Operating Instructions

Centauro air cooled condensers

Keep for future use!

CEN.11.A01

Revision

Date	Chapter(s)	Reason	Person responsible
29.04.2011	All	Update	P. Pereira

We have prepared these operating instructions to the best of our belief. Even so, do let us know should errors or unclear points come to light. We would also be pleased to receive any pointers or suggestions on these instructions.

Operating instructions for air cooled condensers

These operating instructions belong to:

Centauro Portugal – SGPS, S.A. - Zona Industrial, Lote Q-9
Apartado 1001 – 6001-901 Castelo Branco – Portugal
Telef.: +351 272339260 – Fax: +351 272320684
e-mail: mail@centauro.pt – internet: www.centauro.pt

Castelo Branco, 30 April 2011

Operating instructions version: CEN.11.A01

Conteúdo

1. General

1.1. *Introduction*

These operating instructions contain important information on safely handling the Centauro heat exchanger.

These operating instructions are for the experienced refrigerating plant installers. It is essential for technical personnel to thoroughly read and understand these operating instructions before any work is undertaken on or with the product described!

Do turn directly to Centauro (for address see page 2) for more information on the heat exchanger which goes beyond the extent of these operating instructions.

1.2. *Scope of supply*

The Centauro product series comprises the following:

Pipelines protected by a casing and enclosed in fins with a drip tray and fan(s) mounted in the casing.

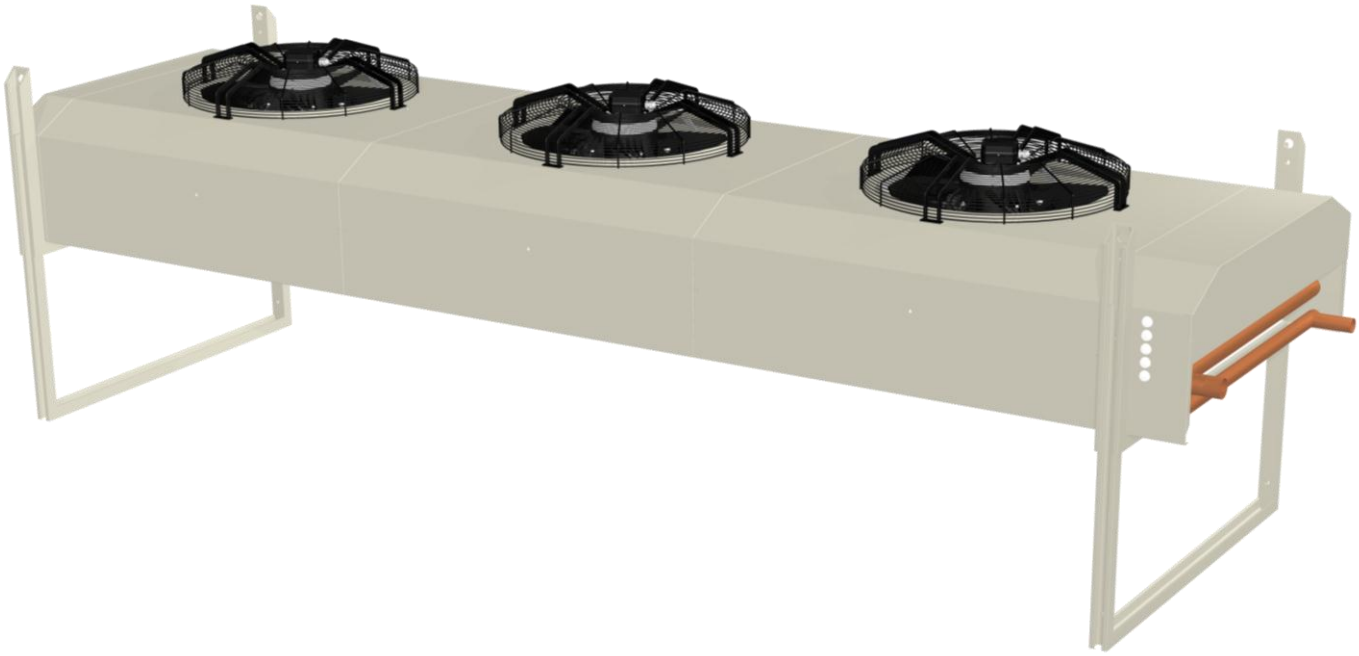
Additionaly, the Centauro heat exchanger is also fitted with various components for the standard version and, if so, the optional components listed below.

Type designation:

The designation on the heat exchanger nameplate provides precise details on the respective product version and includes the following information:

Centauro condenser type AC / ACM / ACH

Centauro condenser type ACI / ACP / ACPD / VAC / VACD



The Centauro heat exchanger is completely assembled prior to delivery. It consists of the following components:

Basic version:

1 casing consisting of:
– Smooth, weather-resistant casing made of
– prepainted, zinc coated steel plate poder painted RAL 7032
– Fan partition plate(s)
– Mounting profiles/feet, straight, supplied loosely (model range ACM with up to 3 fans Ø 500 mm) or
– Mounting profiles/feet, U-shaped, premounted, adjustable in height (ACI / ACP / ACPD)

Heat exchanger coil block
– Corrugated aluminium fins
– Special copper core tube
– Tube bends
– Tubing
– Schrader valve at header
– Headers fixed to the casing

1, 2, 3, 4, 5 or 6 fan(s) with single-row construction,
or rather 2, 4, 6, 8, 10 or 12 fans with double-row construction:
– Axial fan(s) with external rotor
– Fan blades
– Fan guard

Optional accessories (available depending on the model):

- Model range ACM: Mounting feet kit for installing the condenser with vertical air flow
- Maintenance switch
- Epoxy coated aluminium fins
- Antivibration pads
- Speed controller
- Shut-up
- EC fans

1.3. *Liability and warranty*

The stipulated warranty period holds good for the Centauro heat exchanger. Warranty is only taken on when the following conditions are fulfilled:

- The heat exchanger has only been used under the conditions defined in Chapt. 2.1, "Intended use", p. 10
- The entire work on or with the heat exchanger has been solely undertaken by authorized technical personnel.
- Only genuine replacement parts have been used.
- The technical critical values have been adhered to (see Chapt. 3.1, Conditions of operation", p. 16).

1.4. *Applicable documents*

The Centauro heat exchanger is delivered including the complete documentation. It consists of the following documents:

- Operating instructions for the Centauro heat exchanger ordered
- Required certificates

2. Safety

2.1. *Intended use*

The Whiteline heat exchanger in its standard version is intended for the installation in compression refrigerating cycles only. It is for exchanging heat energy between the ambient air and the refrigerants stated below:

The intended use is a decisive factor in the selection of heat exchanger.

The plants in which the Whiteline heat exchanger is installed must comply with the requirements of the European Machinery Directive 2006/42/EC and the European Pressure Equipment Directive 97/23/EC. The whole plant must conform to the appropriate legal regulations.

The Centauro air-cooled condenser is for desuperheating and condensing of the vaporous refrigerant and – with consideration given to the provisions in force – is normally for outdoor deployment. Only under certain conditions (assurance of the required air circulation i.e. supply of fresh air and discharge of exhaust air) can it be set up indoors. The air flow from the fan discharges the heat energy of the refrigerant flowing through the piping to the ambient air via the fin surface.

Use of the Centauro heat exchanger is only permitted with the following refrigerants:

- Refrigerant Fluid Group 2 of the Pressure Equipment Directive 97/23/EC
  - Single substance refrigerants
  - Zeotropic refrigerant mixture
  - Azeotropic refrigerant mixture
  - Inorganic compounds

The instructions in these operating instructions and **those limiting values stipulated** in Chapt. 3, “Technical data“, page 16, must be **strictly** adhered to.

Forbidden are:

- The use of the Centauro heat exchanger for a purpose other than that specified above (e.g. for cooling another fluid).
- The use of non-authorized operating fluids (different to the above refrigerants).
- Incorrect equipment setup or fitting in systems other than the above ones.
- Unauthorized modifications (e.g. function, working point, fan capacity or air quantity) without the manufacturer's written approval.

2.2. *Safety marking*

Special attention is drawn to dangers and vital information in thes operating instructions by the use of signaling words (***DANGER!, WARNING!, CAUTION!, ATTENTION, NOTE***) and symbols. The following applies:

DANGER! ***Danger of personal injury.***
Death or serious injuries WILL arise unless the appropriate steps are taken.

WARNING! ***Danger of personal injury.***
Death or serious injuries MIGHT arise unless the appropriate steps are taken.

CAUTION! ***Danger of personal injury.***
Minor injuries might arise unless the appropriate steps are taken.

ATTENTION ***Danger of material damage.***

NOTE ***Particular feature is on hand.***

2.3. *Safety instructions*

AVISO! ***Inappropriate handling of the heat exchanger can have serious, if not lethal consequences!***

These operating instructions

- ***must have been thoroughly read and understood before any work with or on the heat exchanger,***
- ***must be strictly adhered to,***
- ***must always be available where the heat exchanger is set up.***

WARNING! ***Danger of personal injury.***

The entire work on or with the heat exchanger is only to be undertaken by authorized specialized personnel with profound knowledge of refrigeration systems.

WARNING! ***Danger from falling loads.***

Note weight of the heat exchanger!

Only use suitable hoisting and handling equipment!

DO NOT walk under the suspended load!

WARNING! ***Danger of cuts through to limbs being amputated.***

In instances of handling, installation, maintenance, dismantling and taking out of service, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

WARNING! ***Danger due to rotating fans.***

The heat exchanger may only be commissioned and operated with mounted fan guards!

Do not disassemble the fan guards!
Electrical parts must be isolated from M.P.S (main power supply) during maintenance.

WARNING! ***Danger of severe injuries and even strangling if hair or clothes are drawn in by mobile parts.***

Observe the following when carrying out work on the heat exchanger:

- ***Wear tight-fitting clothes!***
- ***Cover long hair with a hairnet!***
- ***Do not wear jewellery!***

WARNING! ***Danger of injuries to the skin and to the eyes due to parts being thrown out.***

Wear protective goggles when carrying out work on or with the heat exchanger (especially during startup, operation and maintenance)!

Select the installation site such that parts being thrown out from the fans cannot hit people if the wheel breaks.

WARNING!

Danger for the environment.

Refrigerants and lubricants must be prevented from leaking. Make suitable provisions to this end!

DANGER!

Danger due to electricity.

Only electricians may carry out work on electrical equipment!

