

Units Rigging And Handling



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Important basic information

Always keep the operating instructions in the immediate vicinity of the unit.

Make sure that the operating instructions are always accessible to all personnel that have to work with the product in any way.

Make sure that the operating instructions are read and understood by all persons, which have to work with the product in any way.

Importance of the EN 378 standards - Refrigerating systems and heat pumps - Safety and environmental requirements

The EN 378 deals with safety and environmental requirements for design, construction, manufacturing, installation, operation, maintenance and disposal of refrigeration systems and cooling equipment.

EN 378 is oriented towards manufacturers, installers and operators of refrigeration systems and cooling equipment.

The purpose of the EN 378 is to minimize the potential hazards to people, property and environment due to the cooling system, refrigeration equipment, working fluids (refrigerants and coolants).

Insufficient safety measures or non-compliance with safety-related requirements can lead to:

- Breaks or ruptures on parts with the risk materials disappearing (this can be caused by too low temperatures, too high pressures, incorrect usage of the fluid, moving machine parts).
- Leaking working fluid after a rupture/break caused by defective design, improper operation, insufficient maintenance, repairs, refilling and disposal (hazards caused by flammability, explosion hazard, disturbance of the nervous system, suffocation, panic).

Responsibilities

Manufacturer

The guidelines in these operating instructions on secure maintenance of the unit to avoid possible hazards during transportation, installation and assembly, commissioning, operation and maintenance (cleaning, maintenance and repair) refer exclusively to the unit.

The manufacturer's liability is documented in the offer and order (design, manufacture and testing) and in accordance with EN 378-2.

The construction is designed to withstand the foreseeable mechanical, thermal and chemical stresses and resistant to the working fluid used.

The fluid-carrying parts of the unit (tubes, distributor and header) are designed to for the expected mechanical, thermal and chemical stresses, and withstand the maximum operating pressure.

Material, wall thickness, tensile strength, corrosion resistance, shaping process and testing are suitable for the fluid used and chosen to withstand the expected pressures and stresses.

All responsibilities regarding the equipment, in which the unit is integrated, are the exclusive responsibility only to the respective personnel to the individual equipment items involved.

Important basic information

Installer

The responsibilities of the system installer including the brine circuit are according to the design calculation of unit and EN 378-2.

Component supplier - installer interface: Notify EVAPCO Europe a/s if faults occur:

Notify EVAPCO Europe a/s immediately, if faults occur during the installation, commissioning and operation.

The responsibilities of the system installer in particular include:

Planning and preparing emergency measures:

- To avoid significant damage caused by operational disruptions, a warning system must be installed on-site, which signals all faults without delay. Emergency measures must be prepared which prevent subsequent damage to people and/or property, should such faults occur.
- Install emergency stop switches, which can be actuated without danger
- Make maintenance and check intervals and adhere to these. This also include the brine circuit and should be according to EN 378-4

When connecting the unit to the heat transfer circuit of the refrigeration system, this must not deviate from the order-related offer documents and information.

The installer of the system must ensure that the personnel using the system are aware and reconnaissance of the brine used in the heat transfer circuit is based on the relevant safety instructions from the supplier of the brine.

It is recommended that the future customer staff is present - if possible - during the installation and assembly, including with the tightness test and cleaning, with the filling with brine and setting of the system.

Operator

The responsibility of the owner or operator is documented in the operation, maintenance and service of the system according to EN 378-4.

The owner or operator must ensure that the personnel is adequately trained for operating, monitoring and the maintenance of the facility including knowledge of the properties of the brine in question.

Before start-up of the system, the owner or operator must ensure that the operating personnel are well-versed with all relevant parts of the system, which includes the construction, monitoring, operating and maintenance as well as the safety precautions and measures needed due to the system and the brine.

Emergency measures: To avoid possible damages to personnel or system, a warning system must be installed on site, which immediately reports operational faults.

The responsibility remains with the owner or operator of the facility, including for the brine except in case of a specific agreement on shared accountability.

Legal Notice

The unit warranty is void if:

- Faults or damages occur, which can be attributed to non-compliance with the specific operating instructions.
- Use of non-original spare-parts or non-approved by EVAPCO substitutes for these.
- Changes to the unit in comparison to the order-related parameters, such as fluid media, pressure, function, working conditions, without prior consent.

Important basic information

This manual concerns dry coolers and air cooled condensers.

- The exact type of your unit will be apparent in the order-related documents.

Set-up and other applicable documents

The operating instructions for the unit include the following components

- These instructions
- Order-related documents.

Related offer documents to these instructions are:

- The order-related technical data
- The order-related drawings specifying customer, project number and order number.
- Motor connection wiring diagram in the terminal box.
- Wiring diagram for control if applicable.

This manual is part of owner's operating instructions manual of the system, which must also include the fluid media properties and safety precautions.

Warning signs used by EVAPCO and onsite by the owner

EVAPCO Europe a/s will apply the unit applicable warning signs to the unit. It will be the owner's responsibility to apply and install ALL relevant signs on-site, which are not directly attached on the unit by EVAPCO.

These warning signs can be:



Important basic information

Your EVAPCO dry cooler/air cooled condenser is manufactured with great care from the most appropriate materials and should arrive in perfect condition. Please read and follow these instructions and you will ensure long and trouble-free operation of your new equipment.

General Inspection

Prior to off-loading from the vehicle and before signing the Consignment Note, verify that the product and packaging are free of any damage.

If the equipment is damaged:

- Detail the extent of any damage on the Consignment Note before signing and accepting the goods. This is very important if subsequent claims are to be lodged with either the haulier or Insurers. Failure to do so assumes that the product has been received and accepted undamaged.
- Whenever possible photograph the equipment/damaged area(s); preferably while still on the vehicle; otherwise it may prove difficult to assign responsibility to the haulier if the damage is not noticed until after off-loading from the vehicle.
- Immediately or at the very least within 5 days, inform your local EVAPCO representative or the factory in Aabybro, Denmark so that EVAPCO Air Solutions is able to register a transport damage claim, which must be logged within 7 days of shipment of the goods. Failure to comply with the above will result in a disputed claim and any repairs will be at the cost of the Client. Furthermore, as soon as is practical provide on your Company letterhead, details of the damage accompanied by a copy of the signed Consignment Note and any photographs.

In the case of significant damage:

- If significant damage is sustained to the goods, in particular to the tubes and/or headers, the shipment should not be accepted.
- Detail the extent of the damage on the Consignment Note and sign 'goods not accepted'.
- Return the Consignment Note to the carrier with instructions to return the shipment to the factory.
- The details of the damage must be noted on the Consignment Note!
- Photographs are also helpful in quantifying the extent of the damage.
- In case of further onward transportation:
 - As a minimum, always use the EVAPCO provided packaging/crating for further onward transportation.

Unpacking the unit

Remove the straps, holding the bottom palette, the side timber slats and the unit together. Remove the legs, if applicable.

In some instances, the headers are protected during transport with a frame around them affixed to the bottom palette. Remove this.

