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YOUR LOCAL SERVICE CONTRACTOR IS:

COMPANY NAME:

_____

PHONE NUMBER: FAX NUMBER:

_____

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1 General Remarks, Safety Warnings

Industrial cooler Type KSC 215-L-U/S

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Refrigerant	**R134a**
Total filling weight	15,0 kg
Permitted working pressure:	**19 bar**
Cooling medium	**62/38 % water/ Ethylene glycol mixture**

CAUTION! **Ethylene glycol must be added at the rate of 38 % of the cooling medium volume anytime – otherwise warranty void!**

The rate depends not on the local ambient temperature even if you are in a hot climate.

Do not use automotive antifreeze.

Never install automatic water refill system.

IN CASES OF EMERGENCY TURN OFF THE AGGREGATE BY THE MASTER SWITCH !

1.1 Warranty

The unit is supplied finished, tested and ready to work. The unit warranty will be void if any modification to the unit is carried out without written agreement of KKT.
For warranty purposes, the following conditions must be satisfied:

- The initial start of the unit must be carried out by trained personnel from an Authorized KKT Service Partner.
- Maintenance must be carried out at least twice a year by properly trained personnel.
- Only genuine KKT spare parts must be used.
- Ethylene glycol must be added to the rate of 38Vol%.
- The manual (this document) must not remove from the chiller.
- All the scheduled maintenance operations detailed in this manual must be performed at the specified times. Please use a higher amount of services if the local conditions require it.
- **The "Warranty Registration" has to be send return to KKT**
-

Failure to satisfy any of these conditions will automatically void the warranty.

1.2 Safety Warnings

-Cooling water circuit is pressurized.
Switch off the chiller and depressurize before servicing the cooling water circuit.
-Drain water from pipes and spare parts before shipment.
-Nominal static filling pressure when Chiller has been switched off: 1,5bar. The pressure of the expansion tank is without counter pressure from the "water / glycol – side" = 1,0 bar.
-Don`t handle valves while the Chiller is running

-**Ethylene glycol must** be added at the rate of 38% of the volume of water anytime otherwise warranty void.
-The rate depends not on the local ambient temperature.
-Don't use automotive antifreeze.

-Voltage continuous to be present at the terminals, even after the medical device has been switched off.
-Parts in the refrigerant circuit are hot, even the Chiller has been switched off.

Warranty void if manual removed from chiller.

OBSERVE THE SAFETY RULES

Before commencing work on the unit, switch the plant to voltage-free

IN CASES OF EMERGENCY TURN OFF THE AGGREGATE BY THE MASTER SWITCH !

Caution! **Work on electric and refrigerant circuits should only be performed by qualified operatives**
Observe the safety rules!
Wear safety gloves and glasses when working on unit to avoid injury.
Wear long sleeve shirt and pants when working on unit.
No loose clothing items allowed to avoid injury.
Please read the manual.

2 General description

The industrial coolers of the KPC series are fully assembled, factory inspected and tested, and suitable for fully-automated operation. The water or aqueous medium that undergoes cooling is constantly circulated by the pumps. The temperature set on the governor is kept automatically within the limits that are possible for the given degree of temperature exactitude.
The process heat is transmitted from the water in the in-built heat exchanger (evaporator) to the refrigerant circuit (R 134a). The compressor raises the refrigerant to a higher temperature and pressure so that the warmth can be released via the condenser to the surrounding air. Consequently good air supply and escape are vital for the proper running of the plant.
The industrial coolers of the KPC series are fitted with pressure switches as protection against freezing and excess temperature. With this, it is possible to set leaving water temperatures from +16 °C to +25 °C.

Antifrogen (ethylene glycol) must be added at the rate of 38 vol.% and it depends not on the ambient temperature.

Changes in the settings should only be made by qualified operatives.

Cooling block Type KPC 115-L-U/S 60 Hz

Air-cooled design for outdoor use, consisting mainly of:

The housing with stable welded, galvanized framework-construction , lateral cover-plates with drawer-edges made of galvanized steel plate with ventilating nozzles worked into the top plate.

Framework-construction and top-plates, powder-coated on the inside and outside, RAL 1013 -pearl white. All outer fastening screws rust-proof, inspection-caps at the front easily removable for maintenance using casement-fastener caps.

Compressors, cooling and cold-water/ethylene-glycol mountings, additionally sound and rain-proofed using a galvanized cover-plate.

Condenser axial-fans controlled by frequency inverter depends of the condenser pressure. Ventilators equipped with protective-grating on the delivery side

Laterally mounted capacitor heat-exchanger made of Cu-AL with covering galvanized framework, enameled fully in black.

<u>Cooling-unit for fluid cooling, consisting of:</u>

Stable base-frame construction made of steel-profiles, powder-coated. SCROLL-motor compressor, of fully hermetic construction with smooth starter and of suction-gas cooled design complete with special shut-off valves placed at the pressure and suction side. Vibration-absorbing-mounted compressors. Coolant power-inputs of flexible design. Cooling circulation with coolant-collectors, coolant shut-off mounting, filter-dryer, inspection glass and moisture indicator, fluid electro-valve service-valves as well as the complete internal cooling pipe work made of Cu-pipe with coolant and special oil filling.

High-capacity plate-vaporizer of plumbed design. Heat-exchanger plates with optimized profile for safety coolant and built in expansion-valve.

Vaporizer and suction-side pipe work, diffusion-seal insulated.

Safety pack for the cooling circuit, consisting of:

Crankcase heater, high /low pressure pressostat as well as protective motor relay.

Shut-off ball valve at the cold water / ethylene-glycol entry, dirt absorber, expansion tank, feeder and safety valve. High-pressure centrifugal-pump adjusted to the overall system, filling and drainage valve with piping terminal, ventilation, monometer and machine-thermometer in forward and reverse flow. Quantity balancing-valve, with connection piece for computer terminal in cold water / AFN exit.

Temperature control as hot gas by-pass control with electro valve, needle-valve and by-pass cable - 0/50/75/100.

Electronic digital temperature controller with control range limitation for setpoint and actually temperature.

Condenser pressure control via pressure transmitter in the cooling circuit and frequency inverter, overload relay for system safety.

Internal cold water / ethylene-glycol (AFN) piping made of Cu-pipe, brazed, with diffusion sealer, surrounded by armaflex insulation.

All necessary block and clip angles used for cooling and cold water / ethylene-glycol(AFN) construction are made of rust-proof and powder-coated material.

Switch-cabinet integrated in cooling block, system of protection IP 54, wired according to VDE-regulations with a main switch, supply-check indicator lamp, phase monitoring relay and Siemens components such as, overload release, sliding-panel, motor safety-switch, control-switch and indicator lamps.

A pump post-relay for the safety of the vaporizer as well as pot. proof contacts for "supply-control" and "collective fault messages". It is still possible to connect a remote board.

The switch cabinet of the outdoor version contains a switch cabinet heater and a mechanical switch cabinet ventilator.

All parts described above are assembled into a ready-to-connect unit.

2.1 Functional description

The cold water pump starts as soon as the master switch and the pump switch have been turned from 0 to 1. The pump switch is only to be turned to On when the aqueous medium circuit has been completely filled and all air has been removed.

The flow switch protecting of the refrigerating compressors is cut off during start-up.

The pressure on the delivery side of the pump rises directly with the system pressure.

Should this fail to be the case, the plant has either a leak or insufficient water. A flow switch acts to prevent freezing of the evaporator if and when water volumes drop. The refrigerating machines switch on as soon as the fail-safe flow switch and control motor-protection pump is in order.
A lag in connection time has been allowed for in the refrigeration compressors to avoid surges in the current.

The refrigeration compressors keep running as long as cold is required and the reference value for the water temperature has not been reached. The fine adjustment is performed by two hot gas by-pass valves.

The water pump remains in constant operation.

Apart from which, the refrigerating machines are only ever switched off during circulation in cases of low or high pressure in the refrigeration cycle.

When switched off in the normal way, a restart timing relay provides overload protection to the compressor.

If the water temperature rise up to 30 °C (86 °F) the pump will stop after 30 min.
Please check the refrigerant circuit.
Restart is after reset of the button at the switch cabinet.

2.1.1 High-/Low- pressure control

The **high-pressure (HP) control** reacts to excess pressure of the magnitude of 19 bar by shutting off the compressors.

Causes of this include
- failure of condenser fans,
- high outdoor temperatures,
- a dirty condenser.

The compressor can only be put back in operation when the reset switch is activated on the HP-pressure control and the pressure has dropped.

An automatic start has not been provided for.

The **low-pressure (LP) control** also switches off the compressor when the pressure sinks to 1,0 bar. The switch is by-passed during start-up for 90 s.

If after being at rest the pressure rises to 2,0 bar, the compressor will switch on again automatically.

2.1.2 Electronic controls

The control system consists of a 3-step controller. The reference value is set at the works at 18°C for the outlet temperature. The sensor for the controller is installed on the outlet side.

Regulating refrigerating capacity

The exact regulation of the leaving temperature is achieved by means of 3-step controllers and hot gas by-pass injectors with solenoid valves. The setting is based on approx. 50%, 75% of the machine's refrigerating capacity.

Condenser pressure regulation

the condenser-pressure is regulated with help of the Frequency Inverter.
– see captions 4.5 "Frequency Inverter Settings" and 11.5 "Frequency Inverter"

3 Brief operating instructions

See also chapter 5 – 10 in this operating instruction

3.1 Installing, maintenance and repair

Only qualified operatives with the requisite knowledge, equipment and facilities should maintenance and repair the KKT chiller.

If its necessary to change the filling weight of the refrigerant circuit, please note:

Fill only with the refrigerants listed on the manufacturer name plate, and only up to the indicated filling weight.

3.2 Linking to power supply

The size of the connection cable had to be conform to the local regulations. For current values and power input see “Switch gear” point 8.

The industrial coolers of the KPC series are generally designed for a main supply of 480V 3Ph 60 Hz.

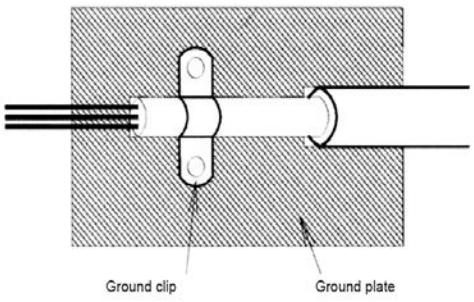
The connection L1, L2, L3, PE is performed via the terminal block in the switch cabinet.

The cooling block is switched on via the master switch .

3.3 EMC Compatibility and Grounding

This comments are compiled to help the field electrician to install the grounding of the power supply and to get a EMC Compatibility.
All electrical equipment produces radio and line-borne interference at various frequencies. The cables pass this on to the environment like an aerial.
The basic countermeasures are isolation of the wiring of control and power components, proper grounding and shielding of cables.

A large contact area is necessary for low-impedance grounding of HF interference. The use of grounding straps instead of cables is therefore definitely advisable.



Moreover, cable shields must be connected with purpose-made ground clips.

The grounding surface must be highly conductive bare metal. Remove any coats of varnish and paint.

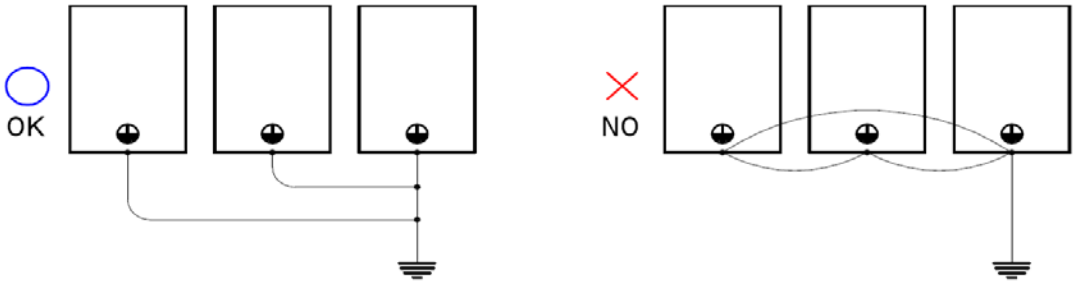
The width of the grounding wire must be min. 16mm² (AWG 6) or of the same width of the power supply. The grounding must be an isolated ground and must connected on the ground terminal (X1) in the switch cabinet. The ground resistance must be less than 10 Ohm.

Metal cable conduits are not allowed for grounding.

The piping of the chiller (supply and return) have to be grounded too.

Do not share the ground wire with other devices.
Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire.

When using more than one Inverter, be careful not to loop the ground wire.
(e.g. a Primus-Chiller KPC115-U/S stands near an Avanto-Chiller KCC215-L-U/S)



3.4 Filling the unit with water

Fill with clean water (drinking water quality) with Antifrogen (AFN)-additive.
Open front panel and fill to a pressure of min.1,5 bar via the feed cock.
After filling, check all connections for leakage.

3.5 Draining air from the unit

The KPC 115 includes a closed water system.

If air get out of the system the water pressure dropes down. If that happens you had to check the water pressure and if its to low you had to refill the water circuit as shown in fig. 1.4

The procedure should be repeated until no more air is in the system

After all these steps, turn both switches to position "1". If all the prerequisites for operation have been met, the chiller will start after 1 minute.

In case of malfunctions: search for faults, take note of Chapter 9, TROUBLE SHOOTING, in this manual.

3.6 Switch settings of main chiller functions (exfactory settings)

	remote control panel		main switch (master switch)		control switch		
	"0"	"1"	"0"	"1"	"0"	"Auto"	"Hand"
standard operation: pump runs, compressor and condenser fan are running on demand. (starts: water temp. higher than 19°C, stops: water temp lower 16°C = water temp setpoint: 17,5 °C), water heater works on demand (starts: water temp.lower than 3,5°C, stops: water temp higher 4,5°C = water temp setpoint: 4,0 °C), overheating protection: pump switches of if water temp. Is longer than 30 minutes higher than 40,1°C)		X		X		X	
	X (or no remote control connected with chiller)			X			X
stand by mode: refrigerant circuit is "switched off", pump and water heater are running on demand (starts: water temp.lower than 3,5°C, stops: water temp higher 4,5°C = water temp setpoint: 4,0 °C),	X (or no remote control connected with chiller)			X	X		
	X			X		X	
		X		X	X		
switched off: no function (switch cabinet is not under voltage)	position without effect		X		position without effect		

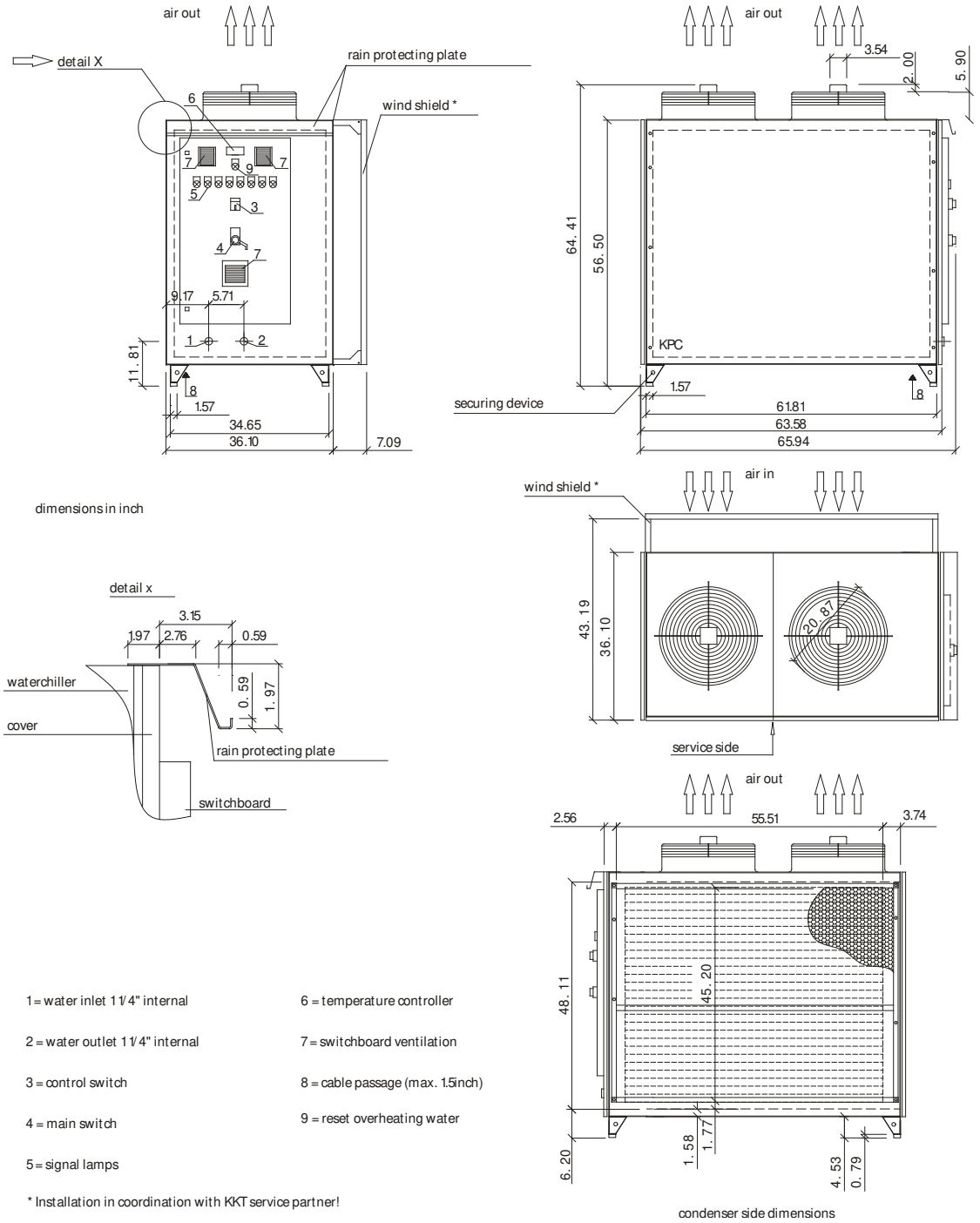
IN CASES OF EMERGENCY TURN OFF THE AGGREGATE BY THE MASTER SWITCH !

4 Technical Specifications

4.1 Data sheet

Model		Outdoor		
Dimensions		Depth	962	mm
		Breadth	1610	mm
		Height	1620	mm
Weight without refrigerant load		ca.	630	kg
Weight with load		ca.	650	kg
Shipping weight		ca.	850	kg
Weight total refrigerant load			15,0	kg
Number of fans			2	
Quantity of air			18000	m³/h
Refrigerant			R134a	
Required quantity of refrigerant	See name plate			
Low-pressure switch			1,0/2,0	bar
High-pressure switch			19	bar
Safety pressure limiter			-	
Water connection inlet		internal	1¼ “	G"
Water connection outlet		internal	1¼ “	G"
Cold water temperature outlet		min.	18	°C ±0,5 K
Cold water temperature outlet		max.	25	°C
Primary water pump type			CR3-9	
Rated water capacity		max.	2,4	m³/h
Rated water pressure			5,5	bar
Ambient temperature		min.	-20	°C
		max.	+50	°C
Cooling capacity			28,0	kW
Rated cold water outlet temperature			18	°C
Temperature of surroundings			48	°C
Exactitude of temperature			±0,5	K
Main supply	480 V / 3Ph / 60 Hz			
Control voltage			24	V
Fluctuations in main voltage		max.	±5	%
Fluctuations in output		max.	±5	%
Power input		max.	15,5	kW
Loudness		at 5 m	65	db(A)

4.2 Dimensional drawing Type KPC 115-L-U/S



condenser side dimensions

1 = water inlet 1 1/4" internal

2 = water outlet 1 1/4" internal

3 = control switch

4 = main switch

5 = signal lamps

6 = temperature controller

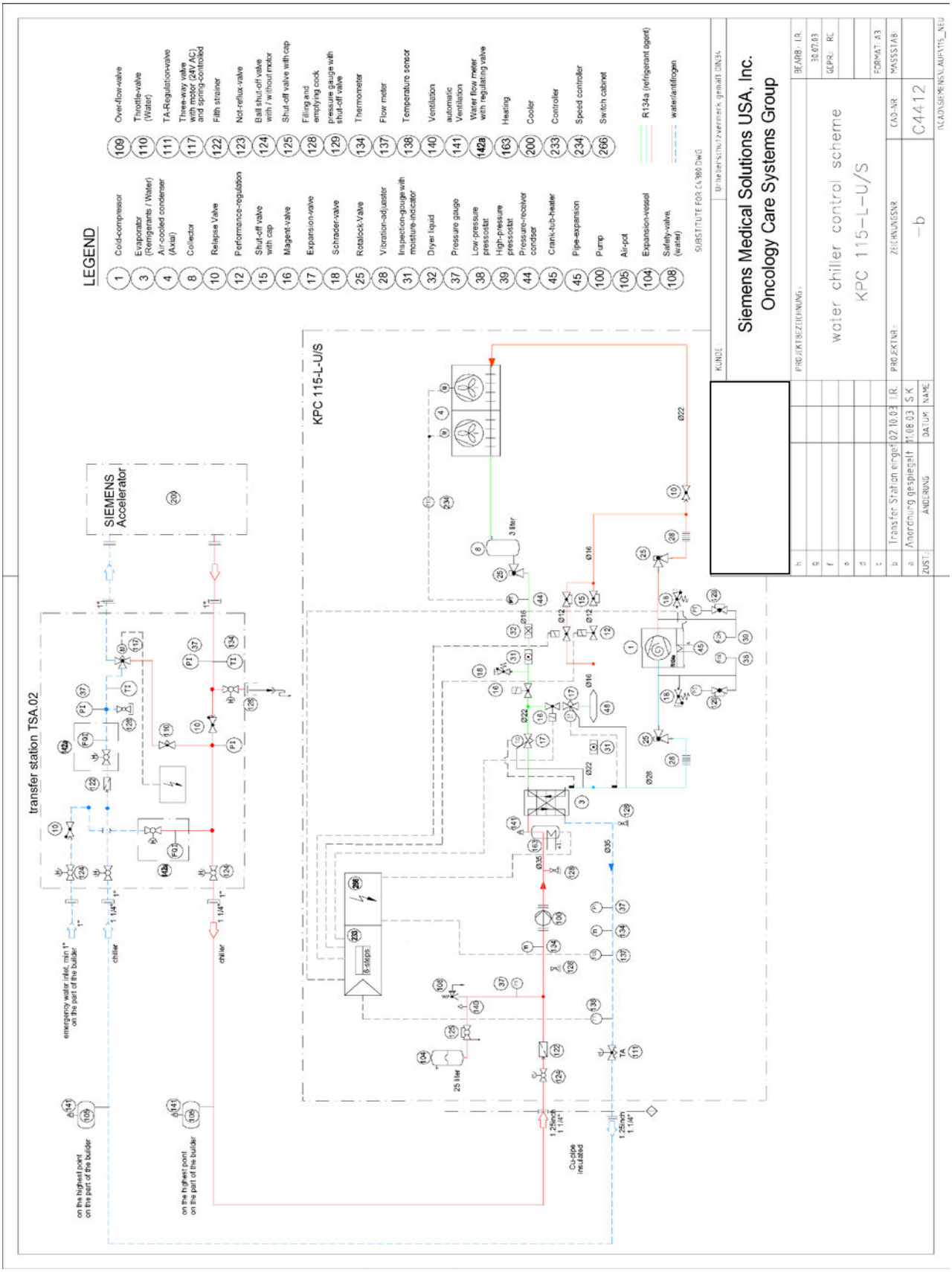
7 = switchboard ventilation

8 = cable passage (max. 1.5inch)

9 = reset overheating water

* Installation in coordination with KKT service partner!