Take the following precautions prior to carrying out any work on electrical equipment:

- ***Switch off the main switch and protect it against reactivation.***
- ***Make sure the unit is off-circuit.***
- ***Ground and short-circuit.***
- ***Cover or fence off parts under voltage.***

Observe the local safety regulations!

Regularly check the state of the cables!

CAUTION!

Danger of burns when touching hot surfaces.

During defrost operations do not touch the heat exchanger surface!

Let the surface firstly cool down after taking out of service!

When working on or with the heat exchanger, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

CAUTION!

Danger of stumbling from incorrect installation.

Danger of slipping from water, refrigerant or oil escaping.

Configure the place of installation so that there is no stumbling or slipping risk.

Regularly check on connections as to seal-tightness!

DANGER!

Danger of injuries to skin and eyes from squirting oil and from gaseous refrigerant under high pressure.

Undertake the following steps prior to maintenance, retrofitting and dismantling:

- ***Wear personal protective gear (in particular protective gloves and protective goggles).***
- ***Shut down the system.***
- ***Wait for a minimum 5 minutes until the refrigerant and oil circulation has come to a standstill.***
- ***Disconnect the heat exchanger from the rest of the system. For this, make use of the envisaged shutoff valves.***
- ***Lower the pressure. Extract the refrigerant from the refrigeration system with a special recovery machine.***

Undertake the following steps at the startup, operation and maintenance stages:

- ***Regularly check on connections, lines and vessels as to seal-tightness and condition!***

DANGER!

Danger of suffocation from inhaling refrigerant vapours.

Danger of poisoning from toxic substances set free.

Only instructed technical personnel are to work on the refrigeration circuit!

Wear personal protective gear (in particular protective gloves and protective goggles).

It is prohibited to work with a naked flame or with extremely high temperatures!

Regularly check on connections, lines and vessels as to seal-tightness and condition!

Ensure that the place where the heat exchanger is installed is well ventilated!

ATTENTION

Risk of material damage!

A fire outside may give rise to damage to the machine unit . For reasons of safety the machine unit is not to be restarted. The machine unit is to be replaced.

2.4. *Remaining risks*

CAUTION!

Location of hazard: Hot surface.

Hazard: Burns.

Protective steps:
- ***Warn personnel of risks.***
- ***Do not touch!***
- ***Wear safety gloves!***
- ***Attach the "CAUTION! High temperatures. Danger of burns." sign to a place on the heat exchanger where it can be readily seen.***

2.5. *Installer's and system operator's obligations*

The installer is responsible for:

- Instructing the assembly and repair personnel
- Keeping to regulations when carrying out installation, retrofitting, repair and dismantling work

The system operator is responsible for:

- Instructing the specialized technical personnel (operators and maintenance staff)
- Arranging for regular maintenance (e.g. cleaning) and ensuring the system's operating safety
- Adhering to workplace regulations

Furthermore, the operator is also to ensure that no third parties access the system!

2.6. *Requirements placed on the personnel, duty of care*

Work on or with the heat exchanger is only to be taken on by specialized technical personnel who are trained and authorized to do so.

Thorough knowledge of refrigeration technology is prescribed especially for assembly and startup work as well as for taking-out-of-service.

3. Technical data

3.1. *Conditions of operation*

ATTENTION ***When arranging and determining the operating limits of heat exchangers, take into consideration that all specifications refer to standard conditions.***

In the case of different operating conditions, observe the heat exchangers operating limits given by the manufacturer!

Pressure of heat exchangers with copper piping

Min. allowable temperature (bar g)	Max. allowable temperature (bar g)
28	31

Heat exchanger temperature application ranges

Min. allowable temperature	Max. allowable temperature
-50 ℃	+120 ℃

Fan temperature application ranges

Centauro wedge air coolers

Model ranges ACM with fans up to Ø 450 mm	
Min. allowable temperature	**Max. allowable temperature**
- 15 ℃	+ 60 ℃
Model ranges ACM with fans starting from Ø 500 mm	
Min. allowable temperature	**Max. allowable temperature**
- 40 ℃	+ 60 ℃
Model ranges ACH / ACI / ACP / ACPD / VAC / VACD / ACJ	
Min. allowable temperature	**Max. allowable temperature**
- 40 ℃	+ 60 ℃

3.2. *Heat exchanger specifications*

The specifications for the Centauro condenser such as dimensions, weight, diameter and number of fans, cooling capacity, air flow, RPM, power input, noise level, surface, tube volume can be taken from the Centauro catalogues, which are on view in the Internet. These operating in- structions should be read in conjunction with the catalogue concerned.

The specifications in the catalogues refer to the standard heat exchanger with its basic equipment. Other heat exchanger designs and options possibly selected (refer here to Chapter 1.2, "Scope of supply", page 5) may result in changes to figures which need to be inquired into from our technical department (for address see page 2). Bear in mind that the power input of the fans under different temperatures and air resistances varies as against the standard input.

3.3. *Fan data*

The Centauro condensers of the ACM range are fitted out with AC motors (230V/1Ph/ 50Hz) with one speed and internal thermal contact.

As far as the ACH/ACI range condensers are concerned, most models are available with AC motors (230V/1Ph/ 50Hz) with one speed and internal thermal contact, as well as, alternatively, with three-phase motors (400V/3Ph/50Hz) with two speeds (star/delta) and external thermal contact

All other model ranges (ACP/ACPD-VAC/VACD-ACJ) are equipped in their standard version with three-phase motors (400V/3Ph/50Hz).

By using the star/delta changeover, the 400V fan motors can be run at two speeds. The direction of rotation must be checked on here. An incorrect direction of rotation would mean having to exchange two phases.

For electrical connection of the heat exchanger, reference is to be made to the terminal connection plans in the caps of the terminal boxes of the fans as well as possibly to the electrical circuit diagrams of the control cabinet (if present).

Centauro reserves the right to use different fan makes. Depending on the respective fan make, the motor data may vary. Ultimately, the electrical data indicated on the fan’s nameplate is applicable.

If needed, please get in touch with our technical department (for address see page 2).

DANGER!

Danger due to electricity.

Only electricians may carry out work on electrical equipment!

Take the following precautions prior to carrying out any work on electrical equipment:

- ***Switch off the main switch and protect it against reactivation.***
- ***Make sure the unit is off-circuit.***
- ***Ground and short-circuit.***
- ***Cover or fence off parts under voltage.***

Observe the local safety regulations!

Regularly check the state of the cables!

4. Heat exchanger description

4.1. *Construction*

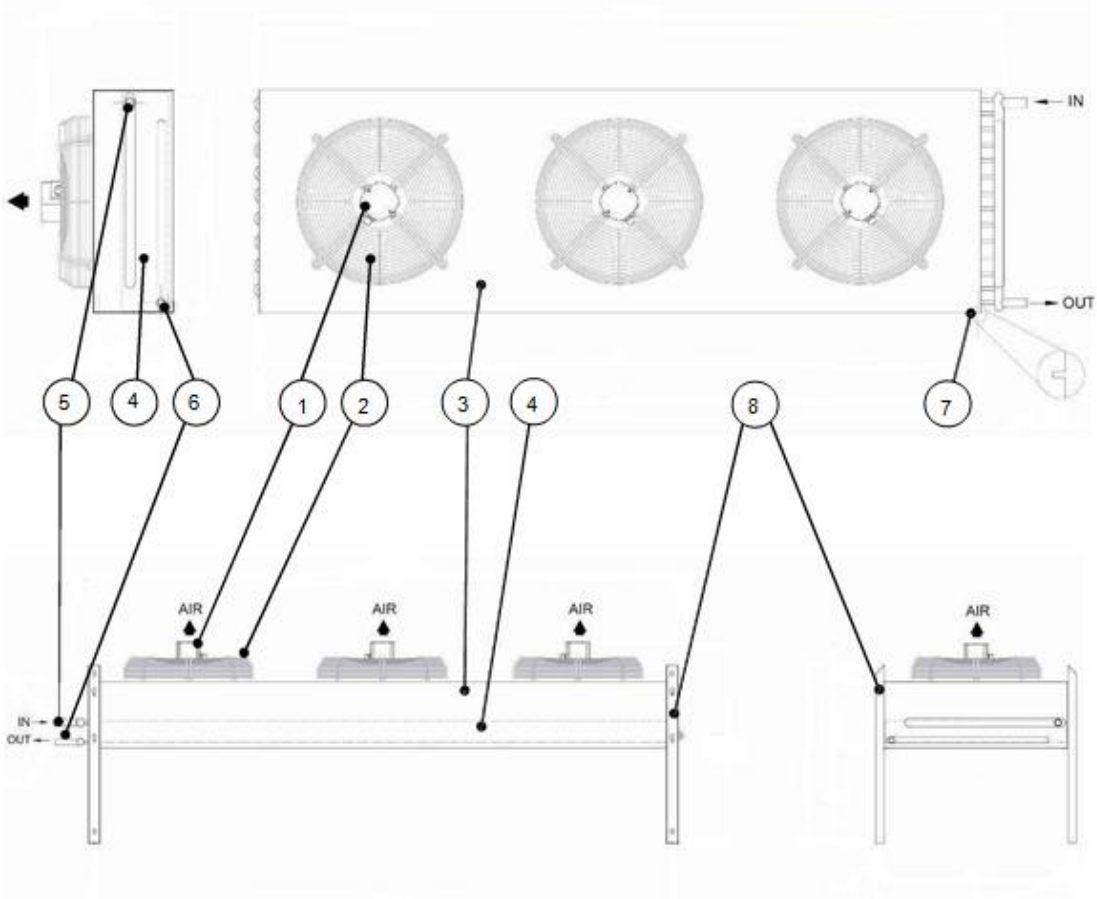


Fig. 1: Example: Condenser of the ACM type (here with 3 fans) – Views installation with horizontal air flow and vertical air flow

Legend

1	Fan	5	Connection heat exchanger inlet
2	Fan guard	6	Connection heat exchanger outlet
3	Casing	7	Mounting point
4	Heat exchanger coil block	8	Feet (foot kit) for installation with vertical air flow

