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Date	March 2018
Supersedes	/

Installation, Operation and Maintenance Manual
D-EIMAC01603-18EN

Air cooled chiller with inverter driven screw compressor

EWAH~TZB

Refrigerant: R1234ze



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Figure 1 - Typical refrigerant circuit

Water inlet and outlet are indicative. Please refer to the machine dimensional diagrams for exact water connections.

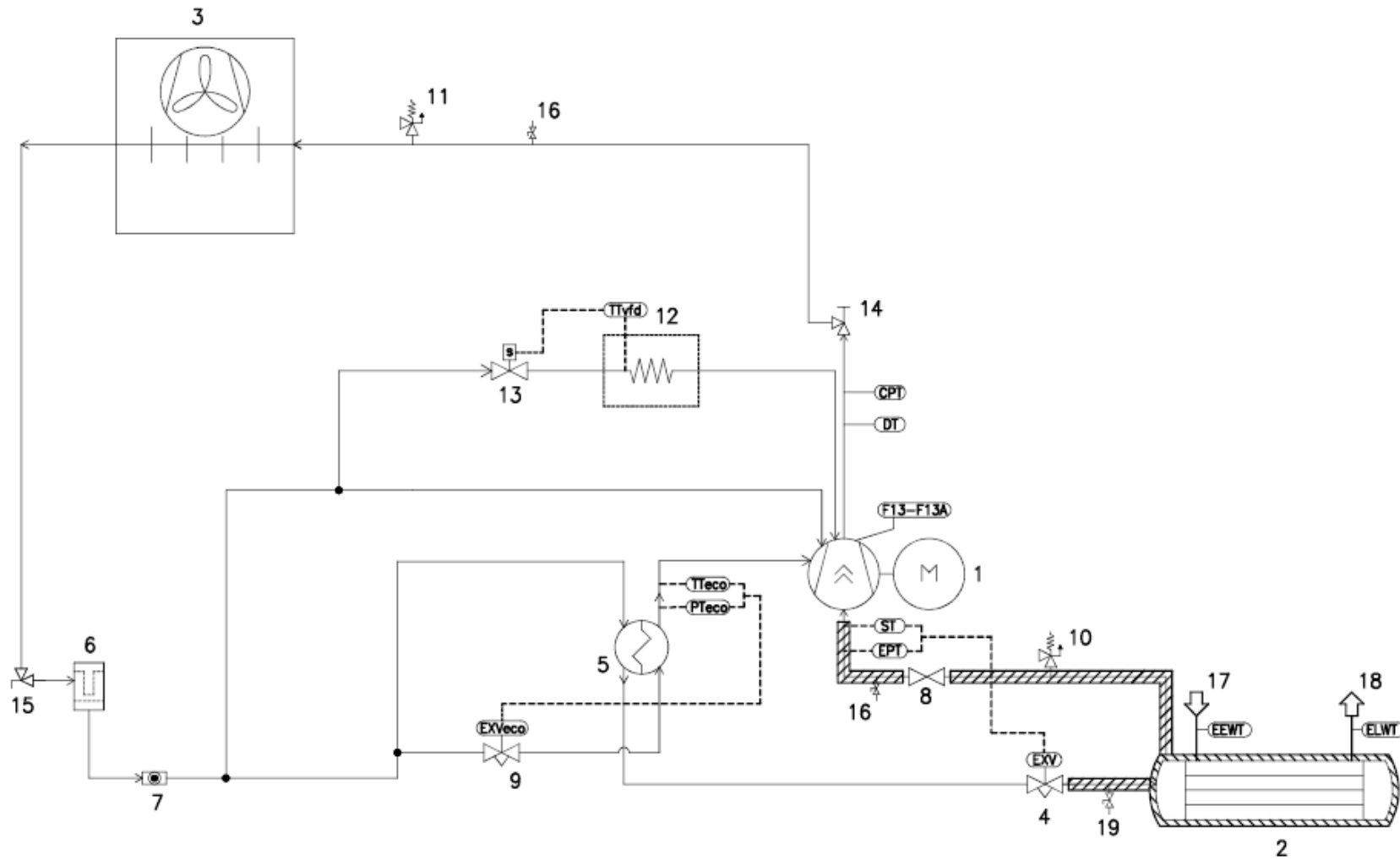
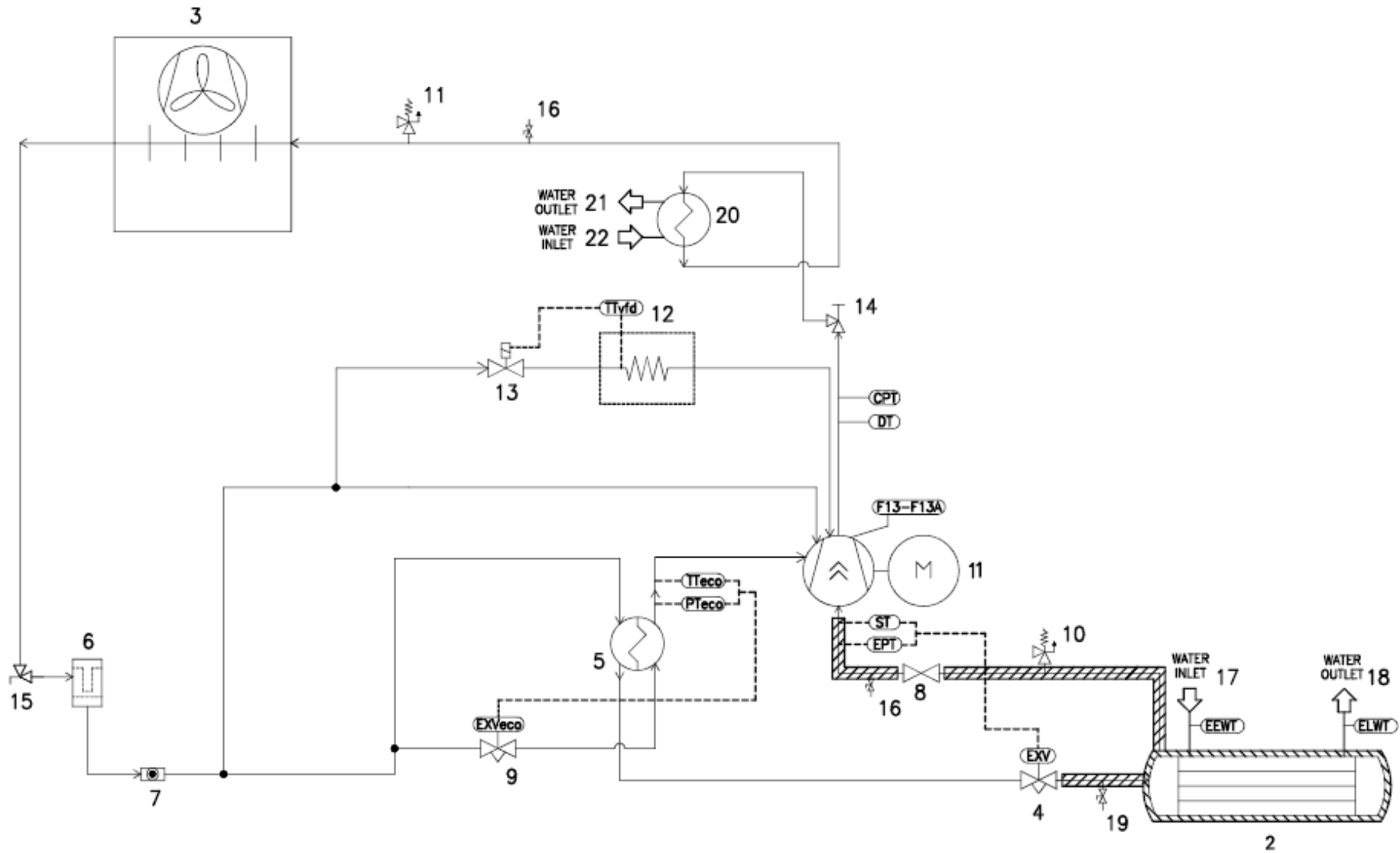


Figure 2 - Typical refrigerant circuit with heat recovery

Water inlet and outlet are indicative. Please refer to the machine dimensional diagrams for exact water connections.



Legend	
1	Compressor
2	Evaporator
3	Condenser coil & Axial fan
4	Electronic expansion valve
5	Economizer
6	Dehydration filter
7	Liquid and humidity indicator
8	Suction valve
9	Economizer electronic expansion valve
10	Low-pressure safety valve
11	High-pressure safety valve
12	Heat exchanger (VFD cooling)
13	Heat exchanger (VFD cooling) solenoid valve
14	Discharge shut off valve
15	Liquid line isolating valve
16	1/4" SAE Flare valve
17	Evaporator water inlet connection
18	Evaporator water outlet connection
19	2 Way charging valve
20	Heat Recovery (Optional)
21	Heat Recovery water outlet connection
22	Heat Recovery water inlet connection
F13-F13A	High pressure switch
DT	Discharge temperature sensor
CPT	Condenser pressure transducer
EPT	Evaporator pressure transducer
ST	Suction temperature sensor
PTeco	Economizer pressure transducer
TTeco	Economizer temperature transducer
TTvfd	VFD Temperature transducer
EEWT	Evaporator Entering Water Temperature probe
ELWT	Evaporator Leaving Water Temperature probe

This manual is an important supporting document for qualified personnel but it is not intended to replace such personnel.

Thank you for purchasing this chiller



READ THIS MANUAL CAREFULLY BEFORE INSTALLING AND STARTING UP THE UNIT.
IMPROPER INSTALLATION COULD RESULT IN ELECTRIC SHOCK, SHORT-CIRCUIT, LEAKS, FIRE OR OTHER DAMAGE TO THE EQUIPMENT OR INJURE TO PEOPLE.
THE UNIT MUST BE INSTALLED BY A PROFESSIONAL OPERATOR/TECHNICIAN
UNIT STARTUP HAS TO BE PERFORMED BY AUTHORIZED AND TRAINED PROFESSIONAL
ALL ACTIVITIES HAVE TO BE PERFORMED ACCORDING TO LOCAL LAWS AND REGULATION.
UNIT INSTALLATION AND START UP IS ABSOLUTELY FORBIDDEN IF ALL INSTRUCTION CONTAINED IN THIS MANUAL ARE NOT CLEAR.
IF CASE OF DOUBT CONTACT THE MANUFACTURER REPRESENTATIVE FOR ADVICE AND INFORMATION.

