GB TECHNICAL MANUAL

LSE

AIR CONDENSED WATER CHILLERS

360 kW - 1200 kW

eco R410A

The technical and dimensional data provided in these documents is subject to change based on improvements made to the product.

- To contact or notify the company, or for information:info@galletti.it
- To find out the weight of each unit,refer to the table in the Nominal Technical Data section

Contents

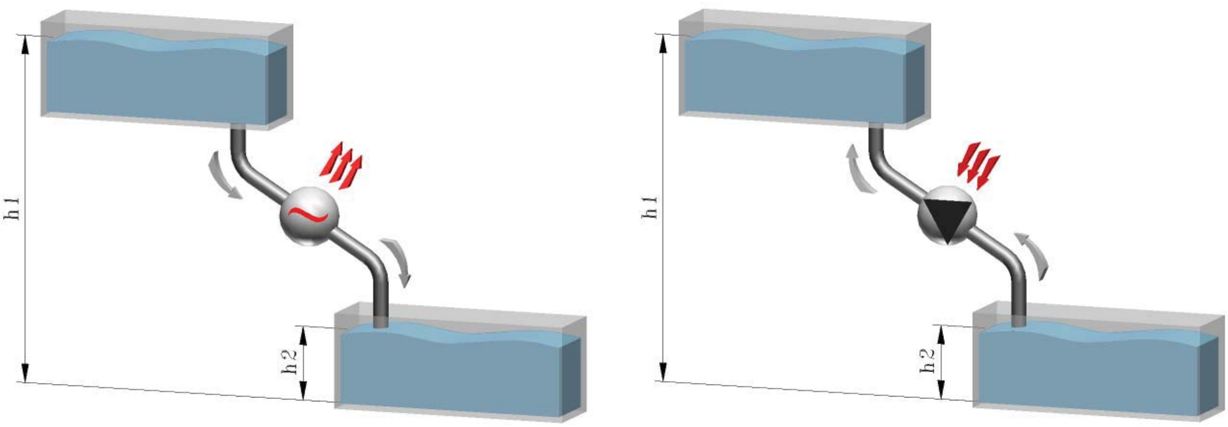
Introduction

The ever-growing need to cool buildings during the summer and to heat them during the winter, in the last few years has brought about the diffusion of one device capable of meeting different thermal requirements: the reversible heat pump.

The principles of thermodynamics tell us that heat can be transferred spontaneously only from a warm body to a cold one. The opposite process can be be conducted only with the help of external energy. The following figure represents a simply hydraulic analogy, where one can see how water flows naturally from the top tank to the one below, with the possibility of supplying mechanical energy, such as through a turbine. In a similar manner in thermodynamics, the transfer of heat from a source at a high thermal level to a lower thermal level produces mechanical energy. On the contrary, to transfer the mass of water from the downstream basin upstream, one needs a pump that uses mechanical energy. The following layout further clarifies the analogy.

Operation of a heat pump is founded on the same basis. It transfers heat from a lower temperature level to a higher one by the use of mechanics in order to obtain the desired temperature conditions (as well as humidity, if required) in the place to be air-conditioned. The unit operates a thermodynamic cycle by exploiting a heat-transfer fluid (refrigerant) which flows inside of the piping of the circuit. It consists of two heat exchangers that transfer thermal energy between the fluid and the sources, a compressor and expansion valve that ensures a correct mass flow rate towards the evaporator under pressure-jumping conditions set by the surroundings.

Upstream basin	↔	High-T source (warm)
Downstream basin	↔	Low-T source (cold)
Upstream basin height	↔	Temperature of warm source
Downstream basin height	↔	Temperature of cold source
Natural outflow of water from upstream to downstream	↔	Spontaneous transfer of heat from the warm source to the cold one (direct cycle)
Pumping from downstream to upstream	↔	Heat pump for air conditioning (inverse cycle)



Hydraulic analogy of thermodynamic processes: natural outflow and pumping

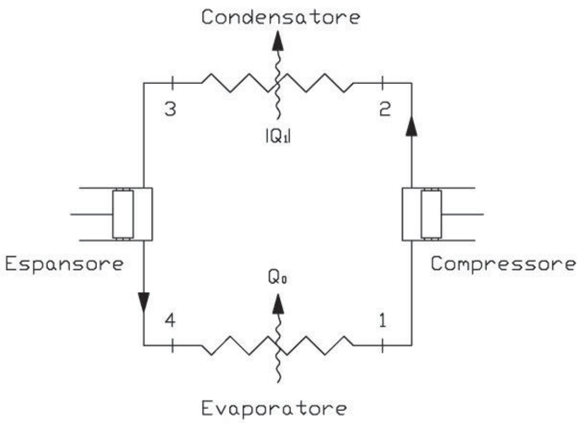


Fig. a) Representative diagram of a heat pump

By administering work from the outside, the unit is therefore able to absorb the amount of heat Q_0 from a low-temperature source, thanks to the evaporation of the refrigerant, and to yield the amount Q_1 at a higher thermal level through condensation of the same refrigerant. Depending on the useful effect intended to be exploited in the atmosphere to be air-conditioned (heat absorption or release) cooling or heating is obtained respectively.

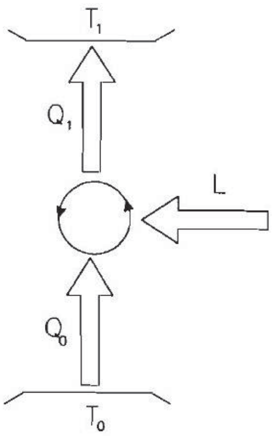


Fig. b) Thermal exchanges in an inverse cycle operated by a heat pump

<u>Inverse Carnot cycle: (ideal)</u>

An inverse cycle is one where the algebraic sum of heat exchanged from the operating substance between the two sources is negative and therefore the work exchanged is also negative. Let us assume T_1 and T_0 (T_1>T_0) are the temperatures of the two sources, Q_1 and Q_0 the respective quantities of heat.

If the process is reversible, having always to be

$$|Q_1|/T_1 = |Q_0|/T_0$$

At the higher temperature source, the following quantity of heat is released

$$|Q_1| = |Q_0| + |L|$$

sum of heat $|Q_0|$ subtracted from the lowest temperature source and of work |L| performed (fig. b).

The purpose of the cycle can be to remove heat from lower temperature bodies (chilling cycle) or to yield heat to higher temperature bodies (thermodynamic heating).

In this second situation, we commonly speak of “heat pump”.

In the first case, the cycle is characterised by the ratio between the heat $|Q_0|$ subtracted from the source at temperature T_0 and the work performed:

$$\varepsilon = |Q_0| / |L| = |Q_0| / (|Q_1| - |Q_0|)$$

This ratio will be called COP = “coefficient of performance” of the cycle. This does not constitute a yield and its value can be greater than the unit. Is also possible to write:

$$\varepsilon = T_0 / (T_1 - T_0)$$

and this value represents the maximum COP limit of any inverse cycle (cooling) operated between the temperature T_1 and T_0.

To remove heat from a body requires much more work the lower the temperature T_0 this body is and the cost tends towards infinity when the temperature T_0 tends to absolute zero.

If the purpose of the cycle is to yield heat to warmer bodies, the cycle is characterised by the ratio between the heat yielded at temperature T_1 and the work expended:

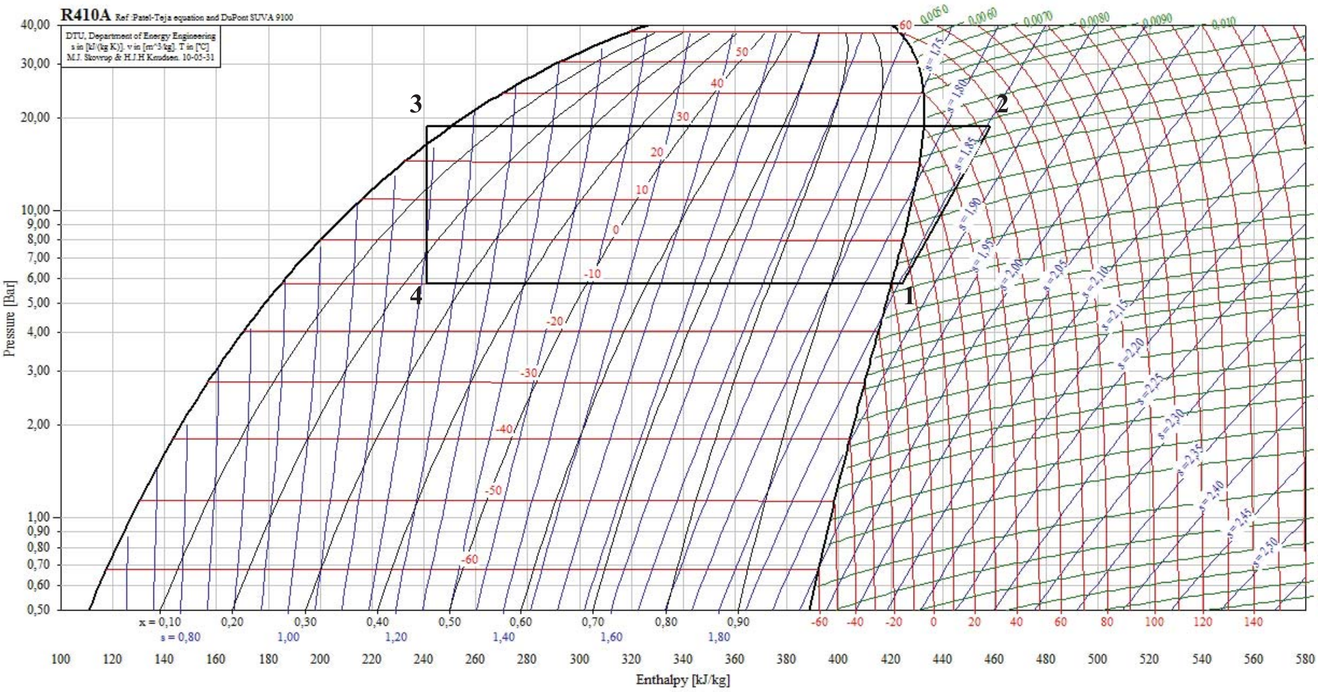
$$\varepsilon_1 = |Q_1| / |L| = |Q_1| / (|Q_1| - |Q_0|) = T_1 / (T_1 - T_0)$$

which results in:

$$\varepsilon_1 = \varepsilon + 1 .$$

The coefficient of performance of a heat pump operating at the inverse Carnot cycle is always greater than the unit. This is precisely because not only is the equivalent of the work expended yielded to the higher temperature source but also the heat (free) absorbed from the lower temperature source.

<u>Real cycle:</u>



Graphical representation of inverse cycle on diagram *p-h*

A classical graphical representation of the cycle (called inverse cycle, run anticlockwise) implemented by the machine is that marked by a thermodynamic diagram *p-h*, in which the vertical axis of the ordinates shows the cooling fluid pressure and the y-axis the Enthalpy:

The four thermodynamic transformations are highlighted by the figure:

1-2: Compression of the refrigerant (to the gaseous state) from pressure level p_1 to p_2 with expended energy
2-3: Gas condensation at pressure p_2 and temperature T_2 and yield of thermal flow q_1
3-4: Isoenthalpic expansion of liquid from p2=p3 to p4 =p1
4-1: Evaporation of the liquid fraction of the mixture at pressure p_e and temperature T_e with absorption of thermal flow q_0
In order to assess the energy performance of the thermodynamic cycle, two sizes must be introduced:

- the Coefficient of Useful Effect in chilling mode:

$$\varepsilon = \frac{Q_0}{|L|}$$

in which Q_0 is called Cooling Effect, namely the energy taken from the low-energy source;

- the Coefficient of Performance *COP* of the heat pump in heating mode:

$$COP = \frac{|Q_1|}{|L|}.$$

Applying the First Principle of Thermodynamics, therefore preservation of the energy of the heat pump system, gives us $Q_0 + L = Q_1$, with the substitution obtains:

$$COP = \varepsilon + 1.$$

The interest from an economical and energy point of view of obtaining the highest possible *COP* values is obvious. In fact, it constitutes a sort of multiplier of the precious energy supplied and makes it possible to provide more useful energy than the electricity required to run the unit.

1 Description of Product

1.1 The series

The name of the series L S E is an abbreviation for

Liquid Chiller
Scroll Compressors
Energy efficient units

The main choice in developing the series of LSE chillers consists in the use of high-efficiency scroll compressors of the last generation, HFC R410A chillers, 316 AISI Stainless steel brazed plate heat exchangers combined among them with an idea of modularity which provides them with a large power availability, optimum efficiency for partial loads and, due to the multiple circuit, greater reliability for the system.

Partial load operation is ever more frequently an object of evaluation and a discriminating factor in the technical choice of thermo-technical designers and the solution selected based on

- Pluriscroll
- Steel brazed plates
- High-efficiency fans
- Electronically controlled electric expansion valve
- Crossed flow dual-circuit plate heat exchangers
- Advanced electronic control

allows us to adequately meet these requirements.

Scroll R410A : processing optimisation together with a careful choice of the intrinsic volumetric compression ratio (ICR) allows for a significant improvement in isentropic compression performance and a consequent reduction in energy loss during the process. The use of a scroll compressor permits using relatively low viscosity oils (32 cSt) which compared to higher viscosity oils greatly reduces thermal resistance for the evaporator with an evaporation Temperature increase beyond 1.5°C (more than 5.5% in EER) respect to other solutions.

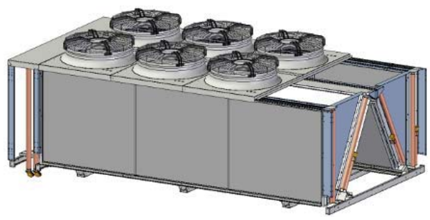
R410A : HFC R410A, even to the detriment of a higher GWP (**G**lobal **W**arming **P**otential GWP = 1975 kg CO_2) than other refrigerants, it features very favourable thermal conductivity of the liquid$_1$ and the almost complete absence$_2$ of Glide ensuring a significant improvement of evaporation performance$_1$ combined with the simultaneous improvement of condenser performance$_2$. The higher operating pressures and a favourable pressure curve (temperature), allow more compact geometries of heat exchange to be used which, for the same exchange surface, feature a reduced internal volume and therefore require less refrigerant load. These factors combine in a reduction of the overall unit GWP in comparison to products with other types of environmentally friendly refrigerants of the HFC family.

Heat Exchangers with INOX AISI 316 Brazed Plates: the attentive study of internal corrugation maximises turbulence (and therefore the thermal exchange coefficient) while minimising the possibility of fouling. The exclusive use of “Cross Flow” systems in perfect counterflow (*) then allows forever preventing exergetic leaks due to water flow mixtures at different T and therefore obtaining the maximum advantages from partial loads.

***Note** : as with all Galletti products, the reversible heat pumps can be provided with the option of the exclusive 4-way water-side valve which maintains the counterflow even if the cycle is inverted, thus improving the COP assessed as approximately 4% at full load depending on the season.*

HyBlade high efficiency fans : 800 mm diameter next generation fans combined with electric motors with external rotor (or synchronous - brushless motors with electronic switch) and perfectly profiled nozzles. They can reach high aeraulic performances and simultaneous reduction in emitted sound power, both at full and partial load.

Finned pack heat exchangers : the “W“ version finned pack heat exchangers allow the maximum front surface to be obtained in relation to the foot print of the unit. The geometry used is equilateral 30 x 26 with a high efficiency 3/8” (9,52mm) copper pipe to ensure the needed pressure resistance. It is all assembled on a “no stress” structure which avoids stress (thermal, transportation) on the copper pipe from the start. The wide front surfaces reduce the risk of fouling and thanks to the reduced through-speed the air-side pressure drops are reduced, which benefits the air flow rate (efficiency) and the emitted sound power of the fans.

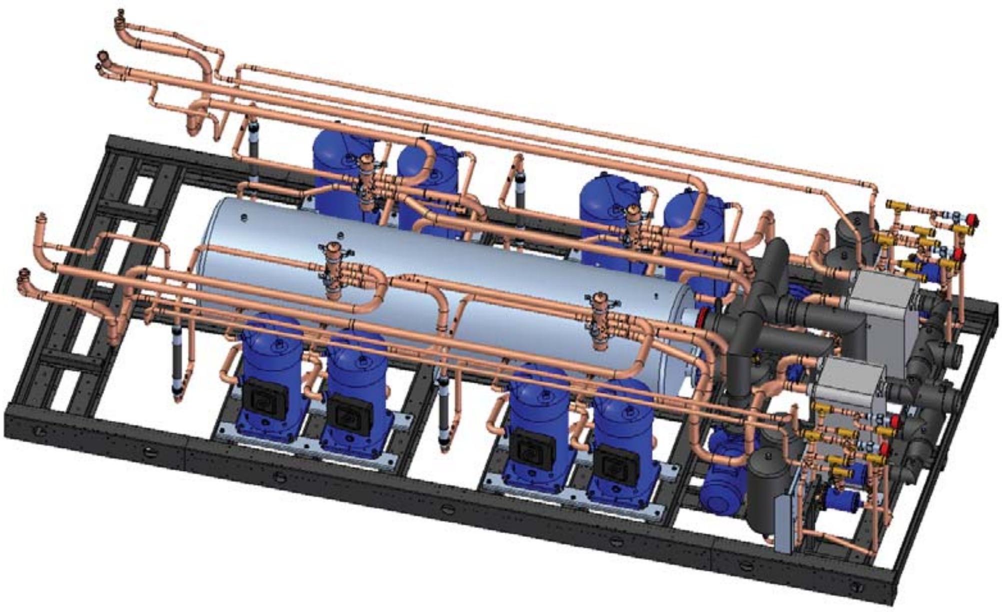


Multiple circuit : pursuing the idea of modularity, the units beyond 540 kW are built with 4 independent circuits ensuring operation even in the event of anomalies. It should be noticed that even on the 1 MW units, the heaviest component on board (the compressor) does not weigh more than 165 kg. This provides clear logistical advantages for eventual maintenance work.

Electric valve with electronic control : standard only on the cold and FC versions, while in the heat pumps, to optimise the operation of the finned pack heat exchangers, each coil has its own expansion valve and use of electronically-controlled valves in heating mode is optional. All of the functioning parameters

- saturated evaporation T
- saturated condensation T
- liquid T and relative sub-cooling of condensation
- T of suctioned gas and relative overheating
- Valve opening pitches

are displayed for a more effective control of the unit's operating status.



The **LSE** series chillers, fluid chillers (CS-CL), chillers in heat pumps (HS-HL) and Free Cooling chillers (FS-FL) cover the output range from 370 to 1,070 kW (with the use of HyBlade fans together with external rotor motors and EC motors as an optional).
The chiller units of the **LSE** series for industrial use are equipped with SCROLL compressors mounted on a sturdy galvanised sheet metal structure painted with black RAL9005 polyester epoxy powder coatings on the bottom part and light RAL9002 on the top. All of the panelling is made of galvanised sheet metal painted in RAL9002 polyester epoxy powders which bestow the unit with a modern and functional look.
The arrangement of the components ensures easy access and the layout ensures an excellent distribution of weights throughout the unit: the 3D representation of the example, provided in dynamic version with every machine sold and that can be viewed with a normal internet browser, refers to a 650 kW LSE 658 HS unit in heat pump version.

1.2 Why

The market is ever more leaning towards the use of R410A fluid which offers undoubted advantages in performance and energy efficiency. Just changing refrigerant (unfavourable critical T of Carnot) is not enough to give good results. But together with interventions on the surfaces-geometries of the heat exchange, the adoption of partialisation compressors and the wise use of electric expansion valves allows us to make products with EER and above all ESEER that are by far superior to alternative technologies.

R410A : the GWP is 1,975 kg Co2 against the 1,177 of R407C and 1,410 of R134a. This disadvantage is made up for with its greater EER and even better ESEER. The GWP is greater than other fluids, but the TEWI (total equivalent warming impact) is much less, thanks to its high efficiency and reduced refrigerant load.
With an average surface increase of 8%, the internal volume of the coils is 23 % less thanks to the use of compact geometries. The average density is then lower and therefore the load of R410A is approximately 27% less than that of the same size R407C units.

TEWI: *Total Equivalent Warming Impact;*
this parameter expresses the mass of CO2 which produces the same overall effect as the refrigerant during its operating life. The main feature of this parameter consists in considering the effects of the use of refrigerant gas not only deriving from accidental emission into the atmosphere, but also the effect on global warming which the emitted carbon dioxide for energy production used to operate the chiller system under examination produces. The TEWI is expressed by a relation whose addends express the component due to indirect effect and that due to the direct effect:

$$TEWI = \alpha_{CO2} \cdot E + GWP \cdot m_{ref}$$

- *E = energy consumed by the chiller system during its operating life*
- *α_{CO2} = amount of carbon dioxide emitted to produce one kWh of electrical energy, and which depends on how it is generated;*
- *m_{ref} = refrigerant load.*

In order to assess the TEWI, it is therefore necessary to estimate the efficiency of the chiller systems from which the consumption of energy, their life, the type of energy source from which it is drawn and the mass of refrigerant contained depend.
This type of approach places attention, besides on the control of emissions into the atmosphere and the choice of refrigerants compatible with the environment, also on improving the overall efficiency of the chiller system which, depending on applications, can carry out an important role on the real impact of the use of a fluid on global warming of the planet. Overall, the indirect contribution is approximately 85% of the total TEWI. Therefore greater focus is placed on the efficiency of the refrigerant rather than on its characteristics.

Scroll : pluri-scroll is the best response to modulation requirements and energy efficiency of partial loads (ESEER). Variable speed in fact, though excellent for modularity, when combined with asynchronous motors, always features considerable losses in the Inverter in addition to stator losses by induction which become significant at low rotation speed.

Hydronic kit options in the whole range
LP = Low Pressure, low head
HP = High Pressure, high head
OR = 2 pumps, each able to supply 100%
AND = 2 pumps, together capable of supplying 100%

Single LP/HP pump
Double “AND” LP/HP pump
Double “OR” LP/HP pump for an excellent yearly saving and considerable reduction on the purchase price: *for a 540 kW chiller in a heat pump in efficiency pack “twin” execution, pumping energy is reduced by 12,000 kWh/year for the pumps alone*.
Otherwise it is possible to have variable speed pumps to have fixed DT while chiller capacity varies or other regulation strategies determined when placing the order.
Integrated tank on the entire range: for machines fractioned in this way, the tank is not required but still contributes to stabilise the water T sent to the system.

EER > 3
La flexibility of the design means that the offer can be composed with practically endless solutions and therefore it is easy to configure units with an EER close to 3 at full load. As an example, since on the market there are even manufacturers who regularly claim 3.6 with peaks of 4.1, please read the note below:

EER *3.6 means that on a 20 kW chiller taken as an example,*
to evaporate at +4° (value improbable in dry expansion)
To condense at +44,5° with a sub-cooling of 5° and a air outlet T greater than the condensation T. This is theoretically possible, but definitely not with heat exchangers with 2 or 3 ranges.
EER 4.1 with water 12/7 and air at 35°C means:
a) to evaporate at +4° (value improbable in dry expansion)
b) to condense at +40° with a sub-cooling of 5° and a air outlet T greater than the condensation T and fluid outlet T equal to that of incoming air. This is impossible, at least at the current state of know-how.

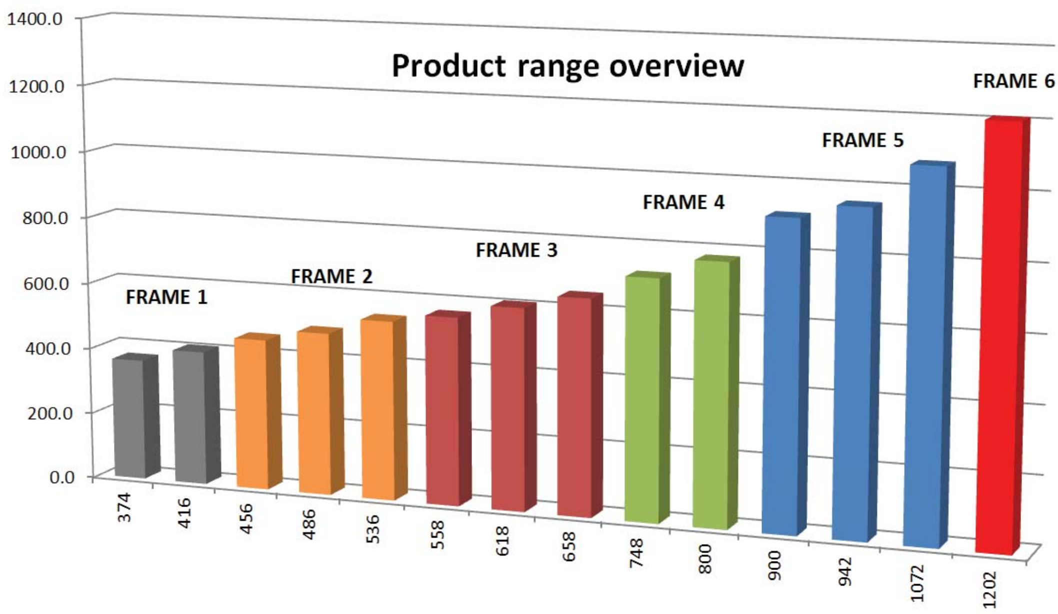
And so be careful to identify those who seem "incredible" and above all to recognise the true competitors with which one wants to be compared.

1.3 Plus

EXTENSION OF THE RANGE

- LSE versions from 370 to 1,200kW;
- All reversible hot/cold until the 650 kW size
- Free Cooling on LSE with an increase of only 0.68m^2 on Foot Print for all the frames;
- Dual-circuit up to 6 compressors and 540 kW yield
- Four-circuit 8 - 12 compressors up to 1200 kW

For all sizes: CS acoustic set-up (silenced) – CL (Low noise)



EXTENDED OPERATION LIMITS FOR LOW TEMPERATURES (-10°C)

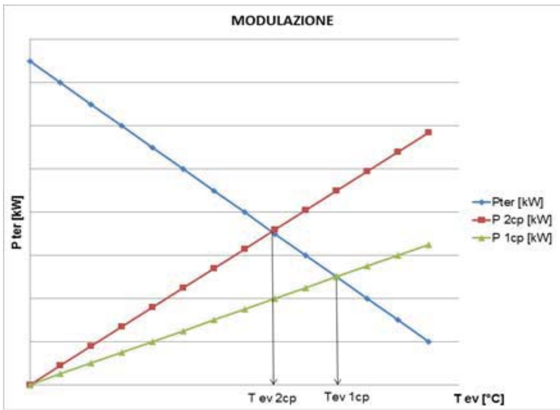
- Electric heater kits to prevent the formation of ice on the plate heat exchangers
- Dual aeraulic circuit
- Variable flow rate pump option (in this case, tank not available)
- ADT Adaptive Defrost Technology for the optimisation of defrost cycles thus increasing efficiency
- Heat pumps with extended operation limits up to Room temp = -10°C (with water production at 40°C)

ENERGY SAVING

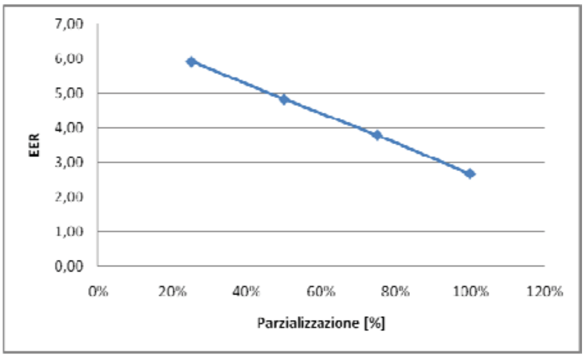
- Patented overheating control to optimise refrigerant flow to partial loads
- *Electronic expansion valve* as per standard for all the machines. This is optional in the heating cycle for reversible heat pumps.
- *Partial load:*
  referring to paragraphs 2.1 and 2.2, the following example assesses the fact that a heat pump in modulation will be much more efficient, providing considerable energy saving compared to non-modulating solutions:

  $P_{ter} = K \cdot S \cdot (T_w - T_{ev})$ *Thermal power*
  $P_{cp} = \eta \cdot \rho \cdot cil \cdot (\Delta h_{ev})$ *Compressor power*

  Tw = T water ; Tev = T evaporation
  $\eta \cdot \rho \cdot cil$ = Mass flow rate of refrigerant
  Pter = Thermal output at heat exchanger
  Pcp = Thermal flow generated by compressor

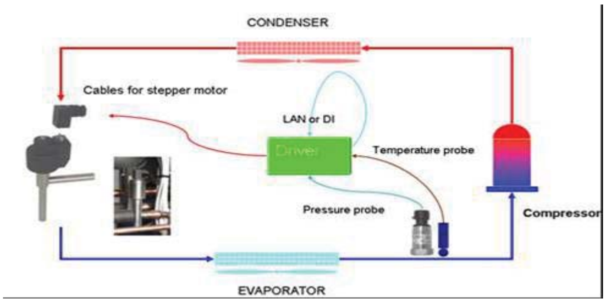


The graphic shows how by modulating power, passing from 2cp to 1cp, the T_{ev} increases.
Also since the density ρ increases exponentially with the T_{ev}, the power supplied by the compressor will be greater at the same absorbed power and therefore a clear EER improvement with



ensuring energy saving.