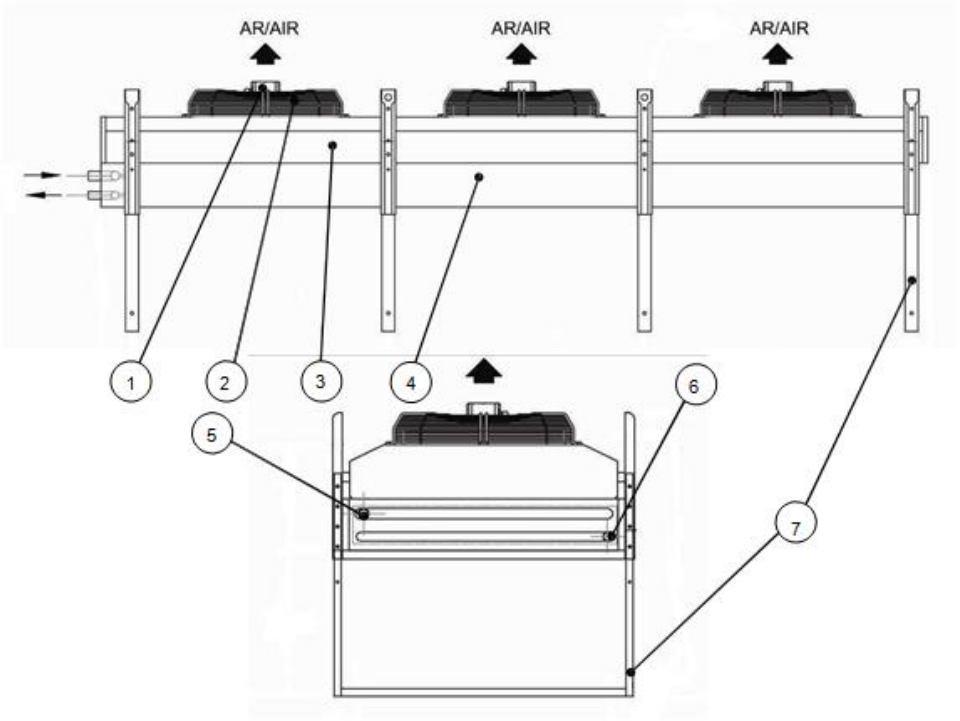


Fig. 2: Example: Condenser of the ACH/ACI/ACP/ACJ type (here with 3 fans) – Views installation with vertical air flow

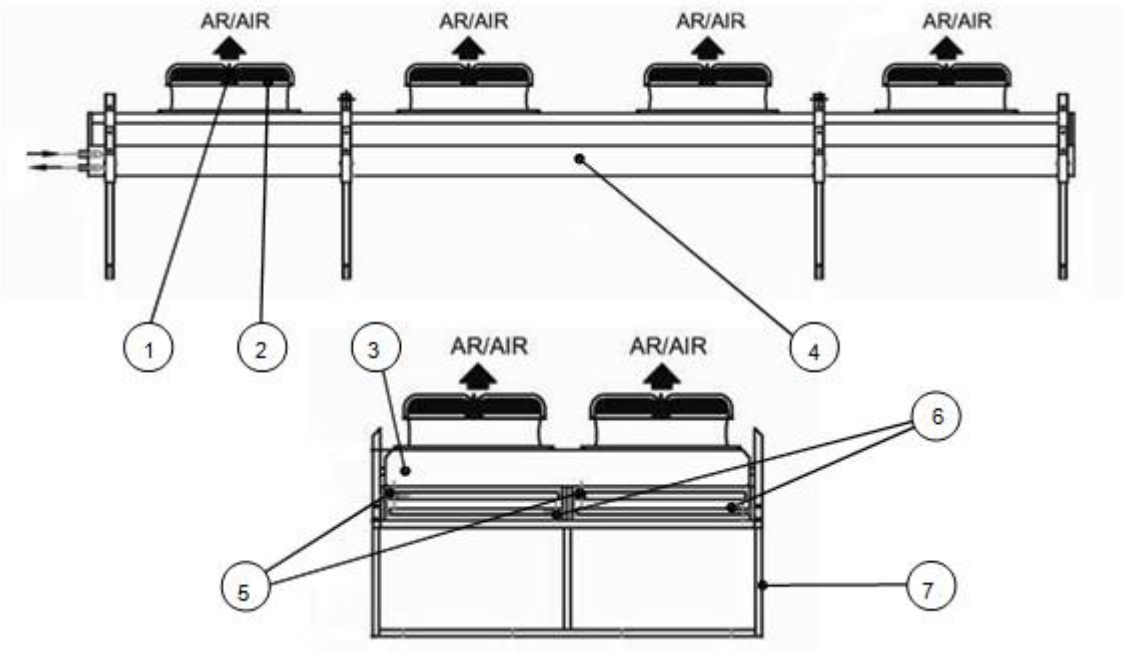


Fig. 3: Example: Condenser of the ACPD type (here with 2 x 4 fans Ø 800 mm) – Views installation with vertical air flow

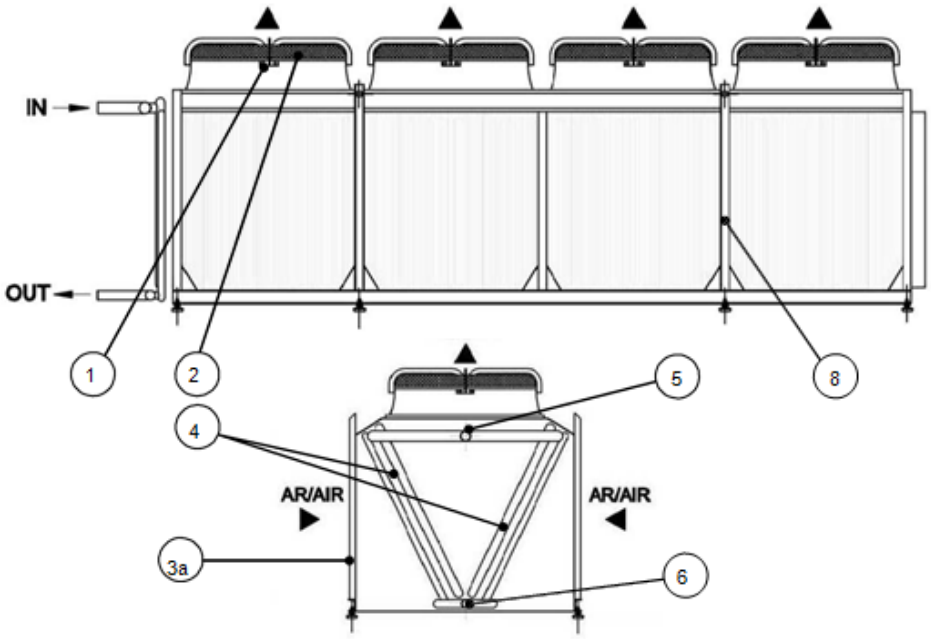


Fig. 4: Example: Condenser of the VAC type single-row (here with 4 fans Ø 910 mm) – Views

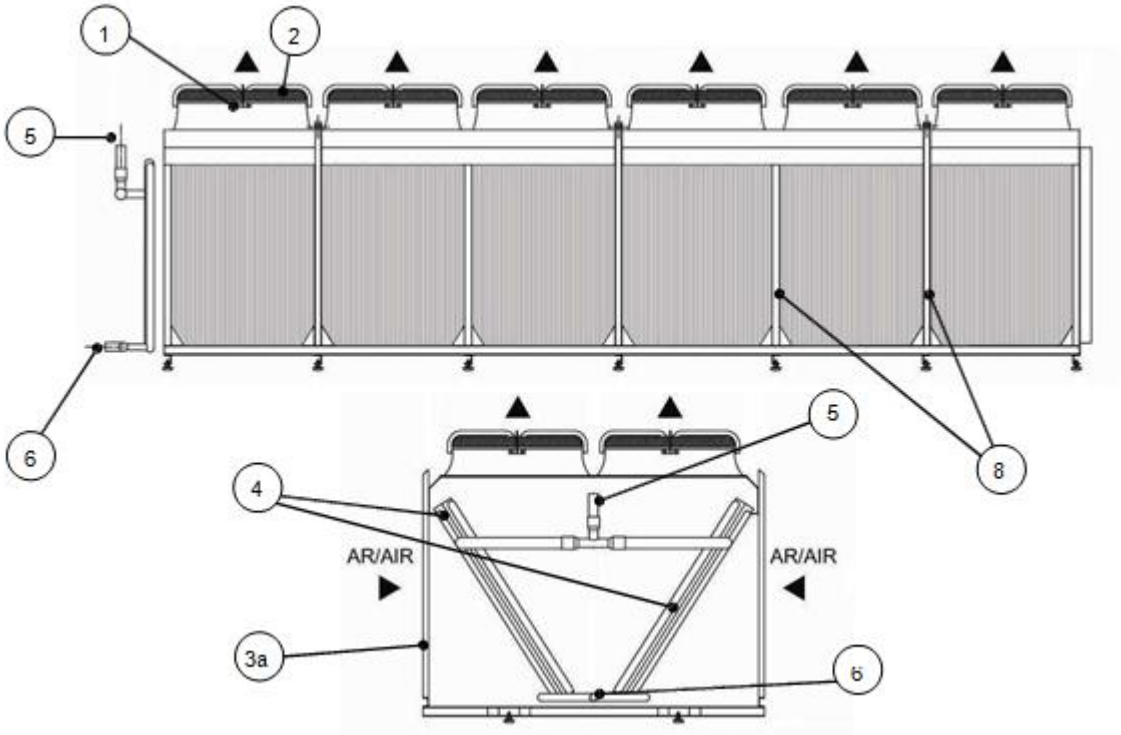


Fig. 5: Example: Condenser of the VACD type double-row (here with 2 x 6 fans Ø 910 mm) – Views

Legend

1	Fan	5	Connection heat exchanger inlet
2	Fan guard	7	Connection heat exchanger outlet
3	Casing	8	Mounting profile/feet, U-shaped
3a	V-shaped casing	9	Fan partition plate(s)
4	Heat exchanger coil block		

4.1.1. Basic version

In the basic version, the heat exchanger consists of the following main components linked to each other. Each of these components fulfills certain functions and reveals certain design features which must be taken note of.

Casing

Each of the heat exchanger components are pre-assembled into a unit in the form of a stable casing (Item 3 or rather 3a in Fig. 1 to 5) and are also ready-for-connection. The casing is made of smooth and weather-resistant casing which is powder-coated.

A ground terminal point is provided in the casing for earthing the heat exchanger after installation in the overall refrigerating plant.

