

## INDUSTRIAL DRY COOLER/RADIATOR

FBL CUSTOMIZED AIR COOLED DRY COOLERS/RADIATORS



## INSTRUCTIONS

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#### **HOW TO CONTACT ALFA LU-VE**

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Visit [alfa.luvegroup.com](http://alfa.luvegroup.com) to get detailed contact information.

TECHNICAL INFORMATION SUPPLIED WITH THIS MANUAL AND OTHER MINOR CHANGES CAN BE MODIFIED WITHOUT NOTIFICATION.

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# A. General

## 1. To the User

Dear User,

This instruction's manual is intended to be your permanent guide for the different situations you may encounter when using this equipment.

Alfa LU-VE recommends you study this manual carefully and ensure that it is available for the personnel installing, operating and maintaining the equipment.

If you might have some problem not reviewed in this manual, don't hesitate to contact the closest Alfa LU-VE's representative. We can offer you our help wherever you may be located.

### **NOTE!**

Alfa LU-VE will not become responsible for any equipment failure if the user misinterprets the instructions of this manual.

## 2. System Warranty

This equipment is designed to operate properly and produce rated capacity when installed in accordance with accepted industry standards. Failure to meet the following conditions may result in voiding of the system warranty:

1. System piping must be installed following industry standards for good piping practices.
2. Inert gas must be charged into piping during welding.
3. System must be thoroughly leak-checked and evacuated before initial charging.
4. As standard the electrical connections must comply with the following conditions:
  - a. All voltages must not exceed  $\pm 5\%$  of nameplate ratings. Frequency 50-60 Hz.
5. Factory installed wiring must not be changed without written approval from Alfa LU-VE

### **NOTE!**

Please follow these instructions to guarantee safe and correct installation, service and use FBL radiators. Please do not change or repair the unit without the manufacturer's permission and instructions! The neglect to follow the instructions may result in warranty expiration.

## B. Safety

### 1. Terms Used in the Manual

**ALWAYS READ THIS MANUAL BEFORE USING THE EQUIPMENT!**



#### Warning and note

**WARNING!**

Includes information, the negligence of which might result in accident or fatality.



**NOTE!**

Includes information, the negligence of which might cause damage to unit, environment, assembly or service.





### 2. Warning Signs

	General warning
	Overhead load
	Forklift trucks and other industrial vehicles
	Moving parts Moving parts can crush and cut. Do not operate with guard removed.
	Hot surfaces sign The temperature is over +45°C (protein clotting) and can cause burns.
	Automatic start-up
	Electricity Danger of electricity shock if voltage parts are touched.




## B. Safety

	Sharp element Contact with sharp element (i.e. fin) can cause injuries
	Crushing of hands Hands and fingers can be crushed, pulled in or otherwise injured with non-compliance








### 3. Prohibition signs

	No stepping on surface
	Do not extinguish with water No attempt to extinguish with water. Disconnect all voltages sources in the control panel
	No open flame. Fire, open ignition source and smoking prohibited Ignition sources must be kept away and ignition sources must not develop
	Do not lift with hook / no lift point




### 4. Mandatory action signs

	Wear eye protection Use eye protection: protective cover, protective glasses or face protection.
	Connect an earth terminal to the ground
	Wear safety footwear

## B. Safety

	Wear head protection
	Wear protective gloves Use hand protection: protective gloves must protect against mechanical and chemical dangers.
	Wear protective clothing Personal protective clothing must be suitable for the working fluid used and for low temperatures and must have good heat insulation properties.
	Ear protection
	Wear respiratory protection Use respiratory protection. Breathing apparatus must be suitable for the working fluid used.
	Disconnect before carrying out maintenance or repair Activate the electrical system and secure against switching on again before starting installation, maintenance and repair work.
	Check guard Before starting working machine, check that the guards of the fans are correctly fixed.

### 5. Operator qualification signs

	Unskilled worker, operator without specific skills capable of performing simple tasks upon instruction by qualified technicians.
	Lifting and moving equipment operator, a qualified operator capable of using the lifting and moving equipment for the materials and machine (while scrupulously following the manufacturer's instructions) in compliance with laws in force in the nation of use.
	Electrician, an authorized electrician how are capable to make electric connections.

## B. Safety



Manufacturer's technician, a qualified technician provided by manufacturer to conduct operations of complex nature in particular situations of whenever agreed with the user. This person may have mechanical and/or electrician and/or hardware and/or software skills as required.

### 6. Other signs



Important information

### 7. Residual Risks



#### **WARNING!**

Before lifting please check from the transport documents or from the product nameplate the unit weight and make sure that the lifting device, crane or truck are appropriate.

1. Attach belts or hooks, only to the equipment is equipped with
2. Be sure that the belts or slings with hooks will lift the equipment in balanced way



Do not stay under the unit being hanged!



#### **WARNING!**

The units must always be installed in a place with no entrance of outsiders.



#### **WARNING!**

For no reason a person should walk or step over unprotected heat transfer section, since besides damage it can generate an accident or a risky situation.



#### **WARNING!**

Before switching on the unit always make sure that everyone is on a safe distance from the unit



















#### **WARNING!**






Risk for slipping or falling down



## B. Safety

  	<p><b>WARNING!</b> Each fan is equipped with fan guard and a lockable service switch the wire spacing in the fan guard and the safety distance of the blade correspond to the safety standard concerning persons over 14 years. The safety guards are protections from contact only. Do not remove the safety guard, before the fan is shut down. The rotating impeller cause danger for cutting off, pulling in</p> 
	<p><b>WARNING!</b> Depending on the installation and operating conditions a sound pressure level greater than 70 dB(A) may arise. Use appropriate ear protection.</p> 
	<p><b>WARNING!</b> Breaks in pressure pipes or components may cause injuries. Do not exceed the unit design pressure. Only perform maintenance work on pressurized parts when the unit is empty.</p> 
	<p><b>WARNING!</b> In operation the heat transfer section and pipe temperatures exceed 45°C. Contact may cause burns. Use hand protection. Hot air over the unit when the unit is operating. Never work long time over unit when unit operates.</p> 
	<p><b>WARNING!</b> The electric connections may be performed by an authorized electrician only.</p> 
	<p><b>WARNING!</b> Before starting the service operation make sure that the electrical supply is reliably isolated; use lock-out/tag-out system! Check always by voltmeter that the unit is electrically isolated and shut off.</p> 
	<p><b>WARNING!</b> Strictly follow the suggestion of working fluid supplier (Material Safety Data Sheet). Prevent release of fluid and minimize the consequence of lacking adopting visual and acoustic alarms. Plan the installation field for recovering or disposing of the fluid.</p> 

## B. Safety

	<p><b>WARNING!</b> Before washing the heat transfer section, read the Material Safety Data Sheet of the detergent and follow the manufacturer's instructions!</p> <p>When vacuum-cleaning and washing, use protection glasses, safety gloves, safety shoes and other personal protection!</p> 
	<p><b>WARNING!</b> Do not lift the unit before it is fully emptied.</p>
	<p><b>WARNING!</b> Sharp edges, use protection glasses, safety gloves, shoes and clothes!</p> 

- Please note that the cables may also carry voltage, even the unit is powered off
- The action service switch on/off shall also restart the machinery/fan, take appropriate precautions.
- All the main pressure bearing parts of the air heat exchanger (AHE) have been design according to PED 2014/68/EU and Harmonized standards only for internal pressure within the limits of PS, TS pointed out in the name plate (positive pressure).
- The end user is responsible for adopting the suitable safety devices against overpressure and overheating (i.e. safety valves).
- The stop/emergency stop device is not supplied by manufacturer, because the total process risk may increase, or new risk would be introduced by the action of a localized stop/e-stop system.
- The periodic inspection of the safety devices installed on air heat exchanger (AHE) is in charge of end user according the national regulations.

# C. General Description

## 1. Equipment Description

### Customized air cooled dry coolers/radiators

**FBL** (FBLGC, FBLGE, FBLGS, FBLMC, FBLMS FBLGA, FBLGY) have been designed for heavy industrial cooling applications for cooling of various process liquids, even in the most extreme conditions.

Dual coil models are available for simultaneous cooling of LT/HT engine circuits.

Applications include:

- diesel and gas engine cooling
- turbine cooling
- oil cooling
- various processes (transformers, air compressors, etc.)

### Code description

FBLG	C	-	1200	-	12	-	6	A	8	-	128	DN100	S	4	+	96	DN80	-	S	2	-	Ep3
1	2		3		4		5	6	7		8	9	10	11		12	13		14	15		16

- 1 Customized Fincoil dry cooler/radiator
- 2 Range (S=standard coil width 2520 mm, C=container coil width 2240 mm, E=custom coil width, A=special coil configuration 2240 mm, Y=stainless steel tubing 2240 mm)
- 3 Coil length (mm)
- 4 Fan diameter (12=1240 mm, 18=1840 mm)
- 5 No. of fans
- 6 Power supply (A=3/380-420V/50Hz, B=3/440-480V/60Hz, C=3/380V/30Hz, D=other)
- 7 No. of motor poles
- 8 No. of LT circuits
- 9 LT connection size
- 10 LT connections (S=same end, D=different ends, A=all at one end)
- 11 LT coil size
- 12 No. of HT circuits
- 13 HT connection size
- 14 HT connections (S=same end, D=different ends, A=all at one end)
- 15 HT coil size
- 16 Coil code (coil configuration+coating+fin spacing)

## 2. Technical Data

Please see the dimensional drawing and Electrical drawings and Separate Datasheet for technical data, product designation, performance data, lifting/fixing points of fan motors, weights, internal volumes, position of connections!

## 3. Identification of the Product

Please check the identification data on the product nameplate! This nameplate is located at the end with inlet connections. The product nameplate includes contact information of the manufacturer, product designation, number of order acknowledgement, technical data of fan motor, operating/test pressure, min/max operating temperature, internal volume, weight, month/year of manufacture and CE/EAC - marking.

Manufacturer	Month/Year
Model: FBLGE-1110-8-6-B- 85DN80S + 102DN100S Serial no: 12345	O.A.: 967545-16
Unit net weight [kg]: -5000 +/- 5% Sn: 12345	
Motors [kW]: 6x 7.5 V <sub>N</sub> [V]: 3x 460 f [Hz]: 50 Current [A]: 15,5	
Country of origin: Finland	
 WARNING Read instructions manual before installation, operation and maintenance to avoid injuries or damages. Service enquiries: www.alfalaval.com	

Manufacturer	Month/Year
Model: FBLGE-1110-8-6-B- 85DN80S + 102DN100S Serial no: 12345	O.A.: 967545-16
Material: Cu FED category: ART 4.3. Volume [l]: 850 Max DN: 100 Fluid Group: 2 Coil TS [°C]: -60/110 PS [bar <sub>all</sub> ]: 9 PT [bar <sub>all</sub> ]: 9 Test date: 11/2018	
 WARNING Read instructions manual before installation, operation and maintenance to avoid injuries or damages. Service enquiries: www.alfalaval.com	

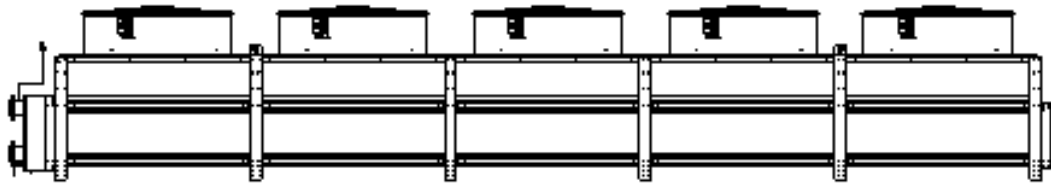
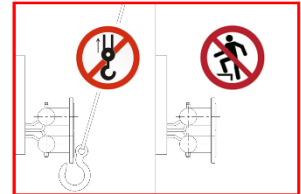
Fig. C.1: Product Nameplate

# D. Installation Instructions

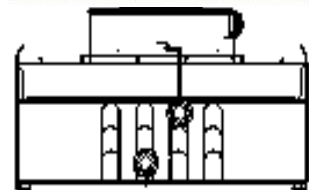
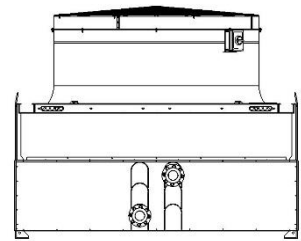
## 1. General

Before starting installation see “Residual risks” in this instruction manual.