Water chiller control scheme



5 Transport

Transport on company premises may be done with a forklift truck. The appliance must however be kept in an upright position and on no account tipped to the side. A visual inspection should be made on delivery to check for any damage. Complaints should be made immediately to the haulage contractor and the insurance company must be notified at once. When transporting by crane,

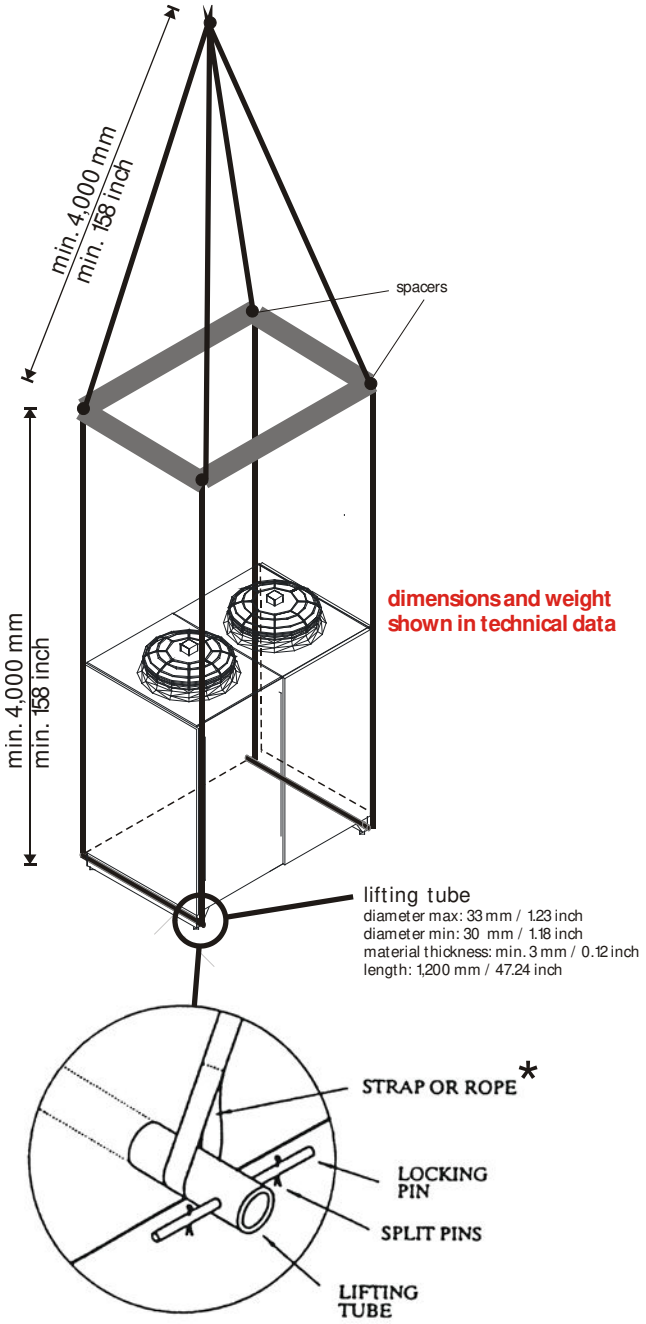
please ensure that the housing is not subjected to pressure at the sides.

Place the lifting tubes in the holes in the feet at the base of the chiller. Lock the ends of the tubes in position with locking pins and split pins as shown.

The capacity of the lifting gear must be adequate to lift the load in question.

Check the weight of the chiller units,
the capacity of the lifting gear and ropes
and the condition and suitability of the
aforementioned equipment.

Weight and dimensions see “Data sheet”, chapter 4.1



* Attention: don´t use metal rope !!

6 Installing the industrial cooler

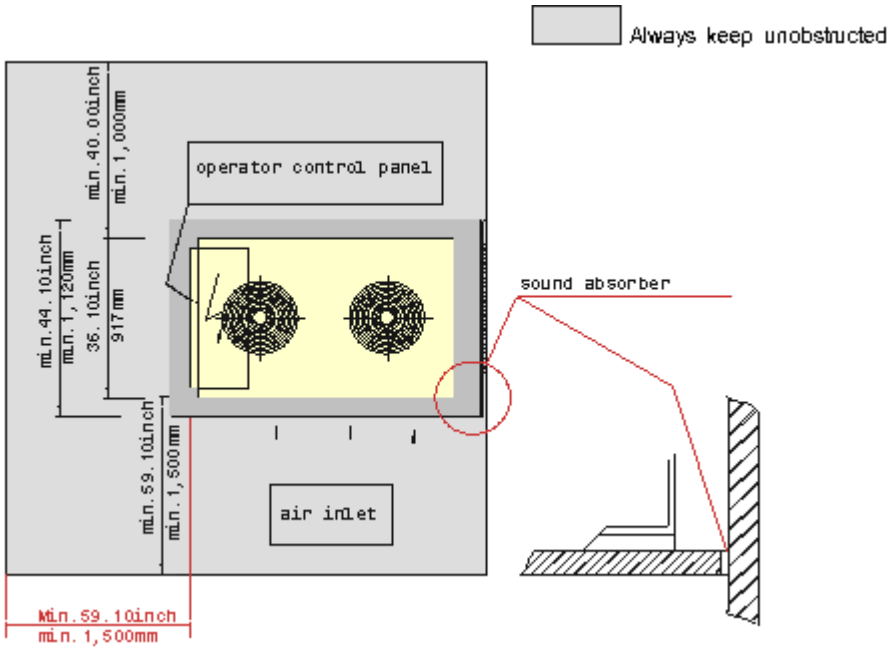
The plant should be mounted in an upright position on a stable foundation.

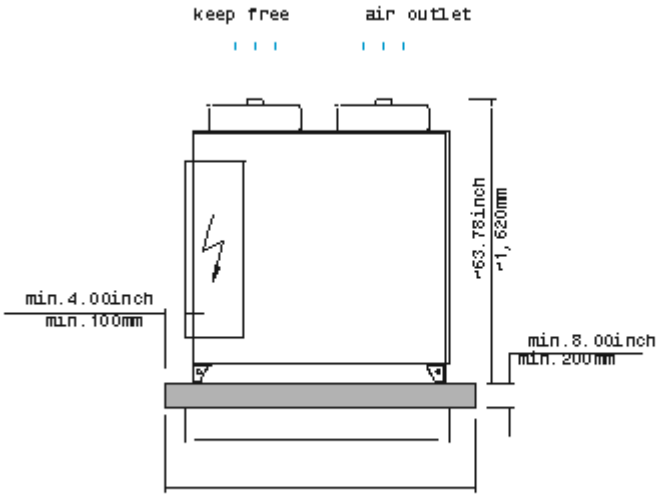
(Weight with load: see technical specifications).

A distance should be kept free on all sides to allow sufficient access for operation and maintenance.

A space of 1,5 m must be left above the apparatus to ensure that air exhaust can leave freely.

Further details can be found in the following installation plans.

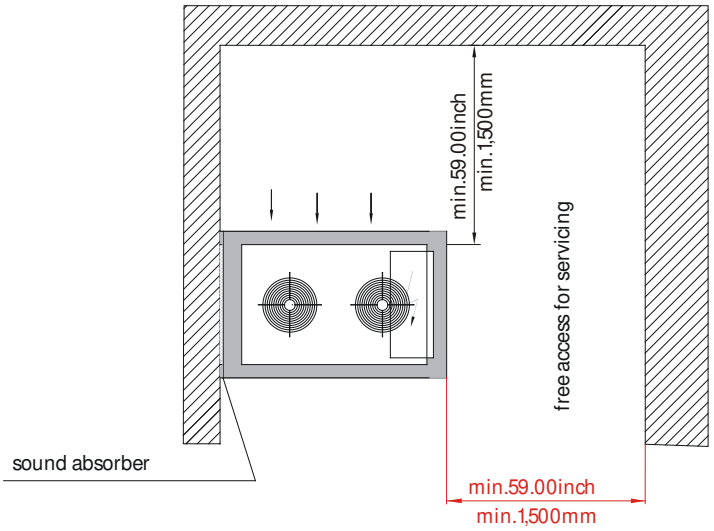




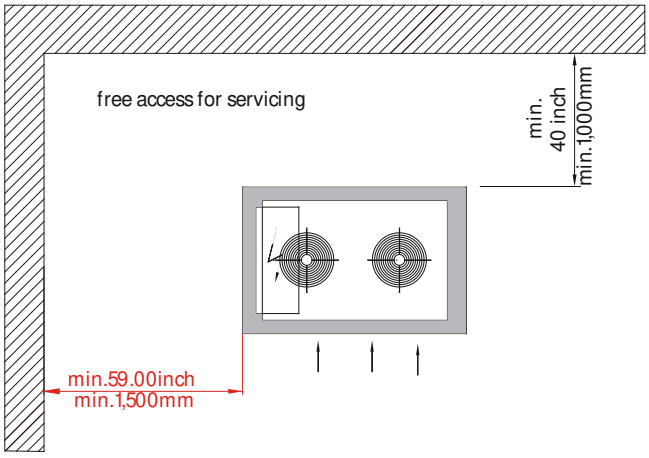
Dimensions for the concrete bed
should be adjusted according to local circumstances.

Alternative installation examples:

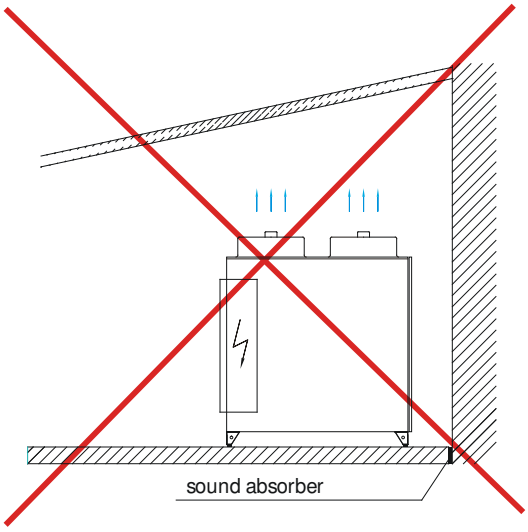
installation example A



installation example B



installation example C



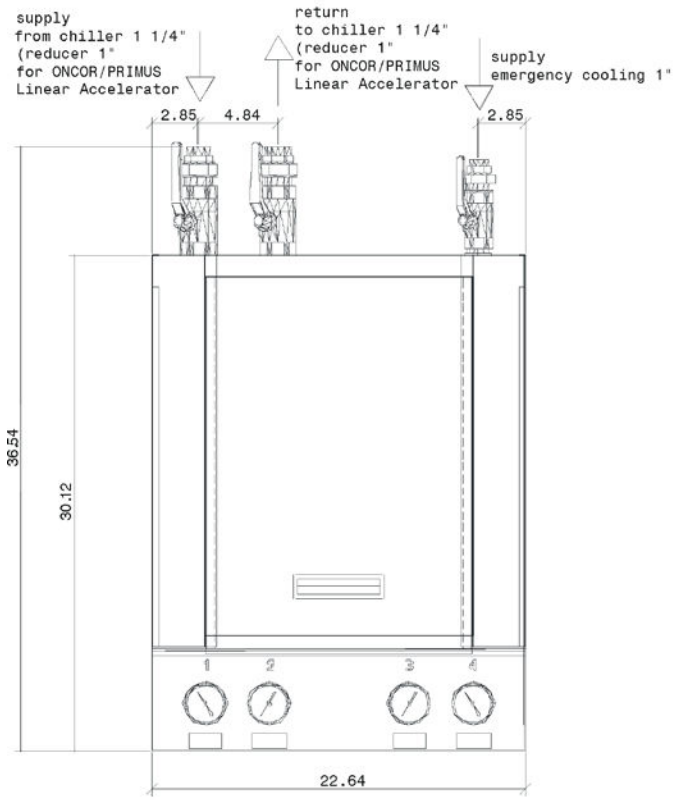
Air outlet keep free!

7 Notes on the water connections

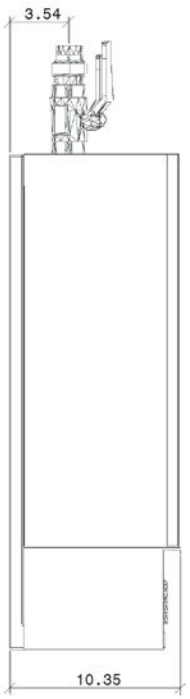
The water connections between industrial coolers of the KPC series and the water supply can be made of steel, copper or plastic. The nominal widths of the piping for distances of up to approx. 45 m should match at least the dimensions of the fittings on the appliance. (see technical specifications)

Reductions in diameter should be avoided. In case of longer pipelines, the pump pressure should be tested. When choosing the pipe materials, ensure that no electrochemical series are created.

Front view

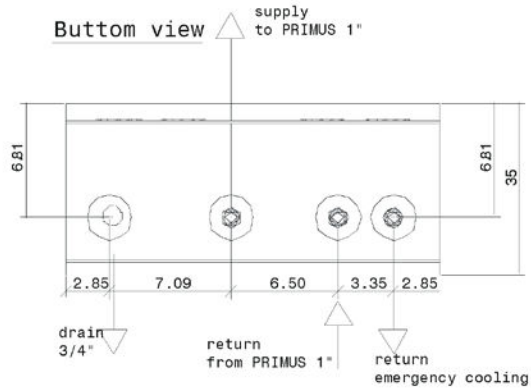


Left view



Dimensions in inch.

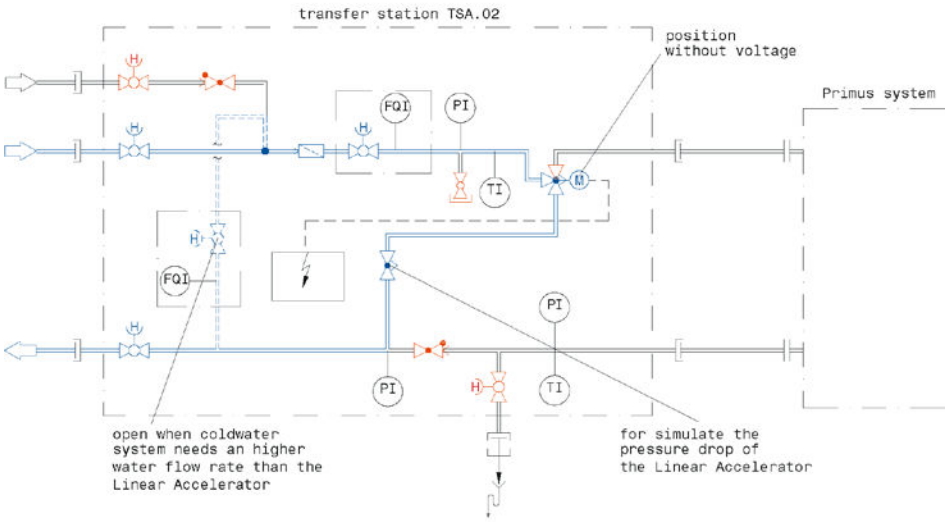
Buttom view



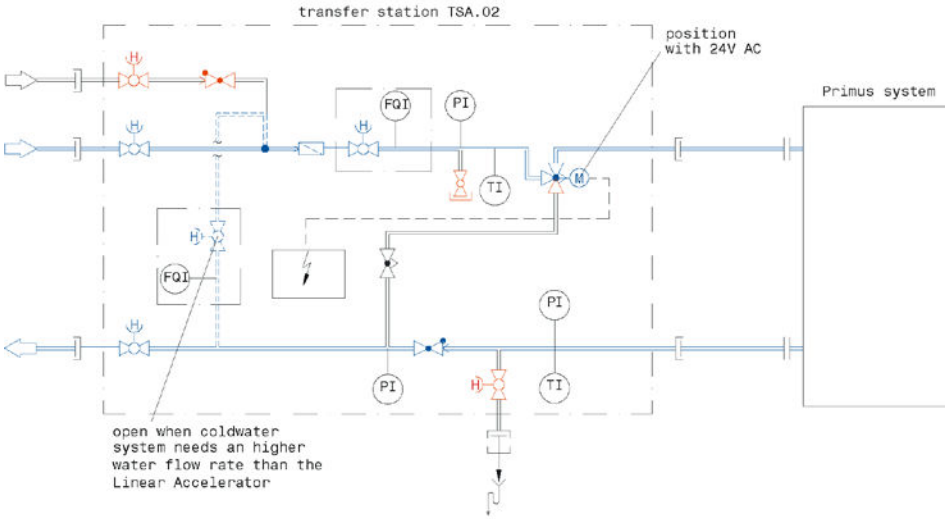
1 = temperature gauge supply
2 = pressure gauge supply
3 = pressure gauge return
4 = temperature gauge return

Operation weight (lb 79.4 / Kg 36)
Pipe and fittings inside humidity covered!

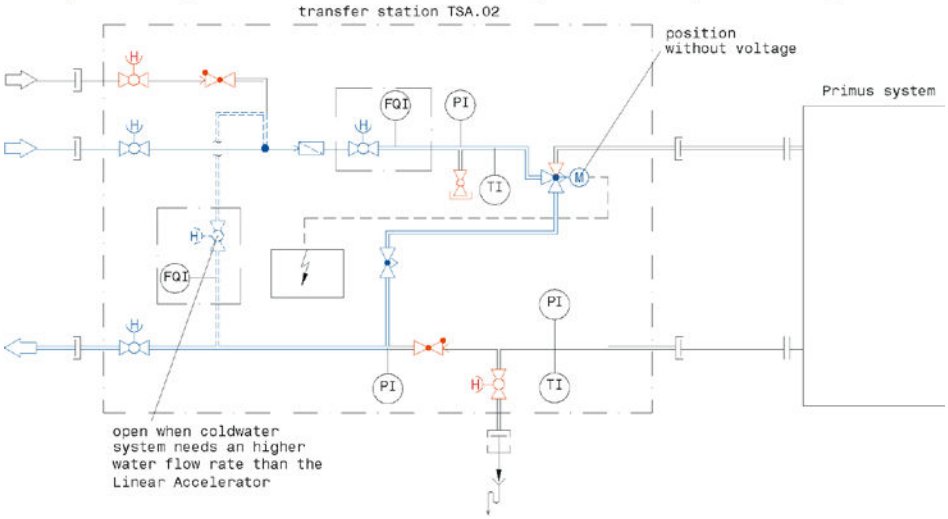
1. regulating phase



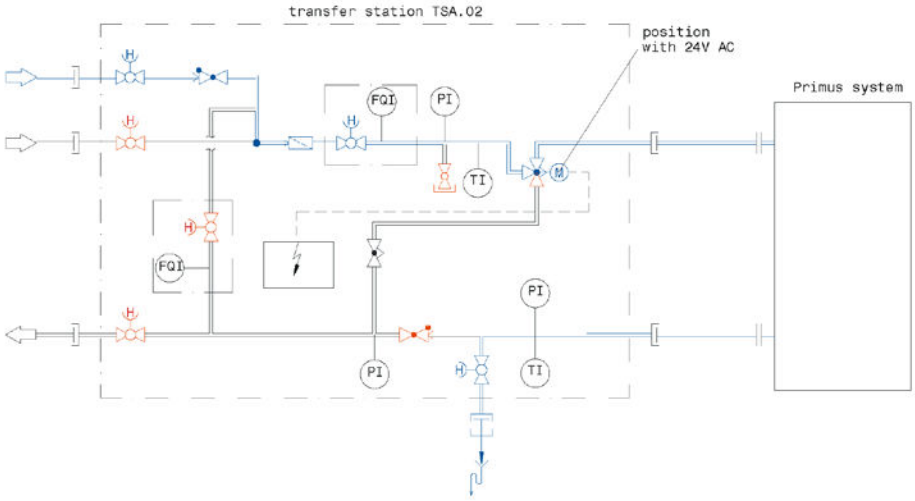
2. operation phase - Linear Accelerator needs cooling (24V AC)



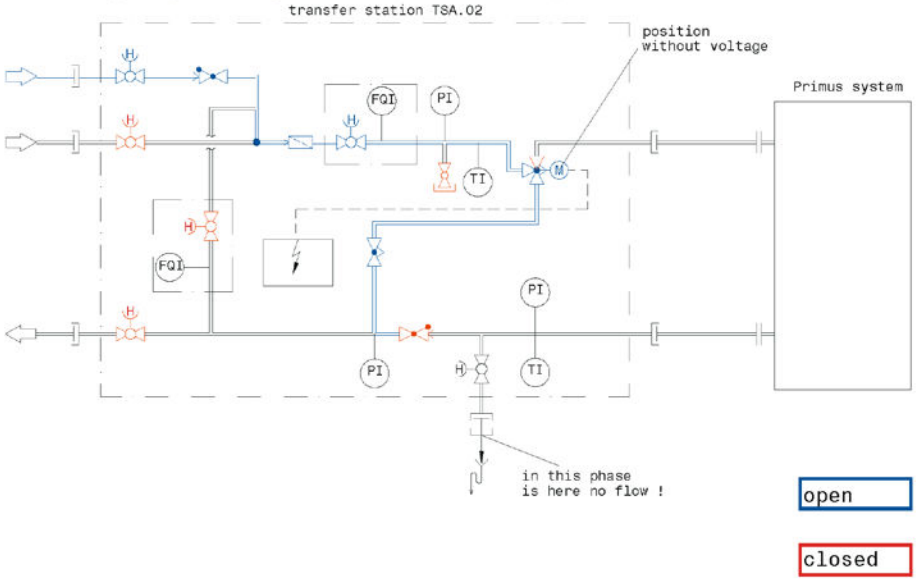
2.1. operation phase - Linear accelerator „power off“ (no 24V AC)



3. emergency cooling - Linear Accelerator needs cooling (24V AC)



3.1. emergency cooling - Linear Accelerator „power off“ (no 24V AC)



The following procedure prevents pressure surges!

