RAL 5017/7035 at 180°C, which makes it highly resistant to weather conditions.

The structure is a load-bearing frame, with removable panelling lined with sound absorbing expanded polyurethane matting.

All screws and bolts are stainless steel.

COMPRESSORS

Compressors are semi-hermetics reciprocating in single or double circuit, with a inverter for each compressor that modulates the working frequency according to the load request. Compressor are optimized for use with propane. All compressors are equipped with crankcase heater, suction and delivery valves as standard.

The compressors are enclosed in a dedicated technical compartment which can be accessed by removing the panels.

Depending on the model, there are the following compressor configurations:

- the models with a single compressor (x.1) require the use of a single compressor with modulating inverter in a circuit.
- the models with two compressors (x.2) require the use of a compressor with modulating inverter for each circuit.

The speed of the modulating compressor is varied, depending on the total heat load, roughly between 30 and 105 rps. 30Hz and 65Hz.

The modulating compressors are driven by inverters. This also has the following functions:

- management of acceleration and deceleration ramps
- management of the operating envelope of the modulating compressor
- management of the alarms and safety devices of the modulating compressor

The use of a modulating compressor allows the total inrush current to be reduced because it is always started with an acceleration ramp.

SOURCE-SIDE HEAT EXCHANGER

(for chiller unit)

The exchangers are made with microchannel aluminium coils. Finned pack coils with copper tubes and aluminium fins can be requested as accessory.

Thanks to continuous research in the alloys field, and sophisticated production methods, microchannel coils are made using specific aluminium alloys for the tubes and for the fins. This allows the effects of galvanic corrosion to be drastically reduced to always ensure protection of the tubes that confine the refrigerant. Tubes and fins are also subjected to SilFLUX coating processes (or equivalent) or have zinc added to further increase their corrosion resistance.

The use of microchannel coils, as opposed to conventional copper/aluminium coils, reduces the total weight of the unit and reduces the refrigerant charge.

Options are available for installation in environments with a particularly aggressive atmosphere or in coastal or highly industrialized areas. See section: "Description of accessories".

(for HP units)

The exchangers are made with finned pack coils with copper tubes and aluminium fins.

The coils have an increased fin pitch to reduce frost formation and to facilitate the outflow of condensed water during defrosting.

At the base of the coils there is a collection tray as standard which facilitates the drain of condensate during the defrost.

The unit is fitted as standard with a heating cable glued to the bottom of the condensate tray to prevent formation of ice.

RAM accessory provide an oversizes electrical heaters system.

Options are available for installation in environments with a particularly aggressive atmosphere or in coastal or highly industrialized areas. See section: "Description of accessories".

FANS

The fans are axial fans, directly coupled to a 6-pole electric motor, with integrated thermal overload protection (Klixon®) and IP 54 protection rating.

The fan includes the shroud, designed to optimize its efficiency and reduce noise emission to a minimum, and the safety guard.

The control manages the speed of the fans through a phase cutting speed adjuster, in order to optimize the operating conditions and efficiency of the unit.

The fan speed regulator is supplied standardly.

This control also has the effect of reducing the noise level of the unit: in fact, the typical conditions under which the control will be modulating the speed of the fans are those of the night, spring and autumn.

For units equipped with EC fans (option), the same function is carried out using the electronically commutated motor of the fans.

USER-SIDE HEAT EXCHANGER

The exchanger is a braze-welded stainless steel plate heat exchanger, insulated with a shroud of closed-cell insulating material.

The exchanger is also equipped with thermostat-controlled anti-freeze heater to protect it from ice formation when the unit is not running.

(for HP units)

The operation of the unit is optimized in heating mode, where the water and refrigerant fluids exchange in countercurrent inside the plate heat exchanger.

REFRIGERANT CIRCUIT

Each refrigerant circuit of the basic unit comprises:

(for chiller unit)

- delivery shut-off valve
- suction shut-off valve
- charging valves
- liquid sight glass
- dehydrating filter
- electronically-controlled thermostatic expansion valve
- high and low pressure switches

(for HP units)

- solenoid valve on the liquid line
- 4-way reversing valve
- delivery shut-off valve
- suction shut-off valve
- liquid receiver
- charging valves
- liquid sight glass
- dehydrating filter
- electronically-controlled thermostatic expansion valve
- high and low pressure switches
- suction liquid separator

The copper pipes are sized with increased thicknesses in order to ensure greater reliability and durability over time.

The pipes of the circuit and the exchanger are insulated with extruded closed-cell expanded elastomer.

The refrigeration circuit is enclosed in a compartment that contains an ATEX certified leak sensor and an ATEX certified extraction fan.

The hydronic module, if present, is also enclosed in the compartment that contains the ATEX certified leak sensor and the ATEX certified extraction fan.

ELECTRICAL CONTROL PANEL

The electrical control panel is made in a painted galvanized sheet-iron box with forced ventilation and IP54 protection rating.

The electrical panel is made following the EN60204-1 standard.

The electrical panel is separated from the compressor compartment.

The electrical control panel of the basic unit comprises:

- general disconnect switch three-phase line
- fuses to protect the compressors, fans and auxiliary circuits
- fan contactors
- phase-cutting fan speed adjuster
- thermal magnetic circuit breakers for pumps (if present)
- phase monitor
- potential-free general alarm contacts
- single potential free operating contacts for compressors, fans and pumps (when present)
- digital input for general ON/OFF
- summer/winter selection by digital input
- external air temperature probe
- microprocessor controller with display accessible from the outside

All the electrical cables inside the panel are numbered and the terminal board dedicated to the customer's connections is coloured orange so that it can be quickly identified in the panel.

The unit power supply is 400V/3~+N/ 50Hz for all models.

CONTROL BLUETHINK

The unit is supplied as standard with an advanced controller.

The control allows the following functions:

- regulation of the water temperature, with preferential control of the inlet water on the single-circuit, and outlet water on the dual circuits
- freeze protection
- compressor timings
- automatic rotation of compressor starting sequence
- recording of the log of all machine inputs, outputs and states
- automatic rotation of compressor starting sequence
- recording of the alarm log
- RS485 serial port with Modbus protocol
- Ethernet serial port with Modbus protocol and integrated web server preloaded web page
- digital input for general ON/OFF
- digital input for Summer/Winter selection

For further details on available functions and on displayed information, refer to the specific documentation of the controller.

By default, the serial connections present as standard are enabled only for reading from BMS. Enabling of writing from BMS is to be requested when ordering.

Main functions of the webserver

As standard, the Bluethink controller integrates a webserver with a preloaded web page that is accessed via password.

The web page allows the following functions to be carried out (some of these are available only for users with advanced level rights):

- display of the main functions of the unit such as unit serial n°, size, refrigerant
- display of the general status of the machine: water inlet and outlet temperatures, external air temperature, mode (chiller or heat pump), evaporating and condensing pressures, suction and discharge temperatures
- display of the status of compressors, pumps, expansion valves
- display in real time of the graphs of the main quantities
- display of the graphs of logged quantities
- display of alarm log
- management of users on several levels
- remote ON/OFF
- remote set point change
- remote time band change
- remote summer winter mode selection

Human-Machine Interface

The control has a graphic display that allows the following information to be displayed:

- water inlet and outlet temperature
- set temperature and differential set points
- description of alarms
- hour meter of operation and number of start-ups of the unit, the compressors and the pumps (if present)
- high and low pressure values, and relevant condensing and evaporating temperatures
- external air temperature
- superheating at compressor suction.

