DAIKIN

Installation, maintenance and operating manual
D–EIMWC00308-16EN

Water-cooled water chillers with stepless compressor rotation speed

EWWD - VZ

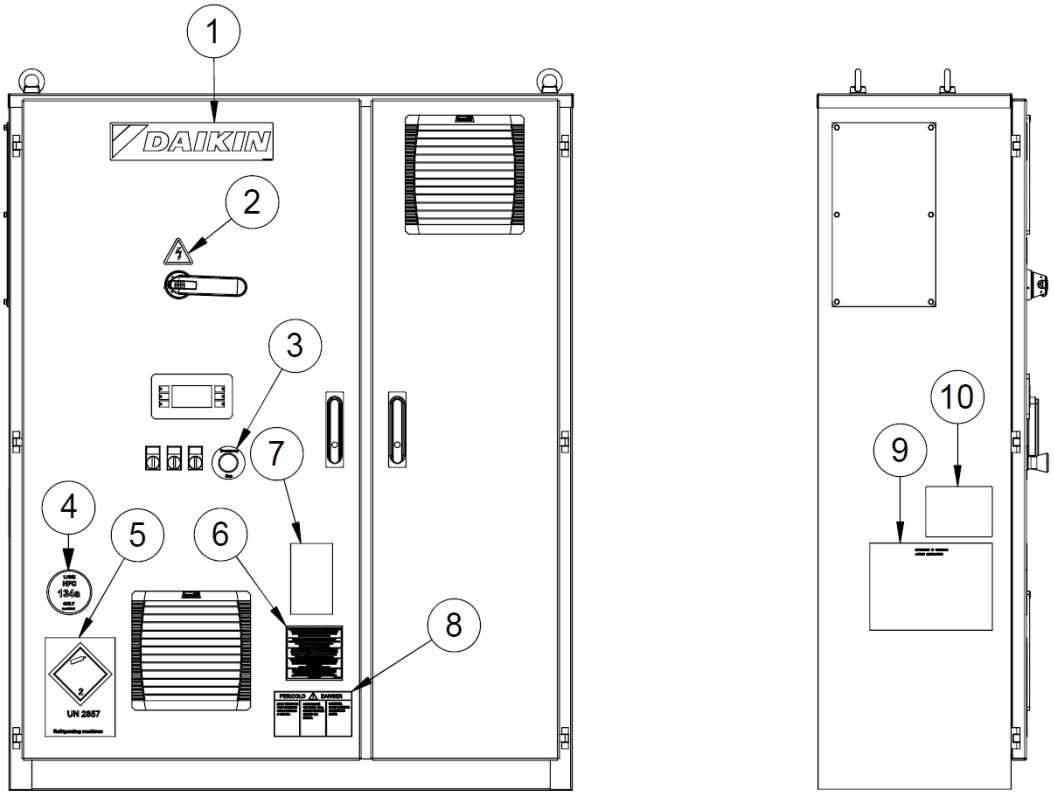
Cooling capacity from 500 to 2100 kW

50Hz - Refrigerant: HFC R134a

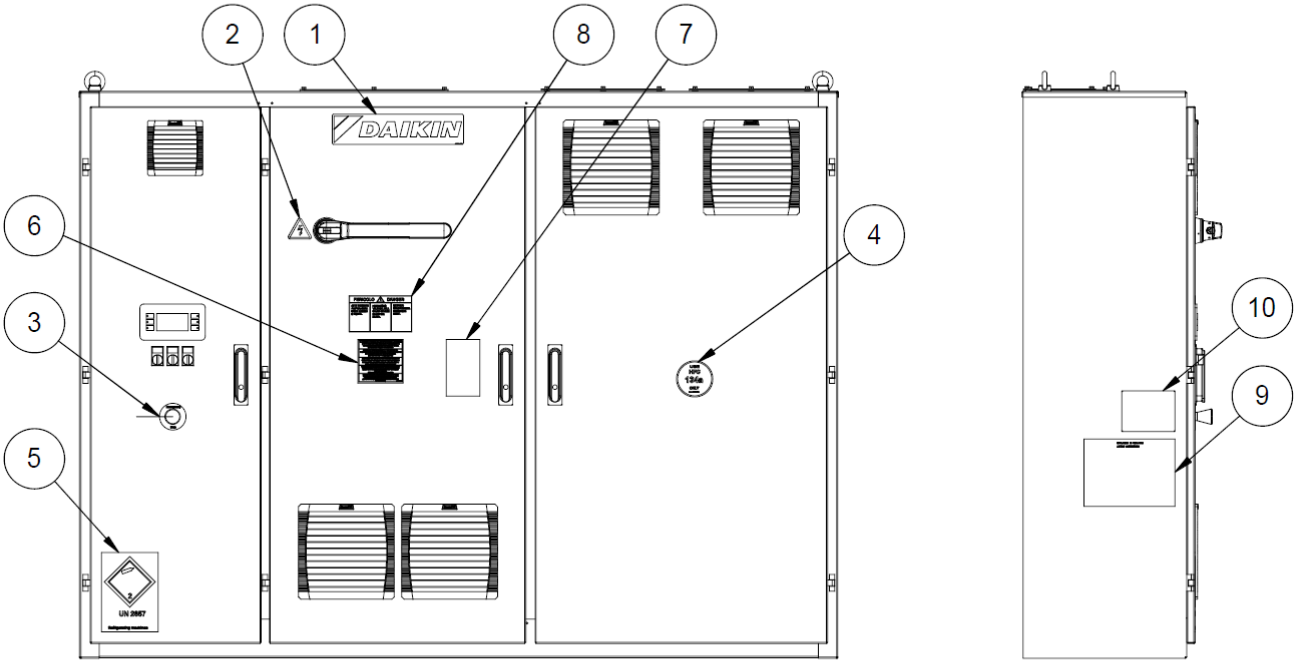
CE

Original Instructions

Description of the labels applied to the electric panel



Single circuit unit



Double circuit unit

Identification of labels

1 – Manufacturer's logo	**6** – Wire tightness check
2 – Electricity warning	**7** - Shutoff valve position
3 – Emergency button	**8** – Shock hazard
4 – Type of gas	**9** – Lifting instructions
5 – Non flammable gas	**10** – Unit nameplate

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Introduction

This manual provides information about the capabilities and standard procedures for all units in the series and is an important support document for qualified personnel but it is not intended to replace such personnel.
All units are supplied complete with wiring diagrams and dimensional drawings that provide information about the size and weight of each model.
In case of discrepancies between the content of the manual and the documentation that came with the unit, always rely to the wiring diagram and dimensional drawings because they **are an integral part of this manual.**
Read this manual carefully before installing and starting up the unit.
Improper installation can cause shock, short circuits, leaks, fire or other damages
to the equipment or personal injury.
The unit must be installed by professionals/professional technicians in accordance with current laws of the country
of installation.
The unit must also be started by authorized and trained personnel and all activities must be conducted in accordance and in full compliance with local standards and laws.

IF THE INSTRUCTIONS IN THIS MANUAL ARE NOT ABSOLUTELY CLEAR, DO NOT INSTALL AND/OR START UP THE UNIT.

If in doubt, for service and further information, contact the manufacturer's authorized representative.

General Description

Daikin water chillers with screw compressor Inverters, are completely factory assembled and tested before shipment.

The EWWD VZ range consists of models with a single cooling circuit and single compressor (from 500 to 1050 kW) and models with two compressors and two independent cooling circuits (1150 to 2100 kW)

The machine, extremely compact, uses R134a refrigerant suitable for the entire machine application range.

The controller is pre-wired, set and tested at the factory. Only normal connections are required on site such as piping, electrical connections and pump interlocks, making installation easier and more reliable. All operating safety and control systems are factory installed in the control panel.

The instructions in this manual apply to all models of this series unless otherwise indicated.

Application

The EWWD VZ units with single screw compressor and adjustment inverters are designed and constructed to cool and/or heat buildings or industrial processes. Daikin technicians, specifically trained for this purpose, must start the final system for the first time. Failure to follow this starting procedure affects the warranty.

The standard warranty covers parts of this equipment with proven defects in material or workmanship. Materials subject to natural consumption are not, however, covered by the warranty.

The cooling towers used with Daikin units with screw compressor must be selected for a wide scope of application, as described in the "Operating limits" section. From an energy savings point of view it is always preferable to keep the temperature difference between the hot circuit (condenser) and the cold circuit (evaporator) to a minimum. However, it is always necessary to verify that the machine works in the temperature range specified in this manual.

Installation Safety

All EWWD VZ machines are built in accordance with the main European Directives (Machinery Directive, Low Voltage Directive, Electromagnetic Compatibility Directive for PED pressurized equipment), 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.
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.

Installation

Storage

Should it be necessary to store the unit prior to installation, it is necessary to observe some precautions.

- Do not remove the protective plastic
- Do not leave the unit exposed to the elements
- Do not expose the unit to direct sunlight
- Do not use the machine near a heat source and/or open flame
- Keep in places where room temperature is between + 5° C to 55° C (room temperature over the maximum limit may trigger the safety valve resulting in loss of refrigerant.

Receiving and handling

Inspect the unit immediately after delivery. In particular, make sure the machine is intact in all its parts and that there are no deformations due to collisions. Should damages be found upon receipt, immediately file a written complaint with the carrier.