During installation, appropriate personal protection equipment (PPE) shall be worn.  
The customer is responsible for the use of the most suitable PPE.  
Installation shall be carried out by qualified personnel.



- Check possible transport damages before installation. The supplier is not responsible for the costs caused by broken equipment as a result of faulty handling or transport damage.
- Check dimensions from dimension drawing.
- Install radiators so that tubes of the heat transfer section are in horizontal position.
- Use all fixing points. If base or concrete is not even (max 2 mm variation between fixing points next to each other), use filling under leg.
- Oval shaped fixing holes in the short legs allow heat expansion (look at the dimension drawing). Use fixing that allows movement to lengthwise direction.
- Trouble free operation of radiators demands good air venting in the system.
- Drain the water circulated radiators or use non- freezing liquid in the temperatures under 0°C.
- Standard model radiators do not feature gravity draining.



## 2. Transport and Storage

- Transport the radiators in a horizontal position (without legs).
- Use support under every leg or every leg fixing beam when storing at site (max 10 mm variation between legs next to each other).
- Long storage may cause damage to motor bearings. Look at the chapter D 3.c

### NOTE!

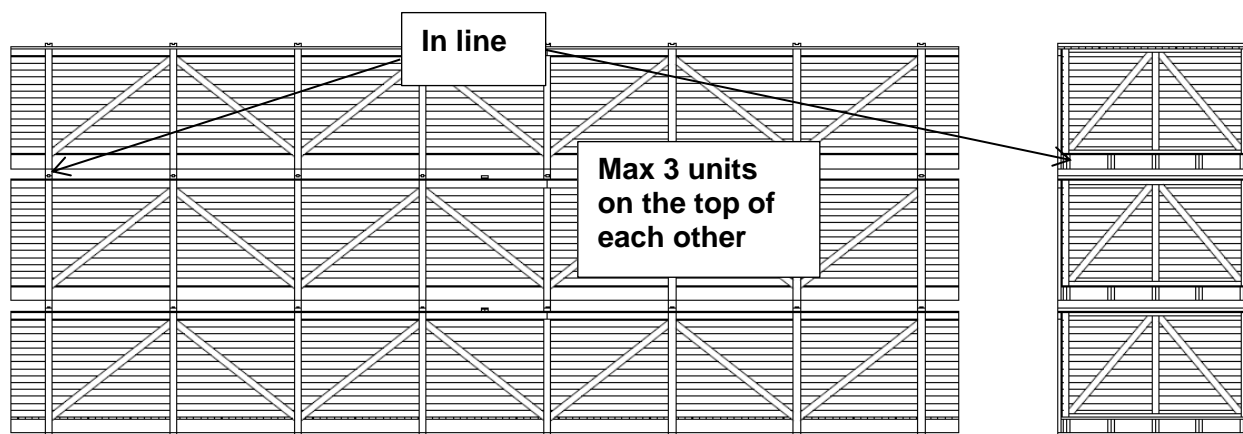
Long storage may cause damage to motor bearings. Look at the chapter D 3.c

## D. Installation Instructions

### Long-term storage of radiators:

#### a) In seaworthy packages

A seaworthy package protects best the radiator during long-term storage. If possible, keep the packages in dry room with even temperature. If the radiator is kept outdoors take care that there is no snow etc. on the package to avoid impressions, water-logging or decay, and to prevent water running into the package. Also take care that the vent holes of the package are clean to enable inside moisture evaporation. If there is moisture between the radiator and the plastic cover, some white rust will form on the hot dip galvanized surfaces. Often this is an aesthetical harm only.



#### WARNING!

To avoid falling of a seaworthy package

- Max 3 unit on top of each other.
- The packages must be placed in line.
- Store packages always in flat straight area.



More detailed instructions about seaworthy packing handling are in the separate instruction included to delivery list (Appendix 1).

## D. Installation Instructions

### b) Unpacked

The units shall be stored in dry spaces with even temperature.

If units are stored in humid outdoor spaces, where water may condensate inside their fan motors, it can cause corrosion and damages of fan motors (functional problem). In humid conditions, where the unit will not keep dry, some "white rust" can exist on the unit surface (visual harm).

During long term storage in humid outdoor space, to protect fan motors, they must be driven for at least 3-4 hours once a month or a continuous low voltage must be lead into the fan motors to keep their surface temperature higher than the air dew point temperature.

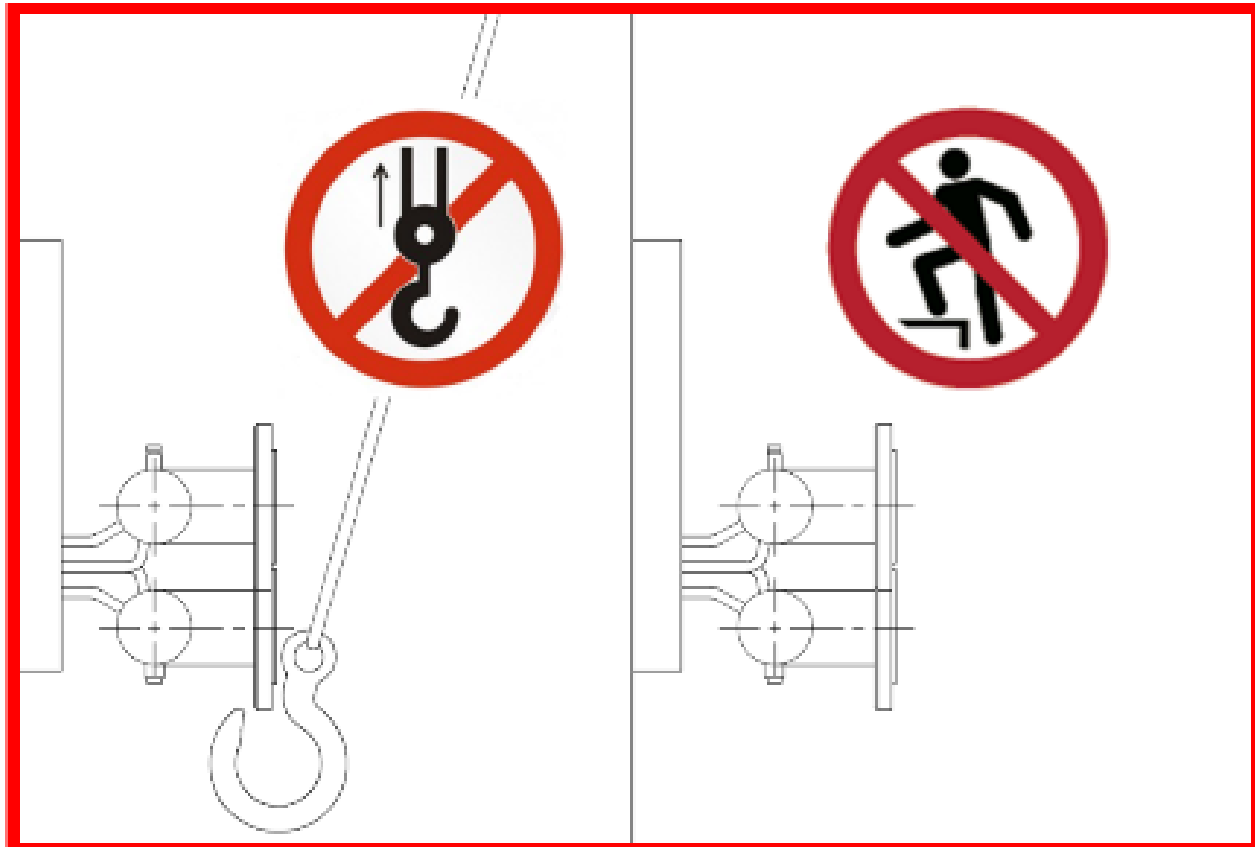


#### **WARNING!**

Before lifting please check from the transport documents or from the product nameplate the unit weight and make sure that the lifting device, crane or truck are appropriate.

1. Attach belts or hooks, only to the equipment is equipped with
2. Be sure that the belts or slings with hooks will lift the equipment in balanced way

Do not stay under the unit being hanged!



## D. Installation Instructions

### 3. Unloading from the container



#### WARNING!

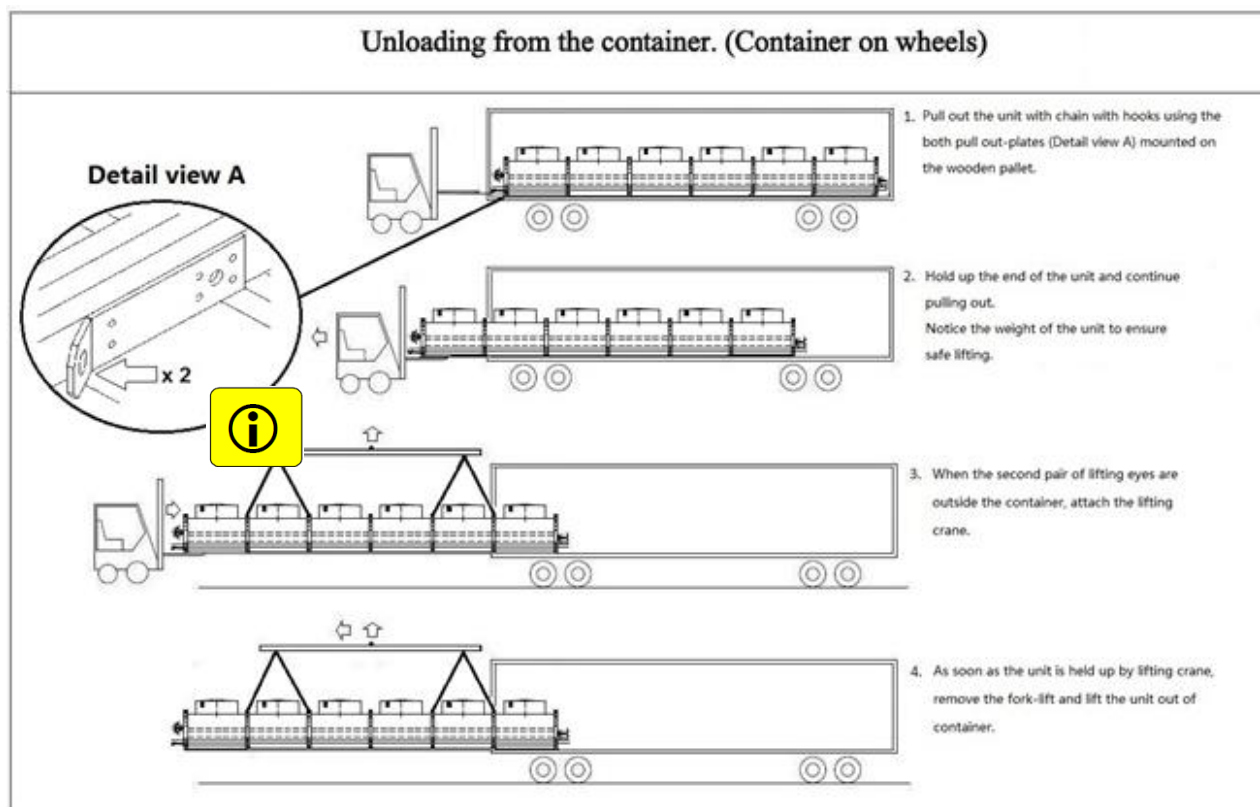
Before lifting please check from the transport documents or from the product nameplate the unit weight and make sure that the lifting device, crane or truck are appropriate.

