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Installation, Operation and Maintenance Manual D-EIMAC00608-16_01EN

Air cooled screw chillers

EWAD~C
EWAD~CF



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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.

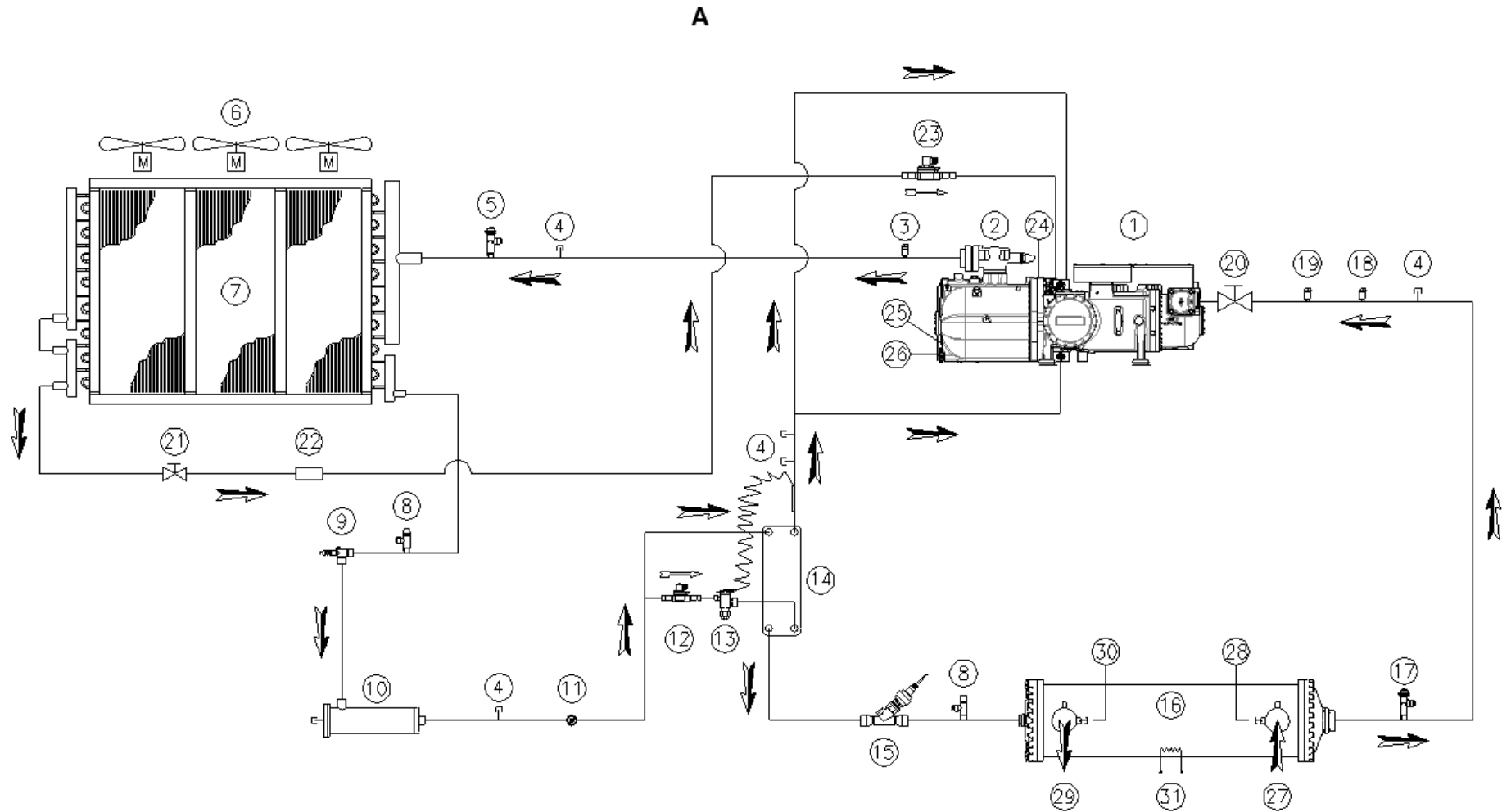
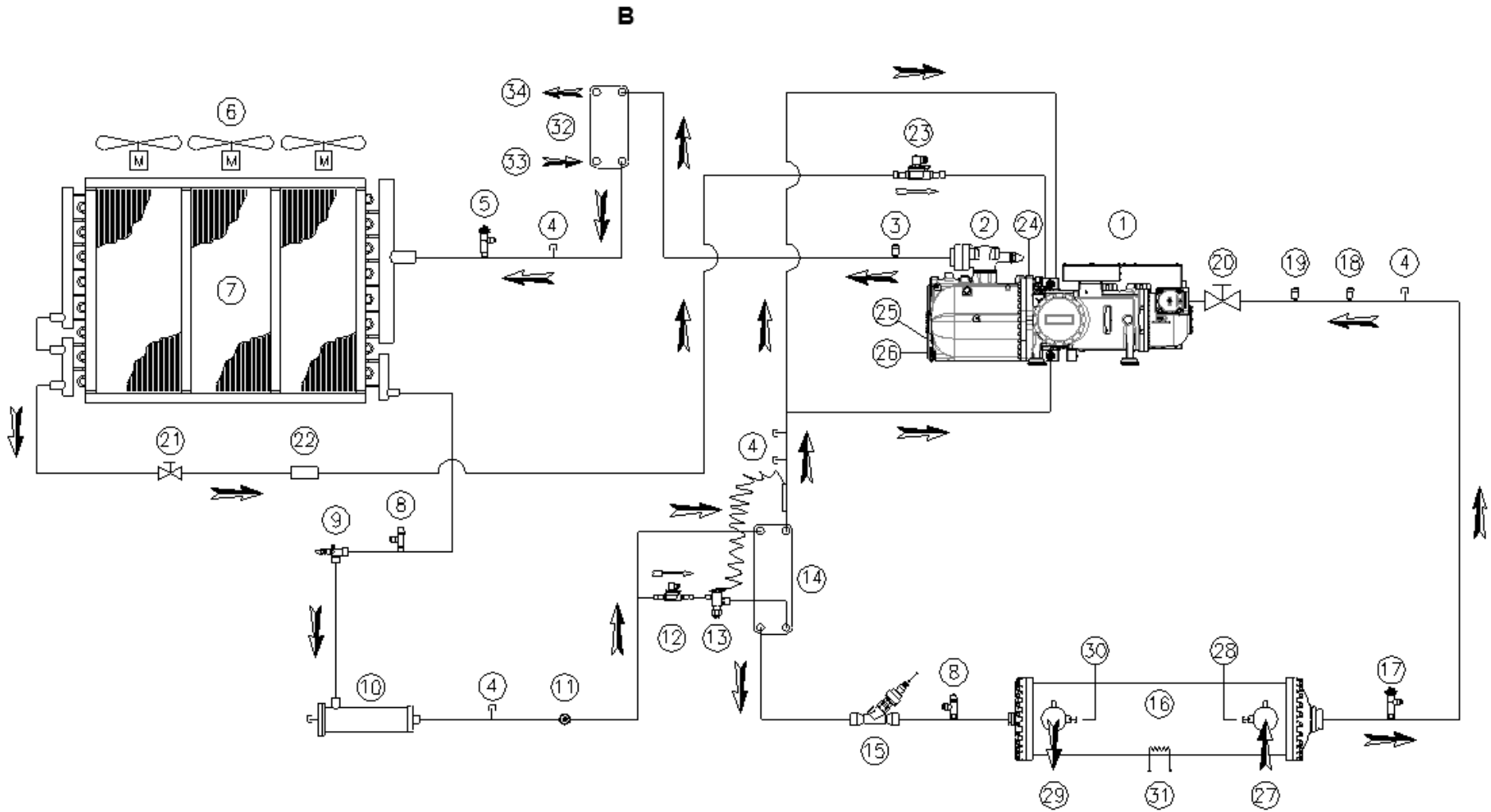