Machine returns are Ex factory Daikin Applied Europe S.p.A.

Daikin Applied Europe S.p.A. cannot be held liable for any equipment damages incurred during transportation to the place of destination.

The isolation of the evaporator corners, where the lifting holes are located, are shipped separately and must be assembled on site after the unit has been permanently installed. Even the anti-vibration pads (optional) are shipped separately. Make sure these items, if required, are delivered with the unit.

Use extreme caution when handling the unit to prevent damage to the control panel and the refrigerant pipes.

The unit must be lifted by inserting a hook in each of the four corners, where the lifting holes are located (see lifting instructions). Distancer bars must be used along the line connecting the lifting holes to prevent damages to the electrical panel and the compressor terminal box (see figure). Do not use any other point to lift the machine.

During the lifting phase, check that the lifting cords and/or chains do not touch the electrical panel and/or piping.

If, to move the machine, slides or shoes are used, just push the base of the machine without touching the copper and steel pipes, compressors and/or electric panel.

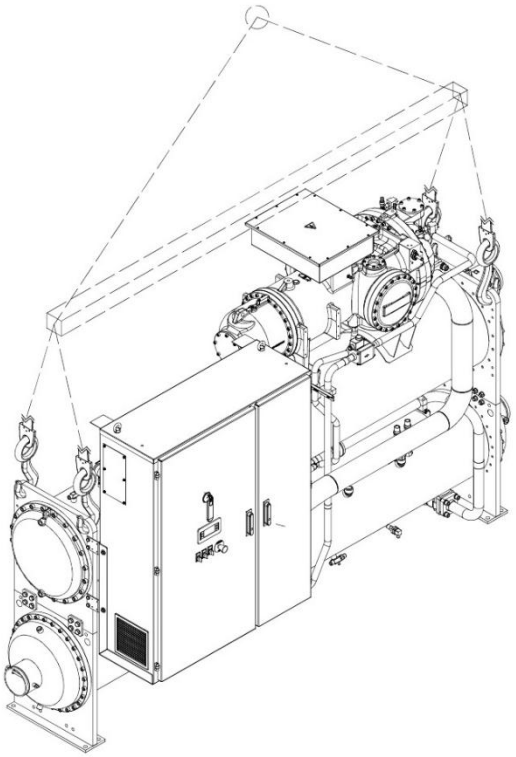
Be careful not to hit, during handling, pipes, cables and installed accessories.

All the necessary devices guaranteeing personal safety must be provided during machine handling.

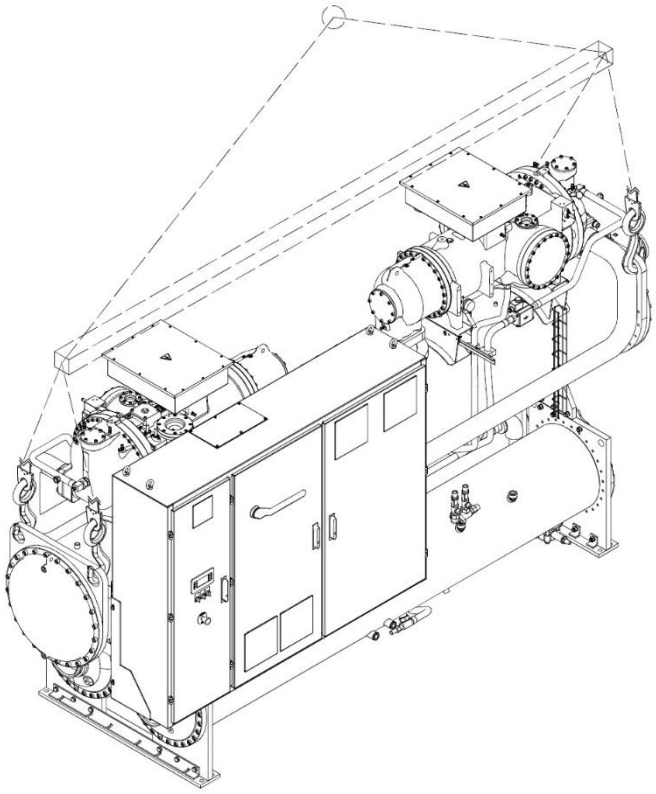
Important note

Refer to the dimensional drawing for hydraulic and electrical unit connections. The overall machine dimensions, as well as the weights described in this manual, are purely indicative. The contract dimensional drawing and relevant wiring diagram are provided to the customer when ordering.

Lifting instructions



Single circuit unit



Double circuit unit

Fig. 1 – Lifting instructions

Lifting instructions:

1) Equipment, ropes, lifting accessories and handling procedures must comply with local regulations and legislation.

2) To lift the machine, use only the holes on the heat exchangers.

3) Any lifting points should be used during handling.

4) Use lifting hooks with closing device exclusively. The hooks must be safely secured prior to handling.

5) The ropes and hooks used must have capacity suited to the load.

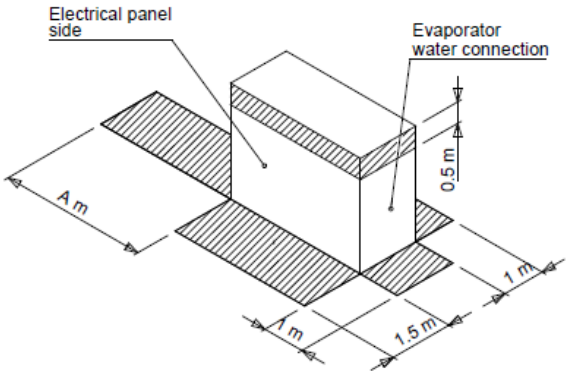
Check the nameplate on the unit that indicates the machine weight.

6) The installer must correctly select and use lifting equipment. We recommend using cables with minimum vertical capacity equal to the total machine weight.

7) The machine must be lifted slowly and well leveled. Adjust the lifting equipment, if necessary, to ensure the leveling.

Positioning and assembly

The unit must be mounted on a level cement or steel base, suitable to support the overall weight of the complete machine in operation, and must be positioned so as to provide space for maintenance at one end of the unit, to allow the cleaning and/or the removal of the evaporator and the condenser pipes. Refer to the figure below for the areas of respect. The condenser and evaporator pipes are expanded inside the pipe plate to allow replacement, if necessary.



Unit type	A (m)
EWWD450÷C11VZ	3.5
EWWDC13÷C21VZ	4.5

Fig. 2 - Unit positioning

The machine position should be designed to ensure access to all the safety and control devices. Never cover the safety devices (safety valves, pressure switches), which, due to their importance, are subject to periodic checks. The safety valves must be connected externally. For safety valve outlet pipe dimensions, we recommend applying harmonized standards EN378 and EN13136.

These units include the installation of two safety valves for each exchanger, installed on an exchange tap, which always maintains an active valve. Thus, both safety valves on each exchanger must be connected outside the engine room. These pipes must be installed so that, in case the valve opens, the discharged refrigerant flow not invest people and/or things, or can enter the building through windows and/or other openings.

The engine room must be adequately ventilated to prevent refrigerant accumulation inside that can deprive air of the right oxygen content that can cause asphyxiation. In this regard, we recommend the application of harmonized standard EN378-3 (Safety and Environmental Requirements - Installation and protection of persons) or equivalent.

DANGER

The air contaminated by a high percentage of refrigerant (see refrigerant safety sheet), can cause asphyxiation, loss of mobility and consciousness if inhaled. Avoid eye and skin contact.

Shock absorbers

The anti-vibration rubber mats (optional), shipped separately, should be placed under the corners of the unit (except for special specifications). These mats provide a minimum insulation. Mats are recommended on all installations where the transmission of vibrations can be considerable. Also install the anti-vibration joints on water pipes to reduce the stress on pipes, vibrations and noise.

WARNING

The units are shipped with refrigerant and oil valves closed to isolate such fluids during shipment. The valves must remain closed until such time as an authorized Daikin technician, after inspecting the machine and checked its installation, commissions the machine.

Anchoring

After positioning, the machine must be firmly anchored to the ground or foreseen metal structure to support the machine. In this regard, 22 mm diameter holes are included on the machine base to ensure the anchoring.

Water pipes

Evaporator and condenser water pipes

The condensers and evaporators are provided with grooved sleeves for Victaulic connections or optionally with flanged connections. The installer must provide the mechanical coupling with the connections appropriately sized to the system.

Important notes regarding welding

1. If the connection flanges require welding, remove the temperature sensors from the wells, to prevent damage to the controller electronic boards.
2. Grounding must be done correctly to avoid damage to the electronic controller.

Some pressure couplings are included on both the inlet and outlet of the exchangers heads. These couplings control water load loss. Water load loss and flow for condensers and evaporators are shown in the relevant product manual. To identify the heat exchanger refer to its plate.

Make sure that the water inlet and outlet connections agree with the dimensional drawing and the indications found on the connections. Incorrect water pipe installation could create machine malfunctions and/or reduce performance.

NOTE

When using a hydraulic connection shared with the heating system, make sure the temperature of the water flowing into the evaporator does not exceed the maximum allowed value. This phenomenon might cause the safety valve to open and thus the refrigerant to discharge into the atmosphere.

The pipes, before being attached to the machine, must be supported to reduce the weight and the stress on connections. In addition, the pipes must be adequately insulated. A water filter that can be inspected must also be installed on both inputs (evaporator and condenser). Install shutoff valves on both heat exchangers with suitable dimensions to permit draining and inspection without having to completely drain the system in addition to the water pressure gages.