Check the unit for damages to ensure no transport damage has occurred. If it is found to be the case, immediately note the damage on the transport papers and report these to EVAPCO in writing.

Some units will be delivered with pressurized air. For such units, please check that this pressure is still present. This can be done by opening the small valve on the header and listening for the escaped air.

Off-loading of the equipment

Generally the equipment has a substantial weight. Consequently be aware that care should be taken in handling the product, as the weight can crush and/or damage persons and components if it falls or is dropped!

If the unit is dropped, please ensure that the unit is not damaged and it has not caused any imbalances. Follow the instructions on the transport labels on the packed units if marked and the following guidelines.

Make sure that the staff is properly trained for unloading.

Use lifting devices appropriate for the entire weight of the unit. Please ensure that during transport, loading and unloading, that no one is under or in the very near vicinity of the unit.

Follow the guidelines for lifting and even weight distribution. Secure the unit against slipping and mechanical damage.

Transport

Read all transport signs on the equipment packaging and in the instructions!

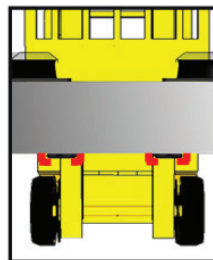
Prolonged mechanical stresses resulting from uneven road surfaces and potholes and vibrations during transport can cause damage and imbalances. Before transporting by sea or in countries with difficult transport routes, remove parts, which can vibrate and thereby be damaged.

Horizontally mounted flatbed products

Generally flatbed units are shipped either strapped to a wooden pallet or enclosed in either an open slatted or alternatively fully enclosed crate. To avoid handling damage, we recommend that the product is off-loaded from the vehicle whilst still attached to its pallet or in its crate.

Removal from the vehicle can be accomplished via forklift or crane.

Handling with forklift:

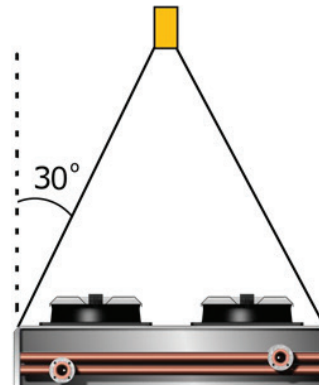


- Fork lift channels can be provided to prevent damage to the fins and facilitate even lifting

- Ensure that the forklift truck is large enough to handle the size and weight of the product required to be off-loaded.
- If fitted, use the EVAPCO optional steel fork lifting channels positioned under the unit.
- Ensure in all cases, that the forks are long enough to protrude at least 30 cm beyond the width of the product. (see diagram).
- Under no circumstances, even if forklift channels are fitted, should 'short forks' be used as this will result in damage to either the product casework or indeed the heat exchanger.
- Ensure that the weight is evenly distributed before attempting to lift the product.
- Follow industry standard forklift recommendations and guidelines.

Off-loading of the equipment

Handling with crane



For products supplied in partially or fully enclosed wooden crates, the riggers may choose to off-load the product whilst still in its packaging ...

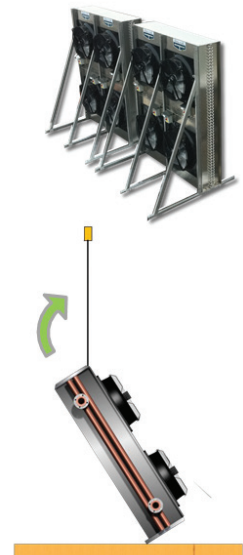
- Ensure that the crane operator uses adequate straps, chains, spreader bars etc., to safely and securely handle the weight of the product. The minimum angle of any rigging for lifting by crane must NEVER exceed 30° (see diagram).

Off-loading a product via its lifting eyes/brackets ...

- Carefully remove the packaging/crating to expose the lifting eyes/brackets.
- Ensure that the crane operator uses adequate chains, spreader bars etc., to safely and securely handle the weight of the product. The minimum angle of any rigging for lifting by crane must NEVER exceed 30° (see diagram).

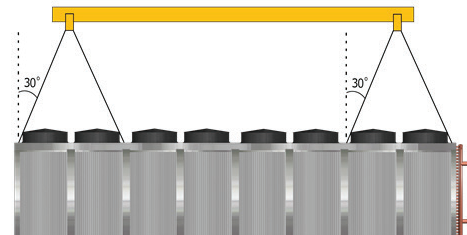
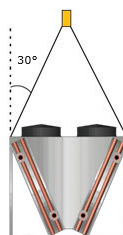
Vertically mounted flatbed products shipped horizontally

- Ensure that the crane operator uses adequate chains, spreader bars etc., to safely and securely handle the weight of the product. The minimum angle of any rigging for lifting by crane must NEVER exceed 30° (see diagram).
- Place suitable wooden beams (or similar protection) to support the product whilst it is tilted upright.
- Attach the chains to the lifting eyes/brackets fitted to what will become the top of the product and gently lift one side of the product until it is an upright position.
- Security lines may need to be attached to the lifting points to ensure that the product does not over-tilt.
- Elevate the product sufficiently to enable the attachment of the support framework (if required) with the bolts provided with the kit.
- Manoeuvre the product onto its foundations or support structure and fix accordingly.



V-Range products

- "V" type units are equipped with factory mounted lifting devices.
- Ensure that the crane operator uses adequate chains, spreader bars etc., to safely and securely handle the weight of the product. The minimum angle of any rigging for lifting by crane must NEVER exceed 30° (see diagram).
- Manoeuvre the product onto its foundations or support structure and fix accordingly.



Basic safety

Behaviour in an emergency

In case of an emergency, please observe all relevant procedures as indicated by the owner. It is the responsibility of the owner to ensure that his personnel is aware and follows the applicable safety precautions necessary for the site, with regard to the system and the fluid media.

Requirements for personnel, due diligence

The unit may only be commissioned, operated and repaired by trained and qualified personnel. The personnel must comply with the requirements specified in EN 378-1, which specify that qualified personnel has to competently perform the required activities to assess, maintain and repair the system, the individual components and fluid media. If the owner chooses to let non-qualified personnel operate the system, it is the owner's responsibility to ensure that this personnel is given sufficient information and formation to ensure a safe operation and monitoring.

Changes to the unit, which the manufacturer has agreed in writing, may only be carried out by trained and qualified personnel.

Electrical installation

Work on the electrical equipment should be performed only by persons who have the required expertise (e.g., a qualified electrician or a specially trained person) and who are authorized by the operator, in compliance with the respective national and international regulations.

Intended use

The unit intended for installation with a brine and for outdoor installation. The unit is calculated with specific operating data as seen on order-related documents and intended for operation at this point. These data comprise among other things, brine flow temperatures and volume, airflow and design ambient temperature.

Hazards caused by the brine

A risk of injury is always present when using brines. Please ALWAYS refer to the brine supplier's guidelines and safety instructions for general guidelines regarding handling of this liquid.

Hazards caused by vibration

Vibrations must be avoided as much as possible.

