Installation, Operation, and Maintenance

FLEX N HP 018..035

Air-sourced Heat Pumps
with Inverter Scroll Compressors
65 - 125 kW
R290

⚠ WARNING

This unit uses R290 flammable refrigerant (propane). Only experienced, responsible personnel are allowed to use the unit; incorrect use may lead to serious harm to people and damage to property.

March 2026

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TABLE OF CONTENTS

CHAPTER 1

GENERAL INFORMATION

1.1 Description

The machines described in this manual may hereinafter be referred to as “HEAT PUMPS”.
This manual is written for those responsible for the installation, use and maintenance of the unit.
These units are designed for cooling (when working as chillers - “SUMMER” mode) or heating (when working as heat pumps - “WINTER” mode) the liquid flow.
All the observations concerning the machine component usually (in SUMMER mode) called a “condenser” also hold true for WINTER mode, bearing in mind that in the latter case the cooling cycle is inverted and that same component works as an evaporator.
In these conditions, the same applies also to the evaporator.
Primary brand components were used and the entire process of design, production and control of the machines was carried out in accordance with ISO 9001 and IEC EN 60335-1 standards.
The liquid to be cooled must be compatible with the materials used. This analysis must be made before purchasing or installing the unit.
Here below the term “PRESSURE” will be used to indicate the gauge pressure.

CAUTION

This manual provides the user, the installer and the maintenance technician with all the technical information required to install, operate the machine and carry out routine maintenance operations that ensure a long service life.
Use only original spare parts for repairs and replacements. Failure to comply with this requirement cannot guarantee the safety of the machine.
Requests for SPARE PARTS and for any INFORMATION concerning the unit must be sent to the distributor or to the nearest service centre, providing the MODEL and SERIAL NUMBER shown on the machine data plate and in this manual.

1.2 Data plate

The data plate attached to the machine shows the main technical data:

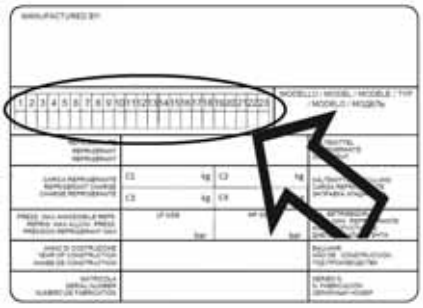
MODEL and CODE	The model number and the code identify the size of the unit and the type of construction.
MANUAL	Code number of the manual.
SERIAL NUMBER	Construction number of the unit.
YEAR OF CONSTRUCTION	The year of the final machine test.
VOLTAGES/PHASES/FREQUENCY	Electrical power supply characteristics.
MAX. CONSUMPTION	Unit current input in limit working conditions.
POWER INSTALLED	Unit power input in limit working conditions.
PROTECTION LEVEL	Protection level of the entire machine, according to European Standard EN 60529.
ELECTRICAL DIAGRAM	Indicates the electrical diagram number.
REFRIGERANT	This is the refrigerant fluid in the unit.
GLOBAL WARMING POTENTIAL	Global warming potential.
REFRIGERANT CHARGE	Quantity of refrigerant fluid contained in the unit.
PRESS. PERMISSIBLE HP SIDE (PS)	This is the design pressure of the HP side refrigeration circuit.
PRESS. PERMISSIBLE LP SIDE (PS)	This is the design pressure of the LP side refrigeration circuit.
PERMITTED TEMP. HP SIDE (TS)	Cooling circuit design temperature (high pressure side).
PERMITTED TEMP. LP SIDE (TS)	Cooling circuit design temperature (low pressure side).
FLUID CIRC. OF USE	Fluid cooled or heated by the machine (usually: water).
PRESS. MAX. ALLOWED (PS)	Max. design pressure of the user circuit.
PERMITTED TEMPERATURE (TS)	Min. and max. design temperature of the user circuit, not to be confused with the maximum operating temperature, defined at the project quote stage.
SOUND PRESSURE LEVEL	Free field sound pressure level in hemispherical radiation conditions (open field) at a distance of 1m from the condenser side of the unit and a height of 1.6m from the ground.
AMBIENT TEMPERATURE	Minimum and maximum value of the cooling or heating air temperature.
WEIGHT	Weight of the unit without packaging.

1.3 How to interpret the codes

/SN	Standard noise
/LN	Jacket on compressor
/XLN	LN version + soundproof vane insulation
/XXLN	XLN version + low noise fans.

1.4 How to interpret the alphanumeric string

The alphanumeric string-code is reproduced on the metallic plate on the manual.



The empty alphanumerical string is circled in the adjacent figure. Each position will be defined by an alphanumeric value (0, 1, 2, A, B, etc.). Specific unit features are established by the position and the alphanumeric values.
Please find below each alphanumeric values position explained, which can be used.

	POS.	VALUE	DESCRIPTION
CERTIFICATION	1	0	CE
		1	CE + AUSTRALIA
VERSION	2-3-4	SN	SN
		LN	LN
		XLN	XLN
		XXL	XXLN
VOLTAGE	5	0	400/3/50
SYSTEM COOLANT LOAD	6	0	LOAD COMPLETE
		1	PRESSURISATION IN NITROGEN
HYDRAULIC MODULARITY	7	0	NO
		1	JAW KIT
		2	JAW KIT + CAPS
3 WAY VALVE	8	0	NO
HYDRAULIC UNIT	9	0	NONE
		1	P2
		6	P3
		T	VF P2
		K	VF P3
		2	P2+P2
		7	P3+P3
		V	VF P2+P2
		Q	VF P3+P3
		3	STORAGE + P2
		8	STORAGE + P3
		X	STORAGE + VF P2
		J	STORAGE + VF P3
		4	STORAGE + P2+P2
		9	STORAGE + P3+P3
		Z	STORAGE + VF P2+P2
		R	STORAGE + VF P3+P3
INSTALLED DEAERATOR	10	0	NO
		1	SI
HEAT RECOVERY	11	0	NO

	POS.	VALUE	DESCRIPTION
FAN CONTROL	12	4	EC BRUSHLESS FANS
		6	HIGH PRESSURE EC FANS
EVAP. ANTIFREEZE PROTECTION	13	1	YES
		2	EVAP. + HYDRAULIC UNIT
CONDENSATE TRAY HEATING ELEMENT	14	0	NO
		1	YES
PREPAINTED CONDENSING COILS	15	0	NO
		1	YES
PANEL GRIDS	16	0	NONE
		1	INTEGRAL PROTECTION GRIDS
		2	BTR PROT. GRILLES
		3	HYDRAULIC COMPARTMENT ENCLOSURE
		4	HYDR. COMP. ENCL. + BTR PROT.
UNIT INTERFACE	17	0	NO DISPLAY
		1	WITH TD7 DISPLAY
ELECTRONIC PACKAGE	18	0	NONE
		1	CONTROL+NOISE+SIGNAL
		2	ENERGY METER+CONTROL N. SIGNAL
ADDITIONAL HEATERS MANAGEMENT	19	0	NO
		1	YES
PRODUCT TYPE	20	X	SPECIAL
		0	STANDARD

1.5 Performance

Unit performance depends mainly on the flow rate and temperature of the chilled water and on the ambient temperature.
These data are specified in the quote, and constitute the reference values.

1.6 Sound level measurements

CAUTION

⚠ In case of sound pressure levels exceeding 80dB(A) during maintenance of the installation, the maintenance technician must be provided with appropriate PPE.

Chiller operation

	standard fan		high pressure fan	
Model	**Lp dB(A) ***	**Lw dB(A) ****	**Lp dB(A) ***	**Lw dB(A) ****
018	74.4	87.4	78.1	91.1
023	75.1	88.1	80.1	93.1
030	77.7	90.7	81.2	94.2
035	77.4	90.4	81.1	94.1

	standard fan		high pressure fan	
Model	**Lp dB(A) ***	**Lw dB(A) ****	**Lp dB(A) ***	**Lw dB(A) ****
018 LN	73.4	86.4	77.4	90.4
023 LN	74.2	87.2	79.5	92.5
030 LN	76.7	89.7	80.4	93.4
035 LN	76.4	89.4	80.4	93.4

	standard fan		high pressure fan	
Model	**Lp dB(A) ***	**Lw dB(A) ****	**Lp dB(A) ***	**Lw dB(A) ****
018 XLN	72.2	85.2	76.4	89.4
023 XLN	73.5	86.5	78.9	91.9
030 XLN	75.4	88.4	79.4	92.4
035 XLN	75.2	88.2	79.4	92.4

	standard fan	
Model	**Lp dB(A) ***	**Lw dB(A) ****
018 XXLN	71.2	84.2
023 XXLN	72.0	85.0
030 XXLN	74.3	87.3
035 XXLN	74.2	87.2

* at a distance of 1m
** global

Test conditions

The sound levels refer to the operation of the unit (in CH mode) at full load under nominal conditions.
Sound pressure level in hemispherical irradiation conditions at a distance of 1m from the condenser side of the unit and height of 1.6m from the ground. Values with tolerance of ± 2 dB.

Sound pressure level: according to ISO 3744.

CHAPTER 2

SAFETY

This system is designed for safety in its intended use, provided it is installed, commissioned, and serviced in compliance with the instructions given in the present manual.
The company excludes any contractual and non-contractual liability for damage caused to people, animals or property, due to installation, adjustment and maintenance errors, improper use or partial or superficial reading of the information contained in this manual.

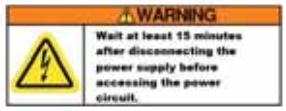
CAUTION

⚠ All persons who interact with the system must be informed of the indications, regulations and prescriptions given in this manual.

Pay special attention when working on the unit: the unit contains electrical components that operate at mains voltage and also moving parts such as fan units.
It must therefore be isolated from the electricity supply network before being opened.

WARNING

⚠ The motors contain DC bus capacitors that can remain charged even when the frequency converter is not powered. Failure to comply with the indicated waiting time after disconnecting the power supply and before carrying out maintenance or repair work, may cause serious or fatal injuries.
1. Stop the engine.
2. Disconnect the AC network.
3. Wait for the capacitors to discharge completely before performing any maintenance or repair work. The waiting time is 15 minutes.



Any maintenance operation that is outside the usual interventions must be carried out by authorised operators that are informed and trained on the specific risks of flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.
Keep unauthorized persons (e.g. children) away from the place of installation of the unit.

2.1 General information

When handling or servicing the unit, personnel must work safely and comply with the prescriptions concerning health and safety in the installation site.

CAUTION

⚠ Personnel must be authorised, informed and trained on the specific risks from flammable gases according to good practices and/or current regulations in accordance with ANNEX HH IEC 60335-2-40.

CAUTION

⚠ Numerous accidents that occur during operation and maintenance of the units are caused by failure to comply with basic safety rules or precautions.

An accident can often be avoided by recognising a situation that is potentially hazardous.
The user must ensure that all personnel involved in operating and servicing the unit **have read and understood** all the warnings, precautions, prohibitions and notes given in this manual and attached to the machine.
Improper operation or maintenance of the unit and auxiliary equipment could be dangerous and result in an accident causing injury or death.
It is not possible to cover all possible circumstances that could feasibly give rise to potential hazards for persons.
The warnings in this manual are therefore not all-inclusive.
If the user adopts operational procedures or uses tools or working procedures that are not specifically recommended, care must be taken to ensure that the unit and the auxiliary equipment are not damaged or made unsafe and that no risks emerge in relation to persons or property.

CAUTION

⚠ Use exclusively suitable methods that offer the maximum environmental respect in daily operation, routine or supplementary maintenance, and at the time of decommissioning of the system.

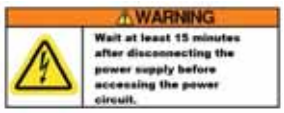
Any improper conduct or incorrect use of the unit by the user automatically releases the manufacturer from all liability for possible damage, injury and/or accidents affecting persons or property.
Arbitrary modifications made to the unit will automatically invalidate all forms of guarantee provided by the manufacturer.

WARNING

⚠ The hot / cold water produced by the units cannot be used directly for hygienic-sanitary or food purposes. In the case of such applications, the installer is responsible for fitting an intermediate exchanger.
If the intermediate exchanger is not fitted, the installer should affix a notice stating “non-drinking water”.

2.2 Symbols

The following symbols are shown on the stickers on the unit as well as on the overall dimension drawing and refrigeration circuits in this manual. Their meaning is the following:

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	Machine water-inlet		Machine water outlet
	Indication of the axis of reference for lifting operations		Drain point to empty the unit of water
	The frequency converter contains DC bus capacitors that can remain charged even when the frequency converter is not powered. After disconnecting the electricity supply, wait at least 15 minutes before accessing the power circuit.		Risk of injury due to sharp edges
	If the product is marked with this symbol, this means that the electric and electronic products cannot be disposed of together with non-separated domestic waste.		Air bleed valve
	Moving parts can crush and cut. Do not operate with guard removed. Follow lockout procedure before servicing.		Risk of burns from contact with high-temperature surfaces
	Hazardous voltage. Disconnect power before servicing or cleaning.		Safety valve discharge

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	Attention: the unit contains R290 flammable refrigerant (propane)		Unit with nitrogen pre-charge (see 9.2.3 “Coolant Charging Procedure”)
	Condensate drain		System charged with flammable refrigerant R290. After positioning the machine and before unpacking, check that there are no refrigerant leaks using a specific gas detector. Check that there are no sources of ignition / open flames / sparks etc. within the safety zone. Do not smoke near the unit. (see ch. 4.2 “Installation precautions”)

2.3 Instructions for the user

The machines must be installed in safe places, free of areas with potentially explosive atmospheres. They must be connected to electrical systems designed according to current standards, in areas compliant with the standards imposed by the Fire Brigade and in environments compliant with local building standards.
Within the potentially explosive areas generated by the machine, also taking into account the national regulations of the country of use, it is necessary to:

- Do not install equipment that is unsuitable for use in these potentially explosive zones (the minimum requirements of the equipment are: 3G IIB T4);
- Avoid naked flames, sparks and hot works;
- Avoid the presence of sources of ignition due to processes that may generate remote triggers (ionising and non-ionising radiation);
- Avoid the direct and indirect effects of lightning;
- Avoid electrostatic charges;
- Avoid interference with potentially hazardous elements such as drains, openings in the earth, basements, power lines, stores of flammable substances, railways, motorways etc.

As the refrigerant gas used is heavier than air, even a small gas leak, which in itself is not dangerous, can cause a build-up of gas if it infiltrates into underground areas, forming pockets.
A suitable “safety” distance should be assured also for chilling systems installed outdoors, in order to minimise the risk that flammable concentrations enter premises occupied by humans (e.g. through windows, ventilation openings, where people meet outdoors, etc.). However, external wind speeds tend to be quite high (compared to indoor environments) even when the air seems “still”, so also the amount of flammable mixture should be adjusted to consider the additional dispersion caused by the surrounding air.

CAUTION

⚠ Two safety areas are defined around the machine:

Safety Area 1:This area extends for 1.5 metres around the machine. Within this area, a potentially explosive atmosphere may form; therefore, ignition sources as defined by standard EN 378-2 must be avoided (for example, open flames, electrical devices not suitable for use in explosive atmospheres, power sockets, etc.).
Safety Area 2:This area extends for 0.5 metres beyond Safety Area 1. Within this area, there must be no locations where, in the event of a leak, refrigerant could accumulate (for example drains, light wells, windows, doors, air intake ducts, etc.).

Refer to paragraph 4.2 “Installation precautions” and to paragraph 4.3 “User requirements” .

2.4 Safety aspects relating to maintenance

WARNING

⚠ Maintainers working on the electrical components or on the components of the refrigerant circuit must be authorised, informed and trained on the specific risks from flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.

Electrostatic charge may build up if refrigerant is leaked into a potentially explosive atmosphere.
To avoid this build-up, antistatic clothing (complying with Standard EN 1149-5) must be worn during machine inspection and maintenance.

DANGER

⚠ **Never use sharp tools to clean the condensing coil. The chiller contains flammable refrigerant.**

Do not clean the chiller with detergent liquid at temperatures greater than 50°C. A temperature greater than that which has been indicated could result in excess pressure inside the cooling circuit, which in turn could cause the refrigerant safety valve to open.
All repairs of the refrigerant circuit must be carried out by authorised, informed and trained operators on the specific risks of flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.
The maintenance operator must also be:

- aware of the potential risks present in explosive atmospheres, and therefore able to prevent them;
- knowledgeable of the work procedure, in order to avoid - as far as possible - the risk of inflammable refrigerant being leaked into the atmosphere.

In the case of extraordinary maintenance operations, the refrigerant circuit must be emptied using a machine suitable for recovering the type of flammable refrigerant in question. During the course of these operations, the surrounding area must be properly ventilated and monitored with the aid of a leak detection device.
In order to avoid creating potential ignition sources, only roller pipe cutters should be used to open the refrigerant circuit.
All subsequent brazing operations must be carried out by authorised operators, informed, trained and trained on the specific risks of flammable gases according to good practices and/or current standards in accordance with Annex HH IEC 60335-2-40 and taking care to flush the refrigeration circuit with nitrogen. The maintenance operations must be carried out in accordance with the national standards and regulations relating to explosive atmospheres (e.g. reference to the **EN 1127-1 standard**).

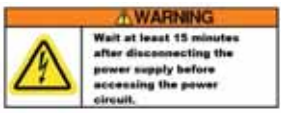
2.5 Essential safety rules for the inverter

Before carrying out any maintenance / replacement of the inverter:

- **Disconnect the inverter and external control circuits from the mains power supply by setting the main switch to 0 and wait at least 15 minutes.**
- Always use a multimeter to make sure there is no dangerous voltage on the heads of the terminals.
- Always make sure the motor is completely idle; a freely rotating motor may produce dangerous voltage on the inverter terminals, even when the inverter isn't powered.
- Make sure the dissipator temperature isn't high: risk of serious burns from contact with the dissipator.
- When the inverter is connected to the mains supply, the U, V, W motor terminals are live even if the motor isn't running.
- Do not take insulation resistance or dielectric rigidity measurements while the inverter is connected.
- The control terminals are insulated from the mains potential. There may, however, be dangerous voltage on the relay outputs even when the inverter isn't connected to the mains.
- The inverter must only be used for the purposes specified by the manufacturer. Do not make any unauthorised repair or alteration to the component.

WARNING

⚠ The frequency converter contains DC bus capacitors that can remain charged even when the frequency converter is not powered. Failure to comply with the indicated waiting time after disconnecting the power supply and before carrying out maintenance or repair work, may cause serious or fatal injuries.
1. Stop the engine.
2. Disconnect the AC network.
3. Wait for the capacitors to discharge completely before performing any maintenance or repair work. The waiting time is 15 minutes.



2.6 General precautions

2.6.1 Liquids in the user circuit

The user circuit liquids must be compatible with the materials used for the construction of the unit's hydraulic circuit.
The use of suitable chemical additives (contact your glycol supplier) is very important even in the case of glycol mixtures, to protect the machine materials from the risk of corrosion caused by the chemical deterioration that glycol is susceptible to.
If the liquids in the circuit contain dangerous substances (e.g. ethylene glycol), any leaking liquid must be collected up to prevent any harm to the environment.
Furthermore, when the unit will not be used for a long period, dangerous liquids must be disposed of by firms specialised and authorised for treating them.

2.6.2 Transporting the unit

The unit must be transported in full compliance with local legislation. The maximum quantity of refrigerant that can be transported will be determined by the applicable transport regulations.
For shipping methods, the international directives ADR, IMDG and IATA are of reference. For road transport in Europe the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) shall apply. This regulation allows a partial exemption provided that the total amount of refrigerant carried on the same truck does not exceed 1000 points (1 kg of A3 corresponds to 3 points, 1 kg of A1 corresponds to 1 point). For example, a truck could be loaded as follows:

- 10 units with 100 kg of R410 per unit => Total Points: 1000
- 10 units with 33 kg of R290 per unit => Total Points: 990≤1000
- 4 units with 200 kg of R410 per unit + 2 units with 33 kg of R290 per unit => Total Points: 998≤1000

To take advantage of this partial exemption from ADR, some simple requirements must be respected, including (non-exhaustive list):

- that the means of transport is equipped with a fire extinguisher of at least 2 kg of powder
- that the means of transport is equipped with a non-sparking torch
- that the correct ADR marking and labelling is placed on the outer packaging of the equipment (a red class 2 label with a minimum side of 10 cm and the number UN 3358 with characters of minimum height of 12 mm)

Refrigerating machines and refrigerating machine components are not subject to ADR requirements if they contain less than 12 kg of gas or if the units are charged with nitrogen under pressure of less than 2 barg.
The unit, if equipped with pressure relief valves, could release refrigerant if exposed to high temperatures. The transport temperature must not exceed 50°C.
In the case of road-sea shipments, the ADR Agreement for road transport and the IMDG code for maritime transport are applicable. The provisions of the IMDG generally prevail over those of the ADR. For maritime transport some limitations may apply and the partial exemption of 1,000 points provided for by the ADR is not applicable, please contact the shipping company.
Transport of refrigerant-laden units by area is not allowed.

2.6.3 Precautions upon receipt of the machine

Upon receipt, check the integrity of the machine considering that the machine has been shipped in perfect condition.
Check the supply of all the accessories supplied.
Check that there are no refrigerant leaks using a specific gas detector.
In case of shortages or damage, inform the sales department as soon as possible and fill out a written report complete with photographs.

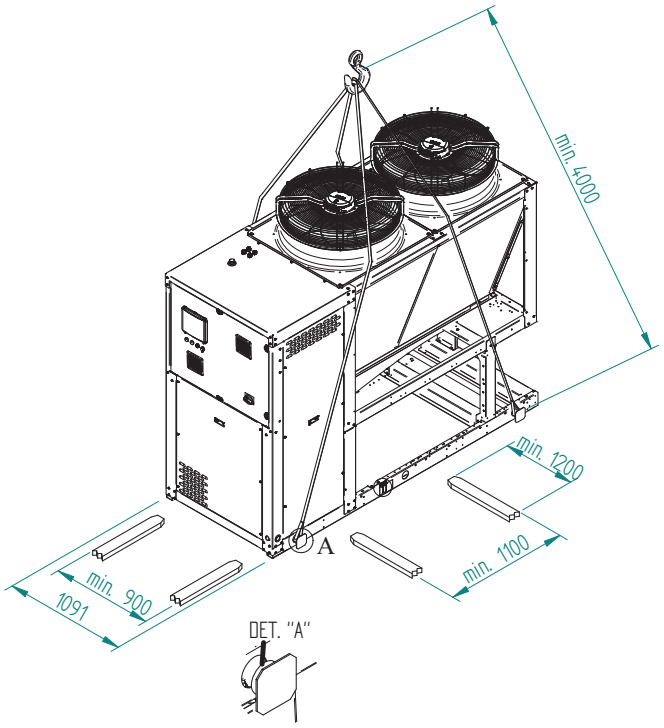
2.6.4 Lifting and transport precautions

The lifting and transport operations must be carried out by properly qualified expert personnel, with all necessary precautions and protections (active and passive, such as protective gloves, protective helmet) in order to work in complete safety.
Avoid injury by using a hoist to lift heavy loads.
Check all chains, hooks, shackles and slings are in good condition and are of the correct capacity.
They must be tested and approved according to local safety regulations.
Cables, chains or ropes must never be applied directly to lifting eyes.

NOTE
The lifting material is not furnished with the unit.

Always use an appropriate shackle or hook properly positioned.
Make sure the lifting cables don't form sharp bends.
Use a spreader bar to avoid side loads on hooks, eyes and shackles.
When a load is lifted from the ground, keep well clear of the area beneath it and the surrounding area.
Keep lifting acceleration and speed within safe limits and never leave a load hanging on a hoist for longer than is necessary.
All unit models have different weights according to the model.
Please see Technical Catalogue or the data plate applied on the casing for weight data.
Systems equipped with pallet must be handled using a forklift, as shown in the diagram below.