Description

The unit you bought is an "air cooled chiller", a machine aimed to cool water (or water-glycol mixture) within the limits described in the following. The unit operation is based on vapour compression, condensation and evaporation according to reverse Carnot cycle. The main components are:

- Screw compressor to rise the refrigerant vapour pressure from evaporation pressure to condensation pressure
- Evaporator, where the low pressure liquid refrigerant evaporates to cool the water
- Condenser, where high pressure vapour condensate rejecting heat removed from the chilled water in the atmosphere thanks to an air cooled heat exchanger.
- Expansion valve allowing to reduced the pressure of condensed liquid from condensation pressure to evaporation pressure.

General Information



All units are delivered with **wiring diagrams, certified drawings, nameplate**; and **DOC (Declaration Of Conformity)**; these documents show all technical data for the unit you have bought and they **MUST BE CONSIDERED ESSENTIAL DOCUMENTS OF THIS MANUAL**

In case of any discrepancy between this manual and the equipment's documents please refer to on board documents. In case of any doubt contact the manufacturer representative.

The purpose of this manual is to allow the installer and the qualified operator to ensure proper installation, commissioning and maintenance of the unit, without any risk to people, animals and/or objects.

Information about used refrigerant

This product is equipped with refrigerant R1234ze(E) which has minimal impact to the environment, thanks to its low value of Global Warming Potential (GWP).

R1234ze(E) refrigerant is classified by European Directive 2014/68/EU as a Group 2 (non-dangerous) substance, as **it is nonflammable at standard ambient temperature and non-toxic**. Due to this, no special precautions are required for storage, transport and handling.

Daikin Applied Europe S.p.A. products comply with applicable European Directives and refer for unit design to product Standard EN378:2016 and industrial Standard ISO5149. Local authorities approval should be verified referring to European Standard EN378 and/or ISO 5149 (where R1234ze(E) is classified A2L – Mildly flammable gas).

Physical characteristics of refrigerant R1234ze (E)

Safety Class	A2L
PED Fluid Group	2
Practical limit (kg/m ³)	0.061
ATEL/ ODL (kg/m ³)	0.28
LFL (kg/m ³) @ 60°C	0.303
Vapour density @25°C, 101.3 kPa (kg/m ³)	4.66
Molecular Mass	114.0
Normal Boling Point (°C)	-19
GWP (100 yr ITH)	7
GWP (ARS 100 yr ITH)	<1
Auto Ignition Temperature (°C)	368

Information about installation

The chillers are built in accordance with the main European Directives (Machinery Directive, Low Voltage Directive, Electromagnetic Compatibility Directive, Pressurized Equipment Directive), make sure you also receive the declaration of product conformity with the directives along with the documentation.

Before machine installation and commissioning, the people involved in this activity must have acquired the information necessary to carry out these tasks, applying all the information collected in this book.

Do not allow unauthorized and/or unskilled personnel to access the unit.

The chiller has to be installed in open air or machinery room (location classification III).

To ensure location classification III a mechanical vent on the secondary circuit(s) has to be installed.

Local building codes and safety standards shall be followed; in absence of local codes and standards refer to EN 378-3:2016 as a guide.

In paragraph "Additional guidelines for safe use of R1234ze(E)" there are provided additional informations that should be added to the requirements of safety standards and building codes.

Additional guidelines for safe use of R1234ze(E) for equipment located in the open air

Refrigerating systems sited in the open air shall be positioned to avoid leaked refrigerant flowing into a building or otherwise endangering people and property.

The refrigerant shall not be able to flow into any ventilation fresh air opening, doorway, trap door or similar opening in the event of a leak. Where a shelter is provided for refrigerating equipment sited in the open air it shall have natural or forced ventilation.

For refrigeration systems installed outside in a location where a release of refrigerant can stagnate e.g. below ground, then the installation shall comply with the requirements for gas detection and ventilation of machinery rooms.

Additional guidelines for safe use of R1234ze(E) for equipment located in a machinery room

When a machinery room is chosen for the location of the refrigerating equipment it shall be located in accordance with local and national regulations. The following requirements (according to EN 378-3:2016) can be used for the assessment.

- A risk analysis based on the safety concept for the refrigerating system (as determined by the manufacturer and including the charge and safety classification of the refrigerant used) shall be conducted to determine whether it is necessary to place the refrigerating system in a separate refrigeration machinery room.
- Machinery rooms should not be used as occupied spaces. The building owner or user shall ensure that access is permitted only by qualified and trained personnel doing the necessary maintenance to the machinery room or general plant.
- Machinery rooms shall not be used for storage with the exception of tools, spare parts and compressor oil for the installed equipment. Any refrigerants, or flammable or toxic materials shall be stored as required by national regulations.
- Open (naked) flames shall not be permitted in machinery rooms, except for welding, brazing or similar activity and then only provided the refrigerant concentration is monitored and adequate ventilation is ensured. Such open flames shall not be left unattended.
- A remote switching (emergency type) for stopping the refrigerating system shall be provided outside the room (near the door). A similar acting switch shall be located at a suitable location inside the room.
- All piping and ducting passing through floors, ceiling and walls of machinery room shall be sealed.
- Hot surfaces shall not exceed a temperature of 80 % of the auto-ignition temperature (in °C) or 100 K less than the auto-ignition temperature of the refrigerant, whichever is higher.

Refrigerant	Auto ignition temperature	Maximum surface temperature
R1234ze	368 °C	294 °C

- Machinery rooms shall have doors opening outward and sufficient in number to ensure freedom for persons to escape in an emergency; the doors shall be tight fitting, self-closing and so designed that they can be opened from inside (antipanic system).
- Special machinery rooms where the refrigerant charge is above the practical limit for the volume of the room shall have a door that either opens directly to the outside air or through a dedicated vestibule equipped with self-closing, tight-fitting doors.
- The ventilation of machinery rooms shall be sufficient both for normal operating conditions and emergencies.
- Ventilation for normal operating conditions shall be in accordance with national regulations.
- The emergency mechanical ventilation system shall be activated by a detector(s), located in the machinery room.
 - This ventilation system shall be:
 - independent of any other ventilation system on the site.
 - provided with two independent emergency controls one located outside the machinery room, and the other inside.
 - The emergency exhaust ventilation fan shall:
 - Be either in the air flow with the motor outside the airflow, or rated for hazardous areas (according to the assessment).
 - Be located to avoid pressurization of the exhaust ductwork in the machinery room.
 - not cause sparks to occur if it contacts the duct material.
 - Airflow of the emergency mechanical ventilation shall be at least

$$V = 0,014 \times m^{2/3}$$

where

V is the air flow rate in m³/s;

m is the mass of refrigerant charge, in kg, in the refrigerating system with the largest charge, any part of which is located in the machinery room;

0,014 is a conversion factor.

- Mechanical ventilation shall be operated continuously or shall be switched on by the detector.
- Detector shall automatically activate an alarm, start mechanical ventilation and stop the system when it triggers.
- The location of detectors shall be chosen in relation to the refrigerant and they shall be located where the refrigerant from the leak will concentrate.
- The positioning of the detector shall be done with due consideration of local airflow patterns, accounting for location sources of ventilation and louvers. Consideration shall also be given to the possibility of mechanical damage or contamination.
- At least one detector shall be installed in each machinery room or the occupied space being considered and/or at the lowest underground room for refrigerants heavier than air and at the highest point for refrigerants lighter than air.
- Detectors shall be continuously monitored for functioning. In the case of a detector failure, the emergency sequence should be activated as if refrigerant had been detected.
- The pre-set value for the refrigerant detector at 30 °C or 0 °C, whichever is more critical, shall be set to 25 % of the LFL. The detector shall continue to activate at higher concentrations.

Refrigerant	LFL	Pre-set alarm
R1234ze	0,303 kg/m ³	0,07575 kg/m ³ 16500 ppm

- All electrical equipment (not only the refrigerating system) shall be selected to be suitable for use in the zones identified in the risk assessment. Electrical equipment shall be deemed to comply with the requirements if the electrical supply is isolated when the refrigerant concentration reaches 25 % of the lower flammable limit or less.
- Machinery rooms or special machinery rooms shall be **clearly marked** as such on the entrances to the room, together with warning notices indicating that unauthorized persons shall not enter and that smoking, naked light or flames are prohibited. The notices shall also state that, in the event of an emergency, only authorized persons conversant with emergency procedures shall decide whether to enter the machinery room. Additionally, warning notices shall be displayed prohibiting unauthorized operation of the system
- The owner / operator shall keep an updated logbook of the refrigerating system.

Receiving the unit

The unit must be inspected for any possible damage immediately upon reaching final place of installation. All components described in the delivery note must be inspected and checked.

Should the unit be damaged, do not remove the damaged material and immediately report the damage to the transportation company and request they inspect the unit..

Immediately report the damage to the manufacturer representative, a set of photographs are helpful in recognizing responsibility

Damage must not be repaired before the inspection of the transportation company representative.

Before installing the unit, check that the model and power supply voltage shown on the nameplate are correct. Responsibility for any damage after acceptance of the unit cannot be attributed to the manufacturer.

Operating limits

Storing Storage

Environmental conditions must be within the following limits:

Minimum ambient temperature : -20°C

Maximum ambient temperature : 57°C

Maximum R.H. : 95% not condensing

Storing below the minimum temperature may cause damage to components. Storing above the maximum temperature causes opening of safety valves. Storing in condensing atmosphere may damage electronic components.

Operation

Operation is allowed within the following limits:

SERIES	SIZE	Evaporator Leaving Water Temperature		Outside Ambient Temperature @ full load
		Cool Mode	Cool with glycol, Ice Mode	
SILVER	160-700	4÷18°C	-8÷18°C	-18÷47°C
	820-C11	4÷20°C	-8÷20°C	-18÷45°C
GOLD	190-680	4÷18°C	-8÷18°C	-18÷50°C
	770-C11	4÷20°C	-8÷20°C	-18÷50°C
PLATINUM	190-620	4÷18°C	-8÷18°C	-18÷53°C
	720-950	4÷20°C	-8÷20°C	-18÷55°C

Operational envelope can be extended through selection of specific options (such as high ambient kit, brine version, etc) which allow the unit to operate with evaporator leaving water temperature below +4°C and/or ambient temperature at full load above +46°C.