WARNING

To prevent damage to exchanger pipes, install a mechanical filter that can be inspected on each input, able to filter solid objects greater than 1.2 mm in size

Flow Switch

A flow switch must be installed on the evaporator inlet pipe to ensure the correct water flow rate, before the unit is started. Furthermore, this device shuts off the unit when water flow is interrupted, protecting the machine from the evaporator freezing.

WARNING

The flow switch must not be used as a machine control system

The absence of the flow switch on the evaporator water connection, voids the warranty for frost damage.

CAUTION

The evaporator and condenser are not self-draining; both must be purged

Thermometers and pressure gages must be installed on the water pipes near the heat exchangers connections. Furthermore, breather valves must also be installed at the highest points on the pipe.

If necessary, only the evaporator water caps can be reversed. If this operation is completed, new gaskets and control sensors have to be repositioned.

WARNING

Condenser inlet and outlet water connections cannot be reversed. The particular condenser configuration only provides optimal machine operations in countercurrent. The wrong water flow direction in the condenser reduces the overall efficiency of the machine.

Should water pump noise be excessive, we recommend using rubber insulating joints at both pump inlet and outlet. In most cases it is not necessary to install anti-vibration joints on condenser pipe inlet and outlet but, where the noise and vibration are critical (for example where a buried pipe passes through a wall in an inhabited area), it may be necessary.

If a cooling tower is used, a balancing valve must be installed. A temperature control system is required if the water tower is very cold. The controller installed on the machine manages tower fan on/off or continuously manages a control vale or fan speed controller by means of a 0-10 V DC analog signal. We recommend that you carry out the connection, allowing fan management by the machine controller (see wiring diagram for connection).

Water treatment

Before commissioning the machine, clean the water circuits. Make sure that the tower purge and emptying system is operational. Atmospheric air contains many contaminants so you need a good water purifier. The use of untreated water can result in: corrosion, erosion, mud, fouling and formation of algae. Daikin Applied Europe is not liable for equipment damage or malfunction due to a lack of a water purifier or water not properly purified.

Glycol solution

WARNING

Use industrial glycol only. Do not use automotive antifreeze. Automotive antifreeze contains inhibitors which cause a plating on copper pipes. Used glycol handling and disposal must be in accordance with current regulations

Temperature limits and water flow

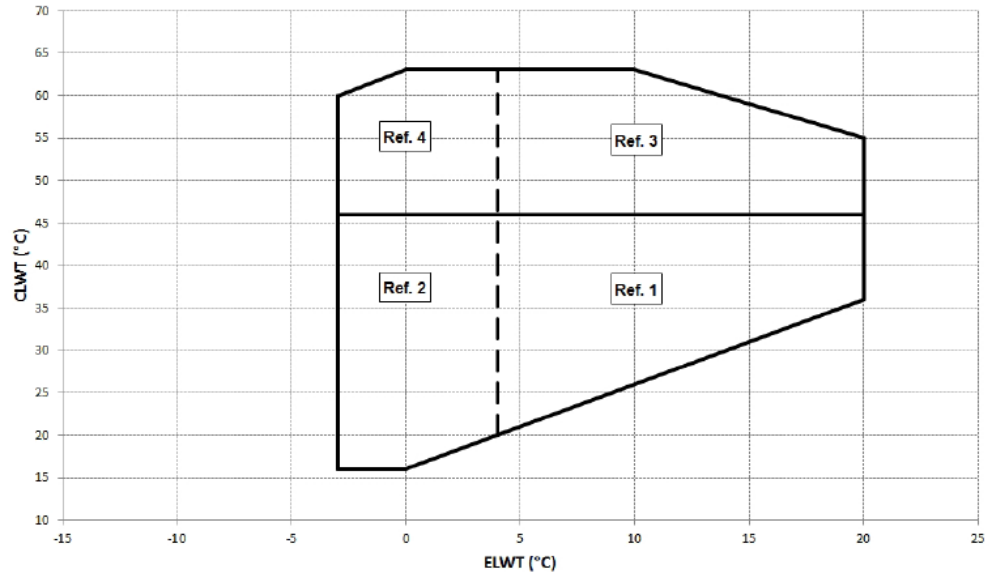
The EWWD VZ units are designed to operate with an evaporator outlet water temperature between -3° C and +20° C and a condenser outlet water temperature between 15° C and 50° C (standard units) and between 15° C and 65° C in case the "High Temperature" kit is installed. However, the minimum temperature difference between the evaporator outlet water temperature and the condenser inlet water temperature must not be less than 15° C. Always check the exact operating point with the selection software. Some simultaneous operating conditions (high evaporator inlet water temperature and high condenser inlet water temperature) may be inhibited.

Glycol must be used for all applications with the evaporator outlet fluid below 4° C. The maximum permissible water temperature in the evaporator with the machine off is 50° C. Higher temperatures could cause the safety valves on the evaporator sleeve to open.

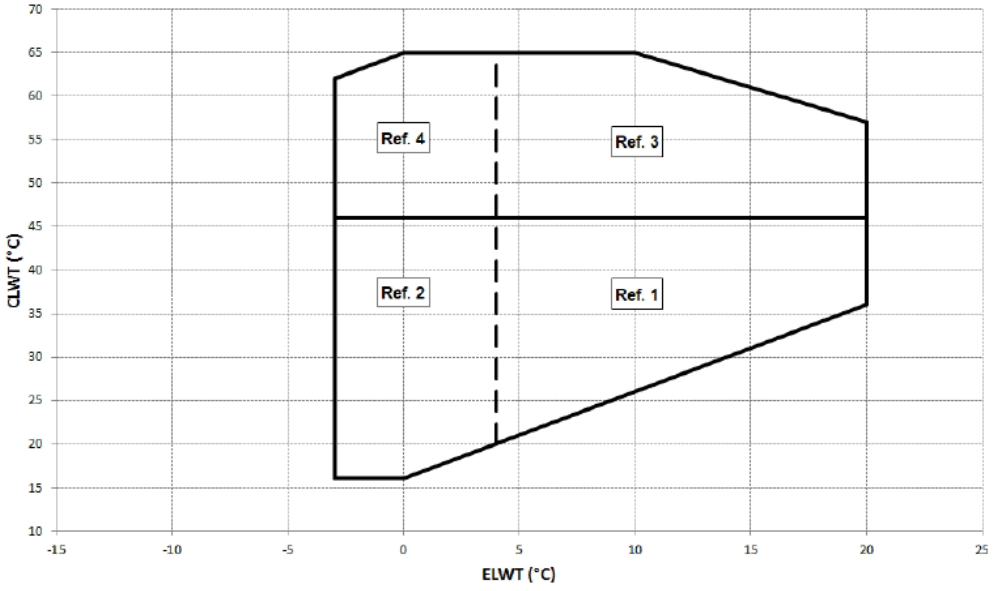
Water flow rate under the minimum value indicated in the condenser and evaporator load loss diagram can cause freezing problems, incrustations and poor control. Water flow rate higher than the maximum value indicated in the condenser and evaporator load loss diagram results in an unacceptable load loss and excessive erosion of the pipes and vibrations that can cause breakage.

Operating limits

EWWD-VZSS - Silver Version



EWWD-VZXS & EWWD-VZPS - Gold & Platinum Version



Legend

ELWT Evaporator outlet water temperature

CLWT Condenser outlet water temperature

Ref.1 Standard unit

Ref.2 Brine version standard unit (option 08)

Ref.3 Standard unit with High Temperature Kit (Option 111)

Ref.4 Standard unit with High Temperature kit plus Brine version (Option 111 + Option 08)

Minimum water content in the system

For correct EWWDxxxVZ machine operations and the necessary operating stability, it is important to ensure a minimum water content in the system. An accumulation tank with suitable volume may be required for this purpose.

The minimum water content must be calculated by considering the following specifications:

Application	EWWD 450÷C11	EWWD C13÷C21
Conditioning	3.3 lt/kW	2.5 lt/kW
Process	6.6 lt/kW	5.0 lt/kW
Variable capacity	6.6 lt/kW	5.0 lt/kW

Note: The EWWD450 ÷ C11 units are machines with a single compressor

The EWWDC13 ÷ C21 units are machines with two compressors

Calculation example for EWWDC11VZ XS units

Cooling capacity at 100% = 1053 kW

Minimum system volume for conditioning: 1053 x 3.3= 3475 lt

Minimum system volume for processing: 1053 x 6.6= 6950 lt

Minimum system volume at variable capacity: 1053 x 6.6= 6950 lt

Note: The calculation formula described above, takes into account several factors such as the compressor stop time and the admissible temperature difference between the last compressor stop and start. In this regard, the minimum water content calculated refers to the machine operations in a normal climate control system. If the machine is used for process activities or if higher operating stability is required, we recommend doubling the calculated water content. In very simple systems, an inertial accumulation tanks may be necessary on the hydraulic circuit to reach the required minimum water volume. Adding this component must guarantee correct water mixing and, therefore, we recommend you select a tank that includes an internal diaphragm for this purpose.

Note: If the evaporator water circuit operates in a variable flow system, the minimum water flow rate must not be less than 50% of the water flow rate at nominal conditions and the variation should not be greater than 10% of the nominal flow per minute.