018-023



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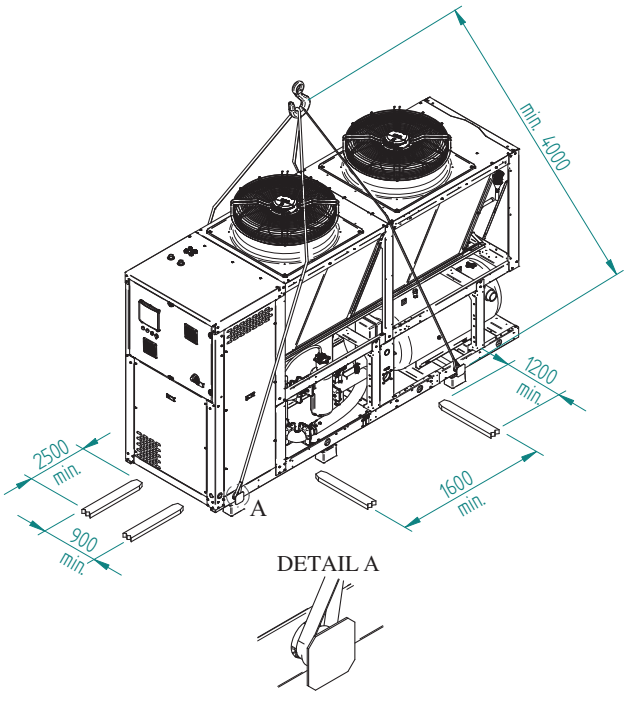


When calculating the lifting capacity, refer to the weight values given in the table below (net weight of unit without water accumulator or pump):

Models	Approximate machine weight [kg]
018	615
023	700
030	1220
035	1250

Please see Technical Catalogue or the data plate applied on the casing for weight data.

2.6.5 Storage of the unit

A3 chiller units and heat pumps with refrigerant must be stored outdoors.
In the event of storage inside the building, it must meet the following requirements (non-exhaustive list):

- Well ventilated and free of combustible materials or waste
- Free of ignition sources
- Absence of direct sunlight and out of the reach of heat sources
- The storage area must be provided with safety signs
- Adequate fire safety measures must have been taken

It is also recommended to use a detection sensor for flammable gases every 36-40 m^2. Always refer to national regulations.
Whether the equipment is stored indoors or outdoors, it must comply with applicable regulations, local legislation and building regulations.
The unit may be equipped with pressure relief valves that could release refrigerant if the unit is exposed to high temperatures.
The storage temperature must not exceed 60°C.

2.6.6 Precautions during operation

Operation must be carried out by competent personnel under a qualified supervisor.
All connections of the refrigerant circuit, electrical system and control unit wiring must be easily identifiable, painted or marked clearly in compliance with local safety prescriptions in force in the place of installation.

DANGER

⚠ **Do not remove or tamper with safety devices, protections, or the insulating materials installed in the unit or in the auxiliary equipment.**

All electrical connections must comply with the local prescriptions in the installation place.
The machine and the auxiliary apparatus must be earthen and protected against short-circuits and overloading.
When the main switch is closed the voltage in the electrical circuit reaches lethal values.
The maximum precautions must be adopted if work is to be carried out on the electrical circuit.
Do not open any protection panels on the electrical equipment while it is live, unless it is necessary for measurements, tests or adjustments.
This work should only be carried out by authorised operators, informed, trained and trained on the specific risks of flammable gases according to good practices and/or current standards in accordance with Annex HH IEC 60335-2-40, equipped with adequate equipment and wearing protections against electrical hazards.

Faults to electronic devices due to electromagnetic fields
Electromagnetic fields are created when using pumps with a frequency converter. This can disrupt electronic equipment. The consequence can be a malfunction of the device that can cause damage to people's health and even death, e.g. in the wearers of implanted active or passive medical devices. For this reason, people fitted with devices such as pacemakers must not stand near the system and/or the pump during machine operation. In the case of magnetic or electronic data support devices, data may be lost.

DANGER

⚠ **Danger due to high magnetic field!**

A high magnetic field is always created in the pump, and this can cause injury or damage if the device is improperly disassembled.
- As a general rule, the rotor should only be removed from the motor by specialised, authorised personnel!
- Risk of getting crushing. When taking the rotor out of the motor, there is a risk that the strong magnetic field pulls it back sharply into its starting position.
- The extraction of the impeller, shield and rotor unit from the engine is very dangerous, especially for people using medical aids, such as pacemakers, insulin pumps, hearing aids, implants or the like. This may result in death, serious bodily injury and property damage. The workplace doctor must issue a declaration for people in this category.
- The strong magnetic field of the rotor may affect the operation of electronic devices, or damage them.
- If the rotor is outside the motor, magnetic objects may be violently attracted. This could lead to injury or material damage.
Once the installation is complete, the magnetic field of the rotor is brought back within the metallic circuit of the motor. In this way, outside the machine there is no magnetic field that may be harmful for people's health.

2.6.7 Precautions for maintenance and repair

Accumulations of electrostatic charges can generate, in the event of loss of refrigerant, a trigger in the event of a potentially explosive atmosphere; to avoid accumulation, antistatic clothing complying with EN 1149-5 must be used during maintenance and inspection of the machine. Antistatic clothing bears the following symbol:

WARNING

⚠ Maintainers working on the electrical components or on the components of the refrigerant circuit must be authorised, informed and trained on the specific risks from flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.

CAUTION

⚠ When it is necessary to discharge waste material do not pollute water pipelines, groundwater or watercourses. Avoid the combustion of materials that could cause atmospheric pollution. Protect the environment by using only approved storage methods.

Keep a written record of all maintenance and repair work carried out on the unit and auxiliary equipment. The frequency and nature of the work required of the unit must not cause abnormal operating conditions.

WARNING

⚠ Use exclusively the refrigerant specified on the unit's data plate.

Make sure that all the instructions concerning operation and maintenance are followed scrupulously and that the entire unit and all the accessories and safety devices are maintained in proper working order.
The accuracy of pressure and temperature gauges must be regularly checked. If values exceeding the permitted tolerances are detected, the gauges must be replaced.
Coloured tracers can be used in service-maintenance operations.

CAUTION

⚠ Do not weld or perform work that generates heat close to a system that contains oil or inflammable liquids. Systems that may contain oil or inflammable liquids must be completely drained and cleaned, for example with steam, before performing any such operations.

To prevent an increase in working temperature and pressure values clean the heat exchange surfaces (e.g. the fins of condensers) regularly. For all units establish a suitable time interval for cleaning procedures.

WARNING

⚠ DO NOT damage the pressure relief valves and other pressure limiting devices.

Do not clog these devices with paint, oil, or accumulated dirt.
Use exclusively original spare parts.
Never use an open flame as a light source to inspect parts of the unit.
When a repair has been completed make sure that no tools or detached parts are left in the unit.
The pipes of the cooling circuit, and generally speaking all cooling circuit components, are not designed to be used in any way other than that specified. Do not use the pipes as a support surface or a step for climbing up.

WARNING

⚠ Check the direction of rotation of the motors when starting the unit for the first time and after work has been performed on the electrical connections or on the power supply sectioning device.

All the protections must be refitted following maintenance or repair work.
Do not use flammable liquid to clean any component during operation.
If non-inflammable hydrocarbons containing chloride are used all the relevant safety precautions must be adopted to protect against the toxic fumes that may be given off.

CAUTION

⚠ Before removing any panels or dismantling any parts of the unit perform the following steps:

- Isolate the unit from the electrical power supply by disconnecting the supply upstream of the power feeding line.
- Lock the disconnector (where present) in the “OFF” position using a padlock.
Attach a tag to the disconnecting switch, stating “WORK IN PROGRESS - DO NOT SWITCH ON”.
- Do not switch on electrical power or attempt to start the unit if a warning label is attached.
- Wait at least 15 minutes before carrying out any operation, to allow the discharging of the condensers inside the inverter.
- Make sure the motor is completely idle. A freely rotating motor may produce dangerous voltage on the inverter terminals, even when the inverter isn't powered.
- Always use a multimeter to make sure there is no dangerous voltage present.

Coloured tracers can be used in service-maintenance operations.
Inspect all refrigerant circuit unions including connectors, flanges, and more generally all critical points (open unions) in order to prevent possible leakage of refrigerant gas.

CAUTION

⚠ The R290 refrigerant used in the chiller is odour-free.

Maintenance and repair must only be carried out by authorised operators, that are informed and trained on the specific risks of flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.
Inspect all the cooling system joints including connectors, flanges and more generally all critical points (open joints) in order to prevent possible leakage of refrigerant gas using specific tools suited for use with flammable refrigerants.

2.6.8 Warnings for extraordinary maintenance and repair

It does not give anyone else the authority to carry out maintenance work on the unit.

- Switch the unit off, disconnecting it from the mains supply.
- Check there are no flammable materials stored in the work area, and no ignition sources such as naked flames, electric heaters, etc.
- Make sure the work area is **well aired** before doing any work on the refrigerant circuit or carrying out any welding or brazing tasks.
- Drain off the refrigerant, using a recovery machine suitable for this type of flammable refrigerant. In the meantime, monitor the area with a gas leak detector.
- Flush the circuit with inert gas (e.g. nitrogen).
- Drain the circuit with a suitable vacuum pump.
- Flush again with inert gas (e.g. nitrogen).
- Open the circuit.
- Using a pipe cutter, cut the cooling circuit components that need to be replaced. DO NOT debraze.



2.6.9 Disposal, disassembly and recycling

The product was designed and built with recyclable materials.
The correct waste sorting for the subsequent start-up of the equipment disposed of for recycling, treatment and for compatible environmental disposal, contributes to prevent possible negative consequences on the environment and health. It also favour the recycling of the materials the equipment is made up with.
The unit may include all or some of the materials listed below:

- refrigerant fluid R290
- copper parts
- aluminium parts
- carbon steel parts
- stainless steel parts
- PVC parts
- CFC-free synthetic insulating material
- polystyrene parts
- PVE oil
- brass

During dismantling, the compressor, pumps, fans, exchangers (if working) can be recovered for possible re-use thanks to specialised centres. All materials must be recycled or disposed of in compliance with the corresponding national regulations.
Refrigerant, oil and possible anti-freeze solutions recycling must be done by specialised companies in compliance with the corresponding local and national legislation.
Electrical and electronic materials cannot not be disposed of together with domestic general waste. They must be disposed of in special collection centres.
Units must be treated at a centre specialised in re-conditioning, recycling and recovery of materials.
The waste sorting of this equipment that reached the end of its useful life is organized and managed by the manufacturer of the newly purchased equipment replacing the present one, if applicable, or, in all other cases by the manufacturer of this equipment.
Therefore, the user who wishes to discard this equipment and has decided to purchase a new equivalent one to replace the present one, must refer to the manufacturer of the new equipment and follow the procedures established by the latter in terms of selective collection of the equipment that has reached the end of its useful life.
Conversely, the user who wishes to discard this equipment and has not decided to purchase a new equivalent one to replace the present one, must refer to the manufacturer of this equipment and follow the procedures established by the latter in terms of selective collection of the equipment that has reached the end of its useful life.

2.7 Refrigerant gases

R290 refrigerant is classified as group 1 “dangerous” on the basis of the criteria of the pressurised equipment directive 2014/68 / EU.

- Type of refrigerant: R290
- Global warming potential GWP: 0,02

In accordance with Standard ISO-817, R290 (E), it is classified in safety group A3: HIGH flammability.
The refrigerant generates toxic gases when placed in contact with open flames.
In order to ensure proper installation, the local regulations and the specified safety standards must be respected. In their absence, reference must be made to the EN-378 standard, with particular regard to the sections concerning flammable refrigerants. The end user must check whether approval is required from the competent authorities for the installation of the unit.
These units may be charged exclusively with R290.
Never attempt to mix refrigerant gases.
To clean a heavily contaminated refrigerant circuit, e.g. after the burning of a compressor, it is necessary that the work is carried out by authorised operators, that are informed and trained on the specific risks of flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.
The use and storage of cylinders containing refrigerants must be in compliance with the prescriptions of the manufacturers of the cylinders and in compliance with the applicable safety laws and prescriptions in force in the place of installation.

CAUTION

⚠ Maintainers working on the electrical components or on the components of the refrigerant circuit must be authorised, informed and trained on the specific risks from flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.

2.7.1 Refrigerants safety datasheet

	R290
Name:	Propane.
HAZARDS	
Main hazards:	Highly flammable gas.
Specific hazards:	Contains pressurised gas; may explode when heated.
FIRST AID MEASURES	
General information:	In high concentrations, it can cause asphyxiation. Symptoms may include loss of mobility and/or consciousness. The victim may not be aware that they are suffering from asphyxia. In low concentration, it can have a narcotic effect. Symptoms may include dizziness, headaches, nausea and loss of coordination.
Inhalation:	Move the victim to a non-contaminated area using the self-contained breathing apparatus. Keep the patient relaxed and warm. Call a doctor. Proceed with the artificial respiration in case of respiratory failure.
Contact with the eyes/face:	Wash the eyes immediately with water, continuing for at least 15 minutes.
Contact with the skin:	In case of contact with liquid, wash with water for at least 15 minutes.
FIRE-FIGHTING MEASURES	
General fire risks:	Exposure to naked flame may cause the container to rupture or explode.
Means of extinction:	Water spray. Dry powder.
Inappropriate extinguishing media:	Do not use water jets to extinguish the fire. Carbon dioxide.
Specific methods:	Use appropriate fire-fighting methods for the fire in the area. Exposure to naked flame and heat may cause the container to rupture. Keep exposed containers cool by showering with water from a safe position. Do not pour water contaminated by the fire into drains. Stop the leakage of product if possible. If possible, use water mist to abate fumes. Do not attempt to extinguish a burning gas leak unless absolutely necessary. The gas may re-ignite spontaneously and cause an explosion. Extinguish all flames in the vicinity. If it is possible to do so safely, move the recipients to a location at a safe distance from the fire.
MEASURES IN THE EVENT OF ACCIDENTAL LEAKAGE	
Individual precautions:	Try to stop the leakage. Evacuate the area. Consider the risk of explosive atmosphere. If it has not been proven that the air is breathable, use self-contained breathing apparatus to enter the area involved. Remove the sources of ignition. Ensure adequate ventilation. Prevent it from running into drains, cellars, excavation areas or places where the accumulation may be dangerous. Follow the local emergency plan. Stay upwind.
Environmental precautions:	Try to stop the leakage.

HANDLING AND STORAGE

Handling: Technical measures/precautions:	Use only in well ventilated spaces.
Recommendations for safe use:	The product must be handled according to the good safety and industrial hygiene practices. The pressurised gas should be handled exclusively by experienced and suitably trained personnel. Install any safety relief valves necessary in the gas circuit. Before use, make sure that the entire gas distribution system has been (or is regularly) checked for leaks. Do no smoke while handling the product. Only use specific equipment, suitable for the product, pressure and temperature of use. In case of doubts, contact the gas supplier. Assess the risk of a potentially explosive atmosphere and the need for explosion-proof equipment. Bleed all the air from the system before inserting the gas. Take precautions against the risk of electrostatic discharges. Keep away from sources of ignition (including electrostatic charges). Assess the need for using only reduced-sparking tools. Do not inhale the gas. Avoid releasing the product in the atmosphere.
Storage:	Observe the local regulations and legal requirements concerning the storage of the containers. The containers should not be stored in conditions that may lead to corrosion. Fit all caps and/or plugs correctly. Containers in storage must be kept in an upright position and secured so that they cannot fall over. The stored containers should be checked regularly to assess their general state and identify any leaks. Keep the container at a temperature below 50°C, in a well-ventilated area. Store de containers in areas in which there is no risk of fire, away from heat and ignition sources. Keep away from combustible substances. Do not store with oxidising gases or other oxidants in general. All electrical equipment in the storage area must be certified for use in explosive atmospheres.

CONTROL OF INDIVIDUAL EXPOSURE/PROTECTION

Control parameters:	OEL (Occupational Exposure Limits): Data not available. DNEL (Derived No Effect Level): Data not available. PNEC (Predictable no-effect concentrations): Data not available.
Respiratory protection:	Filter masks may only be used if all surrounding environmental conditions (e.g. type and concentration of contaminant/s) and the envisaged duration of use are known. Recommended: AX filter (brown). See the instructions provided by the supplier for selecting suitable personal protective equipment. Filter masks do not protect against oxygen-deficient atmospheres. EN 14387 - Respiratory protective devices - Gas filters and combined filters. EN 136 - Respiratory protective devices. Full face masks.
Eye/face protection:	Wear safety eyewear with side shields. Wear safety googles when filling containers and disconnecting the hose.
Protection of the hands:	Wear safety work gloves when handling gas containers.

PHYSICAL AND CHEMICAL PROPERTIES

Colour:	Colourless
Odour:	Often odourless. Sweetish. Less noticeable at low concentrations.
Boiling point:	-42.1°C
Relative density (water =1):	0.58
Relative density (air=1):	1.5
Solubility in water:	75 mg/l
Upper flammability limit:	9.5% (V)
Lower flammability limit:	1.7% (V)
Auto-ignition temperature:	470°C

STABILITY AND REACTIVITY	
Stability:	Stable under normal conditions.
Possibility of dangerous reactions:	May react violently with oxidants. May form explosive mixtures with air.
Materials to avoid:	Air, oxidising agents. Refer to the ISO 11114 standard for further information regarding the material compatibility.
Hazardous decomposition products:	Should not product hazardous decomposition products in normal storage and usage conditions.

TOXICOLOGICAL INFORMATION	
Acute toxicity:	This product has no known toxicological effect.
Local effects:	In high concentrations, it can cause asphyxiation. Symptoms may include loss of mobility and/or consciousness. The victim may not be aware that they are suffering from asphyxia. In low concentration, it can have a narcotic effect. Symptoms may include dizziness, headaches, nausea and loss of coordination.
Long term toxicity:	No carcinogenic, teratogenic or mutagenic effects observed in laboratory animals.

ECOLOGICAL INFORMATION	
Global warming potential GWP (EN378-1:2021):	0,02
Ozone depletion potential ODP (R11=1):	0
Disposal:	Do not discharge gas in areas where there is a risk of the gas forming an explosive atmosphere with air. The gas should be disposed of in a suitable torch with an anti-backfire device. Do not drain the product in places where accumulation may be harmful. Make sure that the emissions limits specified by local regulations or indicated in authorisation documentation are not exceeded.

CHAPTER 3

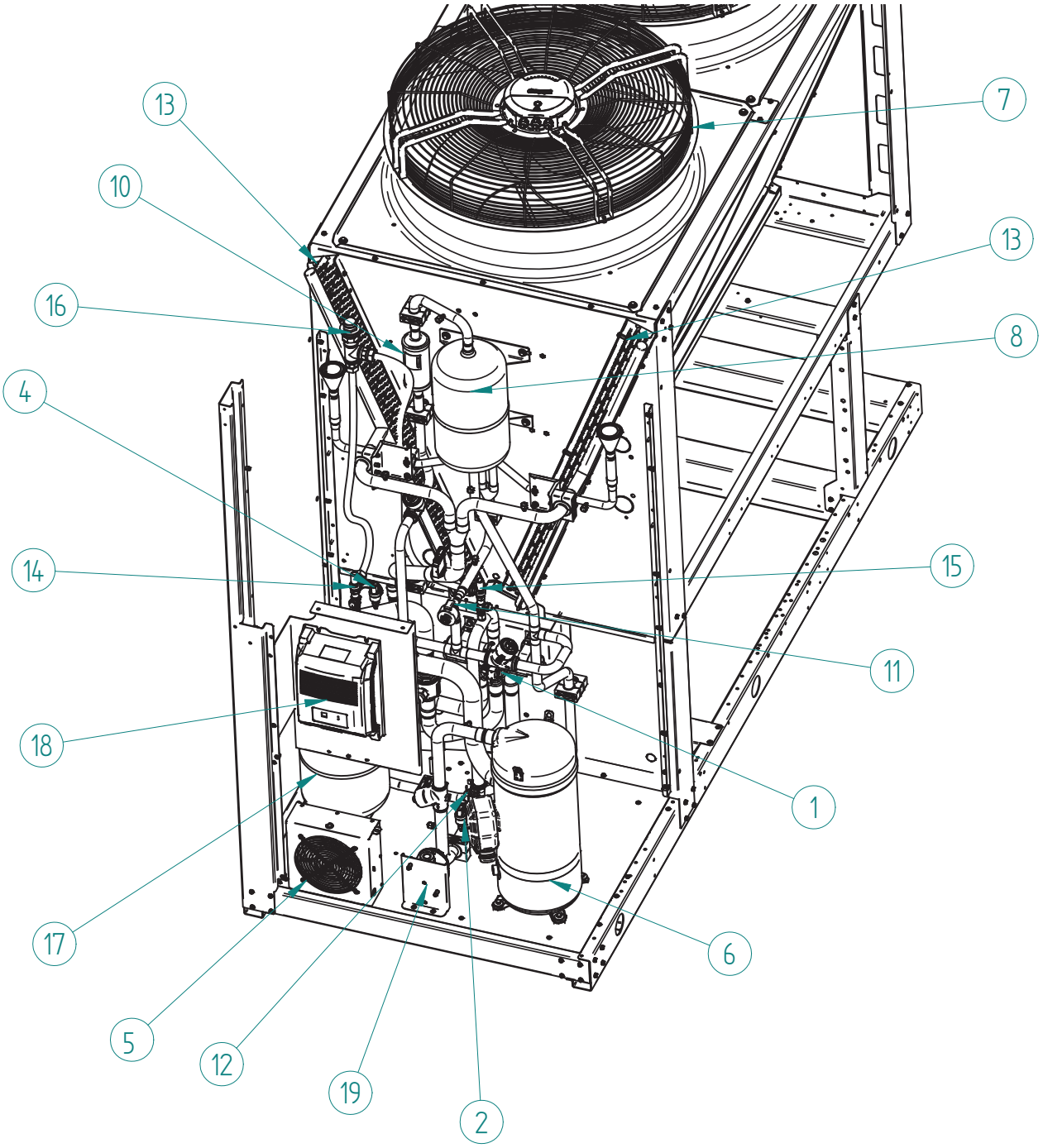
DESCRIPTION

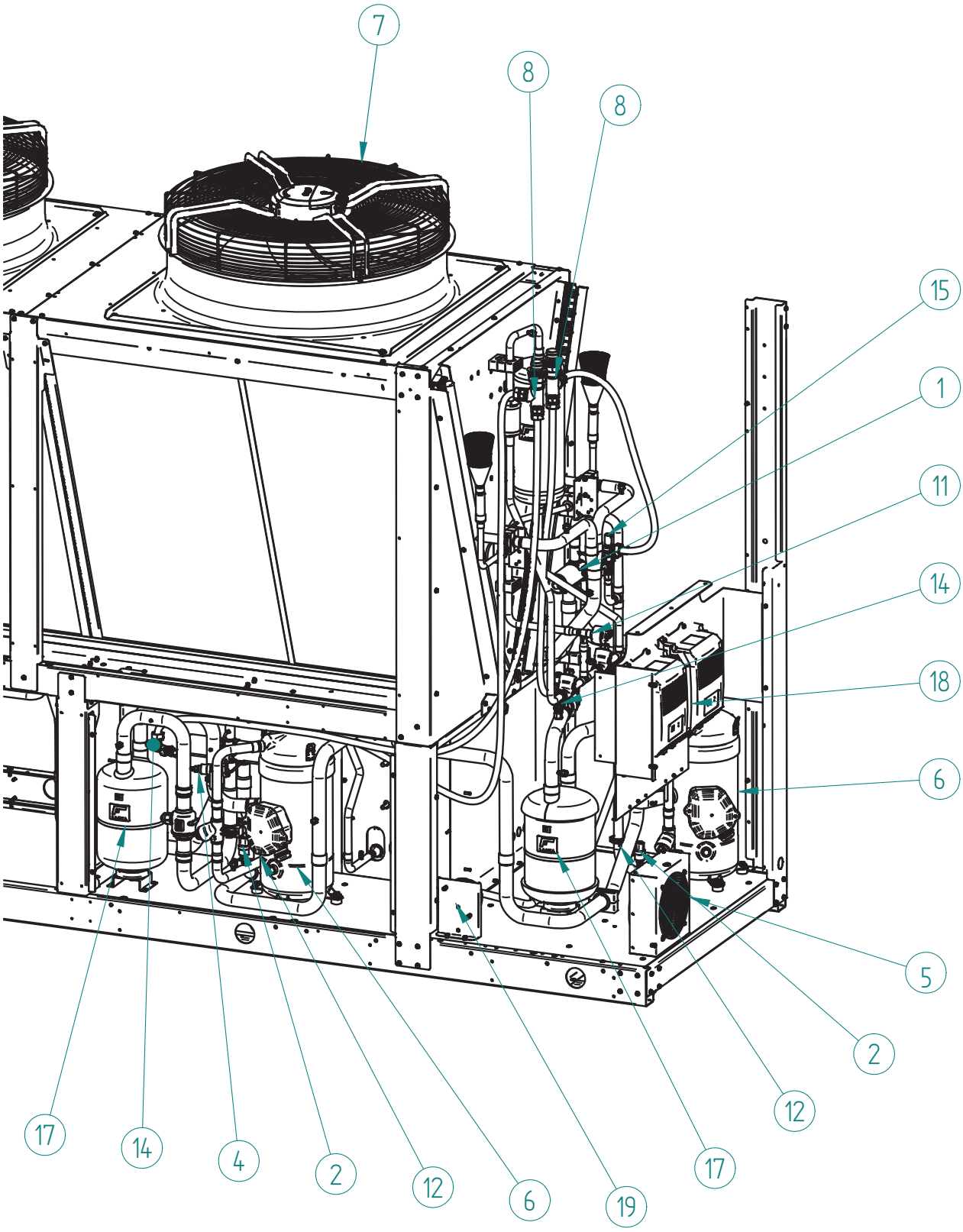
3.1 General information

They are monobloc units with air condensation equipped with hermetic compressors, water unit consisting of plate evaporator, storage tank (optional), pump (optional) and condenser formed by finned batteries and axial fans.
The management of each chiller is entrusted to a microprocessor control that manages all the main functions including adjustments, alarms and external interface.
The coolant used is R290.
All machines are made using premium brand components, and are designed, manufactured and controlled in accordance with ISO 9001 standards.