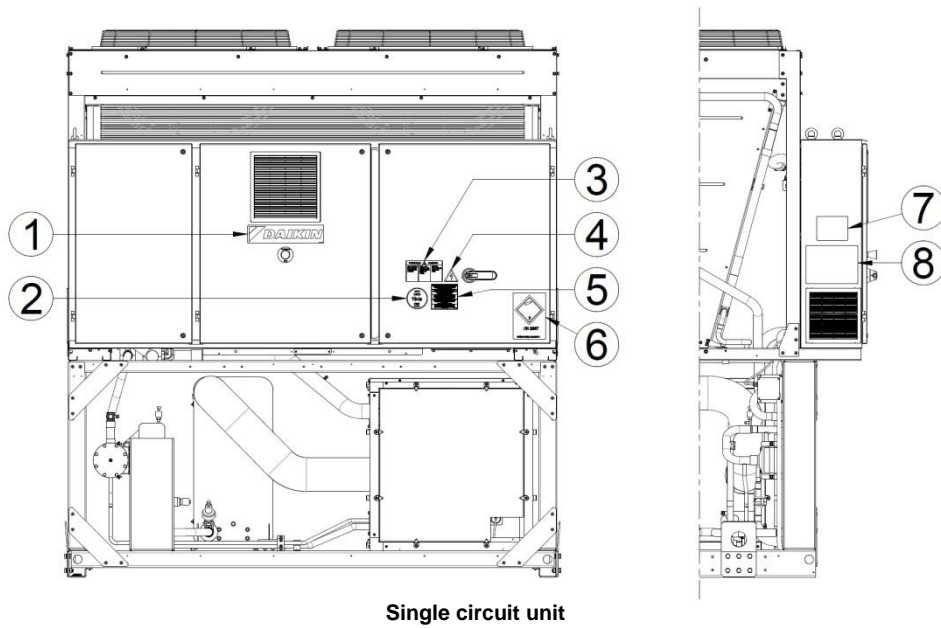
The above mentioned values represent a guideline, please refer to the chiller selection software for real operating limits for the specific model.

As a general rule, the unit should be operated with an evaporator water flow rate between 50% and 120% of nominal flow rate (at standard operating conditions), however check with the chiller selection software the correct minimum and maximum allowed values for the specific model.

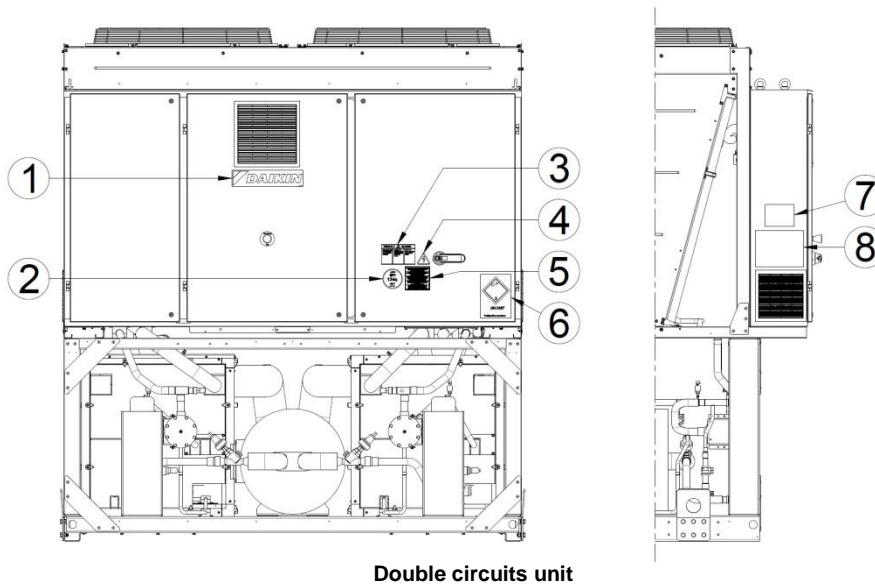
Operation out of the mentioned limits may damage the unit.

In case of doubts contact manufacturer representative.

Figure 3 - Description of the labels applied to the electrical panel



Single circuit unit



Double circuits unit

Label Identification

1 – Manufacturer's logo	5 – Cable tightening warning
2 – Gas type	6 – Transportation Label UN 2857
3 – Hazardous Voltage warning	7 – Unit nameplate data
4 – Electrical hazard symbol	8 – Lifting instruction

Mechanical Installation

Safety

The unit must be firmly secured to the soil.

It is essential to observe the following instructions:

- The unit can only be lifted using the lifting points marked in yellow fixed to its base.
- It is forbidden to access the electrical components without having opened the unit main switch and switched off the power supply.
- It is forbidden to access the electrical components without using an insulating platform. Do not access the electrical components if water and/or moisture are present.
- Sharp edges and the surface of the condenser section could cause injury. Avoid direct contact and use adequate protection device
- Switch off power supply, by opening the main switch, before servicing the cooling fans and/or compressors. Failure to observe this rule could result in serious personal injury.
- Do not introduce solid objects into the water pipes while the unit is connected to the system.
- A mechanical filter must be installed on the water pipe connected to the heat exchanger inlet.
- The unit is supplied with safety valves, that are installed both on the high-pressure and on the low-pressure sides of the refrigerant circuit.

It is absolutely forbidden to remove all protections of moving parts.

In case of sudden stop of the unit, follow the instructions on the **Control Panel Operating Manual** which is part of the on-board documentation delivered to the end user.

It is strongly recommended to perform installation and maintenance with other people. In case of accidental injury or unease, it is necessary to:

- keep calm
- press the alarm button if present in the installation site
- move the injured person in a warm place far from the unit and in rest position
- contact immediately emergency rescue personnel of the building or the Health Emergency Service
- wait without leaving the injured person alone until the rescue operators come
- give all necessary information to the rescue operators



Avoid installing the chiller in areas that could be dangerous during maintenance operations, such as platforms without parapets or railings or areas not complying with the clearance requirements around the chiller.

Noise

The unit is a source of noise mainly due to rotation of compressors and fans.

The noise level for each model size is listed in sales documentation.

If the unit is correctly installed, operated and maintained the noise emission level do not require any special protection device to operate continuously close to the unit without any risk.

In case of installation with special noise requirements it could be necessary to install additional sound attenuation devices.

Moving and lifting

Avoid bumping and/or jolting during loading/unloading unit from the truck and moving it. Do not push or pull the unit from any part other than the base frame. Secure the unit inside the truck to prevent it from moving and causing damages. Do not allow any part of the unit to fall during transportation or loading/unloading.

All units of the series are supplied with lifting points marked in yellow. Only these points may be used for lifting the unit, as shown in the following figure.

Use spacing bars to prevent damage to the condensation bank. Position these above the fan grills at a distance of at least 2.5 metres.



Both the lifting ropes and the spacing bars must be strong enough to support the unit safely. Please check the unit's weight on the unit nameplate.

The unit must be lifted with the utmost attention and care following lifting label instructions; lift unit very slowly, keeping it perfectly level.

Positioning and assembly

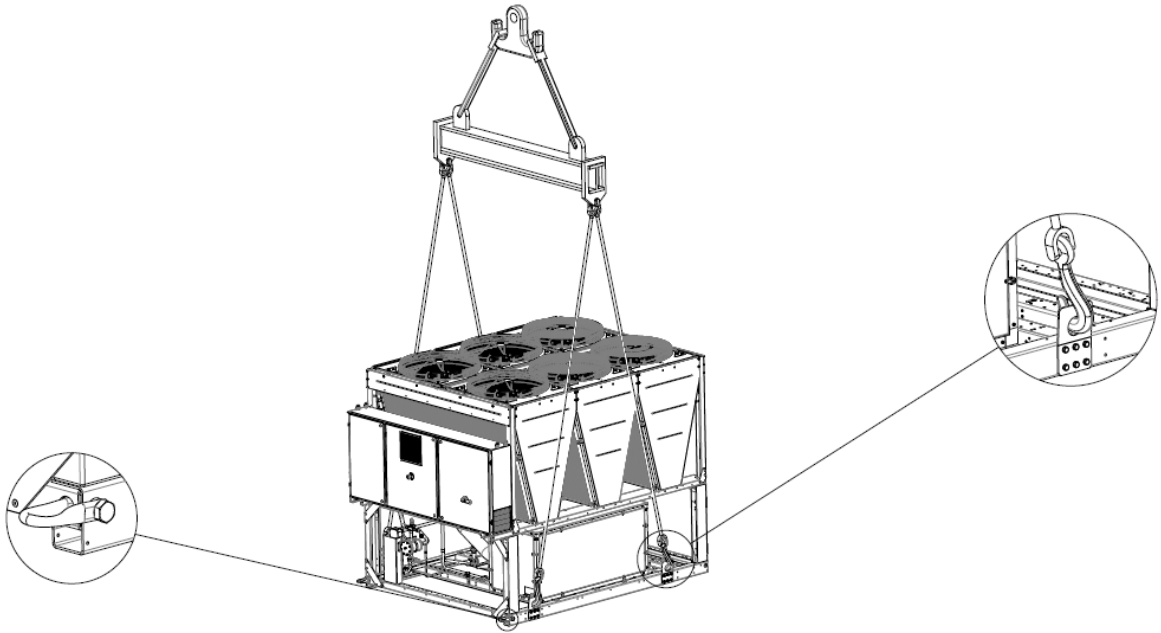
All units are designed for installation outdoors, either on balconies or on the ground, provided that the installation area is free of obstacles that could reduce air flow to the condensers coil.

The unit must be installed on a robust and perfectly level foundation; should the unit be installed on balconies or roofs, it might be necessary to use weight distribution beams.