Heat exchanger coil

The standard Whiteline heat exchanger coil consists of corrugated aluminium fins pressed onto a copper pipe coil. The refrigerant is directed through the copper pipe where it condenses. It does this by emitting the thermal energy to of the ambient air by means of the fins. To avoid an excessive drop in pressure, the refrigerant is guided via a header into a number of pipe runs.

The pipe has both an inlet and outlet for the refrigerant. The heat exchangers also have a service connection (Schrader valve) at the outlet.

Fan

The number, diameter and speed of the fans vary in keeping with the field of application and use of the heat exchanger in question. Between 1 and 6 fans, in double-row models 4 to 12 fans (Item 1 in in Fig. 1 to 5) can be fitted. As far as the model range WVS is concerned, the fans are supplied loosely in the standard version and have to be mounted and electrically wired on the installation site to be ready for connection. The fans of all other Centauro condenser ranges are already wired to the junction boxes on the appliances front side, when delivered.

Axial fans are the fans used. They consist of:

- Drive motor (incl. electrical terminal box)
- Fan blades
- Fan safety guard

The fans work in parallel onto the joint heat exchanger. They draw through the ambient air across the fins of the heat exchanger's external surface.

In order to meet changing operating conditions, the speed of the fans can be controlled.

WARNING! Danger due to rotating fans.

The heat exchanger may only be commissioned and operated with mounted fan guards!

Do not disassemble the fan guards!

Disconnect main power supply (M.P.S.)!

Electrical parts must be isolated from M.P.S (main power supply) during maintenance.

4.1.2. Options

- Maintenance switch
- Epoxy coated aluminium fins
- Antivibration pads
- Speed controller
- EC fans

Maintenance switch

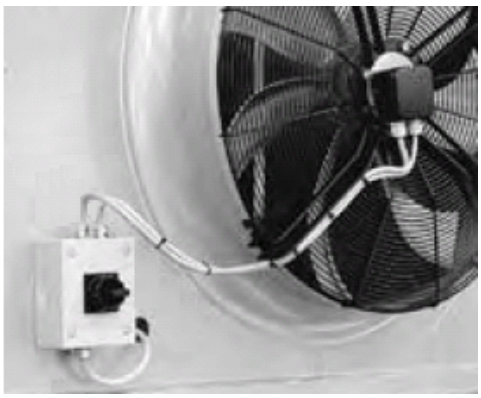


Fig. 6: Maintenance switch

A maintenance switch can be installed and pre-wired for each fan. The maintenance switch is fitted at the condenser housing next to the fan. It is for de-energizing the fan when maintenance and service work is in progress

Epoxy coating

Epoxy resin-coated aluminium fins are protected from especially corrosive ambient air and/or cleaning agents, which could damage their surfaces.

EC fans

EC motors (brushless motors) are electronically commutated motors complete with an integrated electronics system).

They have a number of advantages over the customary 3-phase AC motors: Their efficiency is greater and thus these motors are extremely energy efficient. They are compact and are connected directly at the AC network or the 3-phase current network - with little wiring involved. Each fan has an integrated, stepless and infinitely variable speed controller activated with 0-10V or 4-20mA. The control system is practically loss-free to the exclusion of any control noises. In addition, the motors of the EC fans are low on noise and the fans themselves are reliable, maintenance-free and long- lasting.

Antivibration pads set

Special anti-vibration pads are available for installing the Whiteline heat exchangers. They are to be fitted under the assembly feet and act as dampers. On starting up and during operations, they reduce the transfer of vibrations onto the assembly point. However, the anti-vibration pads cannot get rid of all noises and vibrations.

Make sure that a vibration damper is fitted under each assembly foot to ensure an even distribution of weight. The anti-vibration pads also need to be correctly aligned (see Fig. 7).

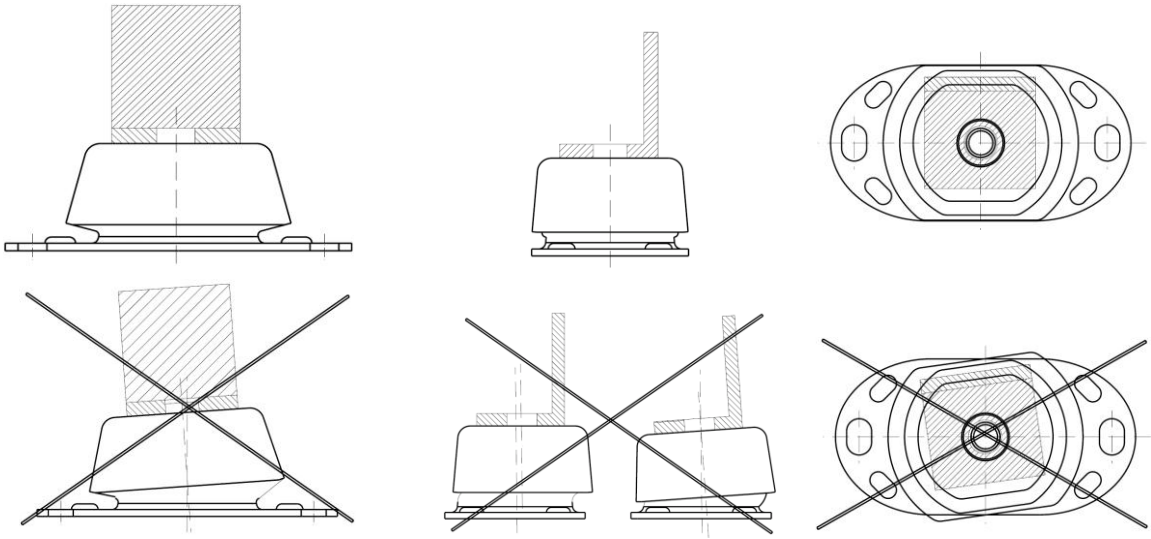


Fig. 7: Alignment of the antivibration pads

Speed controller

As an option, Whiteline heat exchangers can also be equipped with a speed controller.

The speed controller regulates the motor speed of the heat exchanger fan as a direct function of pressure/temperature changes

Use of a speed controller has the following advantages:

- Reduction of condensation pressure fluctuations and maintenance of the minimum required condensation pressure for the expansion valve to function. This ensures that the required refrigeration capacity is met.
- Avoidance of unnecessarily high condensation pressure which has an adverse effect on refrigeration capacity and results in an increased level of compressor energy consumption.
- Marked reduction in the noise of the heat exchanger. This is brought about by not starting and switching off the fan motor all the time and by avoiding over-high speeds.

The speed controller needs to be set before start-up (refer to the manufacturer's documentation). This is to be supplemented by drawing upon and following manufacturer documentation of the individual components enclosed with the documentation.

If needed, please get in touch with our technical department (for address see page 2).

4.2. *Functional principle*

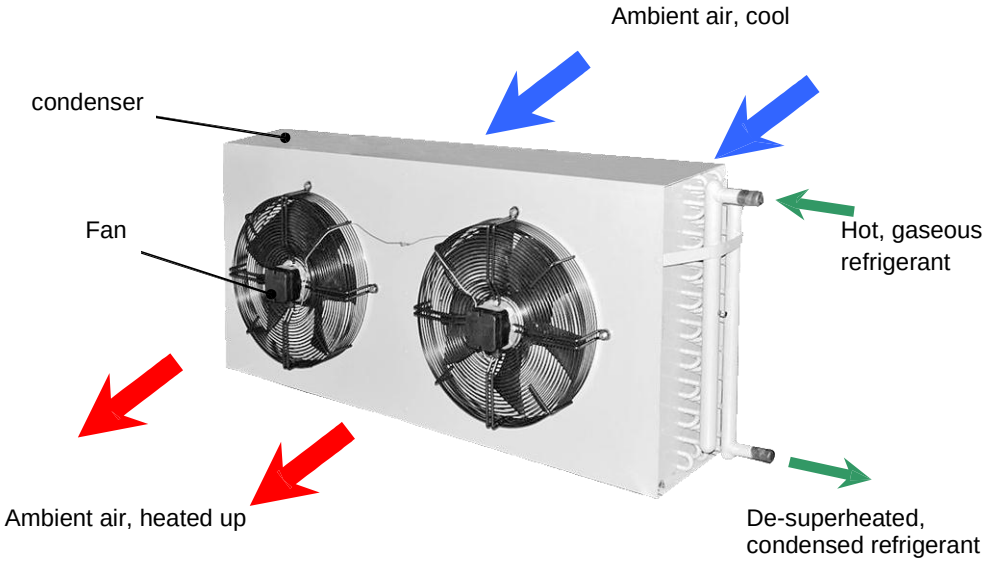


Fig. 8: Functional principle of an air cooled condenser.

A fan-ventilated condenser is a component of a compression refrigeration circuit, which dissipates the heat from the refrigerant into the ambient air.

The condenser is the heat exchanger, in which the entering gazeous refrigerant is de-superheated by rejecting the heat to the ambient air. The ambi- ent air is guided mechanically through built-in fans over the heat transfer area of the heat exchanger, i.e. the entire exterior surface of the condenser.

The gazeaous refrigerant supplied to the condenser is completely condensed into a liquid and subcooled to the greatest possible extent in the consender.

ATTENTION Tubes and individual components of the heat exchanger are designed for certain operating conditions. Continuous operations not respecting these conditions (see chapter 3.1, "Conditions of operation", page 16) are not permitted.

5. Transport and storage prior to startup

5.1. *Transport*

For transportation, the heat exchanger is packed in cardboard boxes or covered with foil and fitted onto a transport pallet or into a wooden crate.

For safety reasons, the heat exchanger may only be transported using permissible and suitable means of load suspension (e.g. lift trucks) that have a sufficient load capacity (for information on this, see weight specifications in the Centauro catalogues, which are on view in the Internet. Take special care in the process!

The forks of the forklift or hand pallet truck have to be driven fully under the heat exchanger or, respectively, the crate/pallet.

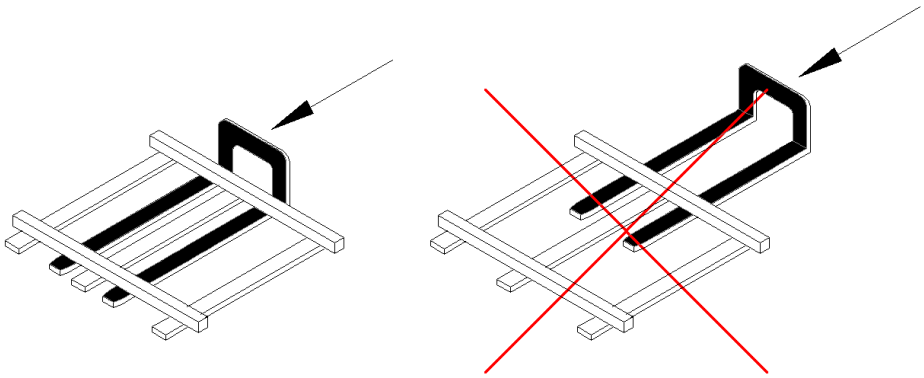


Fig. 8: Load suspension means

WARNING! ***Danger from falling loads.***

Note weight of the heat exchanger!