Vibrations can cause injury and/or damages due to discharged parts during operation. The different components will be fastened and tested by EVAPCO before leaving the factory, if not specifically agreed otherwise. Consequently ALWAYS ensure that the parts are properly fastened after repairs/ maintenance to emulate this factory-designated state.

Please verify that the fans are balanced correctly and no dirt/leaves/ice/snow is present on the impeller blades, as this can affect the balance.

Please ensure that vibrations from the rest of the piping system are not transferred to the unit, e.g. by fitting of compensators and/or flexible connections.

Basic safety

The Unit

The unit comprise different parts, which when mounted together form a working unit.

The coil is dimensioned according to the fluid flow, fluid properties and requested temperature range. The temperature range will be apparent on the name plate on the cooler for the individual coils. Here operating pressure and test pressure will also be shown.

The order related information of coil type, order number, production year and test date will be present on the coil label.

Fans

The fans used for the standard unit type, to which document refer can vary in size from Ø500 mm to 1500 mm, depending on the specifics of the subtype. As standard all fans are 3*400V/50Hz and IP 54 tightness class.

All noise data is calculated according with EN 13487 parallel-piped envelope method. Temperature range for the fans will normally be -30°C to +55°C, for some fans however slightly higher. This will be apparent on the specific unit label with fan data. In some instances thermo contacts will be present in the individual wiring of the fans to safeguard against overheating.

Otherwise this can be accomplished by means of overload in an optional control package.

A fan grid is installed to eliminate the possibility of damaging fingers etc. on the fan blades during operation. This grid is made in accordance with the EN 294 standard.

If the unit is stored or out of operation for longer periods, EVAPCO recommends that the fans are tested at appropriate intervals, see recommended minimum maintenance schedule.

The fans can be either AC fans or EC fans.

AC fans

The AC fans are normally protected against overheating by means of a thermal contact (PTO) or thermistor (PTC).

The fans are all three phase motors, 3*400V/50Hz as standard, which will be wired either in star or delta configuration.

Motors with thermal contact have to be wired so no accidental turning on of the motor can occur, when the thermal contact is triggered.

It is recommended to use a soft start for all fan, but this is especially applicable for motors with more than 5,5 kW. We recommend a soft start solution employing variable voltage or frequency.

EC fans

The EC fan motors have voltage of 3*380-480V AC/50-60Hz. The electrical wiring can be seen on the inside of the motor terminal box.

Controls

Frequency control

A frequency control is available with line voltage 3*208-480V/50/60Hz. If chosen, it is possible to supervise the inverter via Modbus or LonWorks.

It is recommended when using a frequency control to incorporate a sinus filter.

Step control

The step control is available with up to 4 steps, which can dedicated either solely to individual fan control or up to 3 steps for the fans and 1 for spray or Pad system, if such a system is chosen.

If chosen, it is possible to interface the step control to Modbus or LonWorks.

Please ensure that the rotation direction of the fans correspond with the designated.

Basic safety

Voltage control

A voltage control is available with line voltage 3*208-415V/50/60Hz. If chosen, it is possible to supervise the voltage control via Modbus or LonWorks.

However, it must be noted that the voltage control can result in electromagnetic noise due to resonances.

EC control

An EC control is available which can be controlled with a number of optional features, among other a fail-safe bypass, 0-10V potentiometer, control by Modbus (standard) or LonWorks.

Spray system

The option of installing a spray system is available. The purpose of this is to artificially depress the ambient temperature and thereby force an otherwise too small unit to produce the required performance during peak loads or alternatively at specific times exceed the performance in the dry version.

The spray will be diffused into the relative hot air around the cooler, which will absorb the moisture and depress the ambient temperature right before the unit. EVAPCO normally recommend no more than 200 h/year usage, however depending on the water quality used this recommended restriction on usable hours can be augmented.

The pipe system for the spray system can be fitted with valves to control the usage of the spray system.

The water temperature used is standard city mains supply of approx. +10°C and asumed to have a delivery pressure of 2-3 Bar g.

Adiabatic pad system

The option of installing an adiabatic pad system is available. The purpose of this is to artificially depress the ambient temperature and thereby force an otherwise too small unit to produce the required performance during peak loads or alternatively at specific times exceed the performance in the dry version.

The water is drizzled though a pad section, which is constantly wetted and flushed to keep the ambient temperature down below the actual relative hot air around the unit.

Regarding the water quantity mentioned in the offer-related document, 1/3 of the quantity is used for wetting, 1/3 for diffusing in the air and depression of the temperature and 1/3 for flushing. Depending on the water quality not having an adverse impact on the materials, EVAPCO Air Solutions does not impose any limitations on hourly usage per year.

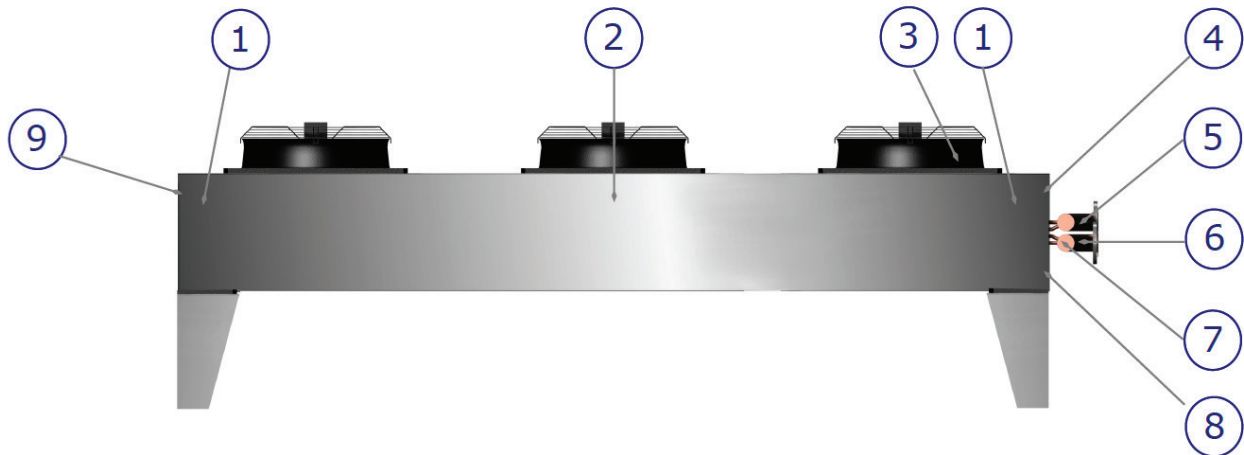
The pad material is a cardboard material, treated to be UV resistant and can be disposed of in the normal renovation, if the water quality used does not preclude this.

The pipe system for the spray system can be fitted with valves to control the usage of the spray system.

The water temperature used is standard city mains supply of approx. +10°C and asumed to have a delivery pressure of 2-3 Bar g.