- *EC fans* – permanent magnet synchronous motors with electronic switching are available for the entire range for the maximum energetic benefits, especially noticeable in the Free-Cooling versions



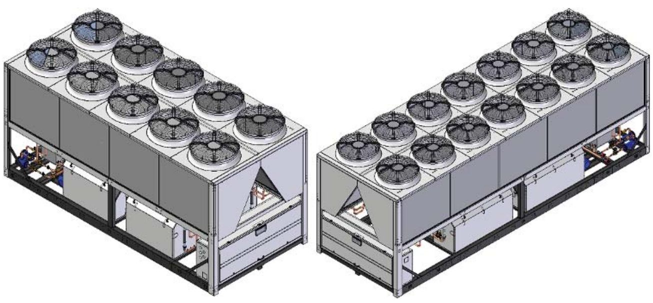
COMPACT FEATURES

- 3000 length up to 410 kW
- 4,000 length up to 540 kW
- 5000 length up to 650 kW
- 6000 length up to 790 kW
- 7000 length up to 1070 kW
- 8000 length up to 1200 kW

NOTE: the data above refers to the most powerful model for each size.

EXCLUSIVENESS

- *Aesthetics*: galvanised panels coated with textured RAL9002 polyester epoxy powder providing excellent protection against weathering and easy access to the electrical control panel, microprocessor and electrical components.



RELIABILITY AND QUALITY

- *Service pack:*

Advanced performance diagnostics, cycle diagram, refrigerant leak forecast. This option is available on request and will make routine and extraordinary maintenance of the unit quicker and easier. The specialised technician will be able to make use of the main data to interpret the parameters recorded during unit operation.
Log data storage and its display (optional Touch screen Display) for up to 42,000 minutes with sampling every 2.
Absorbed load limitation (can be set) from clean contact.

- *Piping:*

All of the copper pipes from ∅28mm upwards (refrigerant side) and steel pipes (chiller water side) are made in-house in order to totally control their manufacturing process and implicitly to improve the quality of our products. Each pipe is inspected in compliance with standard 97/23PED in the most stressed bending point and at the maximum pressure permitted by the safety bodies, considering ample safety coefficients.

The emitted sound power depends on the fans (normally mainly in "CS" versions) and on the compressors. The emitted sound power of the compressors can be eliminated with appropriate strategies (compartment insulated and covered with soundproof material + delivery mufflers) and that of the fans can be reduced by acting on the number of revs:

a) doing so would reduce the COP (at least at full load) and the field of application would be limited (again at full load).
b) Another solution, though more expensive, would be to increase the size of the unit

MANAGEMENT SOFTWARE

All of the management and optimisation software of the chilling cycle, of the electronic and electro-mechanical components is implemented and developed internally by a highly specialised staff who, besides combining the maximum versatility and functionality of the
to standard machine on the price list, is capable of developing new functions on demand without
weighing down product shipping timetables, in most cases.

by reducing the frame and increasing the number of fans, thus reducing at the same time load loss on the air side through the finned pack heat exchangers.

The LSE modular configurator, accessible via the technical/commercial structure, allows to “assemble” condensing sections / chilling sections / ventilating sections in a different way from the standard one found in catalogues in order to provide the best solution for the specific requirements of the system.

SILENT OPERATION

CONFIGURATION AND ACCESSORIES

List of standard features
R410A refrigerant
Scroll compressors
Galvanised and painted sheet-metal structure
Flow switch included
Brazed plate heat exchangers
Expansion valve and 3 bar safety valve (if pumps are fitted)
Programmable control
Second set point on utility side that can be activated from an external input
Unit lifting kit

1 Description of the Product

List of options

Version			
Air condensed chiller	C		
Reversible heat pump	H		
Execution			
standard	S		
low-noise	L		
1 - Electric power supply			
400/3/50 + N	0		
400/3/50 with transformer	1		
400/3/50 + Motor circuit breakers	2		
400/3/50 with transformer + Motor circuit breakers	3		
2 - control microprocessor and expansion device			
programmable (LCD display 8x22) + electronic expansion valve	B		
programmable (LCD display 8x22) + mechanical expansion valve	C		
3 - Utility circuit water pump			
absent	0		
single pump	1		
uprated single pump	2		
double pump for combined operation	3		
uprated double pump for combined operation	4		
double pump in stand-by rotation	5		
uprated double pump in stand-by rotation	6		
4 - Inertial storage tank			
absent	0		
inertial tank on utility circuit	S		
5 - Partial heat recovery (mandatory condensation control)			
absent	0		
de-superheater (40% Pf recovered under normal circumstances)	D		Not available if Field 6 = 0
6 - Air flow rate modulation			
absent	0		
condensation control with cut-off fans	C		
condens. control with "brushless EC" electronic control fans	E		
7 - Anti-freeze kit			
absent	0		
included, base machine (heater only on exchangers)	E		
included, machine with pump/s and vessel	P		
included, machine with pump/s, vessel and tank	S		
8 - Remote communication			
absent	0		
RS485 serial board (Carel or Modbus protocol)	1		
Serial board Lonworks	2		Not available if Field 2 = 0,A
GSM modem kit	3		Not available if Field 2 = 0,A
Ethernet board (SNMP or BACNET protocol) + clock board	4		Not available if Field 2 = 0,A
Ethernet board + clock board + supervision software	5		Not available if Field 2 = 0,A
9 - Coil execution on request			
standard	0		
copper / copper coils	R		
cataphoresis	C		
fin pre-coated with epoxy treatment	B		
10 - Package			
standard	0		
wooden cage	1		
wooden cage	2		
11 - Vibration isolation			
absent	0		
Rubber anti-vibration mounts at base of outdoor unit	G		
Spring anti-vibration mounts at unit base	M		
12 - Remote control			
absent	0		
Simplified remote control panel	1		
Remote display for programmable microprocessor	3		Not available if Field 2 = 0,A

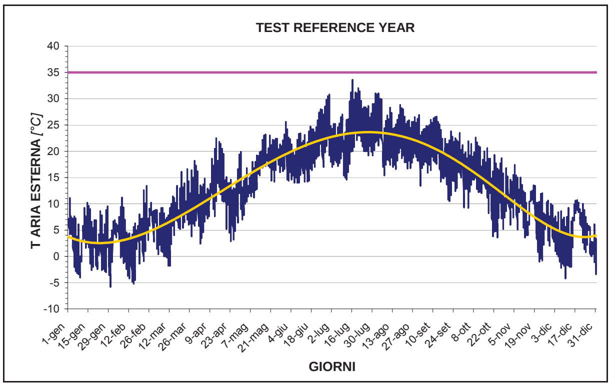
List of accessories

Shunt condensers	A		
Soft-starter kit (only for version 374)	B		
Service kit (probe kit for quick diagnostics)	C		Not available if Field 2 = 0,A
Two Vic-Taulic joints for fast water IN-OUT connection	D		
ON-OFF status of compressors	E		
Remote contact for (step-based= power limitation	F		Not available if Field 2 = 0,A
Configurable digital alarms board	G		Not available if Field 2 = 0,A
Outdoor temperature sensor for set-point compensation	H		Not available if Field 2 = 0,A
Pressure gauges	I		
Filter cut-off kit (solenoid and cock on liquid line)	L		
Reference standard other than 97/23/CE - PED	M		
Clock board	N		Not available if Field 2 = 0,A
Finned coil protection grille	P		
Finned coil protection metal filters	Q		

2 Seasonal Energy Performance

2.1 Partialization system

According to specific standards and current praxis, the performance of a refrigerator is calculated at a 35°C outdoor temperature and 12/7° produced water. In reality such circumstances occur for a few days a year since, in fact, the air temperature remains below 35°C most of the time: see for example the graph below that shows that the so-called T.R.Y. (Test Reference Year) for the city of Venice.



In the presence of such variability in outdoor thermal conditions, the refrigerator operates in a regimen of partialization of the chilling yield due to thermal load variations by users, but above all because of the inevitable air temperature variation. Therefore the energy efficiency of the machine being considered is different from the one calculated with the 35°C reference point according to surrounding conditions.

So how can the energy performance of your refrigerator be assessed upon a seasonal basis?

According to Eurovent® conventions, 100% of the chilling load supplied by the unit is required only 3% of the time when referring to "comfort" applications.

The E.S.E.E.R., European Seasonal Energy Efficiency Ratio allows one to assess the energy efficiency of a seasonal based water chiller "in the cold". This is the result of a weighted average of individual E.E.R. values calculated at four different partial loads: 25%, 50%, 75% and 100%.

E.S.E.E.R. = a x $E.E.R._{100\%}$ + b x $E.E.R._{75\%}$ + c x $E.E.R._{50\%}$ + d x $E.E.R._{25\%}$

where the weighted coefficients are:
a = 0.03 c = 0.41
b = 0.33 d = 0.23
and represent, in percentage, the space of time in which the chiller operates in the partial conditions indicated.

The individual E.E.R. are calculated according to these indications:

- for each partialization condition, the chilled water is produced at the fixed temperature of 7°C;
- The water flow rate is calculated at full load (100%);
- The outdoor air temperature is varied according to the load percentage shown on the table:

Partialization	Text [°C]
100%	35
75%	30
50%	25
25%	20

The result is that the E.S.E.E.R. has much higher values than the E.E.R. calculated at 35°C outdoor air temperature and with water chilled at 12/7°C. It also provides a more rational comparison between different units and a real performance count, and therefore the consumption of a chiller in the space of its real operating life.

2.2 E.S.E.E.R. for air condensed chillers

3 Technical Description - Calibration - Safety devices

3.1 General Information

All the control devices are set and tested in the factory before the unit is dispatched. However, after the unit has been in service for a reasonable period of time you can perform a check on the operating and safety devices. The calibration values are reported in Tables I and II.

All the servicing operations performed on the control equipment must be carried out EXCLUSIVELY BY QUALIFIED PERSONNEL: incorrect calibration values can cause serious damage to the unit and to people.

Many of the operating parameters and system settings are configured by means of the microprocessor control and are protected by passwords.

Table I - Calibration of control devices

CONTROL DEVICE		SET POINT	DIFFERENTIAL
Service thermostat [C - F]	°C	12	4
Service thermostat [H]	°C	40	4

Table II - Calibration of safety - control devices

CONTROL DEVICE		ACTIVATION	DIFFERENTIAL	RESTORATION
Antifreeze thermostat	°C	+4	1	Automatic
Maximum safety pressure switch	bar	45	-13.5	Manual
Maximum safety pressure switch	bar	40.5	-12.2	Manual
High pressure safety valve	bar	-	-	-
Minimum pressure switch	bar	1.5	+1.0	Automatic
Modulating condensation control	bar	18	10	-
Time between two start-ups of the same compressor	s	450	-	-
Flow switch alarm delay	s	20	-	-
Low pressure alarm delay	s	1	-	-
Pump rotation [optional]	h	6		
Defrost end pressure	bar	29	-	-
Maximum defrost time	s	360	-	-
Minimum time between two defrosts	s	1800	-	-

3.2 Indications according to Directive EN 97/23EEC-PED

General Information:
The chillers and heat pumps in question are machines designed for outdoor installation, which implement an inverse steam compression cycle and use R410A refrigerants, or R22 in countries where its use is not prohibited.
These fluids are classified according to standard 97/22/EEC and belong to group 2, i.e. not dangerous (see safety files). Note: its classification in PED 97/23 and in EEC regulation 2037/00, which regulate the use of substances which are harmful to the ozone layer, are exactly the opposite, i.e. while the contents are identical, the group attribution is switched around.
Reference: Standard 97/22 IEC
The machinery in question is equipped with double or quadruple chilling circuit principally made up of:
- A hermetic compressor driven by an electric motor, capable of extracting vapours from the low pressure zone of the circuit and compressing them towards the high pressure zone.
- An expansion device, a flow rate regulator which guarantees the correct supply of refrigerant fluid to the evaporator, with the difference in pressures existing between the low and high pressure sections
- A heat exchanger, for the exchange of heat between refrigerant and air, operating as a condenser: it is a finned-pack exchanger, made with a tube bank, with a diameter of 9.52 mm.
- A heat exchanger, for the exchange of heat between refrigerant and water, operating as an evaporator: it is a brazed AISI 316L stainless steel plate exchanger.
- Copper piping
- Accessories such as refrigerant filters, cut-off valves, 4-way cycle inversion valves, cocks, pressure gauges.
- Control and safety devices such as pressure switches and safety valves
- Refrigerant containers
- Parts for the forced circulation of external fluids (water and air: fans and pumps);

Category Assessment.
Since the machinery is substantially the outcome of the assembly of several components (often built expressly for this purpose), assessment of the

category for each model is obtained by observation of the classification of the components which make them up and coincide with the highest category applicable to them (except for safety devices).
Therefore, in order to identify the category of the machinery, their main components and the categories they belong to are taken into consideration. Some information on these components is provided below.
References: EC 97/23 - Art.10 Par.2 point b

Main components of chillers and heat pumps:

Compressors:
The employed compressors are hermetic and therefore included in the aims of PED 97/23. Depending on the inner volume of the shell of the low pressure part, these components are classified as pressure vessels. Each model is bound by the declaration of conformity of the manufacturer. In relation to the series of machines in question, a part of them belongs to category I, another part belongs to category II and in one case a part belongs to category III: in harmony with the notified body Apave (0398), and having referred to the French technical standards “fiches clapes” (officially recognised as valid by the European Commission), the maximum PS of the low side of the compressor has been downgraded from 30.2bar-r to 29bar-r, fitting the intake pipe with a safety valve set at 29bar-r, in order to fall within category II with the entire range.

Brazed plate heat exchangers:
They are intended to implement thermal exchange between the refrigerant and the water by means of a series of parallel corrugated AISI316L steel plates, brazed together to form 2 channels for the flow of water and 2-1 channels for the flow of refrigerant. The volume of the heat exchanger depends on the number of plates making it up.
These heat exchangers are acquired from manufacturers who certify their products in compliance with PED. The PS pressures considered by the manufacturers are 45bar. They classify and mark the heat exchangers according to this pressure and the volume of each one.
Galletti S.p.A. uses these these exchangers in systems whose maximum pressure P is 40.5 bar.

Finned pack heat exchangers:
These are intended for thermal exchange between refrigerant and air by means of a series of 9.52 mm diameter aluminium finned mandrel pipes of an adequate thickness for optimum efficiency of the finning itself. Since these exchangers are tube banks, they are not considered recipients as in the PED. In any event, they are tested at 100% at 1.1 x PS.

3.3 Indications according to Standard UNI EN 14511

General Information:
The standard specifies the test methods for classification and determination of the performance of air and water cooled air conditioners, of liquid chillers and air/air, water/air, air/water, water/water heat pumps, with electrical compressor when used for heating and/or cooling.

Based on the text of the standard, it can be seen that to be compliant with EN 14511, the COP of any unit taken from the market must be at least 85% the declared value.

3.4 Field of application

These machines are designed to cool-heat water and solutions containing up to 35% glycol (percentage by weight) in civil, industrial and technological air-conditioning systems.
Their use is recommended within the functioning limits carried in this manual, or else the warranty attached to the sales contract would cease.

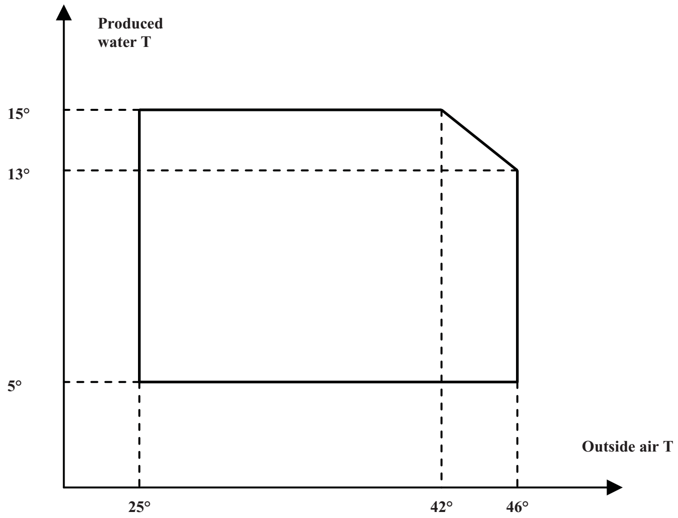
Functioning limits of LSE chillers regarding outlet water temperature from the unit (in parentheses during the heating cycle) and the temperature of the outside air:

	Min.	Max.
Evaporator outlet water temperature [°C]	5 (30)	12 (45)
Outdoor air temperature [°C]	-10	45

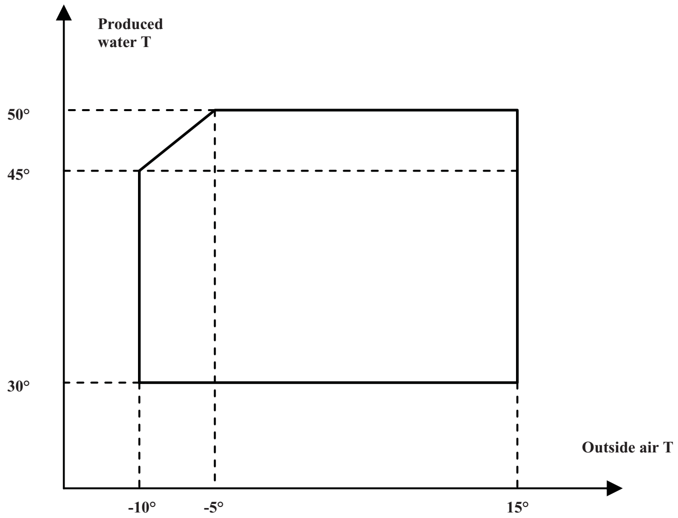
- *Heat transfer fluid* = water or mixture of water and antifreeze
- *Maximum water operating pressure* = 3 bar
- *Maximum operating P high pressure side* = 40.5 bar-r
- *Maximum allowable P high pressure side* = 45.0 bar-r
- *Maximum operating T low pressure side* = 135° C
- *Minimum operating T* = -10°C
- *Maximum operating P low pressure side* = 29 bar-r (*)
- *Power supply voltage* = +/- 10% compared to the voltage on the ID plate.
- *Maximum storage T* = +45°C
- *Minimum storage T* = -20°C (limit dictated by on-board electronics)

(*) this value can only be reached during the storage phase, which determines its limits

➢ *Limits in CS/CL chiller version*



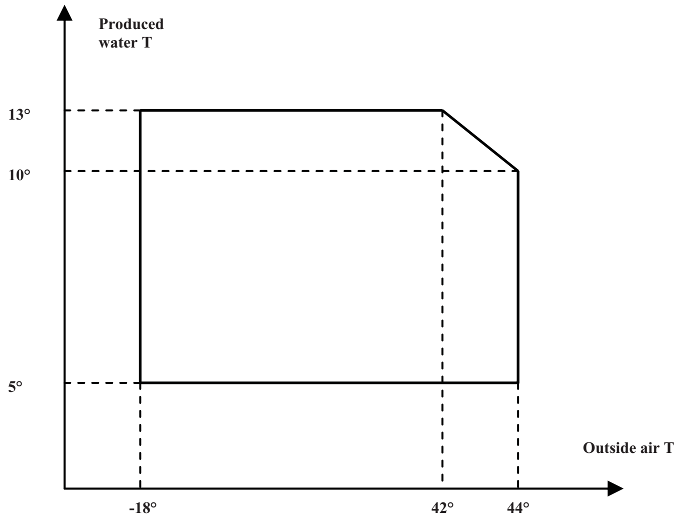
➢ *Limits in HS/HL HEAT PUMP version*



➢ *Limits in version with Free-Cooling FS/FL*

The Free-Cooling unit is available on all cooling-only models. This function cannot be combined with heat pump operation. Due to the special nature of the application, all the units are provided with a condensation control device and an ADVANCED microprocessor control mounted as per standard.

The following figure illustrates the type of standard applications for the Free-Cooling units.



The lower limit is determined by the freezing threshold of the solutions containing glycol at 35% of their weight, the maximum admissible value for the gaskets used on the pumps. On request, special ceramic gaskets can be supplied for the pumps, allowing operation below the specified temperatures (with the use of solutions containing up to 50% glycols, in weight).

% of ethylene glycol	0 %	10 %	15%	25 %	30 %	35 %
Freezing point of mixture	0	- 3	- 5	-11	-14	-18

The units with Free-Cooling and the versions with heat pumps equipped with protective resistances around the oil sump of the compressor.
The problem of inadequate lubrication could occur when the oil sump is not heated properly, especially after long periods of inactivity. During start-up, due to the intake effect of the compressor, there is a sudden pressure drop within the shell, resulting in significant evaporation of the refrigerant previously dissolved in the oil: the high temperature contrasts the tendency of the refrigerant to dilute the oil. Failure to install electric heating elements is the cause of two problems:

- oil dilution and therefore inadequate lubrication at the first start-up;
- migration of the oil towards the cooling circuit due to the refrigerant dragging effect and therefore possible lubrication problems.

Use of electrical resistances is extremely important especially at the first start-up. Therefore it is recommended to leave them inserted for at least 12 hours before starting the compressors.

When the outside T drops considerably, for the Free Cooling systems, the water T inside the system is controlled by the modulating action of fans. In extreme situations (strong prevailing winds) by the extra modulating action of the 3-way valve at high KVS. Only on demand for extreme cases the joint action of the 3-way modulating valve at low KVS is available.

- ***It is forbidden to use the machine in locations with an explosive atmosphere, namely places subject to the ATEX directive.***
- ***Do not tamper with the electrical system for any reason whatsoever.***
- ***Make sure that the power supply voltage is the one required by the unit.***
- ***Any use of the unit that is not covered by this document is considered incorrect or improper use.***

3.5 Calibrations and sizes of the chilling circuit safety devices

For LSE series chillers and heat pumps, the maximum allowable pressure is determined by the use of a PED-classified cat IV safety pressure switch with 45bar-r calibration: LSE series machines are equipped with hermetic "scroll" compressors and a manual resetting pressure switch with fixed calibration.
For high pressure protection on the chilling circuit of the units for production of LSE chilled water, the following devices are foreseen:
- There is one or more high pressure switches (with fixed or manual calibration) all with manual resetting.
- there may be a safety valve (not included on all models) which opens the circuits by bleeding any excess pressure and determining the PS pressure.
Logic has it that the intervention of the high pressure switch has the priority, leaving the safety valve (in case of pressure switch failure) to prevent the risk of explosion.

The current intervention and safety settings always tend to comply with harmonised technical standard UNI-EN378, specific to chiller systems. More in general, the PED directive dedicated to pressure vessels 97/23/EC is the reference directive and must be applied for all pressure equipment with PS>0.5bar.
For all units excluded from the latter (A3p3), the new Machinery Directive 2006/42/EC (ex 98/37/EC) applies.

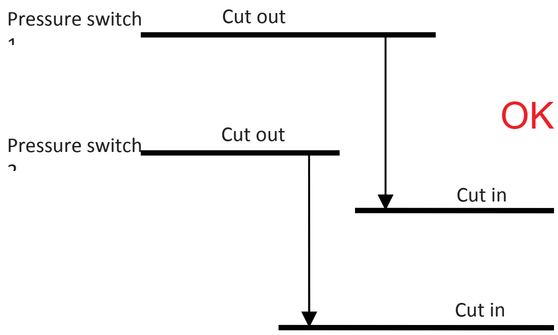
According to the PED it must not be possible to cut off the high pressure switch (as well as the safety valve, if applicable) and therefore no type of isolator device must be set up, not even the Schrader valve which is used to facilitate circuit charge and discharge operations.

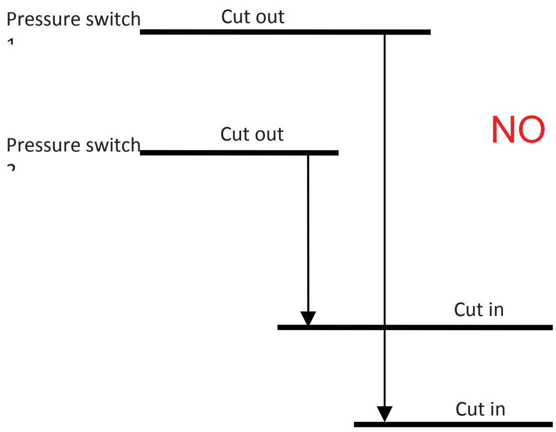
Every pressure switch is provided with a manual restore button in case it is triggered.
Should the latter fail to operate, a second safety pressure switch or safety valve will be triggered. They are also PED approved, calibrated and chosen based on the max discharge flow rate of the corresponding compressor and of the refrigerant taken into consideration.

(*) For units with refrigerant load of group L1 (R407C,R410A,R134a..) less than 100kg and a total volume circulating through the compressor lower than 25 l/s [90m3/h], only one pressure limiting device is required. In this case it will be the high pressure switch calibrated at 40.5bar-r.

	Unit R410A (*)
SPLIT UNITS	Press. A.P. = 40.5bar-r ± 0.7
	Safety valve = 45bar-r +4.5bar-r
MONOBLOC UNIT	Press. **A.P.1**= 40.5bar-r ± 0.7
	Press. **A.P.2**= 45bar-r ± 1

The safety device which determines the PS (maximum operating pressure) of each unit is the pressure switch or safety valve (if present) at a higher calibration.
If there is a second pressure switch, it must be calibrated to = PS x 0.9.
The following is the standard for choosing the high pressure switch when working together with another cascade pressure switch:





During final testing, the pressure switch is checked on each machine to make sure it is working properly.

3.6 Maximum pressure switch

The high pressure switch, with manual rearming and belonging to category IV according to Directive 97/23 EEC, shuts down the compressor directly when the delivery pressure exceeds the calibrated value.

***Caution: do not modify the calibration of the** pressure switch: should the latter fail to work, rising pressure would make the high pressure safety valve open.*

To verify its efficiency, while the compressors are running, close off the passage of air into the condensers and check by referring to the compressor outlet pressure gauge (previously installed) whether the pressure switch trips (i.e. the compressors stop) when the set value is reached.

The high pressure switch is rearmed manually and can be done only when pressure has dropped below the value indicated by the set differential (see Table II).

3.7 Minimum pressure switch

The low pressure switch stops the compressor when the intake pressure drops below the calibration value: the intervention is immediate in order to preserve the integrity of the compressors.
It is rearmed automatically only when pressure has risen above the value indicated by the set differential (see Table II). However the unit will not restart until the alarm memory on the control microprocessor has been reset.

3.8 Service thermostat function

This function activates and deactivates the compressors according to the demand for chilled water by means of a probe at the evaporator inlet [return water from system].
This device is a function included in the microprocessor control and works with a proportional band width that may be set as desired.