During the alternation of „operating phase“ to „ emergency cooling“ first the water supply valve and then the water return valve must be closed.

During the alternation of „emergency cooling“ first the water return valve and then the water supply must be closed.

After „emergency cooling“ test the percent of the necessary antifreeze (ethylene glycol).

8 Power supply

The power supply is wired to the terminal block in the junction box (see technical specifications). The layout of the main cable must comply with the current values and the regulations of the local electricity company.

The Type KPC 115 L-U/S must be run with fuses of no less than 35 in size.

The supply voltage must be 480V / 3ph / 60 Hz.

The master and control switches must be in the "OFF" position when the plant is connected.
The supply line is attached to the terminal PE, L1 L2, L3, .

See also 11.24 “Circuit Diagram”

9 TROUBLE SHOOTING

KIND OF TROUBLE	CAUSE	ELIMINATION
• malfunction of plant/system	1. power failure	- check mains connection
	2. feeler of thermostat defective	- check feeler: clamp feeler and measure the resistance check thermostat: bridge feeler ⇒ the thermostat relay should shut and the compressor should start
	3. feeler malfunction	- check feeler: clamp feeler and measure the resistance
• malfunction of pump	1. main switch not switched on	- switch on main switch
	2. control switch on 'OFF'	- switch control switch to 'AUTO'
	3. main fuse defective	- replace fuse
	4. fuse for control current defective	- replace fuse
	5. pump motor defective	- replace motor
	6. flow controller responded	- check water quantity
	7. shortage of water	- check system pressure, clean strainer
• still malfunction of pump	1. overload trip of pump protection interrupted control circuit	- main switch to '0', push in overload trip
• pump makes gurgling noise	1. circuit is not completely vented	- vent and fill up with water/Ethylene glycol
• compressor stops	1. Klixon/INT69 tripped	- wait until compressor cooled down; perhaps clean condenser or provide fresh air supply
	2. Klixon/INT69 defective	- replace Klixon/INT69
• malfunction of refrigerating machine	1. control thermostat stopped machine, return temperature too cold	- to check function, level down adjustments, wait until return temperature rised

KIND OF TROUBLE	CAUSE	ELIMINATION
• still malfunction of refrigerating machine	1. low pressure in refrigerant circuit	
	- plant looses refrigerant	- find leak, seal, refill circuit
	- dryer in liquid pipe dirty	- replace dryer
	- pressure relief valve defective	- replace pressure relief valve
	- solenoid valve in liquid pipe defective	- replace solenoid valve
	2. high pressure in refrigerant circuit	
	- condenser dirty	- clean condenser
	- fan defective	- put right electric cause; check fuses
	- outside temperature too high	- spray condenser with water
	- pressostate for condenser control defective	- replace pressostate
• refrigerating machine starts and stops short-termed	1. not enough fresh air supply for condenser; high pressure pressostate tries to protect refrigerating machine against overload	- provide enough fresh air supply and fresh air removal; get rid of short-circuit across fresh air and exhaust air
	2. not enough pressure of refrigerant circuit; refrigerant partly escaped; diminished pressure switch shut down compressor	- find leak, seal, refill circuit
• not enough refrigeration power	1. air in water circuit	- vent system
	2. fallen below minimum water agitation quantity	- design cross-section of water pipe right; perhaps open check valve in water circuit completely, increase pipe cross-section
	3. not enough fresh air supply for condenser	- provide enough fresh air supply and fresh air removal; get rid of short-circuit across fresh air and exhaust air
	4. not enough refrigerant in circuit	- find leak, seal, refill circuit

KIND OF TROUBLE	CAUSE	ELIMINATION
• electrical heater in water circuit does not work	1. the electrical heating box becomes more than 266°F (130°C) => an automatic switch breaks the contact 2. control the pressure from the water circuit 3. control the Parameter of the temperature controller witch switches the heater.	- the reset (is under the cover of the heater) must manually be pressed - if necessary: prepare the cause of water lack and fill the water circuit - if necessary: set the right Parameter in the temperature controller (which switches the electrical heater)

10 Preventive Maintenance: Weekly Check, Two-monthly Check

Service and maintenance should always be carried out by skilled technician and, where possible, under a maintenance contract. Nevertheless, certain routine work can be effectively carried out by non-specialists and may become important factor in preventing future damage to the plant.

Weekly Check

1. Check the working of the compressor:

   Look out for too high head temperatures or suspicious noises.

2. Check the refrigerant charge through the sight-glass

3. Check that fans are rotating normally and not making unusual noises

4. Check that the temperatures is within the accepted limit.

   If it is not, check that all the separate elements of the unit are working, by witching them on individually.

   If they are not, see the fault finding guide (9 TROUBLE SHOOTING).

Two-monthly Check

a. The air conditioner unit:

1 Check the air filter and replace it if necessary
2 Check the air circulation fans and check that the bearings are not heating up
3. Check that the heating elements work, by switching them to “MAN”
4. Switch cooling system to “MAN” and check that it is in full working order
5. Check the compressor temperature.
6. Check there is no ice accumulations on the evaporator.
7. Check that the warning lights on the display panel are working properly.
8. Check the main voltage between all the phases
9. Check the principal and secondary circuits thoroughly, inspect the overload cut-outs and thermal relays.
10. Pull out the fuses to check that the safety system works.

b. The condenser

1. Air cooled units:

   Make sure that the fan motor and the condensing coil are working efficiently, if necessary clean the coil.

c. Electric heater

1. Check the heater coil

2. Check the overheating protection switch in the head of the heater .

3. Check the fuses

11 Description of the individual parts

11.1 Evaporator

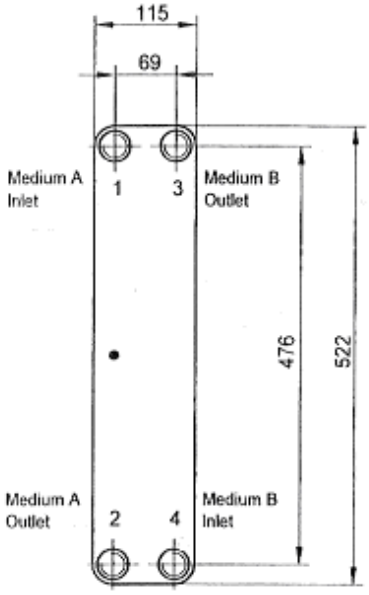
In the form of a brazed plate heat exchanger Type GEA Ecoflex M25-40 GL with thermal insulation.

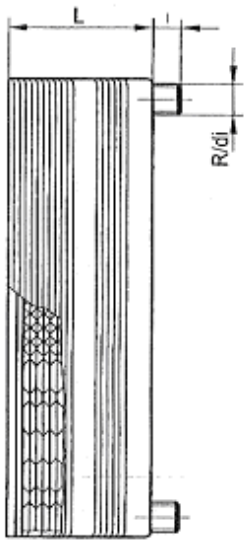
Type-tested	helium test at10 – 8 bar.	Test pressure	Water		24 bar
			Refrigerant	R134a	37,5 bar

GEA Ecoflex GmbH

Dimension sheet
Model 25
brazed plate heat exchanger

No. of plates	L mm	weight empty kg
6	25	3,5
8	30	3,9
10	36	4,3
14	46	5,1
20	61	6,3
24	71	7,1
30	87	8,3
40	112	10,3
50	138	12,3
60	164	14,3
80	215	18,3





Connections

threaded connection:	R = 1”	l = 29,5 mm
soldered connection:	di = 35 mm	l = 29,5 mm

Materials

plates and connections:	W.-1.4401 (AISI 316)
solder:	copper 99,9 %

Operation Plate Heat Exchanger (PHE)

Before each operation make sure that the plate pack is clamped to the correct compression dimension "a" and that the plate heat exchanger is anchored to the ground.

Additionally make sure that all connection pipes are screwed tight and that the permitted values for pressure and temperature given on the fabrication label are not exceeded.

The correct compression dimension can be found on the supplied dimension sheet or fabrication label. Prevent pressure surges when starting up the PHE or after brief stoppages.

If an operating PHE is shut down, it should be cooled down and cleaned afterwards. The plate pack should be loosened to "a" + 10%, starting from the current "a" dimension. This action reduces the pressure on the gaskets
Please check regularly the tightening bolts and coat them with a rust-protection agent (oil or grease).

Copeland Scroll — Single-Stage Hermetic Compliant SCROLL Motor-Compressor

11.2 Compressor

1 Safety instructions

Copeland Scroll™ compressors are manufactured according to the latest European and US Safety Standards. Particular emphasis has been placed on the user's safety.

These compressors are intended for installation in systems according to the EC Machines directive. They may be put to service only if they have been installed in these systems according to instructions and conform to the corresponding provisions of legislation. For relevant standards please refer to Manufacturers Declaration, available on request.

These instructions should be retained throughout the lifetime of the compressor.

You are strongly advised to follow these safety instructions.

1.1 Icon explanation

	**WARNING** This icon indicates instructions to avoid personal injury and material damage.		**CAUTION** This icon indicates instructions to avoid property damage and possible personal injury.
	**High voltage** This icon indicates operations with a danger of electric shock.		**IMPORTANT** This icon indicates instructions to avoid malfunction of the compressor.
	**Danger of burning or frostbite** This icon indicates operations with a danger of burning or frostbite.	***NOTE***	This word indicates a recommendation for easier operation.
	**Explosion hazard** This icon indicates operations with a danger of explosion.		

1.2 Safety statements

- **Refrigerant compressors must be employed only for their intended use.**
- **Only qualified and authorized HVAC or refrigeration personnel are permitted to install, commission and maintain this equipment.**
- **Electrical connections must be made by qualified electrical personnel.**
- **All valid standards for connecting electrical and refrigeration equipment must be observed.**

Use personal safety equipment. Safety goggles, gloves, protective clothing, safety boots and hard hats should be worn where necessary.

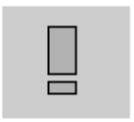
Copeland Scroll — Single-Stage Hermetic Compliant SCROLL Motor-Compressor

1.3 General instructions

WARNING
System breakdown! Personal injuries! Never install a system in the field and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.
System breakdown! Personal injuries! Only approved refrigerants and refrigeration oils must be used.

WARNING
High shell temperature! Burning! Do not touch the compressor until it has cooled down. Ensure that other materials in the area of the compressor do not get in touch with it. Lock and mark accessible sections.

CAUTION
Overheating! Bearing damage! Do not operate compressors without refrigerant charge or without being connected to the system.



IMPORTANT
Transit damage! Compressor malfunction! Use original packaging. Avoid collisions and tilting.

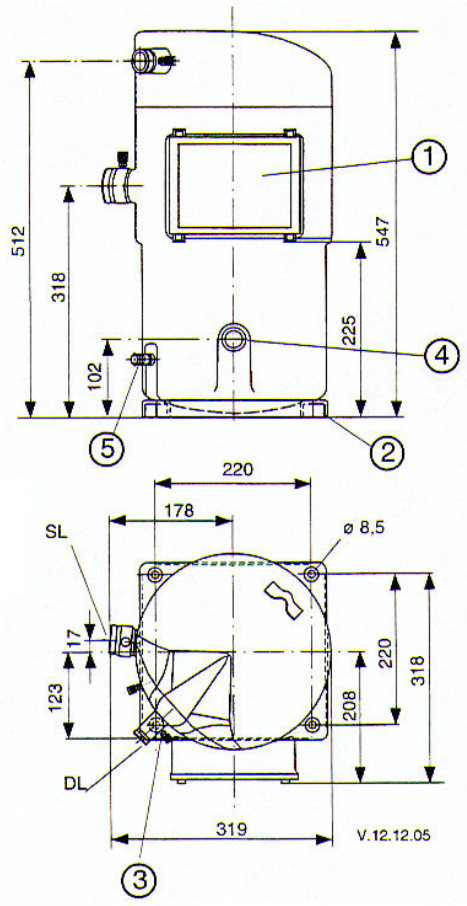
Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR 16 M3E-TWD-561

Data Sheet

max. working pressures	ISO 5149	
high- / low-pressure	28,0 / 17,0	bar
nominal speed (50 Hz / 60 Hz)	2900 / 3500	min^{-1}
displacement, theor. (50 Hz / 60 Hz)	35,6 / 43,0	m^3/h
lubrication by oil-pump		
oil charge	4,0 l	
grade of oil (ester)	Mobil EAL Arctic 22 CC ICI Emkarate RL32 CF	
enclosure class	IP 54 (IEC 34)	
internal motor protection	ELECTRONIC	
weight (net / gross)	103 / 110	kg

SL suction spud	1 3/4" - 12 Rotalock
DL discharge spud	1 1/4" - 12 Rotalock
1 terminal box	
2 rubber grommet	
3 non-return valve	
4 sight glass	
5 oil level adjustment valve	

Volt (±10%)	~	Hz	Connection	Locked Rotor Current (A)	Max. Operating Current (A)	Motor Code
380 - 420	3	50	Y	151 - 167	25,6	TWD
460	3	60	Y	158	25,6	TWD



Accessories

- Crankcase Heater: 220 – 240 V 50 – 60 Hz

Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR 16 M3E-TWD-561

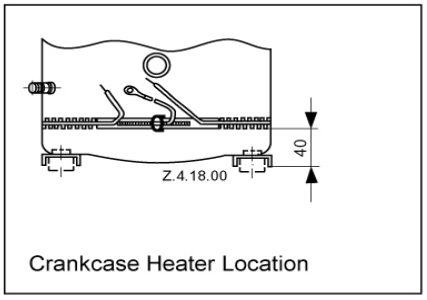
Introduction

This bulletin describes the operating characteristics, design features, and application requirements for 7.5 to 25 HP A/C Scroll Compressors in the range from ZR 90 K3 to ZR 300 KC. This family of scroll compressors is characterized by the pilot duty motor protection system that uses internal sensors and an external electronic module to protect the compressor against motor overheating and excessive discharge temperature. For additional information, please refer to the "Product Catalogue" or to the "Copeland Selection Software" accessible from the Copeland website at www.ecopeland.com. There are several operating characteristics and design features described below that are different from those of the smaller Copeland Scroll compressor models. These guidelines are not meant to replace the system expertise available from system manufacturers.

***ARI-Conditions:**

7,2 °C	evaporating temperature	8,3 K	liquid subcooling
54,4 °C	condensing temperature	35 °C	ambient temperature
11 K	suction gas superheat		

Crankcase Heaters



Crankcase Heater Location

The crankcase heater must be mounted below the oil removal valve located on the bottom shell. **The crankcase heater must remain energized during compressor off cycles.**

The initial start in the field is a very critical period for any compressor because all load bearing surfaces are new and require a short break-in period to carry high loads under adverse conditions. **The crankcase heater must be turned on a minimum of 12 hours prior to starting the compressor**. This will prevent oil dilution and bearing stress on initial start up. If it is not feasible to turn on the crankcase heater 12 hours in advance of starting the compressor, then use one of the techniques listed below to prevent possible flooded-start damage to the compressor:

1) Direct a 500 watt heat lamp or other safe heat source **(do not use torch)** at the lower shell of the compressor for approximately 30 minutes to boil off any liquid refrigerant prior to starting; or
2) Bump start the compressor by manually energizing the compressor contactor for about one second. Wait five seconds and again manually energize compressor for one second. Repeat this cycle several times until the liquid in the shell has been boiled off and the compressor can be safely started and run continuously.

Due to the Compliant Scroll's inherent ability to handle liquid refrigerant in flooded conditions, no crankcase heater is required when the system charge does not exceed following values:

- 7,7 kg for ZR 90 K3* ... ZR 19 M3*
- 11,3 kg for ZR 250 KC*
- 13,6 kg for ZR 300 KC*

A crankcase heater is needed to drive out excessive amounts of refrigerant that have migrated into the shell during standstill periods and no accumulator is piped to provide free liquid drainage during the off cycle.

Minimum Run Time

There is no set answer to how often scroll compressors can be started and stopped in an hour, since it is highly dependent on system configuration. There is no minimum off time, because the scrolls start unloaded, even if the system has unbalanced pressures. The most critical consideration is the minimum run time required to return oil to the compressor after startup. This is easily determined since these compressors are equipped with a sight glass. The minimum on time becomes the time required for oil lost on compressor startup to return to the compressor sump and restore a normal level in the sight glass. Cycling the compressor for a shorter time than this, for instance to maintain very tight temperature control can result in progressive loss of oil and damage to the compressor.

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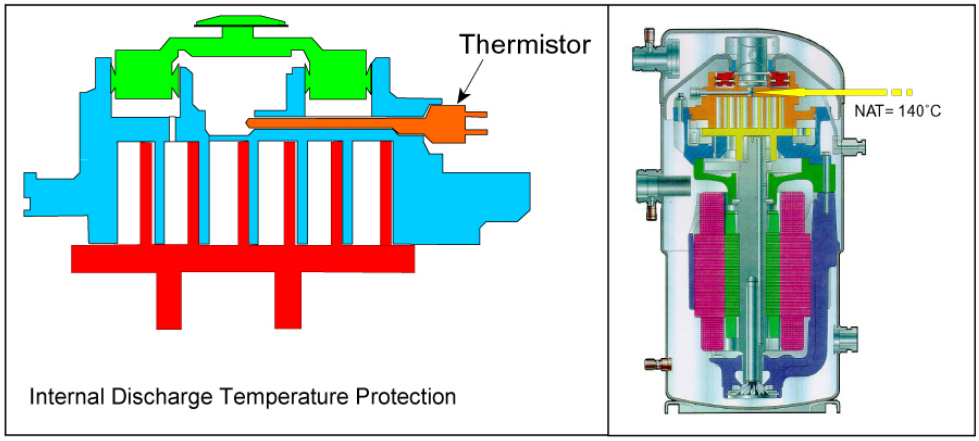
Discharge Temperature Protection

A thermistor with a nominal response temperature of 140 °C is located in the discharge port of the fixed scroll. Excessive discharge temperature will cause the electronic protector module to trip (see also **Electronic Motor Protection**). The discharge gas sensor is wired in series with the motor thermistor chain



Internal Discharge Temperature Protection

Electronic Motor Protection

The electronic motor protection system as used in all ZR 90 K3* ... ZR 300 KC* models is identified by a “W” as the center letter in the motor code. This system utilizes the temperature dependent resistance of thermistors (also called PTC-resistances) to read the winding temperature. A chain of four thermistors connected in series is embedded in the motor windings so that the temperature of the thermistors can follow the winding temperature with little inertia. An electronic module is required to process the resistance values and trip a control relay depending on the thermistor resistance. The characteristic gradient of a thermistor resistance curve is shown in **Fig. 6**. The resistance curve can be designed for different operating points, the nominal response temperature (NAT), e.g. 80°C, 100°C, 140°C, and must comply with the tolerances laid out in the standard DIN 44081.

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Module

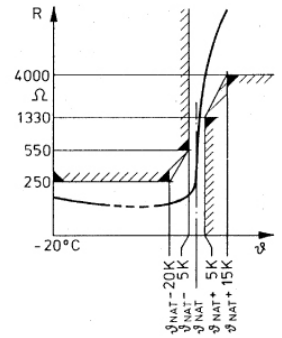
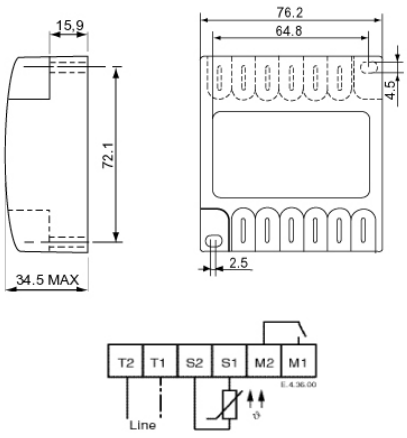


Fig. 6: Thermistor Resistance Curve

Protector Specifications :

Type:	Kriwan INT 69 SC/ Carel
Voltage:	24 V AC; 230 V AC,120/240 V AC
Control Rating:	60 VA, 25 A Inrush 300/375 VA 25/15 A Inrush
Normal PTC resistance:	250 to 1000 Ohms
Trip resistance:	>4500 Ohm +/- 20%
Reset resistance:	<2750 Ohms
Module time out:	30 minutes +/- 5 minutes
Low Voltage Sensing:	None
Phase Monitor:	No



L1/T1 neutral connection
L2/T2 line voltage connection
S1, S2 thermistor chain connection
M1, M2 control circuit connection

Fig. 7: Motor Protection Module

For protection in case of blocked rotor one thermistor for each phase is embedded in the winding heads on the upper (suction gas) side of the compressor motor. A fourth thermistor is located in a winding head at the lower end of the motor. A fifth sensor is located in the discharge port of the fixed scroll to control discharge gas superheat. The entire chain is internally led to the fusite from where it is connected to the module connections S1 and S2 (see **Fig. 7**). When any resistance of the thermistor chain reaches the tripping value, the module interrupts the control line and causes the compressor to switch off. After the thermistor has cooled sufficiently, its resistance drops to the reset value but the module itself resets after a time delay of 30 minutes and restarts the compressor.