Refer on this to the weight specifications in the Centauro catalogues, which are on view in the Internet.

Only use suitable hoists and handling equipment!

DO NOT walk under the suspended load!

Secure the heat exchanger so that it can neither topple over nor slip! Ensure prior to transport that there are no people where the handling equipment is!

ATTENTION ***Heat exchanger lifting from the top only to be done at the envisaged crane hooks and ALWAYS with use made of a lifting beam! Ensure the weight is evenly spread!***

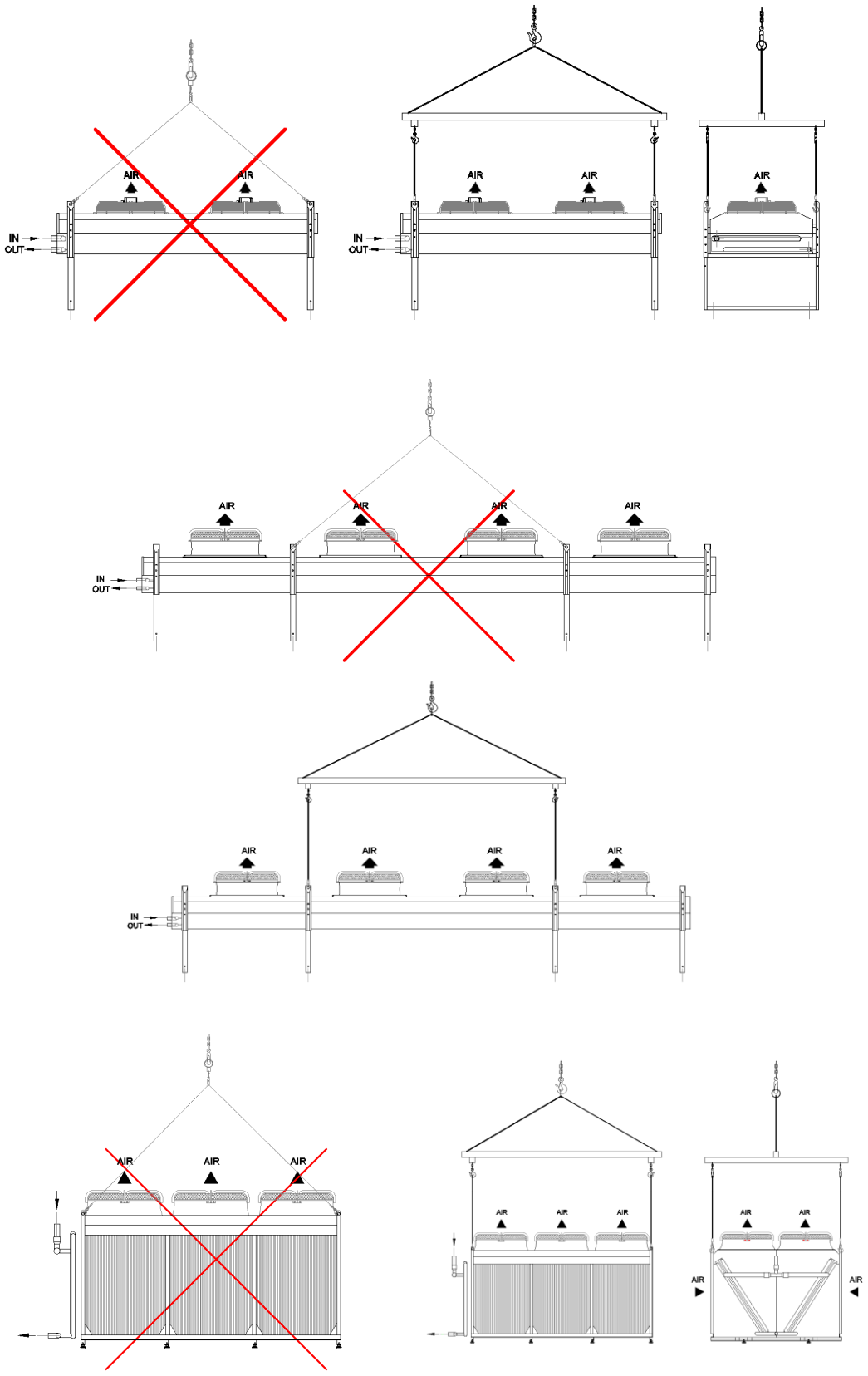


Fig. 10: Lifting instructions

ATTENTION ***Do heat enchangers must not be stacked on top of each other.***

Forbidden are: Lifting and transfer undertaken at piping or other components. This could lead to equipment damage and non-justifiable accident risks.

NOTE ***The warranty becomes null and void on damage arising from non-adherence to the transport conditions and safety steps!***

5.2. *Examination of the delivery*

Check whether the heat exchanger has been delivered in a damage-free condition and whether you have received the full scope of delivery. Let Centauro (for contact address see page 2) know immediately about any damage and record to this effect on the delivery note.

5.3. *Storage prior to startup*

If needed, the heat exchanger can be stored before installation into the overall refrigerating plant. Only store the heat exchanger in an enclosed space with protection from dust, contamination, moisture, damage and other damaging effects.

In view of the corrosion and contamination risk, the heat exchanger is not to be left standing around with open inlet and outlet piping, thus allowing moisture and dirt to penetrate.

ATTENTION ***In case of longer periods of standstill operate the fans 2 to 4 hours a month.***

6. Installation

6.1. *Preliminary notes*

6.1.1. Preparation prior to assembly

WARNING! ***Danger of cuts from contact with the edges and fins of the heat exchanger.***

In instances of handling, installation, maintenance, dismantling and taking-out-of-service, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

ATTENTION ***Danger of damage to the heat exchanger.***

The individual fins must not be bent so as to guarantee the continued functioning of the heat exchanger.

Carefully remove the outer packaging as well as all insulating and packaging material from the heat exchanger.

Prior to delivery, the heat exchanger is subject to a tightness test and filled with inert gas of 2 bar gauge pressure. Should the pressure at the Schrader valve be considerably under this figure on receiving the heat exchanger, then in all probability this points to a lack of tightness.

In this case, the heat exchanger piping is to be examined for tightness! Please then get directly in touch with Centauro (for contact address see page 2).

DANGER! ***Danger from excess pressure.***

The heat exchanger is delivered with a 1 bar gauge pressure of the nitrogen inert gas fill.

Always firstly discharge the inert gas fill when opening a part of the heat exchanger!

Wear personal protective gear (in particular protective gloves and protective goggles).

NOTE ***Penetration of air and/or humidity into the heat exchanger is to be avoided.***

CAUTION ***Danger of injury from incorrect assembly.***

Make a note of the rating plate particulars before mounting the heat exchanger into the overall plant!

6.2. *Place of installation*

The heat exchanger is designed for outdoor installation.

DANGER!

Danger of suffocation from inhaling refrigerant vapours.

Danger of poisoning from toxic substances set free.

Ensure that the place where the heat exchangers are installed is well ventilated!

WARNING!

Danger for the environment.

Refrigerants and lubricants must be prevented from leaking.

Make suitable provisions to this end!

WARNING!

Danger of injuries to the skin and to the eyes due to parts being thrown out.

Select the installation site such that parts being thrown out from the fans cannot hit people if the wheel breaks.

CAUTION!

Danger of stumbling from incorrect installation.
Danger of slipping from water, refrigerant or oil escaping.

Configure the place of installation so that there is no risk of stumbling or slipping.
Regularly check on connections as to seal-tightness!

The installation surface is to be:

- Firm
- Level
- Horizontal

We recommend the use of suitable load suspension means (fork-lift trucks or lifting platforms) to install or move the heat exchangers. Regulations on operational safety prescribe the use of chain hoists if loads are over 25 kg.

ATTENTION

Danger of damage to property

Before installing the heat exchanger check that the permitted load capacity of the floor is not being exceeded by the use of the lifting platform.

To ensure even functioning of the heat exchanger, also note the following when installing the air-cooled condenser:

The intake zone upstream of the condenser must be kept clear to allow the air stream to flow freely through the condenser. In this way, the re- frigerant heat can be discharged via the fins.

An adequate supply of fresh air in the vicinity of the condenser intake zone must be ensured.

The air outlet zone downstream of the condenser must be adequately dimensioned to allow the emitted air flow to be discharged, in order to avoid forming of an air short-circuit flow between the supply and ex- haust air of the condenser.