3.9 Antifreeze thermostat function

The antifreeze probe, located at the evaporator outlet, detects when temperatures are too low and shuts down the unit. This function, together with the water flow meter and the low pressure switch protects the evaporator from the risk of freezing, causing anomalies to the hydraulic circuit.
This device is a function included in the microprocessor control.

3.10 Anti-recycle timer function

The timer function prevents excessively frequent compressor starts and stops.
This device is a function included in the microprocessor control.
It imposes a minimum time lapse of 300 seconds between two successive starts.

Never change the delay time set by the manufacturer: incorrect values could cause serious damage to the unit.

3.11 Oil differential pressure switch

LSE units are equipped with SCROLL compressors: these compressors do not have a lubricant pump and therefore no oil differential pressure switch is provided.

4 Hydraulic Connections and Hydronic Options

4.1 General recommendations for hydraulic connections

When implementing the hydraulic circuit for the evaporator, abide by the instructions below and comply with national or local standards (refer to the layouts included in the manual).

- Fit the piping to the cooler with flexible joints to dampen vibrations and to compensate thermal expansion.

- Install the following components on the piping:

- temperature and pressure indicators for routine maintenance and control of the unit. Pressure control on the water side allows expansion vessel operation to be checked and any water leaks in the system to be detected in advance. **NOTE:** make sure the water pressure on the intake side of the pump is at least +0.6 relative bar; otherwise the buffer tank could be damaged.

- sumps on inlet and outlet piping for measuring temperatures, and for directly viewing the operating temperatures. Temperature readings can in any case be obtained from the microprocessor installed on the unit.

- cut-off valves (gate valves) to isolate the unit from the hydraulic circuit.

- metal mesh filter (incoming pipes), with a mesh not to exceed 1 mm, to protect the exchanger from scales or impurities present in the pipes.

- air vent valves, placed on the higher parts of the water circuit, that bleed the air. [There are air vent valves on the pipes inside the unit for bleeding on board: **this operation must be performed exclusively with power cut from the unit.** Especially on the Free-Cooling versions, make sure that the circuit is completely full of water and then bleed the air from the water coils in order to prevent pump cavitation].

- discharge cock and, if necessary, drain tank to empty the system for maintenance or seasonal stops. [A 1” discharge cock is foreseen on the optional buffer tank: **this operation must be performed exclusively with power cut from the unit**].

- On FS-FL models it is mandatory to use glycol solutions (max. 35% in weight) in order to prevent damage to the finned coil, difficult to repair, caused by it freezing. Carefully assess the minimum air T to which the unit may be exposed and then determine the % of anti-freeze to be added.

4.2 Water connection to evaporator

It is extremely important that the water inlet is connected at the height of the “Water Inlet” sign.

Otherwise the evaporator could risk freezing since it cannot be controlled by the antifreeze thermostat. Moreover the counterflow circuit installation would not be respected in the cooling function causing further risks of malfunctioning or anomalies of the flow meter.
The size and positions of the hydraulic connections are carried on the dimensional tables at the end of the manual.

The hydraulic circuit must be implemented in a way that guarantees a constant nominal flow rate of water (+/- 15%) to the evaporator in every operating condition, unless the flow rate variation is controlled by the chiller.

The compressors work intermittently since the chilling demand of the utility does not generally coincide with that supplied by the compressor. For systems with low water content, where the effect of thermal inertia is less felt, it is recommended to check to make sure that the water content of the cold section satisfies the following relation:

$$V = \frac{Cc \times \Delta\tau}{\rho \times Sh \times \Delta T \times Ns}$$

V = water content in cold section [m3]
Sh = specific heat of the fluid [J/(kg/°C)]
ρ = density of the fluid [kg/m3]

Dτ = minimum time between to 2 compressor start-ups [s]
DT = permitted difference in water T [°C]
Cc = Cooling Capacity [W]
Ns = N° of capacity control steps

Regardless of their configuration, all the units have only one external hydraulic connection (inlet + outlet). This is an important factor which reduces connection times on site. All the units are normally provided with a flow meter which immediately shuts down the unit in case of an anomaly, thus preventing the plate heat exchanger from freezing or being damaged. A water temperature probe is also foreseen on the evaporator discharge side, connected to the antifreeze thermostat.
All the units are provided with optionals which allow to implement various configurations with:

- single and double pumps for applications at –10°C and with a maximum of 35% glycol [on demand available for applications with > 35% glycol with special ceramic gaskets on the pump axis]:
- buffer tank on discharge side of hydraulic circuit. This system facilitates the balancing of inevitable temperature variations by the effect of the modulating action of the compressor.

The **Fig.** shows the integrated and balanced effect of the buffer tank. Its function favours a precise temperature control according to the environmental parameters of the units connected.

As per standard; the LSE units are provided with a water flow rate control device (differential flow meter or pressure switch) on the hydraulic circuit near the evaporator.

If this device is modified, the warranty terminates immediately.

We recommend installing a metal net filter on the water inlet piping.
Warning: Never perform hydraulic connection operations with open flames near or inside the unit.

4.3 How to fill up the tank and/or the pumps (*if required by the system*)

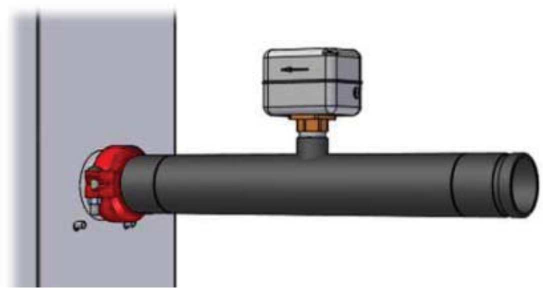
The tank has not been designed to withstand a depression greater than -0.15 relative Bar. For this reason, make sure that the pressure on the pump intake side, where the expansion vessel is positioned, is always above 0.6 Bar with pump running. This helps reduce the risk of cavitation.

It is extremely important that the installer follows and verifies this procedure step-by-step to prevent the risk of tank implosion or pump cavitation:

- ✓ Drain the expansion vessel until the pressure reaches 0.5 bar
- ✓ Fill the system and pressurise it to approximately + 1 bar in pump suction (pump stopped)
- ✓ Bleed the system
- ✓ Check the pump suction pressure (approximately 1 bar) and start up the system
- ✓ Stop the pump after 15-30 minutes and repeat the procedure from step c) until you can no longer hear any noises caused due to the presence of air in the system.

4.4 Paddle-type flow switch

The major limitation of the differential flow switch is that if the heat exchanger is clogged (even due to the formation of ice) a difference in pressure is in any case detected but does not generate alarms and the process degenerates, resulting in the inevitable breakage of the evaporator (unless there is an additional safety device installed at software level). The paddle flow switch detects the actual flow, not associating it to a difference in pressure. The paddle moves, if there is a flow, acting on an electric switch. The LSE series is fitted with a flow switch, already mounted on a suitable steel pipe, to be necessarily installed on the machine.
It is crucial to follow certain installation guidelines, such as sufficient distance from sections of curved pipes and the required horizontal arrangement of the pipe on which it is mounted. Simply connect the wiring and couple the pipe section, via a vic-taulic joint, to the unit inlet connection, according to the dimensional drawing provided.

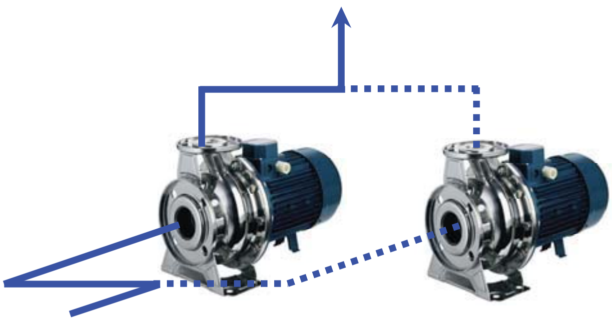


4.5 The pump unit

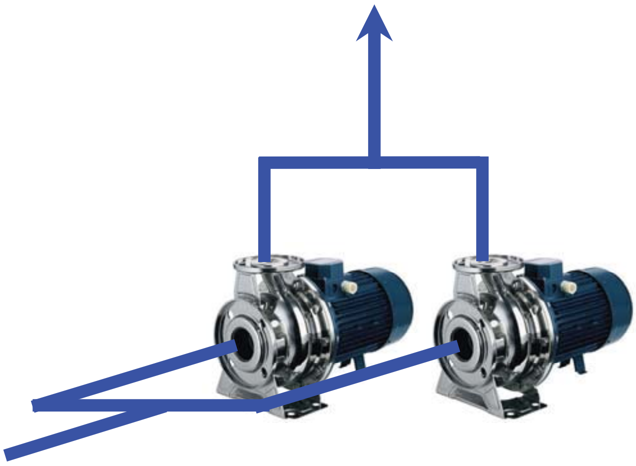
Several pump unit configurations are available:

- Single low head pump
- Single high head pump
- Double “OR” low head pump
- Double “OR” high head pump
- Double “AND” low head pump
- Double “AND” high head pump

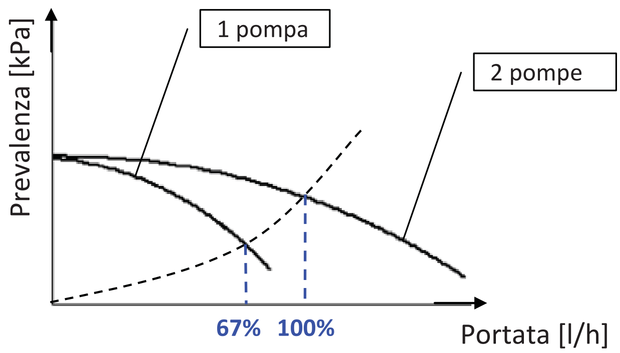
In the “OR” version, the pumps work in stand-by rotation mode: to ensure greater reliability of the system, each pump process the total flow rate of water, providing the head required to overcome all the pressure drops of the plumbing circuit.



The “AND” execution foresees two smaller pumps than the previous ones, each elaborating half of the water flow rate and functioning simultaneously in parallel.

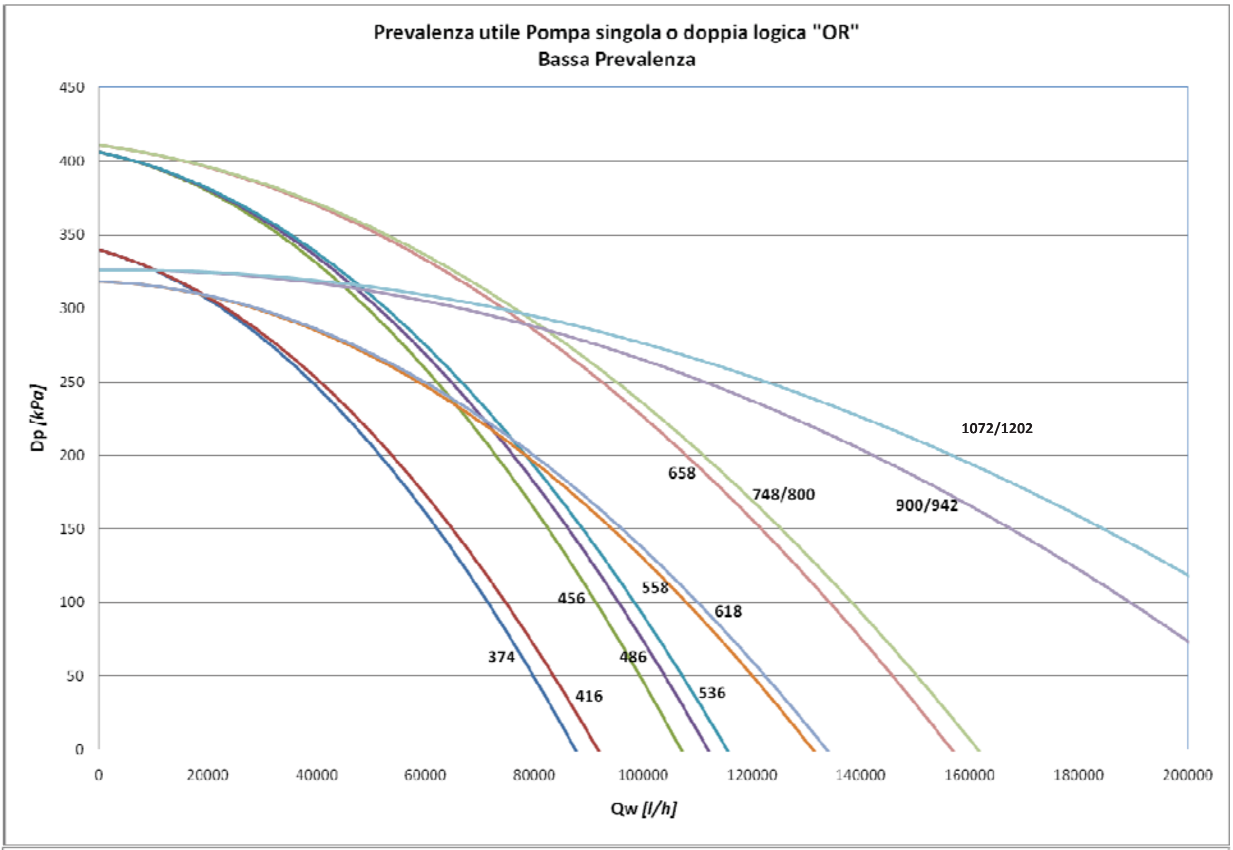


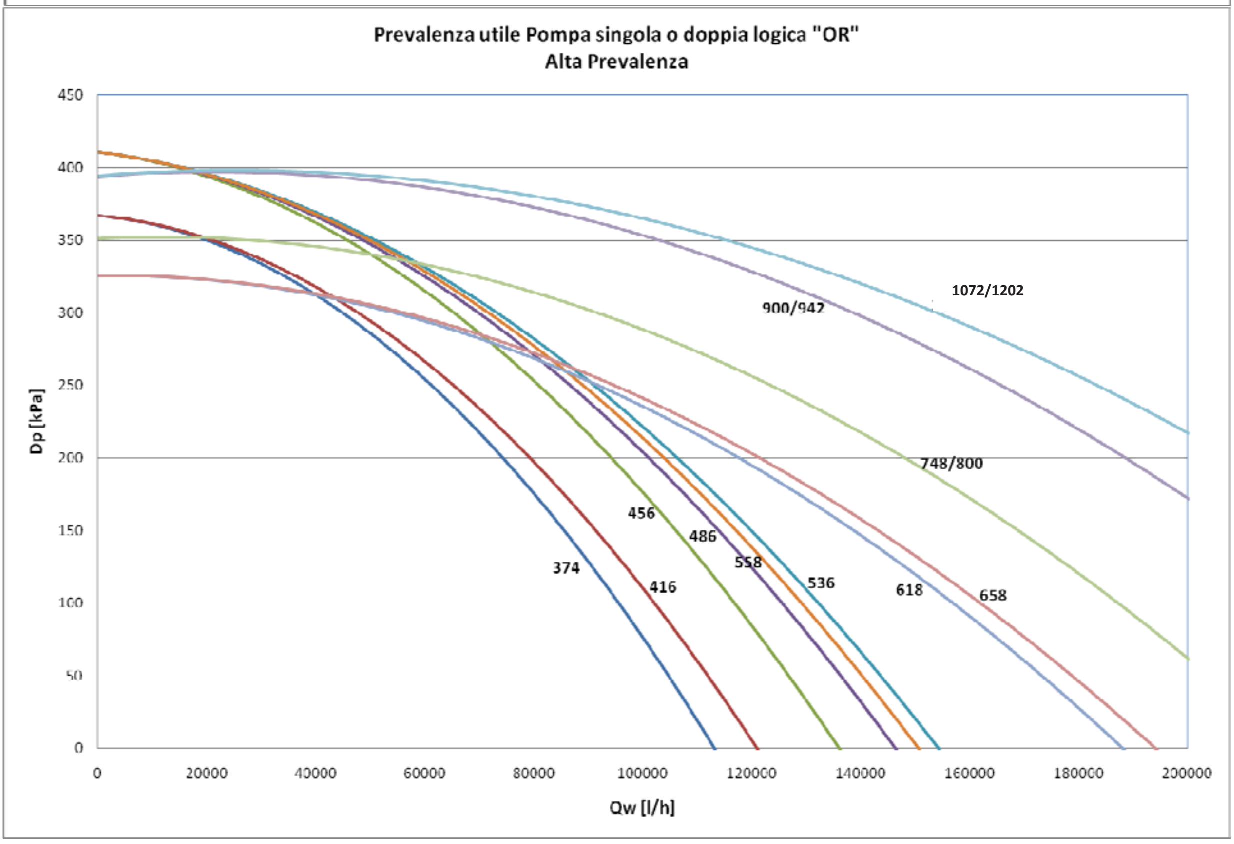
With reference to the characteristic flow rate/head curve of the pump unit, it can be noted how the water flow rate varies when only one of the two pumps is operating. The water flow rate is at the nominal value of 100% when both pumps are on; when the chilling power demand is 50% or less, one of the two pumps turns off (according to the stand-by rotation logic FIFO) and the flow rate becomes 67% the nominal value.
Therefore utility side T difference will increase by about 33% without inconvenient repercussions for the user's comfort, but with great energy saving advantages due to one pump remaining off.

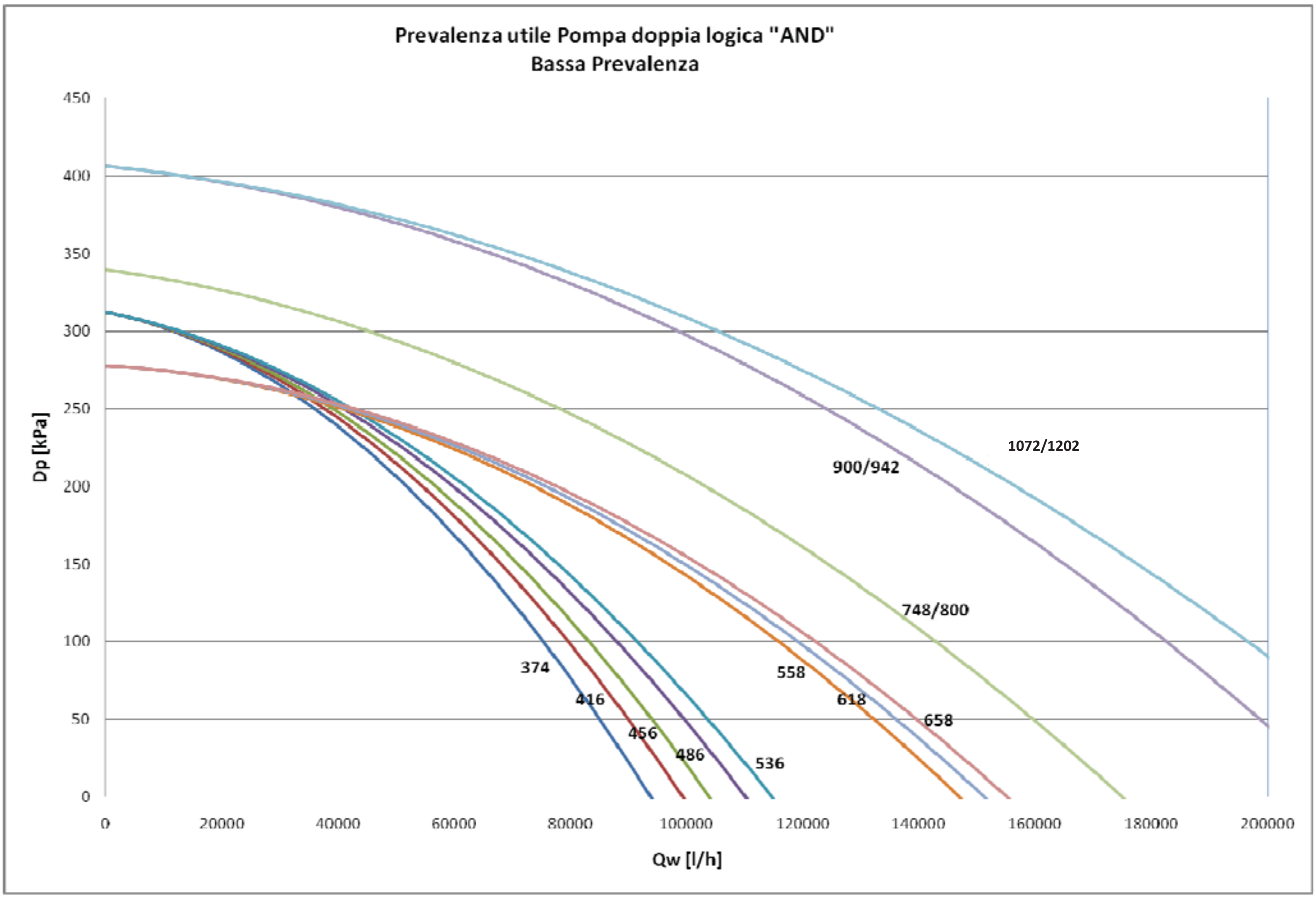


4.5.1 Available heads

The following carries the heads available for the utility for the different OR/AND pump unit configurations relative to the “COLD ONLY” version at nominal conditions:






Prevalenza utile Pompa doppia logica "AND"
Bassa Prevalenza
Dp [kPa]
Qw [l/h]
450
400
350
300
250
200
150
100
50
0
0
20000
40000
60000
80000
100000
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748/800
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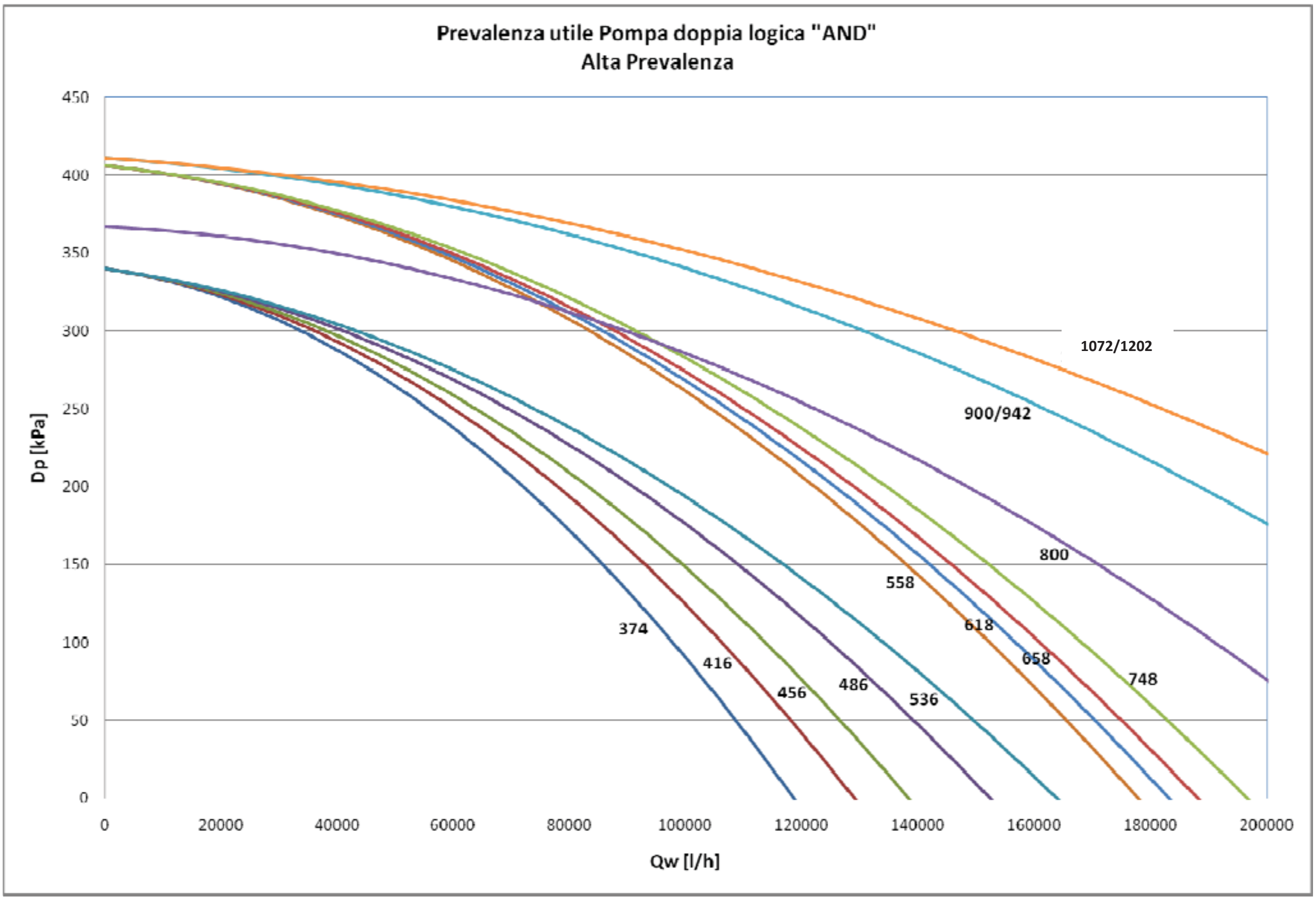
Prevalenza utile Pompa doppia logica "AND"
Alta Prevalenza
Dp [kPa]
Qw [l/h]
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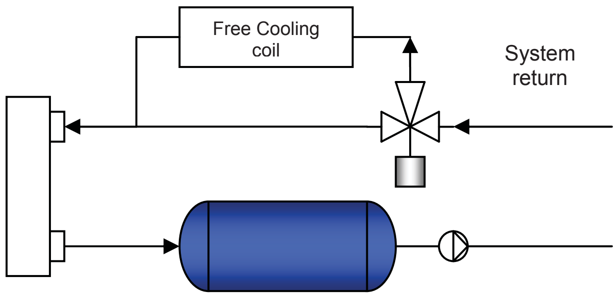
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000
1072/1202
900/942
800
558
618
658
748
374
416
456
486
536

5 Free-Cooling Version Circuit

5.1 The principle of indirect Free-Cooling

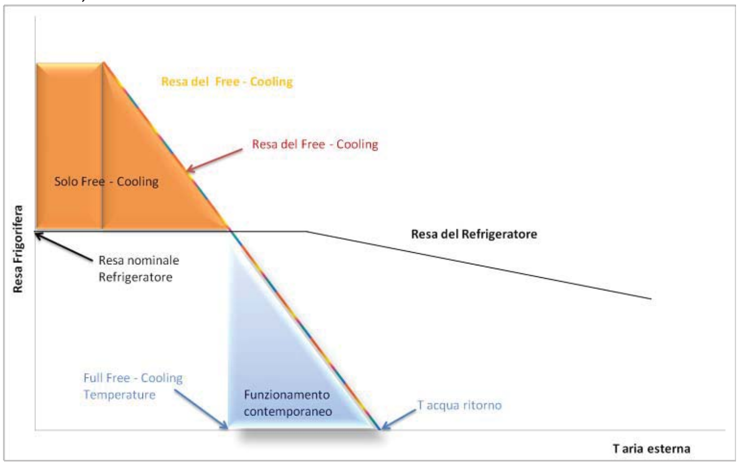
The Free-Cooling versions foresee a 3-way valve capable of deviating the flow towards the Free-Cooling coils placed upstream the condensing coils, in the air flow direction. Valve activation is controlled by the microprocessor (ADVANCED as per standard) assessing the difference between the system return water set point T and the outside air.



The probe placed at the pilot evaporator inlet (T3) and then the activation integrating the compressors if the Free-Cooling performance is not sufficient to cover the entire thermal requirements.