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Evaporator frost protection

1. If the machine is idle during the winter, drain and rinse the evaporator and chilled water pipes with glycol. Drain and air vent connections are included on the evaporator for this purpose.
2. We recommend adding glycol in proper proportion to the condenser cooling system. The freezing temperature, of the water-glycol solution, must be at least 6° C lower than the expected minimum ambient temperature.
3. Insulate pipes especially chilled water ones to avoid condensation.

Note: Damage caused by freezing is not covered by warranty, therefore, Daikin Applied Europe SpA cannot be held liable.

Condenser protection and design considerations

If lake, river or ground water is used as the cooling fluid and the water valves have a leak, the condenser and liquid refrigerant line temperatures could drop under room temperature when the machine is off. This problem occurs when cold water circulates through the condenser and the unit remains off waiting load. If this happens:

1. Turn off the condenser water pump when the compressor is off.
2. Check that the liquid line expansion valve is working properly.

Condensation control with evaporative cooling tower

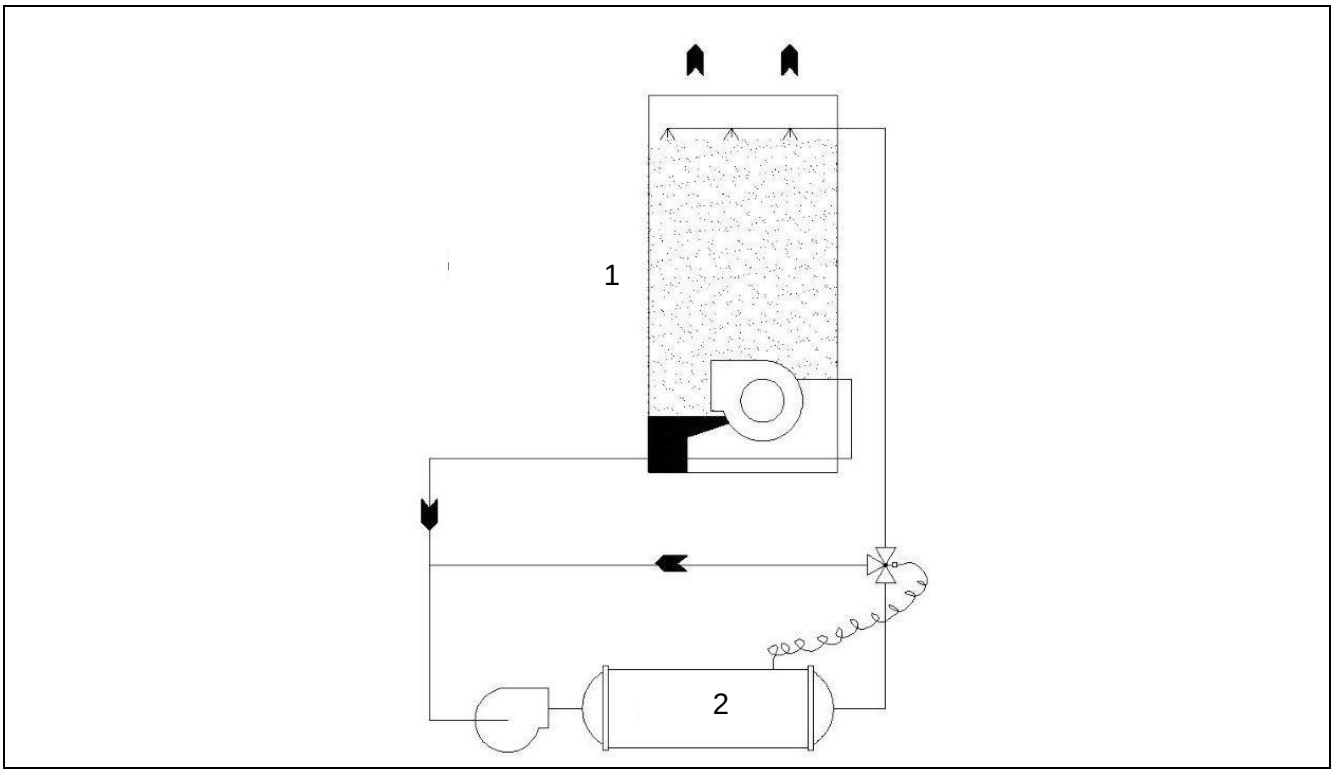
The minimum condenser inlet water temperature should not be less than 20° C at full water tower flow rate.

If the water temperature must be lower, even the water flow must be reduced proportionately.

To modulate the water flow to the condenser, install a three-way by-pass valve. The figure shows how the three-way valve is applied to cool the condenser. The three-way valve can be activated by a pressure actuator which guarantees proper condensing pressure in the case where the water temperature entering the condenser is less than 20° C.

In place of a valve with pressure actuator you might use a three-way servo-operated valve or a circulation pump controlled by an inverter. Both of these two devices may be controlled by an analog 0-10 Vdc signal issued by the machine's electronic controller according to the water temperature entering the condenser.

Fig. 3 – Condenser control scheme with cooling tower



1	Cooling tower
2	Condenser

Condensation control with well water

If ground water is used to cool the condenser, install a normally regulating control valve, direct drive, at condenser outlet. This regulating valve must ensure an adequate condensing pressure in the case where the water temperature entering the condenser is less than 20° C.

A service valve with pressure outlet is provided on the condenser sleeve for this purpose.

The valve must modulate its opening according to condensing pressure. When the machine shuts down, the valve will close preventing the condenser from emptying.

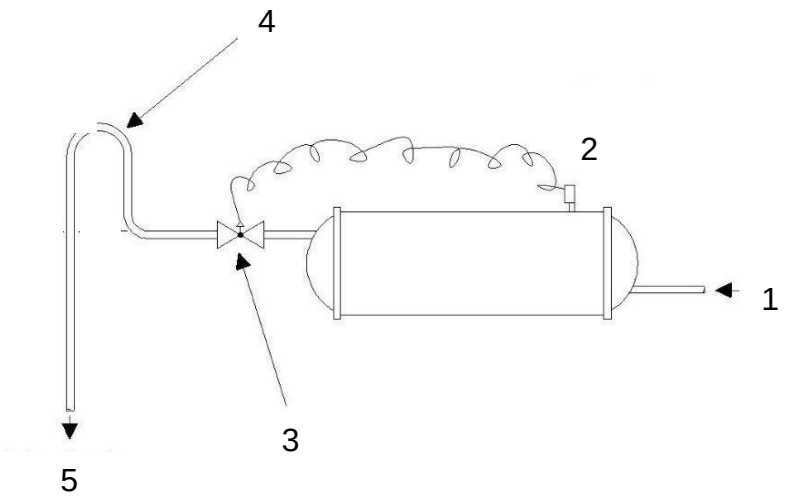


Fig. 4 – Condensation control scheme with well water

1	From the main condenser pump
2	Service valve
3	Direct acting water regulating valve
4	Configuration required when the regulating valve is not used
5	At Drain

Chilled water control sensor

The water cooled EWWD VZ unit is equipped with a microprocessor. Be careful when working around the unit to avoid damaging cables and sensors. Check cables before starting the unit. Prevent rubbing of the cables on the frame or other components. Make sure the cables are securely locked. If the temperature sensor is removed for maintenance, do not eliminate the conductive paste in the well and replace the sensor correctly. After replacing the sensor, tighten the lock nut to prevent accidental slipping.

Safety Valve

Each exchanger (evaporator and condenser) is provided with a safety valve installed on an exchange valve that allows maintenance and periodic checks, without losing a significant amount of refrigerant. Do not leave the safety valve in the intermediate position.

WARNING

To prevent damage due to R134a gas inhalation, do not release the refrigerant in the air or other indoor places. The safety valves must be connected externally in accordance with the regulations in the place of installation. The installer is responsible for connecting the safety valve to the purge pipe and pipe dimensioning. In this regard, refer to the harmonized standard EN13136 to dimension the drain pipes to be connected to the safety valves

Open the isolation and/or shut off valves

Before powering the machine and thus starting the compressors, open all valves that were closed at the factory for shipping.

The valves to be opened are:

1. Valve (optional) installed on the compressor line
2. Oil return pipe shutoff valves (jet pump). These valves are positioned below the evaporator sleeve in the vicinity of the jet pump.
3. Liquid line valve installed under the condenser.
4. Oil valves installed on the line that feeds the compressor lubrication system. This line comes from the bottom of the oil separator located inside the condenser.
5. Valve (optional) installed on the compressor pump line.

Electrical connections

The unit must be connected with in the proper section copper cables relative to the plate absorption values and in accordance with applicable electrical regulations.

Daikin Applied Europe S.p.A. cannot be held liable for improper electrical connections.

Warning

The connections to the terminals must be made with copper terminals and cables.

The electrical connection must be made by qualified personnel.

There is a risk of electric shock

The electrical panel must be connected keeping the correct phase sequence.

Phase imbalance

In a three-phase system, excessive imbalance between the phases is the cause of motor overheating. The maximum allowed voltage imbalance is 2%, calculated as follows:

$$\text{imbalance } \% = \frac{(Vx - Vm) \times 100}{Vm} =$$

Vx = phase with greatest imbalance

Vm = average of the voltages

I.e. the three phases measure 383, 386 and 392 volts respectively, the average is:

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

the percentage of imbalance is thus

$$\frac{(392-387) \times 100}{387} = 1{,}29\%$$ less than the maximum admitted (2%)

WARNING

Before any maintenance and/or electrical connection to the compressor inverter, make sure the system is turned off and the unit main switch open.