Management of defrost cycles (for HP units)

For defrost management, the control of the unit uses a sliding intervention threshold, depending on the pressures inside the unit and the external air temperature. By putting together all this information, the control can identify the presence of ice on the coil and activates the defrosting sequence only when necessary, so as to maximize the energy efficiency of the unit.

Sliding management of the defrost threshold ensures that, as the absolute humidity of outdoor air decreases, the frequency of the defrost cycles gradually decreases because they are carried out only when the ice formed on the coil actually penalizes performance.

The defrost cycle is fully automatic: during the initial stage, a defrost is carried out by cycle reversal with the fans stopped. As soon as the frost on the coil has molten to a suitable level, the unit resumes operation in heat pump mode.

In the two-compressor units, there is aeraulic separation between the two circuits, and this allows the management of independent defrosts with greater stability in the production of hot water.

OPTIONS

/HAT: unit for high external air temperatures (for chiller unit)

The HAT option is designed to expand the work range of the unit.

The unit fitted with this accessory adopts an electrical control panel made using specific components to withstand high temperatures, special cables and oversize protection parts.

The accessory enables the unit to work with external air temperatures of over 45°C as indicated in the section on operating limits.

With this accessory, operation is guaranteed with external air temperature up to 52°C.

/DC: unit with total recovery condenser (for chiller unit)

In addition to the set-up of a chiller only unit, /DC units comprise:

- a heat recovery condenser for recovering 100% of the condensation heat;
- temperature probe at the inlet of the heat recovery heat exchanger;
- liquid receiver
- potential free contact in the electrical control panel for activation of recovery.

When required by the system, through the closing of a contact, the control automatically manages activation of recovery. Recovery management is carried out through a control on the temperature of the return water. The control also automatically manages safety deactivation of recovery if the condensing pressure becomes too high, and changes to using the condensing coils.

This option is not available for /HP units

/DS: unit with desuperheater

/DS units comprise (for each refrigerant circuit) an exchanger for condensation heat recovery of up to 20% (depending on size, version and operating conditions), placed in series with the condensing coil. The exchanger is a braze-welded plate heat exchanger. For multi-circuit units, the exchangers are to be manifolded outside the unit (by the customer).

The desuperheater can be used during operation in cooling mode. However, it can also be used in heating mode on condition that the following measures are taken:

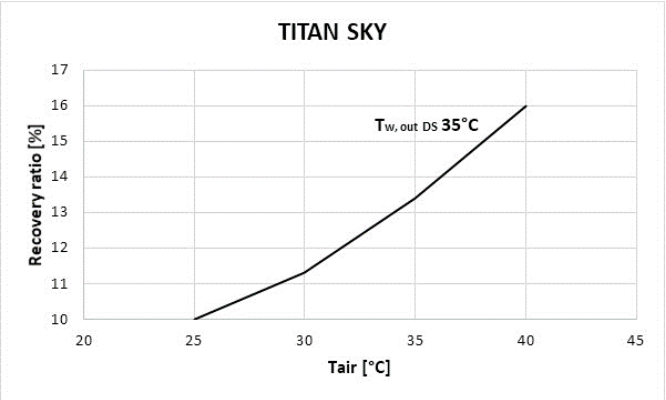
- a valve (either 2- or 3-way) must be installed on the desuperheater water circuit;
- the valve must be monitored using a temperature control system;
- the valve must be operated to regulate the temperature of the input water into the desuperheater = IWTds.

The valve, the control systems and their installation, setup operations, etc. are the responsibility of the client. If heat recovery is not required during operation in heat pump mode, or where the above requirements are not met, the water circuit of the desuperheater must be shut off. Desuperheater operation in heat pump mode reduces the heating capacity transferred from the unit to the user's hydronic circuit. When a desuperheater is fitted, irrespective of it running in either cooling or heating mode, the max. temperature of water delivered to the heating unit (LWTu_ Heating) is reduced, as described in the section "Operating limits".

An illustrative graph is shown below in which, as the ambient temperature changes, (Tair) and as the temperature of the water leaving the heat recovery heat exchanger changes, (Tw,out DS), the percentage of recovered heat is shown as an indication (Recovery ratio).

Condensation heat recovery is a function of size, version and operating conditions.

In the following graph, a constant temperature delta of 5°C between water inlet and outlet at the heat recovery heat exchanger has been considered.



/SLN: super low noise unit

The standard unit requires all compressors to be enclosed within a fully acoustically insulated compartment with sound-absorbing material with interposed sound-proofing material.

The SLN version units use fans with speed regulators with reduced air flow in chiller operation. The speed reduction of the fans is such that, under nominal operating conditions, the air flow rate and noise level are lower than those of the basic version of the unit.

In any case, the use of the speed adjuster to reduce the air flow rate allows rotation of the fans at maximum speed when external air temperature conditions are particularly critical and therefore guarantees the same operating limits as the high efficiency version.

In heating mode, the fans always run at 100% speed.

HYDRAULIC MODULES

All units can be fitted with hydraulic module in various configurations:

- /1P: hydraulic module with one pump
- /2P: hydraulic module with two pumps
- /1PS: hydraulic module with one pump and buffer tank
- /2PS: hydraulic module with two pumps and buffer tank

The following are also available:

- modules /1Pr, /2Pr, /1PrS e /2PrS that have pumps with reduced available discharge head
- modules /1PG, /2PG, /1PGS and /2PGS that have pumps suitable for operating with glycol up to 40%

Hydraulic modules with two pumps have:

- two pumps
- a check valve on the delivery side of each pump

In the version with 2 pumps, these are always with one on standby while the other is working. Switching over between the pumps is automatic and is done by time (to balance the hours of operation of each one) or in the event of failure.

Hydraulic modules with tank also have:

- a gate valve at the inlet of the pump or the suction manifold
- a tank with drain valve and air valve

Refer to the table of configurations that are not possible to check for availability of specific set-ups.

All the hydraulic circuit components are fully insulated, except for:

- drain valves
- venting valves
- tank plugs
- safety valves
- expansion vessel
- probe pockets

CONTROLS AND SAFETY DEVICES

All the units are fitted with the following control and safety components:

- user-side water temperature probe
- antifreeze probe on the user side heat exchanger
- high pressure switch with manual reset
- low pressure safety device with automatic reset, for a limited number of occurrences, managed by the controller
- compressor overtemperature protection
- fan overtemperature protection
- differential flow switch
- ATEX certified leakage sensor
- ATEX certified extraction fan

In the event that the leak detector identifies a gas leak, the following safety procedures are implemented:

- immediate shutdown of the unit
- interruption of the three-phase main power supply
- activation of the extraction fan
- activation of the ventilation fans of the electrical panel

TESTING

All the units are factory-tested and supplied complete with oil and refrigerant.

PACKAGING

The unit is made and shipped on a wooden pallet that allows the unit to be handled using a forklift truck.

CERTIFICATIONS AND REFERENCE STANDARDS

The manufacturer has implemented and keeps the Management Systems listed below and it is certified against them:

- Quality Management System according to standard UNI EN ISO 9000;
- Environmental Management System according to standard UNI EN ISO 14000;
- Health and Safety Management System according to standard BS OHSAS 18000 (as converted into UNI EN ISO 45000).

These management systems ensure that the company puts in place any and all actions and initiatives to define and monitor the standards defined by its Management, which are stated in its Quality, Environmental and Safety policies.