1. Attach belts or hooks, only to the equipment is equipped with
2. Be sure that the belts or slings with hooks will lift the equipment in balanced way

Do not stay under the unit being hanged!



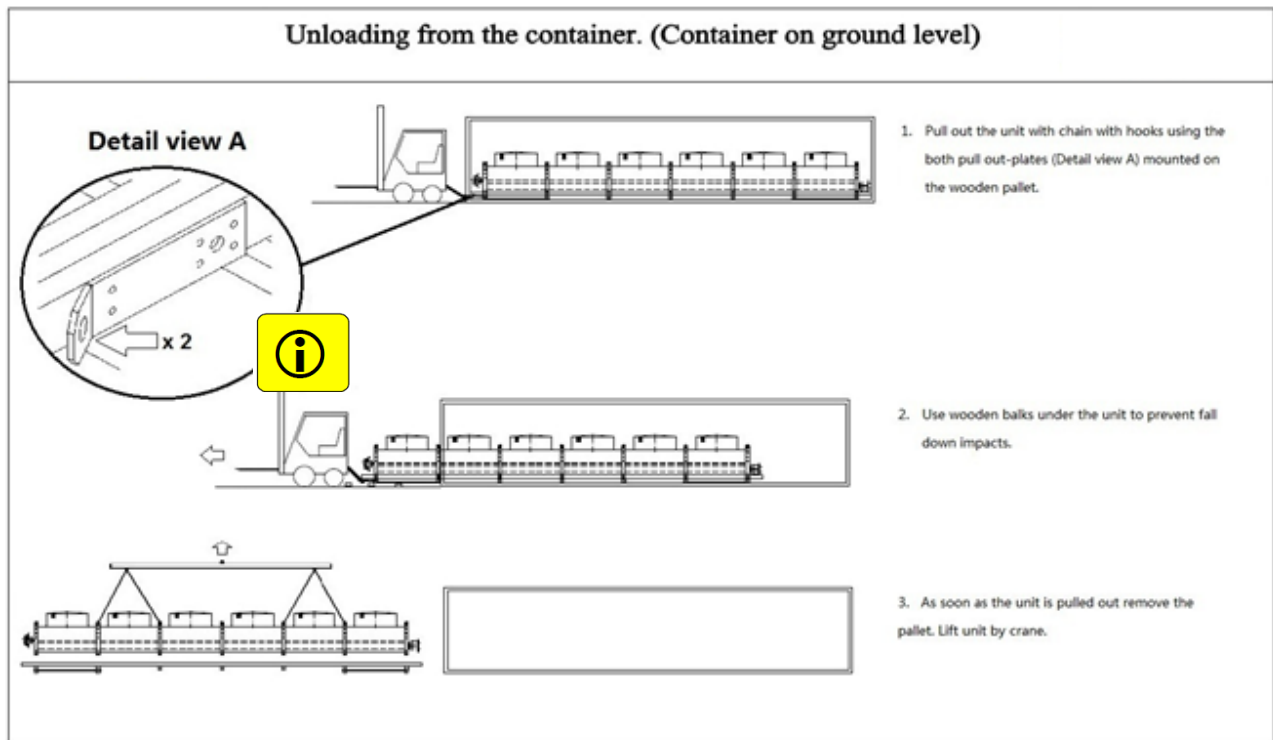
#### 3.1 Container on wheels



1. Open the container and double check. Damages should be claimed immediately to the transportation company in writing in the Delivery Note before being signed. Please check also that nothing is missing. In case of damages, please take photos.
2. Pull out radiator with a fork-lift. Please note: attach cargo straps to the wooden pallet under the radiator.
3. Hold up the end of the radiator and continue pulling out. Please pay attention to the weight of the radiator to ensure safe lifting procedure.
4. When the second pair of lifting points is outside the container, attach the crane.
5. As soon as the unit is held up by crane, remove the fork-lift and lift out the radiator.

## D. Installation Instructions

### 3.2 Container on ground level



1. Open the container and double check. Damages should be claimed immediately to the transportation company in writing in the Delivery Note before being signed. Please check also that nothing is missing. In case of damages, please take photos.
2. Pull out radiator with a fork-lift. Please note: attach cargo straps to the wooden pallet under the radiator.
3. Use wooden support bunks under the unit to prevent fall down impacts.
4. As soon as the unit is pulled out remove the pallet and lift the unit by crane.



## D. Installation Instructions

### 4. Lifting



#### **WARNING!**

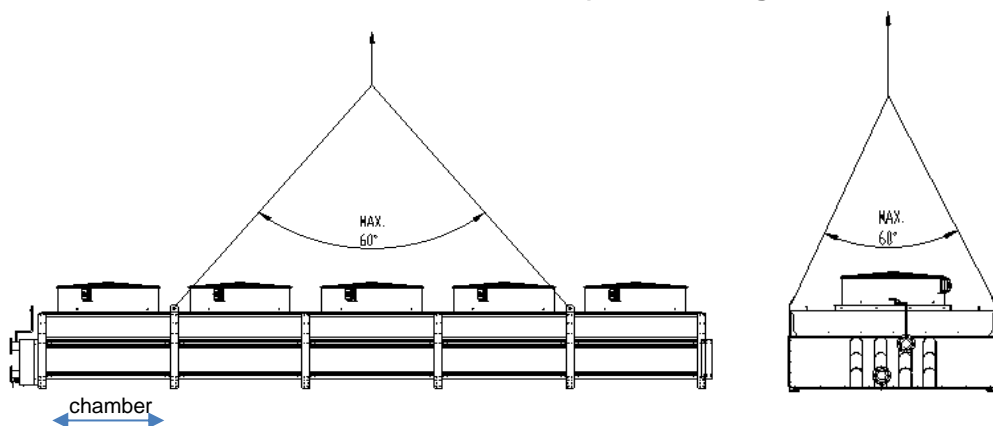
Before lifting please check from the transport documents or from the product nameplate the unit weight and make sure that the lifting device, crane or truck are appropriate.

1. Attach belts or hooks, only to the equipment is equipped with
2. Be sure that the belts or slings with hooks will lift the equipment in balanced way

Do not stay under the unit being hanged!

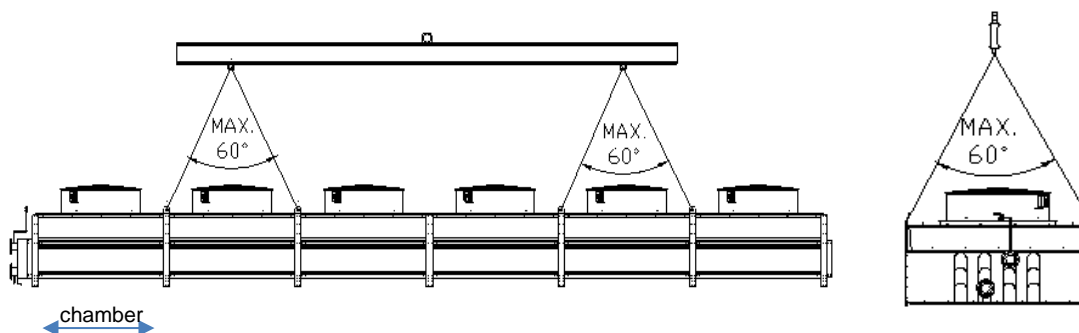


#### 4.1 Radiators with 1.2 m fans $\leq$ 4 chambers ( with 4 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough and a beam so that lifting angles are not exceeded. The minimum length of a lifting chain, when no lifting beam is used= distance of lifting points. See order specific dimensional drawing for details.

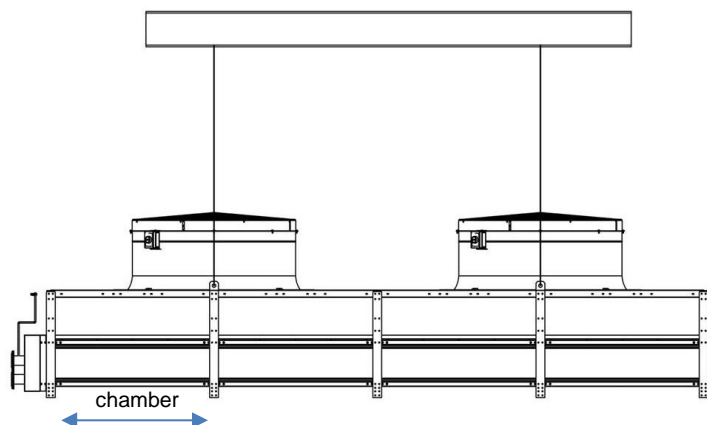
#### 4.2 Radiators with 1.2 m fans $>$ 5 chambers (with 8 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough and a beam so that lifting angles are not exceeded. The minimum length of a lifting chain, when no lifting beam is used=distance of lifting points. See order specific dimensional drawing for details.

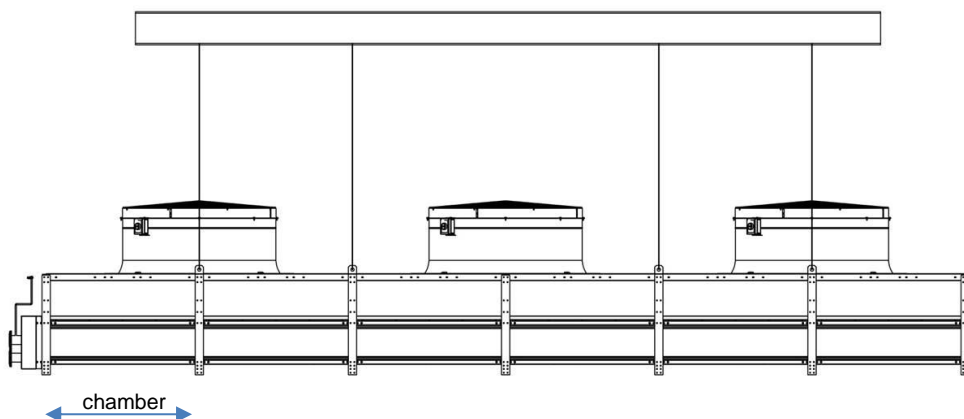
## D. Installation Instructions

### 4.3 Radiators with 1,8 m fans, max number of chamber $\leq 4$ (with 4 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough. Use straight beams for lifting. If the amount of lifting lugs exceeds 4, follow 4.4 guideline. See order specific dimensional drawing for details.