After turning on the main switch, wait at least 20 minutes for the inverter condensers to completely discharge. Do not perform any maintenance and/or electrical connection in this period of time. Risk of electrocution:

Control circuit

The EWWD VZ unit control circuit is powered at 230 Vac.

The controller ON/OFF switch (Q0) must be rotated to the OFF position whenever machine operations are not required.

Water flow switch interlock terminals are included in the controller. See the wiring diagram for the correct connections on the field.

The purpose of the water flow switch interlock is to prevent the compressor from running for enough time to let the two evaporator and condenser water pumps to operate and ensure the correct water flow. The flow switch can be supplied on request from Daikin Applied Europe and in any case must be compulsorily installed on the machine. For better protection against freezing, connecting the evaporator flow switch, contactor clean contact or pump circuit breaker in series.

It is best to leave pump control to the microprocessor for better system management.

If an external system independently manages pump start, follow this logic.

Evaporator water inlet

- turn on the pump 2 minutes before enabling the machine
- turn off the pump 5 minutes after disabling the machine

Condenser water pumps:

- turn the pump on 30 seconds before enabling the machine

- turn the pump off 1 minute after the last compressor is turned off.

With the machine off, the condenser pump must always be turned off.

Testing the control circuit

Each EWWD VZ unit is factory tested. Both the control and power circuits undergo a careful functional test before the machine is shipped.

Operation

Operator's responsibilities

It is important that the operator becomes familiar with the equipment before operating the machine. In addition to reading this manual, the operator should study the operation manual and the wiring diagram supplied with the unit to understand commissioning, operation and the shutdown sequence as well as the shutdown mode and safeties.

During initial machine start-up, the Daikin technician is available to answer any questions and instruct on proper operating procedures.

The operator should keep an operating data log for each specific machine. Furthermore, an additional maintenance log should be kept for periodic maintenance and service.

This Daikin unit represents a substantial investment and deserves the attention and care to keep this equipment in good working order. If the operator observes abnormal or unusual operating conditions, calling Daikin technical service is recommended.

In any case, it is essential to follow the instructions below during operation and maintenance:

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

- 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 electrical components if water and/or moisture are present.

- Ensure that all operations on the refrigerant circuit and on components under pressure are exclusively carried out by qualified personnel.

- Compressors must be replaced and lubricant oil filled by qualified personnel.

- Sharp edges can cause injuries. Avoid direct contact.

- Do not introduce solid objects into the water pipes while the unit is connected to the system.

- A mechanical filter must be fitted to the water pipe connected to the heat exchanger inlet.

- The unit is equipped with high-pressure safety pressure switches on each compressor, which stop it when triggered when the pressure exceeds the set value. If triggered, reset the pressure switches by pressing the blue button and then the alarm on the microprocessor.

- It is absolutely forbidden to remove any protection system covering 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 to a warm place far from the unit and in place him or her in the recovery position.
- Immediately contact any emergency personnel in the building or the call the Emergency Services.
- Wait until emergency personnel arrive and do not leave the injured person alone.
-

Unit description

The machine is made up of a latest generation, high efficiency, new VVR series single screw compressor, flooded shell and tube evaporator with the refrigerant outside the tubes and the water to be cooled flowing inside the tube.

A shell and tube condenser where the refrigerant condenses outside the tubes while the cooling water flows inside of the high-efficiency tubes.

The compressor is of the mono screw semi-hermetic type and utilizes the suction gas coming from the evaporator to cool the motor and permit the optimum operations in all machine load conditions. The compressor, controlled by inverters, changes its cooling load according to the rotational speed decided by the controller. In this way the machine perfectly adapts to system operating conditions to maximize performance.

The oil injection lubrication system, in addition to allowing normal moving part lubrication, also seals the screw ensuring gas compression, without the aid of an external oil pump.

The cooling circuit also installs an electronic overflow valve that, in addition to managing the level of refrigerant in the heat exchangers and guaranteeing the correct operation of the compressor, also manages the PUMP-DOWN function.

All the described components are managed by an innovative microprocessor control system that, by monitoring all the machine operating parameters, optimizes operations.

A diagnostic system helps the operator in identifying alarm and fault causes.

WARNING

Before starting the compressors ensure that all valves are open and the closing caps are repositioned and tightened.

Cooling cycle description

The low temperature refrigerant gas coming from the evaporator is sucked by the compressor and flows through the electric motor, cooling it. It is subsequently compressed and during this phase the refrigerant mixes with the oil, injected in the compressor, from the separator.

The high-pressure oil-refrigerant mixture is introduced inside the three-stage high efficiency oil separator which performs the separation. The oil deposited on the bottom of the separator is sent, by pressure difference, to the compressor again while the refrigerant separated from the oil is sent to the condenser.

The refrigerant fluid inside the condenser, which crosses the heat exchanger pipes in countercurrent, desuperheats and starts to condense. The desuperheating heat and condensation is subtracted from the condensation water which heats accordingly.

The condensed fluid at saturation temperature passes through the subcooling section, where it yields heat to further increase cycle efficiency. The subcooled fluid flows through the overflow device which, through a pressure drop, initiates the expansion process by vaporizing a part of the refrigerant liquid.

The result at this point is a mixture of liquid and gas at low pressure and temperature, poor in heat, which is introduced into the evaporator.

The liquid-vapor refrigerant after being evenly distributed along the tube bundle exchanges heat with the water to be cooled by reducing the temperature, and it gradually changes state until being fully evaporated.

Reaching the vapor state, it leaves the evaporator to be sucked by compressor again and restart the cycle.

Evaporator

The evaporator is a flooded shell and tube type with water flowing inside the tubes and the gas refrigerant outside. Normally it does not require any maintenance and service. Should a tube require replacement, the old tube can be removed and replaced. The water dome gasket must be replaced after tube cleaning and/or replacement.

Condenser

The condenser is a shell and tube type with water flowing inside the tubes and the refrigerant outside. The condenser tubes are externally finned and expanded on the tube plate. A subcooler is built into the condenser on all units. Should a tube require replacement, the old tube can be removed and replaced. The water dome gasket must be replaced after tube cleaning and/or replacement.

Expansion valve

The expansion valve is electrically controlled by the electronic controller by means of a specifically designed electronic board. A special algorithm designed for machines with flooded evaporators, manages the refrigerant flow to the evaporator according to machine operating parameters. In the event of blackout, the expansion valve automatically closes thanks to an electric power accumulation system placed inside the electronic control board (supercap)

Compressors

The refrigeration compressor is the single screw type with the rotation shaft directly coupled to the electric motor.

The vapor flows through the electric motor cooling the windings before entering the suction ports. Sensors able to constantly monitor temperature are located inside the motor windings to fully protect the motor against dangerous overheating. The thermistor and power terminals are housed within a terminal box placed above the motor housing.

Moving compressor parts that effect the compression consist of three rotating parts, there are no parts in eccentric or reciprocating movement in the compressor. The essential components are the main rotor and the two side satellites that perfectly integrate together. The compressor is sealed by a suitably shaped special synthetic material placed between the main rotor and the satellites. The main shaft on which both the motor and the main rotor are installed is supported by three ball bearings. This system is both statically and dynamically balanced before assembly. Two large closing flanges are installed on the sides of the compressor for easy access to the satellites, the rotor, the shaft and the bearings, without which assembly tolerances are influenced with their opening.

Capacity control

The latest generation compressors, installed on EWWD VZ units, are directly controlled by a speed controller with inverter technology. This technology has allowed for the elimination of the shutter trays, improving partial loads performance to a value never reached before. Compressor capacity, therefore, is directly managed by

setting the electric motor rotation speed, as a function of a special control algorithm. The compressor rotation speed can vary from a minimum of 840 RPM (14 Hz) to a maximum of 4800 RPM (80 Hz) according to the system operating conditions and the machine model.

Devices were installed instead of shutter trays to control the volumetric ratio intrinsic to compression.

Volumetric variable compression ratio (VVR)

The compressor is designed to operate in a very wide operating range and ensure the best possible efficiency in each working condition. In this regard, a sophisticated device dynamically manages the volumetric compression ratio (VVR). This system ensures the optimum position of the discharge ports as a function of the operating compression ratio, choosing one among the four available positions. 3 solenoids are evident on the compressor which, directly connected to the machine controller, are powered according to the operating compression ratio.

Oil management system

Each screw compressor is connected to the device (oil separator) that separates oil from the exhaust gases to collect on the bottom of the device itself.

The exhaust gas pressure pushes the oil into the compressor where, after passing through a high-capacity filter, is sent to the main injection port, maintaining compressing and lubricating moving parts.

The oil, during the compression phase, reunites with the exhaust gas to then be sent back in the separator and restart the cycle.

The oil flow is ensured by the pressure difference that is created between the condenser and the evaporator. This difference is dependent on the cooling water temperature and the evaporator water temperature. Therefore, it is important that the correct temperature difference is rapidly established during the starting phase with an adequate control of the cooling water temperature.

In order to ensure the correct pressure difference, it is necessary to install a condenser inlet water temperature regulation system (three-way valve, inverter on the cooling water pump, etc.) to return the machine operating temperatures within the expected operating range.