To meet the safety requirements, the unit was designed and manufactured in compliance with the directives and product regulations below:

- PED Directive: safety criteria to be followed when designing pressure equipment;
- Machinery Directive: safety criteria to be followed when designing machinery;
- Low Voltage Directive: safety criteria to be followed when designing electrical machine parts;
- Electromagnetic Compatibility Directive: electromagnetic compatibility criteria to be followed when designing electrical machine parts;
- WEEE Directive: criteria for product management at the end of its life cycle as waste with a view to environmental protection.

The units are manufactured, tested and checked with reference to the European standards specified in the Declaration of CE Conformity, in accordance with the requirements and procedures of our Quality System.

The transport, installation, use and storage of units with flammable refrigerants (A3 according to ASHRAE 34 standard) must meet European standards and regulations and local regulations where applicable.

For further details, please refer to the "Instruction manual for operation and maintenance".

Responsibilities and obligations exclusive to the installer:

- to carry out a specific risk assessment according to the European regulations/standards above and/or the local laws in order to define the necessary measures for conformity;
- to comply with the requirements and to take the measures resulting from the outcomes of the risk assessment, pursuant to the relevant regulations and standards.

TECHNICAL SPECIFICATIONS

Titan SKY Hi R0

			3.1	4.1	5.1	6.1	7.1	8.1
Cooling								
Refrigeration capacity	(1)	kW	32.5	41.1	52.9	65.5	72.6	82.9
Total absorbed power	(1)	kW	11.6	13.5	18.4	25.5	24.5	28.2
EER	(1)		2.8	3.1	2.9	2.6	3	3
Compressors								
Compressors/Circuits		n°	1	1	1	1	1	1
Minimum capacity reduction step	(7)	%	46	46	46	46	46	46
Refrigerant charge CH (MCHX)	(3)	kg	2.1	4	4.1	4.2	5.5	5.6
Refrigerant charge CH (Cu/Al)	(3)	kg	2.5	4.8	4.9	5	6.9	7
Fans								
Quantity		n°	1	1	1	1	2	2
Total air flow rate CH (MCHX)		m³/h	8500	20500	20500	20500	41000	41000
User-side heat exchanger								
Quantity		n°	1	1	1	1	1	1
Water flow rate CH	(1)	m³/h	5.6	7.1	9.2	11.3	12.5	14.3
Pressure drop CH	(1)	kPa	14.9	18	18.7	20.5	25.2	21.7
Noise levels								
Sound power level cooling	(4)	dB(A)	83	83	87	87	87	89
Sound pressure level cooling	(6)	dB(A)	51	51	55	55	55	57
Dimensions and weights**								
Length		mm	2200	2660	2660	2660	3260	3260
Depth		mm	1130	1130	1130	1130	1130	1130
Height		mm	2136	2136	2136	2136	2136	2136
Operating weight		kg	977	1128	1138	1235	1245	1254

Titan SKY Hi R0

			10.1	12.2	13.2	14.2	17.2	20.2
Cooling								
Refrigeration capacity	(1)	kW	96.2	105.5	131	145.1	165.8	192.4
Total absorbed power	(1)	kW	34.4	36.5	51	48.9	56.4	68.9
EER	(1)		2.8	2.9	2.6	3	3	2.8
Compressors								
Compressors/Circuits		n°	1	2	2	2	2	2
Minimum capacity reduction step	(7)	%	46	23	23	23	23	23
Refrigerant charge CH (MCHX)	(3)	kg	5.7	8.2	8.5	11	11.4	11.8
Refrigerant charge CH (Cu/Al)	(3)	kg	7.1	9.5	9.8	13.6	14.1	14.3
Fans								
Quantity		n°	2	2	2	4	4	4
Total air flow rate CH (MCHX)		m³/h	41000	41000	41000	82000	82000	82000
User-side heat exchanger								
Quantity		n°	1	1	1	1	1	1
Water flow rate CH	(1)	m³/h	16.6	18.2	22.6	25	28.6	33.1
Pressure drop CH	(1)	kPa	22.2	27.9	30.3	37.3	32.9	31.5
Noise levels								
Sound power level cooling	(4)	dB(A)	89	90	90	90	92	92
Sound pressure level cooling	(6)	dB(A)	57	58	58	58	60	60
Dimensions and weights**								
Length		mm	3260	3751	3751	4952	4952	4952
Depth		mm	1130	1130	1130	1130	1130	1130
Height		mm	2136	2405	2405	2405	2405	2405
Operating weight		kg	1291	1629	1749	2012	2032	2048

CH: chiller unit; HP: heat pump unit; MCHX: unit with microchannel coils

(1) External air temperature of 35°C and user-side heat exchanger water inlet-outlet temperature of 12-7°C. Values compliant with standard EN 14511

(3) Theoretical values referred to the basic unit. The amount of gas actually charged in the unit may differ.

(4) Unit operating at rated capacity, with no accessories of any kind - external air temperature 35°C and water input/output temperature from/to heat exchanger and user equal to 12/7°C. Values taken by measurements made in accordance with standard ISO 3744 and the Eurovent certification programme, where applicable. Binding values See NOISE LEVELS section.

(6) Values obtained from the sound power level (conditions: note 4), related to a distance of 10 m from the unit in free field with directivity factor Q=2. Non-binding values See NOISE LEVELS section.

(7) Approximate value. The minimum capacity reached by the unit depends on the operating conditions. The value shown may not be suitable for calculating the minimum volume of water: to do this, consult the "Minimum water content in the system" section.

** Basic unit without included accessories

Titan Sky Hi SLN R0

			3.1	4.1	5.1	6.1	7.1	8.1
Cooling								
Refrigeration capacity	(1)	kW	30.7	39.6	50.3	62.4	70.4	80.1
Total absorbed power	(1)	kW	12.1	13.6	18.7	26.4	24.5	28.5
EER	(1)		2.6	3.1	2.9	2.6	3	2.9
Compressors								
Compressors/Circuits		n°	1	1	1	1	1	1
Minimum capacity reduction step	(7)	%	46	46	46	46	46	46
Refrigerant charge CH (MCHX)	(3)	kg	2.1	4	4.1	4.2	5.5	5.6
Refrigerant charge CH (Cu/Al)	(3)	kg	2.5	4.8	4.9	5	6.9	7
Fans								
Quantity		n°	1	1	1	1	2	2
Total air flow rate CH (MCHX)		m³/h	6500	16000	16000	16000	32000	32000
User-side heat exchanger								
Quantity		n°	1	1	1	1	1	1
Water flow rate CH	(1)	m³/h	5.3	6.9	8.7	10.8	12.2	13.8
Pressure drop CH	(1)	kPa	14.9	18	18.7	20.5	25.2	21.7
Noise levels								
Sound power lev. SLN vers.	(4)	dB(A)	81	81	85	85	85	87
Sound pressure lev. SLN vers.	(6)	dB(A)	49	49	53	53	53	55
Dimensions and weights**								
Length		mm	2200	2660	2660	2660	3260	3260
Depth		mm	1130	1130	1130	1130	1130	1130
Height		mm	2136	2136	2136	2136	2136	2136
Operating weight		kg	977	1128	1138	1235	1245	1254