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Protector Functional Check and Failure Detection

Prior to start-up of the compressor a functional check shall be carried out:
- Switch off power!
- Disconnect one terminal either S1 or S2 of the electronic module. If the compressor is now switched on, the motor should not start.
- Switch off power.
- Reconnect the disconnected thermistor line. If the compressor is now switched on the motor must start.

Protector Fault Diagnosis:

If the motor does not start-up during the functional check, this indicates a disturbance in operation:
- Switch off power.
- Check the connection of the thermistor leads in the terminal box and at the protection module for possible loose connections and check the connection cable for possible breakage.
- The resistance of the thermistor chain shall be measured in a cold condition, i.e. after the motor has sufficiently cooled down.

Caution: Use maximum measuring voltage of 3 V!
In doing so, the thermistor leads at terminals S1 and S2 of the module shall be disconnected and measured between the leads. Resistance must be between 150 and 1250 ohms.
If the thermistor chain has a higher resistance (2750 ohms or greater) the motor temperature is still too high and it has to be allowed to cool.
If the resistor is 0 ohms, the compressor has to be exchanged due to shorted sensor circuit. ∞ ohms indicates an open sensor circuit and the compressor has to be replaced.
If no defect is located in the thermistor chain or there is no loose contact or conductor breakage, the module shall be checked. Then the control connections at M1 and M2 have to be removed (Caution! Switch off voltage supply first!) and check the switching conditions by an ohmmeter or signal buzzer:
- short-cut the already disconnected thermistor contactors S1 and S2 and switch on the voltage supply; the relay must switch; connection established between contactors M1 and M2
-remove the jumper between S1 and S2, the relay must switch off; no connection between contactors M1 and M2
- shortcut the contactors S1 and S2 again, the relay remains switched off; no connection between contactors M1 and M2
- switch off the voltage supply for approximately 4 sec and switch it on again, the relay must switch on now; connection between contactors M1 and M2
If one of the above conditions is not met, the module is defective and has to be exchanged.

Note: The power should be switched off between the tests, in order to avoid short circuits and accidental touching of contacts. The function of the module should be tested each time the fuse in the control circuit breaks the power supply. This makes sure that the contacts did not stick.

Shell Temperature

Certain types of system failures, such as condenser or evaporator fan blockage or loss of charge, may cause the top shell and discharge line to briefly but repeatedly reach temperatures above 177°C as the compressor cycles on its internal protection devices. Care must be taken to ensure that wiring or other materials, which could be damaged by these temperatures, do not come in contact with these potentially hot areas.

Copeland Scroll

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Type ZR 16 M3E-TWD-561

Compressor Functional Check

A functional compressor test with the suction service valve closed to check how low the compressor will pull suction pressure is **not** a good indication of how well a compressor is performing. **Such a test will damage a scroll compressor**. The following diagnostic procedure should be used to evaluate whether a Copeland Scroll compressor is working properly.

1. Proper voltage to the unit should be verified.
2. The normal checks of motor winding continuity and short to ground should be made to determine if an internal motor short or ground fault has developed. If the protector has opened, the compressor must be allowed to cool sufficiently to allow it to reset.
3. Proper indoor and outdoor blower/fan operation should be verified.
4. With service gauges connected to suction and discharge pressure fittings, turn on the compressor. If suction pressure falls below normal levels, the system is either low on charge or there is a flow blockage in the system.
5. If suction pressure does not drop and discharge pressure does not rise to normal levels, reverse any two of the compressor power leads and reapply power to make sure compressor was not wired to run in reverse direction. If pressures still do not move to normal values, either the reversing valve (if so equipped) or the compressor is faulty. Reconnect the compressor leads as originally configured and use normal diagnostic procedures to check operation of the reversing valve.
6. To test if the compressor is pumping properly, the compressor current draw must be compared to published compressor performance curves using the operating pressures and voltage of the system. If the average measured current deviates more than ±15% from published values, a faulty compressor may be indicated. A current imbalance exceeding 15% of the average on the three phases may indicate a voltage imbalance and should be investigated further.
7. **Before replacing or returning a compressor:** Be certain that the compressor is actually defective. As a minimum, recheck a compressor returned from the field in the shop or depot for winding resistance and ability to start before returning. More than one-third of compressors returned to Copeland for warranty analysis are determined to have nothing found wrong. They were misdiagnosed in the field as being defective. Replacing working compressors unnecessarily costs everyone.

Installation System Charging Procedure

Because scrolls have discharge check valves, systems should be charged on both the high and low side simultaneously to assure refrigerant pressure is present in the compressor before it is tested or operated. The majority of the charge should be placed in the high side of the system to prevent bearing washout during first-time start on the assembly line. It is best to charge only vapor into the low side of the system.

Do not operate compressor without enough system charge to maintain at least 0.5 bar suction pressure. Do not operate with a restricted suction. Do not operate with the low pressure cut-out jumpered.

Allowing pressure to drop below 0.5 bar for more than a few seconds may overheat scrolls and cause early drive bearing damage. Do not use compressor to test opening setpoint of high pressure cutout. Bearings are susceptible to damage before they have had several hours of normal running for proper break in.

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Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR xx KCE-TFD-650

2.4 Application range

2.4.1 Qualified refrigerants and oils

IMPORTANT
It is essential that the glide of refrigerant blends (primarily R407C) is carefully considered when adjusting pressure and superheat controls.

Oil recharge values can be taken from Copeland Scroll™ compressors brochures or Copeland® Brand Products Selection Software.

Qualified refrigerants	R22	R407C, R134a, R22	R410A
Copeland® Brand Products standard oil	White oil / Suniso 3 GS	Emkarate RL 32 3MAF	
Servicing oil	Suniso 3 GS / White oil	Emkarate RL 32 3MAF	
		Mobil EAL Arctic 22 CC	

Table 1: Qualified refrigerants and oils

2.4.2 Application limits

CAUTION
Inadequate lubrication! Compressor breakdown! The superheat at the compressor suction inlet must always be sufficient to ensure that no refrigerant droplets enter the compressor. For a typical evaporator-expansion valve configuration a minimum stable superheat of at least 5K is required.

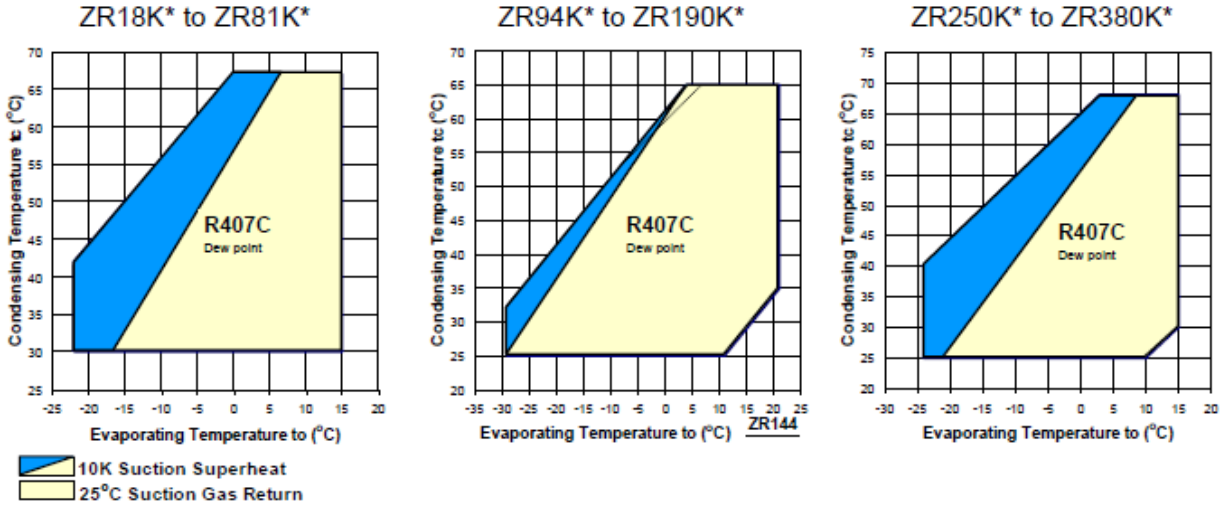

Figure 1: Application envelopes for compressors ZR18K* to ZR380K* with R407C

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3 Installation

WARNING
High pressure! Injury to skin and eyes possible! Be careful when opening connections on a pressurized item.

3.1 Compressor handling

3.1.1 Transport and storage

WARNING
Risk of collapse! Personal injuries! Move compressors only with appropriate mechanical or handling equipment according to weight. Keep in the upright position. Stack pallets on top of each other when not exceeding 300 kg. Do not stack single boxes on top of each other. Keep the packaging dry at all times.

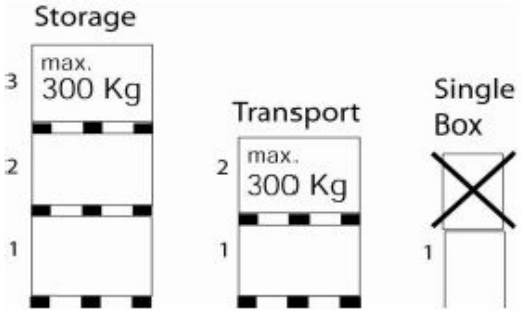

Figure 3

3.1.2 Positioning and securing

IMPORTANT
Handling damage! Compressor malfunction! Only use the lifting eyes whenever the compressor requires positioning. Using discharge or suction connections for lifting may cause damage or leaks.

For models ZR94K* to ZR190K* and ZP103K* to ZP182K*, because oil might spill out of the suction connection located low on the shell, the suction connection plug must be left in place until the compressor is set into the unit. If possible, the compressor should be kept vertical during handling. The discharge connection plug should be removed first before pulling the suction connection plug to allow the dry air pressure inside the compressor to escape. Pulling the plugs in this sequence prevents oil mist from coating the suction tube making brazing difficult. The copper coated steel suction tube should be cleaned before brazing. No object, eg, a swaging tool should be inserted deeper than 51 mm into the suction tube or it might damage the suction screen and motor.

3.1.3 Installation location

Ensure the compressors are installed on a solid level base.

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4 Electrical connection

4.1 General recommendations

The compressor terminal box has a wiring diagram on the inside of its cover. Before connecting the compressor, ensure the supply voltage, the phases and the frequency match the nameplate data.

Attention: Motorcode 650 need Molded Plug for Re power connection!

4.2 Electrical installation

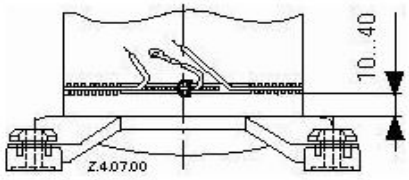
Crankcase heaters

IMPORTANT
Oil dilution! Bearing malfunction! Turn the crankcase heater on 12 hours before starting the compressor.

A crankcase heater is required when the system charge exceeds the compressor charge limits listed in **Table 3**.

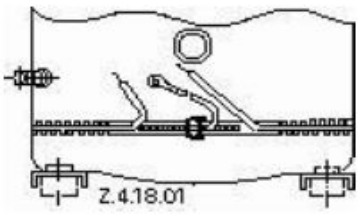
Model	Refrigerant charge limit
ZR18K*	2.7 kg
ZR22K* to ZR81K* / ZP24K* to ZP91K*	4.5 kg
ZR94K* to ZR190K* / ZP103K* to ZP182K*	7.0 kg
ZR250K* / ZP235K*	11.3 kg
ZR310K* to ZR380K* / ZP295K* to ZP385K*	13.6 kg
ZP485K*	16.0 kg

Table 3



For compressors ZR18K* to ZR81K* and ZP24K* to ZP91K*, the crankcase heater must be mounted 10 to 40 mm above compressor legs (see **Figure 12**).

Figure 12: Crankcase heater location, models ZR18K* to ZR81K* & ZP24K* to ZP91K*



For all other compressor models, the crankcase heater must be mounted below the oil removal valve located on the bottom shell (see **Figure 13**).

Figure 13: Crankcase heater location, models ZR94K* to ZR380K* & ZP103K* to ZP485K*

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Type ZR xx KCE-TFD-650

Internal pressure relief valve

There is an internal pressure relief valve on all ZR18K* to ZR81K* and ZP24K* to ZP91K* compressors, which opens at a differential pressure of 28 bar ± 3 bar for ZR compressors and 40 bar ± 3 bar for ZP compressors between high- and low-pressure sides. A high-pressure cut-out may be required according to national regulations and is strongly recommended due to the capabilities of pumping to high pressures once the discharge is obstructed. The internal pressure relief valve is a safety device, not an HP switch. It is not designed for repeated operation and there is no guarantee that it will reset correctly if it does have repeated operation.

The following compressors do NOT have any internal pressure relief valve: ZR94K* to ZR190K* and ZP90K* to ZP182K* (Summit range), ZR250K* to ZR380K* and ZP235K* to ZP485K*.

Discharge temperature protection

The ZR18K* to ZR81K* and ZP24K* to ZP91K* compressors have an internal thermo-disc discharge gas temperature protection. This thermo-disc opens a gas passage from the discharge port to the suction side near the motor protector when the discharged gas reaches a critical temperature. The hot gas then causes the motor protector to trip shutting down the compressor.

ZR94K* to ZR190K* and ZP103K* to ZP182K* Scroll compressors built in October 2004 and later (04J) have the addition of the Advanced Scroll Temperature Protection (ASTP). Advanced Scroll Temperature Protection is also a temperature sensitive thermo-disc that acts to protect the compressor from discharge gas overheating. Once the discharge gas reaches a critical temperature, the ASTP feature will cause the scrolls to separate and stop pumping although the motor continues to run. After running for some time without pumping gas, the motor protector will open.

Copeland Scroll
Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR xx KCE-TFD-650

To identify compressors with Advanced Scroll Temperature Protection, a label has been added above the terminal box.

Figure 14: Advanced Scroll Temperature Protection (ASTP)

NOTE: **Depending upon the heat build-up in the compressor, it may take more than one hour for the ASTP and motor protector to reset!**

For compressors ZR250K* to ZR380K* and ZP235K* to ZP485K*, a thermistor is located in the discharge port of the fixed scroll. Excessive discharge temperature will cause the electronic protector module to trip. The discharge gas thermistor is wired in series with the motor thermistor chain.

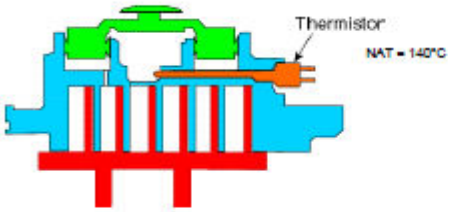
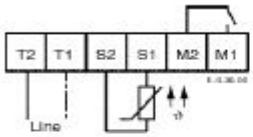


Figure 15: Internal discharge temperature sensor position

Motor protection

For the ZR18K* to ZR190K* and ZP24K* to ZP182K* range of compressors, conventional inherent internal line break motor protection is provided.

The electronic motor protection system used in all ZR250K* to ZR380K* and ZP235K* to ZP485K* models is identified by a "W" as the centre letter in the motor code. This system utilizes the temperature-dependent resistance of the thermistors (also called PTC-resistance) to read the winding temperature. A chain of four thermistors connected in series is embedded in the motor windings so that the temperature of the thermistors can follow the winding temperature with little inertia. An electronic module is required to process the resistance values and trip a control depending on the thermistor resistance.



L1/T1 neutral connection
L2/T2 line voltage connection
S1, S2 thermistor chain connection
M1, M2 control circuit connection

Figure 16: Wiring of the motor protection module

Module

For protection in case of blocked rotor one thermistor for each phase is embedded in the winding heads on the upper (suction gas) side of the compressor motor. A fourth thermistor is located in a winding head at the lower end of the motor. A fifth sensor is located in the discharge port of the fixed scroll to control discharge-gas superheat. The entire chain is internally led to the

fusite from where it is connected to the module connections S1 and S2. When any resistance of the thermistor chain reaches the tripping value, the module interrupts the control line and causes the compressor to switch off. After the thermistor has cooled sufficiently, its resistance drops to the reset value but the module itself resets after a time delay of 30 minutes and restarts the compressor.

Supply voltage: Dual voltage	115-230V AC 50 Hz, -15%...+10%, 3VA
Supply voltage: Dual voltage	120-240V AC 60 Hz, -15%...+10%, 3VA
Supply voltage	24V AC 50/60 Hz, -15%...+10%, 3VA
Supply voltage	24V DC ± 20%, 2W
Ambient temperature range	-30…+70°C
R_{25}, total	< 1,8kΩ
Trip resistance	4,50kΩ ± 20%
Reset time delay type 1 / type 2	30 min ± 5 min / 60 min ± 5 min
Reset of running time	Power interruption / mains failure for approx. 5 sec
Short circuit monitoring system	Typically < 30Ω
Protection class according to EN 60529	IP00
Weight	Approximately 200 g
Mounting	Screw in or snap in
Housing material	PA66 GF25 FR

Table 4: Protection module specifications INT69SC2

Protector functional check and failure detection

WARNING
Conductor cables! Electrical shock! Shut off power supply before and between each test.

Prior to start-up of the fully connected compressor a functional check shall be carried out:

- Disconnect one terminal either S1 or S2 of the protection module. If the compressor is now switched on, the motor should not start (simulation of an open thermistor chain).
- Reconnect the disconnected thermistor line. If the compressor is now switched on, the motor must start.

If the motor does not start up during the functional check, this indicates a disturbance in operation. The following steps should be followed:

Checking the connection

- Check the connection of the thermistor leads in the terminal box and at the protection module for possible loose connections or cable breakage.

If there is neither loose connection nor cable breakage the resistance of the thermistor chain must be checked.

Copeland Scroll
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Checking the compressor thermistor chain

Caution: Use maximum measuring voltage of 3V!

The thermistor leads at terminals S1 and S2 of the module shall be disconnected and the resistance measured between the leads. The resistance must be between 150 Ω and 1250 Ω.

- If the thermistor chain has a higher resistance (2750 Ω or higher), the motor temperature is still too high and it must be allowed to cool. Then measure again.
- If the resistance is below 30 Ω, the compressor has to be exchanged due to shorted sensor circuit.
- An infinite value indicates an open sensor circuit and the compressor has to be replaced.

If no defect is detected in the thermistor chain the module must be checked.

Checking the protection module

The control connections at M1 and M2 have to be removed and the switching conditions must be checked by an ohmmeter or signal buzzer:

- Simulation of a short circuit in the thermistor chain (0 Ω): Bridge the already disconnected thermistor terminals S1 and S2 and switch on the voltage supply; the relay must switch on then off again after a short period; connection established then interrupted between terminals M1 and M2.
- Simulation of an open thermistor chain (∞ Ω): Remove the jumper used for the short-circuit simulation and switch on the voltage supply; the relay remains switched off; no connection between terminals M1 and M2.

If one of the above conditions is not met, the module is defective and has to be exchanged.

***NOTE:* The function of the module should be tested each time the fuse in the control circuit breaks the power supply. This ensures the contacts did not stick.**

High-potential testing

WARNING
Conductor cables! Electrical shock! Shut off power supply before high-potential testing.

CAUTION
Internal arcing! Motor destruction! Do not carry out high-voltage or insulation tests if the compressor housing is under vacuum.

Emerson Climate Technologies subjects all Scroll compressors to a high-voltage test after final assembly. Each motor phase winding is tested, according to EN 0530 or VDE 0530 part 1, at a differential voltage of 1000V plus twice the nominal voltage. Since high-voltage tests lead to premature ageing of the winding insulation additional tests of that nature are not recommended.

If it has to be done for any reason, a lower voltage must be used. Disconnect all electronic devices, eg, motor protection module, fan speed control, etc prior to testing.

5 Starting up & operation

Charging procedure

CAUTION
Low suction pressure operation! Compressor Damage! Do not operate with a restricted suction. Do not operate with the low-pressure cut-out bridged. Do not operate compressor without enough system charge to maintain at least 0.5 bar suction pressure. Allowing pressure to drop below 0.5 bar for more than a few seconds may overheat scrolls and cause early drive bearing damage.

The system should be liquid-charged through the liquid-receiver shut-off valve or through a valve in the liquid line. The use of a filter drier in the charging line is highly recommended. Because R410A and R407C are blends and scrolls have discharge check valves, systems should be liquid-charged on both the high and low sides simultaneously to ensure a positive refrigerant pressure is present in the compressor before it runs. The majority of the charge should be placed in the high side of the system to prevent bearing washout during first-time start on the assembly line.

Copeland Scroll
Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR xx KCE-TWD-650

Initial start-up

CAUTION
Oil dilution! Bearing malfunction! It is important to ensure that new compressors are not subjected to liquid abuse. Turn the crankcase heater on 12 hours before starting the compressor.

CAUTION
High discharge pressure operation! Compressor damage! Do not use compressor to test opening set point of high-pressure cut-out. Bearings are susceptible to damage before they have had several hours of normal running in.

Liquid and high pressure loads could be detrimental to new bearings. It is therefore important to ensure that new compressors are not subjected to liquid abuse and high-pressure run tests. It is not good practice to use the compressor to test the high-pressure switch function on the production line. Switch function can be tested with nitrogen prior to installation and wiring can be checked by disconnecting the high-pressure switch during the run test.

Rotation direction

Scroll compressors, like several other types of compressors, will only compress in one rotational direction. Direction of rotation is not an issue with single-phase compressors since they will always start and run in the proper direction. Three-phase compressors will rotate in either direction depending upon phasing of the power. Since there is a 50-50 chance of connecting power in such a way as to cause rotation in the reverse direction, **it is important to include notices and instructions in appropriate locations on the equipment to ensure proper rotation direction when the system is installed and operated**.