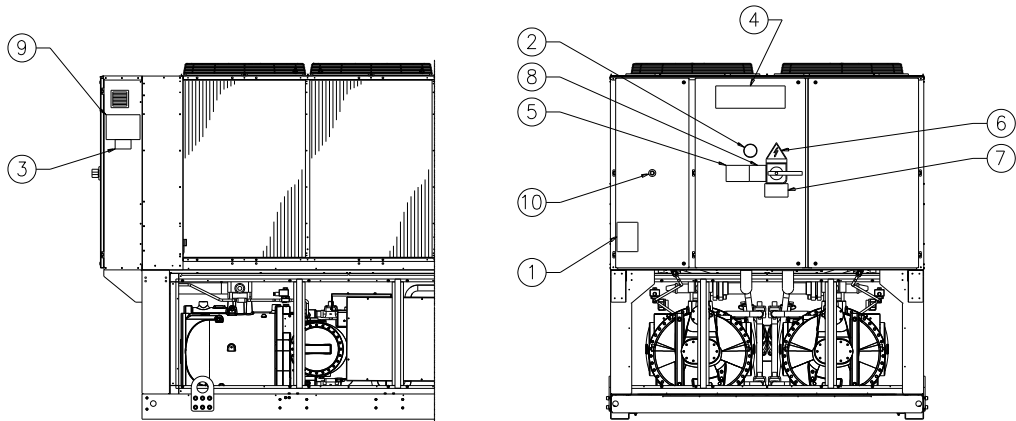
Figure 2 - Typical refrigerant circuit with heat recovery

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



LEGEND	
ID	DESCRIPTION
1	Compressor
2	Discharge shut off valve
3	High-pressure transducer
4	Service port
5	High-pressure safety valve
6	Axial ventilator
7	Condenser coil
8	Load Valve
9	Liquid line isolating valve
10	Dehydration filter
11	Liquid and humidity indicator
12	Economiser solenoid valve
13	Economiser thermostatic expansion valve
14	Economiser (not available for EWAD650C-SS/SL/SR)
15	Electronic expansion valve
16	Evaporator
17	Low-pressure safety valve
18 (ST)	Suction temperature probe
19 (EP)	Low-pressure transducer
20	Suction shut off valve
21	Liquid injection shut off valve
22	Liquid injection mesh filter
23	Liquid injection solenoid valve
24 (F13)	High-pressure switch
25 (DT)	Discharge temperature sensor
26 (OP)	Oil pressure transducer
27	Water inlet connection
28 (EEWT)	Water entering temperature probe
29	Water outlet connection
30 (ELWT)	Water leaving temperature probe
31 (R5)	Evaporator heater
32	Heat recovery
33	Water inlet connection
34	Water outlet connection

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



Label Identification

1 – Non flammable gas symbol	6 – Electrical hazard symbol
2 – Gas type	7 – Hazardous Voltage warning
3 – Unit nameplate data	8 – Cable tightening warning
4 – Manufacturer's logo	9 – Lifting instructions
5 – Water circuit filling warning	10 - Emergency stop

1 INTRODUCTION

This manual provides information on the standard functions and procedures of all units in the series and is an important supporting document for qualified personnel, but can never replace it.

All units are delivered with **wiring diagrams, certified drawings, nameplate, and Declaration Of Conformity**; these documents show all technical data for the unit you have bought. In case of any discrepancies between the contents of the manual and the documentation provided with the unit, always rely on the unit because **it is an integral part of this manual**.

If you are unsure about assistance and for more information, contact an authorized representative of the manufacturer.



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 ABOSOLUTELY FORBIDDEN IF ALL
INSTRUCTION CONTAINED IN THIS MANUAL ARE NOT CLEAR.
IF CASE OF DOUBT CONTACT THE MANUFACTURER REPRESENTATIVE FOR ADVICE
AND INFORMATION.***

1.1 Precautions against residual risks

1. install the unit according to the instructions set out in this manual
2. regularly carry out all the maintenance operations foreseen in this manual
3. wear protective equipment (gloves, eye protection, hard hat, etc.) suited to the work in hand; do not wear clothes or accessories that can get caught or sucked in by flows of air; tie back long hair before entering the unit
4. before opening the machine panelling make sure that it is firmly hinged to the machine
5. the fins on heat exchangers and the edges of metal components and panels can cause cuts
6. do not remove the guards from mobile components while the unit is operating
7. make sure that mobile component guards are fitted correctly before restarting the unit
8. fans, motors and belts drives might be running: before entering, always wait for these to stop and take appropriate measures to prevent them from starting up
9. the surfaces of the machine and pipes can get very hot or cold and cause the risk of scalding
10. never exceed the maximum pressure limit (PS) of the water circuit of the unit.
11. before removing parts on the pressurised water circuits, close the section of the piping concerned and drain the fluid gradually to stabilise the pressure at the atmospheric level
12. do not use your hands to check possible refrigerant leaks
13. disable the unit from the mains using the main switch before opening the control panel
14. check that the unit has been grounded correctly before starting it
15. install the machine in a suitable area; in particular, do not install it outdoors if it is intended for use indoors
16. do not use cables with inadequate sections nor extension cord connections, even for very short periods or emergencies
17. for units with power correction capacitors, wait 5 minutes after removing the electric power supply before accessing the inside of the switch board
18. if the unit is equipped with compressors with integrated inverter, disconnect it from the mains and wait a minimum of 20 minutes before accessing it to carry out maintenance: residual energy in the components, which takes at least this length of time to dissipate, poses the risk of electrocution
19. the unit contains pressurised refrigerant gas: the pressurised equipment must not be touched except during maintenance, which must be entrusted to qualified and authorised personnel
20. connect up the utilities to the unit following the indications set out in this manual and on the panelling of the unit itself
21. In order to avoid an environmental risk, make sure that any leaking fluid is collected in suitable devices in accordance with local regulations.
22. if a part needs to be dismantled, make sure it is correctly re-assembled before starting the unit
23. when the rules in force require the installation of fire-fighting systems near the machine, check that these are suitable for extinguishing fires on electrical equipment and on the lubricating oil of the compressor and the refrigerant, as specified on the safety data sheets of these fluids
24. when the unit is equipped with devices for venting overpressure (safety valves): when these valves are triggered, the refrigerant gas is released at a high temperature and speed; prevent the release of gas from harming people or objects and, if necessary, discharge the gas according to the provisions of EN 378-3 and the local regulations in force.