Titan Sky Hi SLN R0

			10.1	12.2	13.2	14.2	17.2	20.2
Cooling								
Refrigeration capacity	(1)	kW	92.3	102.9	124.8	140.9	160.2	184.6
Total absorbed power	(1)	kW	35	36.6	52.7	48.9	56.9	70.1
EER	(1)		2.7	2.9	2.4	2.9	2.9	2.7
Compressors								
Compressors/Circuits		n°	1	2	2	2	2	2
Minimum capacity reduction step	(7)	%	46	23	23	23	23	23
Refrigerant charge CH (MCHX)	(3)	kg	5.7	8.2	8.5	11	11.4	11.8
Refrigerant charge CH (Cu/Al)	(3)	kg	7.1	9.5	9.8	13.6	14.1	14.3
Fans								
Quantity		n°	2	2	2	4	4	4
Total air flow rate CH (MCHX)		m³/h	32000	32000	32000	64000	64000	64000
User-side heat exchanger								
Quantity		n°	1	1	1	1	1	1
Water flow rate CH	(1)	m³/h	15.9	17.8	21.5	24.3	27.6	31.8
Pressure drop CH	(1)	kPa	22.2	27.9	30.3	37.3	32.9	31.5
Noise levels								
Sound power lev. SLN vers.	(4)	dB(A)	87	88	88	88	90	90
Sound pressure lev. SLN vers.	(6)	dB(A)	55	56	56	56	58	58
Dimensions and weights**								
Length		mm	3260	3751	3751	4952	4952	4952
Depth		mm	1130	1130	1130	1130	1130	1130
Height		mm	2136	2405	2405	2405	2405	2405
Operating weight		kg	1291	1629	1749	2012	2032	2048

CH: chiller unit; HP: heat pump unit; MCHX: unit with microchannel coils
(1) External air temperature of 35°C and user-side heat exchanger water inlet-outlet temperature of 12-7°C. Values compliant with standard EN 14511
(3) Theoretical values referred to the basic unit. The amount of gas actually charged in the unit may differ.
(4) Unit operating at rated capacity, with no accessories of any kind - external air temperature 35°C and water input/output temperature from/to heat exchanger and user equal to 12/7°C. Values taken by measurements made in accordance with standard ISO 3744 and the Eurovent certification programme, where applicable. Binding values See NOISE LEVELS section.
(6) Values obtained from the sound power level (conditions: note 4), related to a distance of 10 m from the unit in free field with directivity factor Q=2. Non-binding values See NOISE LEVELS section.
(7) Approximate value. The minimum capacity reached by the unit depends on the operating conditions. The value shown may not be suitable for calculating the minimum volume of water: to do this, consult the "Minimum water content in the system" section.
** Basic unit without included accessories

TITAN SKY Hi HP R0

			3.1	5.1	7.1	8.1	10.1	12.2	14.2	17.2	20.2
Cooling											
Refrigeration capacity	(1)	kW	29.4	49.7	59	74.3	87.4	99.1	117.2	146.7	174.5
Total absorbed power	(1)	kW	11.8	19.7	24.7	28.3	35.5	39.8	49.8	57.1	71.5
EER	(1)		2.5	2.5	2.4	2.6	2.5	2.5	2.4	2.6	2.4
Heating											
Heating capacity	(1)	kW	31.2	57	68.4	83.3	97.6	114.2	135.2	166.7	195.2
Total absorbed power	(1)	kW	9.7	17.9	21.2	26	31.2	36	42.5	52.4	62.7
COP	(1)		3.2	3.2	3.2	3.2	3.1	3.2	3.2	3.2	3.1
Compressors											
Compressors/Circuits		n°	1	1	1	1	1	2	2	2	2
Minimum capacity reduction step	(7)	%	46	46	46	46	46	23	23	23	23
Refrigerant charge HP	(3)	kg	2.5	4.9	5	7	7.1	9.5	9.8	14.1	14.3
Fans											
Quantity		n°	1	1	1	2	2	2	2	4	4
Total air flow rate HP		m³/h	8500	20500	20500	41000	41000	41000	41000	82000	82000
User-side heat exchanger											
Quantity		n°	1	1	1	1	1	1	1	1	1
Water flow rate CH	(1)	m³/h	5.1	8.6	10.2	12.8	15.1	17.1	20.2	25.3	30.1
Pressure drop CH	(1)	kPa	11.6	13.6	14.9	16.8	17.9	29.1	30.6	30.5	30.1
Water flow rate HP	(1)	m³/h	5.4	9.8	11.7	14.3	16.8	19.6	23.2	28.6	33.5
Pressure drop HP	(1)	kPa	15.4	19.1	20	22.1	24	40.9	42.5	40.7	40.8
Noise levels											
Sound power level cooling	(4)	dB(A)	83	87	87	89	89	90	90	92	92
Sound pressure level cooling	(6)	dB(A)	51	55	55	57	57	58	58	60	60
Dimensions and weights**											
Length		mm	2200	2660	2660	3260	3260	3751	3751	4952	4952
Depth		mm	1130	1130	1130	1130	1130	1130	1130	1130	1130
Height		mm	2136	2136	2136	2136	2136	2405	2405	2405	2405
Operating weight		kg	978	1139	1194	1317	1357	1623	1634	2110	2190

CH: chiller unit; HP: heat pump unit; MCHX: unit with microchannel coils

(1) External air temperature of 35°C and user-side heat exchanger water inlet-outlet temperature of 12-7°C. Values compliant with standard EN 14511

(3) Theoretical values referred to the basic unit. The amount of gas actually charged in the unit may differ.

(4) Unit operating at rated capacity, with no accessories of any kind - external air temperature 35°C and water input/output temperature from/to heat exchanger and user equal to 12/7°C. Values taken by measurements made in accordance with standard ISO 3744 and the Eurovent certification programme, where applicable. Binding values See NOISE LEVELS section.

(6) Values obtained from the sound power level (conditions: note 4), related to a distance of 10 m from the unit in free field with directivity factor Q=2. Non-binding values See NOISE LEVELS section.

(7) Approximate value. The minimum capacity reached by the unit depends on the operating conditions. The value shown may not be suitable for calculating the minimum volume of water: to do this, consult the "Minimum water content in the system" section.

** Basic unit without included accessories

TITAN SKY Hi HP SLN R0

			3.1	5.1	7.1	8.1	10.1	12.2	14.2	17.2	20.2
Cooling											
Refrigeration capacity	(1)	kW	27.5	46.8	55.5	70	82	93.3	110.2	138.4	164.7
Total absorbed power	(1)	kW	11.8	19.5	24.3	27.6	34.9	39.4	49.2	55.6	70.1
EER	(1)		2.3	2.4	2.3	2.5	2.3	2.4	2.3	2.5	2.4
Heating											
Heating capacity	(1)	kW	31.2	57	68.4	83.3	97.6	114.2	135.3	166.7	195.2
Total absorbed power	(1)	kW	9.7	17.9	21.2	26	31.2	36	42.5	52.4	62.7
COP	(1)		3.2	3.2	3.2	3.2	3.1	3.2	3.2	3.2	3.1
Compressors											
Compressors/Circuits		n°	1	1	1	1	1	2	2	2	2
Minimum capacity reduction step	(7)	%	46	46	46	46	46	23	23	23	23
Refrigerant charge HP	(3)	kg	2.5	4.9	5	7	7.1	9.5	9.8	14.1	14.3
Fans											
Quantity		n°	1	1	1	2	2	2	2	4	4
Total air flow rate HP		m³/h	8500	20500	20500	41000	41000	41000	41000	82000	82000
User-side heat exchanger											
Quantity		n°	1	1	1	1	1	1	1	1	1
Water flow rate CH	(1)	m³/h	4.7	8.1	9.5	12	14.1	16.1	19	23.8	28.3
Pressure drop CH	(1)	kPa	10.7	12.7	13.8	16.2	17.1	27.3	28.6	29.6	29.2
Water flow rate HP	(1)	m³/h	5.4	9.8	11.7	14.3	16.8	19.6	23.2	28.6	33.5
Pressure drop HP	(1)	kPa	15.4	19.1	19.9	22.1	24	40.9	42.5	40.7	40.8
Noise levels											
Sound power level cooling	(4)	dB(A)	81	85	85	87	87	88	88	90	90
Sound pressure level cooling	(6)	dB(A)	49	53	53	55	55	56	56	58	58
Dimensions and weights**											
Length		mm	2200	2660	2660	3260	3260	3751	3751	4952	4952
Depth		mm	1130	1130	1130	1130	1130	1130	1130	1130	1130
Height		mm	2136	2136	2136	2136	2136	2405	2405	2405	2405
Operating weight		kg	978	1139	1194	1317	1357	1623	1634	2110	2190