Basic safety

Unit labels



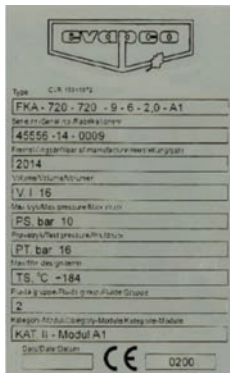
1. Company logo

2. Lifting instructions

3. Fan blade warning



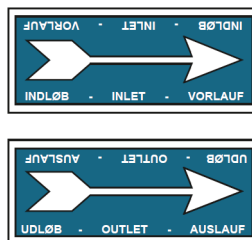
4. Steel product ID



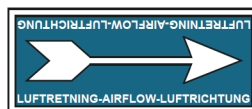
8. Warnings & Instructions label



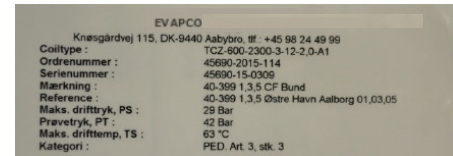
5/6. In-outlet arrow



9. Air direction arrow



7. White product ID sticker



Pre installation precautions

Please follow the supplier's recommendations regarding handling and safety precautions.
Regarding the fluid/refrigerant, strictly follow the installation guidelines in this document and care!

Ensure that no foreign parts get into the system and that tools are not left in/on the unit, which can damage the unit.

The electrical installation of the equipment must be carried out by qualified electricians in compliance with the relevant rules and regulations.

Safety requirements of the system

Ensure that all equipment is integrated in the system both electrical parts, such as fans, controls and emergency stops as well as the required valves and assorted fittings.

Verify that the power supply to the fans is in accordance with name plates on the unit and that all extra electrical installations in conjunction with the unit are in accordance with the EN 60204-1 standard.

Ensure that the unit can be shut off at a safe distance in case of leaks and this can also be wearing full protective gear and breathing apparatus.

Ensure that in case of a leak, that the fluid media cannot enter the water and/or sewage system. Also take the relevant precautions to minimize the danger of fluid media impacting the general environment.

Requirements for the installation site

The installation has to be in accordance with the weight and dimensions of the unit, which can be seen in the orderrelated documents.

The actual placement of the unit has to ensure that it cannot be accidentally damaged by normal site related traffic or can be disturbed or operated by unauthorized persons.

Ensure that when placing the unit, all components are easily accessible for maintenance purposes later on and that all signs are clearly visible.

Pre installation precautions

Layout planning

Single Unit Installations

The recommended place to locate any dry or adiabatic unit is open to the air, by itself. However, when this is not possible, correct layout guidelines must be followed to provide a satisfactory installation.

The first item to consider is the position of the unit with respect to other structures. The top of the unit must be equal to or higher than any adjacent walls, buildings or other structures. When the top of the unit is lower than the surrounding structures (Figure 1 & 2), recirculation can occur. If the unit is on the windward side, as shown in Figure 1, the discharge air will be forced against the building and then spread in all directions, including downward, toward the unit's air inlets.

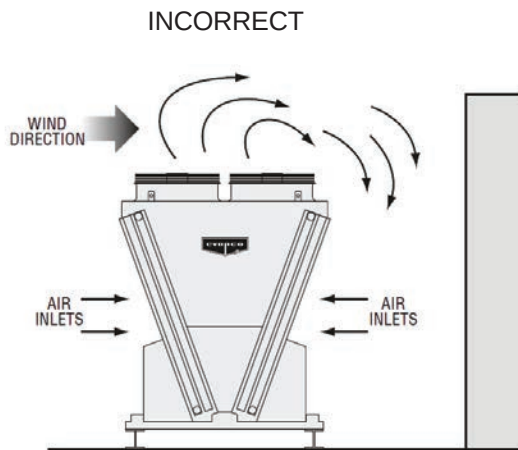


Figure 1 - Installation with Top of Unit Lower than Top of Wall

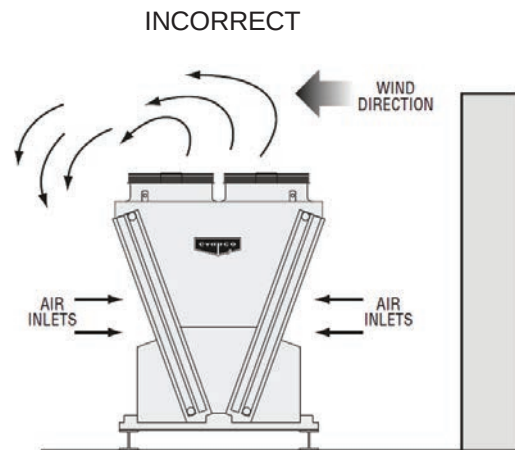


Figure 2 - Wind Effect with Top of Unit Lower than Top of Wall

When the wind comes from the opposite direction, the resulting negative pressure area created by the wind passing over the building will cause the discharge air to be forced back into the unit's air inlets, as shown in Figure 2. If neither of these conditions occurs, the presence of much taller structures can potentially inhibit the dissipation of hot discharge air.

The conditions shown in Figures 1 & 2 can be corrected by elevating the unit on structural steel such that the top of the fan cowl is equal to or higher than the adjacent structures, shown in Figure 3. **For installations where this option is not possible, an experienced engineering decision must be made regarding the potential impact to thermal performance.**

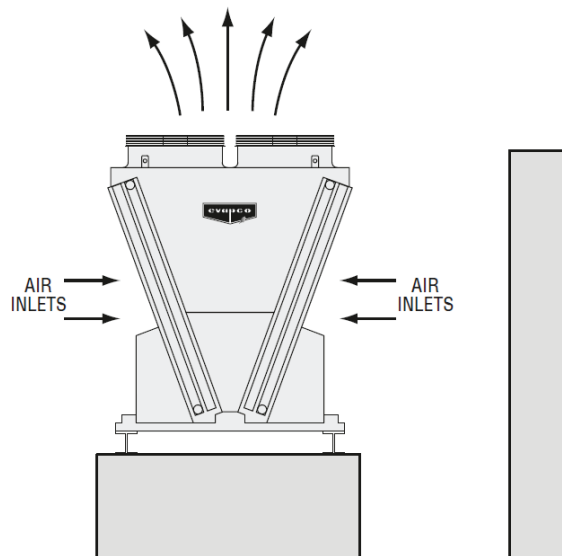
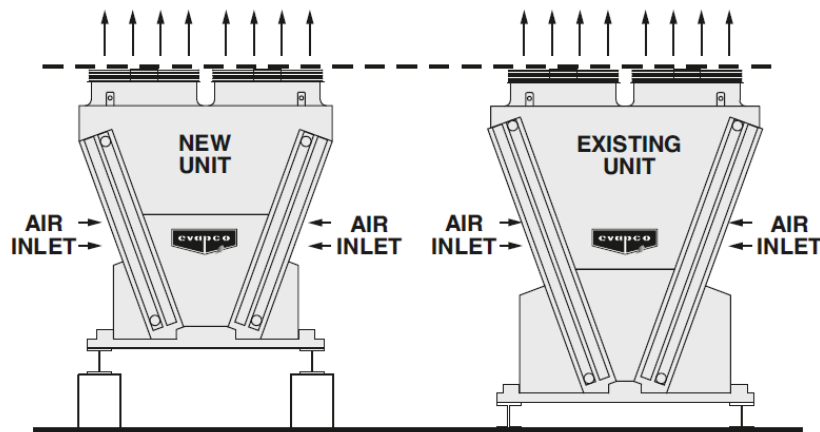