On the compressor, after the oil filter, a pressure transmitter is installed that continuously monitors the oil pressure and sends the valuesto the microprocessor. Oil pressure control protects the compressor from any operating faults. The oil filter must be replaced within the first 500 hours of compressor operations. The electronic controller generates an alarm for high oil differential pressure when 2.5 bar is reached. In this case, replace the oil filter.

The units are already equipped with the correct oil load. Once the system has been started, it is not necessary to add additional oil, except in the event that repairs are carried out or when a large amount of oil has been removed from the system.

CAUTION

Performing incorrect maintenance on the lubrication system, including excessive addition of oil or oil and not suitable to use a different quality oil filter, is harmful to the machine.

Lubricant oils

In addition to bearing and moving part lubrication, the oil also has the important function of maintaining compression thus increasing the efficiency.

The oil approved for the Daikin screw compressor is Mobil EAL Artic 220H.

Liquid injection

EWWD VZ series Daikin units do not require any delivery gas and thus oil cooling system if used within the rated operating range.

In the case where the operating conditions exceed the standard conditions (High Temperature Kit), the compressor requires the oil cooling kit defined as"liquid injection".

This system is directly controlled by the microprocessor installed on the machine, in function of the compressor discharge temperature. Under normal operating conditions and with the compressor off, the solenoid valve that controls liquid injection is off. If the oil temperature exceeds the set point value set in the microprocessor, the system feeds the solenoid valve, by injecting refrigerant liquid into the port designed for this purpose. The oil temperature gradually decreases until reaching the set point less the control differential where the microprocessor de-energizes the solenoid valve. Liquid injection may be activated during system commissioning phases and/or during operation at partial loads.

The liquid injection kit is standard when the "High temperature kit" is required.

Oil recovery system

Each circuit is provided with a system that allows the oil accumulated in the evaporator during normal operation to be recovered.

This system is made up of a "Jet-Pump" which, exploiting the Venturi principle, continuously recovers the oil in circulation in the system that would otherwise accumulate in the evaporator interior due the low speed of the refrigerant gas.

The Jet Pump is fed by the high pressure discharge gas and creates a depression that allows the oil+refrigerant mix to be sucked by the evaporator and conveys it into the compressor to restore the oil level in the lubrication system.

Therefore check:

1) oil recovery system valve opening
2) Correct solenoid valve operations located at Jet Pump feed

Electrical Control Panel

The unit controller is a microprocessor control panel designed to perform compressor start up step by step, monitor and adjust compressor capacity, protecting it, and perform the shutdown sequence in the absence of load or at a set time.

The control panel provides a wide range of data control and registration capacity options. It is important to have good familiarity with the control system for optimal machine operations.

Please note that all units are also provided with the Control Manual.

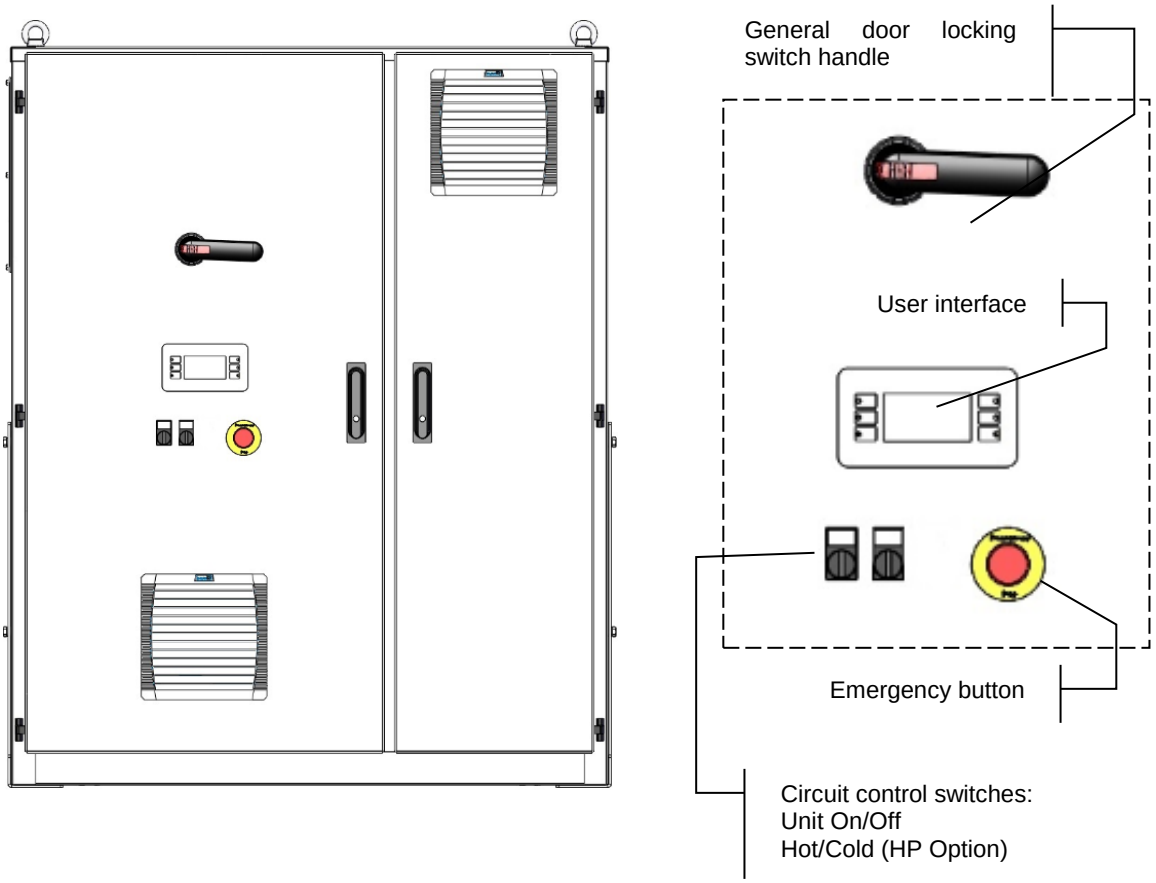


Fig. 5 - Unit interface

Safeties for each refrigerant circuit

- High pressure (pressure switch)
- Motor cooling
- High compressor delivery temperature
- Compressor suction temperature
- Failed start
- High oil pressure differential
- Low pressure

System safeties

- Antifreeze
- Correct phase sequence and phase failure
- Low pressure (pressure switch)
- Evaporator flow switch

Regulation type

PID regulation (Proportional - Integrative - Derivative on the evaporator sensor for perfect water temperature regulation (□T = ± 0.2° C).

Compressor alternation

The water-cooled Daikin EWWD_ VZ units alternate the compressor start sequence (EWWD VZ dual compressor) to balance the number of starts and operating hours. Compressors are automatically alternated by the controller.

If the unit is in automatic mode, the compressor with the lowest number of starts is started first. If both compressors are in operation and one compressor must be turned off, the one with most hours is switched off

High pressure condensation control

The microprocessor is provided with a transducer to monitor condensation pressure. Although the main purpose of the high pressure transducer is to maintain proper control of the condensing pressure (by controlling the cooling towers if connected), another purpose is to send a signal to the microprocessor which stops the compressor in case the discharge pressure is excessive. If the unit is switched off for high condensing pressure, the microprocessor must be reset manually.

High pressure mechanical safety pressure switch

The high pressure safety switch is a single pole switch that opens when the pressure exceeds the set limit. The opening of the mechanical safety pressure switch directly triggers the compressor inverter, stopping the IGBT bridge supply. This condition interrupts the compressor power supply inverter output in accordance with EN 60204-1 (stop category 0), as required by the PED directive (Pressure Equipment Directive).

The pressure switch(es) is mounted on the compressor discharge cap.

If the pressure switch triggers, once evaluated and resolved the cause that made it trigger, the alarm can be reset by pressing the blue button on the pressure switch body itself and then resetting the alarm on the microprocessor.

The high pressure pressure switch can be triggered by:

a) Lack of water flow to the condenser
b) Incorrect control of the cooling tower fan and/or of the condenser water temperature control valve (if present).
c) Wrong measurement of the water temperature in the case of heat pump operation.

Compressor motor protection

The compressor motors are protected against overheating by the use of thermistors inserted on each motor winding. Thanks to these three thermistors, the controller is able to constantly monitor winding temperature and stop the corresponding compressor in the event that the temperature exceeds the safety value.

Repeated interventions of this protection, during normal operation, may indicate a potential problem with the compressor motor or a high suction superheat value due to low refrigerant load. The inverter also has a protective function against overload that stops the corresponding compressor in case of over-absorption. This alarm is manually reset.

Pressure/Temperature Table

HFC-134a Pressure/Temperature Table							
°C	Bar	°C	Bar	°C	Bar	°C	Bar
-14	0.71	12	3.43	38	8.63	64	17.47
-12	0.85	14	3.73	40	9.17	66	18.34
-10	1.01	16	4.04	42	9.72	68	19.24
-8	1.17	18	4.37	44	10.30	70	20.17
-6	1.34	20	4.72	46	10.90	72	21.13
-4	1.53	22	5.08	48	11.53	74	22.13
-2	1.72	24	5.46	50	12.18	76	23.16
0	1.93	26	5.85	52	13.85	78	24.23
2	2.15	28	6.27	54	13.56	80	25.33
4	2.38	30	6.70	56	14.28	82	26.48
6	2.62	32	7.15	58	15.04	84	27.66
8	2.88	34	7.63	60	15.82	86	28.88
10	3.15	36	8.12	62	16.63	88	30.14

Routine maintenance

Check condenser performance

It is important to periodically check the internal cleanliness of the copper tubes, in order to prevent deteriorated performance. This check can be carried out by checking that the difference between the condensation temperature and the condenser outlet water temperature on the microprocessor does not exceed 3-5° C (3° C version EWWD XS and 5° C for the EWWD SS version). If deviations from this value occur, run the specific cleaning procedure.