CH: chiller unit; HP: heat pump unit; MCHX: unit with microchannel coils

(1) External air temperature of 35°C and user-side heat exchanger water inlet-outlet temperature of 12-7°C. Values compliant with standard EN 14511

(3) Theoretical values referred to the basic unit. The amount of gas actually charged in the unit may differ.

(4) Unit operating at rated capacity, with no accessories of any kind - external air temperature 35°C and water input/output temperature from/to heat exchanger and user equal to 12/7°C. Values taken by measurements made in accordance with standard ISO 3744 and the Eurovent certification programme, where applicable. Binding values See NOISE LEVELS section.

(6) Values obtained from the sound power level (conditions: note 4), related to a distance of 10 m from the unit in free field with directivity factor Q=2. Non-binding values See NOISE LEVELS section.

(7) Approximate value. The minimum capacity reached by the unit depends on the operating conditions. The value shown may not be suitable for calculating the minimum volume of water: to do this, consult the "Minimum water content in the system" section.

** Basic unit without included accessories

ECODESIGN

INTRODUCTION

The Ecodesign/ErP Directive (2009/125/EC) lays down new standards for more efficient energy use.

The Directive contains various regulations; as regards chiller products and heat pumps, the regulations of interest are the following:

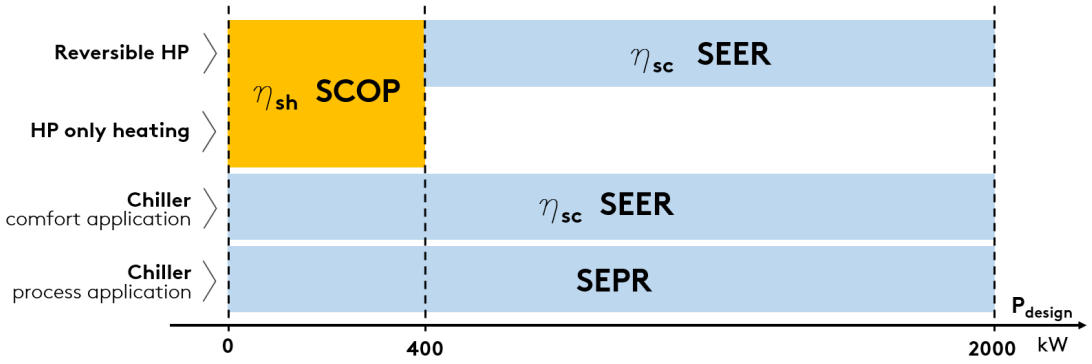
- Regulation 2013/813, for small heat pumps (Pdesign ≤ 400 kW)
- Regulation 2016/2281, for chillers and heat pumps with Pdesign > 400 kW
- Regulation 2013/811, for heat pumps with Pdesign ≤ 70 kW.

The last-mentioned regulation (2013/811) regards the labelling (Ecolabel certification) of small heat pumps.
The other two regulations (2013/813 and 2016/2281) set seasonal efficiency targets that the products must comply with to be sold and installed in the European Union (essential requirement for CE marking).
These efficiency limits are defined through ratios, which are respectively:

- ηsh (SCOP), with reference to regulation 2013/813
- ηsc (SEER) for comfort applications and SEPR for process applications, with reference to regulation 2016/2281.

As regards regulation 2016/2281, with effect from 1st January 2021, the required minimum efficiency limit will be raised (Tier 2) from the current threshold (Tier 1).

The figure below schematically illustrates the correspondence between product and reference energy ratio.



Some notes and clarifications:

For comfort applications, regulation 2016/2281 sets the ηsc (SEER) ratio in two different operating conditions:

- SEER calculated with machine inlet/outlet water temperature of 12/7°C (low temperature application),
- SEER calculated with machine inlet/outlet water temperature of 23/18°C (medium temperature application).

The minimum efficiency requirement is the same, but can be met at condition 12/7°C or at condition 23/18°C, depending on the application envisaged for the machine.

Regulation 2013/813 distinguishes two different types: at low temperature and at medium temperature.
The following refer to the application at low temperature: (low temperature application) all heat pumps whose maximum delivery temperature for heating purposes is lower than 52°C with source at temperature of -7°C and -8°C wet bulb (air-water unit) or inlet 10°C (water-water unit), at the reference design conditions for an average climate.For these, the efficiency ratio is "low temperature application" (outlet water temperature 35°C).
For all the other heat pumps, the efficiency ratio is related to "medium temperature application" (outlet water temperature 55°C).
The ratios must be calculated according to the reference European heating season in average climatic conditions.

The minimum efficiency requirements set by the regulations are indicated below.

REGULATION 2016/2281, comfort application

TYPE OF UNIT		MINIMUM REQUIREMENT			
		Tier 1		Tier 2 (2021)	
SOURCE	**Pdesign**	**ηsc [%]**	**SEER**	**ηsc [%]**	**SEER**
air	< 400kW	149	3,8	161	4,1
air	≥ 400kW	161	4,1	179	4,55
water	< 400kW	196	4,975	200	5,075
water	≥ 400kW and < 1500kW	227	5,75	252	6,375
water	≥ 1500kW	245	6,2	272	6,875

REGULATION 2016/2281, process application

TYPE OF UNIT		MINIMUM REQUIREMENT	
		Tier 1	Tier 2 (2021)
SOURCE	**Pdesign**	**SEPR**	**SEPR**
air	< 400kW	4,5	5
air	≥ 400kW	5	5,5
water	< 400kW	6,5	7
water	≥ 400kW and < 1500kW	7,5	8
water	≥ 1500kW	8	8,5

REGULATION 2013/813

SOURCE	APPLICATION	MINIMUM REQUIREMENT	
		ηsh [%]	**SCOP**
air	low temperature application	125	3,2
water	low temperature application	125	3,325
air	medium temperature application	110	2,825
water	medium temperature application	110	2,95

The conformity of the product must be checked according to the type of application, whether comfort or process, and at the required outlet water temperature.

The two schematic tables below, respectively for comfort application and for process application, indicate the reference of the required conformity according to the type of product and the set point temperature (reference to regulations 2016/2281 and 2013/813).

Important note: for mixed comfort and process applications, the reference application for conformity is the comfort application.