Figure 3 - Installation Elevated so Top of Unit Is Higher than Top of Wall

Pre installation precautions

Multiple units / Expansions to Existing Systems

Expansions to existing systems present the same concerns as multiple unit installations. However, there are additional concerns that must be evaluated when planning a system expansion. Since in an expansion the new unit may not be identical to the existing one, it is important to examine the heights of the new and the existing units. Whenever possible, the tops of ALL of the units should be at the same level to avoid recirculation from one unit to another. If the unit discharge heights are different one or a combination of the following should be implemented. Either structural steel should be used to raise the air discharges of both units to the same level as shown, or the units should be spaced further apart than normally recommended.



Expansion to an Existing Installation

NOTE: For installations where the minimum recommended distances cannot be maintained, contact your local EVAPCO Air Solutions representative.

Space Requirements for Maintenance

When a unit is located in close proximity to other structures, walls or equipment, there are minimum clearances required for periodic maintenance. Proper access must be provided for the removable inspection panel located on both ends of the V configuration units.

Also, in addition to the periodic maintenance items, unit drawings must be reviewed to ensure there is room for any future major repair work. Space should be provided to allow for the replacement of a fan motor, or even a complete coil.

Additional Space Requirements

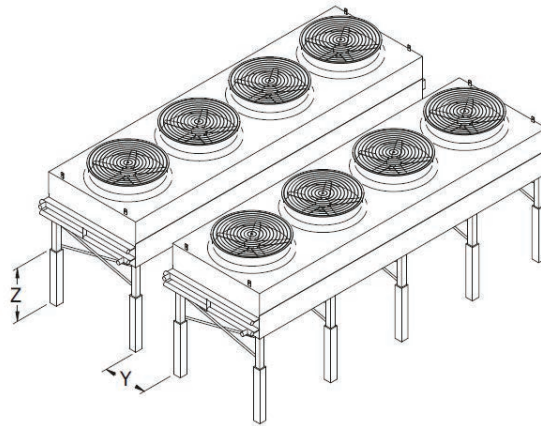
Additional space may be required beyond those provided herein for system piping connection, control panels or other obstructions. These additional space requirements are usually project specific and therefore not covered in this manual. If there are questions please contact your EVAPCO Sales Representative.

Pre installation precautions

Elevated Unit Considerations - Flatbeds

Flat configuration units can be elevated for those layouts where they must be placed closer together than this manual allows. Note the Z is elevation distance beyond standard leg height.

Y	8'	6'	4'	2'	0'
Z	0'	0.5'	1'	2'	4'



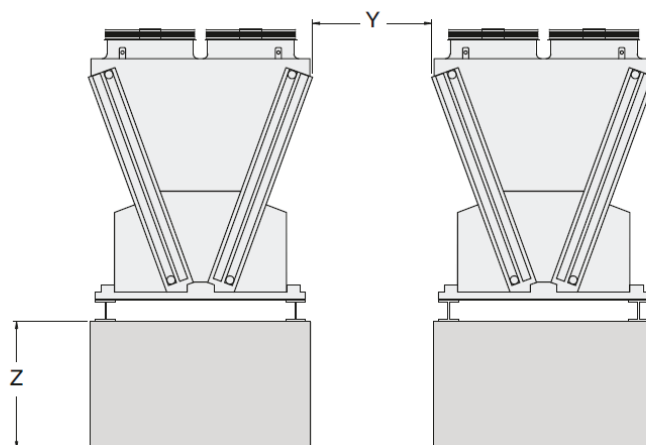
For example, if Y = 4', an additional 1' of elevation is needed beyond standard leg height.

Elevated Unit Considerations - V Range

V configuration units can be elevated for those layouts where they must be placed closer together than this manual allows. The chart below shows minimum elevation for a given distance between units.

For example, if Y = 7', the units must be elevated 7.5'. **The recommended minimum distance between units regardless of elevation is 7'.**

Y	10'	9'	8'	7'
Z	0'	2.5'	5'	7.5'



Adiabatic closed circuit coolers and condensers can be elevated, but grade level layout guidelines apply. They cannot be elevated in lieu of spacing. This also applies to any dry cooler or condenser that would be retrofitted with adiabatic pad systems.

Pre installation precautions

Procedure prior to final positioning

Carefully remove any residual packaging/crating and bindings and remove any fixings holding the product to its pallet.

At this juncture verify that there is no additional damage, which may not have been visible upon receipt of the product.

Note

- Minor fin damage is generally only superficial and can easily be rectified using a fin comb, which can be purchased/supplied upon request.
- Dented or slightly damaged tubes should be repaired by a qualified fitter, following agreement with your EVAPCO a/s representative or the factory directly. If the cooler has suffered from any severe damage to the tubes, headers etc., arrange immediate return of the cooler to the factory and notify your local EVAPCO Air Solutions representative or the factory directly.

According to insurance protocol/procedures, you only have one working week to lodge a claim for any 'unseen' damage if this was not marked on the original Consignment Note.

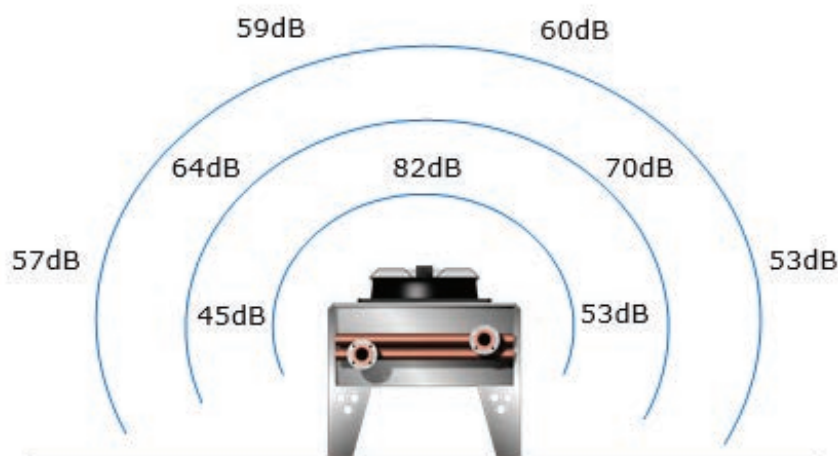
Final positioning

Take adequate precautions to protect all parts of the product especially the return bends, header stubs and connection manifolds and avoid damage to the fins when handling the dry cooler.

Warning: The fin material can be very sharp and can cause injury. Gloves should be worn if contact with the fins is necessary.