3.2 Refrigerator circuit

(See the attached diagrams.)
The descriptions in the following paragraphs refer to machines that work in SUMMER mode (i.e. to cool the user water).
The cooling cycle can be switched to WINTER mode by means of an electrically commanded 4-way valve that reverses the coolant flow, thereby heating the water in the evaporator.
For this reason, the same observations made for SUMMER mode operation will hold true, bearing in mind that the evaporator will work as a condenser and the condenser (of WINTER mode operation) will work as an evaporator.
All the units described in this manual use the same operating principle.
The refrigerant is pumped from the hermetic cooling compressor into the condenser.
The condenser is a heat exchanger of the finned pack type, skimmed by an air flow produced by one fan or more (depending on the machine model).
After leaving the compressor, the refrigerant passes through the reverse cycle valve before it reaches the condenser.
After the condenser, the refrigerant passes through an expansion valve.
It then enters the evaporator, which is of the plate type.
When it leaves the evaporator, it enters the liquid separator and returns to the compressor, then the cycle is repeated.
All the braze-welding for connecting the various components of the cooling circuit is made with silver alloy.
Below is information relating to the components of standard machines.
Components other than standard ones may be used to meet particular requirements.
In this case, refer to the project quote data.
The machine inverter range, in its standard configuration, is equipped with the following components (see images):
1 Cycle reversing valve
2 HP Control Transducer
3 Manual vent valve
4 LP Control Transducer
5 Washing fan
6 Scroll Single Compressor
7 Axial fan
8 Liquid receiver
9 Plate exchanger
10 Refrigerant filter
11 Electronic thermostatic valve
12 High pressure switch
13 Condensing battery
14 LP safety valve
15 HP safety valve
16 Manifold for unloading safety valves
17 Liquid separator
18 Inverter
19 Leak detector

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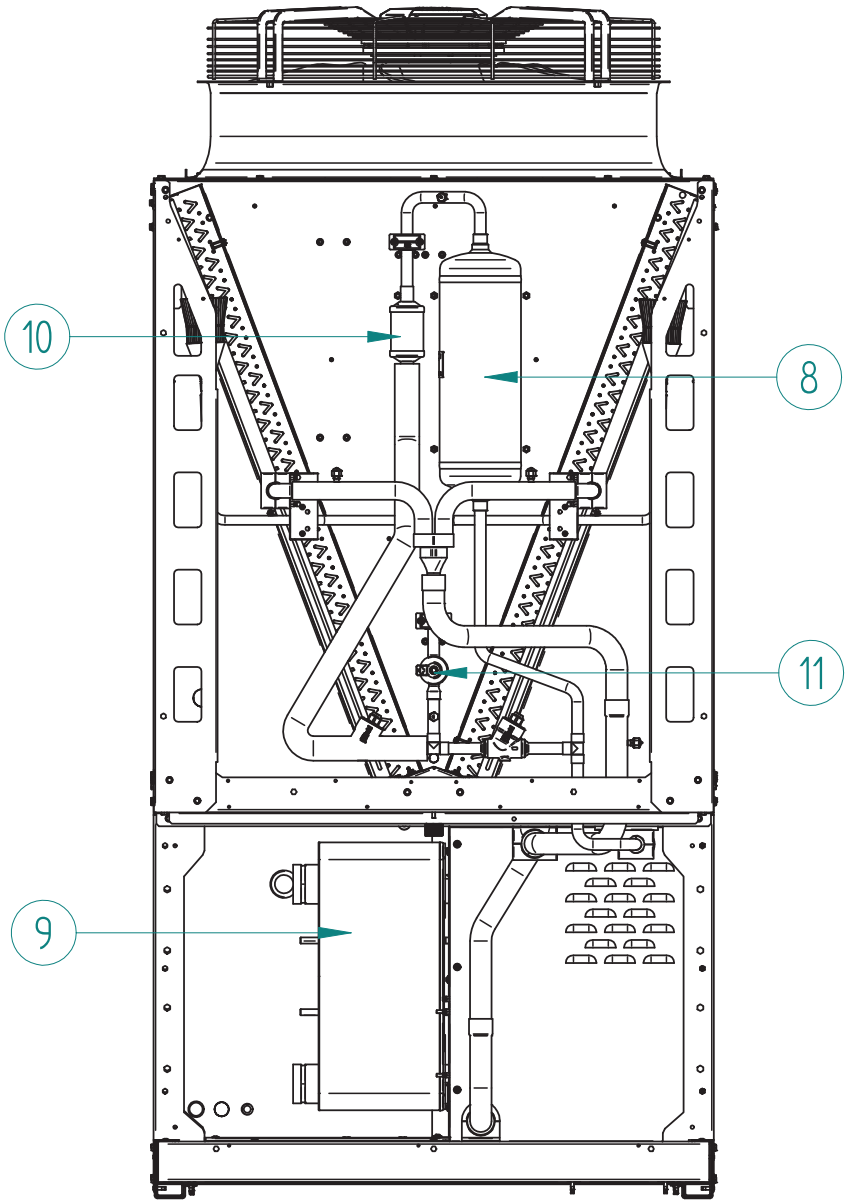
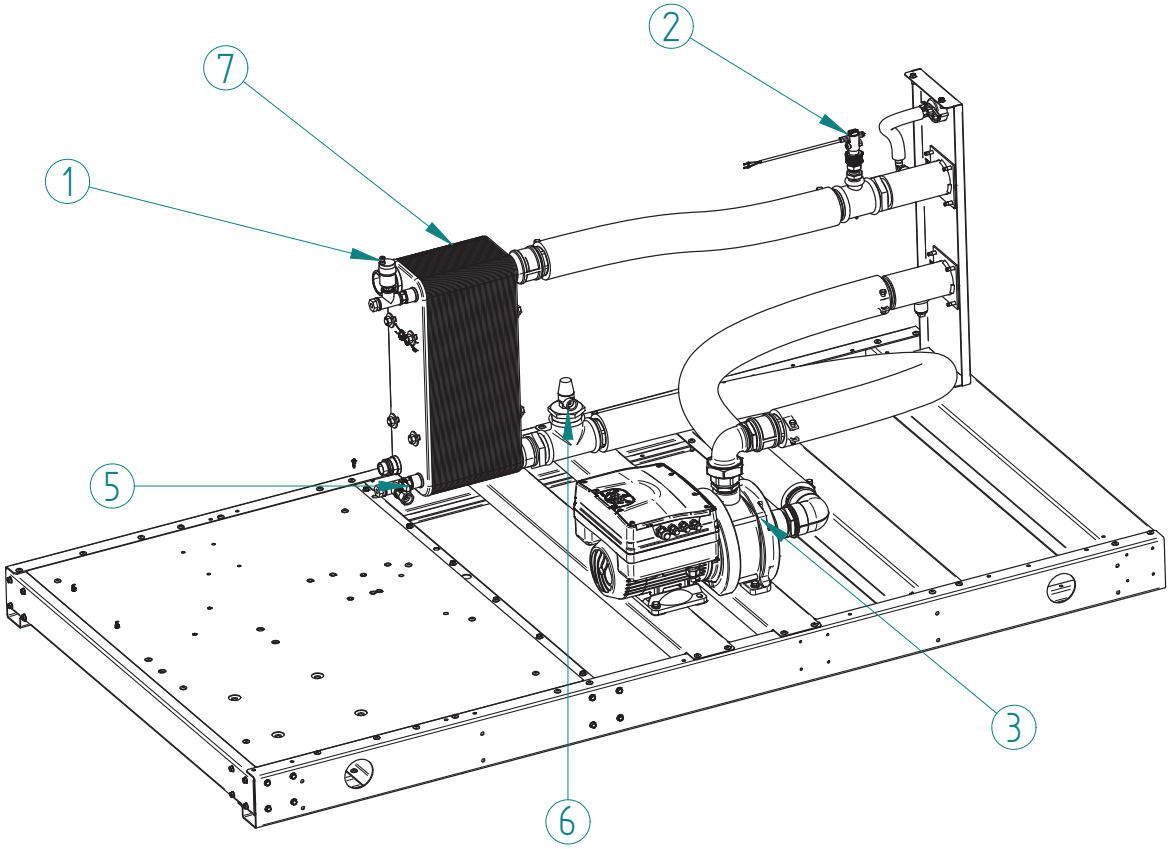


Depending on the operating mode (summer or winter), the cooling circuit cools or heats the water flow by means of a plate evaporator in which the coolant evaporates on one side and the liquid to be cooled flows on the other side.
The cooling compressor is commanded by an electronic control unit that regulates the water inlet temperature on the machine in order to keep the outlet temperature within the predefined limits.

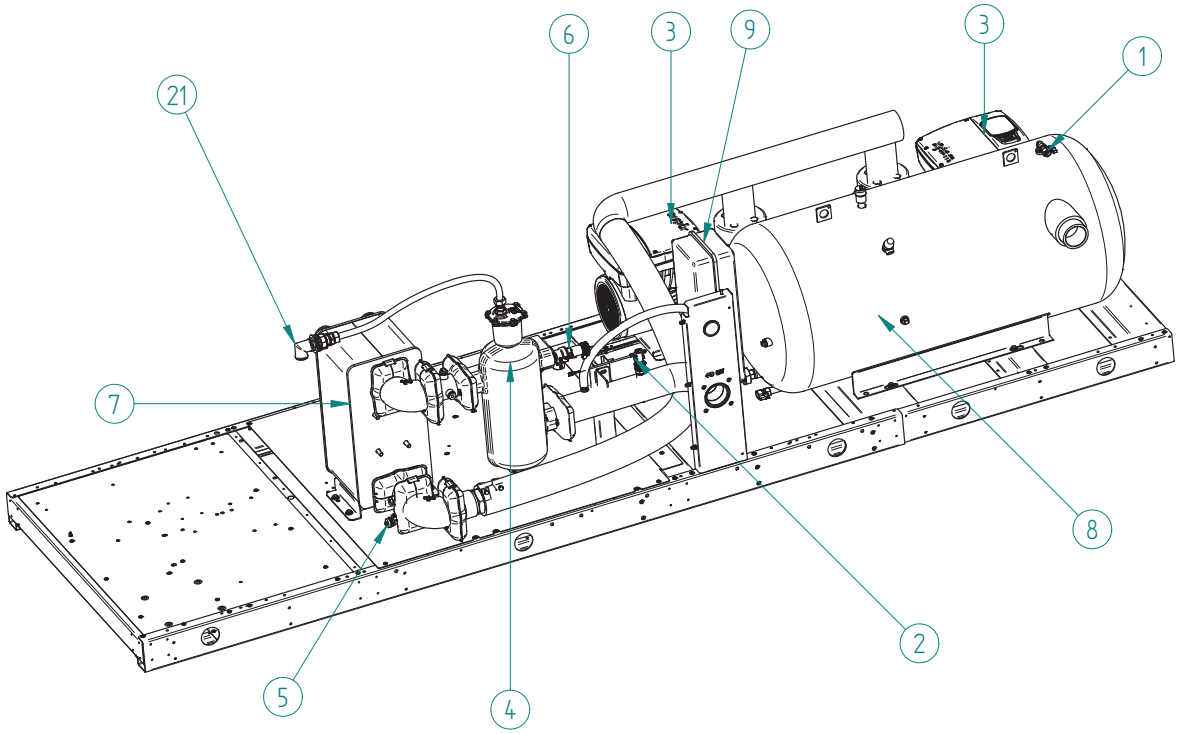
3.2.1 Hydraulic unit

The hydraulic unit consists of (see images):
1 Manual vent valve
2 Flow sensor
3 Pump
4 Deaerator
5 Drain valve
6 Water safety valve
7 Plate exchanger
8 Tank
9 Expansion vessel
21 Deaerator vent

With pump



With tank and pump



3.2.2 Water circuit

When the hydraulic unit is not present, the water circuit will consist only of the plate heat exchanger, where the water flows and exchanges heat with the refrigerant liquid in evaporation phase (CH operation) or in condensing phase (HP operation). If the hydraulic unit is present, a pump sucks up water from the inlet connection or from the accumulation tank (if present) and pushes it into the plate exchanger..

CAUTION

⚠ For correct operation, install a filter close to the unit's water inlet connection (with 0.4 mm mesh). Failure to comply with this requirement may cause irreparable damage to the evaporator. In the case of plate evaporators, the clogging of even a few plates (or gaps) can cause the plate to seize (clogging), leading to damage of part of the exchanger, even if water flow seems regular and operation is apparently normal. For this purpose there is a plate showing the standard water filter symbol affixed to the unit alongside the water inlet connection.

NOTE

For the correct operation of the heat pump, it is necessary to guarantee the availability of a minimum amount of water in the system equal to 10 liters/kW of nominal thermal power, such as to avoid frequent ignition cycles and allow the execution of defrosting cycles.
However, greater amounts of water are always preferable, to further reduce the on and off cycles of the compressors and to increase the efficiency of the system.

WARNING

⚠ Install hydraulic loading unit to always ensure the minimum necessary pressure inside the hydraulic circuit.

3.3 Materials

Data for materials are referred to standard units.
Non-standard materials may be used in order to meet specific requirements. In this case, refer to the project quote data.

3.3.1 Casing

The entire base, the uprights and the buffer panels are made of galvanised carbon steel sheet and are screwed together.
All panels undergo phosphor degreasing treatment followed by epoxy polyester power coating.
The structure is designed to ensure easy access to all the machine components.
In Super-Silenced units (XLN and XXLN), these components are positioned in the compressor site, sound isolated with a soundabsorbent mattress positioned on the side panels, compressor site - fan site separating panel and compressor site closing front panel.

3.3.2 Materials in contact with the liquid of the user circuit

The following description refers to the machine operating in SUMMER (chiller) mode; bear in mind that, after the reversal of the cooling cycle (when the unit is working as a heat pump - WINTER mode), the evaporator will work as a condenser.
The evaporator is of the plate type, in braze-welded stainless steel with copper. The tank is made of carbon steel and the pipes are copper.

3.3.3 Hydraulic unit (optional)

Upon request, these units can be equipped with a hydraulic unit that may consist of:

- Pump P2
- Pump P3
- Pump VF P2
- Pump VF P3
- Pump P2+P2
- Pump P3+P3
- Pump VF P2+P2
- Pump VF P3+P3
- tank + pump P2
- tank + pump P3
- tank + pump VF P2
- tank + pump VF P3
- tank + pump P2+P2
- tank + pump P3+P3
- tank + pump VF P2+P2
- tank + pump VF P3+P3

Pump P2:
With a working head of approx. 20 m.c.a. The pump is already connected to the evaporator and the water inlets/outlets (see overall dimension diagrams in the manual). The electronic control unit commands the pump and manages the thermal protection alarm.
Pump P3:
With a working head of approx. 30 m.c.a. The pump is already connected to the evaporator and the water inlets/outlets (see overall dimension diagrams in the manual). The electronic control unit commands the pump and manages the thermal protection alarm.
Pump VF P2:
Inverter pump with a working head of approx. 20 m.c.a. The pump is already connected to the evaporator and the water inlets/outlets (see overall dimension diagrams in the manual). The electronic control unit commands the pump and manages the thermal protection alarm.
The speed is fixed. The default rpm parameters (which are different in Chiller or in Heat pump operation) are set at the factory and correspond to the nominal design conditions. For any changes, please contact the Service Centre.
Pump VF P3:
Inverter pump with a working head of approx. 30 m.c.a. The pump is already connected to the evaporator and the water inlets/outlets (see overall dimension diagrams in the manual). The electronic control unit commands the pump and manages the thermal protection alarm.
The speed is fixed. The default rpm parameters (which are different in Chiller or in Heat pump operation) are set at the factory and correspond to the nominal design conditions. For any changes, please contact the Service Centre.

WARNING

⚠ The motors contain DC bus capacitors that can remain charged even when the frequency converter is not powered.

Failure to comply with the indicated waiting time after disconnecting the power supply and before carrying out maintenance or repair work, may cause serious or fatal injuries.
Wait for the capacitors to discharge completely before performing any maintenance or repair work. The waiting time is 15 minutes.

Tank and pump unit:
A horizontal, cylindrical tank (185 liters in 023 models, 285 liters in 030-035 models) made of carbon steel with an aluminium-plated, anti-condensate insulating layer. For the description of the pump, see above. The tank and pump are installed on the machine base and are linked with rigid pipes insulated with armaflex. The connections between the evaporator, pumps and machine connection points are made with tubes insulated with armaflex. This option also includes:

- an expansion tank
- a drainage tap
- a safety valve

CAUTION

⚠ The pump must never operate in the absence of water.

3.3.4 Fan(s)

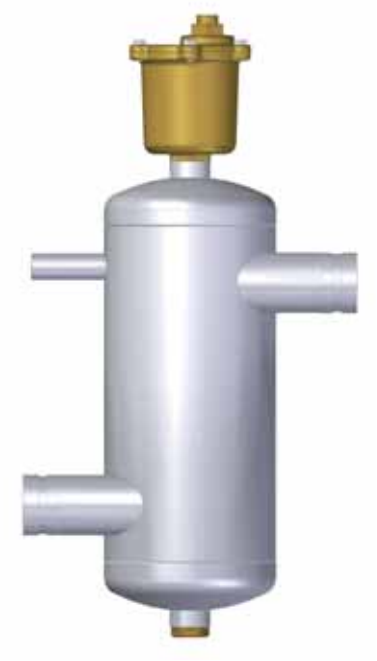
All the machines are fitted with axial fans.
The units are equipped with fans with plastic blades and suitably radiated highdensity polystyrene conveyors.
All the units have fans that are electronically adjusted with an integrated inverter motor and EC technology (permanent magnets and electronic switchover).
The protection level is IP55 with insulation class F, to enable outdoor operation in all climates.
The assembly is completed by an external fan support grille to prevent accidents.

CAUTION

⚠ In the event of maintenance work on the EC fans, the fact that condensers are used means it is necessary to wait at least 15 minutes after disconnecting the power supply to the unit before opening the box containing the electrical contacts.
- To avoid condensation the drive must be continuously energized due to the application of heat, with interruptions such that cooling to the point of condensation does not occur.

3.3.5 Deaerator (optional)

The units can be equipped with a deaerator that allows to continuously remove any refrigerant gas leaks that may come from the exchanger.



CAUTION

⚠ If the deaerator is installed at the factory, the vent is routed to the compressor compartment to ensure the safe shutdown of the machine if R290 refrigerant is present in the hydraulic circuit (e.g. plate heat exchanger damage).

The discharge capacity of this device is very high and allows the circulation of unseparated water, reducing the risk of having R290 in the hydronic circuit.
If not installed or supplied as a kit, the installation is recommended and carried out by authorised, informed and trained personnel on the specific risks from flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.
The device must be protected against external agents' direct effect (e.g. rain, hail, snow), direct sunlight and biological agents.
Possible presence of ice can block the HED (High Efficiency Deaerator) functionality.
The device could withstand ambient temperatures below 0°C, but with the following conditions and precaution:

- no ice formation inside or outside the device;
  a complete insulation of the part is recommended, keeping the air vent outlet be able to evacuate the air/gas anyway;
- in case of use of any additive to water, material compatibility HED operation and performances must be verified by the customer in his own applications and foreseen conditions.

Respect the correct operating flow. The fluid flow has an inlet at the top and an outlet at the bottom.
Make sure that during assembly the surfaces of the connections are not scratched or damaged, compromising the hydraulic seal of the product.
If dirty fluids flow into the product, they could compromise the functionality of the air vent valve; they must be avoided.
Always provide a layout that makes the product replaceable.
The device shall not be subject to permanent forces or bending torques between connections admitted after installation.
Maintenance and possible substitution shall be considered in the system layout.
In accordance with applicable regulations, the safety relief valve drain must be channelled using suitable pipes.
The device must not be subject to eddy currents. Guarantee the equipotentiality of the device with the rest of the system.
The customer should set an adequate plan for verifying the functionality of the product over time.
In case of malfunction it is necessary to replace the device.
The presence of glycol negatively affects the efficiency of deaeration, the more the higher the percentage of glycol present.
In the case of using glycol, it is recommended to use a type of glycol that has the characteristics described in the relevant paragraph.
In the case of using mixtures of water and glycol, it is not recommended to add additives that may cause the formation of foams under certain conditions as they may further negatively affect the performance of the deaerator.

Materials

Element	Material
Main body	Stainless steel
Air vent obturator seal	FKM
O-rings	EPDM (peroxide cured)
Air vent body and cap	Brass CC753S – Brass CW617N-DW-M
Float - stem	Stainless steel

3.3.6 Characteristics of the recommended glycol with deaerator kit

Product identification: **MONOPROPYLENGLICOLE PROPANE-1,2-DIOL**

Below are the characteristics of propylene glycol:

Appearance:	Liquid
Colour:	Colourless
Odour:	Odourless
Melting point/scope: (1013 hPa)	-68°C
Boiling point/range: (1013 hPa)	185°C
Autoflammability:	371°C
Flash point:	101°C
Lower explosion threshold:	2.6 Vol-%
Upper explosion threshold:	12.6 Vol-%
Vapour pressure: (20°C)	0.1 hPa
Density: (20°C)	Data not available
Bulk density: (20°C)	1.036 kg/m^3
Solubility in water: (20°C)	Soluble
Soluble in:	Polar solvents
PH value:	Neutral
Viscosity: (20°C)	46 mPa.s

3.4 Energy meter (optional)

With the option Energy Meter, the user can track energy consumption of the unit on the TD7 display.

The information displayed is as follows:

- Unit power consumpion in kW: the value on the display is updated on the next falling pulse.
- Chiller power demand: this value represents a filtered sliding time window average of the unit power consumption.
- Energy consumption last reset: displays the date and time stamp when the last “Clear energy consumption” was set.
- “Energy consumption non-resettable”: displays accumulated energy consumption over the life of the Symbio 800 in kilowatt-hours.
- “Clear energy consumption”: will clear the “Energy consumption resettable” value and will change the “Energy consumption time of last reset” value to the current date/time.
- Hourly energy consumption: result in Wh, can be displayed as xxxx kWh.
- Daily energy consumption: sum of “Hourly energy consumption” from 00H to 23H.