Observing that suction pressure drops and discharge pressure rises when the compressor is energized allows verification of proper rotation direction. There is no negative impact on durability caused by operating three-phase Copeland Scroll™ compressors in the reversed direction for a short period of time (under one hour) but oil may be lost. Oil loss can be prevented during reverse rotation if the tubing is routed at least 15 cm above the compressor. After several minutes of operation in reverse, the compressor's protection system will trip due to high motor temperature. The operator will notice a lack of cooling. However, if allowed to repeatedly restart and run in reverse without correcting the situation, the compressor will be permanently damaged.

All three-phase scroll compressors are identically wired internally. Therefore, once the correct phasing is determined for a specific system or installation, connecting properly phased power leads to the identified compressor terminals will ensure proper rotation direction.

Starting sound

During the very brief start-up, a clicking sound is audible, resulting from initial contacting of the spirals and is normal. Due to the design of the Copeland Scroll, the internal compression components always start unloaded even if system pressures are not balanced. In addition, since internal compressor pressures are always balanced at start-up, low-voltage starting characteristics are excellent for Copeland Scroll™ compressors.

Copeland Scroll
Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR xx KCE-TWD-650

Deep vacuum operation

CAUTION
Vacuum operation! Compressor damage! Scroll compressors should never be used to evacuate a refrigeration or air-conditioning system.

The scroll compressor can be used to pump down refrigerant in a unit as long as the pressures remain within the operating envelope. Low suction pressures will result in overheating of the scrolls and permanent damage to the compressor drive bearing. ZP and ZR scrolls incorporate internal low vacuum protection; the floating seal unloads when the pressure ratio exceeds approximately 10:1.

Pump down cycle

A pump down cycle for control of refrigerant migration may be used in conjunction with a crankcase heater when the compressor is located so that cold air blowing over the compressor makes the crankcase heater ineffective.

If a pump down cycle is used, a separate external check valve must be added. The scroll discharge check valve is designed to stop extended reverse rotation and prevent high-pressure gas from leaking rapidly into the low side after shut off. The check valve will in some cases leak more than reciprocating compressor discharge reeds, normally used with pump down, causing the scroll compressor to recycle more frequently. Repeated short-cycling of this nature can result in a low oil situation and consequent damage to the compressor. The low-pressure control differential has to be reviewed since a relatively large volume of gas will re-expand from the high side of the compressor into the low side after shutdown.

Pressure control setting: Never set the low-pressure control to shut off outside of the operating envelope. To prevent the compressor from running into problems during such faults as loss of charge or partial blockage, the control should not be set lower than 12 to 15 K equivalent suction pressure below the lowest design operating point.

Minimum run time

Emerson Climate Technologies recommends a maximum of 10 starts per hour. There is no minimum off time because scroll compressors start unloaded, even if the system has unbalanced pressures. The most critical consideration is the minimum run time required to return oil to the compressor after start-up. To establish the minimum run time obtain a sample compressor equipped with a sight tube (available from Emerson Climate Technologies) and install it in a system with the longest connecting lines that are approved for the system. The minimum on time becomes the time required for oil lost during compressor start-up to return to the compressor sump and restore a minimal oil level that will ensure oil pick-up through the crankshaft. Cycling the compressor for a shorter period than this, for instance to maintain very tight temperature control, will result in progressive loss of oil and damage to the compressor.

Shut-off sound

Scroll compressors incorporate a device that minimizes reverse rotation. The residual momentary reversal of the scrolls at shut off will cause a clicking sound, but it is entirely normal and has no effect on compressor durability.

Copeland Scroll
Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR xx KCE-TFD-650

Frequency

There is no general release of standard Copeland Scroll™ compressors for use with variable speed AC drives. There are numerous issues that must be considered when applying Scroll compressors with variable speed, including system design, inverter selection, and operating envelopes at various conditions. Only frequencies from 50 Hz to 60 Hz are acceptable. Operation outside this frequency range is possible but should not be done without specific Application Engineering review. The voltage must vary proportionally to the frequency.

If the inverter can only deliver a maximum voltage of 400V, the amps will increase when the speed is above 50 Hz, and this may give rise to nuisance tripping if operation is near the maximum power limit and/or compressor discharge temperature limit.

Oil level

The oil level should be maintained at mid-point of the sight glass. If an oil regulator is being used the level should be set within the top half of the sight glass.

Copeland Scroll
Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR xx KCE-TFD-650

6 Maintenance & repair

Replacing a compressor

CAUTION
Inadequate lubrication! Bearing destruction! Exchange the accumulator after replacing a compressor with a burned out motor. The accumulator oil return orifice or screen may be plugged with debris or may become plugged. This will result in starvation of oil to the new compressor and a second failure.

Compressor replacement

In the case of a motor burnout, the majority of contaminated oil will be removed with the compressor. The rest of the oil is cleaned through the use of suction and liquid line filter driers. A 100% activated alumna suction line filter drier is recommended but must be removed after 72 hours. **It is highly recommended that the suction accumulator be replaced if the system contains one.** This is because the accumulator oil-return orifice or screen may be plugged with debris or may become plugged shortly after a compressor failure. This will result in starvation of oil to the replacement compressor and a second failure. When a single compressor or tandem is exchanged in the field, it is possible that a major portion of the oil may still be in the system. While this may not affect the reliability of the replacement compressor, the extra oil will add to rotor drag and increase power usage.

Start-up of a new or replacement compressor

Rapid charging only on the suction side of a scroll-equipped system or condensing unit can occasionally result in a temporary no start condition for the compressor. The reason for this is that, if the flanks of the compressor happen to be in a sealed position, rapid pressurisation of the low side without opposing high-side pressure can cause the scrolls to seal axially. As a result, until the pressures eventually equalise, the scrolls can be held tightly together preventing rotation. The best way to avoid this situation is to charge on both the high and low sides simultaneously at a rate which does not result in axial loading of the scrolls.

A minimum suction pressure of 1.75 bar must be maintained during charging. Allowing pressure to drop below 0.5 bar for more than a few seconds may overheat scrolls and cause early drive bearing damage. Never install a system in the field and leave it unattended when it has no charge, a holding charge, or with the service valves closed without securely electrically locking out the system. This will prevent unauthorised personnel from accidentally operating the system and potentially ruining the compressor by operating with no refrigerant flow. **Do not start the compressor while the system is in a deep vacuum.** Internal arcing may occur when a scroll compressor is started in a vacuum causing burnout of the internal lead connections.

Single-Stage Hermetic Compliant SCROLL Motor-Compressor
Type ZR xx KCE-TFD-650

Lubrication and oil removal

CAUTION
Chemical reaction! Compressor destruction! Do not mix up ester oils with mineral oil and/or alkyl benzene when used with chlorine-free (HFC) refrigerants.

The compressor is supplied with an initial oil charge. The standard oil charge for use with refrigerants R407C / R410A / R134a is a polyolester (POE) lubricant Emkarate RL 32 3MAF. In the field the oil level could be topped up with Mobil EAL Arctic 22 CC if 3MAF is not available. The standard mineral oil for R22 is Suniso 3GS or Copeland White Oil according to compressor model. See nameplate for original oil charge shown in litres. A field recharge is from 0.05 to 0.1 litre less.

One disadvantage of POE is that it is far more hygroscopic than mineral oil (see **Figure 17**). Only brief exposure to ambient air is needed for POE to absorb sufficient moisture to make it unacceptable for use in a refrigeration system. Since POE holds moisture more readily than mineral oil it is more difficult to remove it through the use of vacuum. Compressors supplied by Emerson Climate Technologies contain oil with low moisture content, and it may rise during the system assembling process. Therefore it is recommended that a properly sized filter-drier is installed in all POE systems. This will maintain the moisture level in the oil to less than 50 ppm. If oil is charged into a system, it is recommended to use POE with a moisture content no higher than 50 ppm.

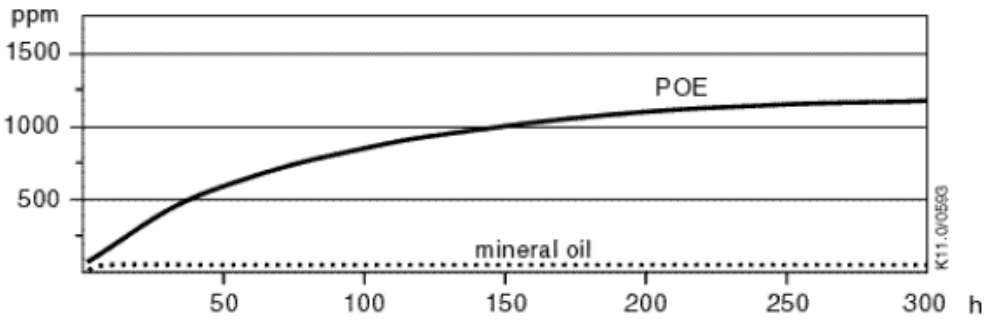


Figure 17: Absorption of moisture in ester oil in comparison to mineral oil in ppm by weight at 25°C and 50% relative humidity (h=hours)

If the moisture content of the oil in a refrigeration system reaches unacceptably high levels, corrosion and copper plating may occur. The system should be evacuated down to 0.3 mbar or lower. If there is uncertainty as to the moisture content in the system, an oil sample should be taken and tested for moisture. Sight glass/moisture indicators currently available can be used with the HFC refrigerants and lubricants; however, the moisture indicator will just show the moisture content of the refrigerant. The actual moisture level of POE would be higher than the sight glass indicates. This is due to the high hygroscopicity of the POE oil. To determine the actual moisture content of the lubricant, samples have to be taken from the system and analysed.

Oil additives

Although Emerson Climate Technologies cannot comment on any specific product, from our own testing and past experience, we do not recommend the use of any additives to reduce compressor bearing losses or for any other purpose. Furthermore, the long term chemical stability of any additive in the presence of refrigerant, low and high temperatures, and materials commonly found in refrigeration systems is complex and difficult to evaluate without rigorously controlled chemical laboratory testing. The use of additives without adequate testing may result in malfunction or premature failure of components in the system and, in specific cases, in voiding the warranty on the component.

11.3 Condenser

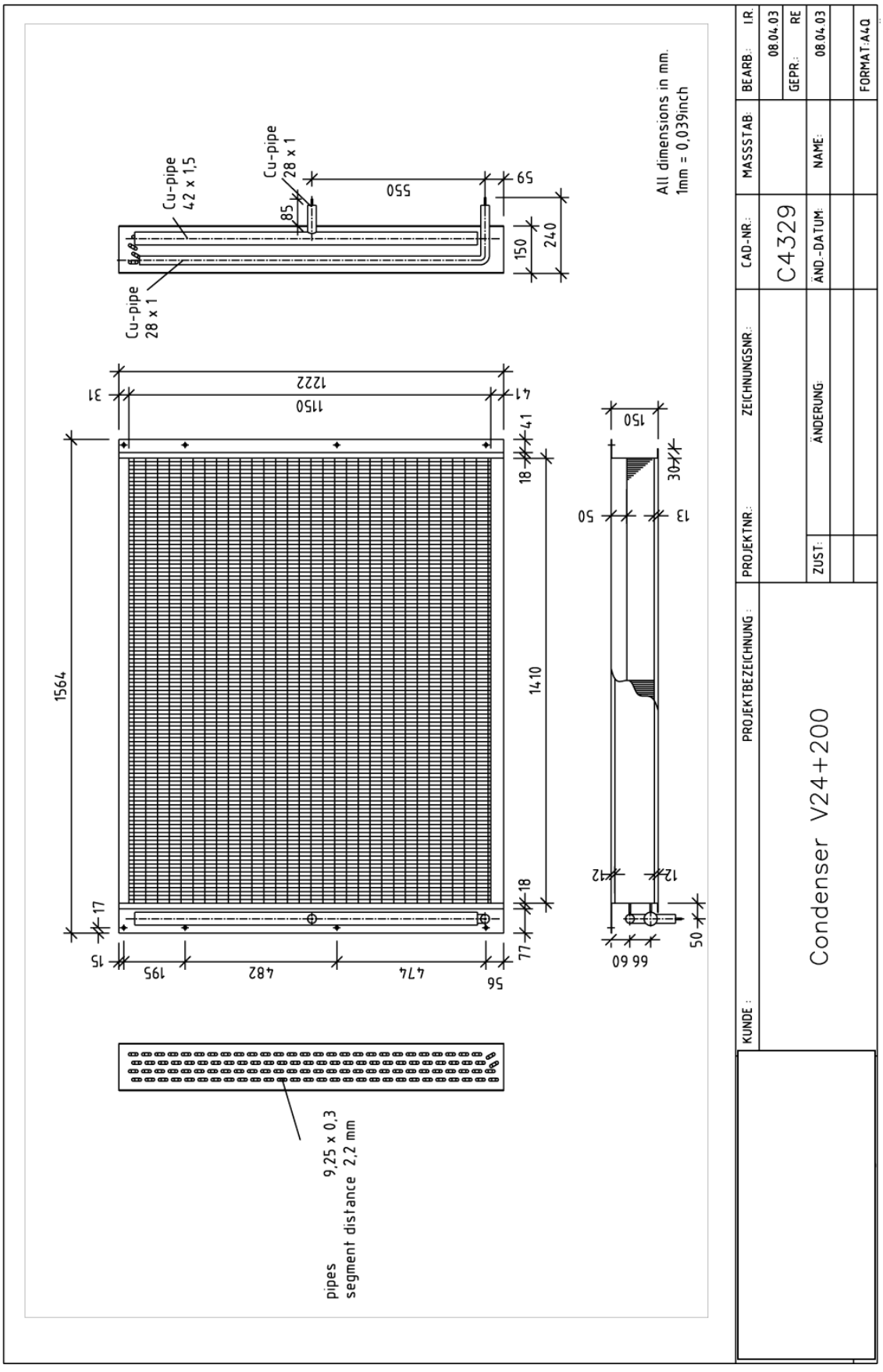
The condenser is a refrigerant-air heat transferor consisting of copper pipes heat exchanger with aluminum plates and two axial fans.

The fans are fitted internally with a full motor protector (Klixon).

The fans are controlled by the Frequency Inverter.

The process heat is transmitted here to the surrounding air.

In order to guarantee optimal heat transmission, the condenser must be kept constantly clean and the fans must be protected from damage.


All dimensions in mm.
1mm = 0,039inch
Cu-pipe 42 x 1,5
Cu-pipe 28 x 1
Cu-pipe 28 x 1
550
85
65
150
240
1222
1150
31
41
18
1564
1410
17
15
195
482
474
56
77
150
30
50
13
42
12
66
60
50
9,25 x 0,3
pipes segment distance 2,2 mm
KUNDE :
PROJEKTBEZEICHNUNG :
Condenser V24+200
PROJEKTNR.:
ZEICHNUNGSNR.:
ÄNDERUNG:
ZUST.:
CAD-NR.:
C4329
ÄND.-DATUM:
MASSSTAB:
NAME:
BEARB.: I.R. 08.04.03
GEPR.: RE 08.04.03
FORMAT:A4Q

11.4 Fans

The axial flow-fans suck the surrounding air through the condenser package and blow the warm air out at the top. The industrial coolers Type KPC 115-L-U/S are fitted with 2 fans Type FE050 VDD.41.6.

The fans are fitted internally with a full motor protector (Klixon).

The fans are controlled by the Frequency Inverter.

ZIEHL-ABEGG — Axial Fan FE-Series

Technical Description

Fan designs

FE - Series
sickle bladed die cast aluminium impeller
∅ 315.....1000 mm
exellent noise spectrum
100 % speed controllable
especially suited to installation in applications

Application:
refrigeration technology
design A / direction of air flow „V“
design K / direction of air flow „VD“
design Q / direction of air flow „AD“

Application:
ventilation technology
design A / direction of air flow „A“
design Q / direction of air flow „AS“
design F / direction of air flow „VD“

Application:
heating technology on request

Axialventilator FE - Reihe
Axial fan FE - Series

Materials/ Corrosion protection

*Axial fans in **series FC, FE** and **FH** are die cast in aluminium alloy that is not resistant to sea water. A two-component plastic paint finish ensures adequate protection against corrosion for the requirements of free air. Please tell us the area of application, especially if there are increased climatic requirements or for use in areas with increased humidity such as breweries, cheese manufacturing, etc.*

Contact protection

The contact protection can only then be included, if a motor suspension, respectively in some cases, a motor suspension with a wall ring, is included in the delivery.

*Depending on the air flow direction, the contact protection is mounted either on the inlet or discharge side of the fan blades. **Please pay attention to the notes to the contact protection in the technical data sheets.***

The range of accessories contains separate guard grilles which can be mounted to DIN EN 294 on either the discharge or inlet side of the fan, as necessary, and depending on the installation situation.

Please note the section “Effect of guard grille” in the General Notes.

Fan characteristics

Series FE
The sickle-shaped design of the profiled die cast aluminium blade reduces the blade passing noise considerably. Optimal sound behavior, however, can only be achieved in an air guiding system that is well designed in terms of flow technology and with a full bell mouth inlet (see the section on installation notes).

The characteristic curve in Fig. 3 shows fan type FE056-SD_.4F._ in a two speed 3~ design without guard grille.
Characteristic curve (2) to (3) = high speed
Characteristic curve (5) to (6) = low speed through Δ/Y switching.

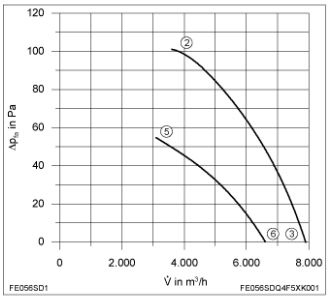


Fig. 3 FE056-SD_.4F._

ZIEHL-ABEGG

Axial Fan FE-Series

Technical Description

Fan drive

*The in the fan hub integrated external rotor motor in three- or single phase design correspond to the regulations for rotating electrical machines in conformity with **DIN EN 60 034-1 (VDE 0530 part 1)**.*
The rated voltage for motors in three phase design is 400 V, for motors in single phase design 230 V.

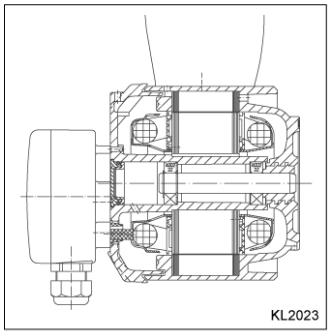
Motor protection
***IP54** in conformity with **DIN VDE 0470 part 1 (EN 60 529)** categorie 2*

Thermal class
F** in conformity with **DIN EN 60 034-1

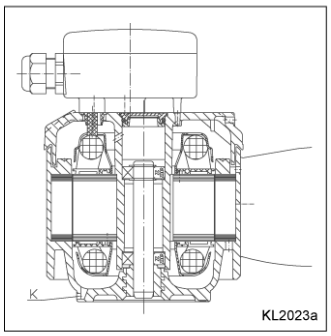
Bearing arrangement
*Deep-groove ball bearing **DIN 625**, closed at both sides, with high temperature grease for thermal class F including subzero temperature range down to -40 °C.*
Applications up to -60 °C upon request.

Balancing quality
***G6.3** according to **DIN ISO 1940 part 1** (**G 2.5** for 2-pole fans)*

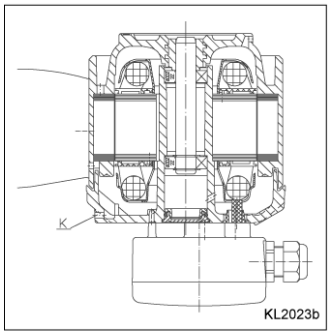
Condensation drain holes
The lower of the condensation drain holes „K“ must be open depending on whether mounting position Vo (rotor above) or Vu (rotor below) is used. With mounting position H, the condensate can escape via the gap between stator and rotor.



Axial fan FE, mounting position H



Axial fan FE, mounting position Vu



Axial fan FE, mounting position Vo

Mounting position and air flow direction

Installation position
The axial fans are suitable for all installation positions.

Airflow direction
Depending on the design of fan, at present there are different options for air flow direction. See the table below for the different airflow directions.

Warning:
Not all axial fans are supplied in the airflow directions shown. Please read the information on the data and dimensions sheets.

ZIEHL-ABEGG

Axial Fan FE-Series

Technical Description

Motor protection

The motors (excluding ex-motors) are equipped with over-temperature protectors (thermal contacts "TC"). Commercial protective switches or bi-metal relaser in the motor feed line work dependent of current and thus offer only incomplete protection, as the current does not allow conclusions to be made about the motor winding temperature under all conditions.
On the other hand, over-temperature protectors are bimetal switches, which are embedded in the motor winding and react directly to the winding temperature. They open an electrical contact, as soon as their nominal switch temperature (NST) is attained.
Thus, also those fans can securely be protected,

- *that are speed control led by voltage*
- *that are operated with excessive switching frequency*
- *that are locked*
- *that are exposed to excessive ambient temperatures*
- *whose cooling has been changed*

The TC's are imbedded in the winding in such a way that they lie between the winding-lines, and are thus heated by both branches, so that they are still effective during the failure of one phase.
Therefore, there are necessary for fans with:

- *1~motor (2 branches): 1 single-TC*
- *3~motors with one winding (3 branches):*
  - *BG 074 to 085: 1 single-TC*
  - *BG 092 to 205: 1 twin-TC (2 TC's switched in series)*
- *3~motors with two separate windings (2x3 branches): 2 twin-TC (4 TC's switched in series)*

*Thermal contacts have to be integrated into the control circuit in a way as to **avoid any automatic switching on** in emergencies after cooling down. Common protection of several motors is possible by one protection device. In order to do this, the thermal contacts of the individual motors have to be connected in series. Please pay attention to the fact that **all** motors are disconnected at the same time in case of a temperature failure at one single motor. In practice, motors therefore are grouped in order to be able to run with reduced power in the **emergency operation** in case the motor fails.*

Thermal contacts

*You can find the shortened-form **technical specifications** for the thermo contacts used in our fans on our web page **www.ziehl-abegg.com** in the „Download" area.*

Installation and safety instructions

Air flow conditions
It is important to ensure good air inlet discharge conditions when fans are installed.