Figure 4– Lifting

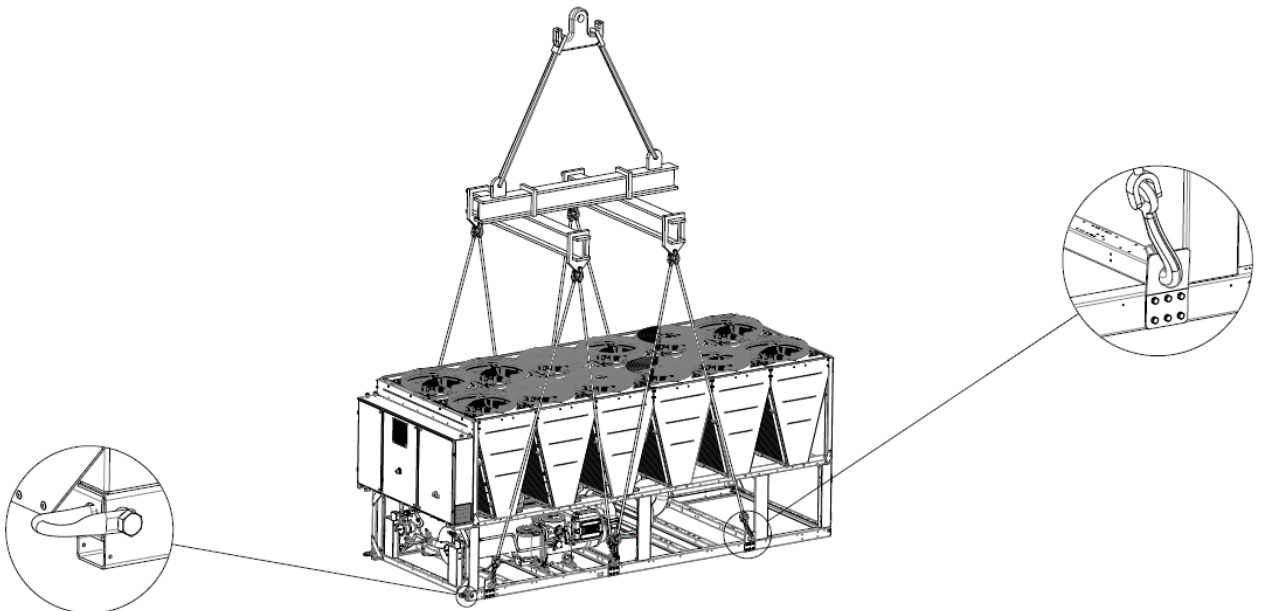
Unit with 4 lifting points

(The drawing shows only the 6 fans version. For the 4 fans version the lifting mode is the same)



Unit with 6 lifting points

(The drawing shows only the 12 fans version. The lifting mode is the same for the different number of fans)



Unit with 8 lifting points

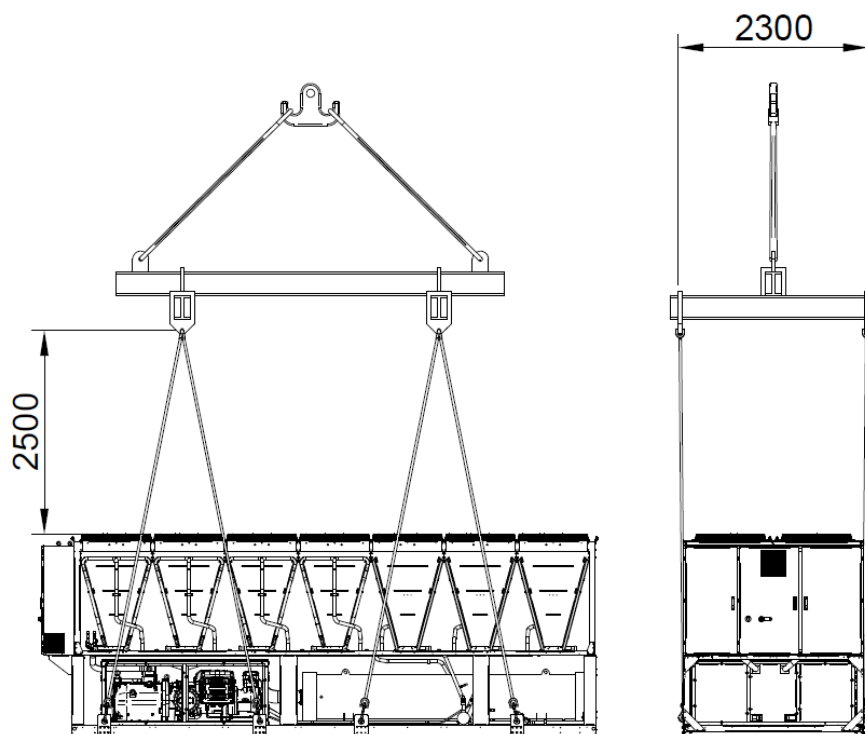
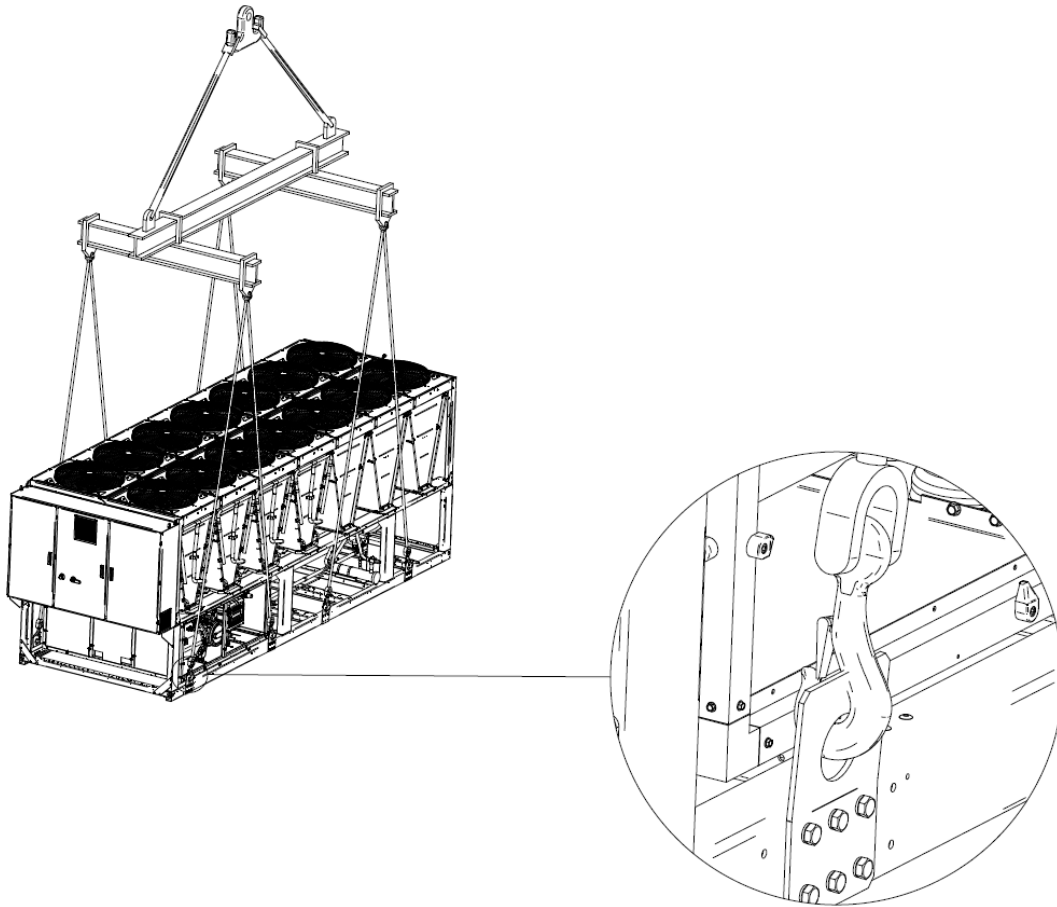
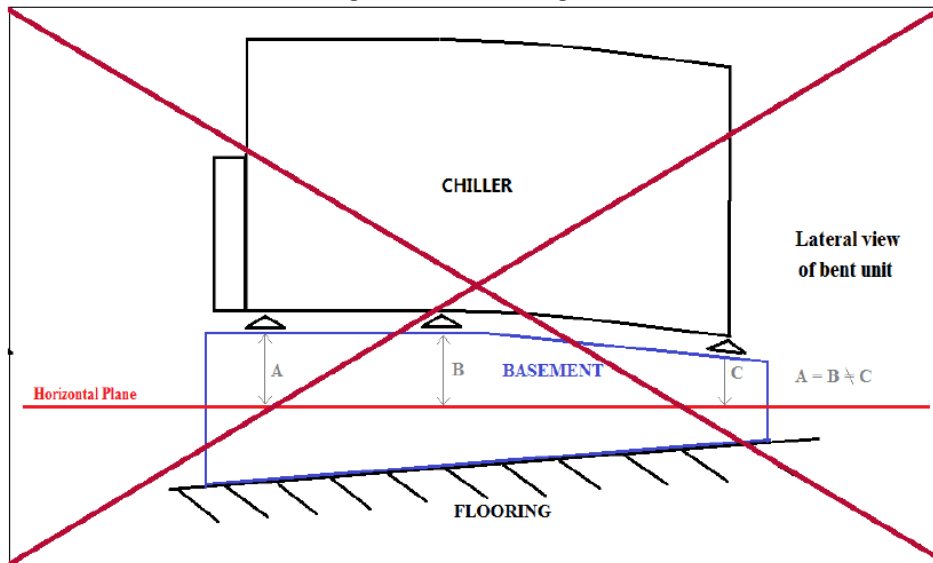


Figure 5– Unit Levelling



For installation on the ground, a strong concrete base, at least 250 mm thickness and wider than the unit must be provided. This base must be able to support the weight of the unit.

The unit must be installed above antivibrating mounts (AVM), rubber or spring types. The unit frame must be perfectly levelled above the AVM.

Installation such as in the figure above must always be avoided. In case the AVM's are not adjustable (spring type are normally not adjustable) the flatness of the unit frame must be guaranteed by using metal plate spacers.

Before unit commissioning, the flatness must be verified by using a laser levelling device or other similar devices. The flatness shall not be over 5 mm for units within 7 m length and 10 mm for units over 7 m.

If the unit is installed in places that are easily accessible to people and animals, it is advisable to install protection grids for the condenser and compressor sections.

To ensure best performance on the installation site, the following precautions and instructions must be followed:

- Avoid air flow recirculation.
- Make sure that there are no obstacles to hamper air flow.
- Make sure to provide a strong and solid foundation to reduce noise and vibrations.
- Avoid installation in particularly dusty environments, in order to reduce soiling of condensers coils.
- The water in the system must be particularly clean and all traces of oil and rust must be removed. A mechanical water filter must be installed on the unit's inlet piping.