25. keep all the safety devices in good working order and check them periodically according to the regulations in force
26. keep all lubricants in suitably marked containers
27. do not store inflammable liquids near the unit
28. solder or braze only empty pipes after removing all traces of lubricant oil; do not use flames or other heat sources in the vicinity of pipes containing refrigerant fluid
29. do not use naked flames near the unit
30. the machinery must be installed in structures protected against atmospheric discharge according to the applicable laws and technical standards
31. do not bend or hit pipes containing pressurised fluids
32. it is not permitted to walk or rest other objects on the machines
33. the user is responsible for overall evaluation of the risk of fire in the place of installation (for example, calculation of the fire load)
34. during transport, always secure the unit to the bed of the vehicle to prevent it from moving about and overturning
35. the machine must be transported according to the regulations in force taking into account the characteristics of the fluids in the machine and the description of these on the safety data sheet
36. inappropriate transport can cause damage to the machine and even leaking of the refrigerant fluid. Before start-up, the machine must be checked for leaks and repaired accordingly.
37. the accidental discharge of refrigerant in a closed area can cause a lack of oxygen and, therefore, the risk of asphyxiation: install the machinery in a well ventilated environment according to EN 378-3 and the local regulations in force.
38. the installation must comply with the requirements of EN 378-3 and the local regulations in force; in the case of installations indoors, good ventilation must be guaranteed and refrigerant detectors must be fitted when necessary.

1.2 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 so cooling 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

2 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.

3 OPERATING LIMITS

3.1 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.

3.2 Operation

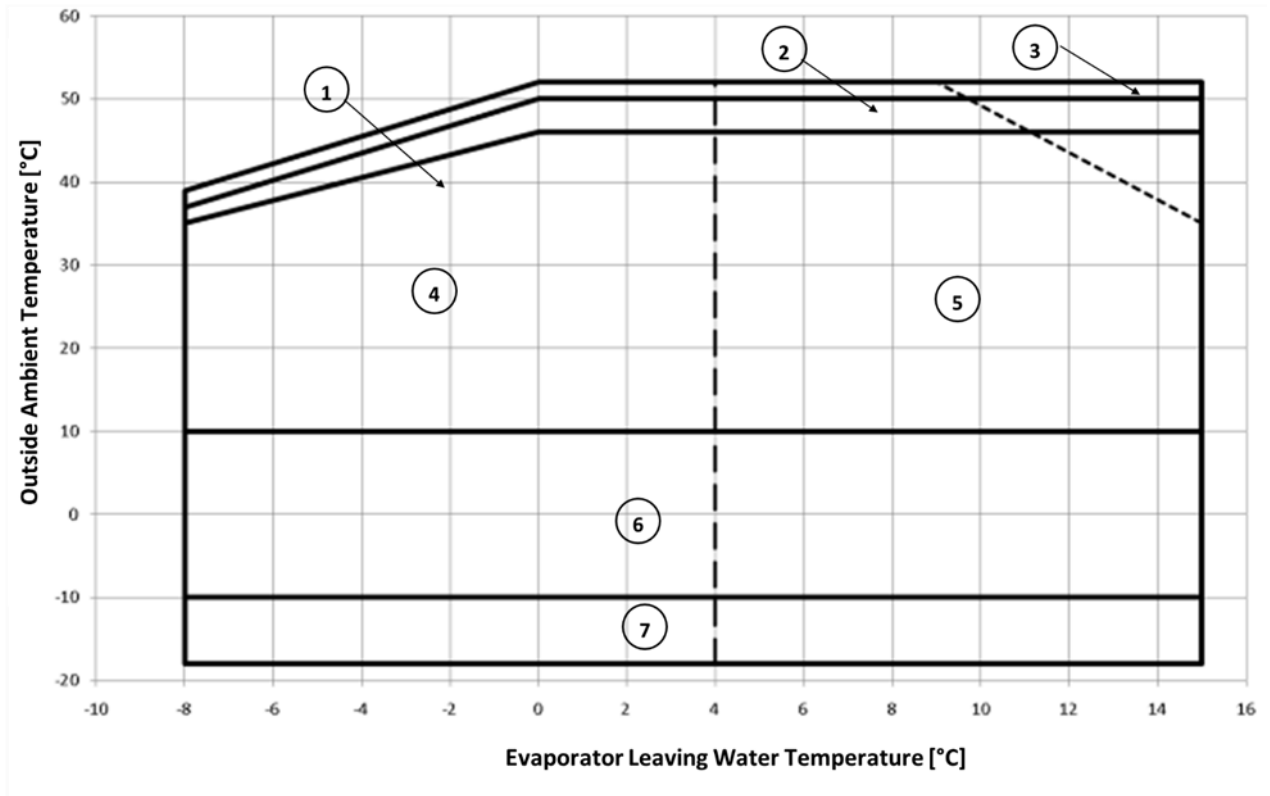
Operation for standard units is allowed within the limits mentioned in Fig. 4 and 5.