COMFORT APPLICATION

PRODUCT	OUTLET WATER TEMPERATURE	COMPLIANCE INDEX	REGULATION
Chiller	< 18°C	SEER/ηsc low temperature application	2016/2281
	≥ 18°C	SEER/ηsc medium temperature application	2016/2281
Heat pumps (reversible and only heating) Pdesign≤400kW		SCOP/ηsh	2013/813
Reversible heat pumps Pdesign>400kW	< 18°C	SEER/ηsc low temperature application	2016/2281
	≥ 18°C	SEER/ηsc medium temperature application	2016/2281
Heat pumps only heating Pdesign>400kW		-	-

- = exemption from Ecodesign

PROCESS APPLICATION

PRODUCT	OUTLET WATER TEMPERATURE	COMPLIANCE INDEX	REGULATION
Chiller	≥ +2°C , ≤ 12°C	SEPR	2016/2281
	> 12°C	-	-
	> -8°C , < +2°C	-	-

- = exemption from Ecodesign

Some specifications and notes follow.

EC fans:

The only option that positively affects the performance of the unit, by increasing its seasonal energy efficiency ratio, is the VEC accessory.

A unit equipped with EC fans has a higher SEER (ηsc) than the configuration with standard fans.

A unit equipped with EC fans has a higher SCOP (ηsh) than the configuration with standard fans.

RANGE - TITAN SKY

As regards, specifically, the Titan SKY range, here below the regulations of interest for the different units in the different configurations.

- chiller version: regulation 2016/2281
- HP version: regulation 2013/813 (since they are all units with Pdesign ≤ 400 kW).

The tables below give information on the conformity of the units and the seasonal energy performance ratios with regard to the reference regulation.

Titan SKY Hi R0

			3.1	4.1	5.1	6.1	7.1	8.1
REGULATION 2016-2281								
COMFORT								
Standard Unit								
ηsc	(1)	%	161.4	164.2	162.2	161.4	163	163.8
SEER	(1)		4.11	4.18	4.13	4.11	4.15	4.17
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
Unit with EC fans (VEC)								
ηsc	(1)	%	162.4	170.9	171.2	164.2	167.9	174.1
SEER	(1)		4.13	4.34	4.35	4.17	4.27	4.42
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
PROCESS								
SEPR	(2)		5.73	5.79	5.55	5.39	5.55	5.28
Compliance Tier 2 (2021)	(2)		Y	Y	Y	Y	Y	Y

Titan SKY Hi R0

			10.1	12.2	13.2	14.2	17.2	20.2
REGULATION 2016-2281								
COMFORT								
Standard Unit								
ηsc	(1)	%	162.2	166.6	161.4	165	170.6	167.8
SEER	(1)		4.13	4.24	4.11	4.2	4.34	4.27
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
Unit with EC fans (VEC)								
ηsc	(1)	%	171.5	171.5	167.9	170.3	176.5	175
SEER	(1)		4.36	4.36	4.27	4.33	4.48	4.45
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
PROCESS								
SEPR	(2)		5.22	5.4	5.19	5.41	5.43	5.18
Compliance Tier 2 (2021)	(2)		Y	Y	Y	Y	Y	Y

Y = unit in compliance with Ecodesign at the indicated condition. N = unit not in compliance with Ecodesign at the indicated condition: it can be installed only in non-EU countries.

(1) User-side heat exchanger water inlet/outlet temperature 12/7°C (low temperature application), with reference to regulation 2016/2281 and standard EN 14825.

(2) User-side heat exchanger water inlet/outlet temperature 12/7°C, with reference to regulation 2016/2281 and norm EN 14825.

Titan Sky Hi SLN R0

			3.1	4.1	5.1	6.1	7.1	8.1
REGULATION 2016-2281								
COMFORT								
Standard Unit								
ηsc	(1)	%	161	161.8	161	161	161	162.6
SEER	(1)		4.1	4.12	4.1	4.1	4.1	4.14
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
Unit with EC fans (VEC)								
ηsc	(1)	%	161.61	164.68	163.74	162.21	162.62	168.4
SEER	(1)		4.12	4.2	4.17	4.14	4.15	4.29
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
PROCESS								
SEPR	(2)		5.57	5.78	5.51	5.4	5.47	5.21
Compliance Tier 2 (2021)	(2)		Y	Y	Y	Y	Y	Y

Titan Sky Hi SLN R0

			10.1	12.2	13.2	14.2	17.2	20.2
REGULATION 2016-2281								
COMFORT								
Standard Unit								
ηsc	(1)	%	161	165	161	162.6	168.2	163.8
SEER	(1)		4.1	4.2	4.1	4.14	4.28	4.17
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
Unit with EC fans (VEC)								
ηsc	(1)	%	166.81	166,85	163.6	164.91	174.02	170
SEER	(1)		4.25	4.25	4.17	4.2	4.43	4.33
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y	Y
PROCESS								
SEPR	(2)		5.18	5.27	5.11	5.38	5.36	5.15
Compliance Tier 2 (2021)	(2)		Y	Y	Y	Y	Y	Y

Y = unit in compliance with Ecodesign at the indicated condition. N = unit not in compliance with Ecodesign at the indicated condition: it can be installed only in non-EU countries.

(1) User-side heat exchanger water inlet/outlet temperature 12/7°C (low temperature application), with reference to regulation 2016/2281 and standard EN 14825.

(2) User-side heat exchanger water inlet/outlet temperature 12/7°C, with reference to regulation 2016/2281 and norm EN 14825.

TITAN SKY Hi HP R0

			3.1	5.1	7.1	8.1	10.1	12.2	14.2	17.2	20.2
REGULATION 2013/813			-								
Pdesign	(1)	kW	22.6	41.1	49.2	61.3	70.5	82.3	98.3	122.6	141
COMFORT											
Standard Unit											
ηsh	(1)	%	139	143.8	143.4	138.6	144.2	146.6	145.8	141.4	147
SCOP LT	(1)		3.55	3.67	3.66	3.54	3.68	3.74	3.72	3.61	3.75
Unit with EC fans (VEC)											
ηsh	(1)	%	143	149	147.8	143.4	151	157	156.2	155	157
SCOP LT	(1)		3.65	3.8	3.77	3.66	3.85	4	3.98	3.95	4
REGULATION 2013/813			-								
Pdesign	(3)	kW	20.5	37.2	43.9	53.7	62	74.5	87.7	107.3	124
COMFORT											
Standard Unit											
ηsh	(3)	%	113.6	117.7	117.1	115	116.3	122.3	121.1	120	120.9
SCOP MT	(3)		2.92	3.02	3	2.95	2.98	3.13	3.1	3.08	3.1
Unit with EC fans (VEC)											
ηsh	(3)	%	116.9	121.4	120.3	119	120	130	128.8	129.3	128.8
SCOP MT	(3)		3	3.11	3.08	3.05	3.08	3.33	3.3	3.31	3.3
REGULATION 2013/811			-								
Standard Unit											
Ecolabel	(2)			A++				-			
Unit with EC fans (VEC)											
Ecolabel	(2)						-				

TITAN SKY Hi HP SLN R0

			3.1	5.1	7.1	8.1	10.1	12.2	14.2	17.2	20.2
REGULATION 2013/813			-								
COMFORT											
Standard Unit											
ηsh	(1)	%	139	143.8	143.4	138.6	144.2	146.6	145.8	141.4	147
SCOP LT	(1)		3.55	3.67	3.66	3.54	3.68	3.74	3.72	3.61	3.75
Unit with EC fans (VEC)											
ηsh	(1)	%	143	149	147.8	143.4	151	157	156.2	155	157
SCOP LT	(1)		3.65	3.8	3.77	3.66	3.85	4	3.98	3.95	4
REGULATION 2013/813			-								
Pdesign	(3)	kW	20.5	37.2	43.9	53.7	62	74.5	87.7	107.3	124
COMFORT											
Standard Unit											
ηsh	(3)	%	113.6	117.7	117.1	115	116.3	122.3	121.1	120	120.9
SCOP MT	(3)		2.92	3.02	3	2.95	2.98	3.13	3.1	3.08	3.1
Unit with EC fans (VEC)											
ηsh	(3)	%	116.9	121.4	120.3	119	120	130	128.8	129.3	128.8
SCOP MT	(3)		3	3.11	3.08	3.05	3.08	3.33	3.3	3.31	3.3
REGULATION 2013/811			-								
Standard Unit											
Ecolabel	(2)			A++				-			
Unit with EC fans (VEC)											
Ecolabel	(2)						-				

Y = unit in compliance with Ecodesign at the indicated condition. N = unit not in compliance with Ecodesign at the indicated condition: it can be installed only in non-EU countries.