Minimum space requirements

It is fundamental to respect minimum distances on all units in order to ensure optimum ventilation to the condenser coils.

When deciding where to position the unit and to ensure a proper air flow, the following factors must be taken into consideration:

- avoid any warm air recirculation
- avoid insufficient air supply to the air-cooled condenser.

Both these conditions can cause an increase of condensing pressure, which leads to a reduction in energy efficiency and refrigerating capacity.

Any side of the unit must be accessible for post-installation maintenance operations. Figure 6 shows the minimum space required.

Vertical air discharge must not be obstructed.

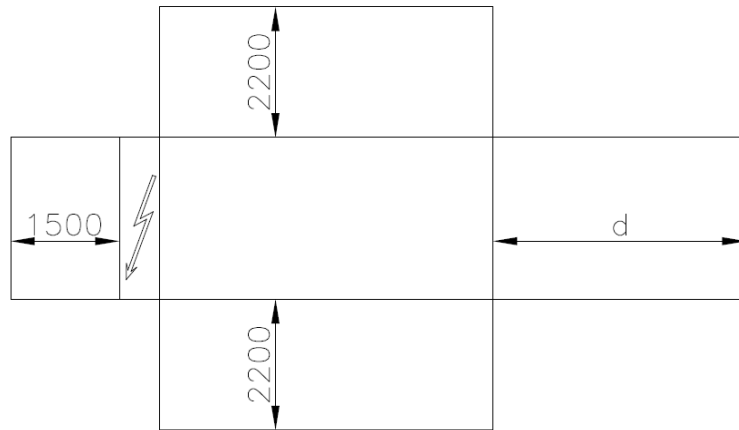
If the unit is surrounded by walls or obstacles of the same height as the unit, this must be installed at a distance no lower than 3000 mm.

In case of two chillers installed in free field, minimum recommended distance between them is 3600 mm; in case of two chillers in a row, minimum distance is 1500 mm. The pictures below show example of recommended installations.

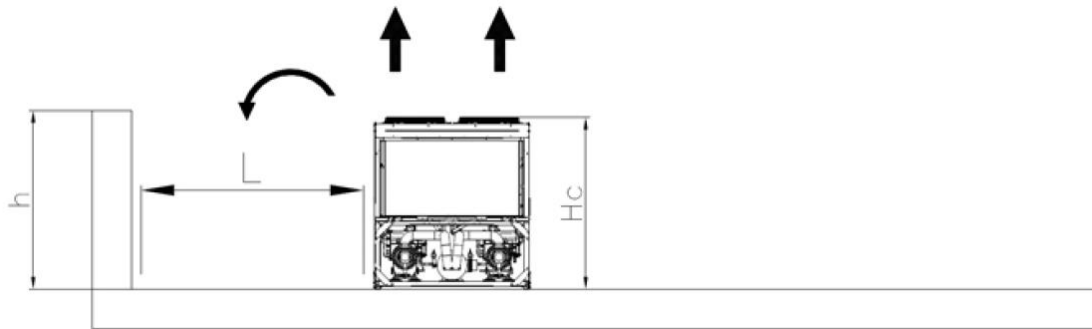
Should the unit be installed without observing the recommended minimum distances from walls and/or vertical obstacles, there could be a combination of warm air recirculation and/or insufficient supply to the air-cooled condenser which could cause a reduction of capacity and efficiency.

In any case, the microprocessor will allow the unit to adapt itself to new operating conditions and deliver the maximum available capacity under any given circumstances, even if the lateral distance is lower than recommended, unless the operating conditions should affect personal safety or unit reliability.

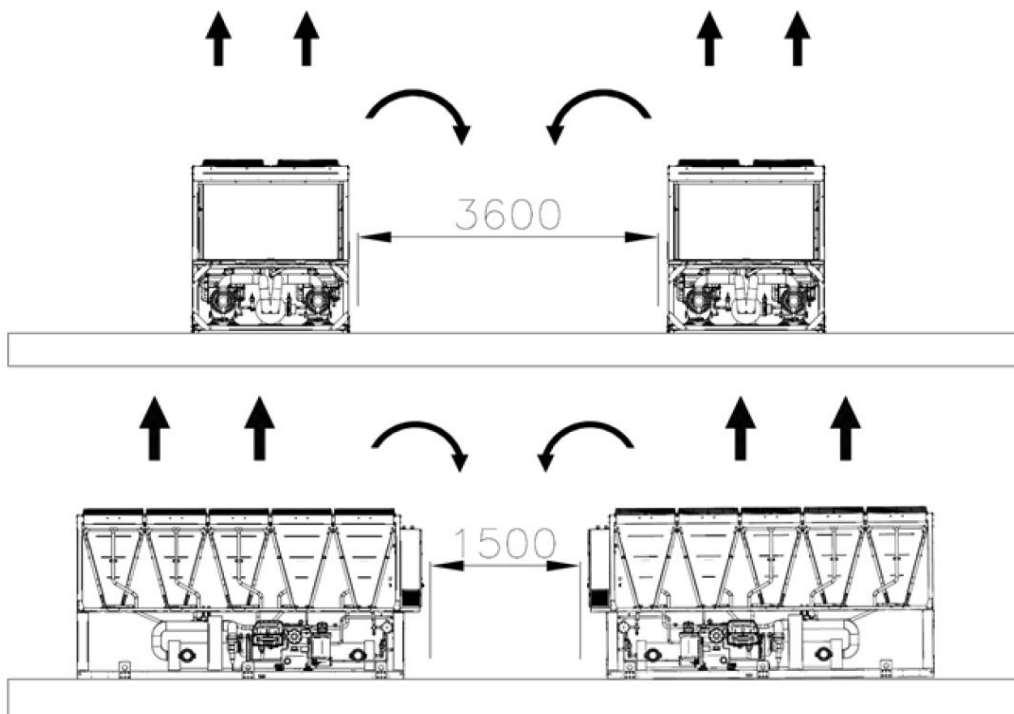
Figure 6- Minimum clearance requirements



d= 1500 mm for single circuit units; d= 3000/3500 mm (according to evaporator dimensions) for dual circuit units



If $h < H_c = 2,4$ m, minimum $L = 3,0$ m; if $h > H_c$ or $L < 3,0$ m contact your Daikin distributor to evaluate the various possible arrangements



The minimum distances, reported above, ensure functionality of the chiller in most applications. However, there are specific situations which include multiple chiller installations: in this case the following recommendations are to be followed:

Multiple chiller installed side by side in a free field with dominant wind.

Considering an installation in areas with a dominant wind from a specific direction (as shown in the Fig.7):

- Chiller N°1: is performing normally without any ambient over-temperature
- Chiller N° 2: is working in a warmed ambient. The first circuit (from the left) is working with air recirculating from Chiller 1 and the second circuit to the recirculating air from the chiller N°1 and recirculation from itself.

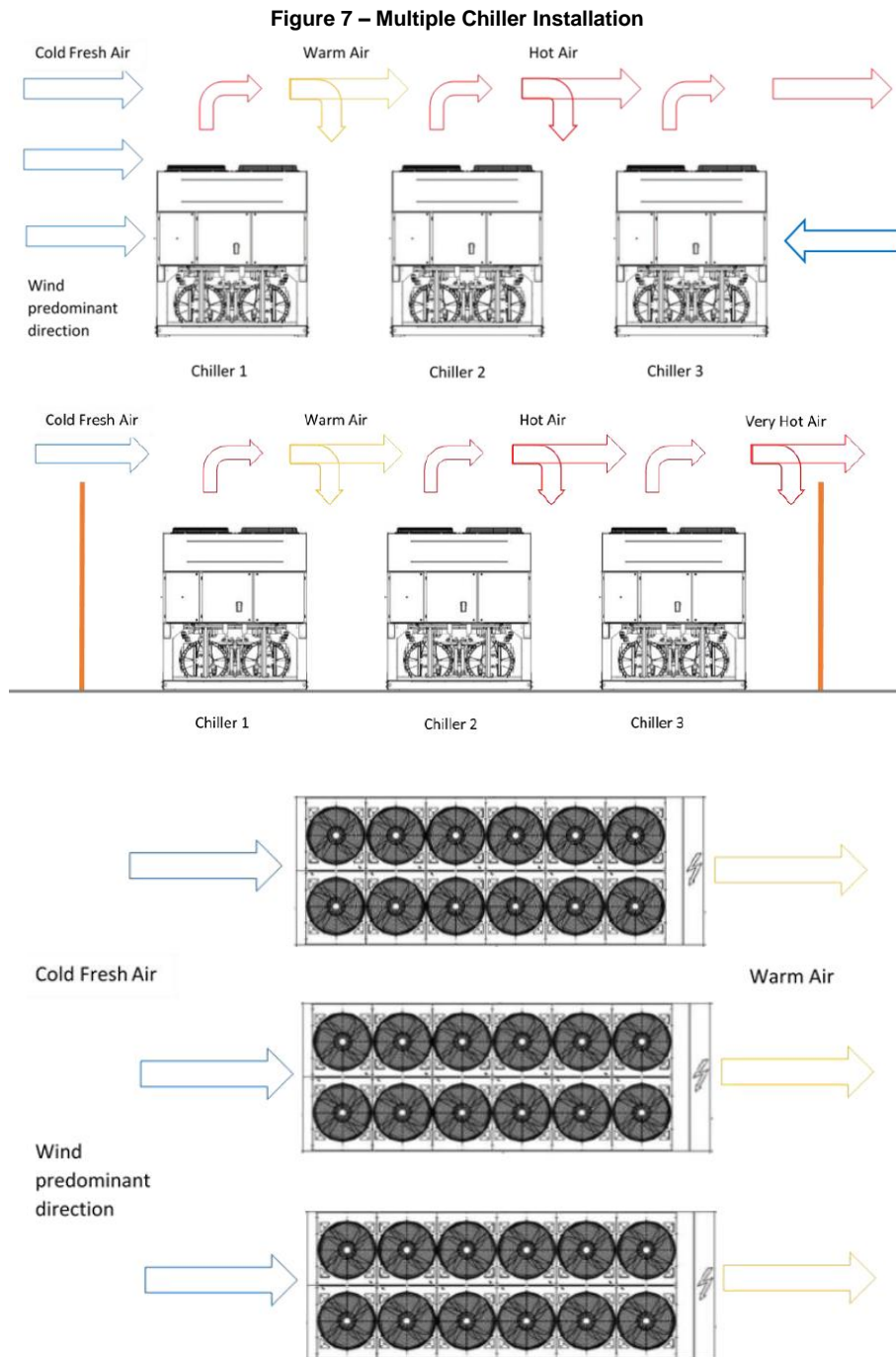
- Chiller N° 3: circuit on the left is working in a over-temperature ambient due to the recirculating air from the other two chillers, circuit on the right is working quite normally.
- In order to avoid the hot air recirculation due to dominant winds, the installation where all chillers are aligned to the dominant wind is preferred (see figure below):

Multiple chiller installed side by side in a compound.