The unit must 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 4 - Operating limits for standard units



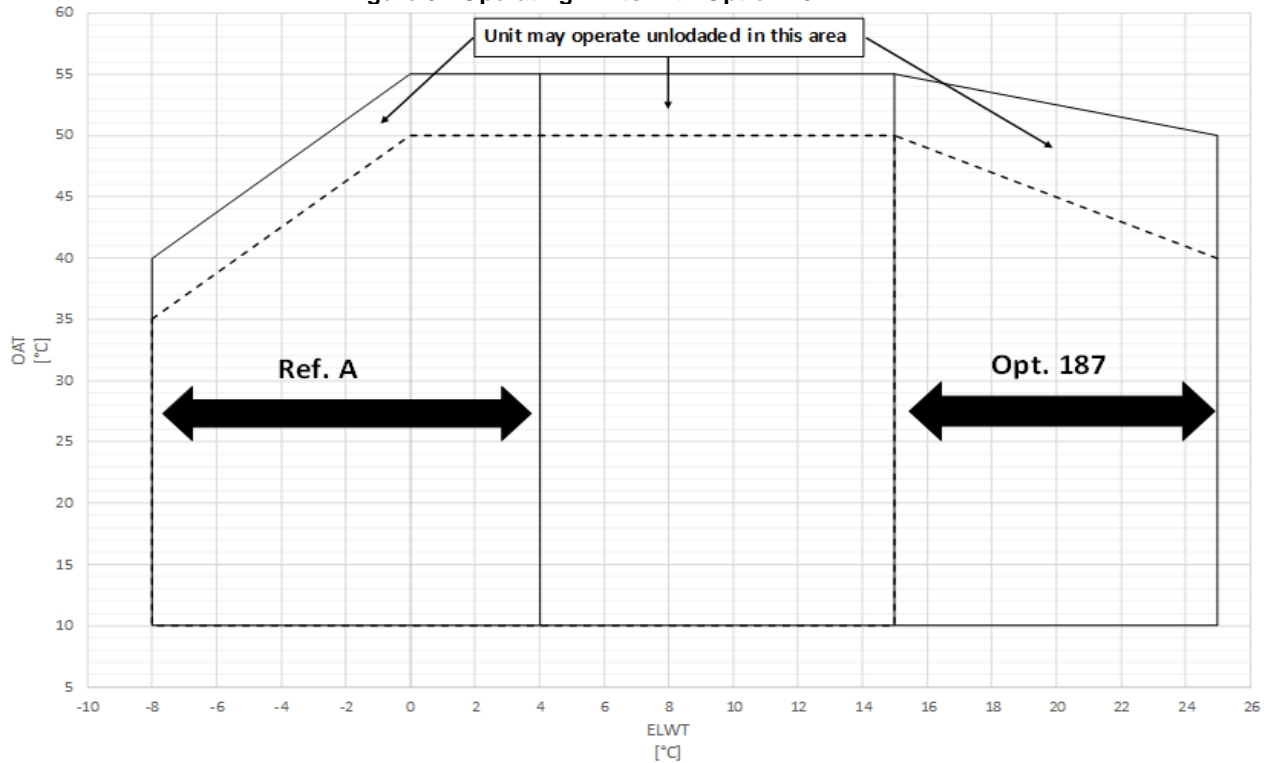
1. Standard Efficiency
2. High Efficiency
3. Premium Efficiency
4. Operation with Water and Glycol
5. In this area, the unit may operate partly. Consult performance tables
6. Operation with fan velocity adjustment only below 10°C ambient temperature
7. Operation with fans with Speedtroll only (below -10°C ambient temperature)

3.3 Operation with Option 187

The following ranges of units can operate with an extended envelope as shown in Fig. 5:

EWAD C-XS	EWAD C-PS
EWAD C-XL	EWAD C-PL

Figure 5 - Operating limits with Option 187



Note.

The above graphic represents a guideline about the operating limits of the range. Please refer to Chiller Selection Software (CSS) for real operating limits working conditions for each size.

4 FREECOOLING UNIT VERSION

Freecooling units have additional coils used to pre-cool the fluid coming from the building and increase the overall efficiency by unloading the compressors until they completely stop if the environments conditions allow it. The water flow can be diverted to the additional coils in case the outside ambient temperature drops below the return water temperature by three way valve (or two single way valves. It depends from chiller size).

Freecooling operation can be enable by QFC switch installed in the control section of the electrical panel . Once the Freecooling function is enabled, the unit controller manages automatically the operation of the water valves. The system controls, also, the operation of fans maximizing the freecooling effect.



**THE WATER SYSTEM MUST BE FILLED WITH THE PROPER PERCENTAGE OF WATER AND GLYCOL.
IT IS RESPOSABILITY OF END USER TO ENSURE TO APPROPRIATE AMOUNT OF WATER/GLYCOL PERCENTAGE.
DAMAGE OF FREECOOLING COILS CAUSED BY FREEZING IS NOT COVERED BY THE WARRANTY.**

Install field-provided flow switches with water pump interlock to sense the system water flow.

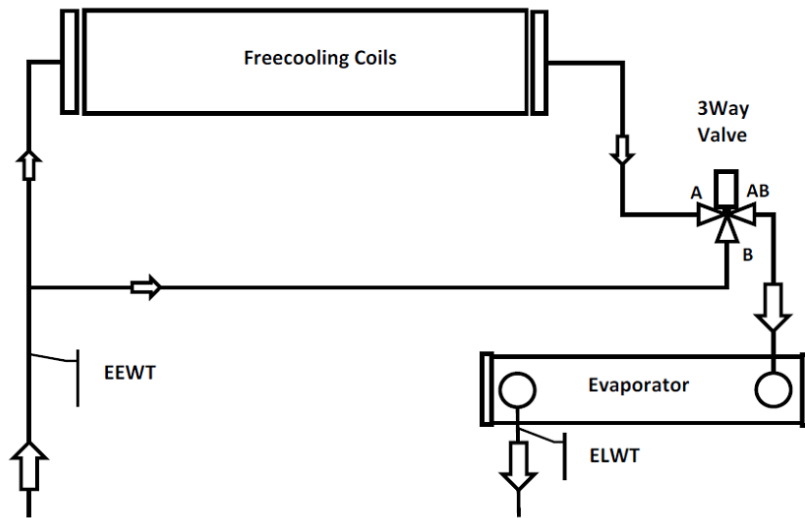


TO PREVENT DAMAGE TO THE FREECOOLING COILS AND EVAPORATOR TUBES, INSTALL A STRAINER IN THE UNIT WATER INLET PIPING. STRAINER MUST HAVE MAXIMUM 0,5 MM MESH

There are two types of freecooling control system:

Figure 6 - Freecooling system with 3 Way Valve

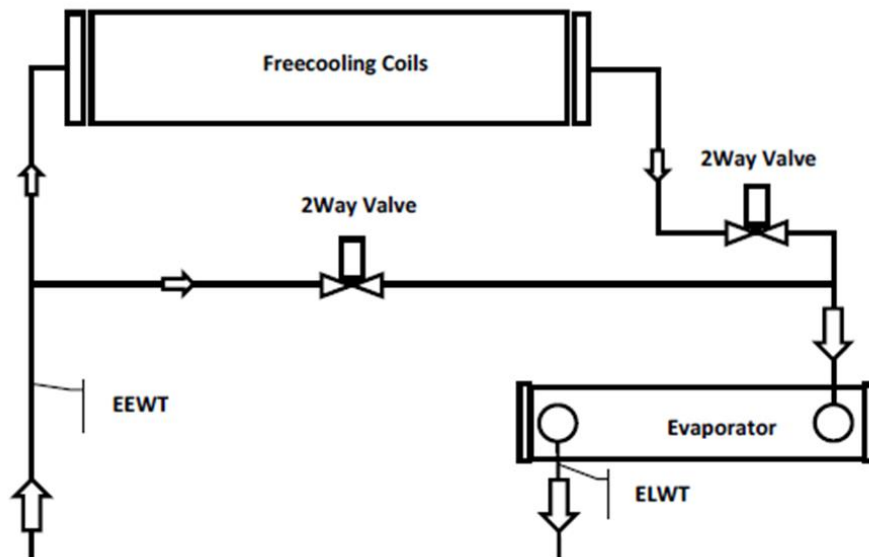
EWAD640CF-XS/XL ÷ EWADC11CF-XS/XL - EWAD600CF-XR ÷ EWADC10CF-XR



EEWT = Water entering temperature probe
ELWT = Water leaving temperature probe

Figure 7 - Freecooling system with 2 Way Valve

EWADC12CF-XS/XL ÷ EWADC16CF-XS/XL - EWADC11CF-XR ÷ EWADC15CF-XR



EEWT = Water entering temperature probe
ELWT = Water leaving temperature probe

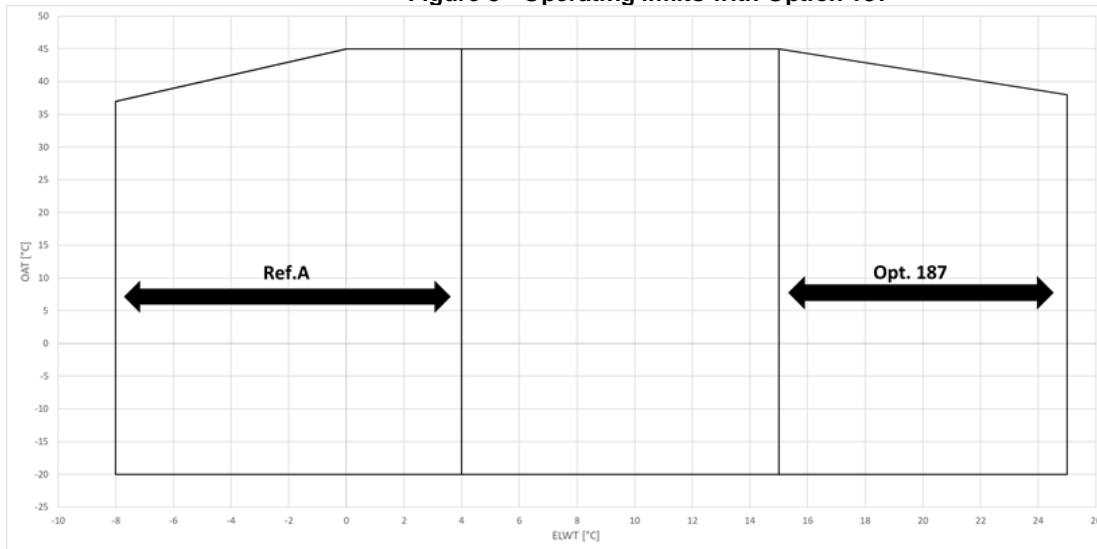
System change over is controlled by embedded unit controller, depending from operating conditions and unit setpoint. Between winter and summer operation the water side pressure drops are different, consequently the chiller water flow could be different. Evaluate that the minimum and maximum water flow, between summer and winter operation, are inside the water flow limits (see product manual).

4.1 Operation with Option 187

The following ranges of units can operate with an extended envelope as shown in Fig. 8

EWAD CF-XS | EWAD CF-XL | EWAD CF-XR

Figure 8 - Operating limits with Option 187



Note.

The above graphic represents a guideline about the operating limits of the range. Please refer to Chiller Selection Software (CSS) for real operating limits working conditions for each size.

5 MECHANICAL INSTALLATION

5.1 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.



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

5.2 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.

5.3 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.

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.

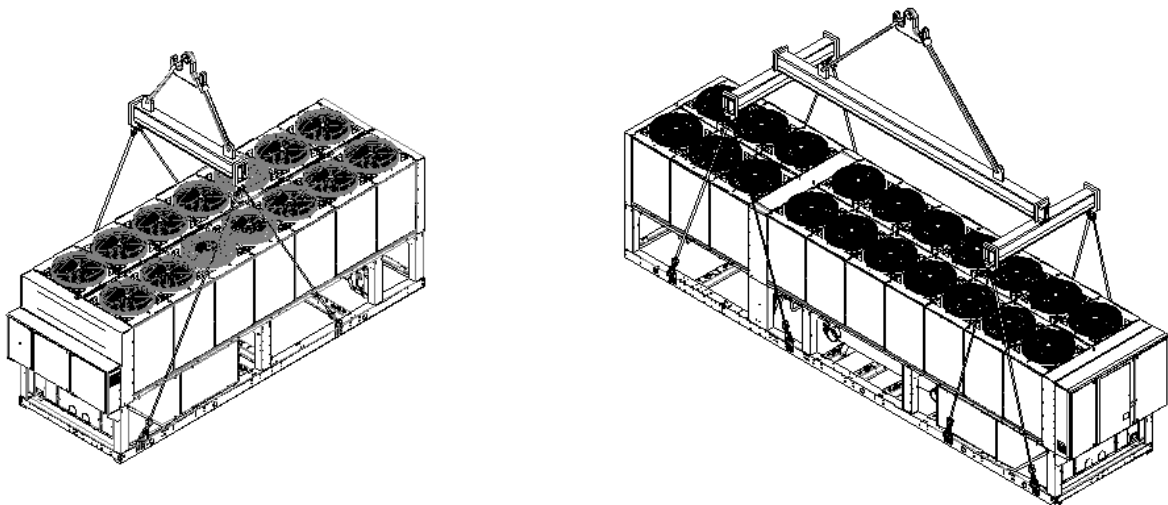
The unit must be lifted with the utmost attention and care following lifting label instructions; lift unit very slowly, keeping it perfectly level..

5.4 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 9 - Lifting of the unit



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.

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.

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 2500 mm. If these obstacles are higher, the unit must be installed at a distance no lower than 3000 mm.

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 personel safety or unit reliability.
When two or more units are positioned side by side, a distance of at least 3600 mm between condenser banks is recommended.

For further solutions, please consult manufacturer representative.