Furthermore, the Energy Meter display shows in real time the information regarding the instantaneous energy consumption of the unit by making the following data available to the user:

- Current:
  instantaneous value: I1, I2, I3, In
  average max. value: I1, I2, I3, In
- Voltages and frequency:
  instantaneous value: V1, V2, V3, U12, U23, U31, F
- Power:
  instantaneous value: 3P, ΣP, 3Q, ΣQ, 3S, ΣS
  average max. value: ΣP, ΣQ, ΣS
- Power factors:
  instantaneous value: 3PF, ΣPF
- Active energy:
  +/- kWh.

3.5 Electronic package (optional)

The unit can be supplied with additional boards for the following functions:

- Auxiliary Setpoint and Ice Making Command Inputs
- External Chilled Hot Water Setpoint, Demand Limit Setpoint and % Capacity Output
- Noise Reduction Request
- Operating Status Programmable Relays Module 1

For further details, refer to the wiring diagram or consult Service.

3.6 Additional heaters (optional)

The unit can be supplied with additional heating elements.
In heating mode, the controller maintains the outlet water temperature at the set value.
When all compressors in the unit are on and the unit is unable to reach the set temperature, additional heating stages are activated.
If additional heating elements are fitted, a control board is installed inside the electrical panel to allow the user to manage them.

CHAPTER 4

INSTALLATION

CAUTION

⚠ Before installing or operating these machines, make sure that all personnel have read and understood Chapter 2 “Safety“ of this manual. The unit must be installed in accordance with current national legislation in the country of use.

4.1 Overall dimensions

See the enclosed diagrams.

4.2 Installation precautions

WARNING

⚠ System charged with flammable refrigerant R290.

After positioning the machine and before unpacking, check that there are no refrigerant leaks using a specific gas detector.
Check that there are no sources of ignition / open flames / sparks etc. within the safety zone.
Do not smoke near the unit. (see sticker ch. 2.2 “Symbols”)

Always perform maximum preparatory work before the unit arrives on site: drilling holes and penetrations, installing cable walkways, installing water piping, etc.
Before transporting the unit to its final location, perform a complete leak detection.
It is also strongly recommended to repeat the detection during the different phases of installation, especially if commissioning takes several days.
Installation work must be carried out by competent personnel under a qualified supervisor.
The connections to be made concern the process water circuit. For the connection to the mains power supply consult the technical documentation attached to the machine.

DANGER

⚠ **The unit must be positioned in an area where there are no continuous ignition sources (e.g. naked flames).**

4.3 User requirements

The machines must be installed in safe places, free of areas with potentially explosive atmospheres. They must be connected to electrical systems designed according to current standards, in areas compliant with the standards imposed by the Fire Brigade and in environments compliant with local building standards.
Within the potentially explosive areas generated by the machine, also taking into account the national regulations of the country of use, it is necessary to:

- Do not install equipment that is unsuitable for use in these potentially explosive zones (the minimum requirements of the equipment are: 3G IIB T4);
- Avoid naked flames, sparks and hot works;
- Avoid the presence of sources of ignition due to processes that may generate remote triggers (ionising and non-ionising radiation);
- Avoid the direct and indirect effects of lightning;
- Avoid electrostatic charges;
- When considering ignition sources, refer to Annex K of standard EN 378-2.
- Avoid interference with potentially hazardous elements such as drains, openings in the earth, basements, power lines, stores of flammable substances, railways, motorways etc.

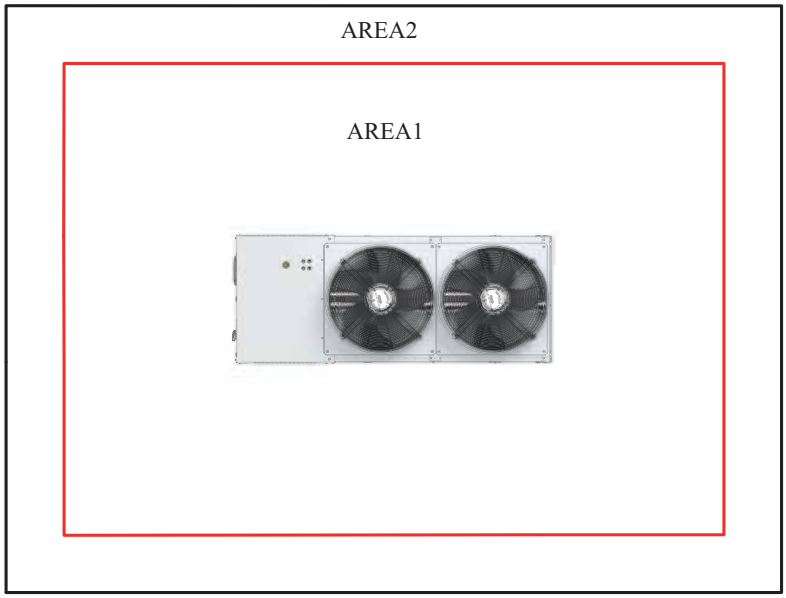
As the refrigerant gas used is heavier than air, even a small gas leak, which in itself is not dangerous, can cause a build-up of gas if it infiltrates into underground areas, forming pockets.
A suitable “safety” distance should be assured also for chilling systems installed outdoors, in order to minimise the risk that flammable concentrations enter premises occupied by humans (e.g. through windows, ventilation openings, where people meet outdoors, etc.). However, external wind speeds tend to be quite high (compared to indoor environments) even when the air seems “still”, so also the amount of flammable mixture should be adjusted to consider the additional dispersion caused by the surrounding air.

CAUTION

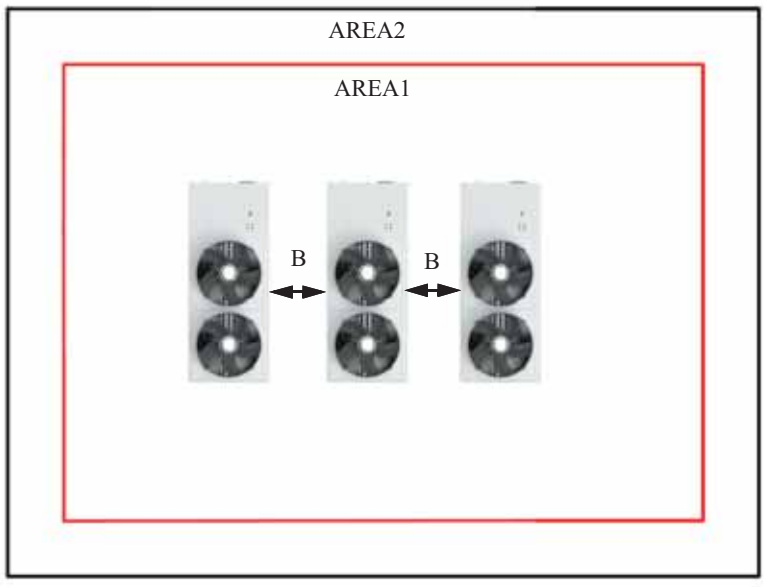
⚠ Two safety areas are defined around the machine:

Safety Area 1:This area extends for 1.5 metres around the machine. Within this area, a potentially explosive atmosphere may form; therefore, ignition sources as defined by standard EN 378-2 must be avoided (for example, open flames, electrical devices not suitable for use in explosive atmospheres, power sockets, etc.).
Safety Area 2:This area extends for 0.5 metres beyond Safety Area 1. Within this area, there must be no locations where, in the event of a leak, refrigerant could accumulate (for example drains, light wells, windows, doors, air intake ducts, etc.).

Safety distance around the machine

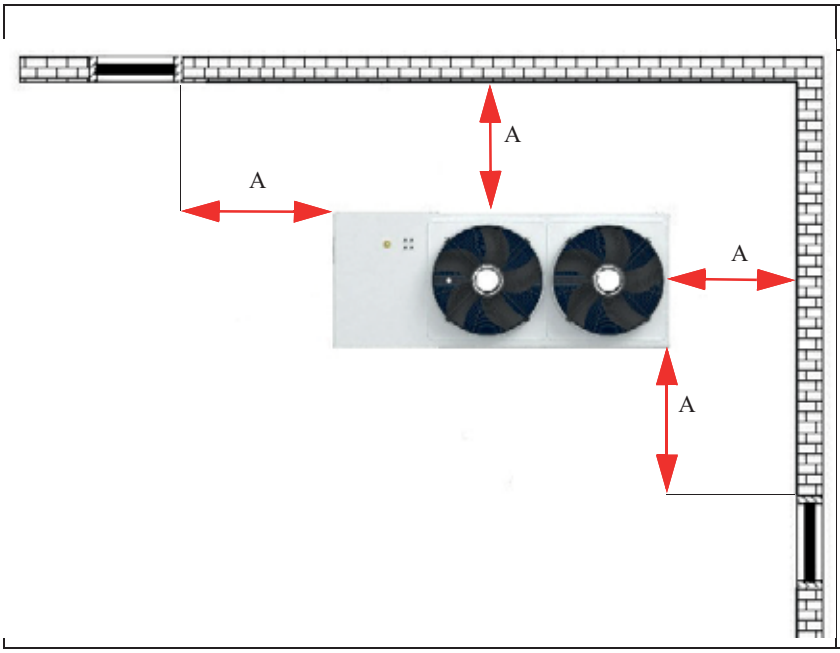


Installing multiple machines



B
250 mm for 018 500 mm for 023÷035

Ground installation in a corner of the building



A	
1500 mm	2000 mm in locations where, in the event of a leak, refrigerant could accumulate (for example drains, light wells, windows, doors, air intake ducts, etc.).

CAUTION

⚠ The electrical panel must always face the opposite side of the wall to ensure safe access.

CAUTION

⚠ The flammability and classification of the danger zone for the place of installation must be assessed by the final customer, who shall refer to the local regulations in force and consequently adopt the most restrictive result.

CAUTION

⚠ Cordon off access to the area to prevent accidents.

The electricity supply line to the machine must be protected with the aid of devices that should be chosen and installed by the user on the basis of the data in the wiring diagram and in ch. 6.2 “Electrical connections” . All the piping of the cooled water must be painted or clearly marked in compliance with the local safety in force in the installation place. All electrical connections must comply with the local prescriptions in the installation place. The machine and the auxiliary apparatus must be earthen and protected against short-circuits and overloading. If raised platforms are required to provide access to the unit they must not interfere with normal operation or obstruct access for lifting or dismantling components. Platforms and stairs should be of grid or plate construction with safety rails on all open sides.

4.4 Location

1. Maximum height above sea level 2000 metres.
2. The machine must only be installed outdoors and in places where natural ventilation is not hampered.
3. In fact, it is strictly forbidden to install the machine within Atex environments generated by other machinery/ plants. If the machine is installed on the roof of a building, the place of installation must be inspected in order to ensure that it is protected against lightning (evaluation of the risk of lightning according to EN 62305).
4. The refrigerant is heavier than air, so even a small leakage may cause a build-up of gas if it seeps into closed areas and stagnates; For this reason, it is important to ensure natural ventilation in the area where the unit is installed.
5. Install the unit so that, in the event of a leakage, the refrigerant cannot seep into buildings; this means guaranteeing that it cannot penetrate via doors, windows or any ventilation opening, and ensuring there is no underground infiltration leading to pockets of refrigerant. The technical rule states the need to maintain minimum installation distances from underground rooms, sewage traps, rainwater traps and any other accessible opening or empty underground container. The distance is determined on the basis of the deposit volume. This problem can be managed by applying the technical fire prevention rule in the place where the machine is installed.
6. The safety valves (if present) must be directed to the outside of the unit in a safe area and away from possible sources of ignition. The discharge must be conveyed at least 1 metre from the ground, and facing upwards. The cross section and length of the discharge pipe must comply with the national laws and the directives applicable in the place of installation.
   To avoid any possible clogging of the pressure discharge pipe, fit a cover to keep out rainwater.
7. The ambient air must be clean, avoid sea ambients (brackish air), and not contain flammable gas or corrosive solvents.
8. The minimum and maximum working ambient temperature are specified on the unit data plate. Ensure that the unit is not installed in flows of hot air emitted by other equipment.
   In extreme temperature conditions, the protection devices may be triggered.
9. Do not obstruct or interfere with the air flow produced by the unit; comply strictly with the minimum spaces/ distances specified in the installation drawings.
10. The machine must be installed on a perfectly horizontal flat surface, built and calculated to withstand the machine's operating weight, especially in the contact points highlighted in the installation drawing. **Installations which fail to comply with the above requirements will immediately render the manufacturer's warranty cover null and void, and could cause machine malfunctioning or even lockout.**
11. The units are shipped from the factory with plastic supports positioned under the base that must be removed during installation. It is advisable, however, to insert a stiff rubber belt between the main frame and the support surface. If greater insulation is needed, anti-vibration supports should be used.
12. Leave some clearance around the machine for access during service interventions (see Annexes).
13. While the heat pump is in operation, the air in contact with the finned coil may reach the dew point, causing the moisture contained in the air to condense. The quantity of condensate water produced depends on ambient conditions. The installation of the unit must allow the correct drainage and outflow of the condensate water.

CHAPTER 5

HYDRAULIC CONNECTIONS

5.1 Evaporator water limit features

Contents		Concentration mg/l or ppm	Material	
			AISI 316L	Copper
pH		<6	o	o
		6-7.5	o	o
		7.5-9	+	+
		>9	+	o
Alkalinity	HCO_3^-	<70	+	o
		70-300	+	+
		>300	+	o
Sulphate	SO_4^{2-}	**<70**	+	+
		70-300	+	-
		>300	+	-
Alkalinity/Sulfate	HCO_3^-/SO_4^{2-}	**>1**	+	+
		<1	+	-
Electrical conductivity	µS/cm	**10-500**	+	+
Ammonium	NH_4	**<2**	+	+
		2-20	+	o
		>20	+	-
Free chlorine	Cl_2	**<1**	+	+
		1-5	-	o
		>5	-	-
Hydrogen sulphide	H_2S	**<0.05**	+	+
		>0.05	+	-
Free carbon dioxide (aggressive)	CO_2	**<5**	+	+
		5-20	+	o
		>20	+	-
Nitrate	NO_3^-	**<100**	+	+
		>100	+	o
Iron	Fe	**<0.2**	+	+
		>0.2	+	o
Aluminium	Al	**<0.2**	+	+
		>0.2	+	o
Manganese	Mn	**<0.1**	+	+
		>0.1	+	o

Chloride content (Cl^-)	Maximum temperature			
	60°C	80°C	120°C	130°C
< 10 ppm	AISI 304L	AISI 304L	AISI 304L	AISI 316L
≤ 25 ppm	AISI 304L	AISI 304L	AISI 316L	AISI 316L
≤ 50 ppm	AISI 304L	AISI 316L	AISI 316L	
≤ 80 ppm	AISI 316L	AISI 316L	AISI 316L	
≤ 150 ppm	AISI 316L	AISI 316L		
≤ 300 ppm	AISI 316L			

+	Good resistance
or	When multiple factors are “o” corrosion can occur
-	Not recommended

WARNING

⚠ Note: It is important to note that this water specification is not a guarantee against corrosion, but should be considered a tool to avoid the most critical water applications.

5.2 Expansion vessel

The expansion vessel must always be installed on the pump suction side.
To calculate the minimum volume of the expansion tank necessary for a given installation, the following calculation can be used, valid if the pressure in the circuit is less than or equal to 0.5 bar when the pump is stopped and the maximum operating pressure of the expansion tank is greater than or equal to 4 bar.
The volume of expansion vessel V in litres is provided by the formula:
$V = 2 \cdot Vt \cdot (Ptmin - Ptmax)$
where:

Vt= Total circuit volume in litres
Ptmin= Specific weight at the minimum temperature that the water can reach during the year °C (even with the system idle)
Ptmax= Specific weight at the maximum temperature reachable by water during the year in °C (even when the system is stopped)

Calculation example:
Vt=200 litres
percent ethylene glycol by volume=30%
tmin = 5°C from the table **Ptmin** = (1.045+1.041)/2 = 1.043
tmax = 40°C from the table **Ptmax** = 1.0282
$V=2 \cdot 200 \cdot (1.043 - 1.0282)=5.92$ litres

Specific densities table P

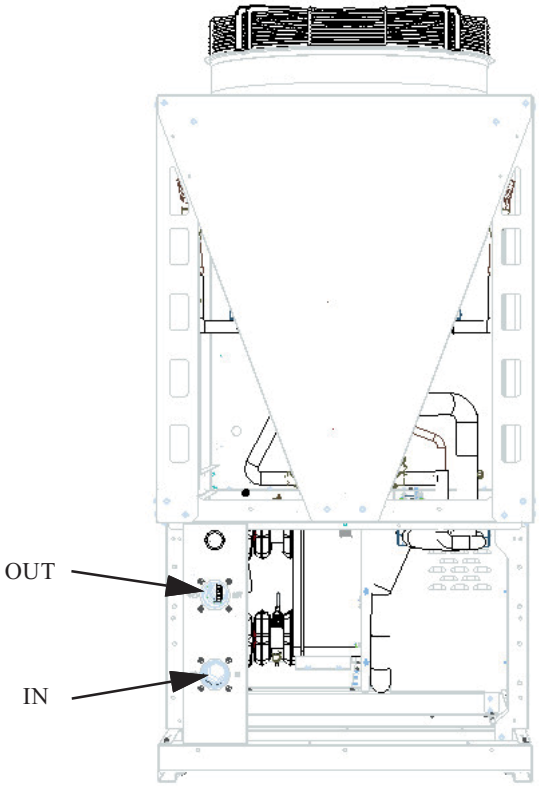
	% Glycol	0%	10%	20%	30%	40%
Temperature [°C]	-20	1.0036	1.0195	1.0353	1.0511	1.0669
	-10	1.0024	1.0177	1.033	1.0483	1.0635
	0	1.0008	1.0155	1.0303	1.045	1.0598
	10	0.9988	1.013	1.0272	1.0414	1.0556
	20	0.9964	1.0101	1.0237	1.0374	1.051
	30	0.9936	1.0067	1.0199	1.033	1.0461
	40	0.9905	1.003	1.0156	1.0282	1.0408

5.3 Hydraulic connections

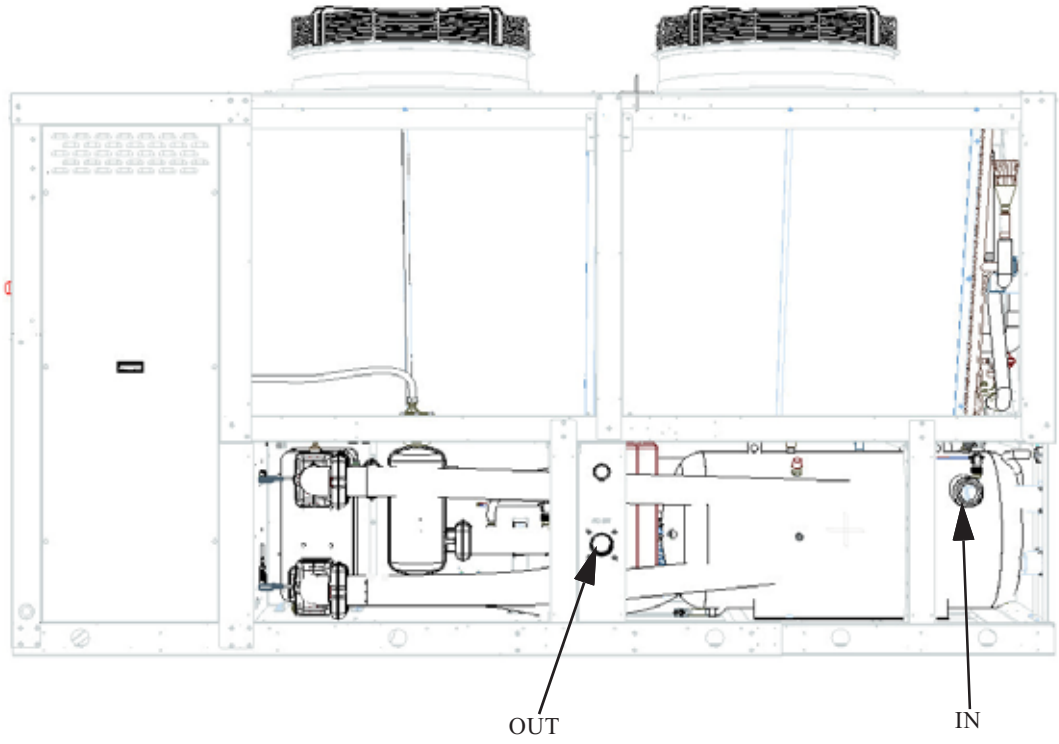
The units have threaded water connections (refer to the figure). The pipe diameters are shown in the table below.
The position of the water connections varies depending on the configuration of the hydraulic circuit.

1. When connecting the machine to the water pipes, respect the direction of the water (as shown in the figures or in the overall dimension drawings attached).
2. Provide two valves (one at the inlet, one at the outlet) to isolate the unit in the case of maintenance work without having to empty the user water circuit.
3. Install Y-filter in suction to the pump.
4. Install hydraulic loading unit to always ensure the minimum necessary pressure inside the hydraulic circuit.
5. Install an expansion vessel (if not already supplied).

Example with pump



Example with tank and pump



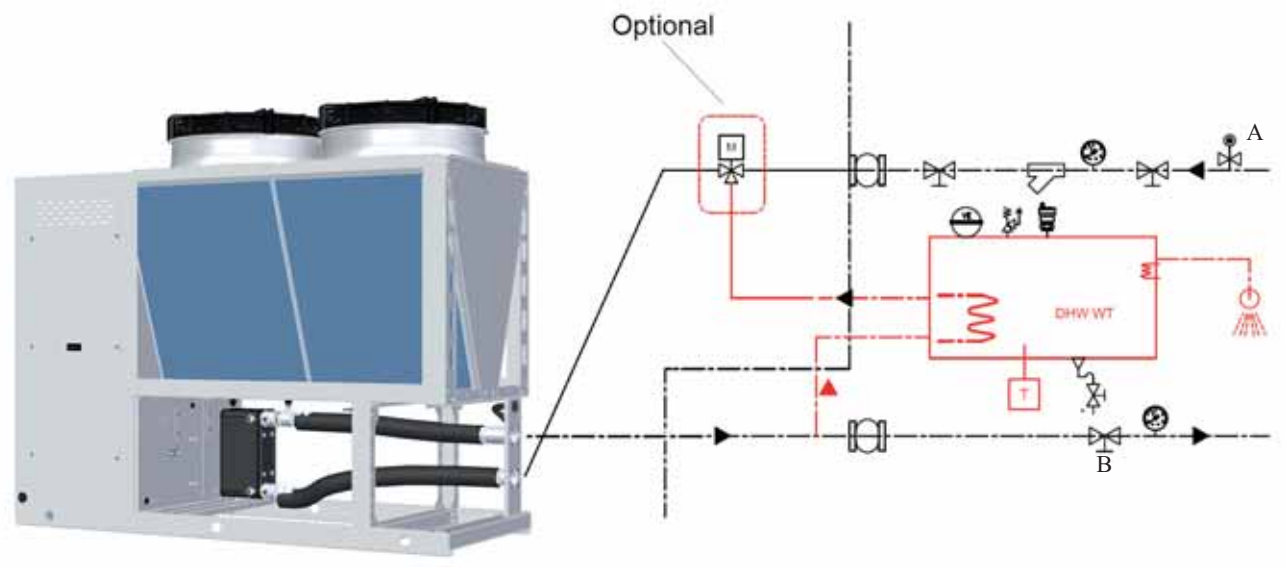
CAUTION

⚠ For proper operation install the filter supplied with the unit (with 0.4 mm mesh). The filter must be installed in the pump suction. Failure to observe this prescription can result in irreparable damage to the evaporator.
In the case of plate evaporators in fact, the clogging of even just some plates (or gaps) can cause the plate to seize (clogging), leading to the breakage of part of the exchanger, even if the water flow seems regular and operation is apparently normal.