(1) User-side heat exchanger water inlet/outlet temperature 30/35°C, Average climate profile, with reference to regulation 2013/813 and norm EN 14825.

(2) Energy efficiency class with reference to regulation 2013/811 (low temperature applications).

(3) User-side heat exchanger water inlet/outlet temperature 47/55°C, Average climate profile, with reference to regulation 2013/813 and norm EN 14825.

INSTALLATION ADVICE

The units described in this document are, by nature, strongly affected by the characteristics of the system, the working conditions and the installation site.

Remember that the unit must be installed by a qualified and skilled technician, and in compliance with the national legislation in force in the destination country.

The installation must be done in such a way that it will be possible to carry out all routine and non-routine maintenance operations.

Before starting any work, you must carefully read the "Installation, operation and maintenance manual" of the machine and do the necessary safety checks to prevent any malfunctioning or hazards.

We give some advice below that will allow you to increase the efficiency and reliability of the unit and therefore of the system into which it is inserted.

Water characteristics

To preserve the life of the exchangers, the water is required to comply with some quality parameters and it is therefore necessary to make sure its values fall within the ranges indicated in the following table:

Total hardness	2,0 ÷ 6,0 °f
	1,2 ÷ 3,4 °d
Langelier index	- 0,4 ÷ 0,4
pH	7,5 ÷ 8,5
Electrical conductivity	10÷500 µS/cm
Organic elements	-
Hydrogen carbonate (HCO3-)	70 ÷ 300 ppm
Sulphates (SO42-)	< 50 ppm
Hydrogen carbonate / Sulphates (HCO3-/SO42-)	> 1
Chlorides (Cl-)	< 50 ppm
Nitrates (NO3-)	< 50 ppm
Hydrogen sulphide (H2S)	< 0,05 ppm
Ammonia (NH3)	< 0,05 ppm
Sulphites (SO3), free chlorine (Cl2)	< 1 ppm
Carbon dioxide (CO2)	< 5 ppm
Metal cations	< 0,2 ppm
Manganese ions (Mn++)	< 0,2 ppm
Iron ions (Fe2+ , Fe3+)	< 0,2 ppm
Iron + Manganese	< 0,4 ppm
Phosphates (PO43-)	< 2 ppm
Oxygen	< 0,1 ppm

Installation of water filters on all the hydraulic circuits is obligatory.

The supply of the most suitable filters for the unit can be requested as accessory. In this case, the filters are supplied loose and must be installed by the customer following the instructions given in the installation, operation and maintenance manual.

Glycol mixtures

With temperatures below 5°C, it is mandatory to work with water and anti-freeze mixtures, and also change the safety devices (anti-freeze, etc.), which must be carried out by qualified authorised personnel or by the manufacturer.

Liquid outlet temperature or minimum ambient temperature	°C	0	-5	-10	-15	-20	-25	-30	-35	-40
Freezing point	°C	-5	-10	-15	-20	-25	-30	-35	-40	-45
Ethylene glycol	%	6	22	30	36	41	46	50	53	56
Propylene glycol	%	15	25	33	39	44	48	51	54	57

The quantity of antifreeze should be considered as % on weight

Minimum water content in the system

For correct operation of the unit, it is necessary to ensure a buffering on the system such as to comply with the minimum operating time considering the greater between the minimum OFF time and the minimum ON time. In short, these contribute to limiting the number of times the compressors are switched on per hour and to preventing undesired deviations from the set point of the delivered water temperature.

Larger amounts of water are in any case always preferable, because they allow a smaller number of starts and switch-offs of the compressors, less wear of them and an increase in the efficiency of the system as a consequence of a reduction in the number of transients.

It should also be pointed out that, for air-water units working in heat pump mode, the minimum amount of water must consider the need of the unit to carry out defrosting. Having an adequate buffering volume will allow prevention of too high drifts of the delivered water temperature at the end of the defrost cycle.

The following experimental formula allows to calculate the minimum water volume of the plant.Formula refers to unit operation in cooling mode and is also valid for heating mode if defrosting cycles are not taken in account.

$$V_{min} = \frac{P_{tot} \cdot 1.000}{N} \cdot \frac{300}{\Delta T \cdot \rho \cdot c_p} + P_{tot} \cdot 0{,}8$$

where

Vmin is the minimum water content of the system [l]

Ptot is the total cooling capacity of the machine [kW]

N: number of capacity reduction steps

ΔT: differential allowed on the water temperature. Unless otherwise specified, this value is considered to be 2.5K

ρ: density of the heat-carrying fluid. Unless otherwise specified, the density of water is considered

cp: specific heat of the heat-carrying fluid. Unless otherwise specified, the specific heat of water is considered

Considering the use of water and grouping together some terms, the formula can be re-written as follows:

$$V_{min} = \frac{P_{tot}}{N} \cdot 28{,}66 + P_{tot} \cdot 0{,}8$$

N is equal to the number of compressors installed in the unit.

For the N values, consider the following convention:

- for units with 1 compressor N = 2
- for units with 2 compressor N = 4

In case of installation in cold climates where the unit has to perform defrostying cycles, it is suggested to use higher water content than that calculated with previous formula; due to very high volumes needed to completely compensate the negative effect of defrost on produced water temperature, are usually accepted higher temperature deviations than typical values accapetd for cooling-only unit.

Water content necessary to balance defrost cycle effect on produced water temperatures, depends on various factors:

- type of system
- compressors and circuits number
- maximum temporary acceptable temperature difference from set-point
- Quantity of defrost cycles necessary to proper functioning of the unit (depending on external and working conditions)
- compressors and circuits number

Installation site

To determine the best installation site for the unit and its orientation, you should pay attention to the following points:

- compliance with the clearance spaces indicated in the official dimensional drawing of the unit must be guaranteed so as to ensure accessibility for routine and non-routine maintenance operations
- compliance with the respect spaces indicated in the installation, use and maintenance manual must be guaranteed, in relation to units with highly flammable A3 refrigerant
- you should consider the origin of the hydraulic pipes and their diameters because these affect the radiuses of curvature and therefore the spaces needed for installing them
- you should consider the position of the cable inlet on the electrical control panel of the unit as regards the origin of the power supply
- if the installation includes several units side by side, you should consider the position and dimensions of the manifolds of the user-side exchangers and of any recovery exchangers
- if the installation includes several units side by side, you should consider that the minimum distance between units is 3 metres
- you should avoid all obstructions that can limit air circulation to the source-side exchanger or that can cause recirculation between air supply and intake
- you should consider the orientation of the unit to limit, as far as possible, exposure of the source-side exchanger to solar radiation
- if the installation area is particularly windy, the orientation and positioning of the unit must be such as to avoid air recirculation on the coils. If necessary, we advise making windbreak barriers in order to prevent malfunctioning.