5.5 Minimum space requirements

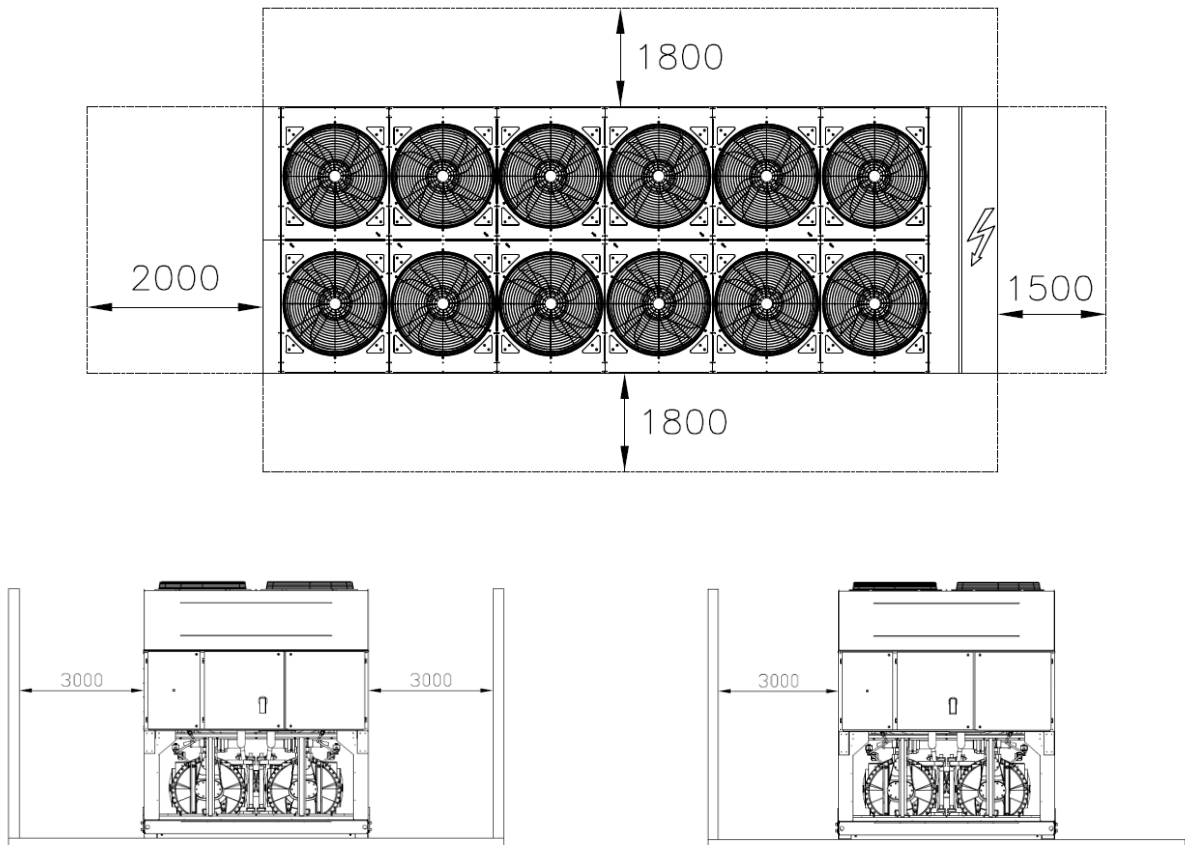
It is fundamental to respect minimum distances on all units in order to ensure optimum ventilation to the condenser coils. When deciding where to position the unit and to ensure a proper air flow, the following factors must be taken into consideration:

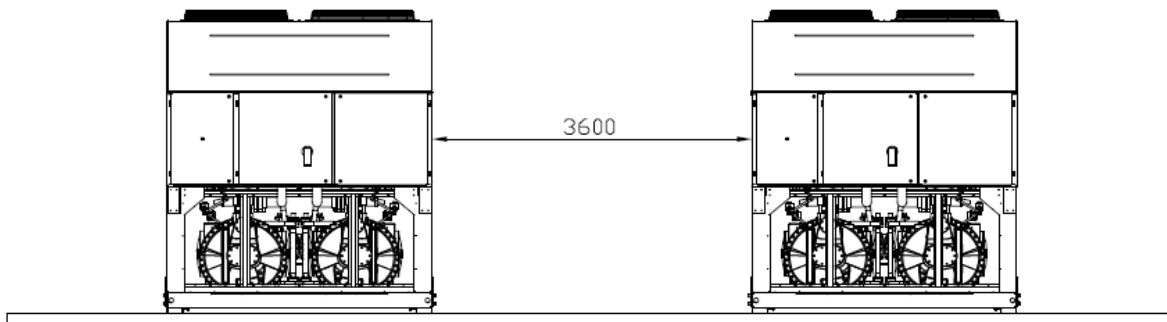
- avoid any warm air recirculation
- avoid insufficient air supply to the air-cooled condenser.

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 3 shows the minimum space required.

Figure 10 - Minimum clearance requirements





5.6 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).

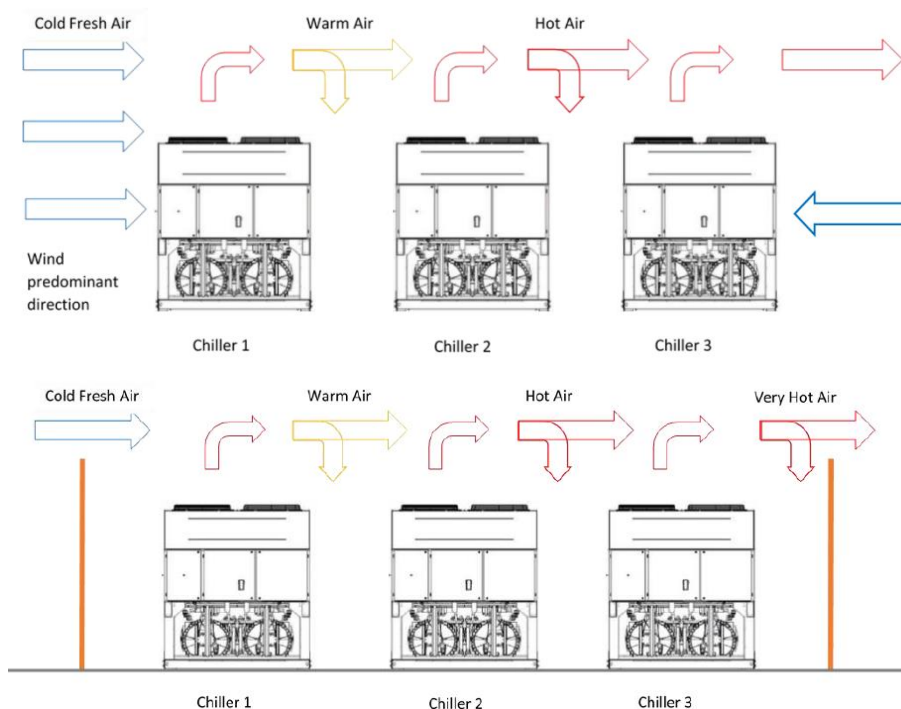
5.7 Multiple chiller installed side by side in a compound.