The hydraulic system must be sized so that the pressure values of the water flowing into the machine are no higher than those shown in the table:

Model	IN/OUT water and gas connection diameter
018	2”
023	2 1/2”
030	2 1/2”
035	2 1/2”

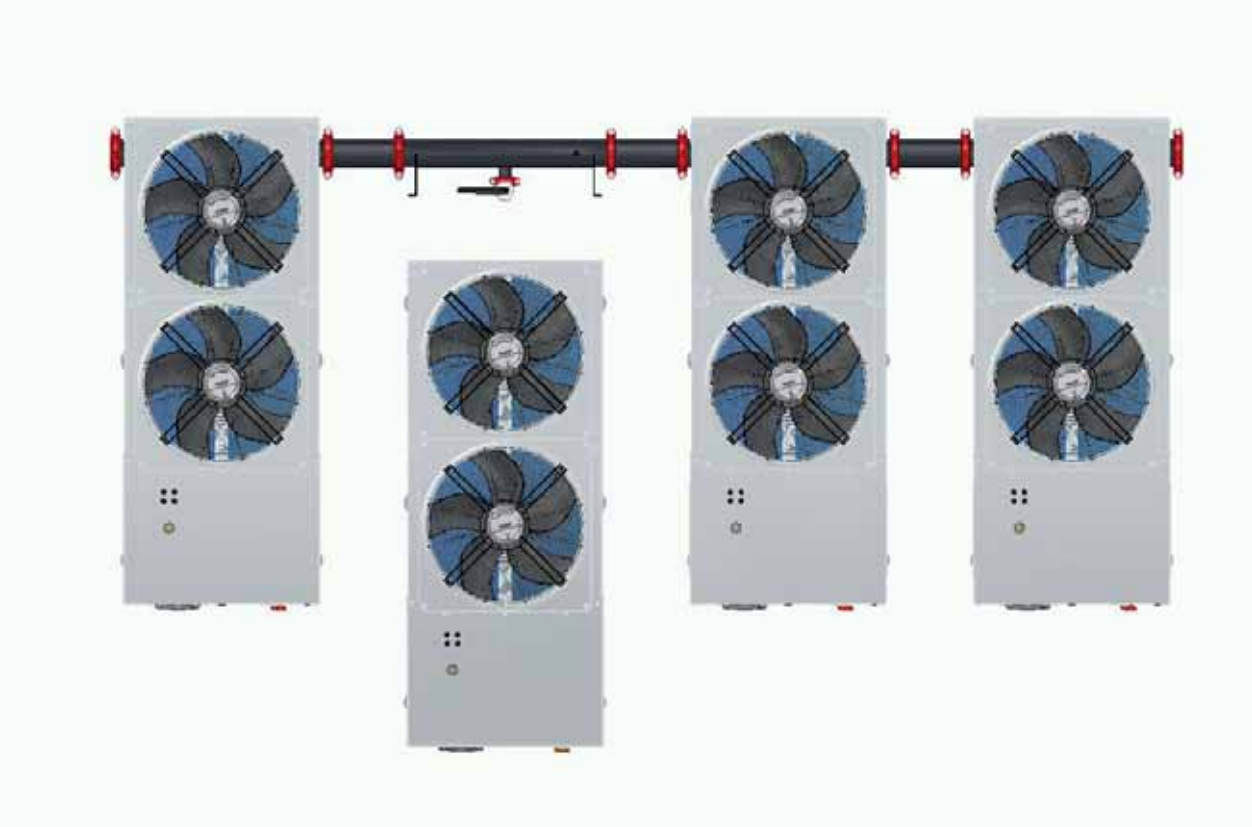
Below is an example of a functional diagram



	Relief Valve		Automatic Water Charge
	Expansion Vessel		Water Discharge
	Gauges		Antivibration System
	Safety Valve		Filter
	Shut Off Valve		3 Way Valve

5.4 Modular installation

The machines can operate in modular configuration (from 2 to 6 units), connected via a hydraulic connection kit.
The distance between one machine and the next depends on the installation site and it can be between 11cm and 50cm.
To position the machines in modular configuration, it is necessary to follow the instructions given in the image below:



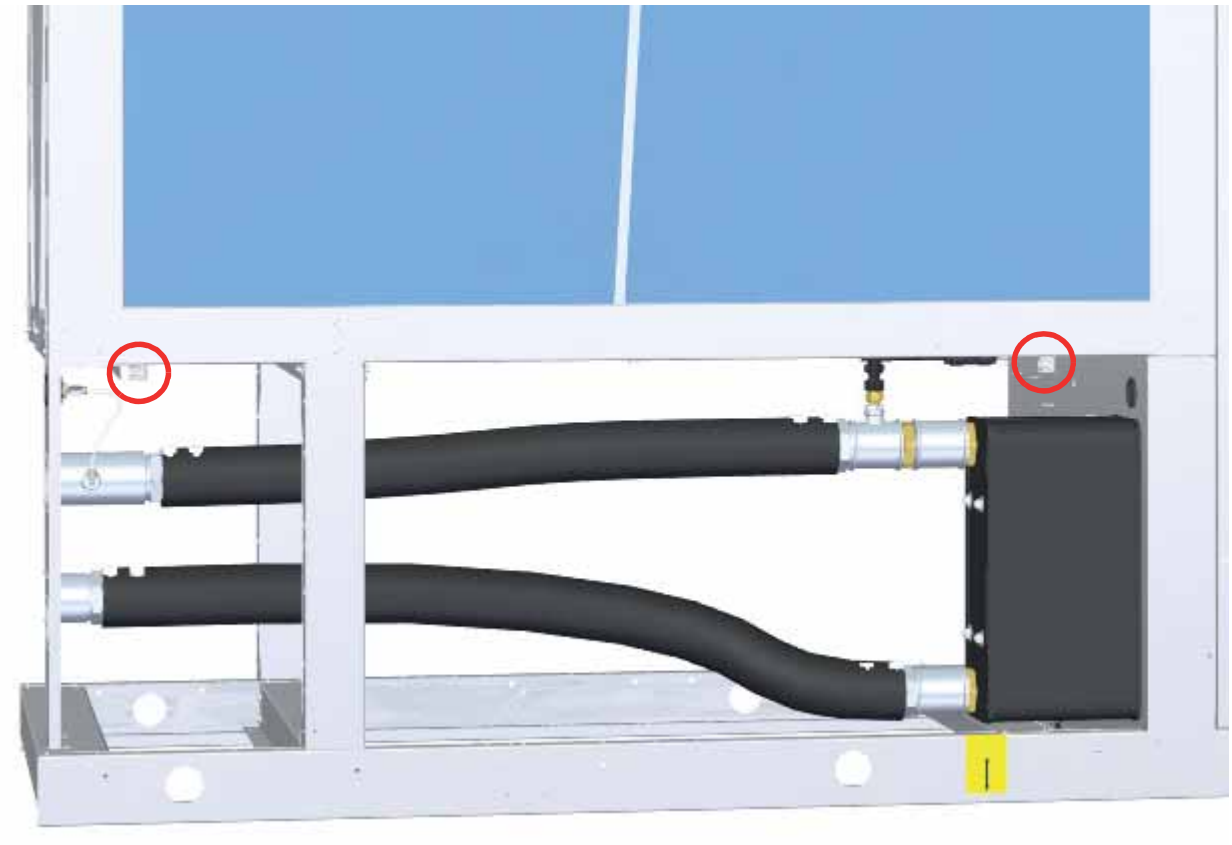
When the machines are in modular configuration, it is necessary to install the multimanager kit; for further details, refer to the corresponding manual.

• up to 6 units • pump management • diagnostics • average unit temperature calculated • manifold inlet/outlet temperature sensors	

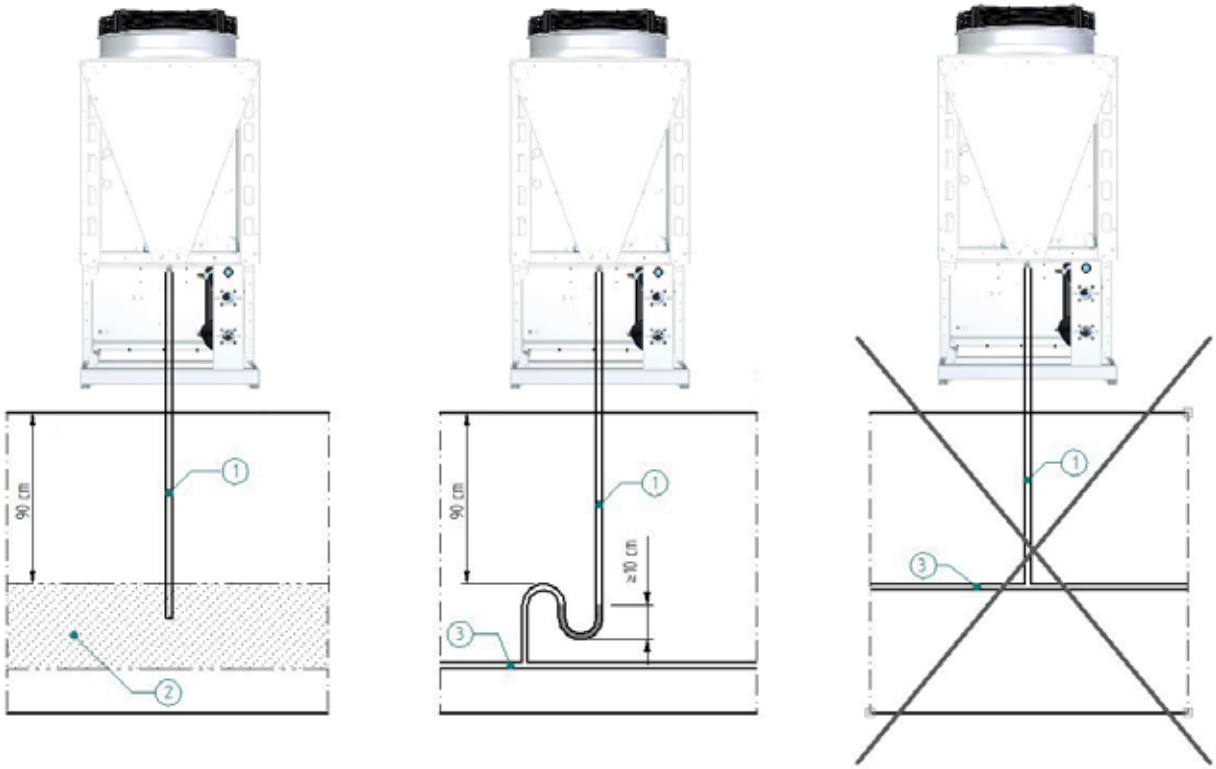
The interlock system kit is also available (to be installed by the Customer)
In modular configuration, in the event of a leak in one or more units, the Interlock System stops all units within the affected safety AREA 1.
Refer to the wiring diagram for correct electrical connections.

5.5 Condensate drain

All units are equipped with a drainage system at the base of the condensate collection tank located under the battery.
If draining is prolonged to convey water, prevent the pipes from freezing.
The condensate drain must not be conveyed into drains where the gas, in case of leakage, can accumulate.
In heat pump operation, the air flow that invests the battery can condense and the water that forms is collected in the basin and from here it must be conveyed to the outside to avoid filling. The conveying can be done by connecting a pipe to the drain fitting to drain the water away from the machine. The condensate drain fitting at the base of the basin must not be obstructed or modified. For the position of the condensate drain please refer to the drawing below.



How to drain condensation:

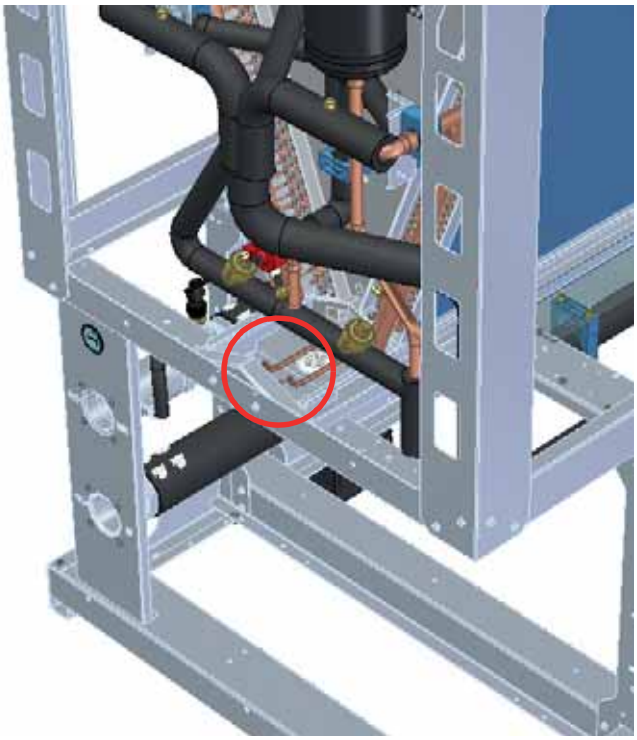


1. Condensate drain pipe DN 50 insulated between floor and heat pump.
2. Gravel layer in the frost-free area to absorb condensation (up to 50 litres per day).
3. Waste water or rain water duct or drainage pipe.

- If inserted into a duct or drainage pipe: take into account the slope of the pipe and opt for a frost-free installation.
- Alternative: let the condensation flow into the building and use a siphon to introduce it directly into the duct. Lifting systems are not allowed.

5.6 Condensate Tray Heating Element

For applications in harsh climates, the water that forms inside the condensate drain pan could freeze leading to a worsening of the operation of the machine, to avoid this it is advisable to install the electrical resistance, provided as an option, in order to avoid freezing.
In case of need, the antifreeze heating elements (one heating element per tray) can be replaced quite easily, because they are of the wire type with very flexible silicone insulation.
The heating element is inserted in a copper tube specifically located under the condenser coil within the tray.
This allows for the heating element to be replaced if necessary.
It may be useful to use a cable pulling rod to insert it.



5.7 Anti-freeze protection

Even if the minimum ambient operating temperature is higher than 0°C, the temperature in the place of installation may be lower than this during the winter, when the machine is not used.
In these cases, if the machine is not emptied, it is necessary, to avoid the formation of ice, to add antifreeze (propylene glycol) in the following percentages:

Ambient temperature up to [°C]	Propylene Glycol [wt %]
0	0
-5	20
-10	30
-15	35
-20	40

NOTE
The unit is equipped with an antifreeze function that starts the pump if the water temperature drops below a set temperature value and activates the antifreeze resistance (when present).

CAUTION

⚠ In the event that the unit must remain de-energised for a certain period of time in an environment whose temperature can reach freezing values of the water contained in the evaporator (risk of evaporator breakage), the antifreeze protection can also be implemented following the instructions in paragraph 9.2.2 “Water circuit loading procedure” or on request it can be carried out by means of an antifreeze resistor whose operating logic is described in chapter 8.10.9 “Antifreeze” .

WARNING

⚠ If the machine is de-energised there is a danger of ice formation, in this case the antifreeze protections are removed.

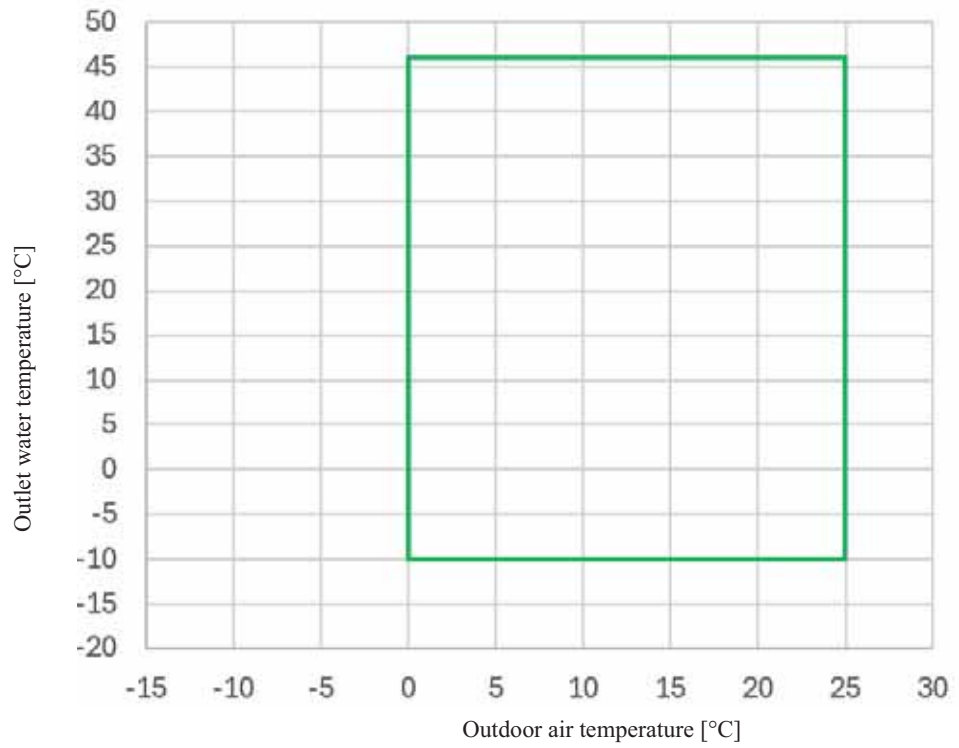
The following are the minimum and maximum flow values during chiller operation:

Model	Flow rate (m^3/h)		
	Min	Nom	Max
018	3.2	8.4	18.0
023	3.9	11.0	23.0
030	5.1	14.0	28.0
035	6.2	16.8	34.0

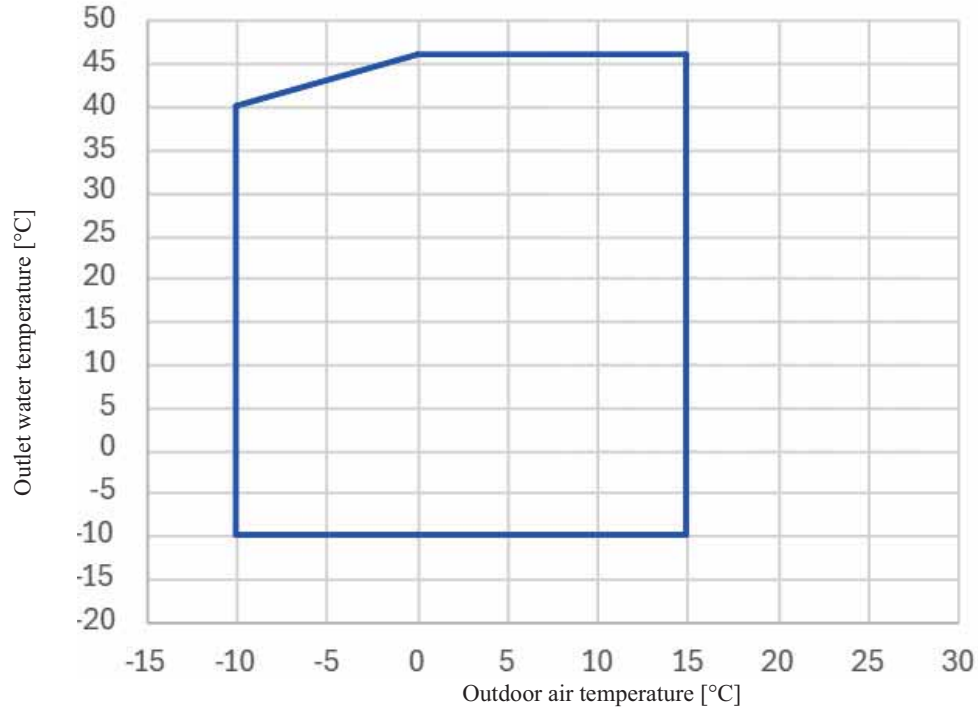
The operating temperature limits are as follows:

Operational map CH mode

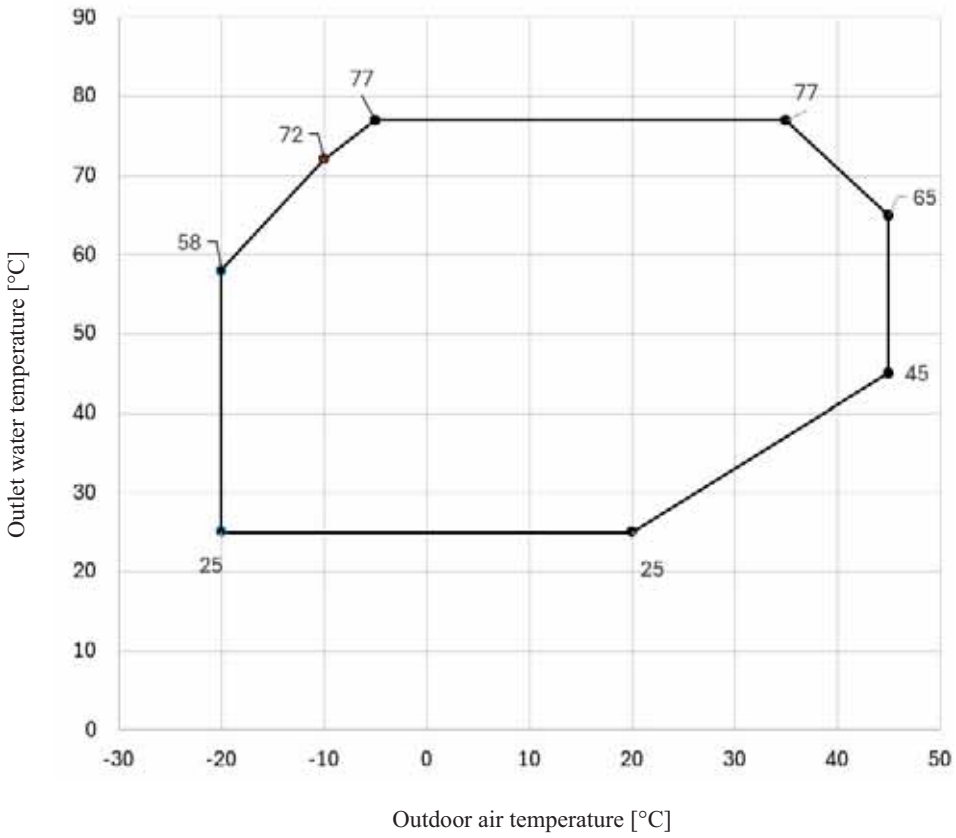
STD LWT



LOW LWT



HP mode



CHAPTER 6

ELECTRICAL CONNECTIONS

6.1 Electrical circuit

The electrical circuit schematic is given in the annexed diagrams.

6.2 Electrical connections

The connection of the machine to the electricity supply must be made in compliance with the laws and regulations in force in the place of installation.
The voltage, frequency and number of phases must comply with the information on the machine data plate.
The power supply voltage must not be outside the tolerance range shown on the electrical diagram, even for short periods.
Unless otherwise specified, the frequency tolerance is +/-1% of the nominal value (+/-2% for short periods).
With a three-phase power supply, the voltage must be symmetrical (the effective values of phase to phase voltages and consecutive phase angles must be identical).
In particular, unless otherwise indicated, the maximum permissible phase imbalance is 2%, calculated for each phase according to the formula:

$$\frac{MaxDifferenceOfPhaseVoltageFromVavg}{Vavg} \bullet 100$$

Vavg= average phase voltage

Example: electricity mains 400V/3Ph/50Hz
L1-L2 = 410; L2-L3 = 400V; L1-L3 = 398V
Vavg= (410+ 400 + 398) / 3 = 403V

$$\frac{(410 - 403)}{403} \times 100 = 1.73$$

With a single-phase power supply, the voltage must be supplied between the phase line and neutral and the neutral conductor must be earthed in the relative step-down substation (TN system in compliance with IEC 364) or upstream by the electricity supply company (TT system in compliance with IEC 364).
The phase and neutral lines must not be swapped over.