Among the options available, the pump unit can be selected with different head levels. For Free-Cooling executions, it is recommended to choose the high head unit to compensate greater internal load losses due to the presence of the 3-way valve and the probable use of glycol mixtures.
Free-cooling execution provides excellent energy savings in all those situations in which the outside temperature is lower than the fluid in circulation (process industry, close control applications, information technology in general, convention halls, etc.). The performance of the Free-Cooling circuit depends on the difference between the outside air T and that of the water circulating, as shown in the figure:

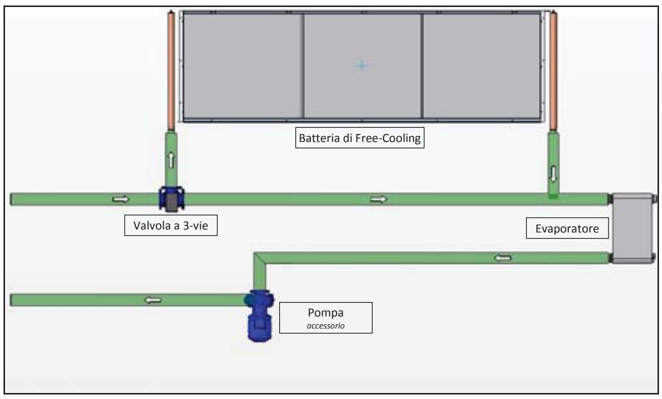
When the outside air T drops below the return water T, there can be



a thermal exchange and therefore Free-Cooling action with integration of one or more mechanical cooling steps.

5.2 Glycol Free version on request

Since the air temperature can be much lower than zero, depending on the harshness of the winter season and the latitude, antifreeze liquids must be used as heat-transfer fluid: these are often glycoled substances.
The standard layout for the Free-Cooling units is represented in the figure below in which the hydraulic circuit often has water mixed with glycol.

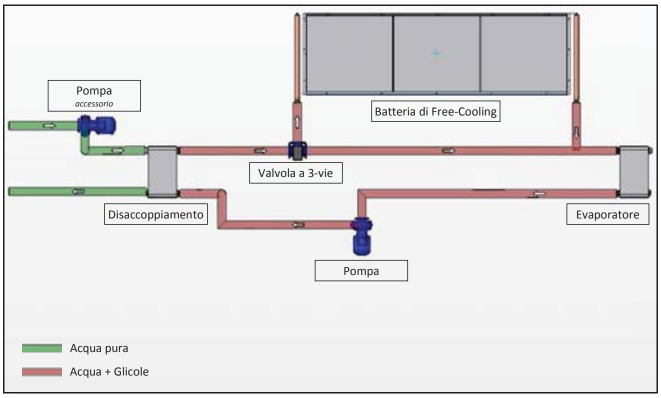


Otherwise, the following special execution solutions are possible (on demand):

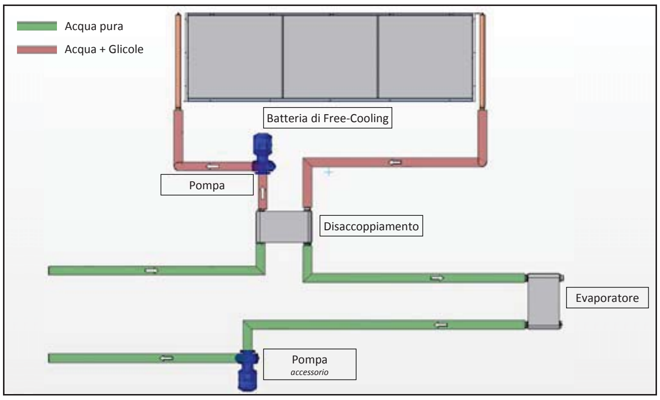
Comparing the various solutions proposed:

	PRO	CON
Solution A	simple execution	presence of glycol in entire circuit low pump consumption (hydraulic load losses depend on operative mode of the unit)
Solution B	simple execution glycol/no-glycol	large quantity of glycol a double thermal exchange occurs → the evaporator set-point is lower → less efficiency
Solution C	no further thermal exchange occurs when in "chiller" mode the amount of glycol is reduced a pump remains off when in "chiller" mode	in any event, hydraulic load losses are greater due to an additional thermal exchange → greater energy consumption of the pump
Solution D	no further thermal exchange occurs when in "chiller" mode the amount of glycol is reduced a pump remains off when in "chiller" mode the primary pump must cope with greater load losses only when the uncoupling exchanger intervenes	greater execution burden than solution "C"

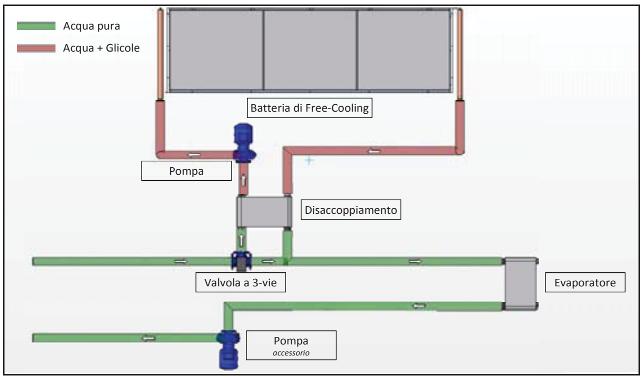
Solution "B":



Solution "C":



Solution "D":



6 Noise level of Units

6.1 LSE … CS (Standard) Acoustic Data

The following charts carry the noise spectrums in octaves of the sound power measured according to the standard ISO 3741 (ISO 3744 and EN 29614-1) and the sound pressure at a distance of 10 m with directionality factor 2.

Freq. [Hz]	31.5	63	125	250	500	1k	2k	4k	8k	Lw [db(A)]	Lp [dB(A)] @ 10m Q=2
374	47.1	66.9	71.2	80.2	81.6	87.2	82.0	76.4	68.9	90	62
416	47.1	66.9	71.2	80.2	81.6	87.2	82.0	76.4	68.9	90	62
456	48.1	67.9	72.2	81.2	82.6	88.2	83.0	77.4	69.9	91	63
486	48.1	67.9	72.2	81.2	82.6	88.2	83.0	77.4	69.9	91	63
536	48.1	67.9	72.2	81.2	82.6	88.2	83.0	77.4	69.9	91	63
558	49.1	68.9	73.2	82.2	83.6	89.2	84.0	78.4	70.9	92	64
618	49.1	68.9	73.2	82.2	83.6	89.2	84.0	78.4	70.9	92	64
658	49.1	68.9	73.2	82.2	83.6	89.2	84.0	78.4	70.9	92	64
748	49.1	68.9	73.2	82.2	83.6	89.2	84.0	78.4	70.9	92	64
800	49.1	68.9	73.2	82.2	83.6	89.2	84.0	78.4	70.9	92	64
900	50.1	69.9	74.2	83.2	84.6	90.2	85.0	79.4	71.9	93	65
942	50.1	69.9	74.2	83.2	84.6	90.2	85.0	79.4	71.9	93	65
1072	50.1	69.9	74.2	83.2	84.6	90.2	85.0	79.4	71.9	93	65
1202	52.1	71.9	76.2	85.2	86.6	92.2	87.0	81.4	73.9	95	67

6.2 LSE … CL (Low – Noise) Acoustic Data

The following charts carry the noise spectrums in octaves of the sound power measured according to the standard ISO 3741 (ISO 3744 and EN 29614-1) and the sound pressure at a distance of 10 m with directionality factor 2. The configuration taken into account includes star (Y) connected fans and compressor compartment closed with panels made of soundproof material.

Freq. [Hz]	31.5	63	125	250	500	1k	2k	4k	8k	Lw [db(A)]	Lp [dB(A)] @ 10m Q=2
374	36.4	60.4	60.8	70.5	74.6	79.3	74.0	68.0	58.5	82	54
416	36.4	60.4	60.8	70.5	74.6	79.3	74.0	68.0	58.5	82	54
456	37.4	61.4	61.8	71.5	75.6	80.3	75.0	69.0	59.5	83	55
486	37.4	61.4	61.8	71.5	75.6	80.3	75.0	69.0	59.5	83	55
536	37.4	61.4	61.8	71.5	75.6	80.3	75.0	69.0	59.5	83	55
558	38.4	62.4	62.8	72.5	76.6	81.3	76.0	70.0	60.5	84	56
618	38.4	62.4	62.8	72.5	76.6	81.3	76.0	70.0	60.5	84	56
658	38.4	62.4	62.8	72.5	76.6	81.3	76.0	70.0	60.5	84	56
748	39.4	63.4	63.8	73.5	77.6	82.3	77.0	71.0	61.5	85	57
800	39.4	63.4	63.8	73.5	77.6	82.3	77.0	71.0	61.5	85	57
900	39.4	63.4	63.8	73.5	77.6	82.3	77.0	71.0	61.5	85	57
942	41.4	65.4	65.8	75.5	79.6	84.3	79.0	73.0	63.5	87	59
1072	44.4	68.4	68.8	78.5	75.6	87.3	82.0	76.0	66.5	90	62
1202	46.4	70.4	70.8	80.5	84.6	89.3	84.0	78.0	68.5	92	64

7 Maintenance and After-Sales Service

7.1 Troubleshooting

On the next pages you will find a list of the most common causes that may cause the chilling unit to fail or malfunction. They are listed according to the easily identifiable symptoms.

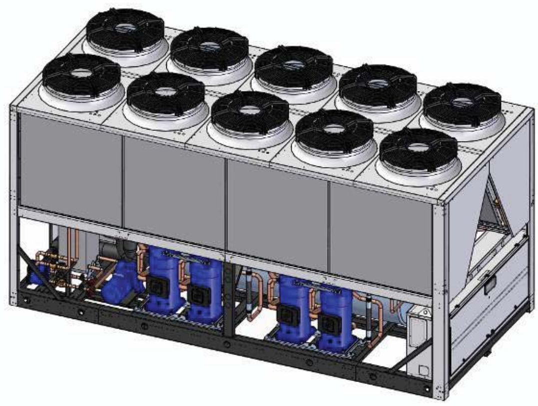
Use extreme caution in executing the suggested operations for the solution of various issues: excessive confidence may cause even serious injury, to inexperienced people. It is therefore recommended to contact the manufacturer or a qualified technician after having identified the cause.

FAULT	Analysis of possible causes	Corrective actions
The unit does not start-up	No electrical power supply.	Check its presence both on the primary and auxiliary circuit.
	The circuit board is not powered.	Check the fuses.
	There are alarms present.	Check the microprocessor panel for the presence of alarms, eliminate their cause and restart the unit.
	Incorrect phase sequence.	Reverse two phases in the primary power line after disconnecting them upstream from the unit.
The compressor is noisy	The compressor is rotating in the wrong direction.	Check the phase sequence relay. Reverse the phases on the terminal board after disconnecting the unit and contact the manufacturer.
Faulty high pressure	Insufficient air flow rate to condenser.	Check that all fans turn correctly.
		Check the condenser air inlet T and prevent recirculation from being formed.
		Check that the maximum RMS voltage reaches the fans. If necessary, check the pressure transducers that control the revolution controller [optional].
		Ensure the finned coils are clean.
	Air in the circuit, detected by air bubbles on the flow indicator and sub-cooling values reaching over 5°C.	Drain and pressurise the circuit and then verify whether there are any leaks. Drain the circuit slowly [more than 3 hours] up to 15 Pa and then recharge in the liquid phase.
	Unit too loaded detectable by sub-cooling greater than 8 °C.	Discharge circuit.
	Clogged thermostatic valve and /or filter. Such faults may occur in the presence of low pressure.	Check the temperature upstream and downstream the valve and filter and have them replaced if needed.
	Insufficient water flow rate if heat pump is operating.	Check the pressure drops of the water circuit and/or the correct operation of the pump [rotation direction]. Check the outlet water T and make sure it is 45 °C or less.

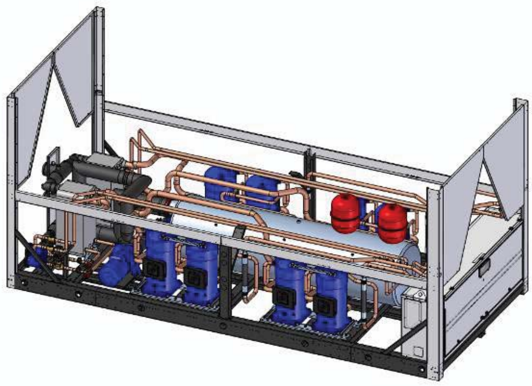
5 Free-Cooling Version Circuit

FAULT	Analysis of possible causes	Corrective actions
Low condensation pressure	Faulty transducers.	Check the transducers and the correct operating of the depressor on the Schrader valves to which they are connected.
	Outdoor T too low and/or presence of strong wind.	Mount the condensation control and/or protect the unit from dominant winds.
	Low water T if heat pump is operating.	Make sure the thermal load is adequate to the power of the unit.
Low evaporation pressure	Low water flow rate.	Check the correct rotation of the pumps. Check for pressure drops on the hydraulic circuit. Check the tightness of the one-way valve of the pump unit (optional).
	Malfunctioning of thermostat valve.	Check its opening, and adjust if necessary, by heating the bulb by hand. If there is no response, replace it.
	Clogged filter.	Load loss through the filter must not exceed 2°C (saturation temperature). Should it happen, replace the filters.
	Low condensation T.	Make sure the condensation control works properly [if present].
	Low refrigerant load.	Check the charge by measuring the sub-cooling; if it is below 2°C, charge with refrigerant
	Coil frosted if heat pump is operating.	Check the correct defrost parameter settings. Make sure the 4-way valve works properly.
	Low outside T if heat pump is operating.	Make sure the work limits are respected and eliminate possible by-passes and air recirculation.
The compressor does not start.	Internal thermal protector tripped.	Check the status of the thermal contact in models equipped with protection modules. Identify the causes after restarting.
	Intervention of circuit breakers or fuses in line after short circuit.	Check the cause by measuring the resistance of the individual coils and the isolation towards the chassis before re-connecting the power.
	Intervention of HP or LP switches.	Check the microprocessor, eliminate the causes.
	The phases in the distribution cabin have been inverted.	Check the phase sequence relay.
High evaporation Pressure	Water T too high.	Check the thermal load and/or efficiency of the thermostat function.
		Check the efficiency of the thermostatic valve.
Free Cooling malfunctioning (FS-FL versions)	No switch of activated 3-way valve.	The opening of the valve can be forced manually, but it is recommended to leave the unit in mechanical operation.
	No switch of deactivated 3-way valve.	The valve must be closed manually, replacing the booster as soon as possible.

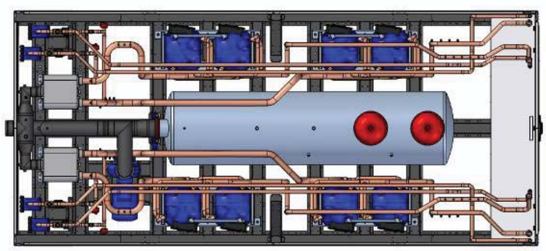
7.2 LSE … CS drawings and layouts



Std Unit CS/HS (cold only/heat pump) version with 4 chilling circuits and 8 partialization steps.

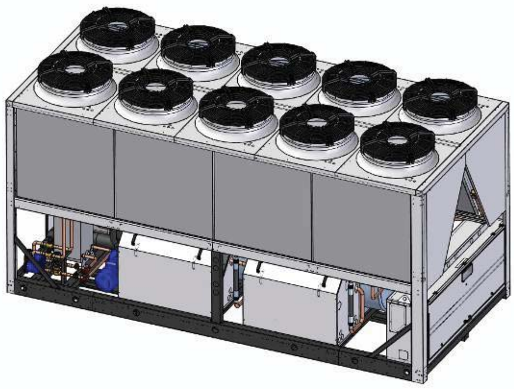


Detail of component layout:
hydronic part on rear side and central inertial tank, electrical control board on front of unit. Compressors and side pumps accessible.

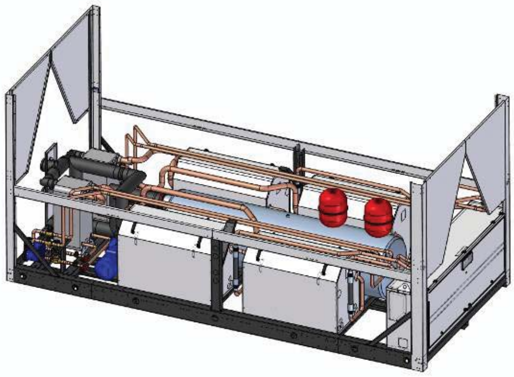


Top view.

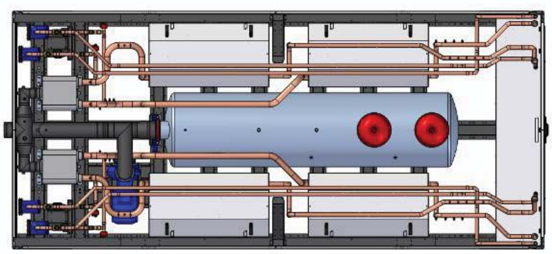
7.3 LSE … CL drawings and layouts



Std Unit CL/HL (cold only/heat pump) silenced version with 4 chilling circuits and 8 partialization steps.

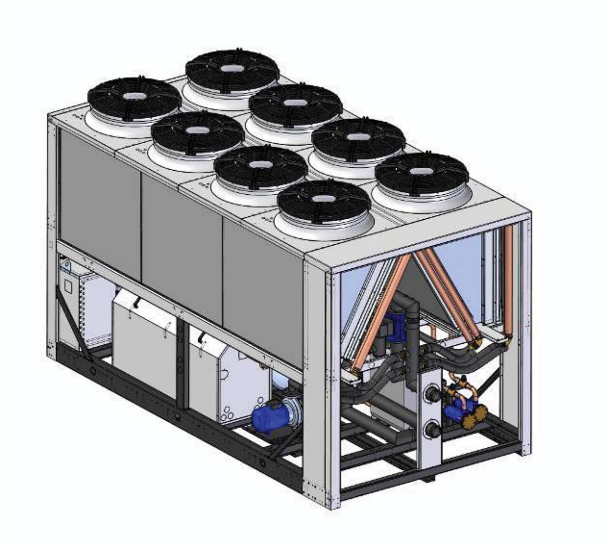


Detail of component layout:
hydronic part on rear side and central inertial tank, electrical control board on front of unit. Compressors and side pumps accessible. Noise restraint compartments for compressors with internal cladding.

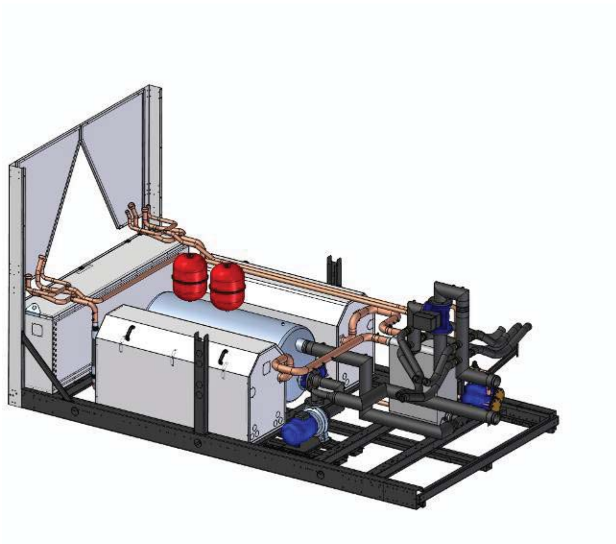


Top view.

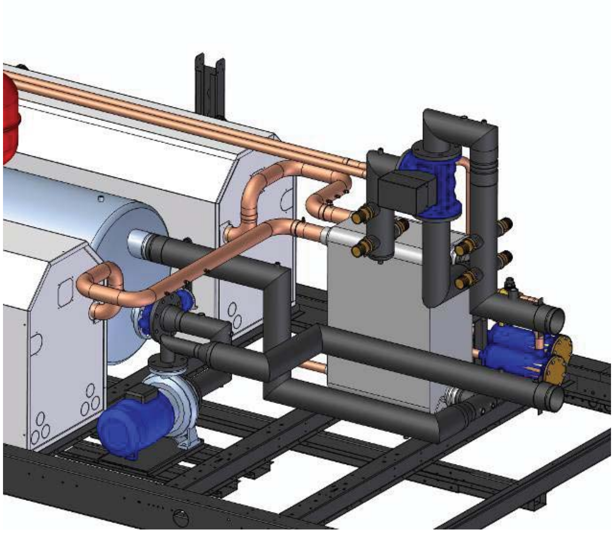
7.4 LSE … Free - Cooling drawings and layouts



Free-Cooling unit in silenced FL version with 2 chilling circuits and 6 partialization steps. Detail of hydronic part on water connection side.



Detail of free-cooling 3-way valve with relative pipe layout.



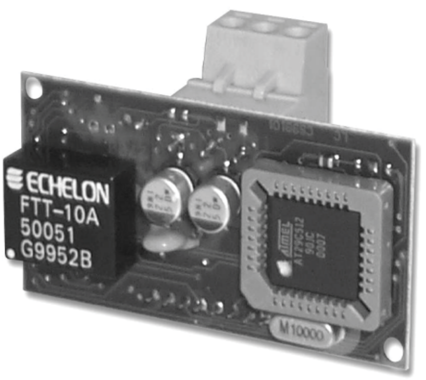
8 Interconnectivity

8.1 RS485 serial board (Carel or Modbus protocol)

The PCO1004850 board (Carel protocol) is an option of the pCO[1] electronic controller which provides it with direct interface with a RS485 network. The board ensures the opto-isolation of the controller respect to the RS485 serial network. The maximum baud rate that can be reached is 19 200 baud (set via software).
The connection to the RS485 network is implemented by means of a removable terminal connector on the board.

8.2 Lonworks serial board (Carel)

The optional PCO20000F0, PCO20000R0, PCO10000F0 and PCO10000R0 boards allow the pCO[2]/pCO[1] electronic controllers to interface with a LonWorks® network.
The PCO2* boards are used exclusively for pCO[2] control and the PCO1* boards for pCO[1] control.
The boards differ for the type of LonWorks® network side interface and the type of electronic controller upon which they can be mounted:
PCO*0000F0 - interfaces with FTT-10A 78 kbs (TP/FT-10);
PCO*0000R0 - interfaces with RS485 39 kbs (TP/485-39).
The baud rate of pCO[2]/pCO[1] must be set at 4800.
The address of pCO[2]/pCO[1] is not important since the board recognises it automatically.



Technical features

Operating conditions: 0T65 °C; 20÷80 % R.H. non-condensing;
Storage conditions: -20T70 °C; 20÷80 % R.H. non-condensing;
Degree of environmental pollution: normal;
Dimensions (mm): 60x30x20, (60x30: base, 20: width of components when fully extended).

8.3 GSM modem kit

The Wavecom WMOD2B modem is used for data and fax transmission as well as for sending SMS (Point to Point and Cell Broadcast) and for voice calls, in order to monitor the machine wherever it is. The connectors fitted in the modem ensure input and output connections.
A removable support allows you to insert the SIM card (Micro-SIM type). A LED also indicates the operating mode.

Physical features

Dimensions	98x54x25 mm (excluding connectors)
Overall dimensions	110x54x25 mm
Weight	< 130 grams
Volume	13.23 cm3
Housing	Aluminium profiled

Functions – GSM modems

Standard	Dual Band Extended GSM 900 MHz Class 4 (2W) and GSM 1800 MHz Class1 (1W)
Interface	Serial interface RS232 V.24/V.28 Autobauding function AT command set based on V.25ter and GSM 07.05 & 07.07
SMS	Mobile Originated (MO) and Mobile Terminated (MT). Mode Text & PDU point to point. Cell broadcast. In accordance with GSM 07.05.
Data	Asynchronous 2400, 4800, 9600 and 14400 bits/s. Transparent and Non Transparent mode . In Non Transparent Mode only: 300, 1200, 1200/75 bauds. Mode 3.1 KHz (PSTN) and V110 (ISDN).
Fax	2400/4800/7200/9600 bits/s GSM teleservice 62 in Transparent Mode. Class 2. Groupe 3 compatible.
Audio	Half Rate / Full Rate / Enhanced Full Rate. Accessories (options): handset and car-kit.

8.4 Carel pCOWEB Ethernet board (SNMP or BACNET protocol)

The optional pCOWeb (PCO10*0W*0) board allows all the system pCO controllers, except for pOCB (from here on called pCO*), to interface with an Ethernet network.
The pCOWeb board allows the pCO* controller to connect with an Ethernet 10 Mbps network and to implement the following functions:
• access to pCO* information (network variables and parameters) via an Internet browser such as Internet Explorer™ installed on a PC and connected on line via TCP/IP at pCOWeb (see Web server);
• connection to supervision network which uses one of the following standard protocols: - SNMP v1 & v2c; - BACnet Ethernet ISO8802-2/8802-3; - BACnet/IP (Addenda A/Annex J).

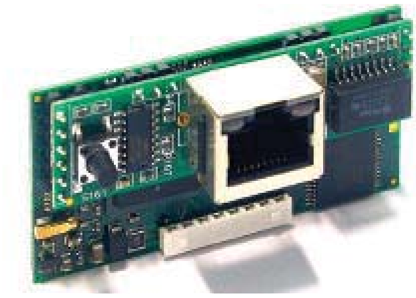
Access to operative system by authentication

It is possible to access the system by means of a telnet terminal or via FTP. The username and password is requested at each access.

General features

Operating conditions:
0T55 °C, 20/80% R.H. non-condensing;
Storage conditions:
-20T70 °C, 20/80% R.H. non-condensing;
Degree of environmental pollution:
normal;
Ethernet interface:
RJ45 connector for Ethernet 10BaseT;
Protocols managed:
HTTP, FTP, SNMP v1, v2c, DHCP, DNS,
BACnet Ethernet ISO8802-2/8802-3,
BACnet/IP (Addenda A/Annex J);
Memory:
16MB RAM, 8 MB Flash (3MB available for web pages and user data);
CPU:
ARM7 TDMI@74MHz clock
Operative system:
LINUX 2.4.21.

8.5 pCOWEB Carel Ethernet board (protocol SNMP or BACNET) + "HIWEB" supervision software



HiWeb supervision software performs the following actions:

- Unit status display
- display of active alarms and alarm history
- Records of 10 variable data that can be set
- Download of records by web browser or via FTP
- Modification of main parameters
- Send e-mail in the event of an alarm with 5 addressees

It can also carry out supervision monitoring via the following protocols:

- with SNMP v1 & v2c protocol
- with BACnet Ethernet or BACnet/IP protocol

The parameter setting relative to SNMP and BACnet protocol management is carried out by means of Administrator configuration pages.