Electronic expansion valve

The EWWD_VZ units using one or two electronic expansion valves according to the number of compressors installed on the machine. The valves are managed and controlled by the main electronic controller that optimizes the flow of refrigerant gas to the evaporator according to machine operating conditions. The valve control logic prevents, together with compressor load control, machine operations beyond the allowed operation limits. Normally, no maintenance is required for this device.

Cooling circuit

Cooling circuit maintenance consists of recording operating conditions and making sure the unit has the correct amount of oil and refrigerant. (See the maintenance schedule and appropriate operating data at the end of this bulletin). Record the following for each circuit upon inspection:

Delivery pressure, discharge temperature, suction pressure, suction temperature, oil pressure, liquid temperature, evaporator inlet/outlet water temperature, condenser inlet/outlet water temperature, absorbed current, power voltage, compressor operating frequency.

Significant discharge subcooling and/or superheating value changes, can be a symptom of low refrigerant load. The correct unit delivery superheating value of the unit at full load must be between 8 and 15° C with R134a fluid, while subcooling must be between 3.5 and 6.0° C (machine at full load).

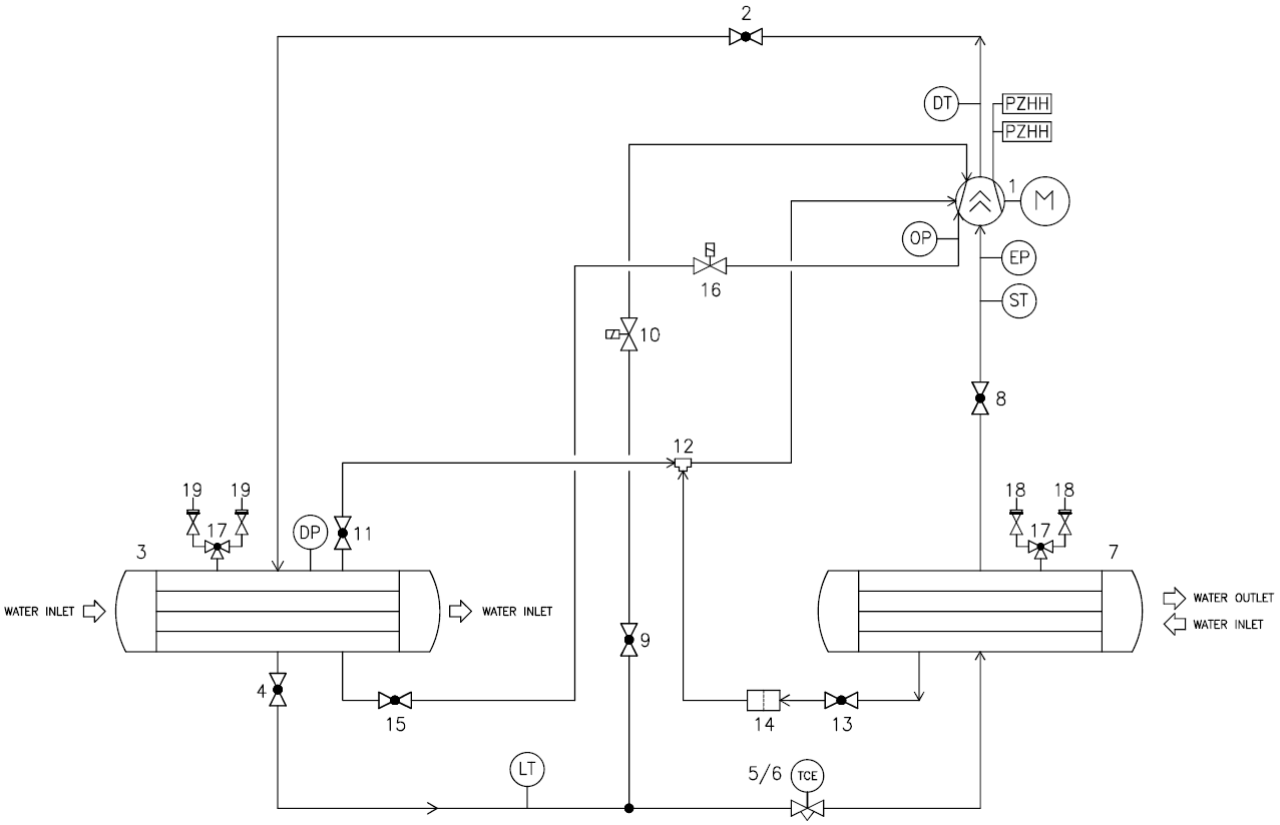


Fig. 6 - Typical single circuit cooling circuit

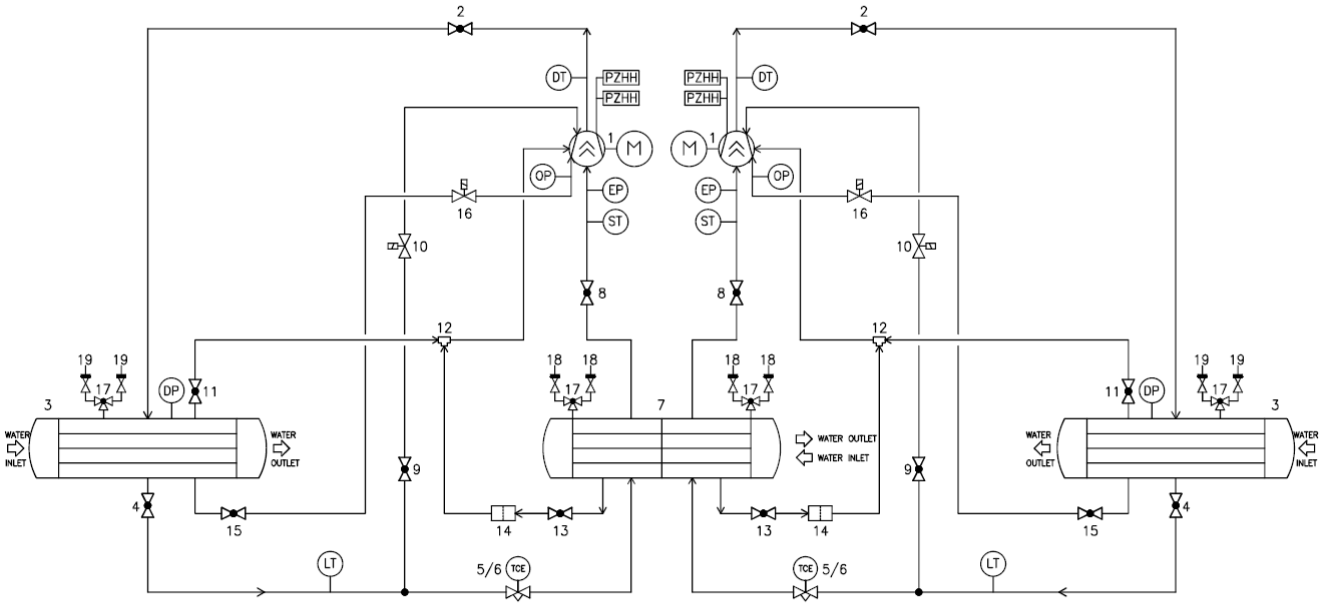


Fig. 7 - Typical dual circuit cooling circuit

Legend

1	Compressor
2	Delivery valve (optional)
3	Oil Condenser/Separator
4	Liquid line valve
5/6	Expansion valve with liquid indicator
7	Flooded evaporator
8	Suction valve (optional)
9	Liquid injection valve (optional liquid injection)
10	Liquid injection solenoid valve (optional liquid injection)
11	Jet pump feed valve
12	Jet pump
13	Jet pump suction valve
14	Jet pump suction filter
15	Oil injection valve
16	Oil injection solenoid valve
17	Safety exchanger valve
18	Low Pressure safety valves
19	High pressure safety valves
PZHH	High pressure switch
M	Compressor electric motor
ST	Suction temperature sensor
DT	Delivery temperature sensor
LT	Liquid temperature Sensor
DP	High pressure transducer
EP	Low pressure transducer
OP	Oil Pressure Transducer

Refrigerant charge

The EWWD VZ units are designed to operate with R134a refrigerant therefore DO NOT USE refrigerants other than R134a

WARNING

When you add or remove refrigerant gas, always ensure correct water flow in the evaporator and the condenser to avoid freezing pipes.
Freeze damage will void the warranty.

The removal of refrigerant and drainage operations has to be made by qualified technicians with the use of appropriate material for the unit. Improper maintenance can lead to uncontrolled loss of pressure and fluid. Also does not pollute the environment with refrigerant and lubricant oil. Always use an appropriate waste disposal system.