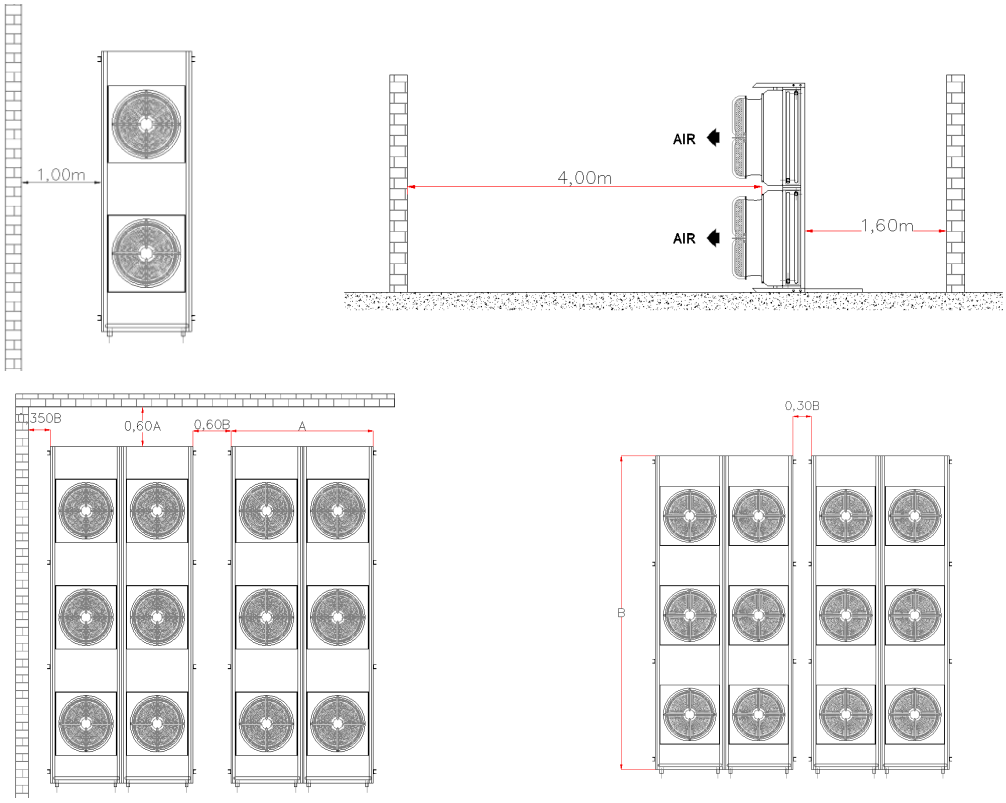


Fig. 11: Required distances for condenser installation

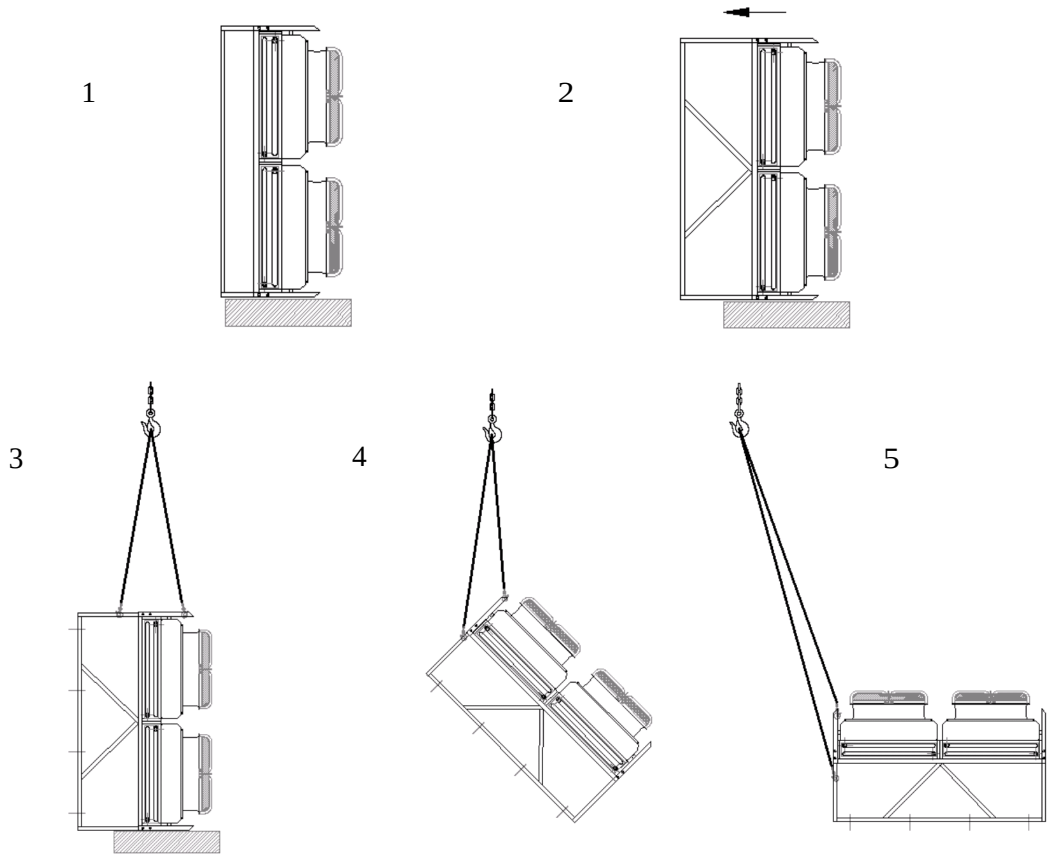


Fig. 12: Condenser types ACI / ACP / ACPD / ACJ Extracting the premounted mounting profiles, tilting from its transport position to its horizontal installation position (if required)

The condensers are to be fixed to the place of installation at their mounting points with screws which correspond to their weight. The company operator or installation firm is responsible for secure fastening of the screwed connections.

The following are to be noted when fixing the appliances:

Choose a place for installation with an effective circulation of air

The total weight during the operation is to be noted when fixing the heat exchanger. The fastening screws must be accordingly adjusted.

A suitable bolt locking device is to be used to stop the fastening screwed connection from becoming undone

The fastening screwed connection must not be over-tightened.

For a preferably even distribution of load, all the fastening screwed connections are to be evenly tightened.

The fastening screwed connection must be checked as to functional reliability as part of interval-based maintenance (refer here to Chapter 9, “Service and Maintenance“, page 45).

The heat exchanger is to be fastened and/or installed so that it is not damaged by possible surrounding hazards (production, materials handling and other operations in the installation area) and/or is not impaired in its function from the operations of non-authorized persons.

NOTE ***All mounting points must constantly maintain the spacing to the fastening surface under load so that no stress develops in the heat exchanger. The heat exchangers are to be fixed in their fastening position to stop appliances shifting.***

ATTENTION ***Mount or install the heat exchanger so that the air inlet and outlet area can be kept largely free and there will never be an air short circuit.***

WARNING! ***Danger of cuts from contact with the edges and fins of the heat exchanger.***

In instances of transport, handling, installation, maintenance, dismantling and taking-out-of-service, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

ATTENTION ***Danger of damage to the heat exchanger.***

The individual fins must not be bent so as to guarantee the continued functioning of the heat exchanger.

ATTENTION ***So as to provide the piping with a certain degree of protection against fracture, no condenser swinging is to be tolerated under operations. This means additionally fixing angle sections or tensioning rods to the vertically installed condensers at the envisaged securing points!***

6.3. *Connecting to the piping*

WARNING! ***Danger of injuries from lines or vessels bursting and given leakages.***

Ensure that joints are seal-tight when connecting the piping!

Only make use of lines, vessels and components of an adequate strength!

The heat exchanger is to be linked to and soldered into the refrigeration plant by the following line connections:

Connection of the heat exchanger inlet

Connection of the heat exchanger outlet

Extreme care and meticulous cleanliness is required when laying piping in refrigeration systems. For refrigeration plants only use appropriate pipes (standards EN 378-2) which inside are absolutely clean, dry and contamination-free (e.g. scale, rust and flux residues).

Possible effects of contamination:

Obstruction of nozzles, filters and needle valves
Contamination of solenoid valve seats
Contamination of optical sensors (e.g. electronic regulators)
Oil slagging
Deposits forming on the inside of the pipe and at moving parts

ATTENTION ***To protect the refrigeration plant from damage and component negative effects, Centauro recommends the fitting of a suction filter as well as other construc- tions to both lower the degree of contamination and stop dirt particles spreading through the overall plant.***

6.3.1. Preliminary notes

Soldering and welding

Always use inert gas (e.g. dried nitrogen) when carrying out soldering and welding work!

Make sure that the required soldering does not lead to parts (e.g. stop valves) overheating.

Proceed as follows when soldering:

- Shield damageable parts (e.g. pipe bends, distributor heads and housing of stop valves) with a protective plate and cover with a damp cloth.
- Direct the flame away from damageable parts.

6.3.2. Heat exchanger inlet connection

Connect the heat exchanger inlet connection to the discharge line of the refrigeration plant. Solder both lines together.

A number of the ACP / ACPD and VAC / VACVD condensers of a double-row design are equipped with two heat exchanger inlet connections (one for each fan row). Here, the connections must firstly be united by the installation firm on the spot into a header which is then to be attached to the hot gas line of the re- frigeration plant. Connection is of the soldering variety.

6.3.3. Heat exchanger outlet connection

Connect the heat exchanger outlet connection to the condensate line of the refrigeration plant leading to the refrigerant receiver. Solder both lines together.

A number of the ACPD and VACD condensers of a double-row design are equipped with two heat exchanger outlet connections (one for each fan row). Here, the connections must firstly be united by the installation firm on the spot into a header which is then to be attached to the condensate line of the refrigeration system. Connection is of the soldering variety.

To guarantee a fast and continuous oil return from the heat exchanger, take note in particular that the refrigerant outlet is located at the lowest point of the heat exchanger, in order that the oil is not trapped but can freely drain out.

6.4. *Electrical connection*

DANGER!

Danger due to electricity.

Only electicians may carry out work on electrical equipment!

Take the following precautions prior to carrying out any work on electrical equipment:

- ***Switch off the main switch and protect it against reactivation.***
- ***Make sure the unit is off-circuit.***
- ***Ground and short-circuit.***
- ***Cover or fence off parts under voltage.***

Observe the local safety regulations!

Regularly check the state of the cables!

Electrically connect the following electrical components individually to the heat exchanger prior to first start-up:

For basic equipment:

– Fan(s)
– Thermal contacts (if external)

Accessories:

– Maintenance switch
– Speed controller

The electric installation of the heat exchanger must be carried out according to current regulations and standards. Take note in particular of the regulations of the local electricity supplier!

For the electric installation refer to the electrical data provided in the Centauro catalogues, which are on view in the Internet.

The electric installation of the heat exchanger is to be carried out according to the circuit diagram in the terminal boxes of the fan(s). In the case of a separate switch cabinet, the wiring diagram will also have to be taken into account.

The electric circuit diagram must also be checked.

ATTENTION ***Danger of damages to the electrical components.***

Prior to connecting the electrical components to the mains, observe the existing voltage and current!

Compare them to the motor specifications on the nameplate of the electrical components!

Mind the rotational direction of the fan(s)!

Ensure the correct rotational direction during the electrical connection of the fans. Like various other types of fan, axial fans only push air in one rotational direction.

Because fans can turn in both directions, the correct rotational direction depends on the connection of phases L1, L2 and L3. If the phase allocation is not precisely known, there is a 1:1 chance of getting the correct rotational direction. For the first start-up of the fan it is important to look out for this and ensure that the fan is rotating in the correct direction. You will recognise this by the fact that the air draft or air pressure (velocity pressure) is ascending, when the fan is in operation.

All three-phase current models are wired identically internally. Once the correct phase sequence has been detected, it is important to keep the appropriate notes and instructions in a suitable place for servicing purposes.