For the entry of the power cable, use the knockouts, as suggested in the drawing below.

For the entry of the cables of the kits and probes, use the knockouts on the back of the machine, as suggested in the drawing below.

The contoured holes are available to the customer to manage the options.

CAUTION

⚠ To enter the electrical panel for the purpose of connecting kits and/or optionals (remote control, general alarm, external tank heating element control, remote gas sensor alarm, etc.), Atex cable glands must be used.
The cable glands must meet at least the following specifications:
Ex II 2GD Ex eb IIC / Ex tb IIIC Db

For the electricity supply:

1. Install the supplied ferrite on the supply line (where present) (installation by the customer) (see note below).
2. Connect the machine (PE terminal in the electrical panel) to the grounding system of the building.
3. Guarantee the automatic interruption of the power supply in the event of insulation failure (protection against indirect contacts according to the requirements of IEC 60364) by means of a type B **differential current device**.
4. Make sure the level of protection against direct contact at the power cable source is at least IP2X or IPXXB (reference CEI EN 60529).
5. Install a device at the origin of the power cable that protects it from overcurrents (short circuit).
6. Use conductors that bring the required max current to the max operating ambient temperature, according to the type of installation chosen (IEC 60364-5-523).
7. Protective devices must be installed that limit the short-circuit current to 17 kA peak in correspondence with the rated breaking capacity if the short-circuit current in the point of installation is greater than an effective value of 10 kA.

Indications on the electrical diagram:

- maximum permitted sized of the type gG fuse.
  In general, the fuses can be replaced by an automatic circuit breaker set in relation to the maximum machine current input (consult the manufacturer if necessary)
- section and type of power cable (if not already supplied).
  Installation: insulated conductors, multi-pole cable in a cable duct installed overhead or fixed to a masonry structure (type C in accordance with IEC 364-5-523 1983), or without any other cables in contact
  Type of cable: copper conductors, 70°C PVC insulation (unless otherwise specified) or EPR 90°C insulation

The wiring of the electricity power cable is the responsibility of the customer.
Remove the machine panels (see paragraph 9.2.1 “Accessing the machine”).

CAUTION

⚠ To check the machine is properly connected to the electricity mains, refer to Chapter 7 “Start-up“.

CHAPTER 7

PRECAUTIONS DURING OPERATION

Operation must be carried out by competent personnel under a qualified supervisor.
Never remove or tamper with the safety devices, guards or insulation materials fitted to the unit or auxiliary equipment.
When the mains switch is ON, lethal voltages are present in the electrical circuit so extreme caution must be exercised if work needs to be carried out on the electrical system.

CAUTION

⚠ Do not exceed the liquid flow to be cooled specified in Chapter 4 “Installation“.

7.1 Start-up

CAUTION

⚠ The first commissioning must be carried out by personnel trained in authorised service centres.

CAUTION

⚠ Before starting up these machines, make sure all personnel have read and understood Chapter 2 “Safety“.

WARNING

⚠ At the first start-up, check the correct operation of all electrical connections.

WARNING

⚠ After powering the machine, if the environmental conditions require it, a phase of forced heating of the compressor oil could be activated, which inhibits its start.
Feed the machine a few hours before turning on the compressor.

CAUTION

⚠ On system start-up:

If the high pressure alarm is triggered when the compressor hasn't been activated, block the machine straight away by pressing OFF on the control.
Now check the refrigerant circuit high pressure value.

CAUTION

⚠ After pressing the main switch, the control display will remain off until the gas leak detector (fixed inside the compressor compartment) has completed the warm-up phase. The waiting time will be about 300 sec.

Before the start-up procedure, check that the system is correctly loaded (see ch. 9.2.2 “Water circuit loading procedure”).

1. Check the unit shut-off valves are open.
2. Check that the circuit is completely filled with water and properly vented from the air.
   Check that the ambient temperature is within the limits indicated on the machine data plate.
3. Check that the main switch is in the open position (“0”).
4. Check that the power supply voltage is correct.
5. Power the machine by means of the supply line protection device (machine in standby).
6. Close the main switch of the machine by putting it in the closed position (“|”).
7. Start up the unit using the defined procedure (see 8.2 “Main operations”).
   After powering the machine, if the environmental conditions require it, a phase of forced heating of the compressor oil could be activated, which inhibits its start.
   Feed the machine a few hours before turning on the compressor.
8. In machines with a three-phase power supply, make sure the compressor is working properly (it must not be noisy), that the circulator rotation direction is correct, and that the fan rotation direction is correct (it's “correct” if it takes the air from inside the machine).
   The machines are manufactured and tested in such a way that the three aforementioned components have a sense of rotation in agreement. Therefore, if one component turns in the correct direction, the others are also correctly connected.
   Check the rotation direction of all the above-mentioned components at the first start-up and after every maintenance intervention.
   If an AC motor is rotating in the wrong direction, invert two phases on the main supply terminals of the control panel.
9. It is possible to check that the flow rate is within the limits by checking it on the appropriate display screen (when the flow meter is available).
   The flow rate can be adjusted with a valve. Consider then that an adjustment of the flow rate can be made by acting on the PLC, in the event of inverter pump (number of revolutions settable).
10. **If, at the first start-up,** the ambient temperature is high and the hydraulic circuit water temperature is much higher than the working value **(e.g. 25-30°C)**, this means that the unit starts up overloaded, and the **protection devices might trip**.
    To lessen this overload, an inlet valve from the machine can be gradually (but not totally!) **closed to reduce the flow of water passing through it.**
    Open the valve as the water temperature in the hydraulic circuit gradually reaches the working value.
11. If the alarm light on the front of the panel is off and the machine display is off, but the disconnecting device is ON, there may be an alarm condition with relative coolant loss. **In this case, contact technical support immediately.**
12. The machine is now ready to start operating.

CAUTION

⚠ **TO SWITCH THE UNIT OFF, USE THE ELECTRONIC CONTROL UNIT AS EXPLAINED IN THE MANUAL (Chapter 8 “Electronic control“).**

The unit must NEVER be switched off by disconnecting the electricity supply (do not turn off the disconnecting switch or any other disconnection device upstream of the machine), to ensure the safety function of the leak detector even with the unit OFF.

When disconnecting the power supply, only in the case of maintenance, first of all make sure the machine has been switched Off via the electronic control unit, and that the compressor, circulator and fan are OFF.

CHAPTER 8

CALIBRATIONS OF OTHER COMPONENTS

8.1 Refrigerant high pressure switch

The machines are equipped with a high pressure switch (HP)
This monitors the refrigerant compressor discharge pressure and prevents it from increasing to potentially hazardous values that could harm the compressor and people within the vicinity.
It is of the “automatic reset” type in models 018 and of the “manual reset” type in models 023÷035.
Its intervention is detected by the electronic control unit, which opens the compressor supply circuit and visualises the **high pressure** alarm signal. When the compressor delivery pressure falls below the reset point, the pressure switch is reset.
If the cause of the pressure switch trip has not been remedied this cycle will be repeated continuously.
The TRIP and RESET values of the pressure switches depend on the type of refrigerant and are shown in the following table:

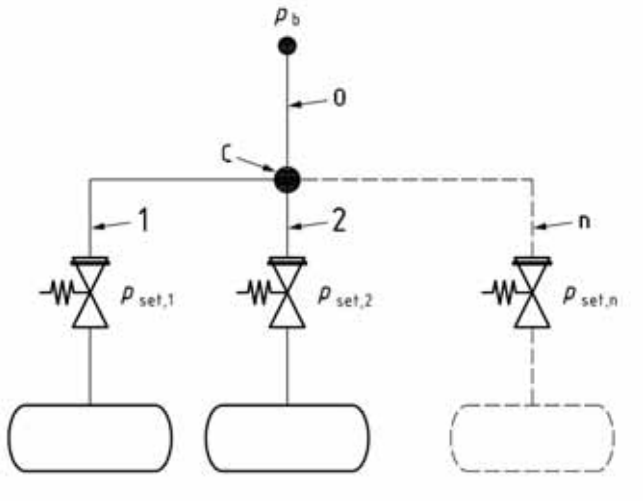
COMPONENT	REFRIGERANT	INTERVENTION		RESTORE	
		bar	°C	bar	°C
High pressure switch HP automatic reset type (018)	R290	34	86	26	72
High pressure switch HP manual reset type (023÷035)		34	86	26	72

8.2 Safety valve

Its task is to protect the system from pressures so high as to cause serious damage to the machine and surrounding things in the event of failure to intervene with other protections.
When the pressure of the refrigerant fluid exceeds the intervention value of the valve (see table below), the latter opens the circuit and lets the gas discharge until the pressure has reached values lower than those set.
Under those conditions, the valve will automatically return to closing.
It is of the fixed calibration type and its calibration is in relation to the design pressure of the weakest component of the circuit.
The valve must be checked regularly, as laid down by the regulations in force.
Upstream of the safety valve, a shut-off valve is installed. Before removing the safety valve (for example, for periodic verification), make sure that the shut-off valve is in the closed position. After repositioning the safety valve, before starting the machine, check that the shut-off valve is in the open position and has been correctly plunged.
The unloading of the safety valve must be conveyed to the outside of the unit in a safe area according to the requirements of EN378-3 and the regulations in force at the place of installation.
The exhaust of the safety valve must be conveyed to the outside of the unit in a safe area and away from possible sources of ignition. The discharge must be positioned at least 1 metre from the ground, and facing upwards.
The cross-section and length of the drain pipe must be sized in accordance with national laws and directives applicable in the country of installation.
The image below shows the unloading of the safety valve, whose position is indicated by the relative adhesive (see 2.2 “Symbols”).

Convey the unloading of the safety valve (to be borne by the end user). Size the conveyor according to standard EN ISO 24664_2025.
To avoid any possible clogging of the pressure discharge pipe, fit a cover to keep out rainwater.

NOTE
If the machines are installed in modular configuration, it is possible to manifold the safety valves according to Section 8.5 “Connection of outlets from several pressure relief valves to a common outlet line” of Standard EN ISO 24664_2025.



DANGER

⚠ **Zone 2 that is generated by the emission of a safety valve can have a horizontal extension of up to 5.7 metres and up to 16.7 metres of vertical extension.**
The assessment of the risk areas is carried out by the installer.
Do not convey the exhaust in the proximity of ignition sources as defined by EN378-2.
If more restrictive, always refer to the local regulations in force.

WARNING

⚠ DO NOT remove or tamper with the safety valve.

COMPONENT	REFRIGERANT	INTERVENTION	
		bar	°C
HP Safety Valve	R290	38	92.0
LP Safety Valve		30	79.5

WARNING

⚠ The intervention of the safety valve indicates a anomalous operation of the unit.
Identify the cause of the anomaly as soon as possible and restore normal conditions.

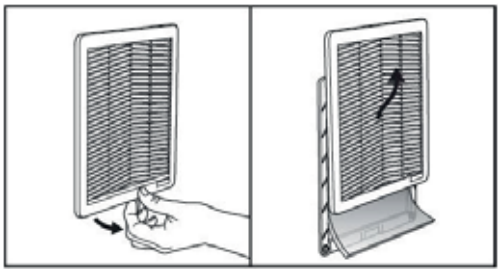
8.3 Forced panel ventilation

The machines can be fitted with a thermostat system for control panel and/or inverter compartment ventilation.
For adequate ventilation, it is necessary to provide for a regular cleaning of the filter cloth present both on the ventilation system and on the ventilation grille.

Replacing and cleaning the filter cloth:

To replace the filter cloth, slide the cover over the base by lifting the lower tab and pushing upwards.
Then reposition the cover.
The filter cloth can be cleaned by rinsing, water jet treatment or tapping.

NOTE
The frequency of its cleaning varies depending on the amount of dust present and the operating time; it must therefore be determined from time to time by the user for each individual use.



DANGER

⚠ **The dirty filter cloth decreases the efficiency of the filter unit causing insufficient or even a total lack of ventilation.**

8.4 Coolant leak detector

DANGER

⚠ **This unit is equipped with a safety device that can detect the gas leakage.**

AFTER INSTALLATION, THIS UNIT MUST NEVER BE TURNED OFF, EXCEPT DURING MAINTENANCE.

DANGER

⚠ **Before starting the machine, make sure that all the panels have been correctly installed.**

On board the units a refrigerant leak detector (Leak Detector) is installed with catalytic sensor that allows the immediate identification of refrigerant leaks. Upon exceeding 25% of the LFL (Lower Flammable Limit), the detector closes an alarm contact and, by means of 2 safety relays, disconnects the control circuit of the electrical panel and the power circuit present in the compressor box; the electrical circuit of the Leak Detector always remains energised.
To restore the system, after the refrigerant gas loss falls below 25% of the LFL, use the “ALARM/reset” button on the left door of the electrical panel to restart the machine.
The restoration operation must be carried out only after careful verification of “non-leakage” by authorised operators, that are informed and trained on the specific risks from flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.
By default, the device is calibrated to 25% of the “LFL”.
Operators must be aware of regulations established by the industrial sector and/or the country of installation to test and calibrate the device.
The sensitive element of the device must be reset annually (see chapter 9.3 “Control and maintenance schedule”).
For the method and methods of testing, calibrating and replacing the device, refer to the authorised service centre.

WARNING

⚠ Refer to your service centre for testing and calibration of the sensitive element.

Replacement is only provided in case of damaged sensor.

WARNING

⚠ On first start-up, it is mandatory to recalibrate the sensor and reset the sensor operation counter.

WARNING

⚠ For remote transmission of the Leak Detector signal, see the wiring diagram.

8.4.1 Leak Detector: checks

In order to access the Leak Detector it is necessary to follow the removal procedure shown in the image above.
The procedure for recalibrating the sensor must be requested at the email address **service@mta-it.com**.
Perform the following checks after recalibration:

1. Reposition all the panels of the machine taking care to position and close all the screws.
2. Turn the unit main switch to the ON position ("|").
3. Check that the red light (WARNING) and the yellow light (FAULT SENSOR) are on, that the display is off and that the washing fan is operating.
4. If one of the two lights is off, immediately disconnect the power to the machine and check its operation by powering it separately (check to be carried out in a safe area), replace it if necessary.
   If the fan should be switched off, immediately disconnect the power to the machine and check its operation; replace it if necessary.
   Restart from point 2.
5. Wait for the end of the leak detector warm-up phase; at the end of the warm-up phase the lights go off, the wash fan turns off and the TD7 display lights on.
6. Using the air/propane mixture of the calibration kit, simulate an intervention by the Leak Detector.
7. Check that the red light (WARNING) lights on, that the TD7 display lights off and that the wash fan is switched on.
8. Leave the wash fan on for at least 5 minutes to allow the air and propane mixture to dilute; press the ALARM/ RESET button to allow the machine to restart.
   The TD7 display is powered.
9. Press and hold 

the display button to activate the unit.
   After the unit has restarted press the 

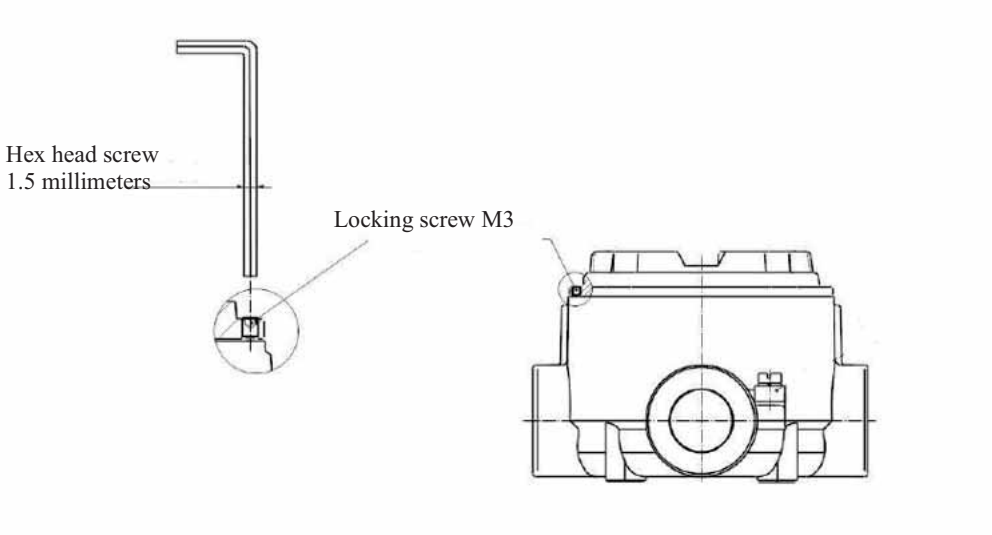
button to put the unit on standby.
10. Disconnect power to the machine by acting on the disconnecting device by moving it to the "O" position.
11. Connect power to the machine by acting on the disconnecting device by moving it to the "|" position.
12. Wait for the warm-up time (equal to 300 sec.) of the leak detector: during this phase, the machine display will be off, but the red light (WARNING) and the yellow light (FAULT SENSOR) under it and the washing fan will be on.
13. At the end of the warm-up time, the red light (WARNING) and the yellow light (FAULT SENSOR) and the washing fan switch off; at this point, the machine is ready to be started safely.

WARNING

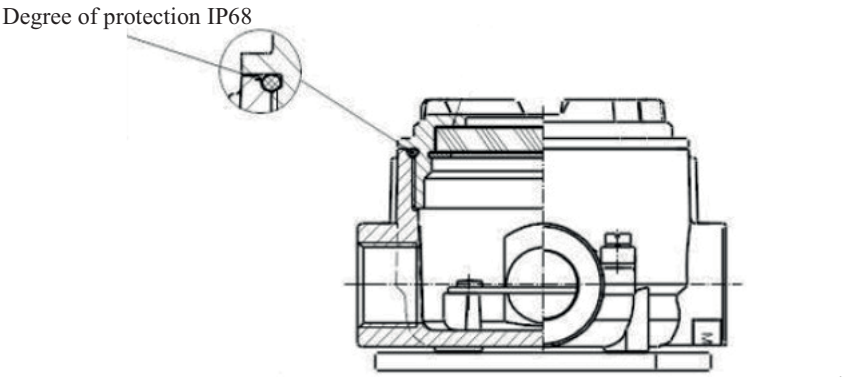
⚠ To ensure the correct seal of the Leak Detector case, follow the procedure below.

LID LOCKING

Lock the cover with the hex head screw using a 1.5 mm flat diameter hex wrench.



Tighten the lid with normal hand force to the end.



CHAPTER 9

OPERATION AND MAINTENANCE

9.1 Operation

Operation of the unit is fully automatic.
It's not necessary to turn it off when there is no thermal load, as it will turn off automatically when the pre-set inlet water temperature is reached.

9.2 Maintenance

WARNING

⚠ The maintenance operations, for which the intervention inside the machine is foreseen, must be carried out by authorised operators, informed and trained on the specific risks from flammable gases according to good practices and/or current standards incompliance with ANNEX HH IEC 60335-2-40, equipped with the appropriate precautions and protections (active and passive e.g. work gloves) in order to be able to operate in maximum safety.
Refer to the provisions of local laws and, in Europe, standard EN378-4 and standard EN13313.

WARNING

⚠ Before installing or operating these machines, make sure that all personnel have read and understood Chapter 2 “Safety“.

WARNING

⚠ This unit will give many years of trouble-free service if properly maintained and serviced.

9.2.1 Accessing the machine

DANGER

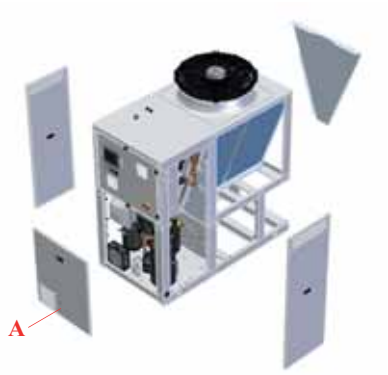
⚠ **The control panel must only be opened when the machine is switched off.**

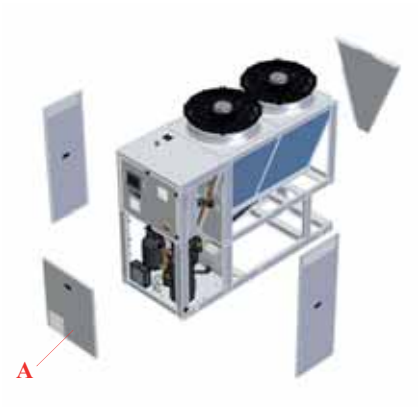
DANGER

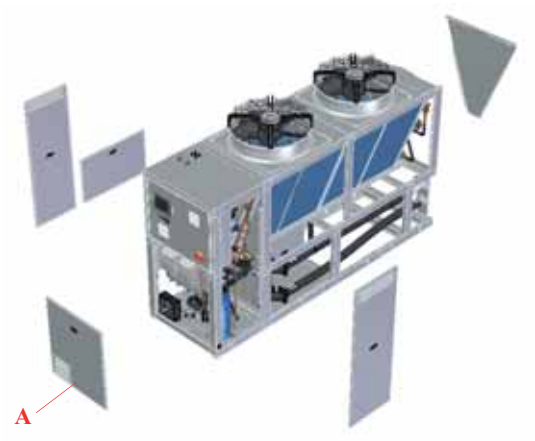
⚠ **Before starting the machine, make sure that all the panels have been correctly installed.**

Failure to comply with this indication does not guarantee the correct operation of the Leak Detector safety device.

To access the components of the cooling and hydraulic circuits, remove the lower panels by using a screwdriver to loosen the screws that attach the panels to the uprights.
To access the electrical cabinet components turn the main switch/disconnect switch to the OFF position “O” and open the electrical cabinet doors by opening the bolts with the key supplied with the unit.
To access the rear compartment, remove the rear panel.

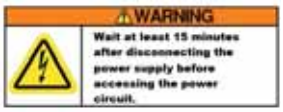






WARNING

⚠ The motors contain DC bus capacitors that can remain charged even when the frequency converter is not powered. Failure to comply with the indicated waiting time after disconnecting the power supply and before carrying out maintenance or repair work, may cause serious or fatal injuries.
1. Stop the engine.
2. Disconnect the AC network.
3. Wait for the capacitors to discharge completely before performing any maintenance or repair work. The waiting time is 15 minutes.



9.2.2 Water circuit loading procedure

With reference to the functional diagram shown in chapter 5.3 “Hydraulic connections” , the system loading procedure is shown below:

1. Connect the water pipes to the machine, respecting the inlet and outlet (see 5.3 “Hydraulic connections”).
2. Connect the water mains to point (**A**) of the functional diagram shown in chaper 5.3 “Hydraulic connections” .
3. Make sure there are vents on the highest points of the hydraulic circuit, where air may collect.
4. Open the vent (**1**) indicated in chapter 3.2.1 “Hydraulic unit” .
5. Open the tap (**B**) of the functional diagram shown in chapter 5.3 “Hydraulic connections” to load the system with water. You are advised to fill the system very slowly, to ensure all the air is vented in the meantime.
6. Close the vent (**1**) indicated in chapter 3.2.1 “Hydraulic unit” and the vents installed on the hydraulic circuit only when the air flow stops and only water comes out.
7. Stop charging when the pressure gauge indicates that a circuit pressure compatible with the expansion vessel has been reached.
8. Start up the pump without activating the compressor, to fully bleed the system, and continue filling if necessary.

Emptying procedure:

CAUTION

⚠ In the case of maintenance operations for which it is necessary to empty the water circuit, the units are equipped with special taps for drainage.

If the system needs to be drained, proceed as follows:
Drain the system:

1. Switch off the machine.
2. Close any shut-off valves installed on the system IN-OUT connections.
3. Open the vent (**1**) indicated in chapter 3.2.1 “Hydraulic unit” .

NOTE
To fully drain the circuit, it's a good idea to blow compressed air into the plate heat exchanger.

CAUTION

⚠ The emptying operation of the water circuit becomes essential when the machine lacks antifreeze resistance, and must remain inactive for a certain period of time in an environment whose temperature can reach freezing values of the water contained in the evaporator (risk of evaporator breakage).