### 4.4 Radiators with 1,8 m fans, max number of chamber $> 4$ (with 8 lifting points)



- Use lifting lugs for lifting the radiators. Use a lifting device long enough. Use straight beams for lifting. See order specific dimensional drawing for details.

## D. Installation Instructions

### 5. Pipe Connections

	<p><b>WARNING!</b> In operation the heat transfer section and pipe temperatures exceed 45°C. Contact may cause burns. Use hand protection.</p> 
	<p><b>WARNING!</b> Breaks in pressure pipes or components may cause injuries. Do not exceed the unit design pressure. Only perform maintenance work on pressurized parts when the unit is empty</p> 
	<p><b>WARNING!</b> Fluid recovery and filling of the units may be performed by an authorized contractor only. Follow fluid suppliers instructions to prevent injuries and damages to environment and property.</p> 

Mount external tube lines so that their weight or heat expansion or vibration will not strain the tubes of the heat transfer section. Ensure allowable external moments and forces for inlet and outlet connections. You can use flexible couplings to ensure this. Alfa LU-VE can offer flexible joint solution See chapter: Expansion Joints (optional).



### 6. Tightening Torques

Size	Torque (Nm)
M6	9.5
M8	20.0
M10	30.0
M12	50.0
M16	120

The recommended torque for tightening the bolts is presented in the table D.1. All bolts used are grade 8.8 according to ISO 898-1. Do not use other type of bolts. For motors and related components follow torques presented in the separate motor manual. **For bolts fastening impeller to motor shaft the max 50 Nm torque must use!**

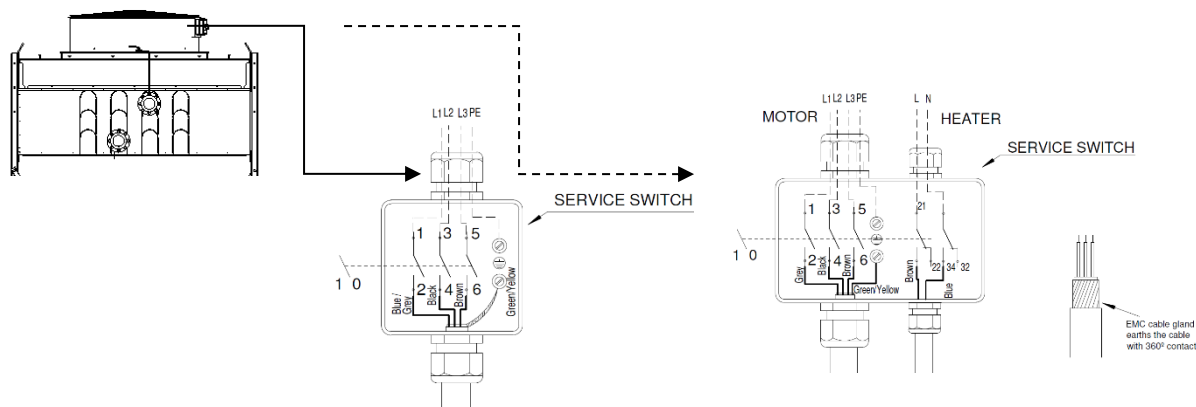
**Table D.1** Tightening tongues for bolts grade 8.8 (ISO 898-1)

### 7. Electric Connections

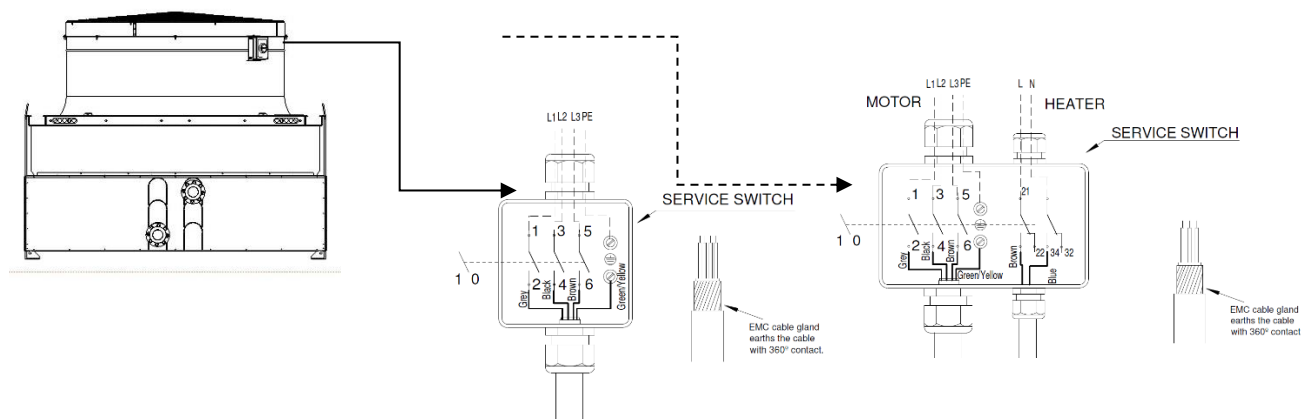
	<p><b>WARNING!</b> The electric connections may be performed by an authorized electrician only.</p> 
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## D. Installation Instructions

- Motors are wired to service switches, which can be locked.
- If separately specified, motors can be wired to a junction box at the radiator end.
- Connections to service switch with and without anticondensate heaters are shown in figures D.8 and D.9 below (standard units with 1.2 m and 1.8 m fans).



**Figure D.8:** Service switch (SW) cable connections with 1.2 m fans Fans' inner connection works as follows: When phases L1, L2 and L3 are connected to SW (junction box), the airflow direction is same as shown in the dimension drawing. Normal fan rotating direction is **counter clockwise**.



**Figure D.9:** Service switch (SW) cable connections with 1.8 m fans Fans' inner connection works as follows: When phases L1, L2 and L3 are connected to SW (junction box), the airflow direction is same as shown in the dimension drawing. Normal fan rotating direction is **clockwise**.

When using frequency converter with the fan motors, make sure that the recommended cable lengths are not exceeded and the fan motors are sufficiently protected.

### 8. Grounding

Radiator is grounded by the earth wires of motors. It's possible to earth the unit also through the leg.



## D. Installation Instructions

### 9. Checking

The equipment has been pressure-tested and the motors test-run at factory.

- Check possible transport damages before installation.
- Check that the fans start properly and their rotation direction is correct.
- Check that the airflow direction is in accordance with dimension drawing.
- Pressure test the tube connections. Use non-freezing liquid in temperatures under 0°C.

#### **NOTE!**

Ensure that possible installed fan transportation fixing belts and weather covers are removed before the first startup.

It is possible that the whole system (a radiator, a base and fixing flexibility) has natural frequency somewhere in operational speed range. If you use frequency converter for fan speed control, it is recommended to check critical frequencies and possible vibration peaks before start up. These frequencies can be avoided by using frequency by-pass.

### 10. Mounting Legs and Handrails (optional)

See separate instructions for installing FBL Mounting legs and Handrails.

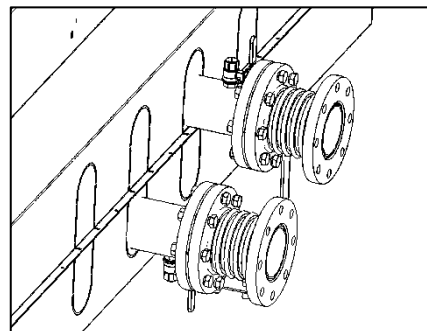
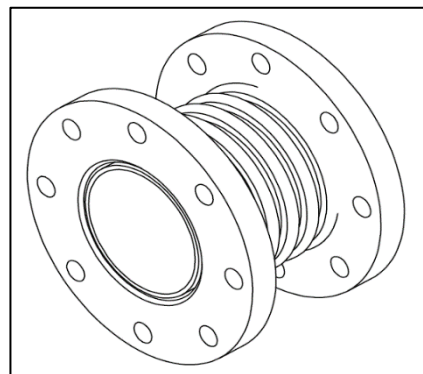
### 11. Expansion Joints (optional)

Benefits of using stainless steel expansion joints:

- Reduce harmful loads from piping to flange connection / manifolds of coolers
- Compensate heat expansion movements
- Reduce possible vibrations of piping
- Gives flexibility and more tolerances for installation
- Wider temperature range up to +125 °C
- Excellent corrosion resistance in different climates

Size	Item Id.	Size	Item Id.
DN65	9460080147	ANSI 2½	9460080145
DN80	9460080148	ANSI 3"	9460080146
DN100	9460080149	ANSI 4"	9460065882
DN125	9460080143	ANSI 5"	9460065883

**Table D.2** Available expansion joint sizes



## D. Installation Instructions

### 12. Cover plates between radiators (optional)



#### WARNING!

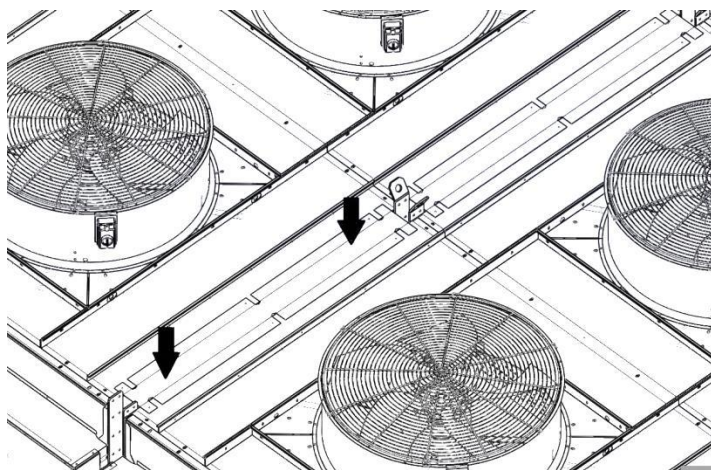
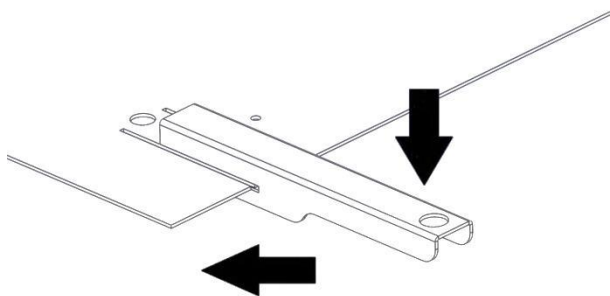
Sharp edges, use protection glasses, safety gloves, shoes and clothes!



#### NOTE!

If cover plates are painted, handle painted plates with care without scratching the painted surfaces!

- If multiple unit delivery includes cover plates, follow these instructions to cover gap between the radiators. Delivery includes a bend tool and drilling screws for cover plates.
- Before mounting cover plates bend the edges as shown in the picture left below with bending tool.
- Picture right above shows how cover plates between radiators are mounted. Mount with 6 drilling screw / cover plate.