All other fans can be connected similarly in this particular system or this installation and the fans will operate in the correct rotational direction.

7. Startup

ATTENTION ***The heat exchangers are designed for installation in compression refrigeration plants which satisfy the requirements of the European Machinery Directive 2006/42/EC and the European Pressure Equipment Directive 97/23/EC. They are only to be put into operation on having been installed into these systems and when the overall plant complies with the respective legal regulations.***

ATTENTION ***To prevent malfunctions of three-phase fans, the rotational direction of the winding connections must be checked before start-up.***

ATTENTION ***Prior to startup of the plant, a test is required on the basis of § 14 of the Workplace Safety Ordinance and/or in keeping with national regulations.***

The heat exchanger would be permanently damaged if operations are carried out at pressures greater than the **max. allowable operating pressures** (refer on this to Chapt. 3.1, “Conditions of operation", p. 16). In the worst possible case the heat exchanger would burst.

DANGER! ***Danger of injury due to squirting refrigerants and oil or parts being thrown out if lines/vessels burst.***

Carry out the following procedures for startup, operation and maintenance:

- ***Regularly check on connections, lines and vessels as to seal-tightness and condition!***
- ***The max. allowable operating pressure (refer to Chapt. 3.1, “Conditions of operation", p. 16) must not be exceeded!***

Adhere to safety instructions when handling pressure vessels!

WARNING! ***Danger due to rotating fans.***

The heat exchanger may only be commissioned and operated with mounted fan guards! Do not disassemble the fan guards!
Electrical parts must be isolated from M.P.S (main power supply) during maintenance.

WARNING!

Danger for the environment.

Refrigerants and lubricants must be prevented from leaking. Make suitable provisions to this end!

WARNING!

Danger of severe injuries and even strangling if hair or clothes are drawn in by mobile parts.

Observe the following when carrying out work on the heat exchanger:

- ***Wear tight-fitting clothes!***
- ***Cover long hair with a hairnet!***
- ***Do not wear jewellery!***

CAUTION!

Danger of frostbite to the limbs when touching the line at the heat exchanger outlet and its components.

The refrigerant causes the piping at the heat exchanger outlet to become extremely cold during op- eration. This is why thermal insulation is to be fitted at the piping running from the heat exchanger.

Startup and operations only with fitted insulation!

Regularly check the thermal insulation as to condition and replace, if necessary!

When working on or with the heat exchanger, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

7.1. *Preparatory works prior to first startup*

ATTENTION

Danger of damage to components from the use of non-permitted refrigerants.

Only use the refrigerants specified!

The following tests and steps are to be carried out prior to first startup of the heat exchanger.

7.1.1. Compression strength test

When completing the "refrigeration plant" assembly, a compression strength test as in keeping with the national regulations is to be carried out and recorded in writing.

7.1.2. Tightness test

The heat exchangers are subject to a pressure tightness test before they are delivered. That is why it is not absolutely necessary for the heat exchanger and its pipe connections to be tested before startup (see Chapt. 6.1, "Preliminary notes", p. 30). However, the components and connecting lines mounted by the refrigeration system installer must be tested by a specialist for seal-tightness and pressure.

Note the following when conducting tightness and pressure tests:

- Carry out the tests in keeping with the provisions and standards in force and record in writing.
- The maximum allowable pressure at the heat exchanger inlet andoutlet must not be exceeded (refer to Chapt. 3.1, ‘‘Conditions of operation", p. 16).

7.1.3. Evacuating and drying

Air and moisture get into the piping and components when the heat exchanger is installed.

Possible effects of air remaining in the refrigeration plant:

- Increased discharge gas temperatures
- Performance losses from non-condensable gases
- Possible failure of compressors from overloading and oil coking

Possible effects from residual moisture:

- Acid forming with failure of the compressor due to motor coil damage
- Metal corrosion
- Reduction in system service life
- Ice forming in valves, control and regulation mechanisms

Piping and components of the refrigerant circuit are therefore to be thoroughly and properly evacuated and dried. Use suitable vacuum pumps.

ATTENTION ***Keep on evacuating the high pressure and low pressure sides until you have a vacuum final figure of at least 0.07 mbar abs. Watch out for any shutoff piping sections.***

ATTENTION ***Plant residual moisture must not be above 100 ppm!***

7.1.4. Control of the electrical connection

DANGER!

Danger due to electricity.

Only electricians may carry out work on electrical equipment!

Take the following precautions prior to carrying out any work on electrical equipment:

- ***Switch off the main switch and protect it against reactivation.***
- ***Make sure the unit is off-circuit.***
- ***Ground and short-circuit.***
- ***Cover or fence off parts under voltage.***

Observe the local safety regulations!

Regularly check the state of the cables!

Check all of the electrical connections. Make sure that the supply line is in order, i.e. the specified values (voltage, frequency, number of phases) are complied with. Only use suitable tools and measuring devices to do this.

ATTENTION ***To prevent malfunctions of the three-phase fans, the rotational direction of the winding connections must be checked before start-up.***

The electric circuit diagram must also be checked.

7.1.5. Final measures

Checking

ATTENTION ***All screw connections (especially on the fans), fixings, electrical connections etc. must be checked for correctness.***

ATTENTION ***The wiring must be checked for correctness and the electrical safety measures for function prior to start-up.***

ATTENTION ***The power input of the fans must be checked***

ATTENTION ***The rotational direction of the three-phase fans must be checked and changed if necessary.***

ATTENTION ***All supply lines to the terminal boxes must be sealed according to their protection rating.***

ATTENTION ***The supply line must always be protected according to the smallest cross-section.***

ATTENTION ***All specified controlling equipment must be checked for correct function.***

ATTENTION ***All safety devices must be checked to ensure that switch-off and switch-on points have been correctly set.***

Opening operating valves

ATTENTION ***Open all operating valves before startup of the over-all refrigeration plant!***

8. Operation

WARNING! ***Inappropriate handling of the heat exchanger can have serious, if not lethal consequences!***

Have you read through all the operating instructions and particularly Chapt. 2.3, "Safety instructions", p. 11? The heat exchanger is not to be operated beforehand!
Note the regulations and standards in force on operating refrigeration and air-conditioning systems!

DANGER! ***Danger of injuries to skin and eyes from squirting oil and from gaseous refrigerant under high pressure.***

Undertake the following steps at the startup, operation and maintenance:

- ***Regularly check on connections, lines and vessels as to seal-tightness and condition!***

WARNING! ***Danger for the environment.***

Refrigerants and lubricants must be prevented from leaking. Make suitable provisions to this end!

Spilled oil is to be removed and properly disposed of i.e. with consideration given to the regulations in force!

WARNING! ***Danger due to rotating fans.***

The heat exchanger may only be commissioned and operated with mounted fan guards! Do not disassemble the fan guards!
Electrical parts must be isolated from M.P.S (main power supply) during maintenance.

WARNING! ***Danger of severe injuries and even strangling if hair or clothes are drawn in by mobile parts.***

Observe the following when carrying out work on the heat exchanger:

- ***Wear tight-fitting clothes!***
- ***Cover long hair with a hairnet!***
- ***Do not wear jewellery!***

WARNING! ***Danger of injury and even blindness due to parts being thrown out.***

Wear protective goggles when carrying out work on or with the heat exchanger (especially for start-up, operation and maintenance)!

CAUTION! ***Danger of burns when touching hot surfaces.***

During defrost operations do not touch the heat exchanger surface!
Let the surface firstly cool down after taking out of service!
When working on or with the heat exchanger, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

The overall refrigeration plant must be in operation for the heat exchanger to be operated.

The heat exchanger is to be switched on by opening the respective stop valves on the connection lines to the overall plant (refrigerant inlet and outlet) and by connection to the electrical system.

At the start, the heat exchanger requires a certain period of operation to get to its optimum working point. This is the case when it has complied with the conditions laid down for the specific application (refer here to the specifications and performance data in the Centauro catalogues in force (can be viewed on the Internet).

The working point is determined by the following parameters:

- Condensing temperature
- Volumetric air flow
- Air inlet temperature

Only on attaining the working point does the heat exchanger then operate under optimum conditions.

The manufacturer must be consulted should operating conditions (in keeping with the order-specific supply offer documents) be at variance with the specification.

9. Service and maintenance

WARNING! ***Inappropriate handling of the heat exchanger can have serious, if not lethal consequences!***

Have you read through all the operating instructions and particularly Chapt. 2.3, "Safety instructions", p. 11? The heat exchanger is not to be operated beforehand!

Note the regulations and standards in force on operating refrigeration and air-conditioning systems!

WARNING! ***Danger of personal injury.***

The entire work on or with the heat exchanger is only to be undertaken by authorized specialized personnel with in-depth knowledge of refrigeration systems..

DANGER! ***Danger of injuries to skin and eyes from squirting oil and from gaseous refrigerant under high pressure.***

Undertake the following steps prior to maintenance, retrofitting and dismantling:

- Wear personal protective gear (in particular protective gloves and protective goggles).

- Shut down the system.

- Wait for a minimum 5 minutes until the refrigerant and oil circulation has come to a standstill.

- Disconnect the heat exchanger from the rest of the system. For this, make use of the envisaged shutoff valves.

- Lower the pressure. Extract the refrigerant from the refrigeration system with a special recovery machine.

Undertake the following steps at the startup, operation and maintenance stages:

- Regularly check on connections, lines and vessels as to seal-tightness and condition!

WARNING! ***Danger for the environment.***

Refrigerants and lubricants must be prevented from leaking. Make suitable provisions to this end!

Spilled oil is to be removed and properly disposed of i.e. with consideration given to the regulations in force!

WARNING! ***Danger due to rotating fans.***

The heat exchanger may only be commissioned and operated with mounted fan guards!
Do not disassemble the fan guards!
Electrical parts must be isolated from M.P.S (main power supply) during maintenance.

WARNING! ***Danger of severe injuries and even strangling if hair or clothes are drawn in by mobile parts.***

Carry out the following procedures prior to maintenance, retrofitting and disassembly:

- ***Switch off the plant and protect it against reactivation.***
- ***Observe the after-running time of the fan wheel!***
- ***Only restart the unit after it has been completely reinstalled!***
- ***Wear a hairnet as well as tight-fitting clothes!***

WARNING! ***Danger of operational malfunctioning due to acidification and the development of toxic gases when undertaking soldering and welding on pipes with refrigerant.***

NO soldering or welding on pipes which contain refrigerant - even if depressurized!