9.2.3 Coolant Charging Procedure

The systems with container shipment are supplied with a nitrogen pre-charge of 1bar (indicated by the sticker below).

When the machine is put into operation this sticker must be removed.
To allow the machine to start up, it is necessary to charge the R290 refrigerant.

NOTE
The quantity of refrigerant per circuit is indicated on the data plate.

CAUTION

⚠ Vacuum / refrigerant gas filling procedures can only be performed by authorised operators, informed and trained on the specific risks of flammable gases according to good practices and/or current standards in accordance with ANNEX HH IEC 60335-2-40.

Comply with the following instructions:

- ensure that other types of refrigerant do not contaminate the R290 (the minimum purity of the refrigerant gas used for charging operations must be at least 99.5%);
- before charging the refrigerant gas, carry out three washing cycles with pressurised nitrogen followed by a suitable vacuum procedure;
- keep the gas cylinder in an upright position at the time of loading;
- use work equipment suitable for use with flammable gas.
  Keep the work area always well ventilated and equip yourself with detection devices for R290;
- do not charge more refrigerant gas than necessary. It is advisable to charge the unit using calibrated scales with a reading sensitivity of at least one tenth of a gram;
- after loading, carry out the leak detection operations before the functional test;
- once all the previous operations have been completed, it is good to carry out a second check to detect any leaks.

CAUTION

⚠ Each unit is equipped with charging connections (high pressure side and low pressure side) to ensure the charging and discharging operations of the refrigerant circuit. The tightening torque of the charging connections is 15 Nm.

9.2.4 Cleaning the plate heat exchanger

The plate heat exchanger may be susceptible to fouling, especially if the machine is operated in heat pump mode and at high produced water temperatures.
The deposit of limestone in the long term compromises the performance of the heat exchanger, leading to inefficiencies of the machine. It is therefore a good idea to monitor the performance of the heat exchanger over time, verifying that the design DeltaT is maintained and also the pressure losses of the heat exchange fluid.
To clean the exchanger, use organic acids such as formic, acetic, or citric acid, in a concentration between 1 and 5%.
Carry out the following procedure:

1. Turn off the machine and make sure the pump is switched off.
2. Disconnect the main circuit from the exchanger, or provide threaded connections during installation to connect with the pipes in which to slide the cleaning solution.
3. Clean the heat exchanger using a 5% phosphoric acid or 5% citric acid solution.
4. Pump the detergent solution through the plate heat exchanger using the bottom connection.
   Reverse the flow every 30 minutes and, if possible, apply a flow rate equal to 1.5 times the nominal flow rate.
   Monitor pH and/or pressure drop. Cleaning is finished when the pH has remained constant for 30 minutes and/or the pressure drop has returned to the initial value.
5. Discharge the detergent from the exchanger and the machine.
6. Pump the cleaning solution through the heat exchanger in backflush mode, at a flow rate 1.5 times the normal rate.
   After use, clean with water.
   A 1–2% solution of sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO3) before the final rinse ensures complete neutralisation of the acid.

9.2.5 Cleaning procedure for condensing batteries

1. Make sure that the unit is switched off and the disconnecting device is padlocked in position “0”.
2. If necessary, clean the area around the unit to ensure that leaves or debris are not blown into the condensing battery.
3. Remove dirt on the surface:
   The dirt on the surface must be removed before cleaning and/or rinsing with water to avoid further airflow restrictions.
   If it is not possible to backwash the side of the battery opposite to that of the air inlet, remove the dirt on the surface with a vacuum cleaner.
   If a vacuum cleaner is not available, a soft non-metallic bristle brush can be used, generally vertically. Battery surfaces can be easily damaged (folded tab edges) if the brush is applied to the tabs.
4. When cleaning, avoid directing the water jet so that it can damage the aluminium fins of the battery.

NOTE
Using a water flow against a battery will push dirt into the battery. This will make cleaning efforts more difficult. The dirt on the surface must be completely removed before completing the cleaning.

5. Rinse with drinking water to remove excess soap residue.
   Starting from the top of the battery, start rinsing it from one side to the other until it reaches the bottom.
   Repeat the operation as many times as necessary to ensure that all sections/panels of the battery have been completed and thoroughly rinsed.
   Any excess soap residue mixed with removed dirt, salt and any material deposited on the batteries can constitute a potential problem and an environment suitable for battery corrosion or degradation.

9.2.6 STO (Safety Torque Off) test procedure

To perform the inverter STO (Safety Torque Off) input test, follow the procedure below:

- switch off the unit
- wait 10 minutes, the time required for the inverter capacitors to discharge
- remove panel **A** (indicated in ch. 9.2.1 “Accessing the machine”)
- disconnect the pressure switch from the STO input of the inverter (see wiring diagram)
- reposition panel **A**
- turn the system on
- check that the system does not start and the alarm code appears on the display: Compressor AFD 1A Not Ready (due to STO of compressor 1, circuit 1), Compressor AFD 2A Not Ready (due to STO of compressor 1, circuit 2)
- restore the connection of the high pressure switch on the inverter by performing the same operations described above.

9.3 Control and maintenance schedule

OPERATION	Daily	Monthly	Every 6 months	Yearly
Check there are no alarm signals.	◊			
Check the water outlet temperature is within the correct range.	◊			
Check that water inlet temperature is in compliance with the value used for selection of the unit.		◊		
Check that the pressure in the hydraulic circuit with the pump stopped is greater than about 0.5 bar.		◊		
In units equipped with a hydraulic unit check that the difference between the pump outlet pressure and suction pressure (measured on the pressure gauge with pump stopped) is within the prescribed range and not lower than the pump maximum flow rate value.		◊		
Clean the water filter. In any case, you are advised to clean the filter one week after the initial machine start-up.		◊		
Check that the unit current absorption is within the data plate values.			◊	
Carry out visual inspection of refrigerant circuit, looking out for any deterioration of the piping or any traces of oil which might indicate a refrigerant leak.			◊	
Check the condition and firmness of the pipe connections.			◊	
Check the condition and security of wiring and electrical connections.			◊	
Using a spanner, check that any ring nuts on the refrigerant compressor intake and delivery pipes have not slackened.			◊	
Check that the environment is well ventilated.		◊		
Check that the fan is activated automatically. Check they are not noisy. Check that the grilles of the unit are free from dirt and any other obstructions.			◊	
Clean the fins of the condensing batteries, if present (see ch. 9.2.5 “Cleaning procedure for condensing batteries”).				◊
Check the condensate drainage holes are not obstructed.		◊		
Calibration or replacement of the sensitive element of the refrigerant leak detector.				◊
Check the correct operation of the high pressure switch that intervenes on the STO digital input of the compressor. (see paragraph 9.2.5 “STO (Safety Torque Off) test procedure”)				◊

CAUTION

⚠ The above maintenance schedule is based on normal use.

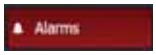
In some cases it may be necessary to increase maintenance frequency.

CHAPTER 10

TROUBLESHOOTING

CHILLER MODE (CH)

PROBLEM	MANIFESTATION	CAUSE/REMEDY
A Unit fails to start	• Unit is powered and yet fails to start.	**Presence of shut-down alarms** Check for the presence of alarms that prevent the unit from starting. **Unit programmed to run by time band** The unit is set to start only within the programmed time bands. **Supervision active** Check that supervision is not enabled on the unit, otherwise disable it.
B Water outlet temperature higher than set-point.	• Unit is operational but water temperature is higher than the set-point value. • Temperature higher than the value envisaged. • High water outlet temperature alarm trip. • Low evaporation pressure. • Presence of a large number of air bubbles in the liquid sight glass. • Excessively noisy operation of compressors.	**Water flow rate too high** Increase the pressure drop in the water circuit (e.g.: partially closing a tap on the pump delivery line). **Thermal load too high** Reduce the thermal load to within preset limits. **Ambient temperature too high** Increase air recirculation. **Condenser fins fouled** Clean the condenser fins. **Front surface of the condenser blocked** Remove the obstruction from the front surface of the condenser. **Circuit has insufficient refrigerant charge** Call in a qualified refrigeration engineer to check for leaks and eliminate them. Fill the plant. **Incorrect compressors rotation** Invert the position of two phase wires of the compressors power supply (see chap.*"7.1 Start-up"*).
C Insufficient pressure head (water pressure) at the outlet of the pump (if present).	• Rise of water outlet temperature. • With pump installed: pressure difference (read on the unit pressure gauge) with pump running and pump stopped is too low. • Increase in the pressure drop due to the presence of ice. • High temperature difference between water inlet and outlet.	**Water flow rate too high** Reduce water flow within design limits, for example by partially closing a pump outlet cock. **Presence of ice in the evaporator** Stop the unit, leave the pump running, edit the set-point value and add glycol to the water. **Evaporator blocked** Supply a high flow rate of water in counter-current conditions. Install a filter upline from the unit.
D The unit is blocked and water does not flow.	• No water flow. • Flow switch alarm trip. • Low pressure alarm trip. • Suction pressure too low.	**Set-point value too low** Increase the SET-POINT value or add glycol (antifreeze) in adequate percentage (see heading *"5.7 Anti-freeze protection"*). ⚠ **The formation of ice can severely damage the unit.**
E High pressure	• High pressure switch trip. • Refrigerant compressor stops. • The icon  lights up. • Intervention of general alarm relay. • Fans stopped or reverse rotation direction. • Water outlet temperature too high.	**Fans stopped** Repair or replace the fan. **Warm air recirculation** Change the position of the unit or the position of any adjacent obstructions to avoid recirculation. **Coil fouled** Clean the condenser fins. **Thermal load too high** Reduce the thermal load to within preset limits. **Pump stopped or no flow** Check the pump for faults or blockages. **Condenser fouled** Clean the condenser. **Machine operating outside the envelope limits** Restore the operating conditions within the envelope limits.

PROBLEM	MANIFESTATION	CAUSE/REMEDY
F Low pressure.	• Refrigerant compressor stops. • The icon  lights up. • Intervention of general alarm relay.	**Circuit has insufficient refrigerant charge** Call in a qualified refrigeration engineer to check for leaks and eliminate them. Fill the plant.
G Compressor internal protection trip	• The icon  lights up. • Intervention of general alarm relay. • Refrigerant compressor stops.	**Thermal load too high** Check that user water temperature and ambient air temperature are within rated limits. Restore the load within the preset limits. Wait a few minutes before turning on again. **Circuit has insufficient refrigerant charge** Call in a qualified refrigeration engineer to check for leaks and eliminate them. Fill the plant.
H Display off.	• Despite the presence of voltage on the board terminals the display remains blank.	**Control board fuse has blown** Change the fuse. Provide cleaner power supply to the unit.
I Pressure transducer faulty or disconnected	• Intervention of general alarm relay.	**Transducer disconnected or short-circuited** Check that the transducer is correctly connected to the control board terminals and the cable is undamaged. If necessary, replace the transducer with a genuine original replacement part.
J Fans overload	• Fans stopped. • Intervention of general alarm relay. • Refrigerant compressor stops. • The icon  lights up. • One of the fans is running noisily.	Check the status of fans, electrical connections, and power supply.
K Pump overload	• The pump doesn't work. • Intervention of general alarm relay. • Refrigerant compressor and pump stop. • The icon  lights up. • Pressure difference (read on the unit pressure gauge) with pump running and pump stopped is lower than the available pressure head.	Reset thermal cut-out. Increase the pressure drop in the hydraulic circuit, for example by partially closing the pump supply cock. Check for the presence of electrical power.
L Flow switch alarm trip	• The icon  lights up. • Intervention of general alarm relay. • Refrigerant compressor and pump stop.	Check condition of pump. The water circuit is obstructed outside the machine.

HEAT PUMP MODE (HP)

PROBLEM	MANIFESTATION	CAUSE/REMEDY
M Unit fails to start	• Unit is powered and yet fails to start.	**Presence of shut-down alarms** Check for the presence of alarms that prevent the unit from starting. **Supervision active** Check that supervision is not enabled on the unit, otherwise disable it.
N Water inlet temperature lower than set-point.	• Unit is operational but water temperature is lower than the set-point value. • Low water outlet temperature alarm trip. • Low condensation pressure. • Excessively noisy operation of compressors.	**Water flow rate too low** Increase the pressure drop in the water circuit (e.g.: partially closing a tap on the pump delivery line). **Thermal load too low** Reduce the thermal load to within preset limits. **Ambient temperature too high** Increase air recirculation. **Condenser fins fouled** Clean the condenser fins. **Front surface of the condenser blocked** Remove the obstruction from the front surface of the condenser. **Circuit has insufficient refrigerant charge** Call in a qualified refrigeration engineer to check for leaks and eliminate them. Fill the plant. **Incorrect compressors rotation** Invert the position of two phase wires of the compressors power supply (see chap. *"7.1 Start-up"*).
O Insufficient pressure head (water pressure) at the outlet of the pump (if present).	• Rise of water outlet temperature. • With pump installed: pressure difference (read on the unit pressure gauge) with pump running and pump stopped is too low. • Increase in the pressure drop due to the presence of ice. • High temperature difference between water inlet and outlet.	**Water flow rate too high** Reduce water flow within design limits, for example by partially closing a pump outlet cock. **Presence of ice in the condenser** Stop the unit, leave the pump running, edit the set-point value and add glycol to the water. **Evaporator blocked** Supply a high flow rate of water in counter-current conditions. Install a filter upline from the unit.
P The unit is blocked and water does not flow.	• No water flow. • Flow switch alarm trip. • Low pressure alarm trip. • Suction pressure too low.	**Set-point value too low** Increase the SET-POINT value or add glycol (antifreeze) in adequate percentage (see heading *"5.7 Anti-freeze protection"*). ⚠ **The formation of ice can severely damage the unit.**
Q High pressure	• High pressure switch trip. • Refrigerant compressor stops. • The icon  lights up. • Intervention of general alarm relay. • Fans stopped or reverse rotation direction. • Water outlet temperature too high.	**Fans stopped** Repair or replace the fan. **Warm air recirculation** Change the position of the unit or the position of any adjacent obstructions to avoid recirculation. **Coil fouled** Clean the condenser fins. **Thermal load too high** Reduce the thermal load to within preset limits. **Condenser fouled** Clean the condenser. **Machine operating outside the envelope limits** Restore the operating conditions within the envelope limits.
R Low pressure.	• Refrigerant compressor stops. • The icon  lights up. • Intervention of general alarm relay.	**Circuit has insufficient refrigerant charge** Call in a qualified refrigeration engineer to check for leaks and eliminate them. Fill the plant.

PROBLEM	MANIFESTATION	CAUSE/REMEDY
S Compressor internal protection trip	• The icon  lights up. • Intervention of general alarm relay. • Refrigerant compressor stops.	**Thermal load too high** Check that user water temperature and ambient air temperature are within rated limits. Restore the load within the preset limits. Wait a few minutes before turning on again. **Circuit has insufficient refrigerant charge** Call in a qualified refrigeration engineer to check for leaks and eliminate them. Fill the plant.
T Display off.	• Despite the presence of voltage on the board terminals the display remains blank.	**Control board fuse has blown** Change the fuse. Provide cleaner power supply to the unit.
U Pressure transducer faulty or disconnected	• Intervention of general alarm relay.	**Transducer disconnected or short-circuited** Check that the transducer is correctly connected to the control board terminals and the cable is undamaged. If necessary, replace the transducer with a genuine original replacement part.
V Fans overload	• Fans stopped. • Intervention of general alarm relay. • Refrigerant compressor stops. • The icon  lights up. • One of the fans is running noisily.	Check the status of fans, electrical connections, and power supply.
W Pump overload	• The pump doesn't work. • Intervention of general alarm relay. • Refrigerant compressor and pump stop. • The icon  lights up. • Pressure difference (read on the unit pressure gauge) with pump running and pump stopped is lower than the available pressure head.	Reset thermal cut-out. Increase the pressure drop in the hydraulic circuit, for example by partially closing the pump supply cock. Check for the presence of electrical power.
X Flow switch alarm trip	• The icon  lights up. • Intervention of general alarm relay. • Refrigerant compressor and pump stop.	Check condition of pump. The water circuit is obstructed outside the machine.

CHAPTER 11

RISK ANALYSIS: RESIDUAL RISK

Description of risk:	Effect:	User instructions:
1. Risk of crushing.	Machine falling onto persons and/or limbs crushed.	Use lifting equipment suitable for the task, to be performed by qualified personnel referring to the labelling instructions and manual.
2. Risk of cutting and detachment caused by sheets or profiles in general.	Risk of cuts to upper limbs on sharp edges created by the shearing of sheets or saw cutting of profiles.	Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 4 “Installation“ and Chapter 9 “Operation and maintenance“.
3. Risk of cutting or detachment due to the finned surface of air-cooled condensers.	Risk of cutting upper limbs.	Strictly observe all manual instructions. Chapter 1 “General information“; Chapter 2 “Safety“ and Chapter 9 “Operation and maintenance“.
4. Risk of cutting or detachment due to fan blades.	Cuts or dissection.	Strictly observe all manual instructions. Chapter 1 “General information“; Chapter 2 “Safety“ and Chapter 9 “Operation and maintenance“.
5. Risk of high pressure fluid ejection from pipelines and/or pressure tanks in cooling circuit due to accidental bursting.	Contact of body parts with refrigerant gas or parts of cooling circuit pipelines launched at high speed.	Strictly observe all manual instructions. Chapter 2 “Safety“, Chapter 4 “Installation“ and Chapter 8 “Calibrations of other components“.
6. Risk of high pressure fluid ejection from pipelines and/or pressure tanks in cooling circuit due to design pressure values being exceeded.	Contact of body parts with refrigerant gas or parts of cooling circuit pipelines launched at high speed.	Strictly observe all manual instructions. Chapter 2 “Safety“;Chapter 4 “Installation“, Chapter 8 “Calibrations of other components“ and Chapter 9 “Operation and maintenance“.
7. Risk of high pressure fluid ejection from pipelines and/or pressure tanks in the hydraulic circuit, due to accidental explosions.	Contact of body parts with fluids or residual parts of hydraulic circuit pipelines launched at high speed.	Disconnect the machine from the electricity supply during interventions on the hydraulic circuit. Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 4 “Installation“ and Chapter 9 “Operation and maintenance“.
8. Risk of high pressure fluid ejection from pipes and/or pressure tanks in the hydraulic circuit, if the project pressure values are exceeded.	Contact of body parts with fluids or residual parts of circuit pipes launched at high speed.	Depressurise the machine before intervening on the hydraulic circuit. Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 4 “Installation“ and Chapter 9 “Operation and maintenance“.
9. Electrical hazards due to direct contact with live parts.	Risk of electrocution and burns.	Strictly observe all manual instructions. Chapter 2 “Safety“ and 6.2 “Electrical connections” .

Description of risk:	Effect:	User instructions:
10. Electrical hazards due to indirect contact with parts that are live due to faults, in particular due to an insulation fault.	Risk of electrocution and burns.	Strictly observe all manual instructions. Chapter 2 “Safety“ and 6.2 “Electrical connections” .
11. Electrical hazards: electrostatic phenomena.	Uncontrolled movements by victim of electrostatic discharge due to contact.	Strictly observe all manual instructions. 6.2 “Electrical connections” .
12. Electrical hazards: heat radiation or other phenomena such as the projection of melted particles, and chemical effects deriving from short circuits, overloads.	Risk of electrocution with live parts due to short-circuits, scalding on contact with hot components due to overload.	Strictly observe all manual instructions. Chapter 2 “Safety“ and 6.2 “Electrical connections” .
13. Heat-associated risk: burns and/or scalding.	Scalding on contact with pipes at temperatures over 65°C and/or freezing due to contact with surfaces at temperatures below 0°C.	Strictly observe all manual instructions. Chapter 2 “Safety“.
14. Hazards generated by noise levels that may impair hearing capacity (deafness) and other physical disorders (such as loss of balance, consciousness).	Loss of hearing capacity by operator.	Secure all components correctly after interventions and maintenance.
15. Hazards generated by materials or substances handled, used, produced or offloaded from the machine, and by the materials used to construct the machine: inhalation of refrigerant gases.	Inhalation of refrigerant gas.	Strictly observe all manual instructions. Chapter 2 “Safety“.
16. Hazards generated by materials or substances handled, used, produced or offloaded from the machine, and by the materials used to construct the machine: discharge of polluting cooling fluids.	Risk of environmental pollution caused by the drainage of water-glycol mixtures.	Strictly observe all manual instructions. Chapter 2 “Safety“.
17. Hazards generated by materials or substances handled, used, produced or offloaded from the machine and materials used to construct the machine: fire or explosion.	Risk of fire or explosion.	Install the system in an environment fitted with adequate fire fighting equipment. Strictly observe all manual instructions. Chapter 4 “Installation“.
18. Hazards generated by failure to use personal protective equipment.	Lacerations to upper limbs during maintenance or installation.	Use adequate personal protective equipment and observe all the instructions given in the manual. Chapter 1 “General information“; Chapter 2 “Safety“; Chapter 4 “Installation“ and Chapter 9 “Operation and maintenance“.
19. Hazards generated by failure to observe principles of ergonomics during machine design, caused, for example, by: unsuitable design, layout or identification of manual controls.	Hazards associated with failure to correctly identify manual controls.	Consult all sections of the manual.

Description of risk:	Effect:	User instructions:
20. Hazards generated by failure to observe principles of ergonomics during machine design, caused, for example, by: inadequate design or layout of visual display units.	Hazards associated with failure to correctly understand the visual display units.	Consult all sections of the manual.
21. Inadvertent start-up, unexpected overstroke/excess speed (or any other similar malfunction) caused by: a fault or malfunction of the command system.	Electrical or mechanical hazard due to incorrect settings of operating parameters or settings.	Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 9 “Operation and maintenance“; 6.2 “Electrical connections” and Chapter 4 “Installation“.
22. Inadvertent start-up, unexpected overstroke/excess speed (or any other similar malfunction) caused by: fault or malfunction of control system with possibility of disabling safety devices.	Electrical hazard during interventions on machine with safety devices inhibited.	Strictly observe all manual instructions. Chapter 2 “Safety“; 6.2 “Electrical connections” ; Chapter 4 “Installation“ and Chapter 9 “Operation and maintenance“.
23. Inadvertent start-up, unexpected overstroke/excess speed (or any other similar malfunction) caused by: a fault or malfunction of the command system.	Electrical hazards associated with environmental work conditions.	Strictly observe all manual instructions. Chapter 2 “Safety“ and 6.2 “Electrical connections” .
24. Inadvertent start-up, unexpected overstroke/excess speed (or any other similar malfunction) caused by: the return of the electricity supply after a failure.	Hazards associated with inadvertent start-up of the machine when electric power supply is restored.	Strictly observe all manual instructions. Chapter 2 “Safety“; 6.2 “Electrical connections” and Chapter 7 “Start-up“.
25. Inadvertent start-up, unexpected overstroke/excess speed (or any other similar malfunction) caused by external factors on the electrical equipment (EMC).	Electrical hazards associated with electric stress faults on internal machine components, short-circuits and overloads.	Strictly observe all manual instructions. Chapter 2 “Safety“; 6.2 “Electrical connections” and Chapter 9 “Operation and maintenance“.
26. Hazards caused by assembly errors.	Hazards associated with machine instability caused by vibrations. Hazards on contact with operating fluids, risk of pollution due to dispersion of fluids into the environment.	Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 4 “Installation“ and Chapter 7 “Start-up“.
27. Risk of falling or projection of objects or fluids.	Contact of body parts with metallic materials such as the fan blades or moving parts of the compressor.	Disconnect the machine from the electricity supply during interventions on the hydraulic circuit. Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 4 “Installation“ and Chapter 9 “Operation and maintenance“.
28. Loss of machine stability / machine overturning.	Crushing of body parts.	Strictly observe all manual instructions. Chapter 4 “Installation“ and the indications on the unit.
29. Loss of stability/overturning of the machine due to installation on unstable ground and/or vibrations caused by the connection pipes.	Crushing of body parts due to overturning of the machine. Contact of body parts with water due to loss of hydraulic circuit connections because of excessive vibrations.	Strictly observe all manual instructions. Chapter 4 “Installation“ and Chapter 7 “Start-up“.