## D. Installation Instructions

### 13. Cable covers (optional)



#### WARNING!

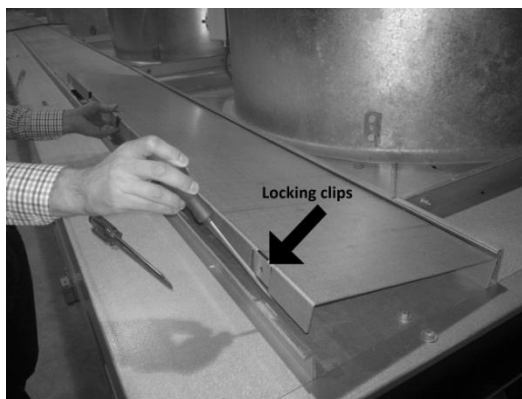
Sharp edges, use protection glasses, safety gloves, shoes and clothes!



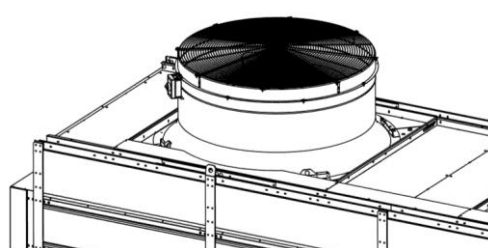
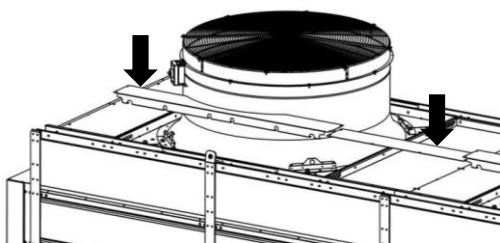
#### NOTE!

Painted cable cover plates are not mounted; handle painted plates with care without scratching the painted surfaces!

Radiator cable covers are already mounted on their places between deck plate bendings, as shown in the below.



**Figure:** For units with 1.2 m fans: Before wiring the radiator, cable cover plates need to be removed. Loosen the locking bend using 2 screwdrivers as shown on the left picture. When mounting the cable covers, make sure the cover plate is under the edge of deck plate. Make sure the cable cover bending clips around the rivets.



**Figure:** For units with 1.8 m fans: Before wiring the radiator, cable cover plates need to be removed. Open M8 hex-screws with tool. Remove cable covers. Install cables through plastic cable glands installed to casing and screw cover plates again to its positions.

# E. Operation

## 1. Operation

Before starting operation see "Residual risks" in this instruction manual.

During operation, appropriate personal protection equipment (PPE) shall be worn.  
The customer is responsible for the use of the most suitable PPE.  
Operation shall be carried out by qualified personnel.



### NOTE!

Ensure that possible installed fan transportation fixing belts and weather covers are removed before the first startup.

### Startup



To operate the unit, the system must be in operation, including the fluid circuit and electrical system. The unit must be started up by opening the respective valves on the inlet and outlet side of the fluid circuit and by connecting to the electrical system:

- Switch on electrical system (automatic startup of the fans)
- Open working fluid-carrying lines

### NOTE!

On freezing conditions open the inlet valve/by-pass valve slowly or control the pump start up speed to avoid tensions on the coil due to freeze structures. When the coil is ice free, continue the normal startup procedure.

## START UP PROCEDURE

- Before starting, check that all the equipment fastening screws are perfectly tightened
- Check that system inlet valve is closed and outlet valve is fully opened
- First open the system and header vent valves and the start liquid feeding pump slowly of open by-pass valve slowly. Fill the unit from bottom to up to avoid trapped air bubbles in the coil.
- When air from the system has been discharged close vent valves.
- Check the absence of leakage



## E. Operation

- Check the electric connections
- Ensure that fans are free from jams/obstacles
- Start the fans

### **NOTE!**

On freezing conditions it is recommended to use continuously fans at minimum speed.  
With cold start ensure that fans can rotate freely before startup.

### **Shutdown**

If the unit requires emptying for maintenance or system shutdown or dismounting, proceed as follows:

- Stop the system with normal shut down procedure;
- Stop/disconnect all the services (water and electrical; ensure that service switches are in off position), make sure that no expected or human error will cause further supply of water and electric power.
- Follow drainage instructions from section F 3.

## F. Service Instruction



### 1. Maintenance

Before starting maintenance see “Residual risks” in this instruction manual.

During service work, appropriate personal protection equipment (PPE) shall be worn.

The customer is responsible for the use of the most suitable PPE.

Maintenance shall be carried out by qualified personnel.

	<b>WARNING!</b> Risk for slipping or falling down
	<b>WARNING!</b> Depending on the installation and operating conditions a sound pressure level greater than 70 dB(A) may arise. Use appropriate ear protection.



Trouble-free operation of FBL radiators provides regular service to check. The necessary intervals between servicing depend upon the specific application and shall be stipulated by the operator according to the respective operating conditions.

However, Alfa LU-VE gives guidelines for regular service inspections:

Task	Inspection Interval
Cleanness and visual condition of the heat transfer section; if required clean unit.	1 week
General radiator and motor conditions	1 month
Fan visual condition and cleanness; if dirty clean the fans.	1 month
Fixing of the units, fans, fan motors and fan guards	1 month
When the radiator capacity is stepwise controlled by changing the number of fans, the running order of fans must be changed periodically	1 month
During stand-stills the fans must be operated for 3...4 hours	1 month
Vibration level and impeller tip clearance	6 month
Complete cleaning (coil)	6....12 months
Leak check	6 month
Normal lubrication period is 15 000 – 30 000 h. Grease amount and type are given in motor nameplate / motor manual	1 year

The Radiator top cover plates can be used as service desk. Alfa LU-VE recommended to install handrails and to use safety harness. Alfa LU-VE can offer solution for handrails and mounting legs.

## F. Service Instructions

### 2. Filling the Unit with Fluid

	<p><b>WARNING!</b></p> <p>Strictly follow the suggestion of working fluid supplier (Material Safety Data Sheet). Prevent release of fluid and minimize the consequence of lacking adopting visual and acoustic alarms. Plan the installation field for recovering or disposing of the fluid.</p> <div data-bbox="359 499 775 568"></div>
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Mix the fluid well before use.

The venting valve must be open

The system circuit filling shall be done “from down to up” to ensure coil circuit deaeration.

**NOTE!**

The Unit venting is not designed to cover whole system deaeration. It's recommended to use system circuiting deaeration to remove all absorbed air including micro-bubbles.

**NOTE!**

With water and improperly chosen brine water solution there is risk for unit freezing at ambient temperatures near 0 °C or below. The water tubing in the coil may be broken due to freezing water.

### 3. Drainage

	<p><b>WARNING!</b></p> <p>Fluid recovery and filling of the units may be performed by an authorized contractor only. Follow working fluid suppliers' instructions to prevent injuries and damages to environment and property.</p> <div data-bbox="352 1377 772 1456"></div>
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You can drain the radiator by using the drainage valve on the outlet connection tube. For drainage it is necessary to get air into the system, for example by opening the venting valve on the inlet header. This way the drainage takes a long time. To ensure complete drainage and to speed it up:

- Use a bigger connection tube for drainage, e.g. open the flange joint on the outlet tube.
- Drain the radiator from lower part of the system to reach a stronger siphon effect.
- Use a bigger connection tube for venting instead of a venting valve.
- The unit may not drain fully with gravity. Use pressurized air to complete emptying.

Prevent fluid escaping from the unit to environment.

## F. Service Instructions

### 4. Heat Transfer Section

	<p><b>WARNING!</b> Do not remove the safety guard, before the fan is shut down. The rotating impeller cause danger for cutting off, pulling in</p> 
	<p><b>WARNING!</b> Sharp edges, use protection glasses, safety gloves, shoes and clothes!</p> 
	<p><b>WARNING!</b> Before starting the service operation make sure that the electrical supply is reliably isolated; use lock-out/tag-out system! Check always by voltmeter that the unit is electrically isolated and shut off.</p> 

The normal and continuous operation of the unit will increase the risk to get the coil dirty. Depending on the environmental working conditions (atmospheric pollution, presence of pollen, dust, working residues, external temperature, distance from the sea, etc.), the build-up of dirt can become serious and lead to the drastic reduction in the performance of the unit.

The heat transfer section needs cleaning only, if over 30% of fin space is blocked-up or cooling capacity is remarkably reduced.

**NOTE!**

Ensure that the cleaning does not damage the heat transfer section.

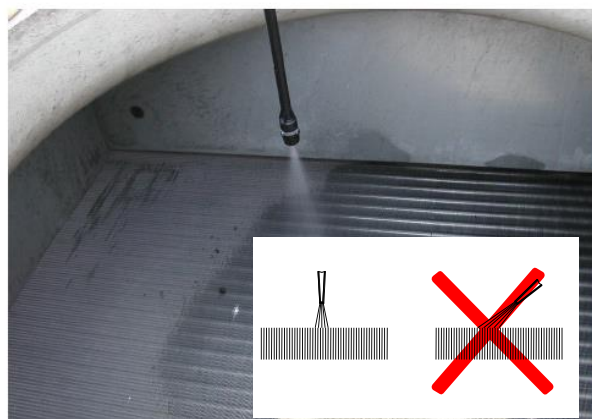
Depending on the amount of dirt, the coil needs an appropriate cleaning plan.

## F. Service Instructions

Remove the dust gathered on the fins of the heat transfer section with a vacuum cleaner on the side of incoming air, or blow off by compressed air in the side of outgoing air.

If vacuuming or blowing doesn't clean the heat transfer section enough, it is possible to wash the fins with running fresh water without using pressure in the side of out coming air. The water jet may not be too strong and shall be directed vertically against the fin sides not to make them bend.

Last possibility is to spray cleaning detergent with a low-pressure sprayer and wash it away with running fresh water from the side of out coming air. This deeper cleaning for coils can be obtained by using of a special solvent/degreaser.



**Fig. F.2** Allowed angle of low pressure cleaning water jet against the coil from side opposite to air flow direction.

It has been demonstrated that the advantages of the **CIP** (cleaning in place) method are:

- Reduction of the air pressure drop, this means save electrical energy for the fans.
- Lengthening of fans life cycle.
- Increase of Performance.

Do not use any strong alkaline detergents/solvents and acids, or dangerous, inflammable or environmentally dangerous detergents! The pH value of the washing water must be between 7-8.

	<p><b><u>WARNING!</u></b> Before washing the heat transfer section, read the Material Safety Data Sheet of the detergent and follow the manufacturer's instructions! When vacuum-cleaning and washing, use protection glasses, safety gloves, safety shoes and other personal protection!</p> <div data-bbox="352 1368 772 1447"></div>
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### CIP - Cleaning in Place

Degreaser must be mixed with hot water (~40°C) and sprayed on the coil (with a normal hand spray system). Once the dirt is dissolved, the coil can be cleaned with water from the top of the coil.

## F. Service Instructions

The quantity consumed may vary depending on the amount of dirt in the coil block.

Estimated time per unit 1.5 hours/module.






Recommended cleaning interval is 6 months to 1 year depending on the site conditions.