Once the best position for the unit has been identified, you must check that the support slab has the following characteristics:

- its dimensions must be proportionate to those of the unit: if possible, longer and wider than the unit by at least 30 cm and 15/20cm higher than the surrounding surface
- it must be able to bear at least 4 times the operating weight of the unit
- it must allow level installation of the unit: although the unit is installed on a horizontal base, make slopes in the support surface to convey rain water or defrost water to drains, wells or in any case to places where it cannot generate an accident hazard due to ice formation. All heat pump version units are equipped with discharge manifolds for the condensed water; these can be manifolded to facilitate condensate discharge.

The units are designed and built to reduce to a minimum the level of vibration transmitted to the ground, but it is in any case advisable to use rubber or spring anti-vibration mounts, which are available as accessory and should be requested when ordering.

The anti-vibration mounts must be fixed on before positioning the unit on the ground.

In the event of installation on roofs or intermediate floors, the pipes must be isolated from the walls and ceilings.

It is advisable to avoid installation in cramped places, to prevent reverberations, reflections, resonances and acoustic interactions with elements outside the unit.

It is essential that any work done to soundproof the unit does not affect its correct installation or correct operation and, in particular, does not reduce the air flow rate to the source-side exchanger.

Installations that require the use of treated coils

If the unit has to be installed in an environment with a particularly aggressive atmosphere, coils with special treatments are available as options.

- e-coated microchannel coils (accessory not available for HP units)
- coils with anti-corrosion treatment (accessory available only for HP units or with Cu/Al coil)

A description of the individual accessories is available in the "Description of accessories" section.

The type of coil treatment should be chosen with regard to the environment in which the unit is to be installed, through observation of other structures and machinery with exposed metal surfaces present in the destination environment.

The cross observation criterion is the most valid method of selection currently available without having to carry out preliminary tests or measurements with instruments. The identified reference environments are:

- coastal/marine
- industrial
- urban with a high housing density
- rural

Please note that in cases where different conditions co-exist, even for short periods, the choice must be suitable for preserving the exchanger in the harsher environmental conditions and not in conditions between the worst and best situation.

Particular attention must be given in cases where an environment that is not particularly aggressive becomes aggressive as a consequence of a concomitant cause, for example, the presence of a flue outlet or an extraction fan.

We strongly suggest choosing one of the treatment options if at least one of the points listed below is verified:

- there are obvious signs of corrosion of the exposed metal surfaces in the installation area
- the prevailing winds come from the sea towards the unit
- the environment is industrial with a significant concentration of pollutants
- the environment is urban with a high population density
- the environment is rural with the presence of organic discharges and effluents

In particular, for installations near the coast, the following instructions apply:

- **for installations between 1 and 20 km from the coast of units with microchannel coil, we strongly recommend using the accessory "E-coated microchannel coils"**
- **for installations between 1 and 20 km from the coast of reversible units or units with Cu/Al coils, is strongly recommended using the accessory "Coil treated with anti-corrosion paints"**
- **for distances within a kilometre of the coast, we strongly recommend using the accessory "Coil treated with anti-corrosion paints" for all units**

To protect the exchangers from corrosion and ensure optimal operation of the unit, we advise following the recommendations given in the user, installation and maintenance manual for cleaning the coils.

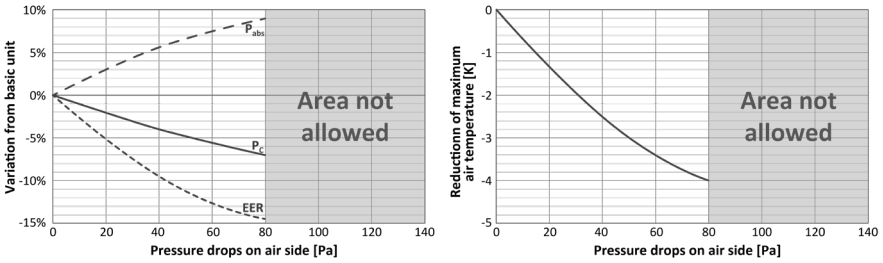
Aeraulic head losses and options available for the ventilating section

With the exception of units for which oversize fans are required, as standard, the units are designed considering that, at the nominal air flow rate, the fans work with null available pressure.

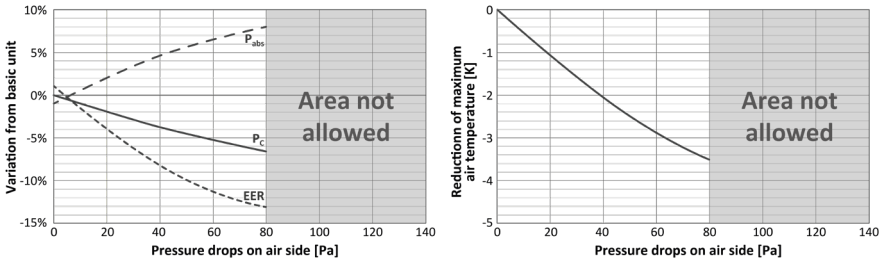
If there are obstacles to free air flow, you should consider the additional aeraulic head losses that will cause a reduction of the air flow rate and a consequent deterioration of performance.

The following diagrams show the trend of cooling capacity (PC), EER, total absorbed power (Pabs) and reduction of the maximum external air temperature in chiller operating mode, depending on the aeraulic head losses that the fans will have to overcome.

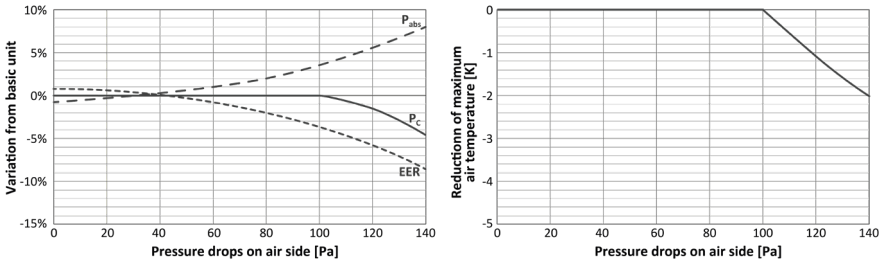
AC fans (Ø 800)



EC fans (Ø 800)



Oversize EC fans (Ø 800)



The indicated values are for the standard machine, without accessories, with AC fans and in any case in the absence of air recirculation.

Example: supposing you expect there to be obstacles that will generate an estimated aeraulic head loss of 60Pa. In this case, there are 3 possibilities:

- use the unit with standard AC fans: compared to ideal conditions, the output power will be reduced by about 5.5%, the total absorbed power will increase by about 7.5%, the EER will be reduced by about 12.5% and the maximum allowed external air temperature for operation at 100% will be reduced by about 3.4K compared to the nominal limit
- use the unit with EC fans: compared to the unit with AC fans working in ideal conditions, the output power will be reduced by about 5%, the total absorbed power will increase by about 6.5%, the EER will be reduced by about 11.5% and the maximum allowed external air temperature for operation at 100% will be reduced by about 2.8K compared to the nominal limit
- use the unit with oversize EC fans: compared to the unit with AC fans working in ideal conditions, the output power of the unit will be unchanged, the total absorbed power will increase by about 1%, the EER will be reduced by about 2% and the maximum external air temperature will remain the one shown in the diagram of the operating limits.

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