Note: Do not lift or manoeuvre the product via the return bends or headers/manifolds assembly. When placing the unit with consideration to sound levels, take note that the sound is a hemispherical measurement with a given distance. The noise level of a product will be affected if placed near to walls or other reflecting object,

Overall sound pressure level 58dB(A) @ 10 meters



Pre installation precautions

Installation

When installing the unit, please ensure that fixing points are correctly distanced according to the order- related documents. These fixing points must be dimensioned bearing in mind the weight of the unit in operation along with miscellaneous weight such as ice, dirt etc. and the specified mounting holes, which are statically calculated according to EN1090-2.

Use fixing bolts to secure the unit and ensure that the bolts are tightened equally and with appropriate force according to standard rules relating to these bolt sizes.

Only use the designated fixing points to secure the unit.

Pipe Work Connection

When connecting the product to the pipe work ...

Each product is marked with arrows to indicate the inlet and outlet connection.

Care should be taken to avoid applying undue torsion forces to the connections fittings and header assembly of the product

- Unit: especially when tightening threaded screw connections or bolts on flanged connections.
- All interconnecting pipe work – outside of the scope of supply of the product – should be independently supported and must not transfer any stress/strain to the product's connection and header assemblies.
- EVAPCO strongly recommend the use of flexible couplings mounted between the product and supply/return pipe work. These couplings should have sufficient flexure to allow for the associated longitudinal, lateral and radial movement as a result of thermal expansion due to temperature fluctuations. Furthermore, flexible couplings can reduce/eradicate pressure pulses generated by pumping/compressor equipment, which can in extreme cases have adverse affects upon the heat exchanger tubes, resulting in leakage.
- If the dry cooler is mounted on AVMs (especially spring-type mounts), flexible couplings must be fitted and should have sufficient additional flexure to accommodate the associated movement of the product.
- Ensure that the connecting pipe work is permanent and immovable if placed in an area with internal traffic. If flexible connections are used, ensure these cannot be accidentally moved.

Dry cooler

- Prior to filling the system ensure that the drain plugs are secured and the air vents are opened. Note: air vent and drain plugs are not suitable for filling the system.
- The system should ideally be filled from the lower connection to allow any retained air to vent.
- Ensure that the system is completely void of air.
- Note: If micro air bubbles exist in the system circulating fluid, the thermal performance can be compromised.
- If welding or brazing has to be conducted upon the product, ensure that the dry cooler is completely empty and ensure the air vents are open to prevent any internal pressure build-up.

Air cooled condenser :

- If welding or brazing has to be conducted upon the product, ensure that the system has been pumped down and all refrigerant evacuated and the system vented to prevent any internal pressure build-up.

Frost

EVAPCO is not responsible for ensuring that the product is adequately protected against frost damage. If the product has occasion to operate in close-to or sub-zero temperatures then either the circulating fluid should be dosed with an adequate anti-freeze additive or provision has to be made to either manually or automatically drain the fluid from the cooler. Note : Opening the air vent and drain connections as a means to fully drain the fluid from the dry cooler is not sufficient to fully empty all the fluid and thus prevent frost damage. In particular for large dry coolers, air pressure assisted drainage is recommended.

If you have any doubts, please contact your local EVAPCO representative or the factory for advice.

In general follow standard safety regulations and requirements, as specified in the EN 378-1, EN 378-2, EN 378-3 and EN 378-4.

Pre installation precautions

Electrical Connection

All electrical equipment factory fitted or supplied by EVAPCO is in accordance with the regulations of CENEL-EC, however, always verify as follows ...

- Ensure that the supply voltage, current and frequency are all in accordance with the nameplate data of the motors fitted to the product.
- Check that all electrical equipment (terminal boxes, safety switches, wires and motors etc.) are intact and check the tightness of all electrical terminals, especially if the product has been subject to long road transport.

Important considerations

- Ensure that all fan guards are secure before starting the fan/motors. The fan guard must never be removed or loosened if the unit is supplied with electrical power or indeed operational.
- Ensure that the fan rotation complies with the 'directional arrows' affixed to the fan discharge rings.
- Following the initial start-up of the motors check for undue vibration. This may suggest possible impeller imbalance or motor bearing problems.
- As standard EVAPCO non-ATEX motors are rated as either IP54 or IP55 but have appropriately positioned drain holes to allow the drainage of any water resulting from internal condensation. Thus the motors are re-rated as IP54.
- Motors fitted to induced draft products are designed for a nominal maximum Air Over Motor (AOM) temperature of 70°C under normal operating conditions. Motors fitted to products with this orientation can exhibit a shorter life cycle if AOM temperatures exceed this limit. Note: EVAPCO Air Solutions can not be held responsible for motor related issues if during capacity control via fan speed regulation
- e.g. variable voltage or frequency inverter control, the AOM temperature exceeds this limit.
- Products fitted with motors which include integral anti-condensation heaters should; upon arrival on site; be connected to a single phase 230VAC electrical supply to ensure that the motors are kept warm. Note: The purpose of these low wattage heaters is to avoid internal motor water condensation and consequential motor bearing related issues. EVAPCO Air Solutions can not be held responsible for such motor problems if the above recommendations are not followed.
- Motors fitted to EVAPCO Air Solutions products are designed to be operational for most of their working life. As a consequence, during elongated 'standstill' periods it is recommended that the motors are started and run at full speed for a minimum period of 30 minutes, twice monthly to both exercise the bearings and avoid 'bearing stiction' issues plus thoroughly dry out the motor and terminal box, if suffering from internal water condensation.

Dry coolers

- EVAPCO recommend the fitting of a suitable filter/strainer in the pipe work system to protect the pump, moving parts etc., from the effects of any circulating dirt or debris. This filter should be checked and either cleaned or replaced at regular intervals. Note: Any solid particles held in suspension in the circulating fluid can cause erosion corrosion ultimately resulting in tube leakage, especially when the tube material is copper.
- If the system has been filled with water and subsequently drained for some purpose, ensure that the heat exchanger is completely empty (see above) to avoid frost damage, should the ambient temperature drop below zero whilst out of operation.

Pre installation precautions

Product Preparation

Following the positioning and installation of the product and associated connection of the services (electrical, water, refrigerant etc.), it should now be ready to perform the initial start-up and checking of the operating functionality.

Products may be supplied with factory fitted capacity control equipment e.g. step control, variable voltage, frequency inverter, EC motor controllers, FlexSpray or FlexPad systems. All these options are 'turn-key' systems and have been factory tested and any associated temperature/pressure Set Points will have been adjusted in-line with the product selection data or specific Customer requirements.