**Fig F.3** CIP equipment. plastic can of degreaser and hand spray system

## F. Service Instructions

### 5. Fans

	<b>WARNING!</b>
	Each fan is equipped with fan guard and a lockable service switch. The wire spacing in the fan guard and the safety distance of the blade correspond to the safety standard concerning persons over 14 years. The safety guards are protections from contact only.
	Do not remove the safety guard, before the fan is shut down. The rotating impeller causes danger for cutting off, pulling in.
	 

#### 5.1 General

Fan motors are especially for outdoor use designed squirrel-cage motors built to the IEC standards or NEMA if separately specified and provided with condensing water outlets.

- Check that all components are properly attached and no damages can be seen.
- If the bearings make a rustling noise, replace the electric motor or its bearings.
- Normal lubrication period is 15 000 – 30 000 h. Grease amount and type are given in motor nameplate / motor manual. If you use some other grease that mentioned in this manual, check the compatibility.
- During standstills (e.g. in winter) run the fans for 3...4 hours at least once a month. It is also recommended to change the fans' starting sequence when using the fans for capacity regulation.
- Other components (blade, motor bracket, fan guard) do not require any maintenance.

#### 5.2 Fan Vibration Level for Single Operating Fan

The Manufacturer is tested at the factory the vibration levels of installed fans. The limits for site vibrations are presented in Table F.1. A sudden change in the vibration level may indicate the need for prompt inspection or maintenance. Transitory changes in vibration level that results from re-lubrication or maintenance should not be used for evaluating the condition of the fan. Vibration sensor is optional for fans.

**Table F.1** Vibration limits of fan for test conducted at site (depending on selected reference measuring point, At site the ref point for outside measurement can be found in the leg near the fan. Use always the same measurement point/s)













Condition	Vibration limit, [mm/s]
Alarm	7.1...9
Shutdown	9.0...14

#### 5.3 Safety and Installation Instructions of Motors

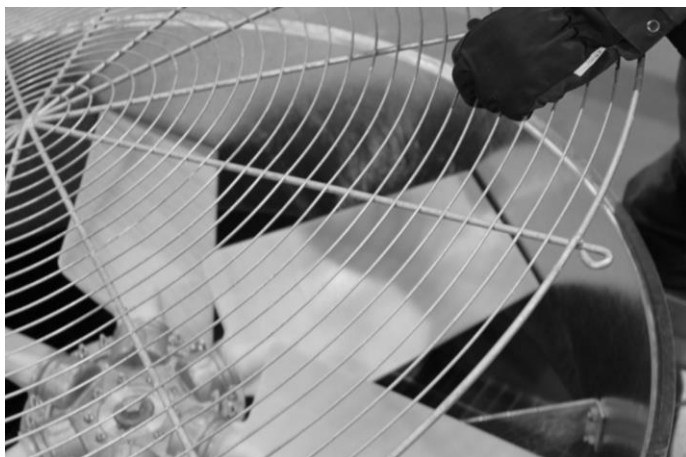
Please see motor manual.

## F. Service Instructions

### 5.4 Replacing the Fan Impeller

	<b>WARNING!</b> Do not remove the safety guard, before the fan is shut down. The rotating impeller cause danger for cutting off, pulling in  
	<b>WARNING!</b> Sharp edges, use protection glasses, safety gloves, shoes and clothes!    
	<b>WARNING!</b> The electric connections may be performed by an authorized electrician only.  Before starting the service operation make sure that the electrical supply is reliably isolated; use lock-out/tag-out system! Check always by voltmeter that the unit is electrically isolated and shut off.   

- Switch off the current in the service switch and lock the switch. Wait until the motor shaft and the blade pole have cooled down to the same temperature. When the motor is running, there is some heat transmission onto the shaft so the blade can be too tight to be removed.
- Remove the fan guard by unscrewing the fixing screws.

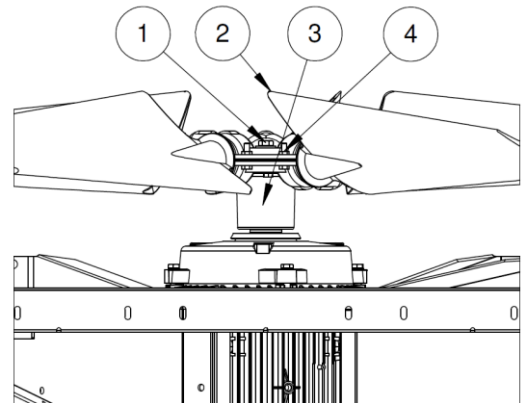
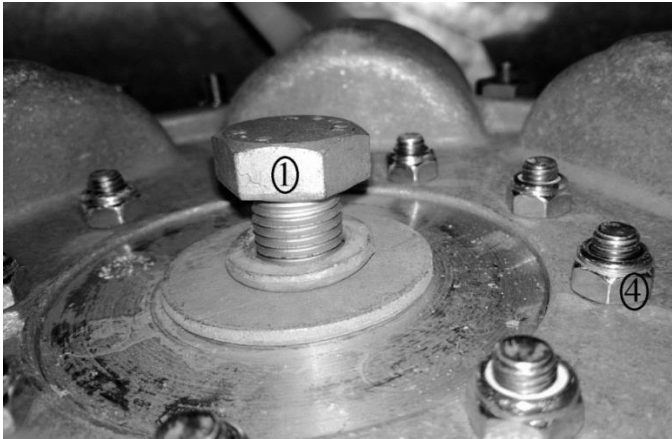


**Picture F.4.** Removing the fan guard.

- Protect heat transfer element with thick cardboard. Dropping tools can damage the element.
- Remove the bolt (1) locking the fan blade to the motor shaft.



## F. Service Instructions



**Picture F.5.** The locking bolt for fan blade and motor (1), the impeller (2), the pole (3) and the bolts around the pole (4).

- If the blade can't be removed by lightly cranking between motor and impeller, pull the blade off by an extractor. Note, that the impellers (2) and poles (3) are balanced. The poles may not be mixed with each other and they always have to be installed back just to the same impeller. Also take care that the pole position with respect to the impeller remains the same – the correct position can be marked e.g. with drawing ink. The impeller can be removed from the blade pole by unscrewing bolts (4) around the pole. Please do not unscrew the fixing bolts of the separate blades on the outer circle! After having removed the impeller, the pole can be removed by using the extractor.

### ***Installing the fan blade***

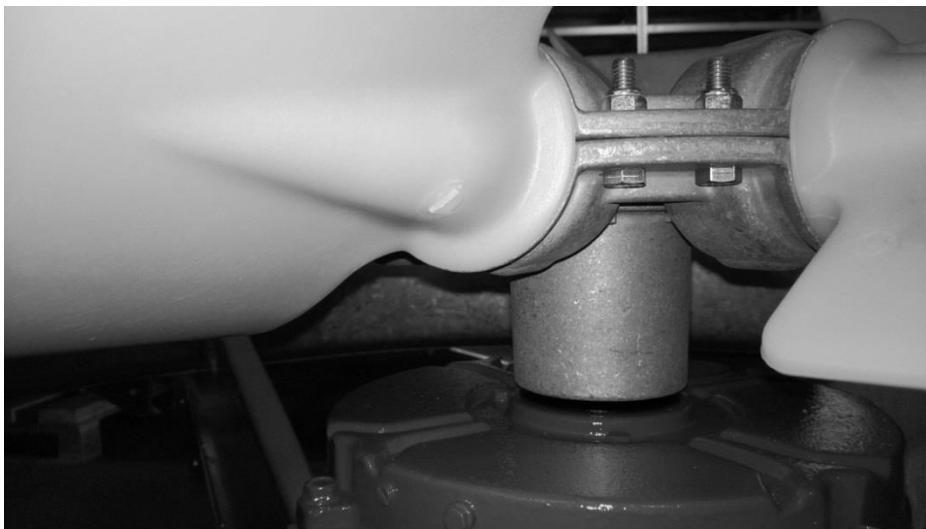
- Clean and lubricate the shaft.
- Mount the new blade onto the shaft (do not forget the wedge!). Push it by hand as much as possible. If it is difficult to push the fan blade manually onto the motor shaft, use cold water or ice to cool the shaft, instead the blade pole can be warmed up from below by e.g. flame. This is shown in picture F.6. Be very careful not to burn the blade or to warm it up unevenly. If the motor and the blade are very tightly fitted, you should simultaneously cool the shaft and warm up the pole. Never install the blade by hitting. Shock loading can damage the motor bearings very easily. A wooden or rubber hammer can be used carefully.

## F. Service Instructions



**Figure F.6.** Warm metallic blade hub slightly outside (around) and inside. Be careful not to heat plastic blades. Install the impeller to the shaft

- After installing the blade there should be a gap between the pole and the body of the motor. The gap should be about 4 – 5 mm long and it is shown in the picture F.7.



**Figure F.7.** The gap between the pole and the body.

- Stroke at the shaft end HI-TEMP 343 RTV silicone rubber sealing spray, according to the instructions. The silicone rubber sealing spray prevents the water running along the joint between the blade hub and the motor shaft into the motor.
- Place a washer at the shaft end on the silicone rubber sealing. Lock the blade with a fixing bolt (Picture F.8) into the motor axle by using torque strong enough. For the M16 bolt the suitable tightening torque is 50 Nm. The washer would not be deformed unless the tightening torque is too strong. When tightening the fixing bolt, some sealing compound presses out through the washer edge and hole (Picture F.9). This shows that enough silicone rubber sealing has been used.

## F. Service Instructions



**Picture F.8.** Bolt, spring washer and washer are used to attach the blade to the motor



**Picture F.9.** The sealing compound presses out through the washer edge and hole.

- Check the blade tip clearance by rotating the blade. The minimum allowable tip clearance is for Ø1240 mm rotor 5 mm and for Ø1800 mm rotor 5 mm.
- If the collar shape is changed during the installation or transportation round it again mechanically in order to maintain acceptable tip clearance.
- Place the fan guard.
- After installation make a test-run for the fan and check the fan visually.







**Table F.2.** The recommended torque for tightening the bolts (4) depends of the size of the bolt.

Size of the bolt and nut	min. torque (Nm)	max. torque (Nm)
M6	7.0	9.5
M8	18.0	20.0
M10	25.0	30.0

The size of the bolt (1) picture F.5 depends of the motor type. For each bolt the tightening torque is  $\approx 50$  Nm.

## F. Service Instructions

### 5.5 Replacing the Electric Motor

	<p><b>WARNING!</b> Do not remove the safety guard, before the fan is shut down. The rotating impeller cause danger for cutting off, pulling in</p> 
	<p><b>WARNING!</b> Sharp edges, use protection glasses, safety gloves, shoes and clothes!</p> 
	<p><b>WARNING!</b> The electric connections may be performed by an authorized electrician only.</p> <p>Before starting the service operation make sure that the electrical supply is reliably isolated; use lock-out/tag-out system! Check always by voltmeter that the unit is electrically isolated and shut off.</p> 

- Switch off the current in the service switch and lock the switch.
- Remove the fan blade from the motor as described in the chapter F 5.4.
- Open the junction box and make sure that the motor is dead.
- Remove the wires from the motor.
- Mount a support for the motor either bracket under the motor or lifting eye and rope for the shaft.
- Unscrew fixing screws of the fan motor.
- Lift up the motor.