9 Technical data

SUMMARY OF LSE CS SERIES TECHNICAL DATA		374	416	456	486	536	558	618	658	748
Refrigerant		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		4/2	6/2	6/2	6/2	6/2	8/4	8/4	8/4	8/4
ESEER		4.10	4.18	4.32	4.25	4.23	4.10	4.15	4.09	4.15
Air Flow Rate	m3/h	118913	118913	159453	159453	159452	209054	204514	199974	251304
Number of Fans		6	6	8	8	8	10	10	10	12
Fan Absorbed Power	kW	11	11	14	14	14	18	18	18	21
Fan Absorbed Current	A	26	26	34	34	34	43	43	43	52
Lw sound output level (base unit)	db(A)	90	90	91	91	91	92	92	92	92
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	62	62	63	63	63	64	64	64	64
Electric voltage	V	400	400	400	400	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	316	352	362	382	420	462	480	506	564
Booster current (LRA) [Without Options]	A	454	506	563	578	563	596	637	648	677
Tank Capacity (optional)	l	600	600	600	600	600	1040	1040	1040	1040
Length	mm	3065	3065	4065	4065	4065	5065	5065	5065	6065
Depth	mm	2250	2250	2250	2250	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650	2650	2650	2650	2650
Weight without accessories	kg	2545	2990	3361	3385	3386	4132	4217	4482	4891
Air @ 35°C cooling - utility 12 / 7°C										
Cooling Capacity	[kW]	364.7	404.5	454.7	488.2	537.7	562.8	604.0	644.7	715.7
Power Absorbed by Compressors	[kW]	121.9	139.1	144.3	159.2	194.7	176.7	193.9	211.2	252.4
Current Absorbed by Compressors	[A]	195.5	223.1	231.4	255.4	312.3	283.4	310.9	338.8	404.7
Fan Absorbed Power	[kW]	10.5	10.5	14.0	14.0	14.0	17.5	17.5	17.5	21.0
Fan Absorbed Current	[A]	25.8	25.8	34.4	34.4	34.4	43.0	43.0	43.0	51.6
Total absorbed power	[kW]	132.4	149.6	158.3	173.2	208.7	194.2	211.4	228.7	273.4
EER		2.75	2.70	2.87	2.82	2.58	2.90	2.86	2.82	2.62
EER according to UNI-14511		2.74	2.69	2.85	2.80	2.56	2.88	2.84	2.80	2.60
Utility side water flow rate	[kg/h]	62629	69464	78093	83837	92341	96656	103730	110719	122909
Utility Water Pressure Drops	[kPa]	52	53	56	50	52	46	48	49	51
Useful head - BP pumps	[kPa]	165.0	143.0	189.0	173.0	139.0	161.0	143.0	210.0	179.0
Useful head - BP pumps	[kPa]	260.0	249.0	271.0	266.0	248.0	245.0	244.0	237.0	265.0
Useful head - BP pumps [AND logic]	[kPa]	173.0	158.0	134.0	125.0	100.0	168.0	157.0	146.0	170.0
Useful head - HP pumps [AND logic]	[kPa]	244.0	236.0	224.0	223.0	211.0	287.0	276.0	265.0	247.0

Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE CS SERIES TECHNICAL DATA		800	900	942	1072	1202
Refrigerant		R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		10/4	10/4	12/4	12/4	12/4
ESEER		4.19	4.33	4.34	4.19	4.28
Air Flow Rate	m3/h	245895	280994	280994	280994	312000
Number of Fans		12	14	14	14	16
Fan Absorbed Power	kW	21	25	25	25	27
Fan Absorbed Current	A	52	55	55	55	56
Lw sound output level (base unit)	db(A)	92	93	93	93	95
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	64	65	65	65	67
Electric voltage	V	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	631	765	771	792	975
Booster current (LRA) [Without Options]	A	738	781	871	890	1190
Tank Capacity (optional)	l	1040	1040	1040	1040	1040
Length	mm	6065	7065	7065	7065	8065
Depth	mm	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650
Weight without accessories	kg	5090	5688	5926	6066	7300
Air @ 35°C cooling - utility 12 / 7°C						
Cooling Capacity	[kW]	774.5	910.2	951.0	1074.7	1206.5
Power Absorbed by Compressors	[kW]	272.1	307.5	320.8	389.8	429.8
Current Absorbed by Compressors	[A]	436.4	493.2	514.5	625.1	689.3
Fan Absorbed Power	[kW]	21.0	24.5	24.5	24.5	26.5
Fan Absorbed Current	[A]	51.6	55.0	55.0	55.0	56.4
Total absorbed power	[kW]	293.1	332.0	345.3	414.3	456.3
EER		2.64	2.74	2.75	2.59	2.64
EER according to UNI-14511		2.62	2.72	2.73	2.58	2.63
Utility side water flow rate	[kg/h]	133003	156306	163309	184557	207186
Utility Water Pressure Drops	[kPa]	58	56	60	51	56
Useful head - BP pumps	[kPa]	146.0	186.0	173.0	154.0	117.0
Useful head - BP pumps	[kPa]	250.0	281.0	269.0	252.0	216.0
Useful head - BP pumps [AND logic]	[kPa]	148.0	189.0	172.0	140.0	88.0
Useful head - HP pumps [AND logic]	[kPa]	248.0	271.0	261.0	248.0	221.0

Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE CL SERIES TECHNICAL DATA		374	416	456	486	536	558	618	658	748
Refrigerant		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		4/2	6/2	6/2	6/2	6/2	8/4	8/4	8/4	8/4
ESEER		4.08	4.11	4.25	4.18	4.16	4.07	4.08	4.02	4.08
Air Flow Rate	m3/h	94300	94300	126557	126557	126557	167300	163050	158800	201182
Number of Fans		6	6	8	8	8	10	10	10	12
Fan Absorbed Power	kW	7	7	9	9	9	12	12	12	14
Fan Absorbed Current	A	15	15	20	20	20	25	25	25	30
Lw sound output level (base unit)	db(A)	82	82	83	83	83	84	84	84	85
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	54	54	55	55	55	56	56	56	57
Electric voltage	V	400	400	400	400	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	305	343	347	368	405	442	462	488	542
Booster current (LRA) [Without Options]	A	442	497	556	573	548	576	619	630	656
Tank Capacity (optional)	l	600	600	600	600	600	1040	1040	1040	1040
Length	mm	3065	3065	4065	4065	4065	5065	5065	5065	6065
Depth	mm	2250	2250	2250	2250	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650	2650	2650	2650	2650
Weight without accessories	kg	2650	3110	3481	3525	3526	4312	4397	4662	4996

Air @ 35°C cooling - utility 12 / 7°C		374	416	456	486	536	558	618	658	748
Cooling Capacity	[kW]	352.3	388.6	440.1	470.8	515.5	546.5	583.4	620.4	691.7
Power Absorbed by Compressors	[kW]	129.9	147.4	151.2	167.3	207.5	184.6	203.6	222.6	266.4
Current Absorbed by Compressors	[A]	208.2	236.4	242.5	268.3	332.8	296.0	326.5	357.0	427.3
Fan Absorbed Power	[kW]	7.0	7.0	9.3	9.3	9.3	11.6	11.6	11.6	13.9
Fan Absorbed Current	[A]	15.0	15.0	20.0	20.0	20.0	25.0	25.0	25.0	30.0
Total absorbed power	[kW]	136.8	154.3	160.5	176.6	216.8	196.2	215.2	234.2	280.3
EER		2.57	2.52	2.74	2.67	2.38	2.79	2.71	2.65	2.47
EER according to UNI-14511		2.56	2.50	2.72	2.65	2.37	2.77	2.70	2.63	2.45
Utility side water flow rate	[kg/h]	60494	66738	75578	80855	88523	93853	100185	106538	118787
Utility Water Pressure Drops	[kPa]	49	49	53	47	47	43	45	46	48
Useful head - BP pumps	[kPa]	175.0	156.0	200.0	187.0	158.0	170.0	154.0	223.0	192.0
Useful head - BP pumps	[kPa]	266.0	257.0	279.0	274.0	260.0	253.0	249.0	244.0	271.0
Useful head - BP pumps [AND logic]	[kPa]	181.0	167.0	143.0	135.0	115.0	173.0	164.0	155.0	179.0
Useful head - HP pumps [AND logic]	[kPa]	249.0	243.0	230.0	229.0	220.0	293.0	283.0	274.0	256.0

Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE CL SERIES TECHNICAL DATA		800	900	942	1072	1202
Refrigerant		R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		10/4	10/4	12/4	12/4	12/4
ESEER		4.12	4.26	4.27	4.12	4.28
Air Flow Rate	m3/h	196109	223266	223266	213120	280000
Number of Fans		12	14	14	14	16
Fan Absorbed Power	kW	14	16	16	18	23
Fan Absorbed Current	A	30	35	35	42	54
Lw sound output level (base unit)	db(A)	85	85	87	90	92
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	57	57	59	62	64
Electric voltage	V	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	609	743	749	767	975
Booster current (LRA) [Without Options]	A	716	759	851	869	1190
Tank Capacity (optional)	l	1040	1040	1040	1040	1040
Length	mm	6065	7065	7065	7065	8065
Depth	mm	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650
Weight without accessories	kg	5195	5928	6166	6406	7300

Air @ 35°C cooling - utility 12 / 7°C						
Cooling Capacity	[kW]	743.3	873.4	912.5	1022.8	1177.5
Power Absorbed by Compressors	[kW]	288.1	328.4	339.8	420.5	444.1
Current Absorbed by Compressors	[A]	462.1	526.7	544.9	674.4	712.1
Fan Absorbed Power	[kW]	13.9	16.2	16.2	18.0	22.5
Fan Absorbed Current	[A]	30.0	35.0	35.0	42.0	54.2
Total absorbed power	[kW]	302.0	344.6	356.0	438.5	466.6
EER		2.46	2.53	2.56	2.33	2.52
EER according to UNI-14511		2.45	2.52	2.55	2.32	2.51
Utility side water flow rate	[kg/h]	127649	149993	156702	175639	202208
Utility Water Pressure Drops	[kPa]	54	51	56	47	53
Useful head - BP pumps	[kPa]	164.0	197.0	185.0	170.0	127.0
Useful head - BP pumps	[kPa]	258.0	292.0	281.0	267.0	225.0
Useful head - BP pumps [AND logic]	[kPa]	160.0	204.0	188.0	161.0	101.0
Useful head - HP pumps [AND logic]	[kPa]	257.0	281.0	271.0	261.0	228.0

Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE HS SERIES TECHNICAL DATA		374	416	456	486	536	558	618	658
Refrigerant		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		4/2	6/2	6/2	6/2	6/2	8/4	8/4	8/4
Air Flow Rate	m3/h	118913	118913	159453	159453	159452	209054	204514	199974
Number of Fans		6	6	8	8	8	10	10	10
Fan Absorbed Power	kW	11	11	14	14	14	18	18	18
Fan Absorbed Current	A	26	26	34	34	34	43	43	43
Lw sound output level (base unit)	db(A)	90	90	91	91	91	92	92	92
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	62	62	63	63	63	64	64	64
Electric voltage	V	400	400	400	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	316	352	362	382	420	462	480	506
Booster current (LRA) [Without Options]	A	454	506	563	578	563	596	637	648
Tank Capacity (optional)	l	600	600	600	600	600	1040	1040	1040
Length	mm	2650	2650	2650	2650	2650	2650	2650	2650
Depth	mm	3065	3065	4065	4065	4065	5065	5065	5065
Height	mm	2250	2250	2250	2250	2250	2250	2250	2250
Weight without accessories	kg	2685	3130	3501	3545	3546	4382	4467	4682
Air @ 35°C cooling - utility 12 / 7°C									
Cooling Capacity	[kW]	364.7	404.5	454.7	488.2	537.7	562.8	604.0	644.7
Power Absorbed by Compressors	[kW]	121.9	139.1	144.3	159.2	194.7	176.7	193.9	211.2
Current Absorbed by Compressors	[A]	195.5	223.1	231.4	255.4	312.3	283.4	310.9	338.8
Fan Absorbed Power	[kW]	10.5	10.5	14.0	14.0	14.0	17.5	17.5	17.5
Fan Absorbed Current	[A]	25.8	25.8	34.4	34.4	34.4	43.0	43.0	43.0
Total absorbed power	[kW]	132.4	149.6	158.3	173.2	208.7	194.2	211.4	228.7
EER		2.75	2.70	2.87	2.82	2.58	2.90	2.86	2.82
EER according to UNI-14511		2.74	2.69	2.85	2.80	2.56	2.88	2.84	2.80
Utility side water flow rate	[kg/h]	62629	69464	78093	83837	92341	96656	103730	110719
Utility Water Pressure Drops	[kPa]	52	53	56	50	52	46	48	49
Useful head - BP pumps	[kPa]	165.0	143.0	189.0	173.0	139.0	161.0	143.0	210.0
Useful head - BP pumps	[kPa]	260.0	249.0	271.0	266.0	248.0	245.0	244.0	237.0
Useful head - BP pumps [AND logic]	[kPa]	173.0	158.0	134.0	125.0	100.0	168.0	157.0	146.0
Useful head - HP pumps [AND logic]	[kPa]	244.0	236.0	224.0	223.0	211.0	287.0	276.0	265.0
Air @ 7°C heating - utility 40 / 45°C									
Thermal Output	[kW]	422.7	469.1	513.2	550.8	620.5	647.1	695.1	743.1
Power Absorbed by Compressors	[kW]	116.9	129.3	139.6	149.4	173.5	172.0	186.3	200.7
Current Absorbed by Compressors	[A]	187.5	207.3	223.9	239.6	278.3	275.8	298.8	321.8
Fan Absorbed Power	[kW]	10.5	10.5	14.0	14.0	14.0	17.5	17.5	17.5
Fan Absorbed Current	[A]	25.8	25.8	34.4	34.4	34.4	43.0	43.0	43.0
COP		3.32	3.36	3.34	3.37	3.31	3.41	3.41	3.41
COP according to UNI-14511		3.28	3.32	3.30	3.33	3.27	3.38	3.38	3.37
Utility side water flow rate	[kg/h]	73456	81517	89183	95725	107833	112455	120797	129138
Utility Water Pressure Drops	[kPa]	66	66	67	72	77	56	59	60
Useful head - BP pumps	[kPa]	116	88	136	105	48	112	88	153
Useful head - BP pumps	[kPa]	227	212	238	219	188	198	217	208
Useful head - BP pumps [AND logic]	[kPa]	135	114	94	70	29	136	122	108
Useful head - HP pumps [AND logic]	[kPa]	218	208	199	185	165	254	240	226

Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE HL SERIES TECHNICAL DATA		374	416	456	486	536	558	618	658
Refrigerant		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		4/2	6/2	6/2	6/2	6/2	8/4	8/4	8/4
Air Flow Rate	m3/h	94300	94300	126557	126557	126557	167300	163050	158800
Number of Fans		6	6	8	8	8	10	10	10
Fan Absorbed Power	kW	7	7	9	9	9	12	12	12
Fan Absorbed Current	A	15	15	20	20	20	25	25	25
Lw sound output level (base unit)	db(A)	82	82	83	83	83	84	84	84
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	54	54	55	55	55	56	56	56
Electric voltage	V	400	400	400	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	305	343	347	368	405	442	462	488
Booster current (LRA) [Without Options]	A	442	497	556	573	548	576	619	630
Tank Capacity (optional)	l	600	600	600	600	600	1040	1040	1040
Length	mm	2650	2650	2650	2650	2650	2650	2650	2650
Depth	mm	3065	3065	4065	4065	4065	5065	5065	5065
Height	mm	2250	2250	2250	2250	2250	2250	2250	2250
Weight without accessories	kg	2790	3250	3621	3665	3666	4562	4647	4912
Air @ 35°C cooling - utility 12 / 7°C									
Cooling Capacity	[kW]	352.3	388.6	440.1	470.8	515.5	546.5	583.4	620.4
Power Absorbed by Compressors	[kW]	129.9	147.4	151.2	167.3	207.5	184.6	203.6	222.6
Current Absorbed by Compressors	[A]	208.2	236.4	242.5	268.3	332.8	296.0	326.5	357.0
Fan Absorbed Power	[kW]	7.0	7.0	9.3	9.3	9.3	11.6	11.6	11.6
Fan Absorbed Current	[A]	15.0	15.0	20.0	20.0	20.0	25.0	25.0	25.0
Total absorbed power	[kW]	136.8	154.3	160.5	176.6	216.8	196.2	215.2	234.2
EER		2.57	2.52	2.74	2.67	2.38	2.79	2.71	2.65
EER according to UNI-14511		2.56	2.50	2.72	2.65	2.37	2.77	2.70	2.63
Utility side water flow rate	[kg/h]	60494	66738	75578	80855	88523	93853	100185	106538
Utility Water Pressure Drops	[kPa]	49	49	53	47	47	43	45	46
Useful head - BP pumps	[kPa]	175.0	156.0	200.0	187.0	158.0	170.0	154.0	223.0
Useful head - BP pumps	[kPa]	266.0	257.0	279.0	274.0	260.0	253.0	249.0	244.0
Useful head - BP pumps [AND logic]	[kPa]	181.0	167.0	143.0	135.0	115.0	173.0	164.0	155.0
Useful head - HP pumps [AND logic]	[kPa]	249.0	243.0	230.0	229.0	220.0	293.0	283.0	274.0
Air @ 7°C heating - utility 40 / 45°C									
Thermal Output	[kW]	420.4	466.5	510.8	547.8	617.1	644.1	691.5	739.0
Power Absorbed by Compressors	[kW]	116.9	129.2	139.6	149.2	173.5	172.0	186.2	200.5
Current Absorbed by Compressors	[A]	187.6	207.1	223.9	239.3	278.3	275.8	298.7	321.5
Fan Absorbed Power	[kW]	7.0	7.0	9.3	9.3	9.3	11.6	11.6	11.6
Fan Absorbed Current	[A]	15.0	15.0	20.0	20.0	20.0	25.0	25.0	25.0
COP		3.39	3.43	3.43	3.46	3.38	3.51	3.50	3.48
COP according to UNI-14511		3.36	3.39	3.39	3.42	3.33	3.48	3.46	3.45
Utility side water flow rate	[kg/h]	73058	81067	88772	95199	107248	111933	120182	128431
Utility Water Pressure Drops	[kPa]	65	66	66	71	76	55	59	59
Useful head - BP pumps	[kPa]	118	90	138	107	51	114	90	155
Useful head - BP pumps	[kPa]	229	213	239	221	191	200	218	209
Useful head - BP pumps [AND logic]	[kPa]	136	116	95	72	32	137	123	110
Useful head - HP pumps [AND logic]	[kPa]	219	209	200	187	166	255	241	228

Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE FS SERIES TECHNICAL DATA		374	416	456	486	536	558	618	658	748
		F1	F1	F2	F2	F2	F3	F3	F3	F4
Refrigerant		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		4/2	6/2	6/2	6/2	6/2	8/4	8/4	8/4	8/4
Air Flow Rate	m3/h	111560	111560	149794	149794	149794	195564	191786	188008	235228
Number of Fans		6	6	8	8	8	10	10	10	12
Fan Absorbed Power	kW	11	11	14	14	14	18	18	18	21
Fan Absorbed Current	A	26	26	34	34	34	43	43	43	52
Lw sound output level (base unit)	db(A)	90	90	91	91	91	92	92	92	92
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	62	62	63	63	63	64	64	64	64
Electric voltage	V	400	400	400	400	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	316	352	362	382	420	462	480	506	564
Booster current (LRA) [Without Options]	A	454	506	563	578	563	596	637	648	677
Tank Capacity (optional)	l	600	600	600	600	600	1040	1040	1040	1040
Length	mm	3415	3415	4415	4415	4415	5415	5415	5415	6415
Depth	mm	2250	2250	2250	2250	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650	2650	2650	2650	2650
Weight without accessories	kg	3055	3500	3931	3955	3956	4902	4987	5252	5781
Air @ 35°C cooling - utility 15 / 10°C										
Cooling Capacity	[kW]	392.2	434.0	492.6	526.1	569.0	604.8	648.3	691.3	768.2
Power Absorbed by Compressors	[kW]	126.6	144.0	148.8	164.4	201.2	181.9	200.1	218.5	261.9
Current Absorbed by Compressors	[A]	203.1	231.0	238.7	263.6	322.7	291.7	321.0	350.5	420.0
Fan Absorbed Power	[kW]	10.5	10.5	14.0	14.0	14.0	17.5	17.5	17.5	21.0
Fan Absorbed Current	[A]	25.8	25.8	34.4	34.4	34.4	43.0	43.0	43.0	51.6
Total absorbed power	[kW]	137.1	154.5	162.8	178.4	215.2	199.4	217.6	236.0	282.9
EER		2.86	2.81	3.03	2.95	2.64	3.03	2.98	2.93	2.72
EER according to UNI-14511		2.83	2.78	2.99	2.92	2.61	3.00	2.95	2.90	2.69
Utility side water flow rate	[kg/h]	74574	82521	93659	100037	108193	114984	123257	131438	146063
Utility Water Pressure Drops	[kPa]	74	75	76	72	86	65	67	70	71
Useful head - BP pumps	[kPa]									
Useful head - BP pumps	[kPa]	233.0	217.0	236.0	225.0	194.0	197.0	222.0	211.0	239.0
Useful head - BP pumps [AND logic]	[kPa]									
Useful head - HP pumps [AND logic]	[kPa]	224.0	213.0	198.0	193.0	169.0	259.0	245.0	229.0	204.0
Air @ 35°C Free-Cooling - utility 15°C										
Free-Cooling output	[kW]	151.5	155.0	209.8	212.8	216.4	274.1	275.8	277.4	340.3
Fan Absorbed Power	[kW]	10.5	10.5	14.0	14.0	14.0	17.5	17.5	17.5	21.0
Fan Absorbed Current	[A]	25.8	25.8	34.4	34.4	34.4	43.0	43.0	43.0	51.6
Utility side water flow rate	[kg/h]	74574	82521	93659	100037	108193	114984	123257	131438	146063
Total Water pressure drop	[kPa]	87.0	91.0	102.0	101.0	119.0	111.0	119.0	128.0	155.0

Free-Cooling: outside air temperature -5°C, water temperature 15°C. (data refers to utility side flow rate with evaporator water temperature 15°C / 10°C)
Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE FS SERIES TECHNICAL DATA		800	900	942	1072	1202
		F4	F5	F5	F5	F6
Refrigerant		R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		10/4	10/4	12/4	12/4	12/4
Air Flow Rate	m3/h	230721	257000	257000	257000	300000
Number of Fans		12	14	14	14	16
Fan Absorbed Power	kW	21	25	25	25	27
Fan Absorbed Current	A	52	55	55	55	57
Lw sound output level (base unit)	db(A)	92	93	93	93	95
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	64	65	65	65	67
Electric voltage	V	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	631	765	771	771	970
Booster current (LRA) [Without Options]	A	738	781	871	871	1185
Tank Capacity (optional)	l	1040	1040	1040	1040	1040
Length	mm	6415	7415	7415	7415	8415
Depth	mm	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650
Weight without accessories	kg	5980	6698	6936	7136	8150
Air @ 35°C cooling - utility 15 / 10°C						
Cooling Capacity	[kW]	839.2	975.9	1036.2	1124.4	1273.8
Power Absorbed by Compressors	[kW]	283.4	323.1	336.8	410.4	444.4
Current Absorbed by Compressors	[A]	454.4	518.2	540.2	658.3	712.7
Fan Absorbed Power	[kW]	21.0	24.5	24.5	24.5	27.0
Fan Absorbed Current	[A]	51.6	55.0	55.0	55.0	57.0
Total absorbed power	[kW]	304.4	347.6	361.3	434.9	471.4
EER		2.76	2.81	2.87	2.59	2.70
EER according to UNI-14511		2.73	2.78	2.84	2.56	2.67
Utility side water flow rate	[kg/h]	159568	185547	197009	213787	242198
Utility Water Pressure Drops	[kPa]	70	74	70	83	91
Useful head - BP pumps	[kPa]					
Useful head - BP pumps	[kPa]	224.0	243.0	230.0	192.0	134.0
Useful head - BP pumps [AND logic]	[kPa]					
Useful head - HP pumps [AND logic]	[kPa]	227.0	240.0	231.0	200.0	157.0
Air @ 35°C Free-Cooling - utility 15°C						
Free-Cooling output	[kW]	343.5	393.8	398.6	404.8	472.5
Fan Absorbed Power	[kW]	21.0	24.5	24.5	24.5	27.0
Fan Absorbed Current	[A]	51.6	55.0	55.0	55.0	57.0
Utility side water flow rate	[kg/h]	159568	185547	197009	213787	242198
Total Water pressure drop	[kPa]	169.0	145.0	149.0	174.0	220.0

Free-Cooling: outside air temperature -5°C, water temperature 15°C. (data refers to utility side flow rate with evaporator water temperature 15°C / 10°C)
Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

SUMMARY OF LSE FL SERIES TECHNICAL DATA		374	416	456	486	536	558	618	658	748
		F1	F1	F2	F2	F2	F3	F3	F3	F4
Refrigerant		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		4/2	6/2	6/2	6/2	6/2	8/4	8/4	8/4	8/4
Air Flow Rate	m3/h	87649	87649	117810	117810	117810	154778	151365	147952	186234
Number of Fans		6	6	8	8	8	10	10	10	12
Fan Absorbed Power	kW	7	7	9	9	9	12	12	12	14
Fan Absorbed Current	A	15	15	20	20	20	25	25	25	30
Lw sound output level (base unit)	db(A)	82	82	83	83	83	84	84	84	85
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	54	54	55	55	55	56	56	56	57
Electric voltage	V	400	400	400	400	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	305	343	347	368	405	442	462	488	542
Booster current (LRA) [Without Options]	A	442	497	556	573	548	576	619	630	565
Tank Capacity (optional)	l	600	600	600	600	600	1040	1040	1040	1040
Length	mm	3415	3415	4415	4415	4415	5415	5415	5415	6415
Depth	mm	2250	2250	2250	2250	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650	2650	2650	2650	2650
Weight without accessories	kg	3160	3620	4051	4095	4096	5082	5167	5432	5886
Air @ 35°C cooling - utility 15 / 10°C										
Cooling Capacity	[kW]	375.4	411.4	473.2	503.6	540.2	583.4	621.3	659.9	736.3
Power Absorbed by Compressors	[kW]	136.1	153.8	157.1	174.5	218.3	191.2	212.1	232.6	279.4
Current Absorbed by Compressors	[A]	218.3	246.6	252.0	279.8	350.0	306.7	340.1	373.1	448.1
Fan Absorbed Power	[kW]	7.0	7.0	9.3	9.3	9.3	11.6	11.6	11.6	13.9
Fan Absorbed Current	[A]	15.0	15.0	20.0	20.0	20.0	25.0	25.0	25.0	30.0
Total absorbed power	[kW]	143.1	160.8	166.4	183.7	227.5	202.8	223.7	244.2	293.3
EER		2.62	2.56	2.84	2.74	2.37	2.88	2.78	2.70	2.51
EER according to UNI-14511		2.60	2.54	2.81	2.71	2.35	2.85	2.75	2.68	2.49
Utility side water flow rate	[kg/h]	71373	78218	89978	95745	102718	110930	118139	125477	139997
Utility Water Pressure Drops	[kPa]	68	68	71	67	83	61	62	64	66
Useful head - BP pumps	[kPa]									
Useful head - BP pumps	[kPa]	244.0	232.0	249.0	240.0	209.0	211.0	232.0	222.0	250.0
Useful head - BP pumps [AND logic]	[kPa]									
Useful head - HP pumps [AND logic]	[kPa]	233.0	225.0	208.0	204.0	179.0	268.0	257.0	244.0	219.0
Air @ 35°C Free-Cooling - utility 15°C										
Free-Cooling output	[kW]	137.0	139.8	189.9	192.2	194.9	248.7	249.3	249.8	308.1
Fan Absorbed Power	[kW]	7.0	7.0	9.3	9.3	9.3	11.6	11.6	11.6	13.9
Fan Absorbed Current	[A]	15.0	15.0	20.0	20.0	20.0	25.0	25.0	25.0	30.0
Utility side water flow rate	[kg/h]	71373	78218	89978	95745	102718	110930	118139	125477	139997
Total Water pressure drop	[kPa]	80.0	83.0	95.0	94.0	113.0	104.0	110.0	118.0	144.0

Free-Cooling: outside air temperature -5°C, water temperature 15°C. (data refers to utility side flow rate with evaporator water temperature 15°C / 10°C)
Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