CAUTION! ***Danger of burns when touching hot surfaces.***

During defrost operations do not touch the heat exchanger surface!
Let the surface firstly cool down after taking out of service!
When working on or with the heat exchanger, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

WARNING! ***Danger of injury and even blindness due to parts being thrown out.***

Wear protective goggles when carrying out work on or with the heat exchanger (especially for start-up, operation and maintenance)!

Maintenance (upkeep and repairs) and recurrent tests are to be implemented according to the specifications of the regulations and standards in force.

The operator is responsible for keeping to the deadlines for the requisite recurrent tests and for proper operation of the refrigeration plant (see the valid regulations and standards).

Only persons of competence as envisaged by the German Workplace Safety Ordinance or Technical Rules for Operational Safety (TRBS) No. 1203 and/or in accordance with the national provisions and regulations in force are to carry out maintenance work and repairs.

We recommend that you refer to the EN 378 as a maintenance plan in the form of a checklist for refrigeration plants.
Regular checks and upkeep ensure trouble-free operations. The place of installation and operating conditions determine which maintenance intervals are involved. During upkeep checks particular attention should be paid to signs of contamination, frost and/or ice forming, leaks, corrosion and vibrations.

9.1. *Heat exchanger maintenance*

WARNING! ***Danger of cuts from contact with the edges and fins of the heat exchanger.***

In instances of handling, installation, maintenance, dismantling and taking-out-of-service, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

ATTENTION ***Danger of damage to the heat exchanger.***

The individual fins must not be bent so as to guarantee the continued functioning of the heat exchanger.

The heat exchanger can only perform as projected and guaranteed if the coil block is clean. Dirt and frost and/or ice forming must be removed from the fins and also from the area close to the heat exchanger.

Dry dust or dirt can be removed with a brush, a broom or with pressurised air (pressure max. 50 bar; against the direction of the airflow of the-heat exchanger) or a high-performance industrial vacuum cleaner.

ATTENTION ***Danger of damage to property.***

- ***Always brush lengthways along the fins!***
- ***Use soft brushes!***
- ***Never brush crossways to the longitudinal direc-***

tion of the fins!
- Mechanical cleaning using hard objects, e.g. steel brushes, screwdrivers etc.) damage the heat exchanger and are prohibited.

Very damp or oily contamination must be dealt with using a high pressure water jet (pressure max. 50 bar), or steam pressure jet (pressure max. 50 bar), from a distance of at least 200 mm, and, if necessary using neutral cleaning agents, always against the direction of the airflow.

ATTENTION ***Cleaning should be carried out from the inside to the outside and from the top to the bottom.***

The jet of the cleaning device must never be applied at an angle to the surface of the fins, but only parallel to them (max. ±5 degree deviation), to avoid bending the fins.

Cleaning must be carried out until all dirt is removed.

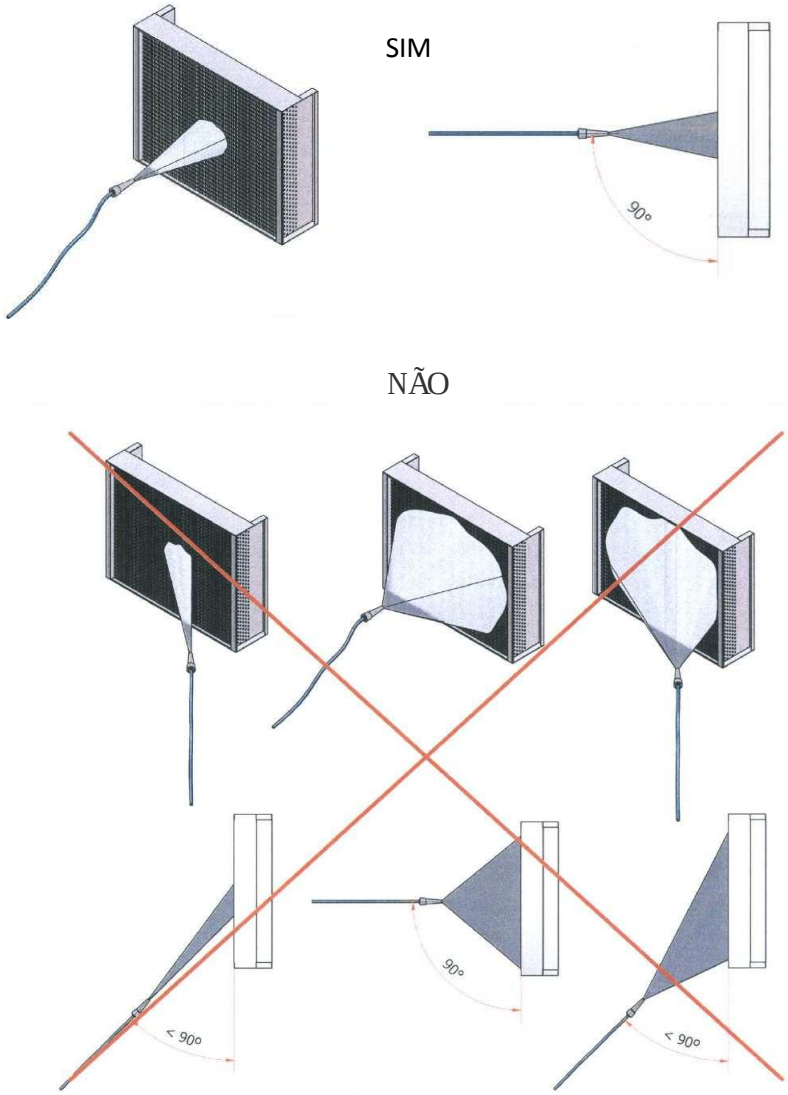


Fig. 13: Cleaning of the fins with water pressure jet or steam pressure water jet

DANGER!

Danger through electricity.

During the cleaning the heat exchanger MUST be switched off both at the refrigeration plant and electrically.
Electrical connections and motors must not come into contact with water or steam jets.

ATTENTION

Danger of damage to property.
When using cleaning agents in cold rooms, attention must be paid to the corrosion resistance of the heat exchanger materials to the cleaning agents used!

Only use cleaning agents which act neutrally towards the device materials and not aggressively or corrosively.

Dirt and other contamination on the fans and the fans' protective guards must be removed regularly, because otherwise this will lead to imbalance to the point of destruction or to loss of performance. The fan motors themselves are maintenance-free.

WARNING!

Danger due to rotating fans.

The heat exchanger may only be commissioned and operated with mounted fan guards!
Do not disassemble the fan guards!
Electrical parts must be isolated from M.P.S (main power supply) during maintenance.

Attention is also to be paid to the following:

- Check the pipe system for leaks. In case of leaks moisture and air may penetrate the pipe system. Seal the system and generate a vacuum. Then recharge the system.

- Check the fins for visibly unusual ice deposits. Increased formation of ice may indicate faulty or inadequate defrost heating or incorrect attaching of the defrost sensor.

- Check whether the fans can run freely in the wall ring nozzle.

- Strange noises during the fan's operation indicate faulty bearings.

10. Disassembly, storage and disposal

WARNING! ***Inappropriate handling of the heat exchanger can have serious, if not lethal consequences!***

Have you read through all the operating instructions and particularly Chapt. 2.3, "Safety instructions", page 11? The heat exchanger is not to be dismantled beforehand!

Note the regulations and standards in force on operating refrigeration and air-conditioning systems!

WARNING! ***Danger of personal injury.***

The entire work on or with the heat exchanger is only to be undertaken by authorized specialized personnel with in-depth knowledge of refrigerating systems.

DANGER! ***Danger of injuries to skin and eyes from squirting oil and from gaseous refrigerant under high pressure.***

Undertake the following steps prior to maintenance, retrofitting and dismantling:

- ***Wear personal protective gear (in particular protective gloves and protective goggles).***
- ***Shut down the system.***
- ***Wait for a minimum 5 minutes until the refrigerant and oil circulation has come to a standstill.***
- ***Disconnect the heat exchanger from the rest of the system. For this, make use of the envisaged shutoff valves.***
- ***Lower the pressure. Extract the refrigerant from the refrigeration system with a special recovery machine.***

CAUTION! ***Danger of burns when touching hot surfaces.***

During operations do not touch the heat exchanger surface!
Let the surface firstly cool down after taking out of service!
When working on or with the heat exchanger, personal protective gear (protective goggles, protective gloves, safety shoes) is to be worn!

WARNING! ***Danger of severe injuries and even strangling if hair or clothes are drawn in by mobile parts.***

Carry out the following procedures prior to maintenance, retrofitting and disassembly:

- ***Switch off the plant and protect it against reactivation.***
- ***Observe the after-running time of the fan wheel!***
- ***Only restart the unit after it has been completely reinstalled!***
- ***Wear a hairnet as well as tight-fitting clothes!***

10.1. *Disassembly*

Proceed as follows in dismantling the heat exchanger from the overall plant:

- After having disconnected the power supply to the switch cabinet, first of all, shut-off the electrical connections of the various heat exchanger components. For information on the individual parts, refer to the Centauro catalogues, which are on view in the Internet.
- Relieve the plant from pressure. For this purpose, withdraw refrigerant from the entire refrigeration plant using a suitable recovery machine (avoid any emission of refrigerants!). There are connections specially rovided for this on the common suction and common discharge line of the refrigeration machine unit. Connect the recovery machine to them and withdraw the refrigerant.
- Refrigerant is only to be stored in approved recycling pressurized gas tanks.
- Close all the stop valves in the refrigerant circuit.
- Then disconnect the following pipe links to the overall plant:
  - Refrigerant inlet
  - Refrigerant outlet

10.2. *Storage after disassembly*

The following steps must be carried out once the heat exchanger is dismantled and stored:

- Dry out the heat exchanger.
  Before storage ensure that no moisture is left in the complete unit.
- Hermetically seal the connections.
  Also place an end section on the end of each of the following open lines and thoroughly seal them:
  - Refrigerant inlet
  - Refrigerant outlet

ATTENTION ***Danger of damage to the heat exchanger.***

On no account is any moisture to get into the pipe system during the time the heat exchanger is stored!

ATTENTION ***In case of longer periods of standstill operate the fans 2 to 4 hours a month.***

10.3. *Disposal*

Consideration is to be given to the relevant, valid regulations and standards (incl. waste disposal ordinance) when disposing of the heat exchanger!

WARNING! ***Danger for the environment.***

Spilled oil is to be removed and properly disposed of i.e. with consideration given to the regulations in force!