#### ***Installing the motor***

- Lift the new motor to right position.
- Install the fixing screws of the fan motor. The tightening torque for the motor bolts shown in the picture below is 150 Nm.
- Attach the wires to the motor. Make sure the current is still off.
- Fix the blade as described in the chapter F 5.4 installing the fan blade.
- If Alfa LU-VE has not delivered the new motor, drill condensing water outlets in accordance with motor manufacturer's instructions and make sure that the motor's lubrication is correct.
- Make a test-run and check that the airflow direction is in accordance with dimension drawing.





## F. Service Instructions

### 6. Electrical Safety Checklist

All service, maintenance, repair, controls and installation employees must have this list with them at every job and read through it before they start the job.

**These are the minimum requirements. If you cannot meet these requirements, you cannot start the work**

#### 6.1 Lockout and Tagout

1. Notify affected persons of the shutdown.
2. Shut down the equipment by the normal process.
3. Disconnect and lock and tag all energy sources.
4. Released any stored energy (capacitors, transformers, etc.).
5. All employees working on the equipment must have their own personal lock in place  
tulee olla oma lukitus asetettuna paikoilleen.
6. Prior to servicing equipment a check must be made with a **“proximate voltage sensor”** to ensure that the frames or control enclosures of equipment being serviced are not energized.
7. Check that circuit-testing devices are working
8. **Verify the absence of electrical current or voltage with a circuit-testing device; use insulated gloves and an insulated mat.**
9. Notify affected persons of the return of electrical power.

Lockout/Tagout



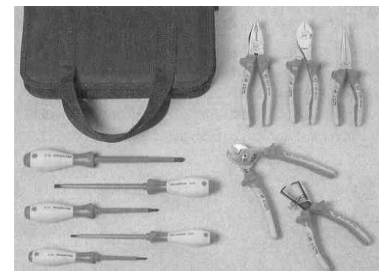
Verify with a testing device



#### 6.2 Diagnosing a Problem where Power is Required

1. Remove all conductive clothing or accessories.
2. Do not use any conductive equipment or tools.
3. Use insulated tools and safety glasses
4. **Do Not** work on electrical circuits greater than 600 volts unless you have received specific training
5. Suspend work or have a shelter during adverse weather conditions.
6. Use a certified insulated mat to stand on while doing the testing.
7. Use certified electrical insulated gloves while doing the testing.
8. After diagnostic work is completed and service work is required you must complete logout and tagout.

Wear PPE



#### 6.3 Tools and Equipment (PPE)

Ensure that electrical equipment you are working on is grounded.

Ensure that electrical power tools are double insulated or have a ground plug.

Use Ground Fault Circuit Interrupters (GFCI).







Inspect power tools, insulated hand tools and electrical cords for damage

Damaged tools and cords shall not be used.

Do not use conductive equipment e.g. metal ladders.

## F. Service Instructions

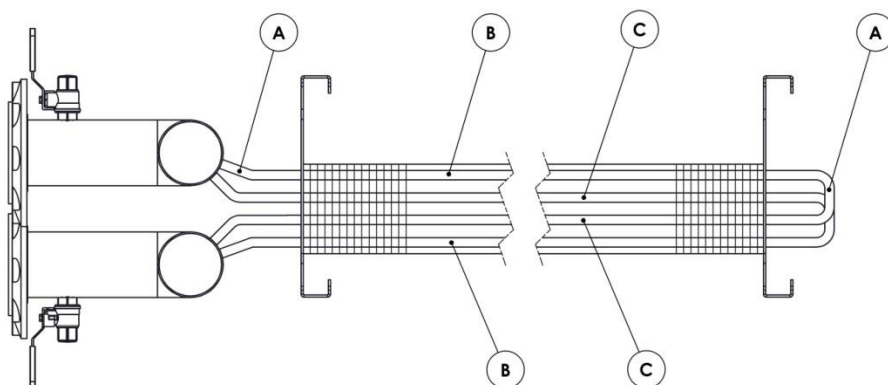
### 7. Tube Leakage

	<p><b>WARNING!</b> In operation the heat transfer section and pipe temperatures exceed 45°C. Contact may cause burns. Use hand protection.</p> 
	<p><b>WARNING!</b> Breaks in pressure pipes or components may cause injuries. Do not exceed the unit design pressure. Only perform maintenance work on pressurized parts when the unit is empty</p> 
	<p><b>WARNING!</b> Fluid recovery and filling of the units may be performed by an authorized contractor only. Follow working fluid suppliers' instructions to prevent injuries and damages to environment and property.</p> 

A refrigeration service man can do reparation according these instructions. Otherwise ask for more detailed instructions from our factory.

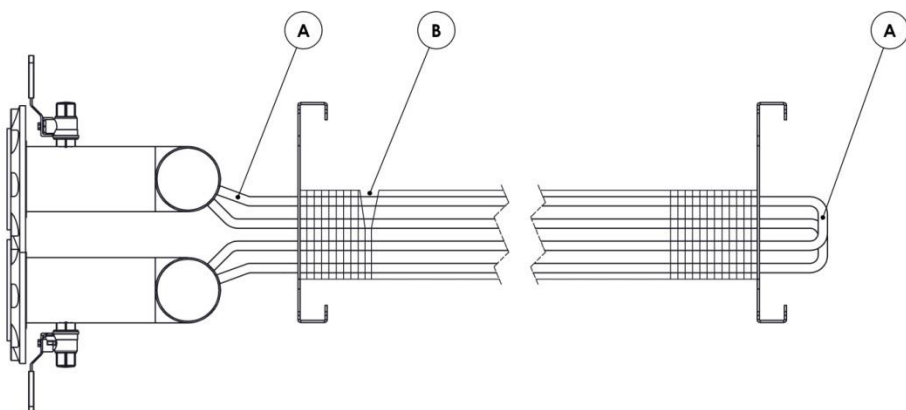
Repair of tube leakage depends on location of leakage.

- A. Leakage in tube bend in connection tube joint.
- B. Leakage in upper or lower tube row of the coil block.
- C. Leakage in inner tube row of the coil block.

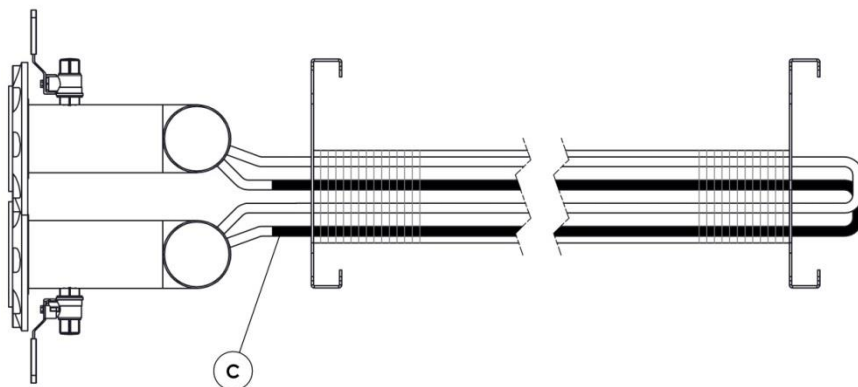


## F. Service Instructions

- A. Change the failed tube bend or connection tube joint.
- B. Move carefully the coil block fins round the leakage and repair the leakage by hard solder.

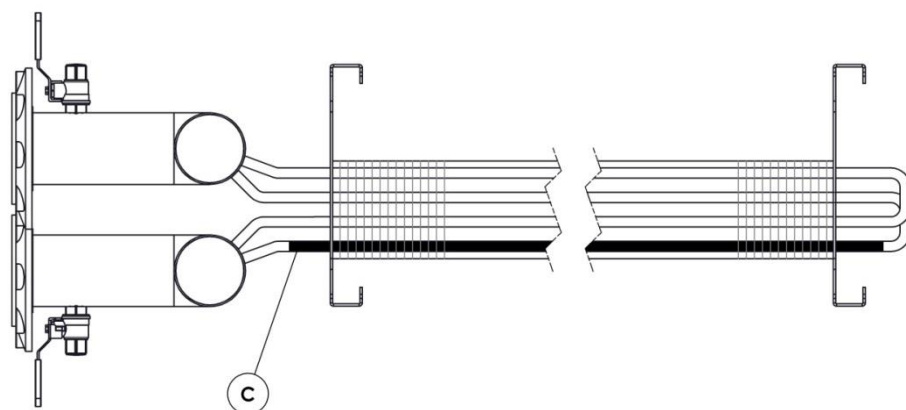


- C. Close the circuit including the leaking tube by closing with hard solder the inlet and outlet tubes on the header.



Or repair the leaking tube by using inner tube:

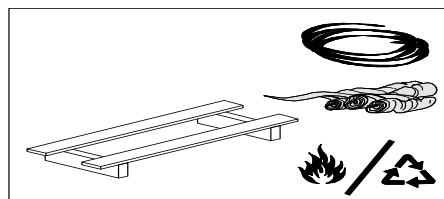
- Expand the original coil tube up to ID = 13.0 mm
- Install the inner tube into leakage point
- Expand the tube ends of the inner tube
- Join by hard solder into the circuit



## G. Discharge and Recycling

### 1. Discharge and Recycling of Packing Materials

All packing materials are suitable either for recycling or for energy recovery. Wood material is according to ISPM 15.






### 2. Recovery of Fluid

For drainage see chapter F.2.

#### NOTE!

In demolishing the unit and in recovery, recycling and discarding of brine, components and materials shall the local, national and international regulations be followed.

### 3. Demolishing the Unit

	<b>WARNING!</b> Before discarding and demolishing the unit make sure that the unit is electrically isolated and dead. 
	<b>WARNING!</b> Do not lift the unit before it is fully emptied.

- Remove the unit from the installation site and transfer it to the place of demolishing. Please follow the instructions for lifting the unit.
- Turn the unit with horizontal air flow into horizontal position by paying attention to the lifting instructions.
- Remove the fans, fan motors and cables.
- Remove the fan plate, legs and side plates.
- Remove the headers from the heat transfer section by cutting off the connection tubes.
- The fans are integrated to dry cooler. Fans shall only be used for the purpose which it is designed.

### 4. Material Recycling and Discharging

- |  |  |
|--|--|
| • Sheet metals, Fe + Zn –                  | to steel scrap                                 |
| • Heat transfer section, Cu-tube / Al-fin– | to mixed copper scrap                          |
| • Header, Cu –                             | to copper scrap                                |
| • Fan collar / motor bracket, Fe + Zn –    | to steel scrap                                 |
| • Fan guard, Fe + Zn                       | to steel scrap                                 |
| • Motors                                   | recycling / scrapping (authorized contractor). |
| • Safety switches, cables                  | recycling / scrapping (authorized contractor)  |
| • Water jet tubing, Cu –                   | to copper scrap                                |



## H. Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Short of capacity	Liquid flow too low	Check the valves/filters!
	Leakage in system / coil block	Check the connections, brazings in heat transfer section and the tubing. When there is leakage in the heat transfer section, please take contact with the manufacturer for further repair instructions!
	The wrong flow direction in the circuiting	Change tube connections
	Air in system	Ventilate the system!
	Fan/fans do not operate.	Localize the problem, repair it or change the fan unit.
	Heat transfer section blocked up/ dirty	Vacuum-clean/ wash the heat transfer section
	Incoming air flow too low	Make sure that there are no obstacles for the air flow.
	Wrong fan rotation direction	Wrong phase sequence. Change the connection on motor coupling or from the switch board.
	Inlet air too warm	Check the location of the units and prevent air recirculation
Vibration in the unit	Broken fan	Repair/ change the fan!
	The vibration is conducted from other installation	Install vibration dampers to the radiator legs
Fan stops.	Voltage break	Blown-out fuses
	Low voltage	Check that the voltage given the product nameplate is followed. Check the connections!
Motor takes high amp.	Too low voltage	Check the size of cables on basis of voltage drop.
	Too low supply voltage	Check the supply voltage
Wrong rotation direction	Wrong sequence of phases	Change the connection on motor coupling or from switchboard.