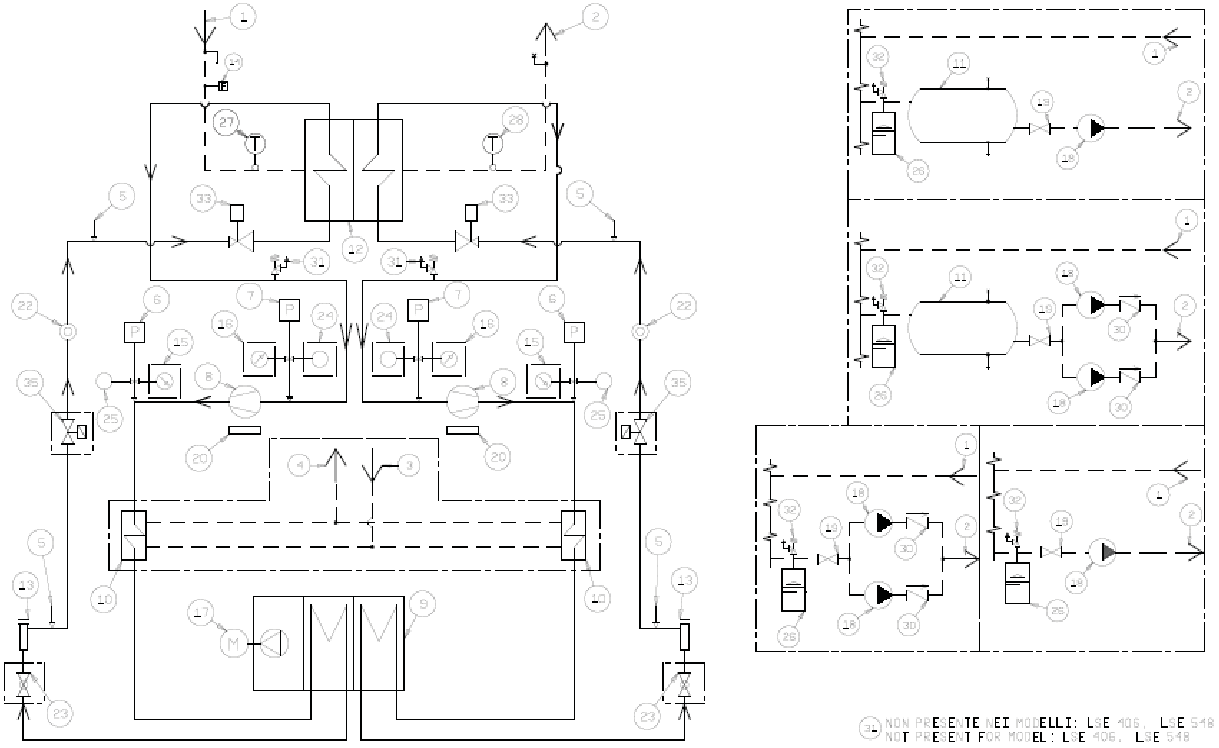
SUMMARY OF LSE FL SERIES TECHNICAL DATA		800	900	942	1072	1202
		F4	F5	F5	F5	F6
Refrigerant		R410A	R410A	R410A	R410A	R410A
Compressors/Circuits		10/4	10/4	12/4	12/4	12/4
Air Flow Rate	m3/h	182161	200700	220000	220000	260000
Number of Fans		12	14	14	14	16
Fan Absorbed Power	kW	14	16	19	19	21
Fan Absorbed Current	A	30	35	44	44	46
Lw sound output level (base unit)	db(A)	85	85	87	90	92
Lp Sound Pressure Level (base unit) @10 m Q=2	db(A)	57	57	59	62	64
Electric voltage	V	400	400	400	400	400
No. of phases / Power supply frequency	Hz	3+N / 50	3+N / 50	3+N / 50	3+N / 50	3+N / 50
Maximum current (FLA) [Without Options]	A	609	743	749	756	965
Booster current (LRA) [Without Options]	A	716	759	851	856	1180
Tank Capacity (optional)	l	1040	1040	1040	1040	1040
Length	mm	6415	7415	7415	7415	8415
Depth	mm	2250	2250	2250	2250	2250
Height	mm	2650	2650	2650	2650	2650
Weight without accessories	kg	6086	6938	7176	7136	8150

Air @ 35°C cooling - utility 15 / 10°C		800	900	942	1072	1202
Cooling Capacity	[kW]	802.8	926.8	1002.0	1082.6	1229.1
Power Absorbed by Compressors	[kW]	300.4	350.4	351.4	435.4	466.3
Current Absorbed by Compressors	[A]	481.7	561.9	563.6	698.3	747.7
Fan Absorbed Power	[kW]	13.9	16.2	19.0	19.0	21.0
Fan Absorbed Current	[A]	30.0	35.0	44.0	44.0	46.0
Total absorbed power	[kW]	314.3	366.6	370.4	454.4	487.3
EER		2.55	2.53	2.71	2.38	2.52
EER according to UNI-14511		2.53	2.51	2.68	2.36	2.49
Utility side water flow rate	[kg/h]	152632	176215	190511	205830	233695
Utility Water Pressure Drops	[kPa]	65	68	66	77	85
Useful head - BP pumps	[kPa]					
Useful head - BP pumps	[kPa]	237.0	261.0	243.0	210.0	155.0
Useful head - BP pumps [AND logic]	[kPa]					
Useful head - HP pumps [AND logic]	[kPa]	239.0	255.0	242.0	214.0	173.0

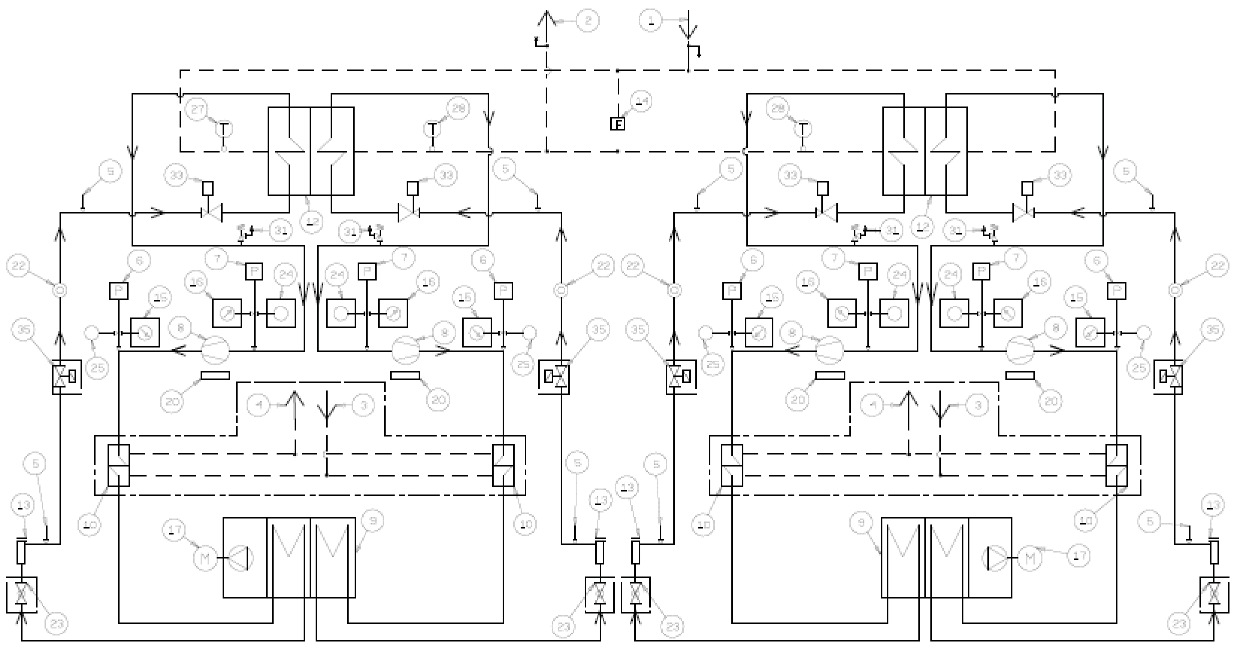
Air @ 35°C Free-Cooling - utility 15°C		800	900	942	1072	1202
Free-Cooling output	[kW]	309.9	349.8	369.9	374.9	440.4
Fan Absorbed Power	[kW]	13.9	16.2	19.0	19.0	21.0
Fan Absorbed Current	[A]	30.0	35.0	44.0	44.0	46.0
Utility side water flow rate	[kg/h]	152632	176215	190511	205830	233695
Total Water pressure drop	[kPa]	156.0	133.0	140.0	162.0	207.0

Free-Cooling: outside air temperature -5°C, water temperature 15°C. (data refers to utility side flow rate with evaporator water temperature 15°C / 10°C)
Sound power measured according to standard ISO 3741 -- ISO 3744 and EN 29614--1.
Sound pressure measured at a distance of 10 m with directionality factor 2.

10 Water - Chiller layouts

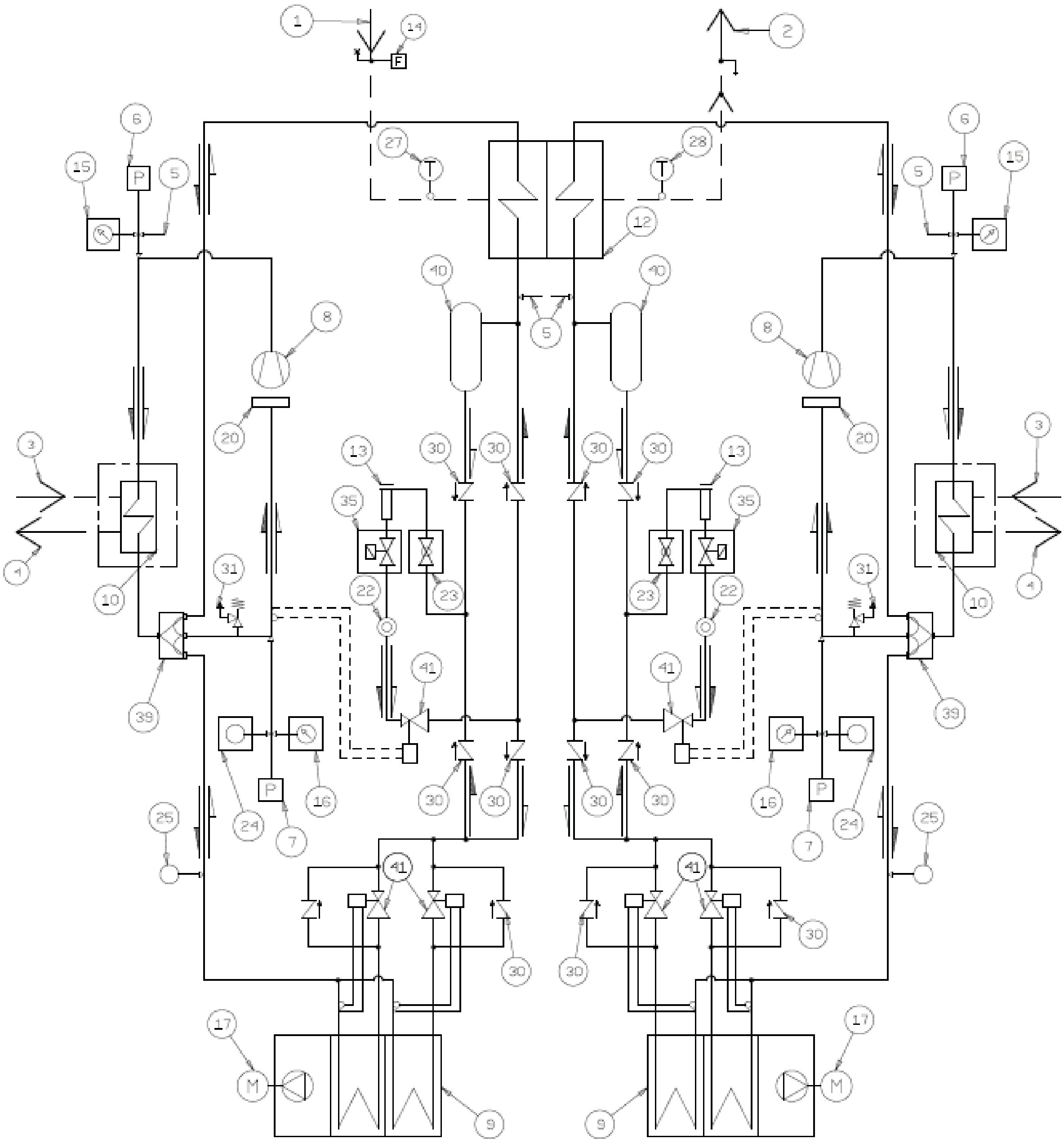


1) chiller – hydraulic layout COLD ONLY 2 circuit version



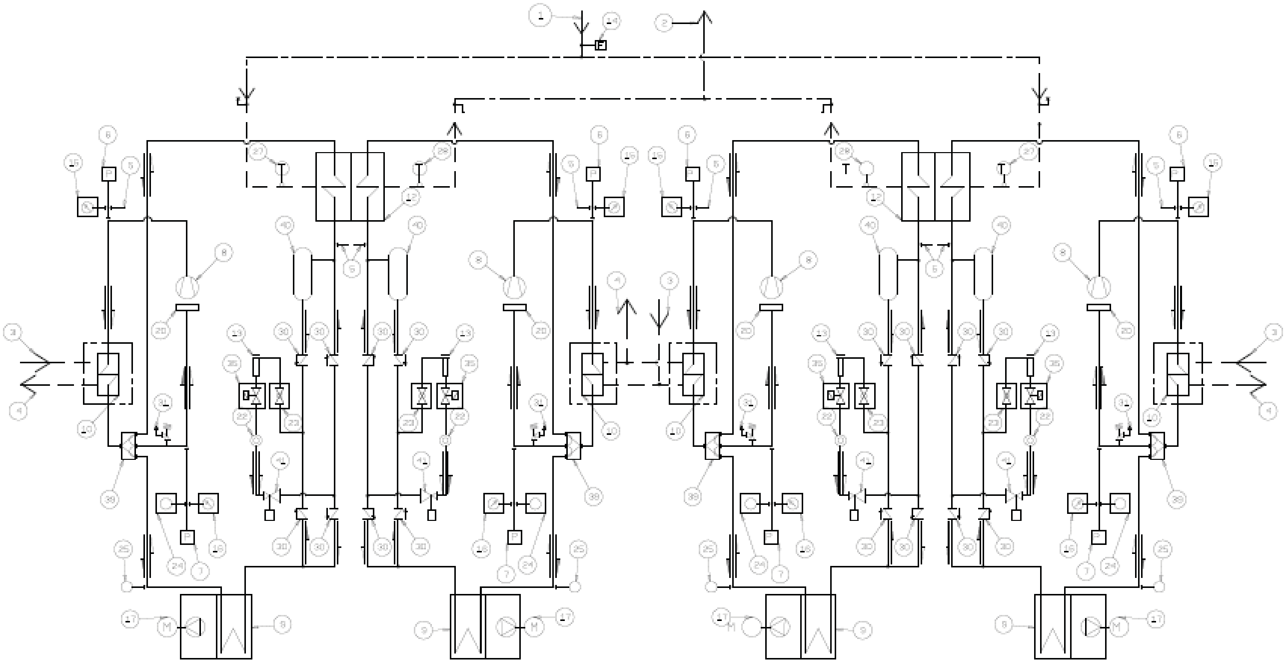
2) chiller – hydraulic layout COLD ONLY 4 circuit version

	ITALIANO	ENGLISH	DEUTSCH	FRANCAIS	ESPANOL
———	CICUITO REFRIGERANTE	REFRIGERANT CIRCUIT	KAELTEMITTELKREISLAUF	CIRCUIT REFRIGERANT	CIRCUITO REFRIGERADOR
— —	CIRCUITO ACQUA	WATER CIRCUIT	KALTWASSERKREISLAUF	CIRCUIT EAU	CIRCUITO AGUA
	REFRIGERATORE	REFRIGERATOR	KALTWASSERSATZ	REFRIGERATEUR	ENFRIADOR
	POMPA DI CALORE	HEAT PUMP	WARMEPUMPE	POMPE A CHALEUR	BOMBA DE CALOR

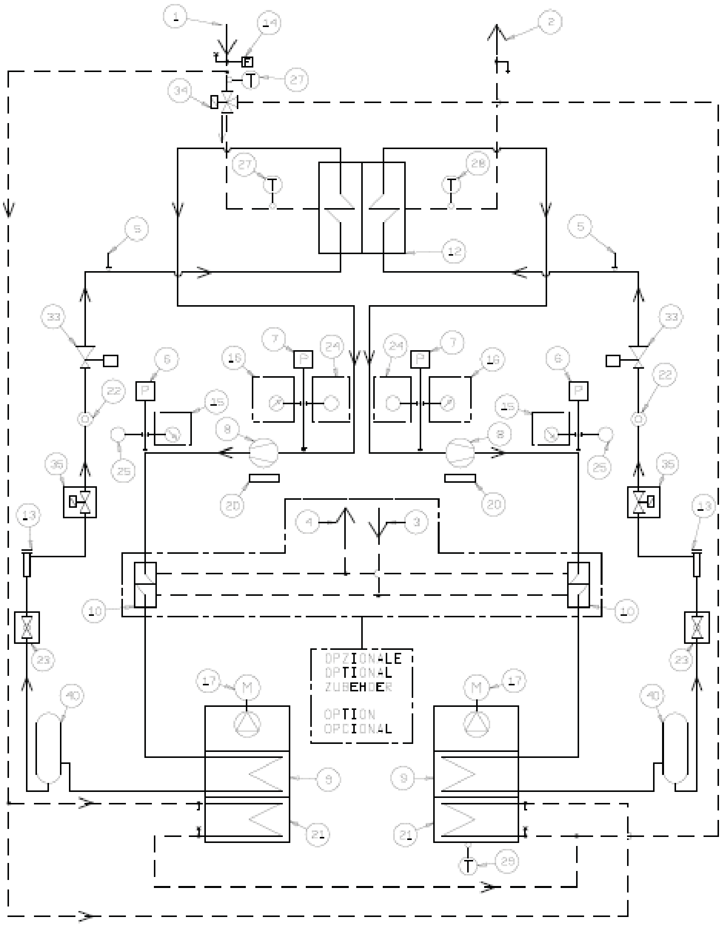


(31) NON PRESENTE NEI MODELLI: LSE 406, LSE 548
NOT PRESENT FOR MODEL: LSE 406, LSE 548

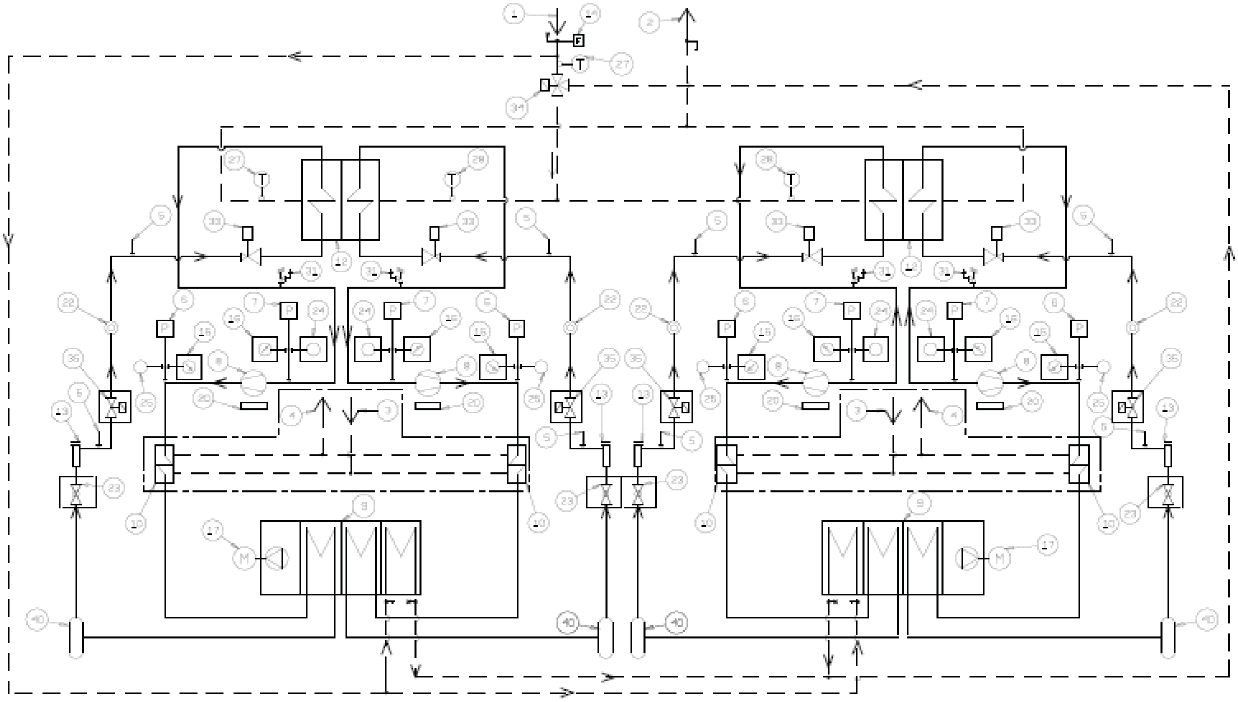
3) chiller – hydraulic layout HEAT PUMP 2 circuit version