All units are shipped with a full refrigerant charge. If the unit needs to be recharged in the field, follow these recommendations. The optimum charge is one that allows the unit to operate with a correct flow of refrigerant in all conditions.

Check the refrigerant charge

To check whether the unit is operating with the correct refrigerant charge, you should check the following:

1. Bring the machine to maximum load conditions
2. Ensure that the evaporator outlet water temperature is in the range of 6 to 8° C.
3. Verify that the condenser inlet water temperature is between 25 and 32° C.
4. Under the conditions described above, check that:
    a) Delivery superheating is between 8 and 15°C.
    b) Subcooling is between 4 and 6° C
    c) The temperature difference between outlet water and evaporation is comprised between 0.5 and 4° C.
    d) The temperature difference between condensation and condenser outlet water is between 1 and 3° C.
5. Make sure the indicator on the liquid tube is full.

If one of these parameters exceeds the indicated limits, the machine may require additional refrigerant.

Note: As the unit changes the load, the subcooling value varies, but will stabilize in a short period of time and in any case should never be less than 3° C. The subcooling value slightly varies as evaporator and condenser outlet water temperature varies.

A loss of refrigerant can be so small as to have little effect on the circuit, or may be so obvious as to cause the machine to shutdown triggered by safety protections.

Electrical Installation

The electrical installation involves the application of some general rules as described below:

1. The current absorbed by the compressor must be compared with the nameplate value. Normally, the absorbed current value is less than the nameplate value that corresponds to compressor absorption at full load at maximum operating conditions.
2. At least once every three months all the safety checks should be made to intervene to check its functionality. Each unit, with aging, can change its operating point and this should be monitored to possibly fix or replace it. Pump interlocks and flow switches should be checked to make sure that they interrupt the control circuit when triggered. The high-pressure switches must be checked on the bench separately.
3. The compressor motor ground resistance must be checked every six months. This checks insulation deterioration. A resistance of less than 50 ohms indicates a possible defect in insulation or moisture in the circuit that must be checked.

CAUTION

Never measure the motor resistance while it is empty.

It may cause serious damage.

Cleaning and Storage

A common cause of the equipment failure and subsequent service call is dirt. This can be prevented with regular maintenance. System components more prone to dirt are:

1. Clean the electrical panel ventilation and cooling filters, make sure ventilation correctly starts on the electrical panel.
2. Remove and clean the filters in the chilled water system, in the cooling water system at each inspection.

Seasonal maintenance

Before you turn off the unit for a long period of time and starting it again, proceed as follows:

Seasonal shutdown

1. Where the unit may be subject to freezing temperatures, the condenser and the cooling water pipes must be disconnected and drained of all water. Blow dry air through the condenser; this operation will help to eliminate all water. Both the condenser that the evaporator is not self-draining. If water remains in the pipes and the heat exchanger, these can be damaged in case of freezing.

   The forced circulation of the antifreeze solution through the water circuit is a sure way to eliminate the risk of freezing.
2. Care should be taken to prevent the accidental opening of the water circuit shut-off valves.
3. If you are using a cooling tower and if the water pump is exposed to freezing temperatures, remove the pump drain plug to prevent the accumulation of water.
4. Open the compressor switch and remove the fuses. Set the 1/0 manual switch to 0.
5. To avoid corrosion, clean and paint rusted surfaces.
6. Clean and drain the water tower on all units operating with a tower. Make sure tower emptying is effective. Follow a good maintenance program to prevent the formation of limescale deposits both in the tower in the condenser. Take into account that the atmospheric air contains many contaminants that increase the need of proper water purification. The use of untreated water can result in corrosion, erosion, fouling or the formation of algae. We recommend you contact an expert for reliable water purification.
7. Remove the condenser heads at least once a year to inspect the pipes and clean if necessary.

CAUTION

Daikin Applied Europe Spa cannot be held liable for damage caused by untreated or improperly treated water.

Seasonal start up

Annual start up is a good time to assess motor winding ground resistance. A semi-annual check and recording the resistance value measured keeps track of insulation deterioration. All new units have a resistance over 100 Mega Ohm between each motor terminal and grounding.

1. Check and tighten all electrical connections.
2. The control circuit must be switched off for the entire time.
3. Replace the cooling tower pump drain plug if it was removed during previous season shutdown.
4. Install the main fuses (if removed).
5. Reconnect water lines and refill the circuit. Purge the condenser and check for leaks.

Service schedule

It is important that all air conditioning systems receive adequate maintenance. The entire system benefits if the system is in good conditions.

The maintenance program must be continuous from first system start: Full inspection must be made after three or four weeks of normal operation and continue regularly.

Daikin Applied Europe offers a variety of maintenance services through its local Daikin service departments and through a worldwide service organization and can adapt their services to the customer's needs.

For more information on service availability, contact your Daikin service department.

Maintenance Schedule

	Monthly	Quarterly	Semi-annually	Annually	As Required By Performance
A. Capacity assessment (recording and analysis) *	O				
B. Motor					
• Winding insulation			X		
• Current balance (within 10%)		X			
• Check terminals (connection tightening, porcelain cleanliness)				X	
C. Lubrication system					
• Oil line temperature	O				
• Oil solenoid operation		X			
• Oil Analysis				X	
• Oil appearance (color and quantity)	O				
• Oil filter change					X
• Change oil if indicated by the analysis					X
D. Shutter operations					
• Compressor load:					
Record motor current		X			
• Compressor discharge:					
Record motor current		X			
E. Check internal compressor					X
II. Checks					
A. Operating checks					
• Check settings and operation			X		
• Check shutter and operating settings			X		
• Check load balancing			X		
B. Protection checks					
• Function test on:					
Alarm relays		X			
Pump interlocks		X			
High and low pressure intervention		X			
High discharge temperature intervention		X			
Oil pressure differential intervention		X			
III. Condenser					
A. Capacity assessment	O				
B. Test Water Quality		X			
C. Clean condenser tubes				X	
E. Seasonal Protection					X
IV. Evaporator					
A. Capacity assessment (record conditions and analysis)	O				
B. Test Water Quality		X			
C. Clean evaporator tubes (when required)					X
E. Seasonal Protection					X
V. Expansion valves					
A. Capacity assessment		X			

Legend: O = Performed by internal staff X = Performed by McQuay technical staff

	Monthly	Quarterly	Semi-annually	Annually	As Required By Performance
VI. Compressor- Unit					
A. Capacity assessment	O				
B. Leak test:					
• Compressor connections and terminals		X			
• Pipe connections		X			
• Oil joints and connections		X			
• Exchanger safety valves		X			
C. Vibration isolation Test		X			
D. General appearance:					
• Paint				X	
• Insulation				X	
VII. Starter					
A. Check Inverter		X			
B. Test Electrical connections		X			
VIII. Optional checks					
. Liquid injection checks (operating check if applicable)		X			

Legend: O = Performed by internal staff X = Performed by McQuay technical staff

Pre-start checks

	Yes	No	N/A
Chilled water			
Pipe completion	☐	☐	☐
Fill water circuit, purge air	☐	☐	☐
Pump installation (check rotation), clean filters	☐	☐	☐
Control operations (three-way valve, bypass valve, damper, etc.)	☐	☐	☐
Water circuit and flow balance operations	☐	☐	☐
Condenser water			
Filling and purging the cooling tower	☐	☐	☐
Pump installation (check rotation), clean filters	☐	☐	☐
Control operations (three-way valve, bypass valve, damper, etc.)	☐	☐	☐
Water circuit and flow balance operations	☐	☐	☐
Electrical network			
Power cables connected to the electrical panel	☐	☐	☐
Wired pump starter and interlock	☐	☐	☐
Wired cooling tower fans and controls	☐	☐	☐
Electrical connection in accordance with local electrical codes	☐	☐	☐
Condenser pump starter relay installed and wired	☐	☐	☐
Miscellaneous			
Safe vale pipes complete	☐	☐	☐
Check installed wells, thermometers, pressure gages, controls etc.	☐	☐	☐
Availability of at least 25% of machine load for the test and the Control settings	☐	☐	☐

Note

This list must be completed and sent to the local Daikin Service department at least two weeks before the start.

Mandatory periodic checks and commissioning of pressure vessels

The units described in this manual fall under category IV of the classification determined by the European Directive 2014/68 / EC (PED). For chillers in that category some local regulations require a periodic inspection by an authorized agency.
Please verify and contact these organizations to also request authorization to start it up.

Important information on the used refrigerant

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

Refrigerant type: R134a
GWP(1) value: 1300

(1) GWP = Global Warming Potential

The amount of refrigerant is indicated on the nameplate with the unit name.
It is possible that periodic inspections are necessary to check for any refrigerant leaks in accordance with local and/or European regulations.
For more detailed information, contact your local authorized dealer.

Demolition and disposal

The unit is made up of metal, plastic and electronic components. All these components must be disposed of in accordance with local laws regarding disposal.
Batteries, oil and electrical components must be sent to specific waste collection centers.
Prevent refrigerant gases from polluting the environment using suitable pressure vessels and means to transfer the pressurized fluid. This operation must be carried out by personnel trained in refrigeration plants and in accordance with applicable laws of the country of installation.

Duration

The useful life of this unit is 10 (ten) years.
After this period, the manufacturer recommends the installation is overhauled and, especially, that pressurized cooling circuit integrity is checked as required by the laws in force in some EU countries.

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