## H. Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Fan does not start	Fan is frozen in the fan collar	Remove ice
	The fuse has blown out	Replace the fuse
	Overload release	Check and reset from the overload release switch!
	Wrong supply voltage	Check that the supply voltage corresponds to the value marked on the motor sign.
	Wrong connection	Check the connections from the item "Motor connections" and from the product nameplate.
	Break in coil or in control circuit	If the switch is in off-position, there will be bumbling noise. Check the slack line switches! Check that the line switches close.
	Mechanical failure	Check that the fan motor and fan blade rotate freely. Check the bearing and lubrication!
	Short circuit in coil	Can be indicated by a blown-out fuse. The motor has to be replaced.
	One phase in the motor can be broken.	Check the connection!
Fan starts, then stops	Failure in supply voltage	Check the loose connections, fuses and control circuit.
Fan does not reach the maximum speed	Wrong fan motor type	Ask the supplier about a correct type of fan.
	Too low voltage at the fan motor terminals because of voltage drop.	Use higher voltage or a starter transformer. Check the connections and the correct cable size.
	Broken rotor	Check eventual breaks in short-circuiting ring. Generally, a new rotor or motor is needed
Fan motor overheating.	Motor body or cooling openings may be dirty or blocked-up, therefore hindering proper motor ventilation.	Clean the motor and ensure trouble-free air circulation.
	One motor phase may be open.	Check the connection.
	Earth fault	Identify and repair
	Asymmetric supply voltage to motor terminal	Check the cables and connections.

## H. Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Vibrating fan	Loosen motor fixing	Tighten the fixing screws and check the alignment
	Unbalanced fan blade/Fan blades misaligned	Balance the blade or change it. Check that drain holes of blades are open and clean at the tip (hollow blade profiles e.g. with tick blade profile AI impellers)
	Faulty bearings	Change the bearings
	3-phase motor running as single phase	Check the connections
	Too big axial play	Check the bearings
Abrasive noise in fan	Fan blade is chafing against fan collar.	Check the motor centering and fixing.
	Motor ventilator is chafing against the cover.	Repair the fan/cover.
	Ventilator hits on insulation.	Prevent the touch.
	Motor has got loose from its fixing.	Tighten the fixing bolts and rebalance the fan.
Exceptionally heavy noise of running	Air gap not centralized.	Check steering turning and bearings.



### **WARNING!**

Before move to the solution, assure that the unit is in safety conditions. See residual risks in this manual.

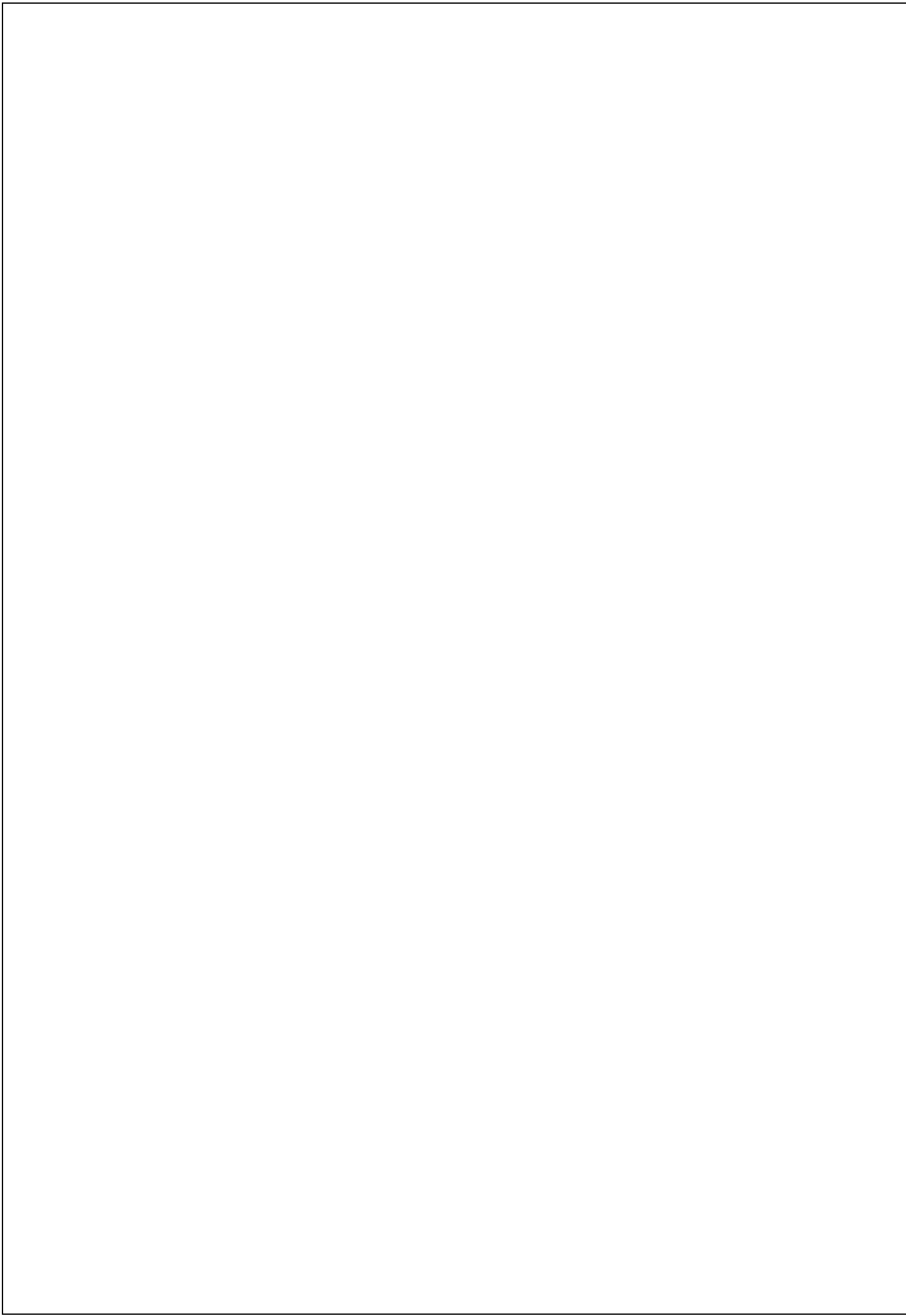
# I. Spare Parts

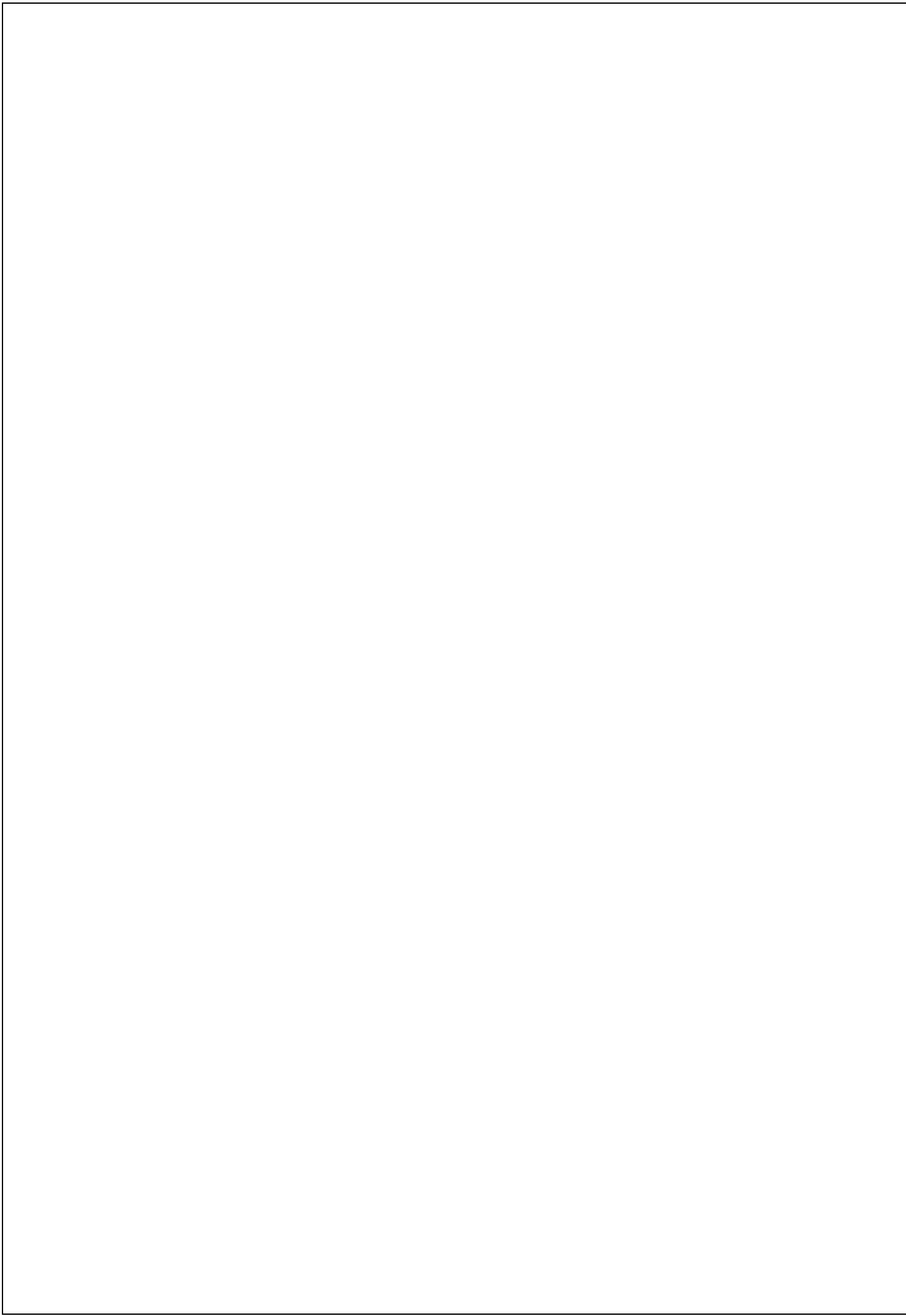
Item Description	Order
Safety guard for fan	Unit order number_Safety guard
Motor	Unit order number_Motor
Motor bearing	Unit order number_Motor gear
Impeller	Unit order number_Impeller
Service switch	Unit order number_Service switch

For unit order number refer to order or the identification number of the unit. For the replacement of the unit.

# Appendix 1

## Appendix 1: SEAWORTHY PACKING HANDLING







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