In case of compounds with walls of the same height of the chillers or higher, the installation is not recommended. Chiller 2 and chiller 3 work with sensible higher temperature due to the enhanced recirculation. In this case special precautions must be taken in to account according to the specific installation (eg: louvered walls, install the unit on base frame in order to increase the height, ducts on the discharge of the fans, high lift fans, etc).

All the above cases are even more sensitive in case of design conditions close to the limits of the unit operating envelope.

NOTE: Daikin cannot be considered responsible in case of malfunctions generated by hot air recirculation or insufficient airflow as result of improper installation if the above recommendations are ignored.



Sound protection

When sound levels require special control, great care must be exercised to isolate the unit from its base by appropriately applying anti-vibration elements (supplied as an option). Flexible joints must be installed on the water connections, as well.

Water piping

Piping must be designed with the lowest number of elbows and the lowest number of vertical changes of direction. In this way, installation costs are reduced considerably and system performance is improved.

The water system must have:

1. Anti-vibration mountings in order to reduce transmission of vibrations to the structures.
2. Isolating valves to isolate the unit from the water system during maintenance.
3. Flow switch, in order to protect the chiller must be protected against freezing by continuous monitoring of the water flow in the evaporator. In most cases, on-site the flow switch is set to produce an alarm only when the water pump switches OFF and the water flow fall to zero. it is recommended to adjust the flow switch in order to produce a "Water Loss Alarm" when the water flow reaches 50% of the nominal value, in this case the evaporator is protected against the freezing and the flow switch can detect the water filter clogging.
4. Manual or automatic air venting device at the system's highest point.; drain device at the system's lowest point.
5. Neither the evaporator nor the heat recovery device must be positioned at the system's highest point.
6. A suitable device that can maintain the water system under pressure (expansion tank, etc.).
7. Water temperature and pressure indicators to assist the operator during service and maintenance.
8. A filter or device that can remove particles from the fluid. The use of a filter extends the life of the evaporator and pump and helps to keep the water system in a better condition. **The water filter must be installed as close as possible to the chiller**, as in Figs. 8 and 9. If the water filter is installed in another part of the water system, the Installer has to guarantee the cleaning of the water pipes between the water filter and the evaporator.

Recommended maximum opening for strainer mesh is:

- 0,87 mm (DX S&T)
- 1,0 mm (BPHE)
- 1,2 mm (Flooded)

9. Evaporator has an electrical resistance with a thermostat that ensures protection against water freezing at ambient temperatures as low as -25°C .
All the other water piping/devices outside the unit must therefore be protected against freezing.
10. The heat recovery device must be emptied of water during the winter season, unless an ethylene glycol mixture in appropriate percentage is added to the water circuit.
11. In case of unit substitution, the entire water system must be emptied and cleaned before the new unit is installed. Regular tests and proper chemical treatment of water are recommended before starting up the new unit.
12. In the event that glycol is added to the water system as anti-freeze protection, pay attention to the fact that suction pressure will be lower, the unit's performance will be lower and water pressure drops will be greater. All unit-protection systems, such as anti-freeze, and low-pressure protection will need to be readjusted.
13. Before insulating water piping, check that there are no leaks.

Water treatment

Before putting the unit into operation, clean the water circuit.

The evaporator must not be exposed to flushing velocities or debris released during flushing. It is recommended that a suitably sized bypass and valve arrangement is installed to allow flushing of the piping system. The bypass can be used during maintenance to isolate the heat exchanger without disrupting flow to other units.

Any damage due to the presence of foreign bodies or debris in the evaporator will not be covered by warranty. Dirt, scales, corrosion debris and other material can accumulate inside the heat exchanger and reduce its heat exchanging capacity. Pressure drop can increase as well, thus reducing water flow. Proper water treatment therefore reduces the risk of corrosion, erosion, scaling, etc.. The most appropriate water treatment must be determined locally, according to the type of system and water characteristics.

The manufacturer is not responsible for damage to or malfunctioning of equipment caused by failure to treat water or by improperly treated water.

Table 1 - Acceptable water quality limits

pH (25°C)	6,8÷8,0	Total Hardness (mg CaCO_3 / l)	< 200
Electrical conductivity $\mu\text{S}/\text{cm}$ (25°C)	<800	Iron (mg Fe / l)	< 1.0
Chloride ion (mg Cl^- / l)	<200	Sulphide ion (mg S^{2-} / l)	None
Sulphate ion (mg SO_4^{2-} / l)	<200	Ammonium ion (mg NH_4^+ / l)	< 1.0
Alkalinity (mg CaCO_3 / l)	<100	Silica (mg SiO_2 / l)	< 50

Evaporator and recovery exchangers anti-freeze protection

All evaporators are supplied with a thermostatically controlled anti-freeze electrical resistance, which provides adequate anti-freeze protection at temperatures as low as -25°C .

However, unless the heat exchangers are completely empty and cleaned with anti-freeze solution, additional methods should also be used against freezing.

Two or more of below protection methods should be considered when designing the system as a whole:

- Continuous water flow circulation inside piping and exchangers
- Addition of an appropriate amount of glycol inside the water circuit
- Additional heat insulation and heating of exposed piping
- Emptying and cleaning of the heat exchanger during the winter season

It is the responsibility of the installer and/or of local maintenance personnel to ensure that described anti-freeze methods are used. Make sure that appropriate anti-freeze protection is maintained at all times. Failing to follow the instructions above could result in unit damage. Damage caused by freezing is not covered by the warranty.

Installing the flow switch

To ensure sufficient water flow through the evaporator, it is essential that a flow switch be installed on the water circuit. The flow switch can be installed either on the inlet or outlet water piping. The purpose of the flow switch is to stop the unit in the event of interrupted water flow, thus protecting the evaporator from freezing.

The manufacturer offers, as optional, a flow switch that has been selected for this purpose.

This paddle-type flow switch is suitable for heavy-duty outdoor applications (IP67) and pipe diameters in the range of 1" to 8".

The flow switch is provided with a clean contact which must be electrically connected to terminals shown in the wiring diagram. Flow switch has to be tune to intervene when the evaporator water flow is lower than 50% of nominal flow rate.

Heat recovery

Units may be optionally equipped with heat recovery system.

This system is made by a water cooled heat exchanger located on the compressors discharge pipe and a dedicated management of condensing pressure.

To guarantee compressor operation within its envelope, units with heat recovery cannot operate with water temperature of the heat recovery water lower than 28°C.

It is a responsibility of plant designer and chiller installer to guarantee the respect of this value (e.g. using recirculating bypass valve).

Figure 8 - Water piping connection for evaporator

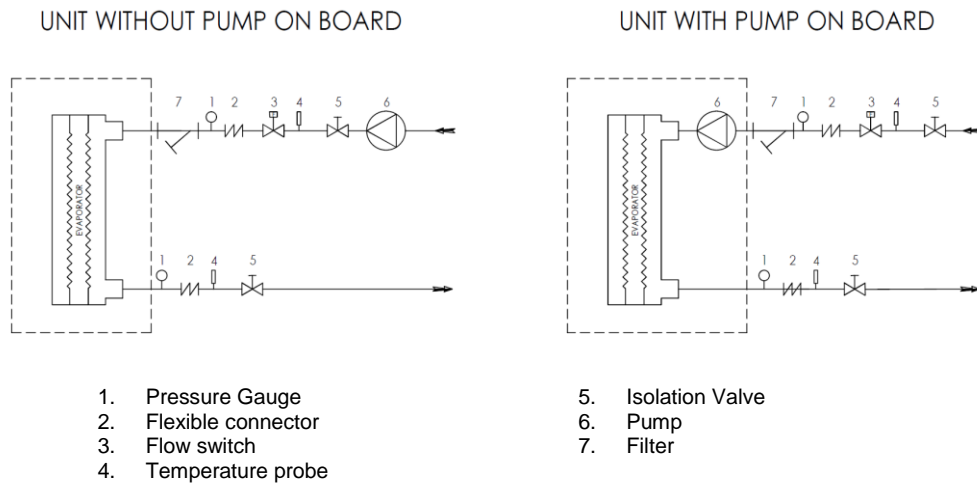
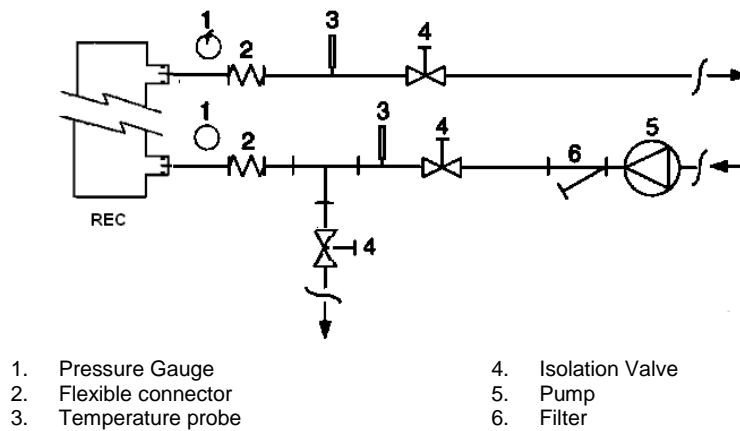


Figure 9 - Water piping connection for heat recovery exchangers



Electrical Installation

General specifications



All electrical connections to the unit must be carried out in compliance with laws and regulations in force.

All installation, management and maintenance activities must be carried out by qualified personnel.

Refer to the specific wiring diagram for the unit you have bought. Should the wiring diagram not be on the unit or should it have been lost, please contact your manufacturer representative, who will send you a copy.

In case of discrepancy between wiring diagram and electrical panel/cables, please contact the manufacturer representative.