Start-up Check List

- Refer to the Maintenance Manual and ensure that all the points mentioned have been checked
- Ensure that the product has been correctly connected to the hydraulic/refrigeration system and electrical power supply
- Consult the Operating Manual to commence the initial start-up of the product
- If the product is to be operated under different operating conditions that those stipulated in the order related documentation or outside of the specified normal operating range, the manufacturer's warranty is null and void
- Ensure that ..
 - Dry cooler : the system is completely full with coolant/anti-freeze and that the system is free from any entrapped air
 - All air vent and drain connections are closed
 - All isolating valves are open
 - Condenser : the system has been evacuated and charged with the correct amount of refrigerant
- All isolating valves should be open
- Ensure all fan/motor safety switches (if fitted) are in the 'ON' position
- Supply power to the system via the Main Power Switch and the system should begin to operate
 - Note: the fan/motors may not operate if the product is fitted with a controller which registers that the fans do not need to run. In this event refer to the control system's Quick Start-up Guide
- During the first 48 hours of operation it is recommended that system parameters (temperatures and pressures) are logged at intervals to ensure that the system is behaving as designed and operating in a stable fashion

Safety

- Only qualified personnel should work upon the equipment
- Always wear safety glasses, gloves and head protection when working upon the equipment
- Avoid contact with sharp edges and exposed finned surfaces which can cause injury
- Never apply heat to fully charged refrigeration system
- Never operate the fans without the fan guards being fitted
- Ensure all sub-zero pipework is sufficiently insulated to avoid frost injury should there be any accidental contact
- Ensure all very hot surfaces are sufficiently insulated to avoid burning should there be any accidental contact

Pre installation precautions

Shutting Down the Product

The product is part of a cooling process or refrigeration system, where the cooling medium is an integral part of the system. Steps should be taken to ensure that when the equipment is shut down for prolonged periods, the cooling medium is managed in the correct fashion.

Dry coolers

- Ensure the process is run down and the system temperature has reached the safe shut down conditions
- Turn off the pump
- Close the isolating valves
- If the cooler will be subjected to sub-zero temperatures and is not filled with a suitable antifreeze, open the air vent and drain connection(s) and drain the coolant. Assistance via applying a positive pressure to the air vent connection(s) will help ensure that there is no coolant retention, which could lead to frost damage
- Switch off the fans and power to the product

Air cooled condensers

- Ensure that the refrigeration load is removed
- Perform a system 'pump down' sequence to ensure that a majority of the refrigerant is contained in the liquid receiver
- Isolate the valves on the liquid receiver
- Switch off the fans and power to the product

For prolonged periods of shut down; as recommended in the Operating Manual; it is advised to exercise the fan/motors at full speed for a period of 30 minutes, twice monthly.

Resuming Operation after a Shut Down

- Visually inspect the product for signs of leaks, corrosion, frost damage and accumulated debris etc.
- Clean and remove as appropriate
- Ensure the fans rotate freely before applying any power
- Follow the Start-up Check List described above

Changing the Coolant/Refrigerant

The cooling medium may be changed providing the following is considered ..

- Safe disposal of the old coolant/refrigerant in line with local regulations – responsibility of the system owner or designated company
- Replacement with similar or compatible coolant/refrigerant. If necessary consult EVAPCO Ensure any deviation from the original coolant/refrigerant does not breach the PED categorisation of the product. If necessary consult EVAPCO Air Solutions.

Maintenance Manual

During normal maintenance, all relevant national and company safety regulations should be observed, as well as the appropriate guidelines imposed by the suppliers of relevant medias, such as cooling media.

It is recommended to implement an inspection and maintenance plan for the unit.

Inspection and maintenance plan

EVAPCO recommends at least the following points get checked at appropriate intervals. It is up to the owner to adjust the inspection and maintenance plan according to the requirements of the specific site. However, it is not recommended to enlarge the intervals.

Job	Weekly	Monthly	Half yearly	Yearly
Check unit for dirt build-up	x			
Check unit for damages	x			
Check performance data		x		
Check unit for leaks			x	
Check connections for tightness				x
Check cooling media pressure		x		
Check unit for corrosion			x	
Check fans for vibrations			x	
Check fans for noise			x	
Check fans for corrosion				x
Cleaning the coil			x	

Cleaning

- It is essential to understand that fouled or dirty fins can substantially reduce the thermal performance of a dry cooler or air cooled condenser.
- Regular visual inspections of the product and in particular the heat exchanger is recommended.
- Check for fouling of the fins by using a flash light to shine between the fins to establish the accumulation of dust, dirt or debris. If it is concluded that such fouling has impacted upon the airflow, performance or resulted in the motors drawing a higher than normal running current (Amps), the heat exchanger surface should be cleaned.
- Accumulation of dry dust or sand, usually on the air inlet face of the heat exchanger, can simply be removed by one of the following methods ...
 - Low pressure compressed air jet applied against the normal air direction of dry cooler.
 - A suitable industrial vacuum cleaner.
 - A soft hand brush. Sweep along the fins and under no circumstances across the fins.
- Moist, sticky accumulations or grease should be removed by means of hot water or a steam jet cleaning appliance applied against the normal air flow direction. Note: Ensure the jet of the cleaning appliance is kept at an angle of no more than 15° from vertical position, to avoid deforming the edges of the fins.
- Under no circumstances use organic solvents and cleaning products.
- If in doubt contact the manufacturer of the proposed cleaning products to confirm which cleaning agents are suitable for the product's tube, fin and casework material. If in doubt, contact your local EVAPCO representative or the factory.
- Avoid mechanical cleaning with any hard objects, which might damage the tubes or fins resulting in a capacity issue or perhaps even leaks.

Maintenance Manual

Cleaning

Cleaning hydraulically

When cleaning the coil hydraulically, with water under pressure, ensures that the water spray used has maximum 50 Bar.

Always clean in the vertical direction. Never across the fins, as this will damage the fins. And always from the top down to avoid the water spray entering the fans (this can short circuit the fans).

For oily or otherwise difficult to remove dirt, it is possible to add a chemical cleaning agent to the water used in the hydraulic compressor. Ensure that the cleaning agent is compatible with the materials used in the unit and that it is an environmentally friendly agent.

Cleaning with compressed air

If cleaning the unit with compressed air (max. 80 Bar pressure) for the purpose of removing dirt and other things, please ensure that the air stream is COMPLETELY VERTICAL to the fins as the air stream can otherwise damage the fins.

Cleaning with brushes

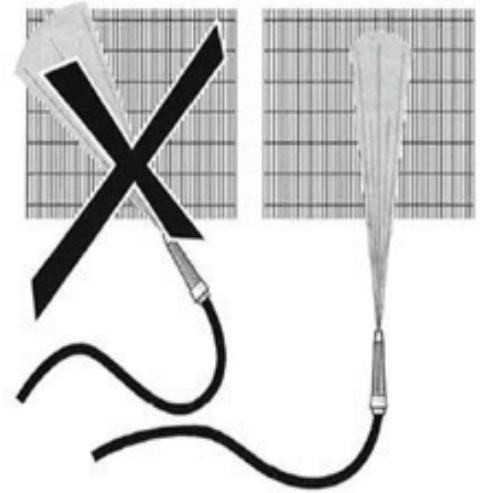
Dry dust and some dirt can be removed with brushes, possibly in conjunction with compressed air (the last keep in mind the previously mentioned guidelines and a minimum distance to the fins of 200 mm) or an industrial vacuum cleaner.