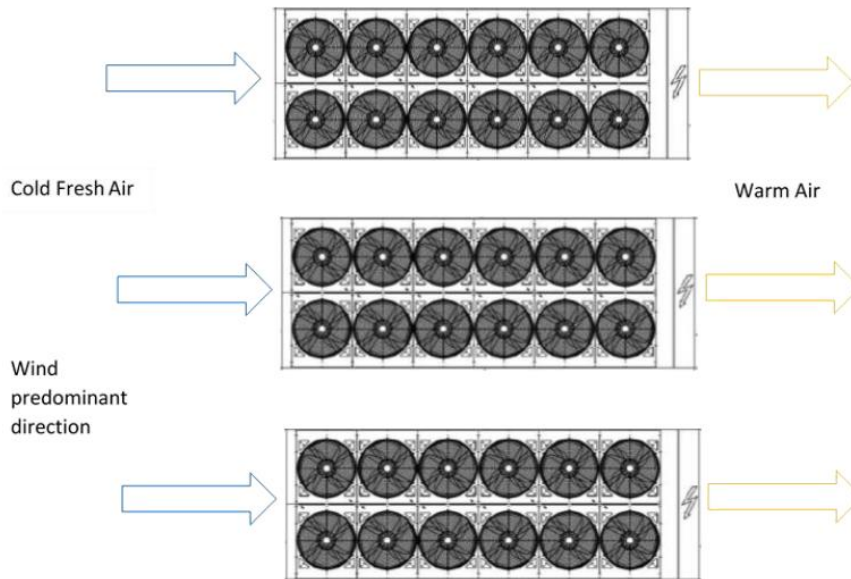
In case of compounds with walls of the same height of the chillers or higher, the installation is not recommended. Chiller 2 and chiller 3 work with sensible higher temperature due to the enhanced recirculation. In this case special precautions must be taken in to account according to the specific installation (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.

Figure 11 – Multiple Chiller Installation





5.8 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.

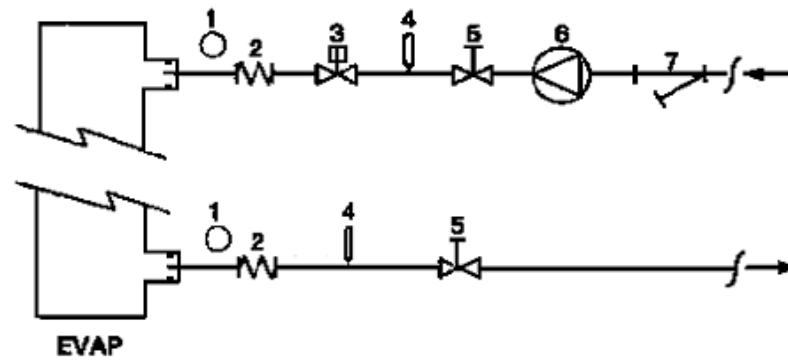
5.9 Water piping

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:

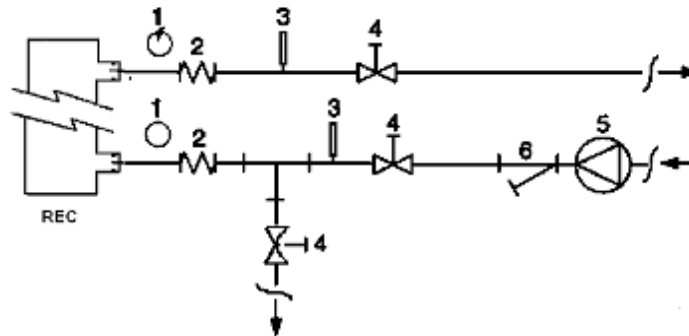
1. Anti-vibration mountings in order to reduce transmission of vibrations to the structures.
2. Isolating valves to isolate the unit from the water system during maintenance.
3. Flow switch.
4. Manual or automatic air venting device at the system's highest point.; drain device at the system's lowest 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.
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 -16°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

Figure 12 - Water piping connection for evaporator



- | | |
|-----------------------|--------------------|
| 1. Pressure Gauge | 5. Isolation Valve |
| 2. Flexible connector | 6. Pump |
| 3. Flow switch | 7. Filter |
| 4. Temperature probe | |

Figure 13 - Water piping connection for evaporator



- | | |
|-----------------------|--------------------|
| 1. Pressure Gauge | 4. Isolation Valve |
| 2. Flexible connector | 5. Pump |
| 3. Temperature probe | 6. Filter |

5.10 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.

Dirt, scales, corrosion debris and other 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

DAE Water quality requirements	Shell&tube + Flooded	BPHE
Ph (25 °C)	6.8 ÷ 8.4	7.5 – 9.0
Electrical conductivity [$\mu\text{S}/\text{cm}$] (25°C)	< 800	< 500
Chloride ion [$\text{mg Cl}^- / \text{l}$]	< 150	< 70 (HP ¹); < 300 (CO ²)
Sulphate ion [$\text{mg SO}_4^{2-} / \text{l}$]	< 100	< 100
Alkalinity [$\text{mg CaCO}_3 / \text{l}$]	< 100	< 200
Total Hardness [$\text{mg CaCO}_3 / \text{l}$]	< 200	75 ÷ 150
Iron [$\text{mg Fe} / \text{l}$]	< 1	< 0.2
Ammonium ion [$\text{mg NH}_4^+ / \text{l}$]	< 1	< 0.5
Silica [$\text{mg SiO}_2 / \text{l}$]	< 50	-
Chlorine molecular ($\text{mg Cl}_2/\text{l}$)	< 5	< 0.5

Note: 1. Heat Pump
2. Cooling Only

5.11 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 -16°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.

5.12 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 6".

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 nomila flow rate.

5.13 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 managment of condensing pressure.

To gurantee 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 grantee the respect of this value (e.g. using recirculating bypass valve)

6 ELECTRICAL INSTALLATION

6.1 General specifications

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.



***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.
There is a risk of electric shock.***

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.



***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 20 minutes after the unit has been switched off.***

Electrical equipment is capable of operating correctly in the intended ambient air temperature. For very hot environments and for cold environments, additional measures are recommended (contact the manufacturer representative).

The electrical equipment is capable of operating correctly when the relative humidity does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidities are permitted at lower temperatures (for example 90% at 20 °C).

Harmful effects of occasional condensation shall be avoided by design of the equipment or, where necessary, by additional measures (contact the manufacturer representative).