4) chiller – hydraulic layout HEAT PUMP 4 circuit version



5) chiller – hydraulic layout FREE COOLING 2 circuit version



6) chiller – hydraulic layout FREE COOLING 4 circuit version

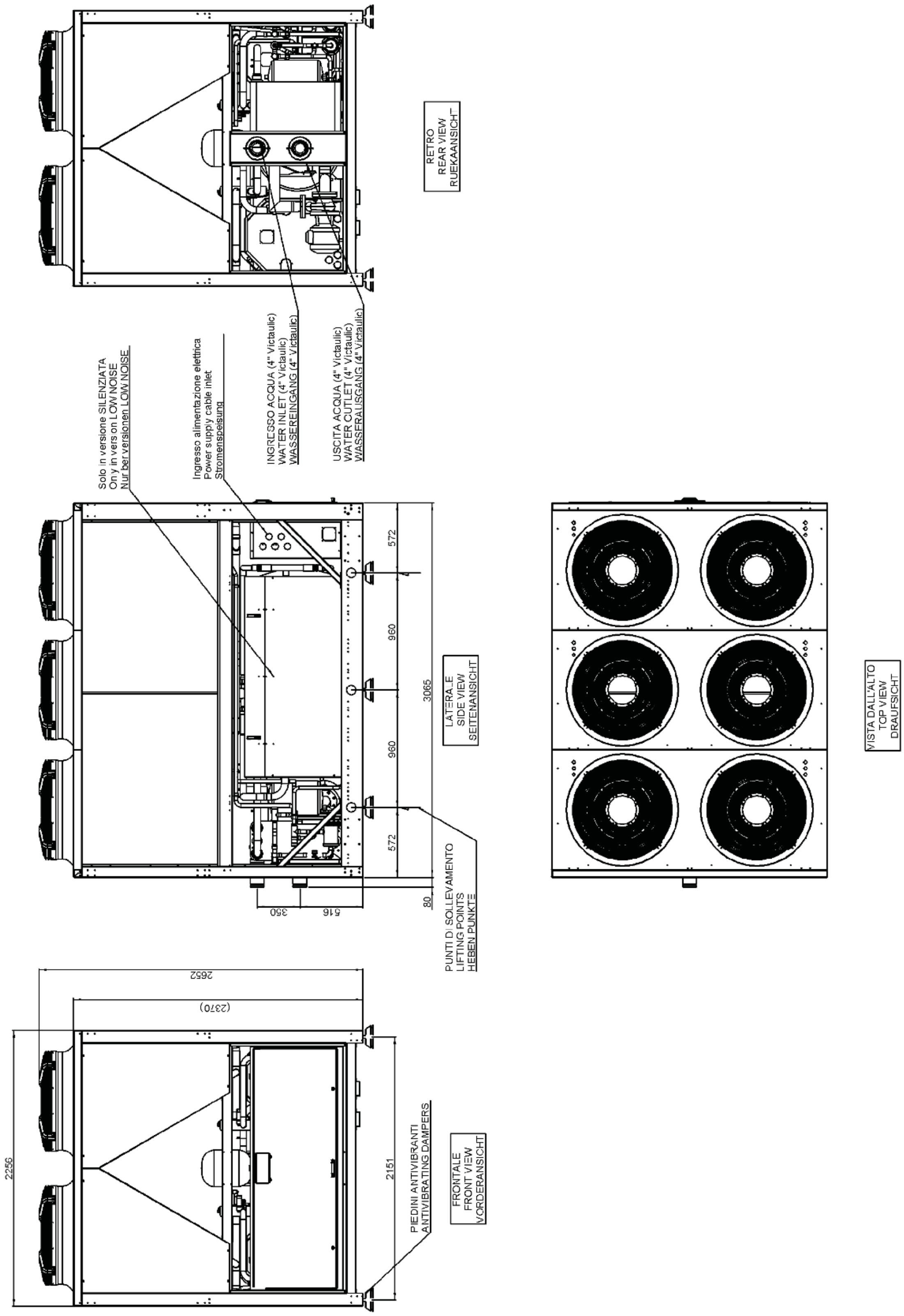
7) key

ITALIANO	ENGLISH	DEUTSCH	FRANCAIS	ESPANOL
——— CICUITO REFRIGERANTE	——— REFRIGERATION CIRCUIT	——— KAELTEMITTELKREISLAUF	——— CICUIT REFRIGERANT	——— CICUITO REFRIGERADOR
- - - CIRCUITO ACQUA	- - - WATER CIRCUIT	- - - KALTWASSERKREISLAUF	- - - CIRCUIT EAU	- - - CIRCUITO AGUA
1 INGRESSO ACQUA UTILIZZATORE	1 USER WATER INLET	1 BENUTZERWASSEREINGANG	1 ENTREE EAU UTILISATEUR	1 ENTRADA AGUA USUARIO
2 USCITA ACQUA UTILIZZATORE	2 USER WATER OUTLET	2 BENUTZERWASSERAUSGANG	2 SORTIE EAU UTILISATEUR	2 SALIDA AGUA USUARIO
3 INGRESSO ACQUA DESURRISCALDATA	3 HEAT RECOVERY WATER INLET	3 EINGANG WAERMERUECKGEWINNUNG	3 ENTREE EAU DE RECOUVREMENT	3 ENTRADA AGUA RECUPERADOR
4 USCITA ACQUA DESURRISCALDATA	4 HEAT RECOVERY WATER OUTLET	4 AUSGANG WAERMERUECKGEWINNUNG	4 SORTIE EAU DE RECOUVREMENT	4 SALIDA AGUA RECUPERADOR
5 ATTACO DI CARICA	5 CHARGE CONNECTION	5 FUELLANSCHLUSS	5 CONNEXION DE CHARGE	5 CONEXION DE CARGA
6 PRESSOSTATO DI ALTA	6 HIGH PRESSURE SWITCH	6 HOCHDRUCKSCHALTER	6 PRESSOSTAT HAUTE PRESSION	6 PRESOSTATO ALTA PRESION
7 PRESSOSTATO DI BASSA	7 LOW PRESSURE SWIITCH	7 NIEDERDRUCKSCHALTER	7 PRESSOSTAT BASSE PRESSION	7 PRESOSTATO DE BAJA PRESION
8 COMPRESSORE	8 COMPRESSOR	8 VERDICHTER	8 COMPRESSEUR	8 COMPRESOR
9 SCAMBIATORE DI DISSIPAZIONE	9 DISSIPATOR	9 VERPRASSER	9 ECHANGEUR DE DISSIPATION	9 INTERCAMBIADOR DE DISIPACION
10 RECUPERATORE DI CALORE	10 HEAT RECOVERY EXCHANGER	10 WAERMERUECKGEWINNUNG	10 ECHANG. DE RECOUVREMENT DE CHALEUR	10 RECUPERADOR DE CALORE
11 SERBATOIO DI ACCUMULO	11 BUFFER TANK	11 PUFFERSPEICHER	11 RESERVOIR TAMPON	11 DEPOSITO DE ACCUMULACION
12 SCAMBIATORE DI UTILIZZO	12 USER EXCHANGER	12 BENUTZER WAERMETAUSCHER	12 ECHANGEUR DE UTILISATION	12 INTERCAMBIADOR DE UTILIZACION
13 FILTRO DEIDRATORE	13 FILTER DRIER	13 FILTERTROCKNER	13 FILTRE DESHYDRATEUR	13 FILTRO DESHIDRATADOR
14 FLUSSOSTATO	14 FLOW SWITCH	14 STROEMUNGSWAECHTER	14 INTERRUPTEUR DE DEBIT	14 FLUJOSTATO
15 MANOMETRO ALTA PRESSIONE	15 HIGH PRESSURE MANOMETER	15 HOCHDRUCKMANOMETER	15 MANOMETRE HAUTE PRESSION	15 MANOM. ALTA PRESION
16 MANOMETRO BASSA PRESSIONE	16 LOW PRESSURE MANOMETER	16 NIEDERDRUCKMANOMETER	16 MANOMETRE BASSE PRESSION	16 MANOM. BAJA PRESION
17 MOTOVENTILATORE	17 FAN MOTOR	17 VENTILATOR	17 MOTEUR DU VENTILATEUR	17 MOTOVENTILADOR
18 ELTTROPOMPA DI CIRCOLAZIONE	18 WATER PUMP	18 WASSERPUMPE	18 POMPE DE L'EAU	18 BOMBA AGUA
19 SARACINESCA	19 GATE VALVE	19 2 WEGE VENTIL - WASSER	19 VANNE	19 VALVULA DE CIERRE
20 RESISTENZA CARTER	20 CRANKCASE HEATER	20 KURBELWANNENHEIZUNG	20 RESISTANCE DE CARTER	20 RESISTENCIA DE CARTER
21 RADIATORE ENERGY - SAVING	21 ENERGY - SAVING COIL	21 FREIKUEHLREGISTER	21 RADIATEUR "ENERGY - SAVING"	21 RADIADOR "ENERGY - SAVING"
22 SPIA DI FLUSSO	22 SIGHT GLASS	22 SCHAUGLASS	22 VOYANT LIQUIDE	22 VISOR DE FLUJO
23 RUBINETTO A SFERA	23 BALL VALVE	23 KUGELVENTIL	23 VANNE A SPHERE	23 VALVULA DE ESFERA
24 SONDA PRESSIONE EVAPORAZIONE	24 EVAPORATING PRESSURE PROBE	24 VERDAMPFUNGSDRUCKFUEHLER	24 SONDE PRESSION EVAPORACION	24 SONDA DE PRESION D'EVAPOR.
25 SONDA PRESSIONE CONDENSAZIONE	25 CONDENSING PRESSURE PROBE	25 VERFLUESSIGUNGSDRUCKFUEHLER	25 SONDE DE PRESSION CONDENS.	25 SONDA DE PRESION DE CONDEN.
26 VASO DI ESPANSIONE	26 EXPANSION TANK	26 AUSDEHNUNGSGEFAESS	26 RESERVOIR D'EXPANSION	26 VASO DE EXPANSION
27 SONDA TEMPERATURA INGRESSO ACQUA	27 WATER INLET TEMPERATURE SENSOR	27 TEMPERATURFUEHLER WASSEREINGANG	27 SONDE DE TEMP. DU RESERVOIR	27 SONDA TEMPERATURA ENTRADA AGUA
28 SONDA TEMPERATURA USCITA ACQUA	28 WATER OUTLET TEMPERATURE SENSOR	28 TEMPERATURFUEHLER WASSERAUSGANG	28 SONDE DE TEMP. D'EAU SORTIE	28 SONDA TEMPERTAURA SALIDA AGUA
29 SONDA TEMPERATURA ARIA ESTERNA	29 EXTERNAL AIR TEMPERATURE SENSOR	29 TEMPERATURFUEHLER AUSSENLUFT	29 SONDE DE TEMP. DE AIRE EXTERIEURE	29 SONDA TEMPERAURA DEL AIRE EXTERIOR
30 VALVOLA DI RITEGNO	30 CHECK VALVE	30 RUECKSCHLAGVENTIL	30 SOUPAPE DE RETENUE	30 VALVULA DE RETENCION
31 VALVOLA DI SICUREZZA	31 SAFETY VALVE	31 SICHERHEITSVENTIL KAELTEMITTEL	31 SOUPAPE DE SICURITE	31 VALVULA DE SEGURIDAD
32 VALVOLA DI SICUREZZA ACQUA	32 WATER SAFETY VALVE	32 SICHERHEITSVENTIL KALTWASSER	32 SOUPAPE DE SICURITE EAU	32 VALVULA DE SEGURIDAD AGUA
33 VALVOLA TERMOSTATICA	33 THERMOSTATIC VALVE	33 THERMOSTATISCHES EXPANSIONSVENTIL	33 VANNE THERMOSTATIQUE	33 VALVULA TERMOSTATICA
34 VALVOLA CONTROLLO CONDENSAZIONE	34 CONDENSING CONTROL VALVE	34 VENTIL	34 VANNE DE CONTROLE CONDENSATION	34 VALVULA CONTROL CONDENSACION
35 ELETTROVALVOLA DEL LIQUIDO	35 SOLENOID VALVE	35 ELEKTROVENTIL FLUSSIGHEIT	35 ELECTRO-VANNE DU LIQUIDE	35 ELECTRO VALVULA DE LIQUIDO
36 ELETTROVALVOLA PARZIALIZZAZIONE	36 PARTIALIZATION SOLENOID VALVE	36 TEILLAST VENTIL	36 ELECTRO-VANNE DE PARTIELLESATION	36 ELECTRO VALVULA DE PARCIALISACION
37 INGRESSO ACQUA DISSIPATORE	37 DISSIPATOR WATER INLET	37 VERPRASSER WASSEREINGANG	37 ENTREE EAU DISSIPATEUR	37 ENTRADA AGUA DISSIPADOR
38 USCITA ACQUA DISSIPATORE	38 DISSIPATOR WATER OUTLET	38 VERPRASSER WASSERAUSGANG	38 SORTIE EAU DISSIPATEUR	38 SALIDA AGUA DISSIPADOR
39 VALVOLA 4 VIE	39 4-WAY VALVE	39 4 WEGE VENTIL	39 VANNE 4 VOIES	39 VALVULA DE 4 VIAS
40 RICEVITORE DEL LIQUIDO	40 LIQUID RECEIVER	40 FLUESSIGKEITSAMMLER	40 RECEPTEUR DE LIQUID	40 RECEPTOR DE LIQUIDO
41 VALVOLA ESPANSIONE ELETTRONICA	41 ELECTRONIC EXPANSION VALVE	41 ELEKTRONISCHES EXPANSIONVENTIL	41 VANNE D'EXPANSION ELECTRONIQUE	41 VALVULA DE EXPANSION ELECTRONICA
42 SEPARATORE DI LIQUIDO	42 LIQUID SEPARATOR	42 FLUESSIGKEITSCHEIDER	42 SEPARATEUR DE LIQUIDE	42 SEPARADOR DE LIQUIDO
43 VALVOLA BY-PASS	43 VALVOLA BY-PASS	43 BYPASS VENTIL	43 VANNE DE BY-PASS	43 VALVULA DE BY-PASS
44 VALVOLA 4 VIE LATO ACQUA	44 4-WAY WATER VALVE	44 4 WEGE WASSERVENTIL	44 VANNE 4 VOIES DE L'EAU	44 VALVOLA DE 4 VIAS AGUA

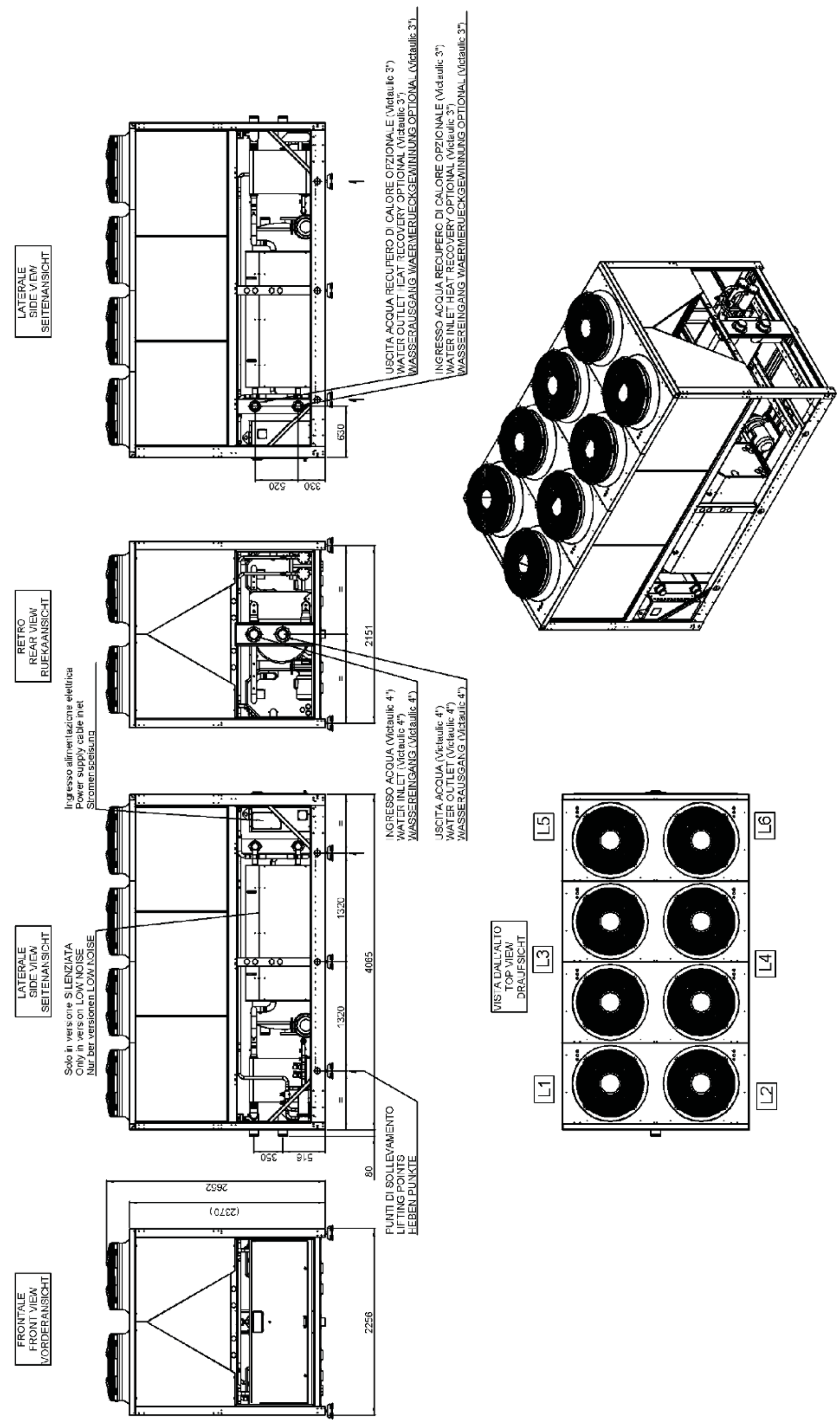
11 Dimensional layouts

11.1 Standard

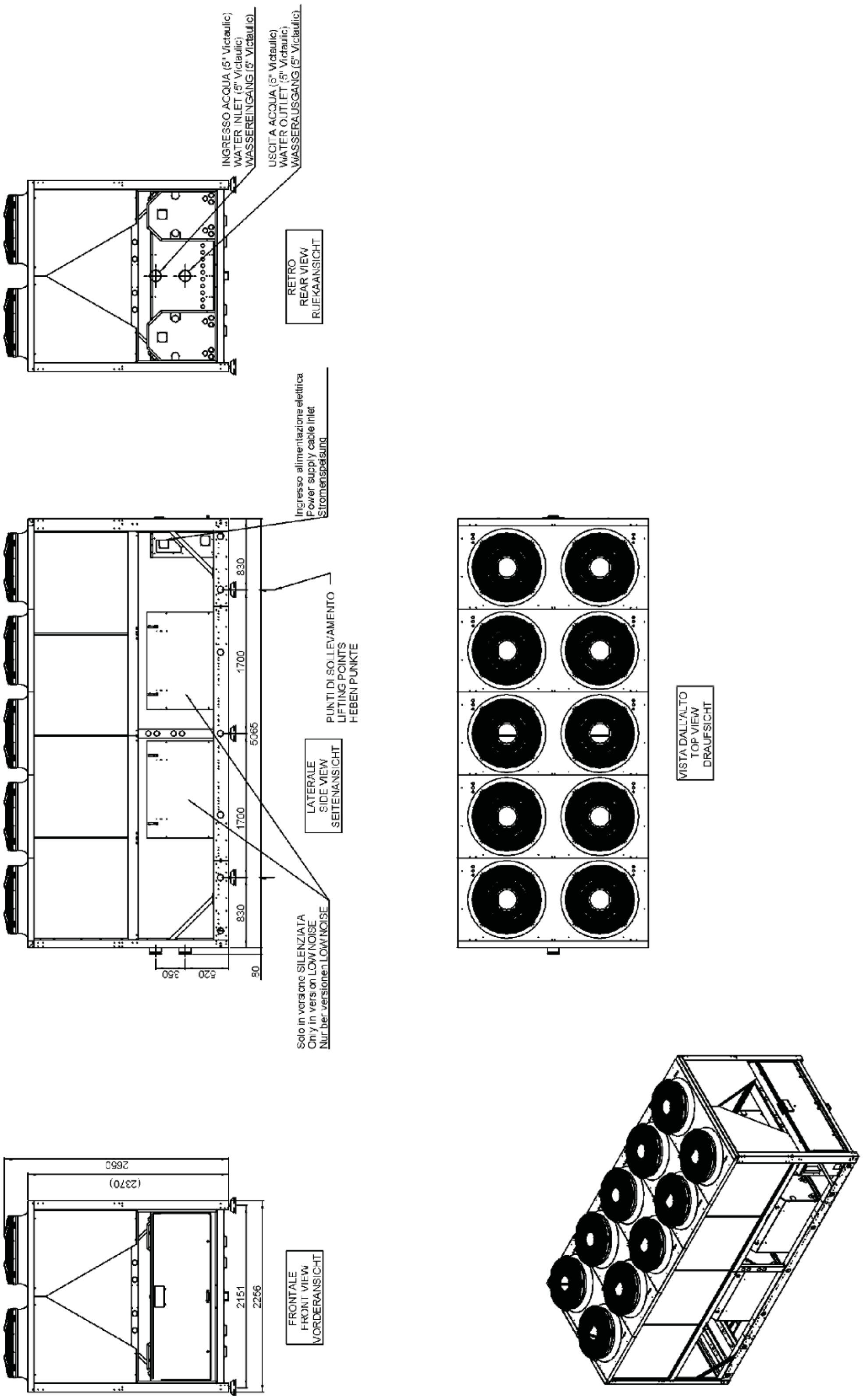
Frame1



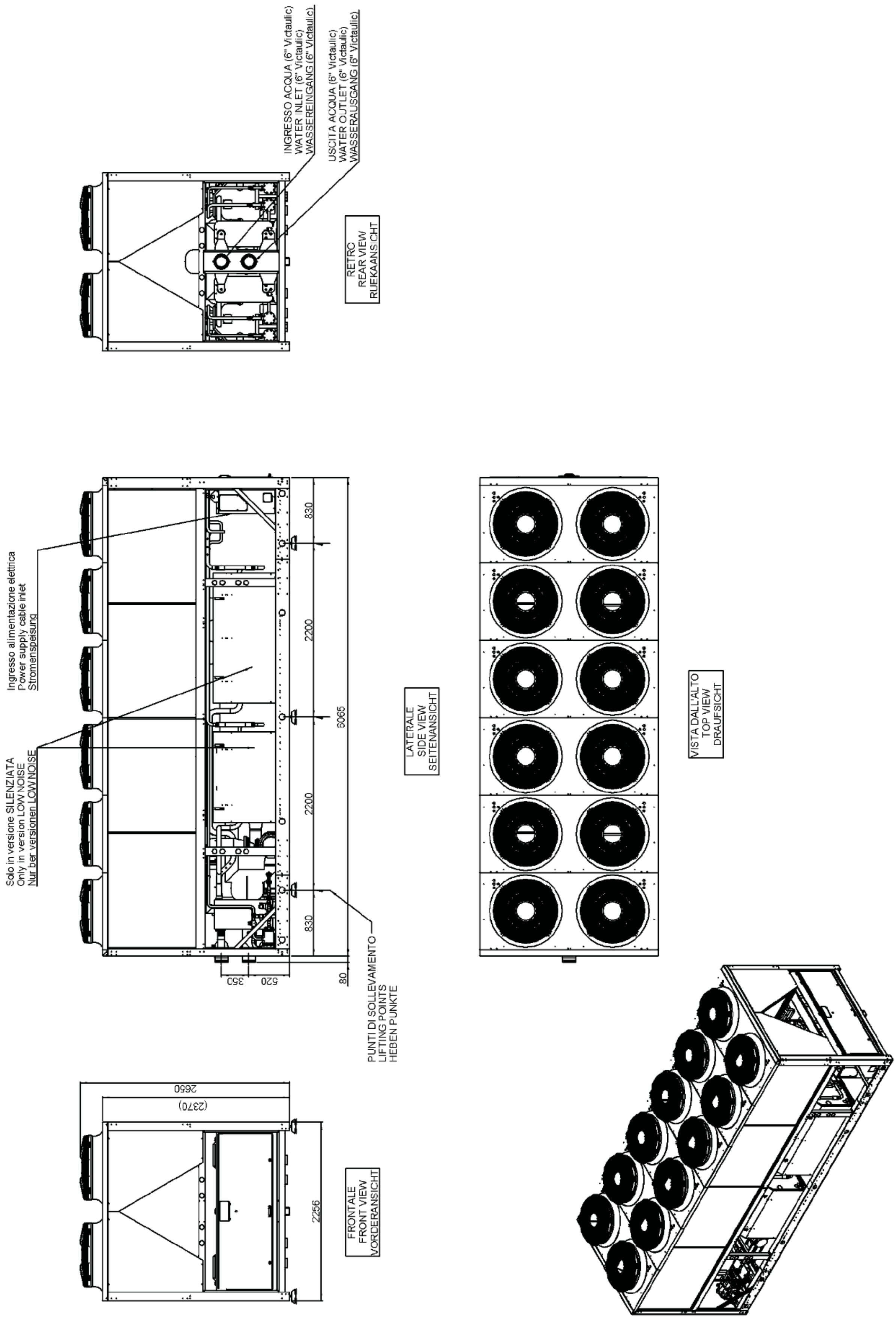
Frame 2


LATERALE
SIDE VIEW
SEITENANSICHT
FRONTALE
FRONT VIEW
VORDERANSICHT
USCITA ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 3")
WATER OUTLET HEAT RECOVERY OPTIONAL (Victaulic 3")
INGRESSO ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 3")
WATER INLET HEAT RECOVERY OPTIONAL (Victaulic 3")
INGRESSO ACQUA (Victaulic 4")
WATER INLET (Victaulic 4")
USCITA ACQUA (Victaulic 4")
WATER OUTLET (Victaulic 4")
Ingresso alimentazione elettrica
Power supply cable inlet
Solo in versione SILENZIATA
Only in version LOW NOISE
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
TOP VIEW
DRAUFSICHT
L1
L2
L3
L4
L5
L6
2256
2652
(2370)
4065
1320
1320
2151
630
330
520
350
518
80

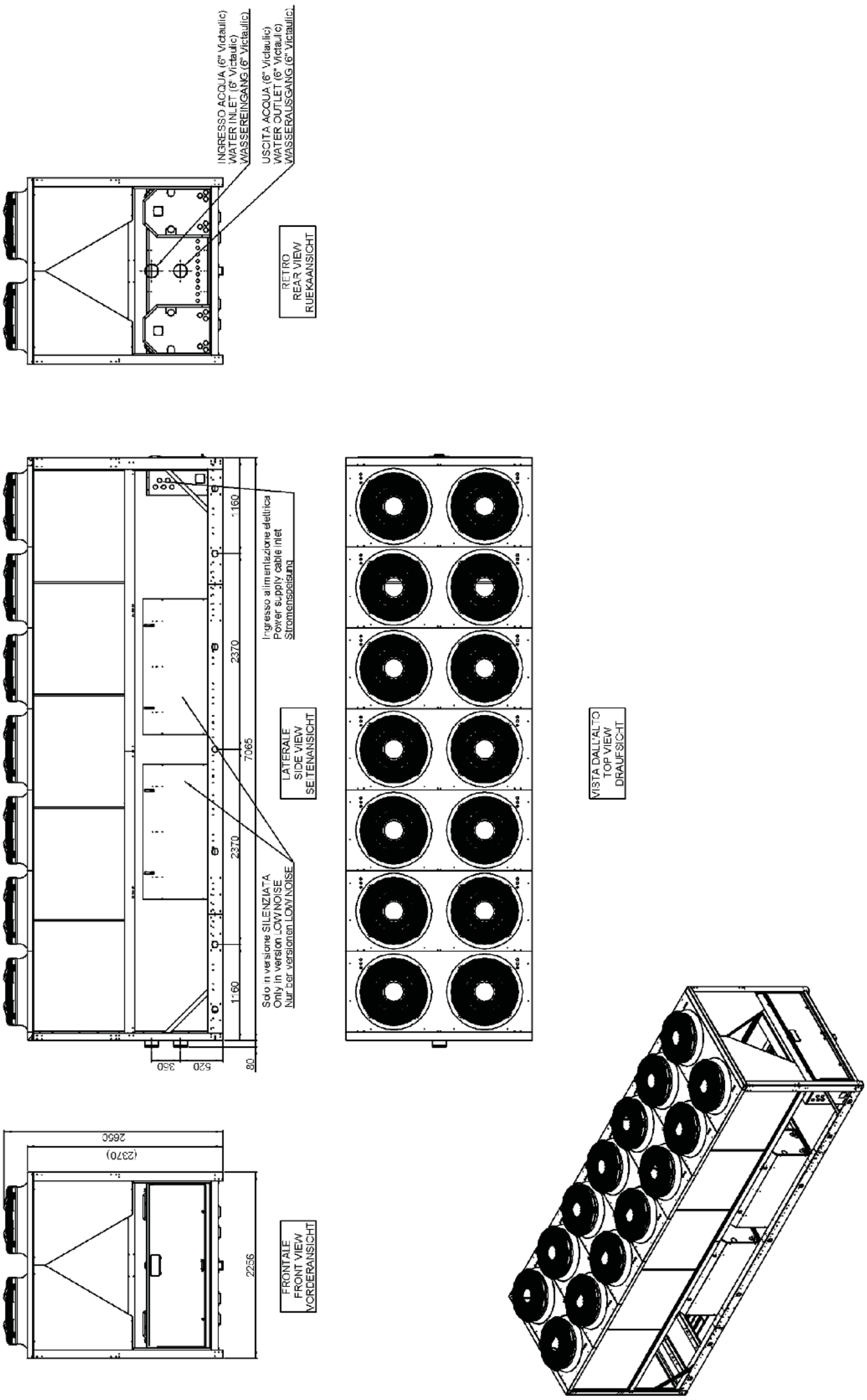
Frame 3


INGRESSO ACQUA (5" Victaulic)
WATER INLET (5" Victaulic)
WASSEREINGANG (5" Victaulic)
USCITA ACQUA (5" Victaulic)
WATER OUTLET (5" Victaulic)
WASSERAUSGANG (5" Victaulic)
RETRO
REAR VIEW
RUEKAANSICHT
Ingresso alimentazione elettrica
Power supply cable inlet
Stromeinspeisung
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
HEBEN PUNKTE
LATERALE
SIDE VIEW
SEITENANSICHT
830
1700
6065
1700
830
350
520
80
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur bei version LOW NOISE
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
2660
(2370)
2151
2256
FRONTALE
FRONT VIEW
VORDERANSICHT

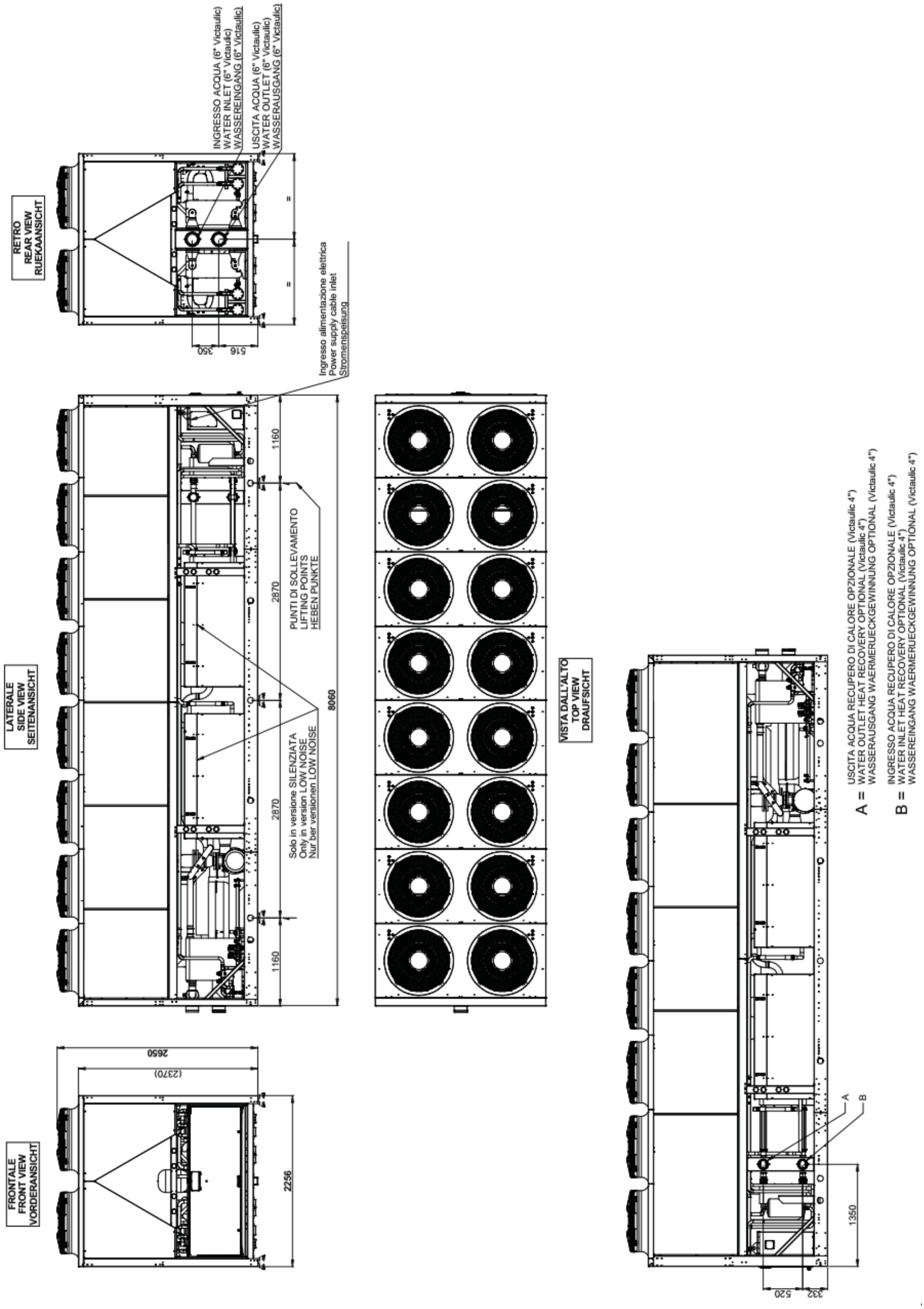
Frame 4


INGRESSO ACQUA (6" Victaulic)
WATER INLET (6" Victaulic)
WASSEREINGANG (6" Victaulic)
USCITA ACQUA (6" Victaulic)
WATER OUTLET (6" Victaulic)
WASSERAUSGANG (6" Victaulic)
RETRO
REAR VIEW
RUEKAANSICHT
Ingresso alimentazione elettrica
Power supply cable inlet
Stromenspeisung
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur ber versionen LOW NOISE
830
2200
6065
2200
830
350
520
80
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
HEBEN PUNKTE
LATERALE
SIDE VIEW
SEITENANSICHT
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
2650
(2370)
2256
FRONTALE
FRONT VIEW
VORDERANSICHT