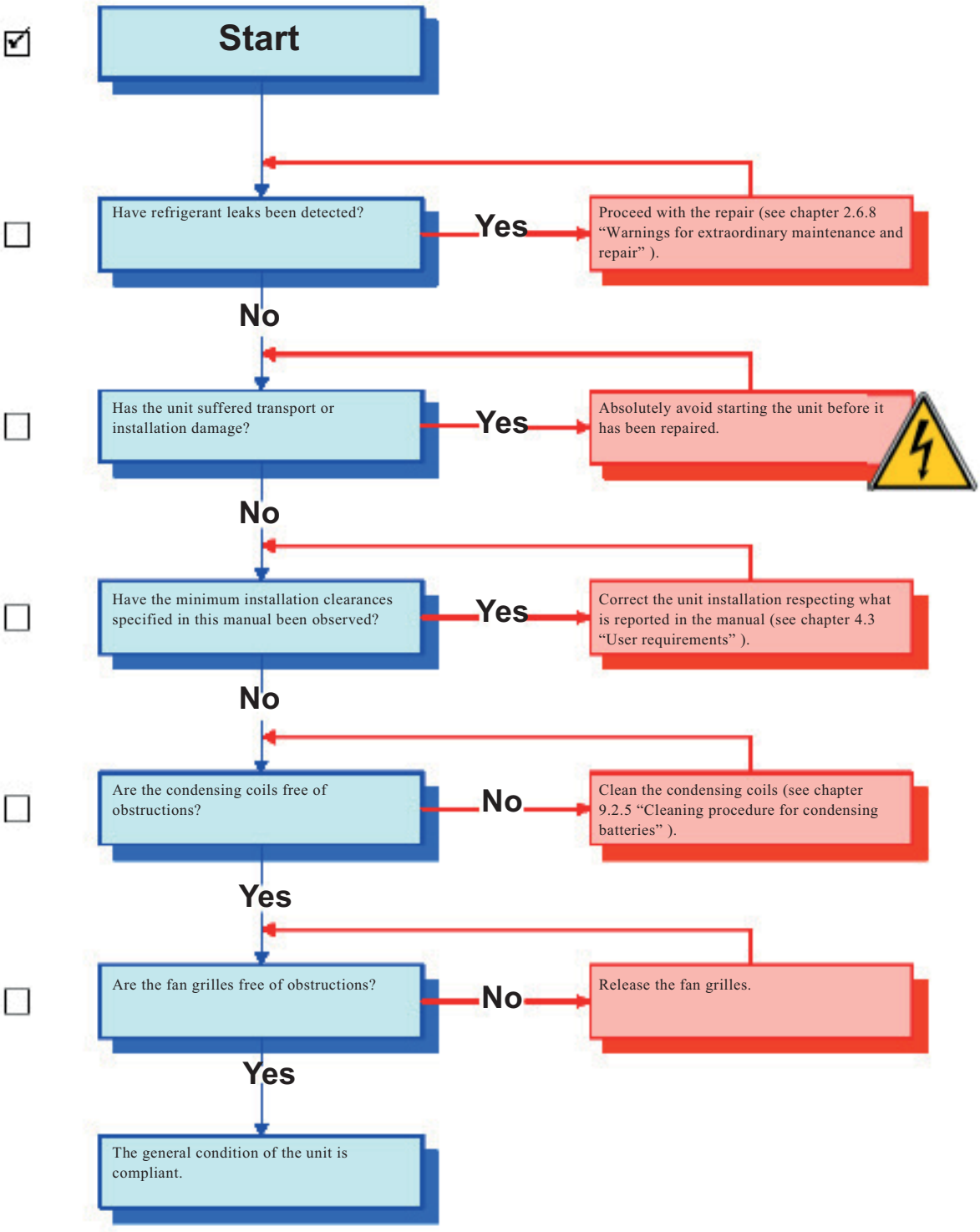
Description of risk:	Effect:	User instructions:
30. Hazards generated by the absence or incorrect position of safety measures/tools: all guards.	Hazard caused by contact with machine components and processed or used materials due to sudden ejections.	Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 4 “Installation“; Chapter 7 “Start-up“ and Chapter 9 “Operation and maintenance“.
31. Hazards generated by the absence or incorrect position of safety measures/tools: graphic safety signs.	Hazard associated with the lack of or inadequate graphic instruction and warning symbols related to dangers that could not be eliminated in design.	The operator must respect all the graphic symbols on the machine, and replace them when worn or illegible. Strictly observe all manual instructions. Chapter 1 “General information“.
32. Hazards generated by the absence or incorrect position of safety measures/tools: manual.	Hazards associated with incorrect preparation of the manual due to absent and/or unclear information required to ensure operator safety and safe machine use.	Consult all sections of the manual.
33. Hazards generated by the absence or incorrect position of safety measures/tools: disconnection of power sources.	Contact with live parts, contact with high pressure fluids or gas.	Strictly observe all manual instructions. Chapter 2 “Safety“ and 6.2 “Electrical connections” .
34. Hazards generated by the absence or incorrect position of safety measures/tools: instruments and accessories for adjustments and/or maintenance in safe conditions.	Hazard of cutting, ejection of high pressure fluids or gases, scalding, or vibrations caused by incorrect maintenance.	Strictly observe all manual instructions. Chapter 2 “Safety“; Chapter 4 “Installation“; Chapter 9 “Operation and maintenance“.

APPENDIX

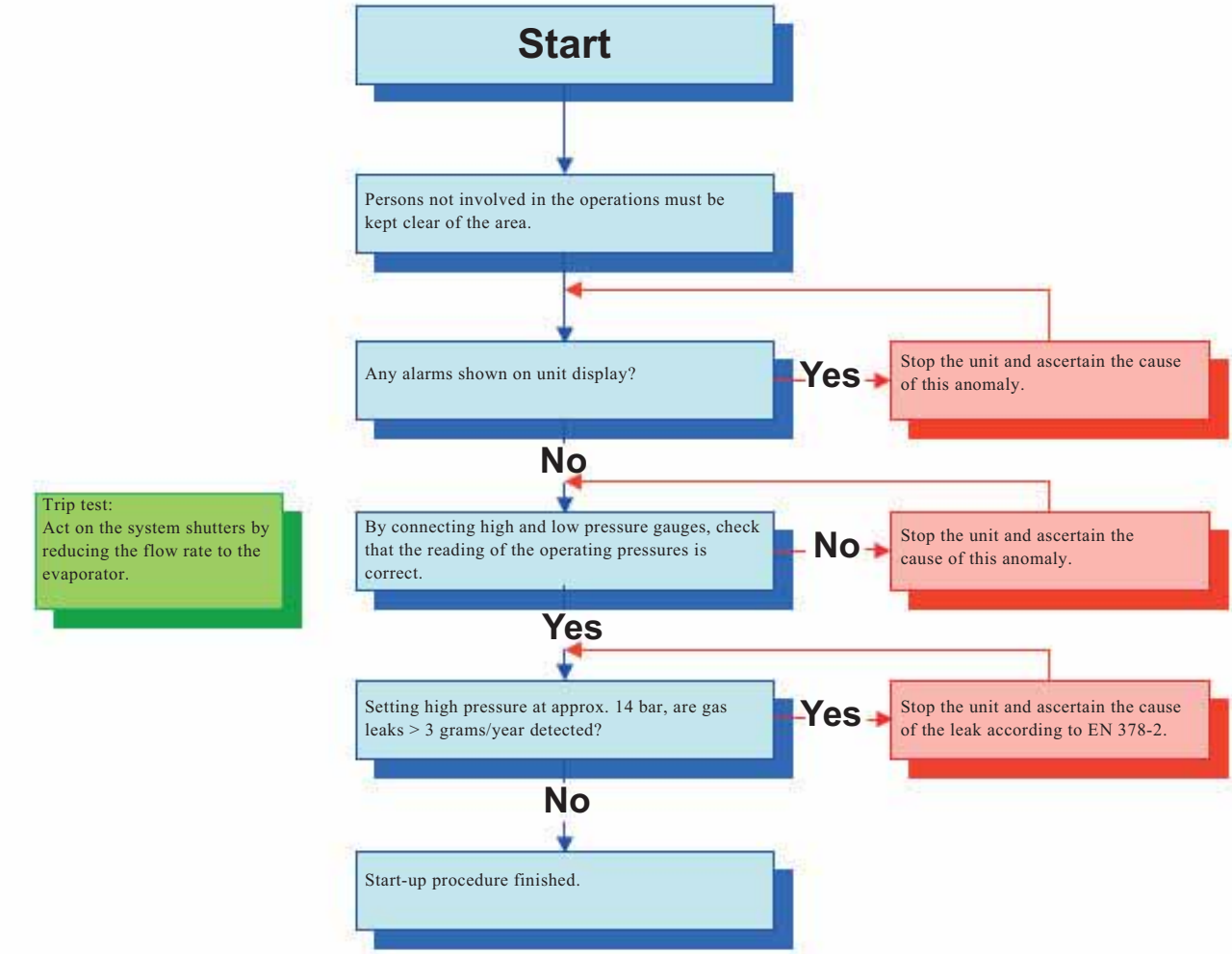
GENERAL CONDITIONS CHECKLIST

CAUTION

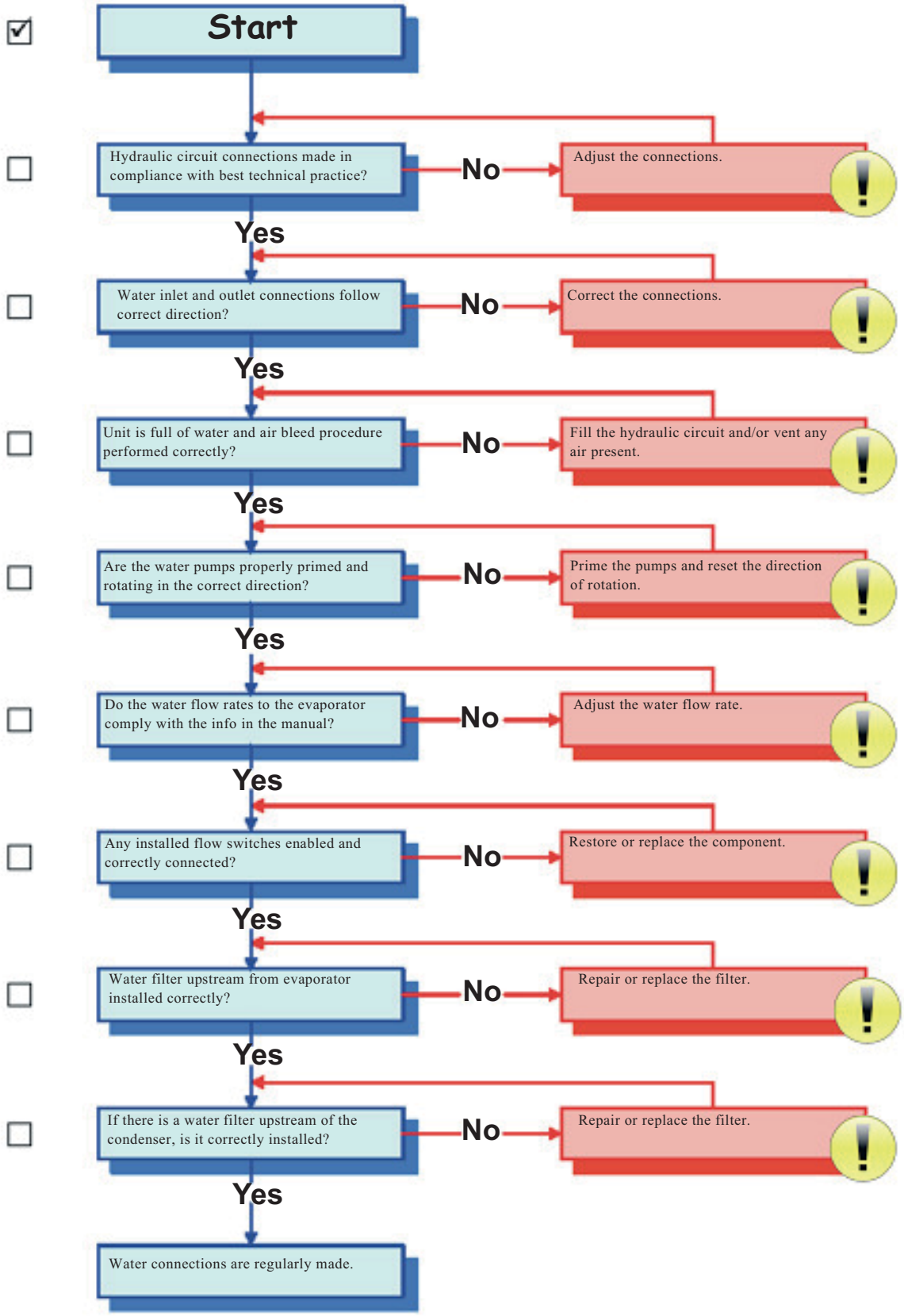
⚠ DO NOT SUPPLY THE UNIT



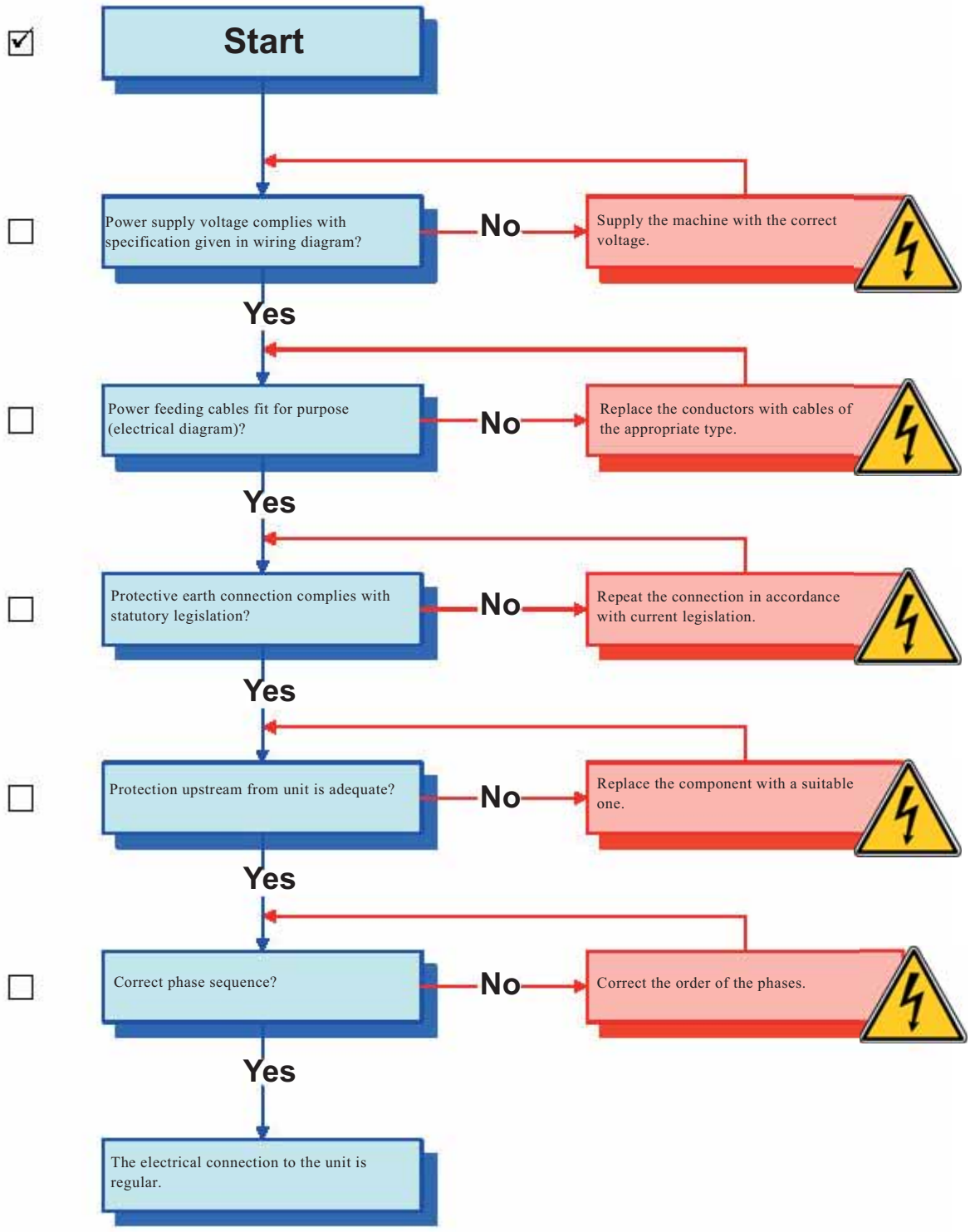
FIRST START CHECKLIST



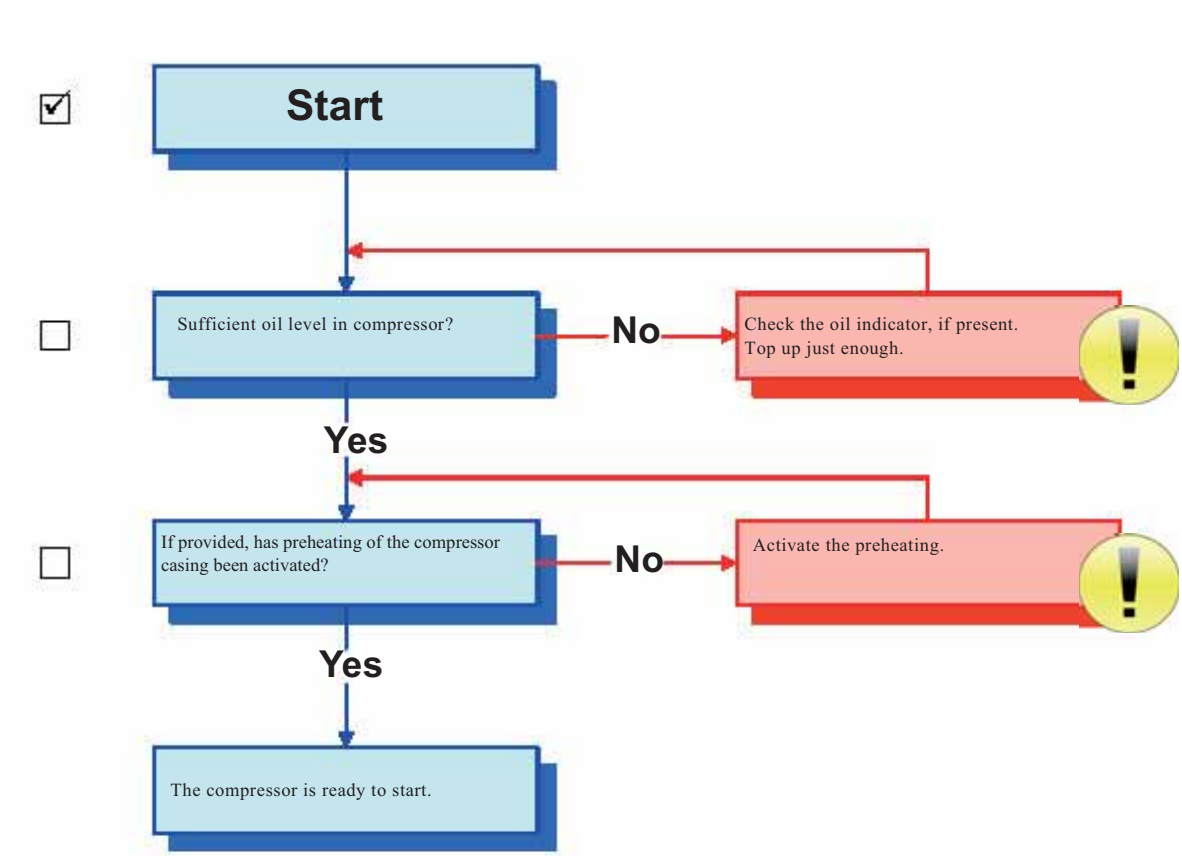
HYDRAULIC CIRCUIT CHECK LIST



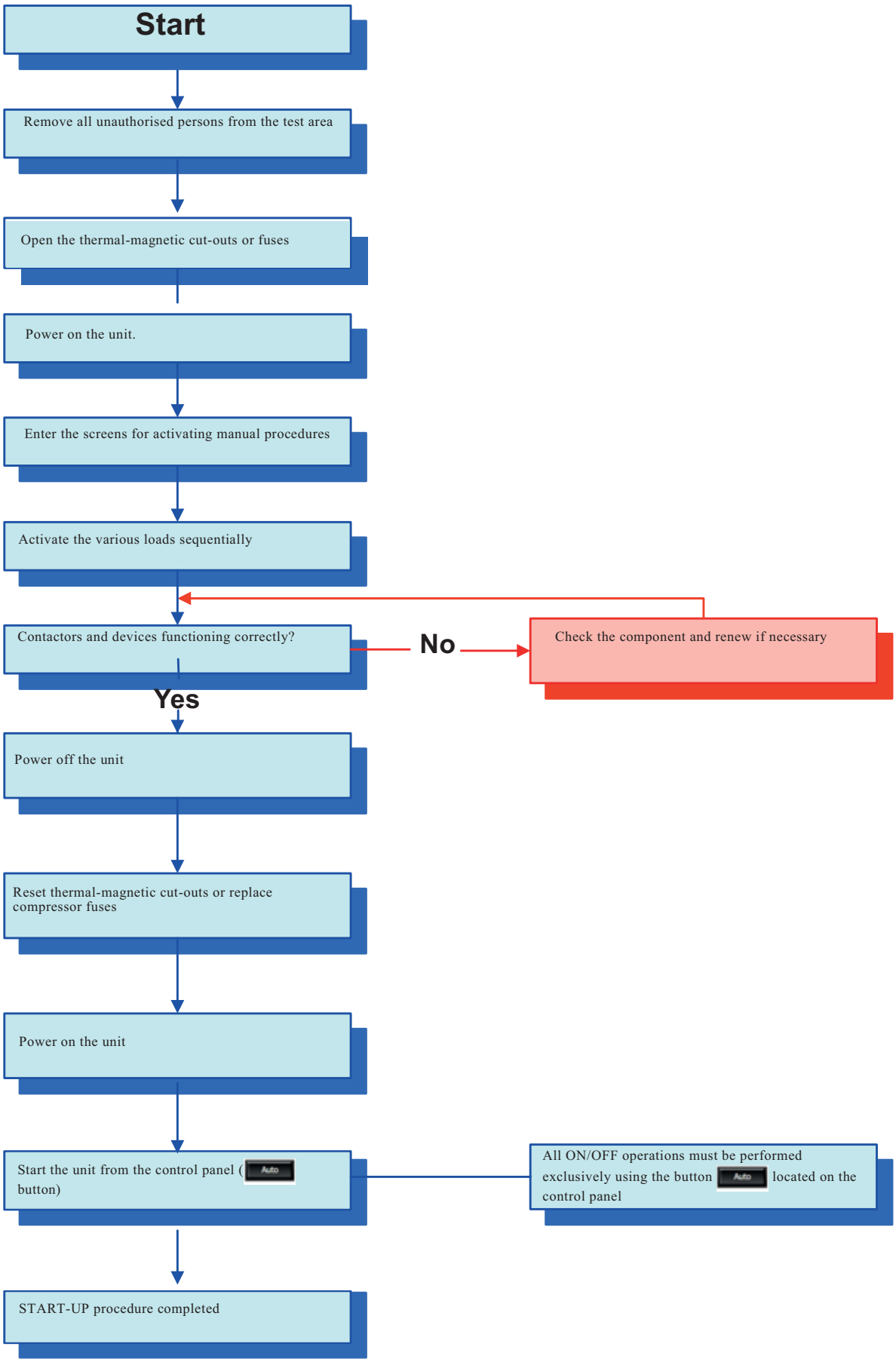
CONTROLLER CHECK



OIL CHECKLIST



UNIT OPERATING CHECKLIST



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