I free air flow into fan mounted upstream of coil

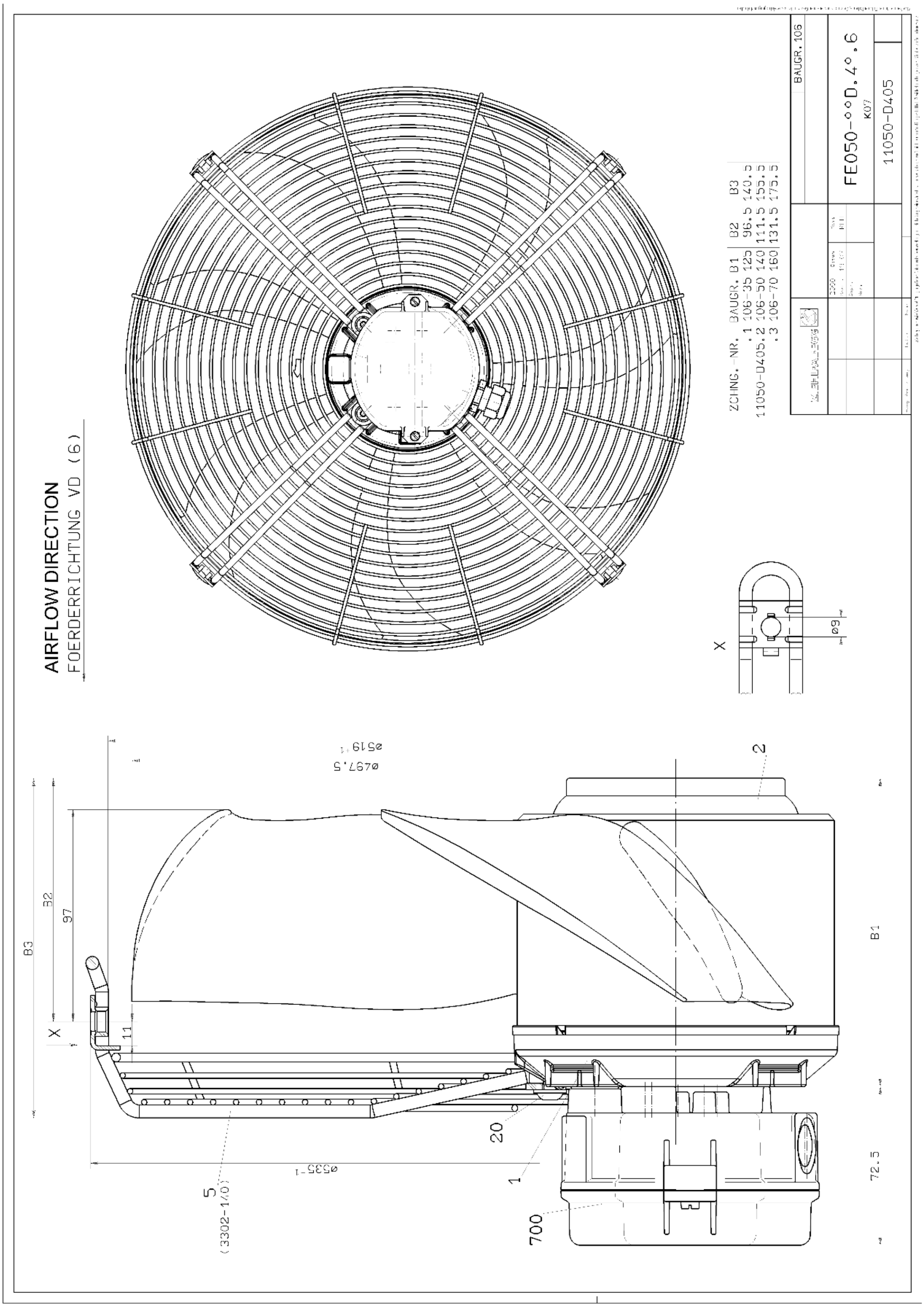
II free blowing fan mounted downstream of coil

III Bell mouth inlet to fan

IV Affect of the bell mouth on performance

Safety information
Ziehl-Abegg axial fans are designed to be installed within systems, and are thus integral components within such equipment or systems.

*The manufacturer is therefore responsible for maintaining the safety specifications for the equipment or system according to **DIN EN 294.***


AIRFLOW DIRECTION
FOERDERRICHTUNG VD (6)
FE050-··D.4°.6
11050-D405
BAUGR. 106
ZCHNG.-NR. BAUGR. B1 B2 B3
.1 106-35 125 96.5 140.5
11050-D405.2 106-50 140 111.5 155.5
.3 106-70 160 131.5 175.5
X
ø9
ø519
ø497,5
ø535
B3
B2
97
11
B1
72.5
2
20
1
5
(3302-1/0)
700

ZIEHL-ABEGG

Axial Fans

Operating Instructions

Application

- *Ziehl-Abegg axial fans of the series* **FA, FB, FC, FE, FH, FK, FS** *with integrated external rotor asynchronous motor are not ready-to-use products, but designed as components for air-conditioning, air supply and air extraction. A special motor design makes the speed control by voltage reduction possible. By operation with frequency inverters see the notes in the section Operating Conditions. The fans may only be operated when they are installed as intended, and when safety is ensured by safety equipment according to DIN EN 294 (DIN EN 292) or by other protection measures.*

Safety information

- *The fans are only intended for the transfer of air or air-like mixtures. They cannot be used in hazardous areas for the transfer of gas, mist vapours or mixtures. Nor can they be used for the transfer of solid components in the transfer medium.*
- *Mounting, electrical connection and commisioning must only be carried out by trained personnel (definition in DIN EN 50 110 or IEC364)*
- *The fan is only to be operated within the ranges specified on the type plate! Use the fan only in the authorised fashion and only for the tasks and flow media specified in the order!*
- *The maximum permissible operating data given on the rating plate are valid from air density ρ=1,2 kg/m³.*
- *The temperature monitors or PTC resistors built in to the winding serve as motor cut-out switches and must be connected!*
- *Allowable testing voltage for thermistors max. 2.5 v.*
- *For motors without temperature monitors, it is imperative that a motor cut-out switch should be employed!*
- *The EMC guideline is to be observed in connection with our control units. If the fans are completed with components of other manufacturers, the manufacturer or operator of the entire plant is responsible for keeping to the EMC guideline 89/336/EWG.*
- *Pay attention to the notes which concerning maintenance and service*
- *The Operating Instructions are part of the product and have to keep carefully.*

Transport, storage

- *Ziehl-Abegg axial fans are packaged at the factory to comply with requirements for the agreed mode of transport*
- *Transport the fan(s) either in the original packaging or greater fans using the transport fixtures provided (the bored holes in the supporting arms, wall ring plates or motor housing intended for screwing in lifting eye bolts). Use suitable lifting equipment.*
- *Do not transport the fan by the connecting cable !*
- *Avoid excessive vibration and shockloads.*
- *Be on the alert for any damage to the packaging or the fan.*
- *Store the fan in the original packaging in a dry area protected from the weather or protect it from dirt and weather until final installation.*
- *Avoid exposure to extreme heat and cold.*
- *Avoid excessive storage periods (we recommend a one year max.) and inspect the motor bearings for proper operation prior to installation.*

Installation

Installation, electrical connection and commissioning are only to be performed by trained service personnel.

- *The system manufacturer or the machine builder is responsible that the inherent installation and security informations are harmonized with the valid standard and guidelines (DIN EN 292 / 294).*
  - ***Fans design A**, for mounting on static motor flange. Use screws of class 8.8 and secure with Loctite. Starting torques allowed: M6 = 9.5 Nm; M10 = 46 Nm; M12 = 79 Nm*
  - ***Fans design Q with plastic wall plate**: Use U-plates DIN 125 to secure. Starting torques allowed: M8 = 10 Nm; M10 = 21 Nm*
- *The following applies for **all** axial fans:*
  - *Do not install without adequat support. Mounting surfaces must be even.*

  - *Ensure that the clearance (gap) „a“ see fig. between the fan impeller and the stationary housing section is constant. Distortion due to uneven surface may lead to fan failure.*
  - *For motors mounted with shaft vertical, the condensation water drain underneath the shaft must be open.*
  - *Electrical connection corresponding to connection diagram*
    a) in terminal box
    b) by cable design connection diagram on stator housing or on wall ring.
  - ***Do not use metal compression-gland fittings with plastic terminal boxes. Danger of an electric shock if connection is not made correctly !***
  - *Use a dummy plug seal for the compression-gland fitting as well.*
  - *For operation under extreme conditions (damp operating environment, open-air installation) use pre-installed sealing elements.*
  - *Depending on the type of cable gland, attach a water drain sleeve or use a sealing compound.*
  - *Screw on plastic terminal box covers should be sealed with sealant.*
  - *Starting torque for screw on covers*
    Plastic version 1.3 Nm
    Metal version 2.6 Nm
  - *Secure fan connection cable to the contact protection grille or the motor struts with cable fasteners.*
  - *Temperature monitors and PTC resistors with triggering device must be connected.*
  - *Temperature monitors must be integrated in the control circuit in such a way that, if a fault occurs, **the motor cannot switch on again automatically** after it has cooled down. The protection of several motors using one protection device is possible by connecting the temperature monitors of the individual motors in series. It must be remembered that, if a temperature fault occurs at one motor, **all** motors will then be switched off. In practice, motors are therefore assembled in groups so that **emergency operation** with reduced performance is still possible if a motor fails.*

ZIEHL-ABEGG

Axial Fans

Operating Instructions

Operating Conditions

- *Do not operate the fan in an explosive atmosphere*
- *Switching frequency:*
  - *The fan is rated for S1 continuous operation.*
  - *Controls must not allow extreme switching operation.*
- *Ziehl-Abegg axial fans are suitable for operation with frequency inverters when the following points are observed:*
  - *Between the inverter and the motor, sinusoidal filters should be incorporated which are effective for all phases (sinusoidal output voltage, phase against phase, phase against protective conductor) as offered by manufacturers. Please ask for our technical information L-TI-0510.*
  - ***du/dt filters (also called motor or suppression filters) cannot be used in place of sinusoidal filters.***
  - *When using sinusoidal filters, screened motor leads, metal terminal boxes and a second earth connection to the motor can, if necessary, be omitted. Check-back by the supplier of the sinusoidal filter.*
  - *If the operational leakage current exceeds 3.5 mA, earthing in compliance with DIN VDE 0160/5.88, Art. 6.5.2.1 must be provided.*
  - *In the case of speed control by voltage reduction (phase cutting), increased noise may be caused by resonance depending on the mounting position and location. We recommend the additional installation of a noise filter type GFD3 resp. GFD3E for control cabinets.*

Commissioning

- *Before initial operation, check the following:*
  - *Installation and electrical connection have been properly completed.*
  - *Safety equipment is in place (→ Contact protection).*
  - *All leftover installation materials and other foreign materials have been removed from the fan cavity.*
  - *Protective conductor has been connected.*
  - *Temperature monitor motor cut-out switch has been properly installed and is operational.*
  - *Cable gland is sealed (see "Installation").*
  - *Installation position and the arrangement of condensation water drains correspond to each other.*
  - *Connection data complies with the specifications on the type plate.*
  - *Motor operating capacitor data (1~ motors) complies with the specifications on the type plate.*
- *Commissioning may only take place if all safety instructions have been checked and danger can be excluded.*
  - *Check sense of rotation / air feed direction .* ***Definition of the sense of rotation according to the different designs with view to the rotor.***
  - *See to smooth running*
    Intensive vibrations due to uneven running (out-of-balance) e.g. because of damage intransit or improper handling may lead to outage.

Maintenance, service

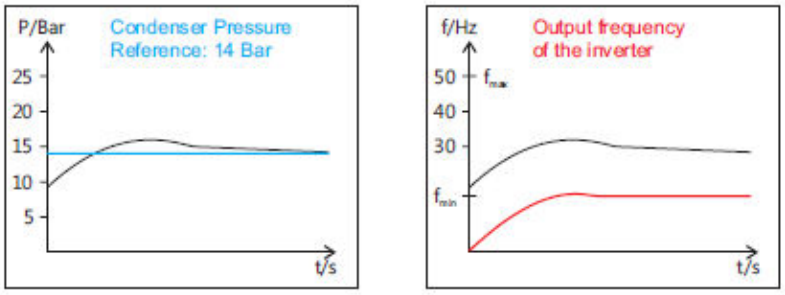
- *Due to the selection of bearings with "lifetime lubrication", the axial fan is maintenance-free. Once the grease consumption period has expired (for standard applications, approx. 30-40,000 hrs.), it is necessary to replace the bearings.*
- *On 1~ motors, condenser rating can decrease with time. Life expectancy approx. 30,000 hrs. per DIN EN 60252.*
- *Regular inspection, if required and cleaning where necessary to prevent imbalance due to ingress of dirt.*
  - *Achieve smooth running by carrying out periodic maintenance to limit level of dirt.*
- ***Outdoor fans:***
  If a fan is stationary for long periods in a humid atmosphere, it should be switched ON for minimum of two hours every month to remove any moisture that may have condensed within the motor.
- *Maintenance operation is only to be performed by trained service personnel !*
- *Please observe the safety regulations and the worker´s protection rules by all maintenance and service work. (DIN EN 50110)*
- ***Fan impeller has come to a standstill!***
  - ***Power supply interrupted and secured against restoration!***
  - ***No maintenance work at running fan !***
  - ***Do not clean running fan with a high-pressure cleaner ("steam jet")!***
  - ***Wet cleaning under voltage may lead to an electric shock - danger to life !***
  - ***Keep the airways of the fan free - danger because of objects dropping out !***

- *Take note of abnormal operating noise!*
- *Replace the bearings at the end of the grease-consumption period, or if they should become damaged. Ask for our Maintenance Guide or contact our Repair Department (special tools may be required!).*
- *Replace bearings only with original parts (Ziehl-Abegg special-grease).*
- *In the event of any other damage (e.g. winding damage), please contact our Repair Department.*

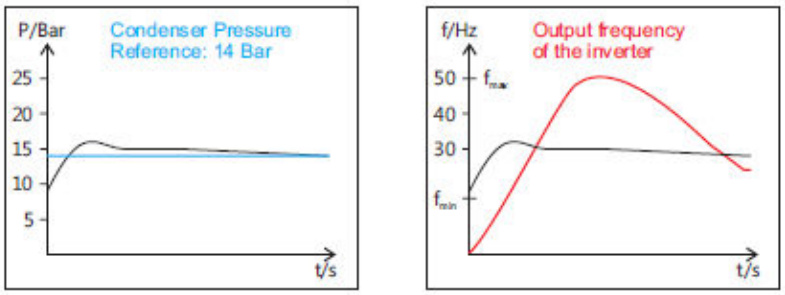
11.5 Frequency Inverter

YASKAWA Mechatronics Solutions

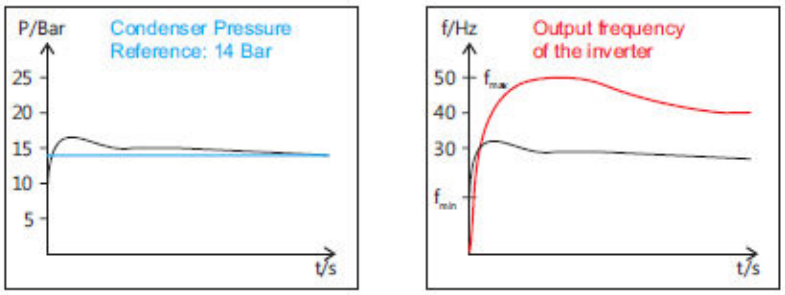
Frequency Inverter YASKAWA E7–Series



Condenser "ON" at low ambient temperatures.



Condenser "ON" at normal ambient temperatures.

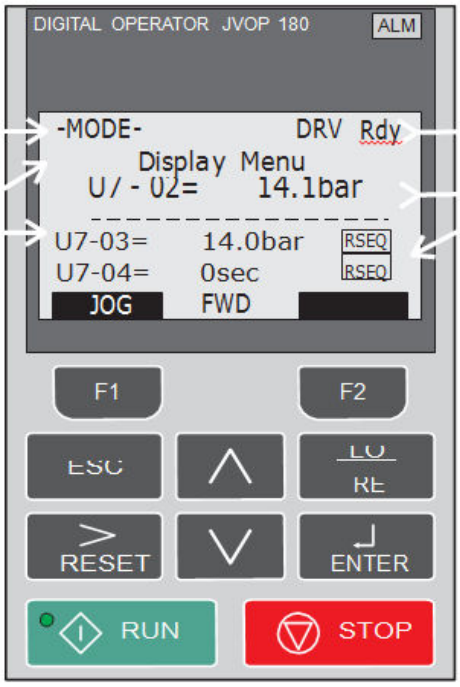


Condenser "ON" at high ambient temperatures.

YASKAWA Mechatronics Solutions

Frequency Inverter YASKAWA E7–Series

Digital Operator Display



Text display

Line 1 Left Corner "MODE" is lit The inverter is in DRV mode.

Line 2 Text description of the parameter indicated in line 2

Line 4 Pressure setpoint in Bar

Line 1 Right Corner Rdy is lit: Rdy = Ready

Line 3 Parameter No: Displays the feedback value in "Bar".

Line 5 Displays the ON Timer

Pressing the UP/DOWN keys changes the mode:

> Drive mode "DRV"
> Quick Programming mode
> Advanced Program mode
> Modified Constants
> Auto-Tuning

Pressing the ENTER Key is used to get access to the menus:

> Access to operation data
> Access to quick programming mode
> Access to all parameters
> Access to all modified parameters
> Access to auto tuning mode

UP - Key
Selects user numbers
Increments setting values

DOWN - Key
Selects user constant numbers
Decrements setting values

RESET
Shift/Reset Key
Sets the no. of digits
Acts as the RESET-key

ESC - Key
Returns to the status before DATA/ENTER key was pressed

LO RE
LOCAL/REMOTE - Key
LO: Operation via Operator
RE: Operation via terminals

F1
Function key 1
Function is depending on the menu that is currently displayed

Function key 2
Function is depending on the menu that is currently displayed

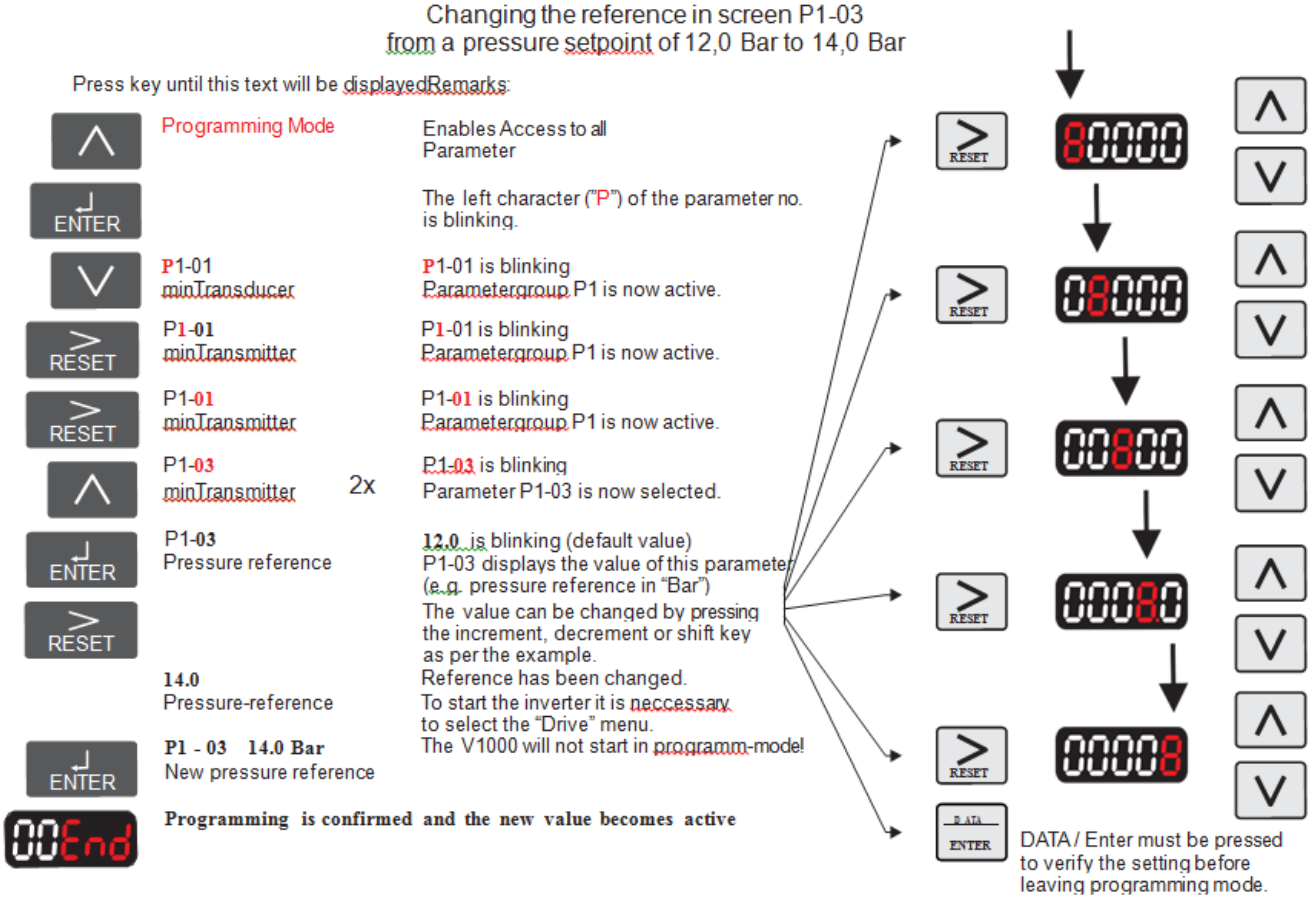
RUN - Key
Starts the inverter via Operator

STOP - Key
Stops inverter operation with the operator

YASKAWA Mechatronics Solutions — Frequency Inverter YASKAWA E7–Series

Operation Example:

Changing the reference in screen P1-03
from a pressure setpoint of 12,0 Bar to 14,0 Bar



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Frequency Inverter YASKAWA E7–Series

Short discription of the most useful parameters.