Frame 5

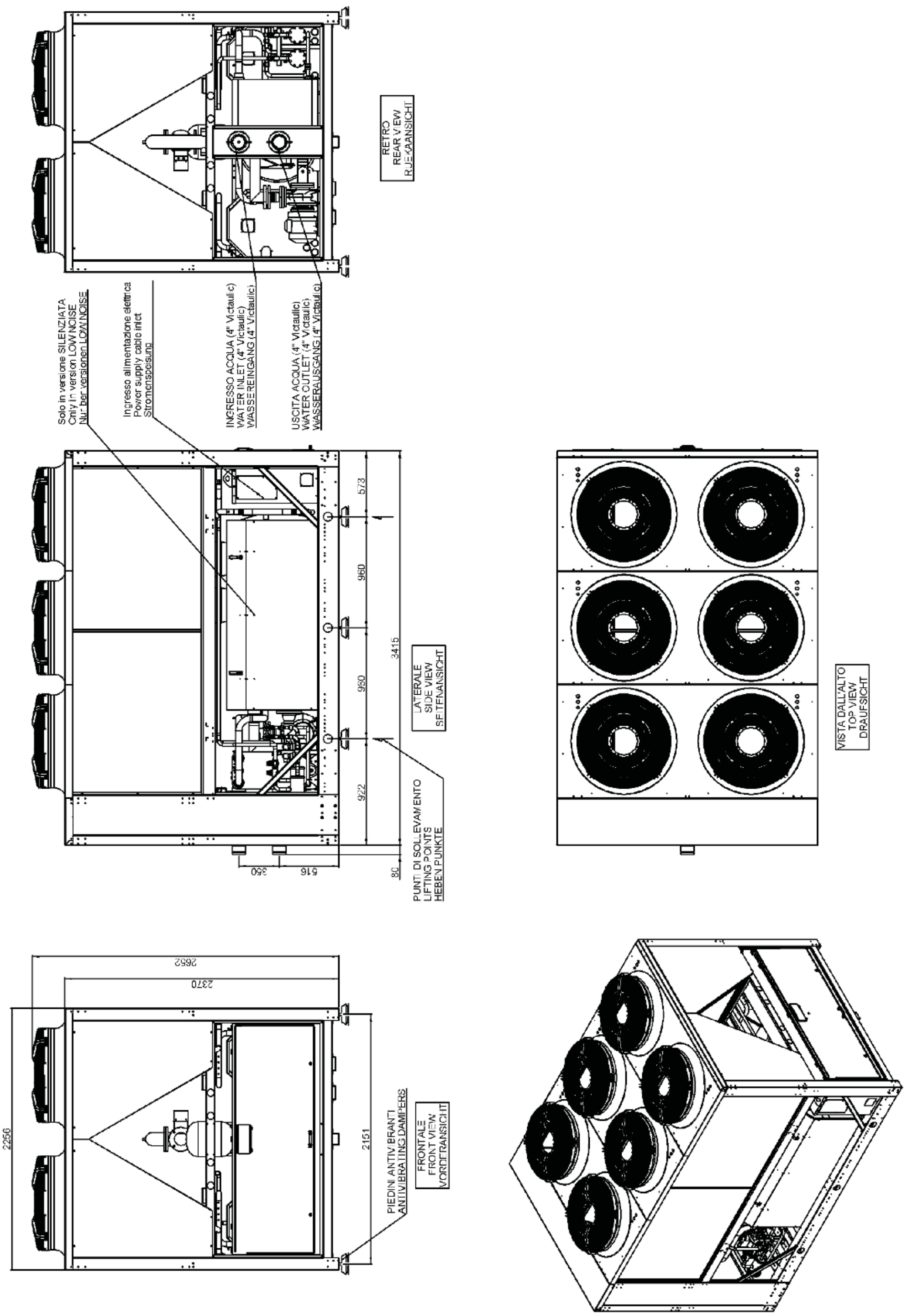

INGRESSO ACQUA (6" Victaulic)
WATER INLET (6" Victaulic)
WASSEREINGANG (6" Victaulic)
USCITA ACQUA (6" Victaulic)
WATER OUTLET (6" Victaulic)
WASSERAUSGANG (6" Victaulic)
RETRO
REAR VIEW
RUEKAANSICHT
Ingresso alimentazione elettrica
Power supply cable inlet
Stromenspeisung
160
2370
7065
2370
160
350
520
80
LATERALE
SIDE VIEW
SEITENANSICHT
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur bei versionen LOW NOISE
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
2650
(2370)
2256
FRONTALE
FRONT VIEW
VORDERANSICHT

Frame 6


RETRO
REAR VIEW
RUEKAANSICHT
INGRESSO ACQUA (6" Victaulic)
WATER INLET (6" Victaulic)
WASSEREINGANG (6" Victaulic)
USCITA ACQUA (6" Victaulic)
WATER OUTLET (6" Victaulic)
WASSERAUSGANG (6" Victaulic)
350
516
Ingresso alimentazione elettrica
Power supply cable inlet
Stromenspeisung
LATERALE
SIDE VIEW
SEITENANSICHT
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
HEBEN PUNKTE
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur ber versionen LOW NOISE
1160
2870
2870
1160
8060
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
FRONTALE
FRONT VIEW
VORDERANSICHT
2650
(2370)
2256
A = USCITA ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 4")
WATER OUTLET HEAT RECOVERY OPTIONAL (Victaulic 4")
WASSERAUSGANG WAERMERUECKGEWINNUNG OPTIONAL (Victaulic 4")
B = INGRESSO ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 4")
WATER INLET HEAT RECOVERY OPTIONAL (Victaulic 4")
WASSEREINGANG WAERMERUECKGEWINNUNG OPTIONAL (Victaulic 4")
A
B
1350
520
332

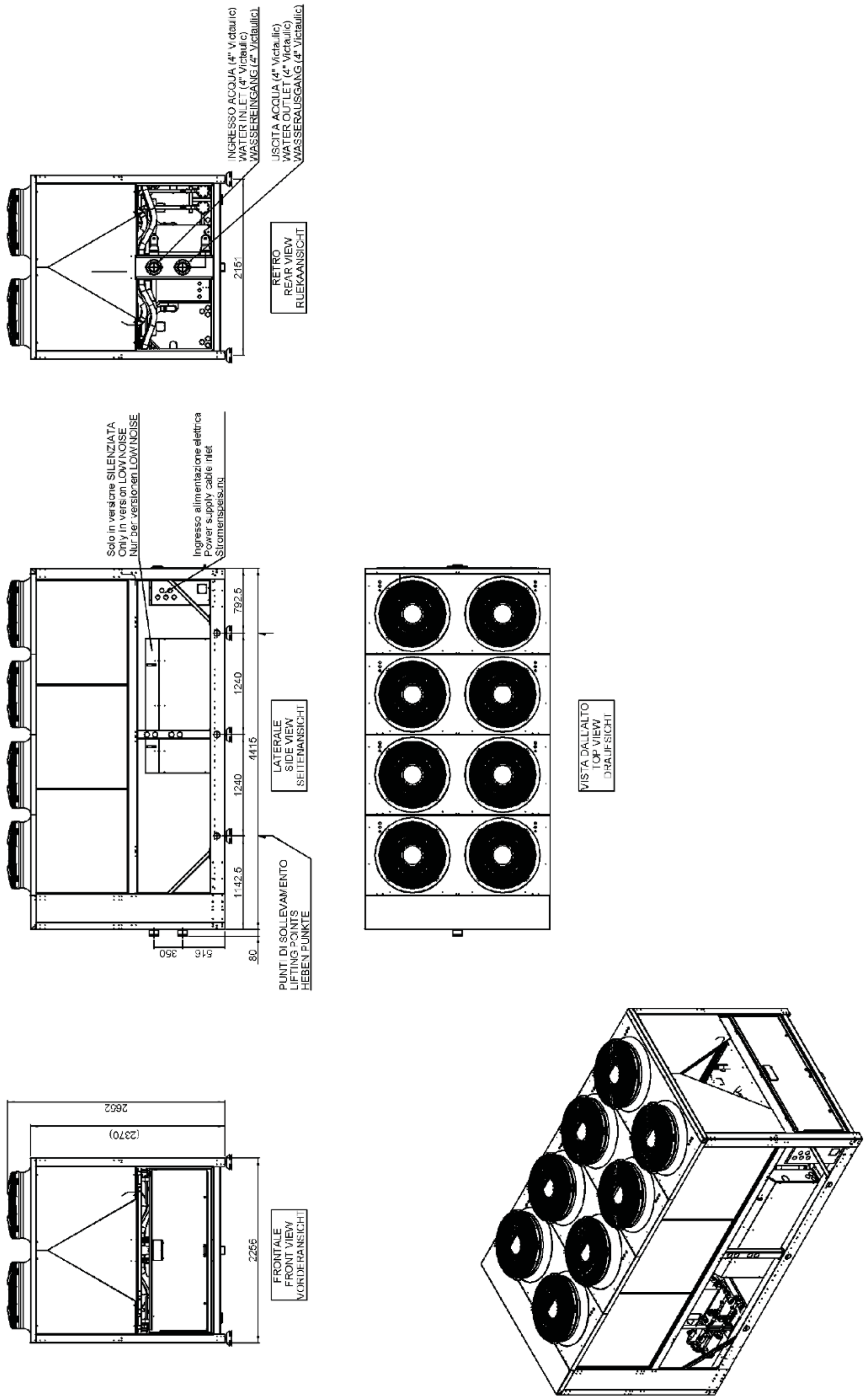
11.2 Free-Cooling

Frame 1

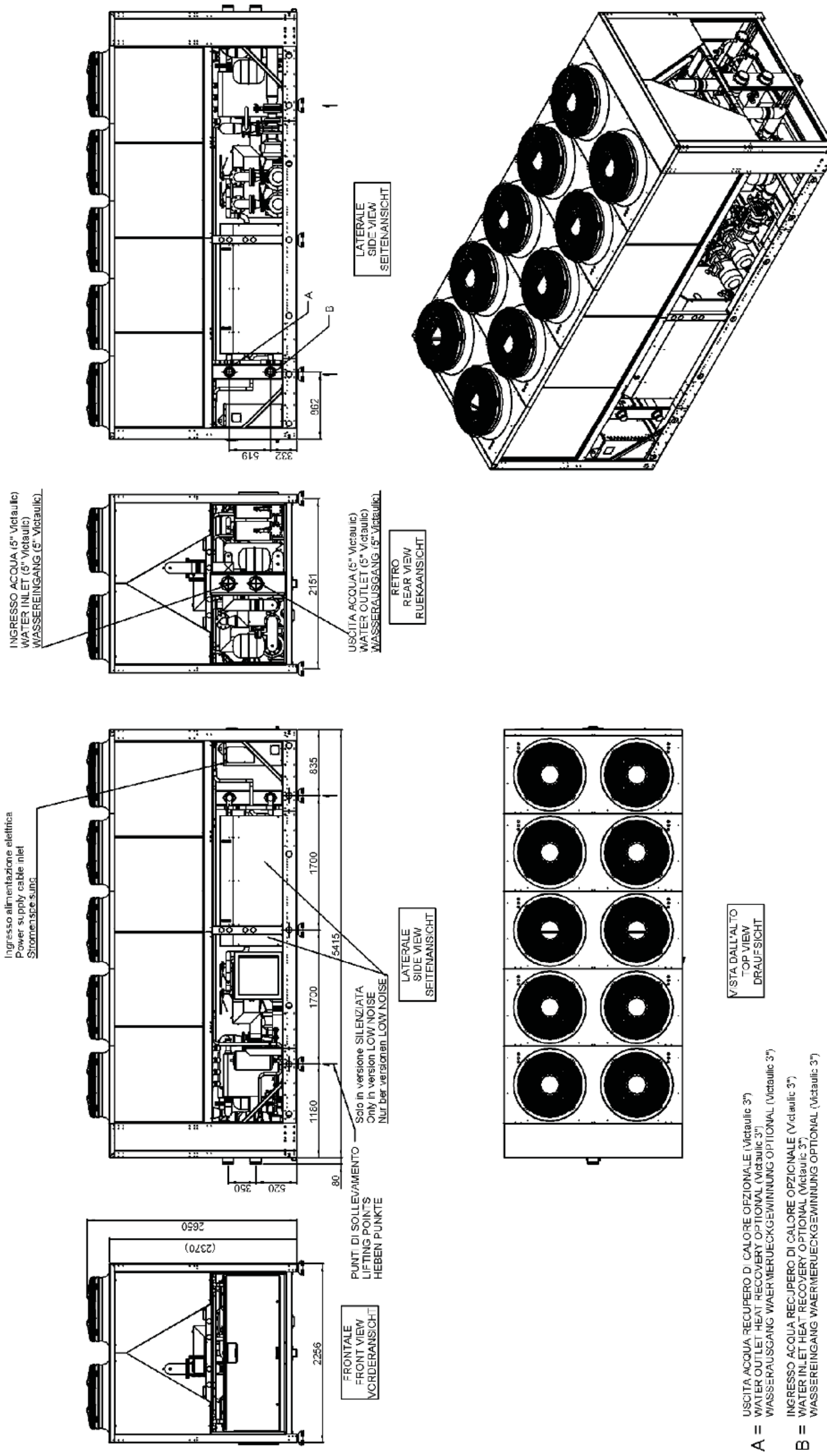


11 Water - Chiller layouts

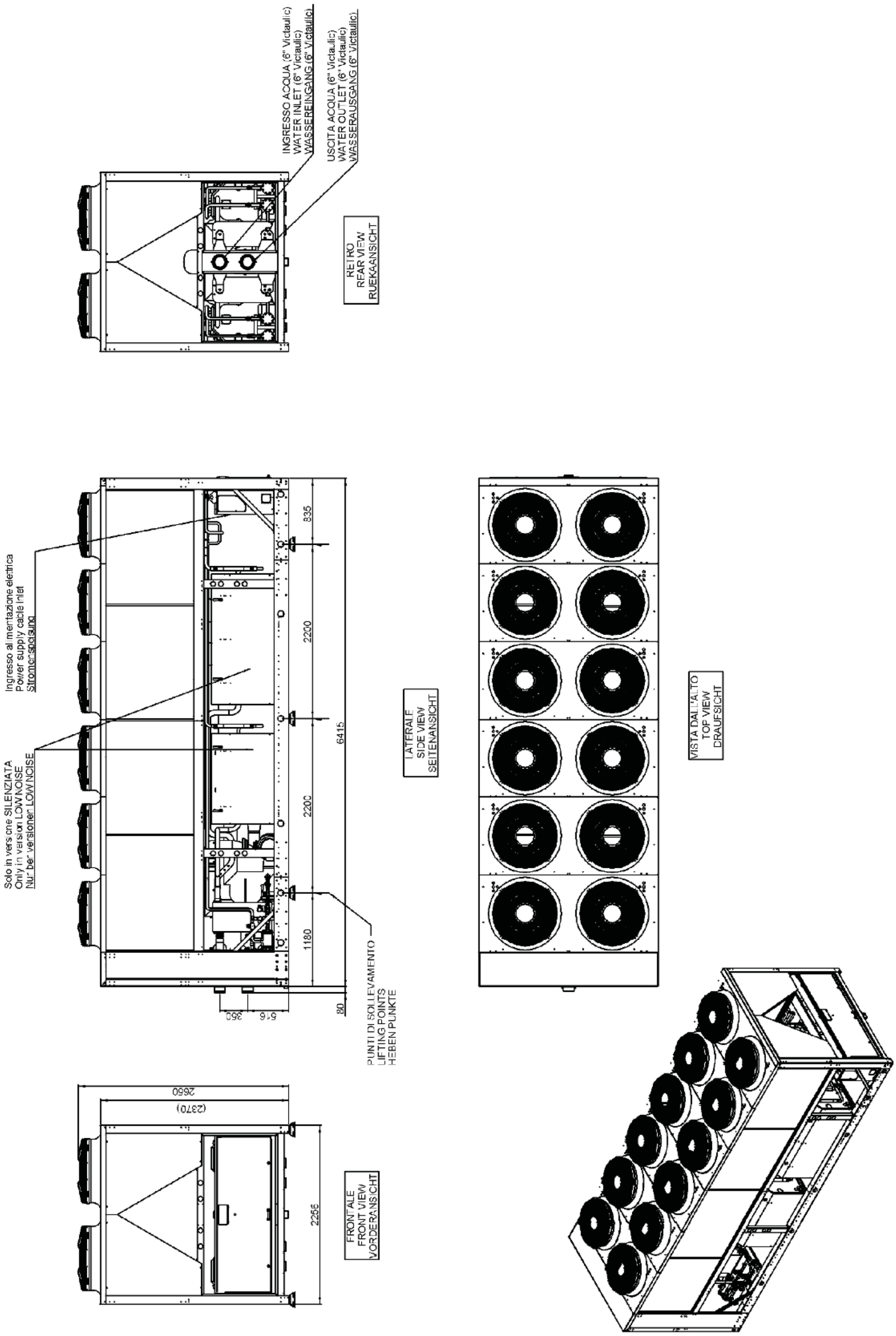
Frame 2



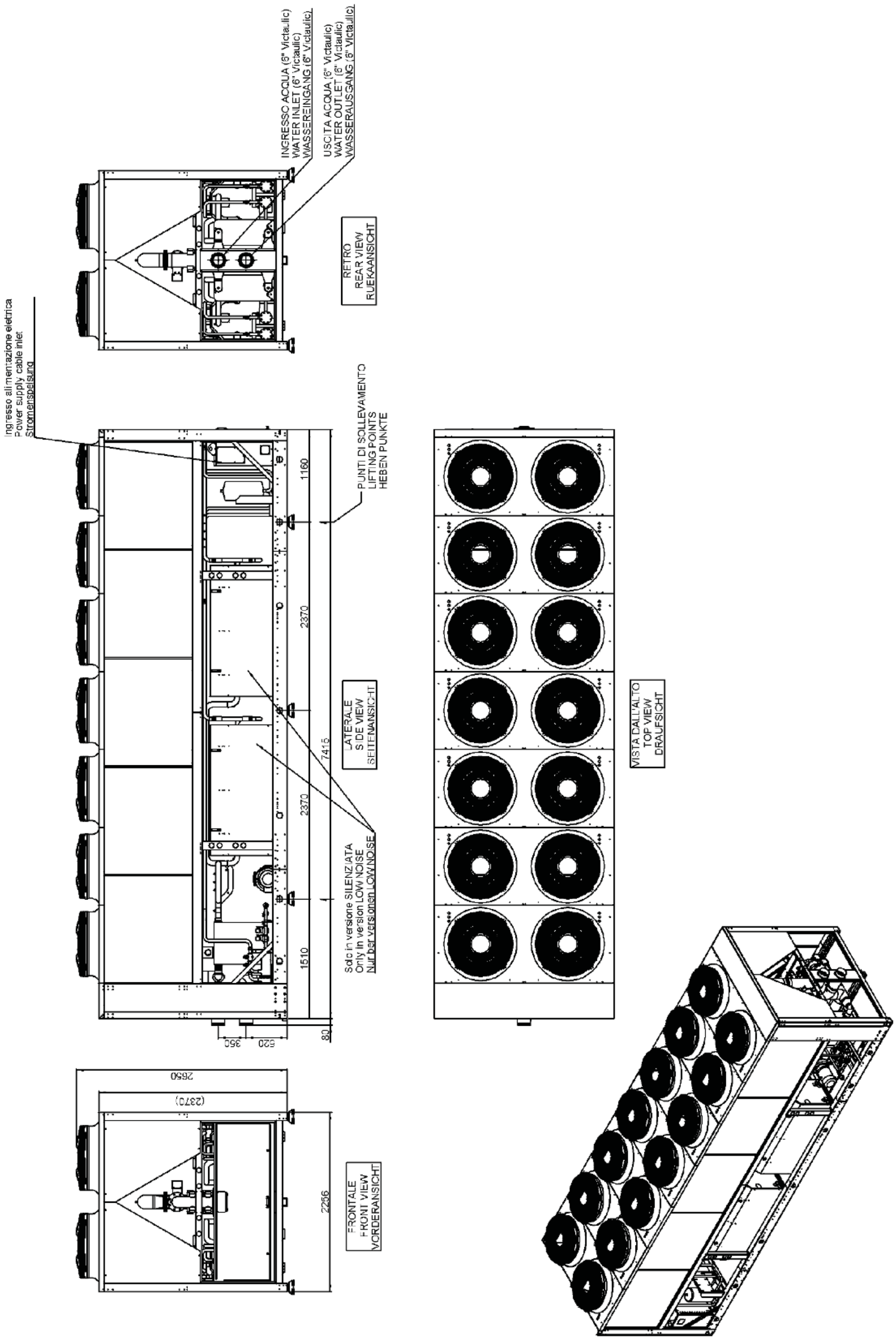
Frame 3


LATERALE
SIDE VIEW
SEITENANSICHT
RETRO
REAR VIEW
RUEKAANSICHT
FRONTALE
FRONT VIEW
VORDERANSICHT
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
INGRESSO ACQUA (5" Victaulic)
WATER INLET (5" Victaulic)
WASSEREINGANG (5" Victaulic)
USCITA ACQUA (5" Victaulic)
WATER OUTLET (5" Victaulic)
WASSERAUSGANG (5" Victaulic)
Ingresso alimentazione elettrica
Power supply cable inlet
Stromerscesung
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
HEBEN PUNKTE
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur ber versionen LOW NOISE
A = USCITA ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 3")
WATER OUTLET HEAT RECOVERY OPTIONAL (Victaulic 3")
WASSERAUSGANG WAERMERUECKGEWINNUNG OPTIONAL (Victaulic 3")
B = INGRESSO ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 3")
WATER INLET HEAT RECOVERY OPTIONAL (Victaulic 3")
WASSEREINGANG WAERMERUECKGEWINNUNG OPTIONAL (Victaulic 3")
2650
(2370)
2256
5415
1180
1700
1700
835
2151
962
519
332
350
520
80

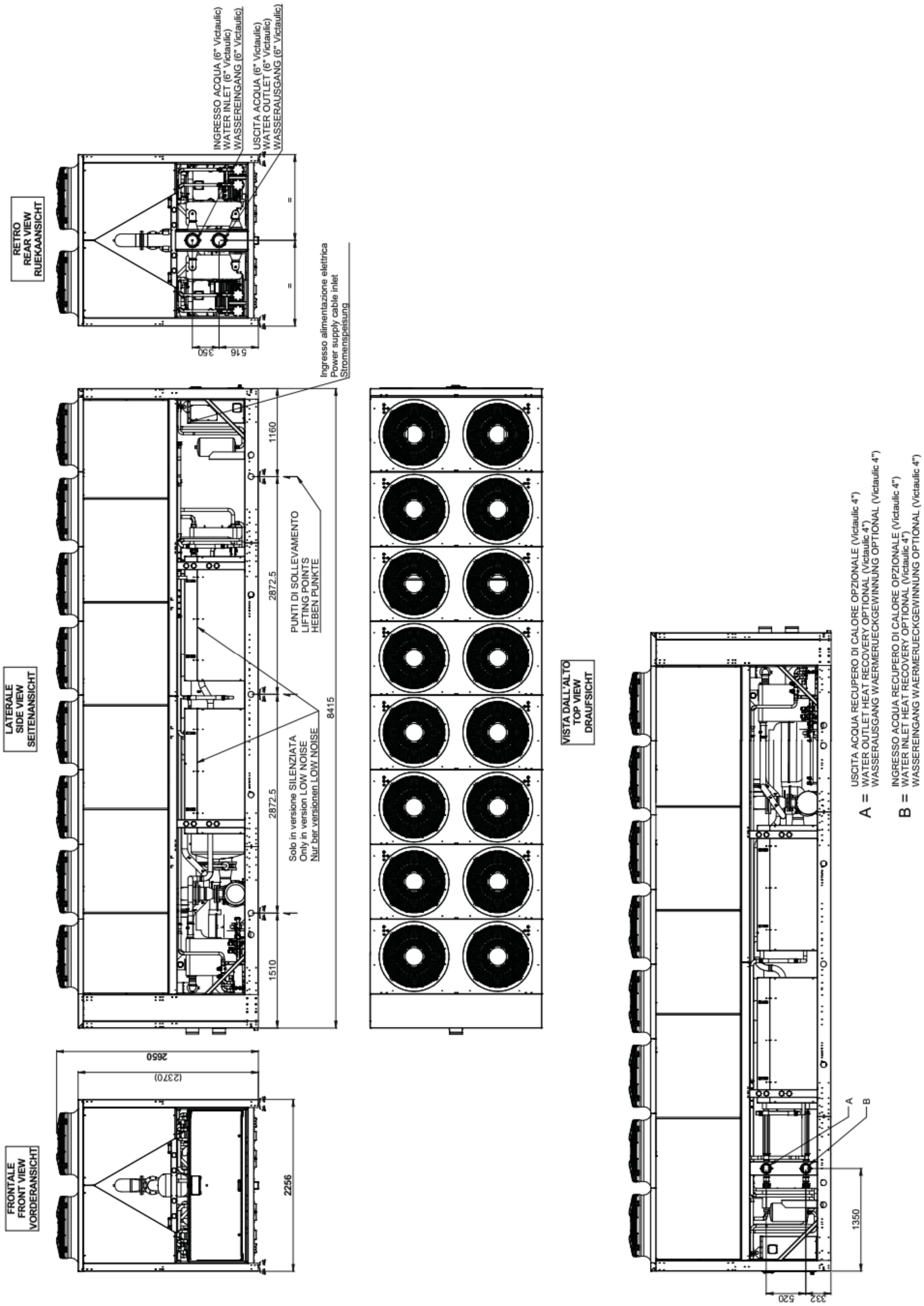
Frame 4


INGRESSO ACQUA (6" Victaulic)
WATER INLET (6" Victaulic)
WASSEREINGANG (6" Victaulic)
USCITA ACQUA (6" Victaulic)
WATER OUTLET (6" Victaulic)
WASSERAUSGANG (6" Victaulic)
RETRO
REAR VIEW
RUEKAANSICHT
Ingresso alimentazione elettrica
Power supply cable inlet
Stromversorgung
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur bei versioner LOW NOISE
835
2200
2200
1180
6415
80
350
919
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
HEBEN PUNKTE
LATERALE
SIDE VIEW
SEITENANSICHT
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
2650
(2370)
2256
FRONTALE
FRONT VIEW
VORDERANSICHT

Frame 5


INGRESSO ACQUA (6" Victaulic)
WATER INLET (6" Victaulic)
WASSEREINGANG (6" Victaulic)
USCITA ACQUA (6" Victaulic)
WATER OUTLET (6" Victaulic)
WASSERAUSGANG (6" Victaulic)
RETRO
REAR VIEW
RUEKAANSICHT
Ingresso alimentazione elettrica
Power supply cable inlet
Stromerspeisung
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
HEBEN PUNKTE
1160
2370
7415
2370
1510
80
350
520
LATERALE
SIDE VIEW
SEITENANSICHT
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur bei versionen LOW NOISE
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
2650
2256
FRONTALE
FRONT VIEW
VORDERANSICHT

Frame 6


RETRO
REAR VIEW
RUEKAANSICHT
INGRESSO ACQUA (6" Victaulic)
WATER INLET (6" Victaulic)
WASSEREINGANG (6" Victaulic)
USCITA ACQUA (6" Victaulic)
WATER OUTLET (6" Victaulic)
WASSERAUSGANG (6" Victaulic)
350
516
Ingresso alimentazione elettrica
Power supply cable inlet
Stromenspeisung
LATERALE
SIDE VIEW
SEITENANSICHT
1160
2872.5
2872.5
1510
8415
PUNTI DI SOLLEVAMENTO
LIFTING POINTS
HEBEN PUNKTE
Solo in versione SILENZIATA
Only in version LOW NOISE
Nur ber versionen LOW NOISE
VISTA DALL'ALTO
TOP VIEW
DRAUFSICHT
FRONTALE
FRONT VIEW
VORDERANSICHT
2650
(2370)
2256
A = USCITA ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 4")
WATER OUTLET HEAT RECOVERY OPTIONAL (Victaulic 4")
WASSERAUSGANG WAERMERUECKGEWINNUNG OPTIONAL (Victaulic 4")
B = INGRESSO ACQUA RECUPERO DI CALORE OPZIONALE (Victaulic 4")
WATER INLET HEAT RECOVERY OPTIONAL (Victaulic 4")
WASSEREINGANG WAERMERUECKGEWINNUNG OPTIONAL (Victaulic 4")
A
B
1350
520
332

NOTES

AIR CONDITIONING

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