Only use copper conductors. Failure to use copper conductors could result in overheating or corrosion at connection points and could damage the unit.

To avoid interference, all control wires must be connected separately from the power cables. Use different electrical passage ducts for this purpose.

Particular care must be taken when realizing wire connections to the switchbox; if not properly sealed, cable entries may allow ingress of water into the switchbox which may cause damage to the equipment inside.



Before any installation and connection works, the unit must be switched off and secured. Since this unit includes inverters, the intermediate circuit of the capacitors remains charged with high voltage for a short period of time after being switched off. Do not operate to the unit before 5 minutes after the unit has been switched off.

This unit includes non-linear loads such as inverters, which have a natural current leakage to earth. If an Earth Leakage Detector is installed upstream the unit, a type B device with a minimum threshold of 300 mA must be used.

This product complies with EMC standards for industrial environments. Therefore it is not intended for use in residential areas, e.g. installations where the product is connected to a low voltage public distribution system. Should this product need to be connected to a low voltage public distribution system, specific additional measures will have to be taken to avoid interference with other sensitive equipment.

Operation

Operator's responsibilities

It is essential that the operator is appropriately trained and becomes familiar with the system before operating the unit. In addition to reading this manual, the operator must study the microprocessor operating manual and the wiring diagram in order to understand start-up sequence, operation, shutdown sequence and operation of all the safety devices.

During the unit's initial start-up phase, a technician authorized by the manufacturer is available to answer any questions and to give instructions as to the correct operating procedures.

The operator must keep a record of operating data for every installed unit. Another record should also be kept of all the periodical maintenance and servicing activities.

If the operator notes abnormal or unusual operating conditions, he is advised to consult the technical service authorized by the manufacturer.

Maintenance

Routine maintenance

This chiller must be maintained by qualified technicians. Before beginning any work on the system the personnel shall assure that all security precautions have been taken.

Personel working on the electrical or the refrigeration components must be authorized, trained and fully qualified.

Maintenance and repair requiring the assistance of other skilled personnel should be carried out under the supervision of the person competent in the use of flammable refrigerants. Any person conducting servicing or maintenance on a system or associated parts of the equipment should be competent according to EN 13313.

Persons working on refrigerating systems with flammable refrigerants should have competence in safety aspects of flammable refrigerant handling supported by evidence of appropriate training.

Always protect the operating personnel with personal protective equipment appropriate for the tasks to be performed. Common individual devices are: Helmet, goggles, gloves, caps, safety shoes. Additional individual and group protective equipment should be adopted after an adequate analysis of the specific risks in the area of relevance, according to the activities to be performed.

<p>electrical components</p>	<p>Never work on any electrical components, until the general supply to the unit has been cut using the disconnect switch(es) in the control box. The frequency variators used are equipped with capacitor batteries with a discharge time of 20 minutes; after disconnecting power wait 20 minutes before opening the control box.</p>
<p>refrigerating system</p>	<p>The following precautions should be taken before working on the refrigerant circuit:</p> <ul style="list-style-type: none"> — obtain permit for hot work (if required); — ensure that no flammable materials are stored in the work area and that no ignition sources are present anywhere in the work area; — ensure that suitable fire extinguishing equipment is available; — ensure that the work area is properly ventilated before working on the refrigerant circuit or before welding, brazing or soldering work; — ensure that the leak detection equipment being used is non-sparking, adequately sealed or intrinsically safe; — ensure that all maintenance staff have been instructed. <p>The following procedure should be followed before working on the refrigerant circuit:</p> <ol style="list-style-type: none"> 1. remove refrigerant (specify the residual pressure); 2. purge circuit with inert gas (e.g. nitrogen); 3. evacuate to a pressure of 0,3 (abs.) bar (or 0,03 MPa); 4. purge again with inert gas (e.g. nitrogen); 5. open the circuit. <p>The area should be checked with an appropriate refrigerant detector prior to and during any hot work to make the technician aware of a potentially flammable atmosphere.</p> <p>If compressors or compressor oils are to be removed, it should be ensured that it has been evacuated to an acceptable level to ensure that there is no flammable refrigerant remaining within the lubricant.</p> <p>Only refrigerant recovery equipment designed for use with flammable refrigerants should be employed.</p> <p>If the national rules or regulations permit the refrigerant to be drained, this should be done safely, using a hose, for example, through which the refrigerant is discharged into the outside atmosphere in a safe area. It should be ensured that an inflammable explosive refrigerant concentration cannot occur in the vicinity of an ignition source or penetrate into a building under any circumstance.</p> <p>In the case of refrigerating systems with an indirect system, the heat-transfer fluid should be checked for the possible presence of refrigerant.</p> <p>After any repair work, the safety devices, for example refrigerant detectors and mechanical ventilation systems, should be checked and the results recorded.</p> <p>It should be ensured that any missing or illegible label on components of the refrigerant circuit is replaced. Sources of ignition should not be used when searching for a refrigerant leak.</p>

Neglecting unit maintenance in these environments, could degrade all parts of the units (coils, compressors, frames, pipes, etc..) with negative effect on performances and functionality.

There are two different levels of maintenance, which can be chosen according to the type of application (critical/non critical) or to the installation environment (highly aggressive).

Examples of critical applications are process cooling, data centres, etc.

Highly Aggressive Environments can be defined as the follows:

- Industrial environment (with possible concentration of fumes result of combustion and chemical process)
- Costal environment;
- Highly polluted urban environment;
- Rural environment close to of animal excrement and fertilizers, and high concentration of exhaust gas from diesel generators.
- Desert areas with risk of sandstorms;
- Combinations of the above

Table 2 lists all Maintenance activities for standard applications and standard environment.

Table 3 lists all Maintenance activities for critical applications or highly aggressive environment.

Following below instructions is mandatory for cases listed above, but also advised for units installed in standard environments.

Table 2 – Standard Routine Maintenance Plan

List of Activities	Weekly	Monthly (Note 1)	Yearly/Seas Onal (Note 2)
General:			
Reading of operating data (Note 3)	X		
Visual inspection of unit for any damage and/or loosening		X	
Verification of thermal insulation integrity			X
Clean and paint where necessary			X
Analysis of water (6)			X
Check of flow switch operation		X	
Electrical:			
Verification of control sequence			X
Verify contactor wear – Replace if necessary			X
Verify that all electrical terminals are tight – Tighten if necessary			X
Clean inside the electrical control board			X
Visual inspection of components for any signs of overheating		X	
Verify operation of compressor and oil heater		X	
Measure compressor motor insulation using the Megger			X
Clean air intake filters of the electrical panel		X	
Verify operation of all ventilation fans in the electrical panel			X
Verify operation of inverter cooling valve and heater			X
Verify status of capacitors in the inverter (signs of damage, leaks, etc)			X
List of Activities	Weekly	Monthly (Note 1)	Yearly/Seas Onal (Note 2)
Refrigeration circuit:			
Check for any refrigerant leakage		X	
Verify refrigerant flow using the liquid sight glass – Sight glass full	X		
Verify filter dryer pressure drop		X	
Verify oil filter pressure drop (Note 5)		X	
Analyse compressor vibrations			X
Analyse compressor oil acidity (7)			X
Condenser section:			
Clean water rinse condenser banks (Note 4)			X
Verify that fans are well tightened			X
Verify condenser bank fins – Comb if necessary			X

Notes:

1. Monthly activities include all the weekly ones.
2. The annual (or early season) activities include all weekly and monthly activities.
3. Unit operating values should be read on a daily basis thus keeping high observation standards.
4. In environments with a high concentration of air-borne particles, it might be necessary to clean the condenser bank more often.
5. Replace the oil filter when the pressure drop across it reaches 2.0 bar.
6. Check for any dissolved metals.
7. TAN (Total Acid Number) :
 - ≤0,10 : No action
 - Between 0.10 and 0.19 : Replace anti-acid filters and re-check after 1000 running hours. Continue to replace filters until the TAN is lower than 0.10.
 - >0,19 : Replace oil, oil filter and filter dryer. Verify at regular intervals.

Table 3 –Routine Maintenance Plan for Critical Application and/or Highly Aggressive Environment

List of Activities (Note 8)	Weekly	Monthly (Note 1)	Yearly/Seasonal (Note 2)
General:			
Reading of operating data (Note 3)	X		
Visual inspection of unit for any damage and/or loosening		X	
Verification of thermal insulation integrity			X
Clean		X	
Paint where necessary			X
Clean and paint where necessary			X
Analysis of water (6)			X
Check of flow switch operation		X	
Electrical:			
Verification of control sequence			X
Verify contactor wear – Replace if necessary			X
Verify that all electrical terminals are tight – Tighten if necessary			X
Clean inside the electrical control board		X	
Visual inspection of components for any signs of overheating		X	
Verify operation of compressor and oil heater		X	
Measure compressor motor insulation using the Megger			X
Clean air intake filters of the electrical panel		X	
Verify operation of all ventilation fans in the electrical panel			X
Verify operation of inverter cooling valve and heater			X
Verify status of capacitors in the inverter (signs of damage, leaks, etc)			X
Refrigeration circuit:			
Check for any refrigerant leakage		X	
Verify refrigerant flow using the liquid sight glass – Sight glass full	X		
Verify filter dryer pressure drop		X	
Verify oil filter pressure drop (Note 5)		X	
Analyse compressor vibrations			X
Analyse compressor oil acidity (7)			X
Condenser section:			
Clean water rinse condenser coils (Note 4)		X	
Quarterly clean condenser coils (E-coated only)			X
Verify that fans are well tightened			X
Verify condenser coil fins – Comb if necessary		X	
Check the aspect of the plastic protection of the copper/aluminum connection		X	

Notes:

- Units placed or stored in a Highly Aggressive Environment for long time without operation are still subject to those routine maintenance steps.

Unit Maintenance and Cleaning

Unit exposed to a highly aggressive environment can face corrosion in a shorter time than ones installed on a standard environment. Corrosion causes a rapid rusting of the frame core, consequently decreases unit structure life time. To avoid that, it is necessary to wash periodically the frame surfaces with water and suitable detergents.

In case of part of unit frame paint came off, it is important to stop its progressive deterioration by repainting the exposed parts using proper products. Please contact factory to get the required products specifications.

Note: in case of just salt deposits are present, it is enough to rinse the parts with fresh water.