Para-meter No.:	Default value:	Range: min	Range: max	Change during Operation Yes/No	Manual Page:	Parameter name:	Parameter MENU: PROGRAMMING — Select Parameter group with UP / DOWN key. Changes to the individual parameter (RESET). Selects parameter.
P1-01	0	0	9999	N	CASE	Parameter name:	
P1-01	1	0	1	N	CASE	Condensing Program	Mode: 1sets the inverter into Condensing mode; Changes: P1-01=0.0; P1-02=30.0; P1-03=14.0; P1-04=13.0; P1-05=2.0
A1-03	0	0	3330	N	P. 100	Initialize to factory settings	Mode: 2220 sets the inverter back to factory settings.
b1-01	5	0	5	N	P. 104	Reference selection	Sets the reference input method; 0=Operator; 1=Terminals 2= Comms; 3=Option-PCB; 5=Case-Software (Value in Bar)
b1-02	5	0	5	N	P. 106	Operation method selection	Set the run command input method: 0=Operator; 1=Terminals; 2,3=Comms; 5=Case-Software (Auto-Switch-Off)
b5-01	1	0	3	N	P. 120	PI control mode selection	Mode: 0=Disabled (Off); 1=Enabled (On)
b5-02	1.10	000	2500	Y	P. 120	Proportional gain (P)	Sets the proportional gain as a factor from 0.00 to 25.00. P-control is not active when the setting is 0.00.
b5-03	80	00	3600	Y	P. 120	Integral - time (I)	Sets the integral time (I) in 1s steps from 0.0 to 360.0s. I-control is not active whenn the setting is 0.00.
b5-09	1	0	1	N	P. 121	PI-Output characteristic	PI output characteristic : 0=output is positive; 1=output is negative (Reference increases --> output frequency increases)
C1-01	50	00	6000	Y	P. 127	Acceleration-time 1	Sets the acceleration time to accelerate from 0 Hz to the max. output frequency. C1-02 sets the deceleration time.
d2-02	150	0	100	N	P. 138	Frequency refer-ence lower limit	Sets the output frequency lower limit as a percentage of the max. output frequency.
E1-01	480	310	510	N	P. 146	Input voltage setting	Sets the inverter input voltage. This setting is used as a reference value in protection functions.
E1-03	6	0	F	N	P. 146	V/Hz - pattern selection	Mode 6 = 60Hz, Variable torque Mode 5 = 50Hz, Variable torque
E2-01	44	05	106	N	P. 149	Motor rated current	These values will become the reference values for motor pro-tection, torque limits and torque control.
b3-10	6	0	6	N	P. 182	Function Analog Input A2	Mode "b" fixes analogue Input A2 as a reference source of the PI control.
L2-01	2	0	2	Y	P. 190	Momentary Power loss behavior	In mode "2" the V1000 will not trip because of undervoltage, once power is back the drive will continue to run.
L5-01	10	0	10	Y	P. 201	Number of Auto-Restarts	Automatically restarts after a supply fault occurs. The counter is reset, once normal operation has continued for 10 Minutes.
P1-01	00	-1000	1000	N	CASE	Transducer range low pessure	Indicates the min. pressure level of the transducer (e.g. 4_20mA = 0 to 30 Bar: min. level is 0.0 Bar=4mA)
P1-02	300	-1000	1000	N	CASE	Transducer range high pressure	Indicates the max. pressure level of the transducer (e.g. 4_20mA = 0 to 30 Bar: max. level is 30.0 Bar=20mA)
P1-03	140	-1000	1000	N	CASE	Pressure reference	Determines the pressure level setpoint of the condenser. Pressure level unit is "Bar".
P1-04	130	-500	500	N	CASE	Pressure sleep level	If the pressure feedback level is below this value, inverter should go to sleep mode. This function is off when 0.0 is set.I
P1-05	20	0	3000	N	CASE	Pressure sleep start delay time	Determines a delay time for the sleep function in P01-04. This mode is active if the level is less than P01-04 within this time.
P1-06	05	00	100	N	CASE	Pressure on - hysteresis	Determines the pressure difference to re-start the inverter from sleep mode. (E.g P01-04=10Bar/P01-06=5Bar: On level=15Bar.
P1-07	0	00	3000	N	CASE	Pressure start delay time	Determines a delay time for the re-start function in P01-06.
P2-02	160	50	500	N	CASE	Pressure level "Summer"	If the feedback level has exceeded this value, "Summer" settings will be active for the time adjusted in P2-04 during power on.
P2-03	800	000	2500	Y	CASE	Proportionalgain (P) "Sommer"	Proportional gain "Summer", if the pressure feedback level is exceeding the level adjusted in P2-01 during power on.
P2-04	05	00	3600	Y	CASE	Integral time (I) "Summer"	Integral time "Summer", if the pressure feedback level is exceeding the level adjusted in P2-01 during power on.
P2-05	250	00	600	Y	CASE	"Summer" start time	Determines the time after power on where as "Summer" PI-control is active.
P3-06	40	000	1500	N	CASE	Pressure level "Winter"	If the feedback level has below this value, "Winter" settings will be active for the time adjusted in P3-04 during power on.
P3-07	10	000	2500	Y	CASE	Proportionalgain (P) "Winter"	Proportional gain "Winter", if the pressure feedback level is below the level adjusted in P3-01 during power on.
P3-08	50	00	3600	Y	CASE	Integral time (I) "Winter"	Integral time "Winter", if the pressure feedback level is below the level adjusted in P3-01 during power on.
P3-08	50	00	6000	Y	CASE	"Winter" start time	Determines the time after power on where as "Winter" PI-control is active.

The correct settings are individual and you will find it in the test report.

YASKAWA Mechatronics Solutions

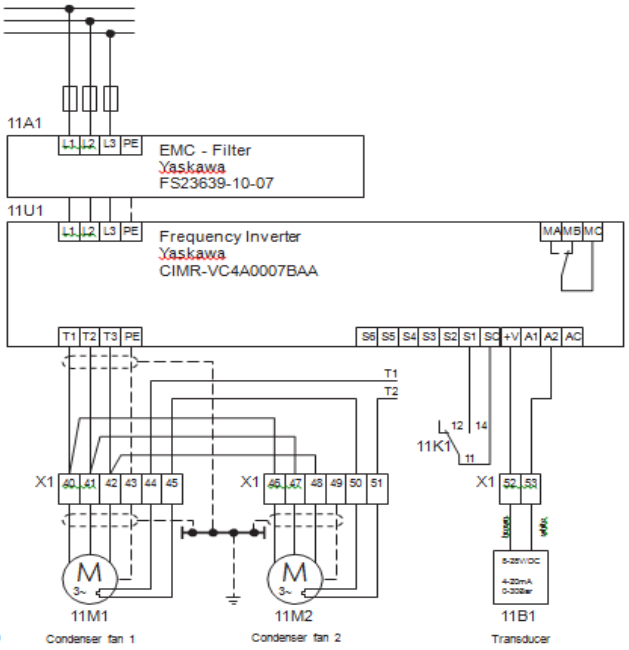
Frequency Inverter YASKAWA E7–Series

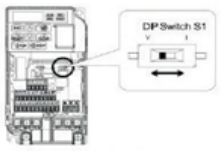
Technical Data

Frequency inverter: Yaskawa CIMR-VC4A0007BAA

Specification:	Data:
Input ratings	
Rated supply voltage	380 - 480 V/AC -15/+10%
Rated supply frequency:	50 - 60 Hz +/-5%
Output ratings	
Recommended motor power:	2,2 kW @ 50°C
Rated output capacity:	4 kVA
Rated output current:	5,5 A
Max. output current:	8,2 A
Max. output frequency:	400 Hz
Control characteristics	
Control method:	Sine wave PWM
Speed controm range:	1:40
Frequency accuracy:	+/- 2%
Frequency setting signal:	4-20 mA (250 Ohm); 0-10 V (20 kOhm)
Acc.- Deceleration time:	0,01 - 6000 s
V/Hz - Pattern:	Free programmable
Protective functions	
Motor protection:	Thermal elektronic algorythm
Overload protection:	150% rated current for 60s
Overvoltage protection	Trips at 820V/DC
Undervoltage protection:	Trips at 268V/AC
Power loss ride through:	for < 2 s
Heatsink temperature:	Thermistor protected
Stall prevention:	During acceleration, Decelerationand while running
Earth fault protection:	By electronic circuits
In- and Outputs	
Digital Inputs:	6, free programmable
Digital Outputs:	3 free programmable (1xRelay, 2 open coll.)
Analogue Inputs:	2, 0-10 V and 4-20 mA free programmable
Analogue Outputs:	1, 0-10 V free programmable
Digital Operator	
Optional LCD Display:	Textdisplay, 5-lines; 9 keys
Environment	
Ambient operating temperature:	-10 - +40°C at rated load -10 - +60°C ati 80% rated load = 4 A -20 - + 60°C

Standard-wiring





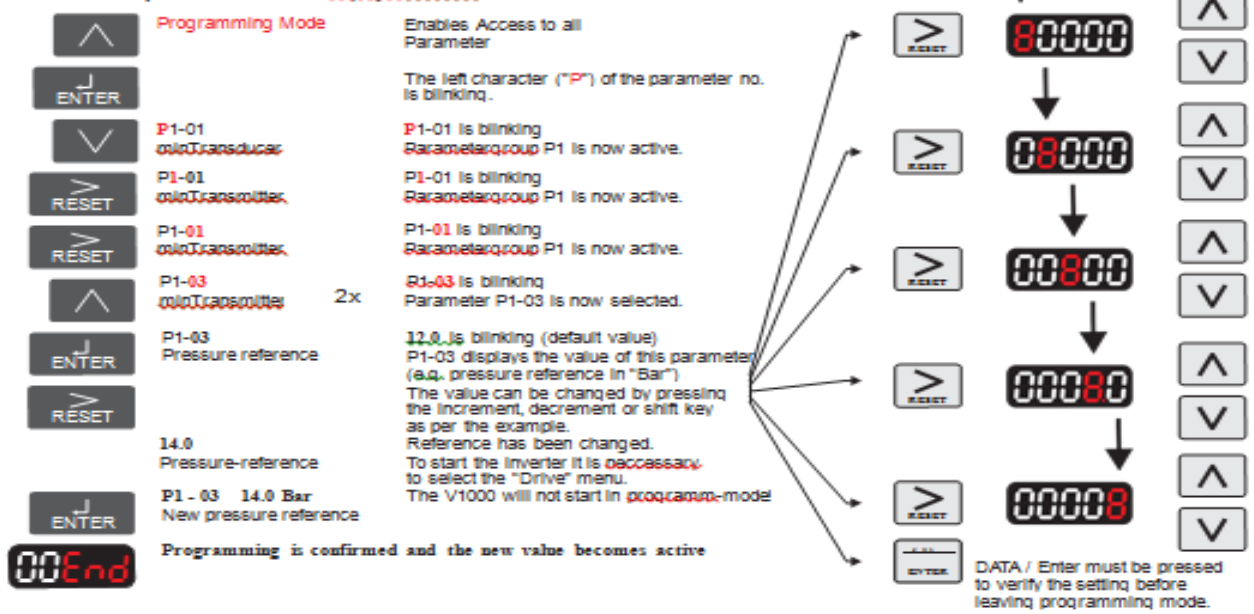
S1: DIP-Switch 1.2:
I = Analogue Input A2 4-20mA
(I = Default)
V = Analogue Input A2 0-10V

Figure 3.25 DIP Switch S1

Operation Example:

Changing the reference in screen P1-03
from a pressure setpoint of 12,0 Bar to 14,0 Bar

Press key until this text will be displayedRemarks:



11.6 Electronic temperature controller

Temperature regulation is attended to by the temperature controller installed in the switch cabinet. It controls the leaving temperature of the medium and switches the refrigeration compressors and/or the capacity reducing valve (hot gas solenoid valve) on or off.

The digital temperature gauge shows the actual readings of the initial medium temperature.

The reference value is shown by pressing the reset button.

Settings for the parameter values – see chapter 4.6 Operating Instruction Industrial Cooler of the KPC Series.

Set leaving temperature 18°C

STÖRK TRONIC — 6-Stages temperature controller ST710-PWHVM.26

Front view

General Data

After "Mains ON" the display will show “OFF” when Standby function is activated.
Otherwise the display shows the actual value.
The LED “°C” stands for temperature display in °C,
“bar” stands for pressure display in bar ,
“%” stands for power display in %.

button 1: UP 

Simultaneously pressing the SET button together with the UP button increases the value of the setpoint or selected parameter.

button 2: DOWN 

Simultaneously pressing the SET button together with the DOWN button decreases the value of the setpoint or selected parameter.

button 3: 

with this button its you can switch to power display.

button 4: SET 

Pressing this button displays the setpoint value.

button 5: StandBy 

Standby-Mode can be activated for this button by parameter A45.

The function of the controller can be programmed by a various list of parameters. The adjustment can be done in three levels. In order to prevent accidental or unauthorised changes to the preset parameter values, access to the parameter levels has been made difficult.

STÖRK TRONIC

6-Stages temperature controller ST710-PWHVM.26

First level SET-POINT adjustment

The controller is normally at the Setpoint Level. Under normal working conditions the display shows the actual value of the process. The Setpoint 1 is displayed by pressing the SET button. If the SET button is pressed with either the UP or DOWN button Setpoint 1 is increased or decreased. The same procedure for Setpoint 1' if E1 is closed.

Settings for the parameter values S1, S1' – see chapter 4.6 Operating Instruction Industrial Cooler of the KPC Series.

Note: The setpoint can be set over a LON network too.

Second level Setting of P-Parameters

Simultaneously pressing the UP and DOWN button for about 4 seconds switches the controller to the Parameter Level, and allows adjustment of the P parameters.

Use the UP or DOWN button to select the parameters.

To display and adjust the value, press the SET button and the existing value of the choosen parameter is displayed.

By simultaneously pressing the SET button and either the UP or DOWN button this value can be increased or decreased as required.

Settings for the parameter values P1 ... P44 – see chapter 4.6 Operating Instruction Industrial Cooler of the KPC Series.

Attention: At operation modes with bypass groups, the time of the power reduction valves will not be stored. the involved parameters stay unchanged.

Third level Setting of A-Parameters

This level contains the safety relevant characteristics which are pre-set by the factory.

In order to prevent accidential or unauthorised changes to the preset parameter values, access to the A-parameter level has been made difficult.

To enter the A- level simultaneously press the UP and DOWN button for about 3 seconds and 'P1' appears in the display. Press the UP button until the highest p number is displayed. Keep the UP button pressed for a further 15 seconds and the display will change to 'PA'. Simultaneously press the UP and DOWN button until 'A1' is displayed.

The controller is now in the A-Level, and the parameters can be adjusted using the same method as in the P-Level.

Settings for the parameter values A1 ... A59, as far as L0 and L1 – see chapter 4.6 Operating Instruction Industrial Cooler of the KPC Series.

Information

If the display is changed from temperature to pressure (A15) the input has to be changed too. (A35)
Otherwise the display will show "FP" after leaving the parameter level.

The other case measuring input pressure and display temperature is possible. The pressure values of the defined range (A38 and A39) are converted to temperature values according the refrigerant set in parameter A37.

Depending on input (A35), display (A15), and refrigerant, some parameters will be initialised with different values.

6-Stages temperature controller ST710-PWHVM.26

Technical data

Measuring inputs:	temperature sensor Pt100, 3 wire, range -200...850 °C, accuracy of controller +/-0,5 % of range, maximum +/-1 K input 4...20 mA, optional 0...20 mA available. The display range has to be set by the parameters A38 and A39.
Outputs:	K1 – K5: relay, 250V /6 A (cosφ=1), max. standing current 2 A, n.o, function set by parameter K6: relay, 250V /8 A (cosφ=1), max. standing current 5 A, n.o, function set by parameter K7: relay, 250V /8 A (cosφ=1), max. standing current 5 A, n.o, function set by parameter

Notice: The standing current at connecting point 9 is the summary of K1 – K6 an might not be higher than 8A !!

Indication:	One 4-digit red LED digital display, 13 mm high, for temperature- or pressure. Three LED's for status messages, diameter 3 mm.
Supply:	16-36 V DC or 12-24 V AC +/-10 %, 50/60 Hz. power consumption max. 3 VA
Serial bus:	2-wire, twisted Pair, maximal length 100 m.
Connectors:	Plug and socket connectors connector A: 12 points, Raster 5,0 mm, for cable up to 2,5 mm² connector B: 11 points, Raster 3,5 mm, for cable up to 1,5 mm²
Ambient conditions:	Storage temperature: -20 ...+70°C Operating temperature: 0 ...+55°C Relative humidity: 75 % maximum without dew
Weight:	app. 130 g
Enclosure:	Protection category to the front IP65, IP20 to the back

Error messages

Message	reason	action
F 1	Sensor error (open circuit or shortcut)	please check the sensor
F P	wrong setting (A15 and A35 don't fit together))	A15 or A35 new setting
flashing display	temperature alarm at upper- or lower limit (if activated)	

11.7 High-/ Low-Pressure limiter

High-pressure switch

Monitors the condensation pressure and switches the compressor off before the max. permitted pressure of 19,0 bar has been reached.
Restarting the unit is only possible once the pressure has dropped and the reset button has been activated.

For this it is necessary< to remove the front panel.

Type ALCO PS2-C7A

Low-pressure switch

Monitors the evaporation temperature and switches off the compressor when it falls below the set value. (See technical specifications for standard setting). With this the condenser is protected. Moreover, this also prevents the evaporator from freezing.

The low pressure switch resets automatically once the pressure rises.

Type ALCO PS2-C7A

Pressure Controls Series PS2
Type C7A

Fig. 1a

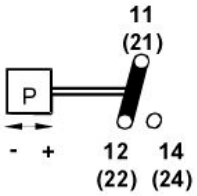


Fig. 1b

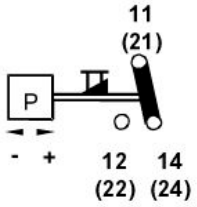
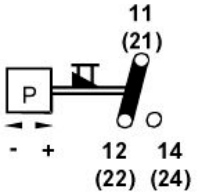


Fig. 1c



For application in refrigeration systems and heat pumps.

Technical data:

- Protection class: IP44 (IEC 529/EN 60529)
- Ambient temperature (housing): -50°C to +70°C
- Storage and transportation temperature: -50°C to +70°C
- Medium temperature: -50°C to 70°C
- Operating pressure: -0.9 bar to 31 bar
- Leakage test pressure: *see type code / pressure range*
- Vibration resistance: 4g (10...1000 Hz)
- Electrical rating

Heating load (AC1):	24 A / 230 V AC
Inductive load (AC15):	10 A / 230 V AC
Inductive load (DC13):	0.1 A / 230 V DC
	3 A / 24 V DC
Start-up (AC3):	144A / 230 V AC
Motor rating (FLA):	24 A / 230 V AC
Locked rotor (LRA):	144 A / 230 V AC

- Medium compatibility: HFC, HCFC, CFC
  not released for inflammable refrigerants
- Dimensions:
  width x height x depth (mm): 139 x 75 x 44
  without reset button, without pressure connector

Type code:

PS2 - ① ② ③ e.g. PS2-A 7 A

① Function

A = Both sides: automatic pressure control
B = Both sides: pressure cut out, external manual reset, TÜV/DIN 32733
C = Left: pressure limiter, automatic, TÜV/DIN 32733. Right: pressure cut out, external manual reset, TÜV/DIN 32733
G = Left: pressure cut out, external manual reset, internal manual reset, TÜV/DIN 32733
L = Left: automatic pressure control. Right: pressure control, extern. manual reset
M = Left: automatic pressure control. Right: convertible reset from R to A
R = Both sides: pressure control, external man. reset
S = Both sides: Safety pressure cut out, internal manual reset, TÜV/DIN32733
T = Left: pressure limiter, automatic, TÜV/DIN 32733. Right: safety pressure cut out, internal manual reset, TÜV/DIN32733.
U = Convertible from function 'R' to 'A'
W = Both sides: pressure limiter, automatic, TÜV/DIN32733

NOTE: Manual reset versions in combination with the low pressure side of Pressure Range 7 or 9 have a low pressure manual reset function. Manual reset versions in combination with the high pressure side of Pressure Range 7, 8 or 9 have a high pressure manual reset function.