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.

6.2 Electrical supply

The electrical equipment can operate correctly with the conditions specified below:

Voltage	Steady state voltage: 0,9 to 1,1 of nominal voltage
Frequency	0,99 to 1,01 of nominal frequency continuously 0,98 to 1,02 short time
Armonics	Harmonic distortion not exceeding 10 % of the total r.m.s. voltage between live conductors for the sum of the 2nd through to the 5 th harmonic. An additional 2 % of the total r.m.s. voltage between live conductors for the sum of the 6th through to the 30th harmonic is permissible.
Voltage unbalance	Neither the voltage of the negative sequence component nor the voltage of the zero sequence component in three-phase supplies exceeding 3 % of the positive sequence component
Voltage interruption	Supply interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions.
Voltage dips	Voltage dips not exceeding 20% of the peak voltage of the supply for more than one cycle with more than 1 s between successive dips.

6.3 Electric connections

Daikin Applied Europe S.p.A. declines all responsibility for an inadequate electrical connection.



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.
 The power supply to the unit must be set up in such a way that it can be switched on or off independently from that of other system components and other equipment in general, by means of a general switch.
 The electrical connection of the panel must be carried out maintaining the correct sequence of the phases.



Do not apply torque, tension or weight to the main switch terminals. Power line cables must be supported by appropriate systems.

Simultaneous single and three-phase loads and phase unbalance can cause ground losses of up to 150 mA during normal unit operation. The unit includes devices that generate higher harmonics, such as an inverter, that can increase ground losses to much higher values, about 2 A.

The protections for the power supply system must be designed according to the values mentioned above.

A fuse must be present on each phase and, where provided for by the national laws of the country of installation, a leak detector to earth.

Make sure that the short-circuit current of the system at the installation point is less than the rated short-time withstand current (I_{cw}); the value of I_{cw} is indicated inside the electrical panel.

The standard equipment has to be used in TN-S earthing system; if your system is different please contact the manufacturer representative.

6.4 Cable requirements

The cables connected to the circuit breaker must respect the insulation distance in the air and the surface isolation distance between the active conductors and the earth, according to IEC 61439-1 table 1 and 2, and to the local national laws.

The cables connected to the main switch must be tightened using a pair of keys and respecting the unified clamping values, relative to the quality of the screws of the washers and nuts used.

Connect the earth conductor (yellow / green) to the PE ground terminal.

The equipotential protection conductor (earth conductor) must have a section according to table 1 of EN 60204-1 Point 5.2, shown below.

Table 1 - Table 1 of EN60204-1 Point 5.2

Section of the copper phase conductors feeding the equipment S [mm ²]	Minimum cross-section of the external copper protection conductor S_p [mm ²]
$S \leq 16$	S
$16 < S \leq 35$	16
$S > 35$	$S/2$

In any case, the equipotential protection conductor (earth conductor) must have a cross section of at least 10 mm², in accordance with point 8.2.8 of the same standard.

6.5 Phase unbalance

In a three-phase system, the excessive imbalance between the phases is the cause of the engine overheating. The maximum permitted voltage unbalance is 3%, calculated as follows:

$$Unbalance \% = \frac{(V_x - V_m) * 100}{V_m}$$

where:

V_x = phase with greater unbalance

V_m = average of the tensions

Example: the three phases measure 383, 386 and 392 V respectively. The average is:

$$\frac{383 + 386 + 392}{3} = 387 \text{ V}$$

The unbalance percentage is:

$$\frac{(392 - 387) * 100}{387} = 1.29 \%$$

less than the maximum allowed (3%).

7 OPERATION

7.1 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.

8 MAINTENANCE

8.1 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.

Neglecting unit maintenance, 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)
- Coastal 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/ 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 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
Verify that fans are well tightened			X
Verify condenser coil 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
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:

- Monthly activities include all the weekly ones.
- The annual (or early season) activities include all weekly and monthly activities.
- Unit operating values should be read on a daily basis thus keeping high observation standards.
- In environments with a high concentration of air-borne particles, it might be necessary to clean the condenser bank more often.
- Replace the oil filter when the pressure drop across it reaches 2.0 bar.
- Check for any dissolved metals.
- TAN (Total Acid Number) : $\leq 0,10$: 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.
- Units placed or stored in a Highly Aggressive Environment for long time without operation are still subject to those routine maintenance steps.

8.2 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.

8.3 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 give 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

9 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 80% of the nominal flow rate.

10 IMPORTANT INFORMATION REGARDING THE REFRIGERANT USED

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

Refrigerant type: R134a
 GWP(1) value: 1430
 (1)GWP = Global Warming Potential

The refrigerant quantity necessary for standard operation is indicated on the unit name plate.

Periodic inspections for refrigerant leaks may be required depending on European or local legislation. Please contact your local dealer for more information.

10.1 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.

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:**

$$GWP * total\ charge\ [kg]/1000$$

The diagram shows a rectangular label with the following elements:

- Top left: Warning icon and text "Contains fluorinated greenhouse gases" (labeled 'a').
- Top right: Unit serial number "CH-XXXXXXXX-KKKKXX" (labeled 'p').
- Middle left: Refrigerant type "R1234ze" (labeled 'm') and "GWP: 7" (labeled 'n').
- Middle: Three rows for circuit charges:
 - Row 1: "1 = [] + [] kg" (labeled 'e'). The first [] is labeled 'b' (Circuit number), the second [] is labeled 'c' (Factory charge), and the third [] is labeled 'd' (Field charge).
 - Row 2: "2 = [] + [] kg" (labeled 'e').
 - Row 3: "3 = [] + [] kg" (labeled 'e').
- Bottom left: Total charge calculation: "1 + 2 + 3 = [] + [] kg" (labeled 'f').
- Bottom middle: "Total refrigerant charge Factory + Field [] kg" (labeled 'g').
- Bottom right: "GWP x kg/1000 [] tCO₂eq" (labeled 'h').

- 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



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.

11 PERIODIC CHECKS AND COMMISSIONING OF PRESSURE EQUIPMENT

The units are included in category IV of the classification established by the European Directive PED2014/68EU. For chillers belonging to this category, some local regulations require a periodic inspection by an authorized agency. Please check with your local requirements.

12 DISPOSAL

The unit is made of metal, plastic and electronic parts. All of these components must be disposed of in accordance with local disposal laws and if in scope with the national laws implementing the Directive 2012/19/EU (RAEE).

Lead batteries must be collected and sent to specific waste collection centers.

Avoid the escape of refrigerant gases into the environment by using suitable pressure vessels and tools for transferring the fluids under pressure. This operation must be carried out by competent personnel in refrigeration systems and in compliance with the laws in force in the country of installation.



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