Microchannel Coil Maintenance

Routine cleaning of coil surfaces is essential to maintain proper operation of the unit, avoid corrosion and rusting. Elimination of contamination and removal of harmful residues will greatly increase the life of the coil and extend the life of the unit. Relative to fin and tube heat exchangers, microchannel coils tend to accumulate more of the dirt on the surface and of the less dirt inside which can make them easier to clean.

The following maintenance and cleaning procedure are recommended as part of the routine maintenance activities.

- Remove surface dirt, leaves, fibers, etc. with a vacuum cleaner (preferably with a brush or other soft attachment rather than a metal tube), compressed air blown from the inside out, and/or a soft bristle (not wire!) brush. Do not impact or scrape the coil with the vacuum tube, air nozzle, etc..

NOTE: Use of a water stream, such as a garden hose, against a surface loaded coil will drive the fibers and dirt into the coil. This will make cleaning efforts more difficult. Surface loaded fibers must be completely removed prior to using low velocity clean water rinse.

- Rinse. Do not use any chemicals (including those advertised as coil cleaners) to wash microchannel heat exchangers. They can cause corrosion. Rinse only. Hose the MCHE off gently, preferably from the inside out and top to bottom, running the water through every fin passage until it comes out clean. Microchannels fins are stronger than traditional tube & fin coil fins but still need to be handled with care.

It is possible to clean a coil with a high pressure washer (max 62 barg) only if a flat shape of the water spray is used and direction of the spray is kept perpendicular to the fin edge. If this direction is not respected the coil may be destroyed if using a pressure washer so we do not recommend their use.

NOTE: A monthly clean water rinse is recommended for coils that are applied in coastal or industrial environments to help to remove chlorides, dirt and debris. It is very important when rinsing, to water temperature is less than 55 °C. An elevated water temperature (not to exceed 55 °C) will reduce surface tension, increasing the ability to remove chlorides and dirt.

3. Quarterly cleaning is essential to extend the life of an E-coated coil and is required to maintain warranty coverage. Failure to clean an E-coated coil will void the warranty and may result in reduced efficiency and durability in the environment. For routine quarterly cleaning, first clean the coil with an approved coil cleaner. After cleaning the coils with the approved cleaning agent, use the approved chloride remover to remove soluble salts and revitalize the unit.

NOTE: Harsh chemicals, household bleach or acid cleaners should not be used to clean E-coated coils. These cleaners can be very difficult to rinse out of the coil and can accelerate corrosion and attack the E-coating. If there is dirt below the surface of the coil, use the recommended coil cleaners as described above.

Galvanic corrosion of the connection Copper/Aluminum can occur in a corrosive atmosphere under the plastic protection; during the maintenance operations or periodic cleaning, check the aspect of the plastic protection of the copper/aluminum connection. If it is inflated, damaged or took off contact the manufacturer representative for advice and information.

Inverter Electrolytic Capacitors

Compressor Inverters include electrolytic capacitors which have been designed to last a minimum of 15 years in normal use. Heavy duty conditions may reduce the actual life of capacitors.

The chiller calculates capacitor residual life based on actual operation. When residual life gets below a given threshold, a warning is issued by the controller. In this case replacement of capacitors is recommended. This operation must be done only by qualified technicians.

Replacement must be carried out through the following procedure:

- Power off the chiller
- Wait for 5 minutes before opening the inverter case
- Check that residual dc voltage in the dc link is zero.
- Open the inverter case and replace old capacitors with new ones.
- Reset the chiller controller through the maintenance menu. This will allow the controller to recalculate the new estimated life of the capacitors.

Capacitor Reforming after long shut-off period

Electrolytic capacitors may lose part of their original characteristics if they are not powered for more than 1 year. If chiller has been shut off for a longer period a "reforming" procedure as follows is necessary:

- Power on the inverter
- Keep it powered on without starting the compressor for at least 30 minutes
- After 30 minutes the compressor can be started

Low Ambient Start-up

Inverters include a temperature control which allows them to withstand ambient temperatures down to -20°C. However they should not be switched on at temperatures lower than 0°C unless the following procedure is executed:

- Open the switchbox (only trained technicians should perform this operation)
- Open compressor fuses (by pulling the fuse holders) or compressor circuit breakers
- Power on the chiller
- Keep the chiller powered on for 1 hour at least (this allows inverter heaters to warm-up the inverter).
- Close fuse holders
- Close the switchbox

Service and limited warranty

All units are factory-tested and guaranteed for 12 months as of the first start-up or 18 months as of delivery.

These units have been developed and constructed according to high quality standards ensuring years of failure-free operation. It is important, however, to ensure proper and periodical maintenance in accordance with all the procedures listed in this manual and with good practice of machines maintenance.

We strongly advise stipulating a maintenance contract with a service authorized by the manufacturer in order to ensure efficient and problem-free service, thanks to the expertise and experience of our personnel.

It must also be taken into consideration that the unit requires maintenance also during the warranty period.

It must be borne in mind that operating the unit in an inappropriate manner, beyond its operating limits or not performing proper maintenance according to this manual can void the warranty.

Observe the following points in particular, in order to conform to warranty limits:

1. The unit cannot function beyond the specified limits
2. The electrical power supply must be within the voltage limits and without voltage harmonics or sudden changes.
3. The three-phase power supply must not have an unbalance between phases exceeding 3%. The unit must stay turned off until the electrical problem has been solved.
4. No safety device, either mechanical, electrical or electronic must be disabled or overridden.
5. The water used for filling the water circuit must be clean and suitably treated. A mechanical filter must be installed at the point closest to the evaporator inlet.
6. Unless there is a specific agreement at the time of ordering, the evaporator water flow rate must never be above 120% and below 50% of the nominal flow rate.

Periodic obligatory checks and starting up of appliances under pressure

The units are included in category I → III of the classification established by the European Directive 2014/68/EU (PED).

For chillers belonging to this category, some local regulations require a periodic inspection by an authorized agency. Please check with your local requirements.

Important information regarding the refrigerant used

This product contains fluorinated greenhouse gases. Do not vent gases into the atmosphere.

Refrigerant type: R1234ze
GWP(1) value: 7
(1)GWP = global warming potential

The refrigerant quantity necessary for standard operation is indicated on the unit name plate.
Periodical inspections for refrigerant leaks may be required depending on European or local legislation.
Please contact your local dealer for more information.

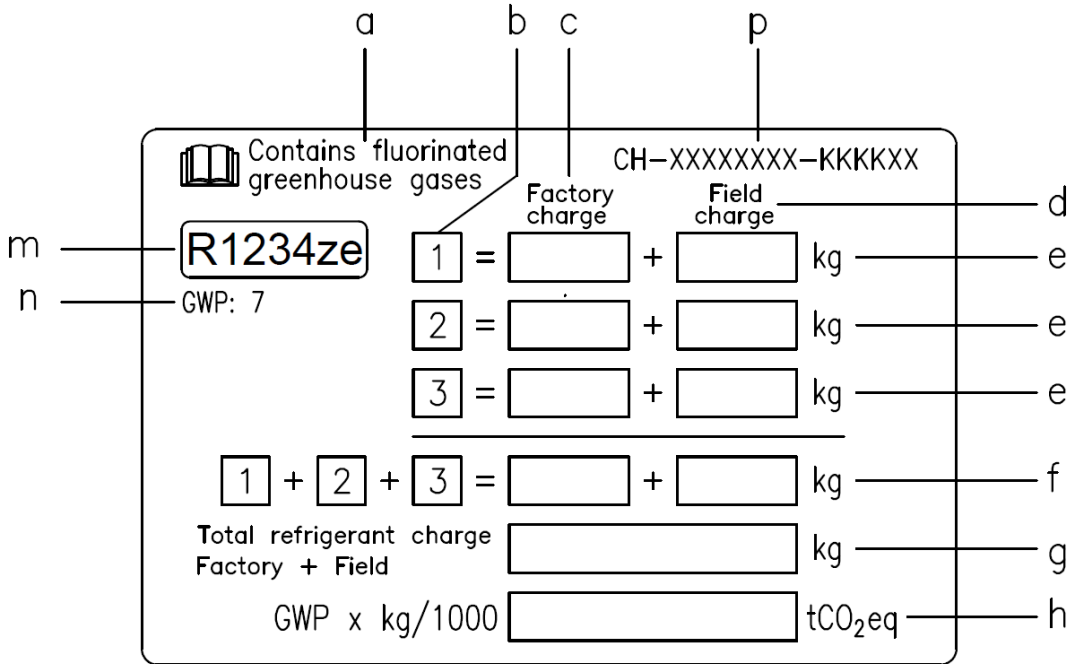
Factory and Field charged units instructions

The refrigerant system will be charged with fluorinated greenhouse gases, and the factory charge(s) are recorded on the label, shown below, which is adhered inside the electrical panel. Periodic inspections for refrigerant leaks may be required depending on European or local legislation. Please contact your local dealer for more information.

Do not vent gases into the atmosphere.

1 Fill in with indelible ink the refrigerant charge label supplied with the product as following instructions:

- Any refrigerant charge for each circuit (1; 2; 3) added during commissioning
- the total refrigerant charge (1 + 2 + 3)
- **calculate the greenhouse gas emission with the following formula:**
GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000



- a Contains fluorinated greenhouse gases
- b Circuit number
- c Factory charge
- d Field charge
- e Refrigerant charge for each circuit (according to the number of circuits)
- f Total refrigerant charge
- g Total refrigerant charge (Factory + Field)
- h **Greenhouse gas emission** of the total refrigerant charge expressed as tonnes of CO₂ equivalent
- m Refrigerant type
- n GWP = Global Warming Potential
- p Unit serial number

2 The filled out label must be adhered inside the electrical panel.

NOTICE

In Europe, the **greenhouse gas emission** of the total refrigerant charge in the system (expressed as tonnes CO₂ equivalent) is used to determine the maintenance intervals. Follow the applicable legislation.

Formula to calculate the greenhouse gas emission:

GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000

Use the GWP value mentioned on the greenhouse gases label. This GWP value is based on the 4th IPCC Assessment Report. The GWP value mentioned in the manual might be outdated (i.e. based on the 3rd IPCC Assessment Report)

Disposal

The unit is made of metal, plastic and electronic parts. All these parts must be disposed of in accordance with the local regulations in terms of disposal.

Lead batteries must be collected and sent to specific refuse collection centres.

Oil must be collected and sent to specific refuse collection centres.



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