However, ensure that soft brushes are used and when possible all cleaning should be from the top down. ALWAYS brush along the fins. NEVER across the fins, as this will damage the fins.

Cleaning the fans

ALWAYS ensure that the power to fans has been isolated prior to cleaning and ensure that the fans cannot be accidentally started during maintenance. If the grids are removed, ensure that after maintenance, they are reattached in the same position and securely fastened before restarting the system.

It is recommended to clean the fans either by means of brushes or with compressed air. Maximum air pressure 10 bar g.



Maintenance Manual

Wear and tear

- Generally, dry coolers and air cooled condensers are a low maintenance product where only the rotating components suffer any wear and tear. The exception is when the product is exposed to an aggressive or corrosive environment. In such a case the tube, fin and casework materials may suffer from various forms of corrosion. However, if correctly specified, the materials of manufacture should be suitable for the operational environment.
- Motor bearings have a nominal life cycle of 40000 hours and are normally sealed for life and thus require no maintenance under normal circumstances. However, if problems do arise they may be able to be replaced following removal of the motor from the product and removal of the impeller from the shaft. (Refer to our bearing change instructions, available upon request). Otherwise the whole fan/ motor assembly can be replaced.
- Depending upon the product range, some models use impellers manufactured from UV stabilized composites but these are designed to last for the lifetime of the product.

Safety Precautions

The following Health and Safety legislation and codes of practise etc. should be acknowledged ...

- The product is designed with the design noise level as a design parameter. However, noise generated by the product can still become a nuisance and it is the responsibility of the owner of the equipment to comply with local noise regulations/ constraints.
- Only use the coolant/refrigerant specified for the design of the dry cooler. Failure to do so may damage the tubes of the heat exchanger resulting in leaking tubes. If in doubt consult EVAPCO.
- All products are designed in accordance with the PED and categorized in-line with the specified design pressure. Therefore ensure that this design pressure is not exceeded. Failure to comply may result in damage to the unit and could result in injury.
- Care should be taken when in close proximity to the heat exchanger finned surface, which comprises sharp edges and can inflict injury. Use of gloves is recommended.
- Under no circumstances should any fans or motors be worked upon without first electrically isolating the unit or fan/motor to be worked upon via its lockable safety switch. The fan guard should only be removed when the fan/motor is isolated.
- If ladders are used to access part of the unit, they should be securely fastened to the product to avoid slippage and injury.
- If products are installed upon elevated support structures, the use of safety harnesses secured to appropriate fixing points are recommended.

Repairs

In the event that the product needs to be repaired, certain recommendations should be followed.

- Electrical - Always electrically isolate the whole dry cooler or specific fan/motor prior to commencing any repair work such as removing the fan guard, removal of the impeller or motor.
- Welding / Brazing - Ensure that the product is completely isolated and drained of coolant/refrigerant plus ensure that any fitted air vents are open prior to commencing any repair work on the heat exchanger. Failure to do so may result in the build-up of excessive internal system pressure and may result in tube/pipe failure and potential injury.

Maintenance Manual

Troubleshooting

If faults or errors occur, the steps recommended in the user manual under safety are to be followed. If the faults are outside the outlined, please contact EVAPCO for clarification.

Troubleshooting table.

Fault	Potential cause	Remedy
Cooling media escaping	Coil leaking	Establish the leaking spot. Switch off cooling media and fans. Empty the unit. Close the leak or tightening the packing, if this is the leaking spot.
Capacity not reached	Coils are dirty	Clean according to maintenance manual
Capacity not reached	Insufficient fluid flow	Check pumps with regards to required values. Reset value or change faulty equipment, if pumps or valves are faulty
Capacity not reached	Cooling media concentration has changed	Adjust the mixture
Capacity not reached	Fans down or not functioning correctly	Repair or change the affected fan
Fan not running	Power supply interrupted	Restore power
Fan not running	Fan blades stuck or otherwise impeded	Remove obstacle and ensure rotation possibility
Vibration	Vibration from the pump	
system	Install vibration dampers	
Vibration	Fan blades defective or not balanced	Change fan blades
Vibration	Loose fixation of fan or motor	Tighten fans blades or motor
Bearing noise	Defective motor	Replace motor
Bearing noise	Missing lubrication in motor	Lubricate bearings in motor if possible

Documents

Wiring diagram for fan

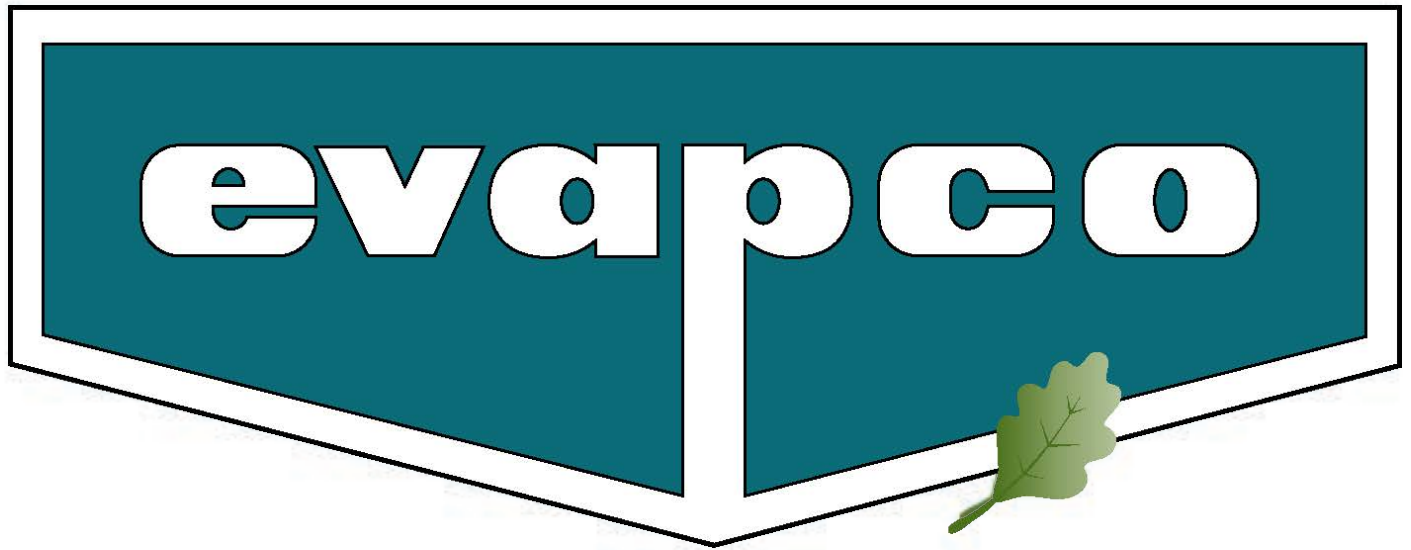
See inside of the motor terminal box cover on the fan

Wiring diagram for control box

If applicable, see order-related documents

General unit drawing

See order-related offer documents.



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