Pressure Controls Series PS2
Type C7A

Fig. 2

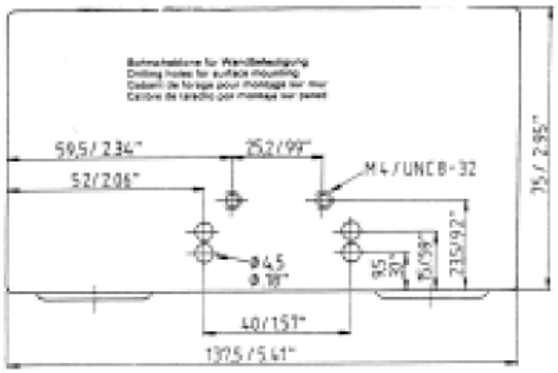
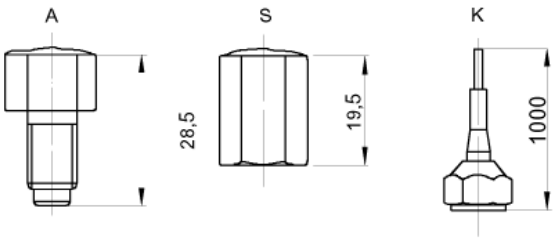


Fig. 3



② **Pressure range (leakage test pressure) left/right**

7 =	-0.75 … 3 bar (25 bar)	6 … 31 bar (36 bar)
8 =	6 … 31 bar (36 bar)	6 … 31 bar (36 bar)
9 =	-0.75 … 3 bar (13 bar)	6 … 31 bar (36 bar)

③ **Pressure connection**

A = 7/16"-20 UNF male;
C = R1/4 male, stainless steel with steel bellows
K = 1 m capillary tube with nut 7/16"-20 UNF, schrader valve opener
L = 1/4"-ODM solder with 1m capillary tube
U = 6 mm - ODF solder, 80 mm length
X = ¼" - ODF solder, 80 mm length
F = ¼-18 NPTF, stainless steel with steel bellows

Safety instructions:

- **Read installation instructions thoroughly. Failure to comply can result in device failure, system damage or personal injury.**
- **It is intended for use by persons having the appropriate knowledge and skill.**
- **Before opening any system make sure pressure in system is brought to and remains at atmospheric pressure.**
- **Ensure supply voltage and current of electric device match rating on PS2 name plate. Disconnect supply voltage from system and PS2 before installation or service.**
- **Do not exceed test pressure.**
- **Keep temperatures within nominal limits.**

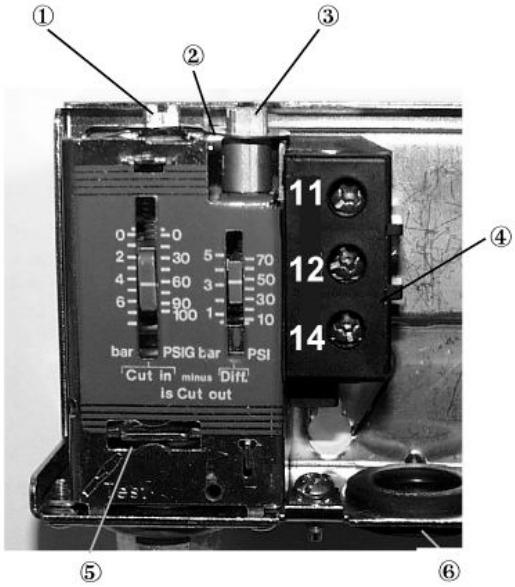
Function/Type of switch (Fig. 1):

Fig. 1a: Automatic reset function
Fig. 1b: Manual reset function for low pressure reset
Fig. 1c: Manual reset function for high pressure reset

- PS2 Pressure switches are equipped with two independent SPDT snap action contacts switching from 11-12 (21-22) to 11-14 (21-24) on rising and from 11-14 (21-24) to 11-12 (21-22) on falling pressure.
  Reaching the preset switch point on rising pressure, contact 11-12 (21-22) breaks while contact 11-14 (21-24) makes and vice versa on falling pressure.
- Terminal labels 11, 12 and 14 refer to the left side of the control and terminal labels 21, 22, 24 refer to the right side of the control.
- PS2 w. manual reset (high pressure/low pressure reset):
  Reaching the preset switching point contact 11-14 (21-24) breakes (low pressure switch) or contact 11-12 (21-22) makes (high pressure switch) and locks in this position.
  After the pressure rises or drops by a fixed differential the switch can be reset by pushing the reset button.
- PS2 with manual reset are "trip-free".

Pressure Controls Series PS2
Type C7A

Fig. 4



① Range spindle / Bereichsspindel
② Lockplate / Sicherungsblech
③ Differential spindle / Differenzspindel
④ Electrical terminals / Elektrische Anschlussklemmen
⑤ Check-out lever / Testhebel
⑥ Cable entry grommet / Kabeldurchführung

Fig. 5a

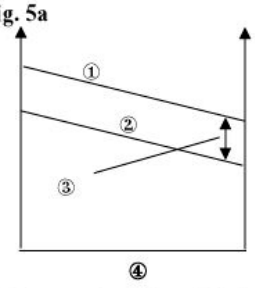
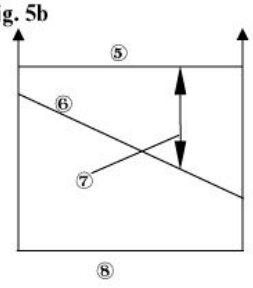


Fig. 5b



① Upper setpoint / Oberer Schaltpunkt
② Lower setpoint / Unterer Schaltpunkt
③ Differential = constant / Differenz = konstant
④Turning range spindle / Drehungen der Bereichsschraube

⑤ Upper setpoint / Oberer Schaltpunkt
⑥ Lower setpoint / Unterer Schaltpunkt
⑦ Differential = variable / Differenz = variabel
⑧ Turning differential spindle / Drehungen der Differenzspindel

Mounting (Fig. 2):
- PS 2 controls may be installed by using a mounting plate or as a wall-mounted device against a flat surface.
- Use universal thread M4 or UNC8-32 mounting holes for installation via mounting plate
- Use the standard mounting holes at the backside for wall mounting.
- Use mounting screws supplied with control
- Mounting screws must not penetrate control backside by more than 8 mm to ensure proper operation
- PS2 can be installed in any direction except upside-down
- **In order to achieve protection class IP44, the following instructions must be observed:**
  - ❖ Cover must be closed and cover screw fastened
  - ❖ Control must be mounted against a flat surface so that all openings on the housing backside are fully covered

Mounting direction:
Any direction except upside down

Pressure connection (Fig. 3):
- Connection of the pressure side depends on the exact model / pressure connector.
- Connectors A, C, F and S: Do not apply torsional load to pressure connnector; use second spanner to counter-balance torque when tightening pressure connection.
- Connector A: high pressure versions (pressure range '5') are equipped with a snubber to dampen pulsations.
- When connecting PS2 to the hot gas line of a refrigeration system, a pipe, capillary or flexible tube of at least 80 mm shall be used to allow sufficient temperature drop between refrigeration line and pressure switch bellows.
- K-type connectors: Use copper gasket supplied with control.

Electrical connection (Fig. 4):
- **Note: Comply with local electrical regulations when conducting electrical wiring.** Wire size must match the electrical load connected to the switch contacts.
- Feed cables through rubber grommet at switch bottom.
- Optionally, the rubber grommet may be replaced by a standard PG 13.5 cable gland.
- Connect wires to terminals 1, 2 and 4. by taking into account switch functions as shown in Fig.s 1a to 1c.
- Fasten terminal screws with torque 1.2 Nm.
- For electronic applications with low electrical loads (voltage ≤24 V and current <50 mA) gold plated contacts are recommended.

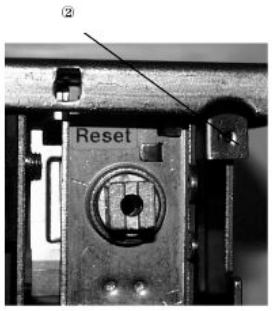
Setpoint adjustment (Fig. 4, Fig. 5):
- PS2 pressure switches come with individually adjustable range and differential depending on the exact model.
- Manual reset switches always have a fixed differential.
- Use a flat screw driver or a ¼" refrigeration (square)

Pressure Controls Series PS2
Type C7A

Fig. 6a

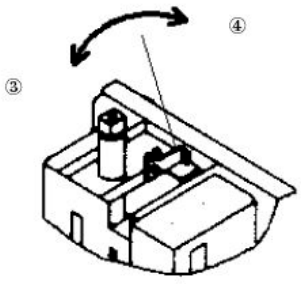
① Reset button for external reset /
Rückstellknopf bei externer Handrückstellung

Fig. 6b



② Reset button for internal reset /
Rückstellknopf bei interner Handrückstellung

Fig 6c



③ Universal reset toggle: position manual reset / Konvertierbarer Reset in Position: Handrücktellung
④ Universal reset toggle: automatic reset / Konvertierbarer Reset in Position: automatische Rückstellung

wrench to adjust setpoints as described below.

- Adjust upper setpoint using the range spindle.
- Adjust lower setpoint by turning the differential spindle.
- **Upper setpoint – Differential = Lower setpoint**
- A separate gauge must be used for exact adjustment of the setpoints. The integrated display scale can only be used for obtaining approximate settings.
- Refer to the ALCO catalogue for standard factory settings.

Manual reset / Universal reset (Fig. 6)

- Manual reset (external): Press the reset button as indicated by Fig. 6a.
- Manual reset (internal): Remove the housing cover and press the reset button as indicated by Fig. 6b
- Note that the reset is 'trip-free', i.e. reset is only possible if the pressure has reached its reset treshold.
- Universal reset: Remove the cover and change the universal toggle to the desired position (manual reset or auto reset) as indicated by Fig. 6c.

Check-out lever (Fig. 4)

- Use the check-out lever to manually override the electrical contact position for testing out the system
- Use the check-out lever on low pressure switches to manually override the electrical contact position for evacuating the refrigeration system

Standards

- DIN 32733 / EN 12263: specific models
- Low Voltage Directive 73/23/EWG; 93/68/EWG; EN 60947-1; EN 60947-5-1
- UL/CSA: all models (pending)

11.8 Sight glass

ALCO CONTROLS

Moisture Liquid Indicator
AMI – 1SS5

General information and technical data:

The **AMI** series of Moisture Indicators are designed to monitor the moisture content within the liquid line of a Refrigeration system. When the liquid line is empty, circles may be seen in the glass. However, when the liquid refrigerant touches the glass, the circles disappear indicating the system is fully charged.

- Maximum working pressure: 35 bar,
- Medium temperature : -40 to 100 °C
- Compatibility :

Refrigerants: R22, R404A, R507, R134a, R407C, R502, and R12. Not suitable for R11 or Ammonia.

Oils: Mineral, Alkyl benzene and ester lubricants.

- For further information, see technical data sheet.

Safety instructions:

- **Read installation instructions thoroughly. Failure to comply can result in device failure, system damage or personal injury.**
- **It is intended for use by persons having the appropriate knowledge and skill. Before attempting to install the indicator, make sure pressure in system is brought to and remains at atmospheric pressure.**
- **Do not release any refrigerant into the atmosphere.**
- **Do not use on any other fluid media without prior approval of Alco Controls. Use of fluids not listed could result in chemical deterioration of components.**

Mounting location:

- AMI is bi-directional and may be installed in any position which allows visual access to the indicator window itself.
- The Moisture indicator is normally located after the filter drier and before the solenoid valve.

Installation:

- Do not remove seal caps until ready for installation.
- The seal caps should be removed with care to avoid damaging the extension tube connections.
- To avoid oxidization, it is advised to purge the system with an inert gas such as nitrogen while brazing.
- **Do not exceed the maximum temperature of 100°C.**
- The lens assembly on "SS" models should be removed before brazing. Do not exceed 8 Nm (70 inch lbs) when reassembling to avoid damaging the "O" ring seal.
- When brazing, direct the flame away from the main body. If in doubt about temperature, use wet rags or other suitable heat protection (see Fig. 1).
- To avoid overheating it is advised to make the joint at one end and cool the AMI completely before repeating the procedure on the other end connection.
- Test for leakage on connections after completion of installation.

Warning: Failure to do so could result in loss of refrigerant.

AMI – 1SS

Type	Order-No.	Connection mm	Connection inch	Configuration
AMI - 1 SS 5	805 716	16	5/8	Female Solder x Female Solder ODF x ODF

Refrigerant	Liquid Temperature °C	blue dry	violet	purple Caution	red Caution - wet
R 134a	25	20	35	90	130
	38	35	55	120	160
	52	50	85	150	190

11.9 Filter drier

Filter drier ADK 165

General information and technical data:

ADK/BFK Liquid line filter-driers are for new installation or after service.

- Maximum working pressure : 34 bar
- Maximum proof pressure : 34 bar
- Compatibility : CFCs, HCFCs, HFCs, mineral, Alkyl benzene and ester lubricants
- For further information, see technical data sheet.

Safety instructions:

- **Read installation instructions thoroughly. Failure to comply can result in device failure, system damage or personal injury.**
- **It is intended for use by persons having the appropriate knowledge and skill. Before attempting to install the filter-drier make sure pressure in system is brought to and remains at atmospheric pressure.**
- **Do not release any refrigerant into the atmosphere.**
- **Do not use on any other fluid media without prior approval of Alco Controls. Use of fluids not listed could result in chemical deterioration of the desiccant in filter-drier.**
- **In a severely contaminated system, avoid breathing acid vapours and avoid contact with the skin from contaminated refrigerant / lubricants. Failure to do so could result in skin injury.**

Operation:

- After leakage test, start system and after sufficient running time, check colour of moisture indicator for moisture level. We recommend the use of ALCO moisture indicators. The colour calibration of ALCO moisture indicators provide a positive and precise indication of the system's moisture condition.
- In systems with excessive moisture it may be necessary to replace filter-drier for several times in order to bring moisture in the system to a safe level.

ADK

Type ADK	Order No.	Connection Flare/SAE	
		mm	inch
165	003 620	16	5/8

Size	Water adsorption capacity (gram) Liquid Temperature		Acid Adsorption Capacity (gram)
	24°C R134a	52°C R134a	
ADK16	23,0	20,8	4,5

Service hints:

- On field installed systems or retrofit, the use of ADK/BFK Filter Driers with the companion ALCO BTAS or ASD/ASF suction line filter drier/filter is recommended.
- For system clean-up after burn-out, we recommend installing an oversized filter-drier. To provide positive compressor protection, add an ALCO ASD or BTAS filter-drier in suction line.
- Always install a new filter-drier when existing ones become saturated with moisture and foreign materials.

Caution: Do not attempt to dry out a used filter-drier.

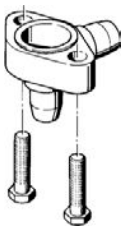
11.10 Thermo-Expansion valves

Thermo-Expansion Valve TCLE 750 MW

Series	R 134a Type	R 134a Nom. Cap. kW	Orifice	Power Assembly
TCLE	750 MW	32,0	X 22440-B7B	XB1019...1 B

TCLE

Angle Style Type	Angle Style Order No.	Connections mm Solder ODF	for Valve Series
A 576 - MM	803 239	16 x 22	TCLE

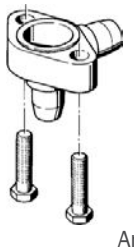


Angle Style Flange

Liquid Injection Valve LCLE 3,5

Series	Nominal Capacity Q_n kW R 134a	Orifice	Connections Flange C 501 – 7 Solder/ODF mm	Power Assembly
LCLE 3,5 *	9,3	X 22440-B3,5B	12 x 16	XB1019...2B

LCLE



Angle Style Flange

11.11 Solenoid valves

ALCO CONTROLS

2-Way Solenoid Valves
200 RB

Type	Order-No.	Connection				Nominal Capacity Q_n (kW)	
		Solder/ODF		Flare/SAE		Liquid	Hot Gas
		mm	inch	mm	inch	R 134a	R 134a
200 RB 3 T3	801 239	10	3/8			6,6	3,0
200 RB 4 T3	801 190		3/8			15,5	7,1
200 RB 6 T5	801 186	16	5/8			27,3	12,5

Type	Order-No.	kv-Value m^3/h	Vp min. bar	Coil Type
200 RB 3 T3	801 239	0,4	0,00	ASC
200 RB 4 T3	801 190	0,9	0,05	
200 RB 6 T5	801 186	1,6		

11.12 Liquid receiver

GÜNTNER

Liquid receiver GBV 3 (vertical)

Volume	Dimensions mm						Type ZU434/1: ● = ja ○ = nein	Inspection glasses	Position of SG	Brazed connections		Weight
										Inlet	Outlet	
l	D	L	B	B1	E	F				Ø mm	Ø mm	kg
3	125	360	-	100	9	30	m	-	-	12	12	6

11.13 Primary water pump

Fully installed and plumbed-in water pump Type Grundfos CR 3-9U (see technical specifications and appendix).

The pump is switched on by turning the master switch to position "Auto"/"Hand" and the control switch for the pump likewise to position "Auto"/"Hand"!.

The water is kept in constant circulation. The water pump is interlocked with the compressor, i.e. cooling is unable to take place if the pump is not on.

It is essential that the pump is filled with the cooling medium and de-aerated before it is started.

GRUNDFOS

Vertical Multistage Centrifugal Pump
Type CR 3-9 U-FGJ-A-E-HQQE

Vertical, non-self-priming, multistage, in-line, centrifugal pump for installation in pipe systems and mounting on a foundation.

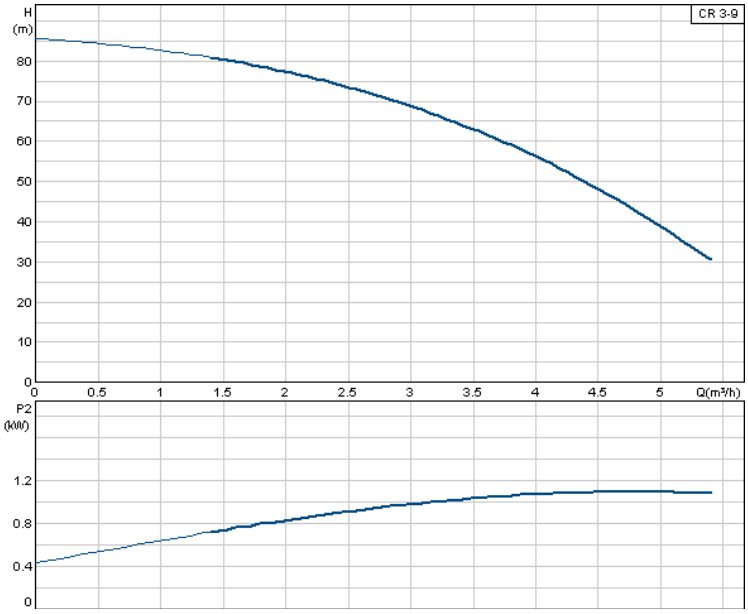
The pump has the following characteristics:

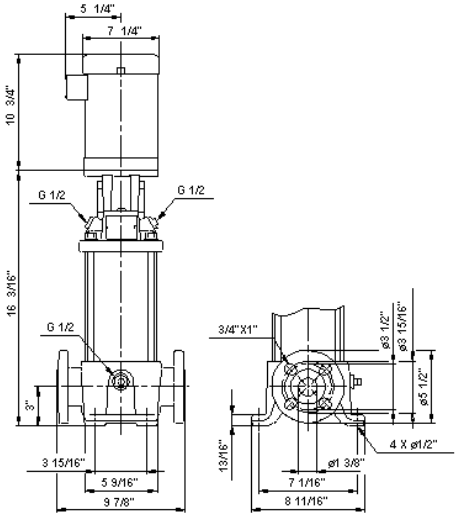
Impellers and intermediate chambers are made of Stainless steel DIN W.-Nr. 1.4301 DIN W.-Nr...
Pump head and base are made of Cast iron.
The shaft seal has assembly length according to DIN 24960.
Power transmission is via cast iron split coupling.
Pipework connection is via ANSI flanges.

The motor is a 3 -phase AC motor.

Installation:

Maximum ambient temperature:	104 °F	40 °C
Max pressure at stated temp:	363 / 250 psi/°F	25 / 120 bar/°C





GRUNDFOS

Vertical Multistage Centrifugal Pump
Type CR 3-9 U-FGJ-A-E-HQQE

Technical Data

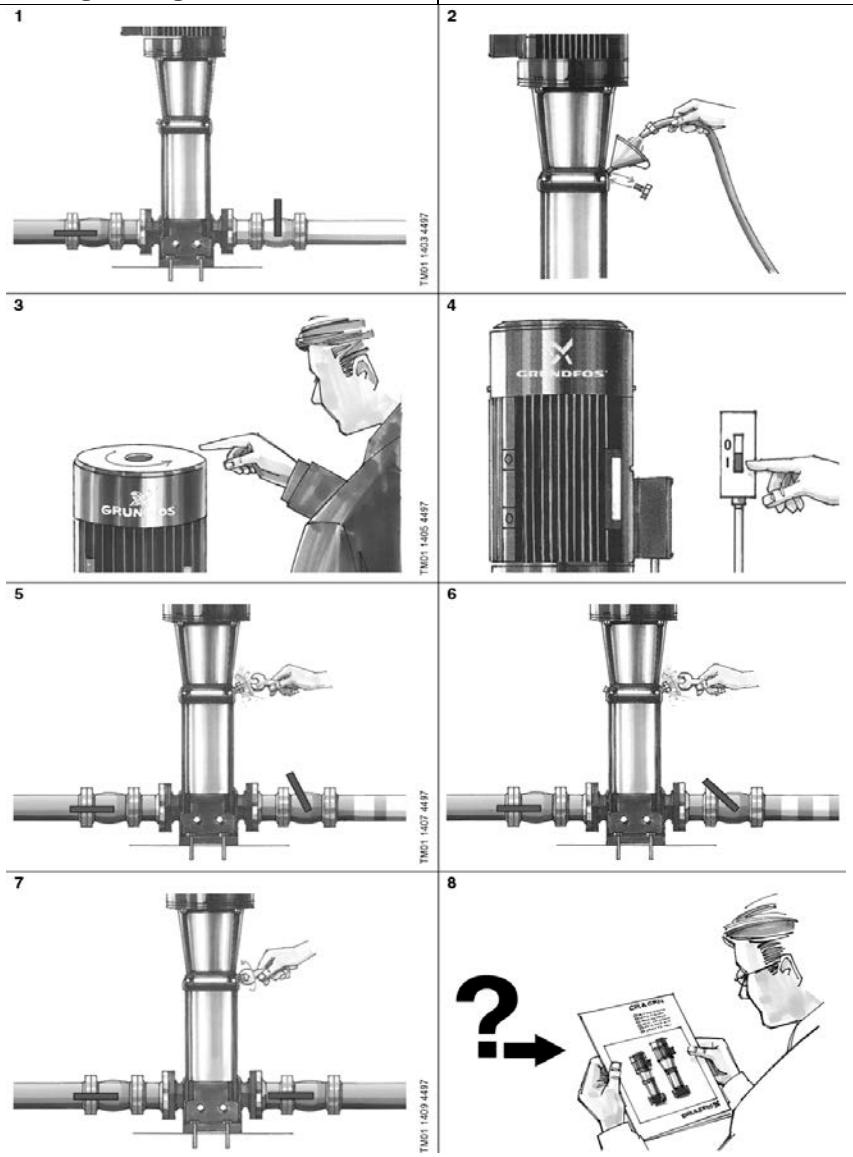
Description	Value	Unit
Product name	CR 3-9	
Product No.	96083214	
EAN number	5700395183825	
Pump version	U	
Connect code	FGJ	
Material code	A	
Code for rubber	E	
Shaft seal	HQQE	
Cooling	TEFC	
Flange standard	ANSI	
Gross weight	35.8	kg
Impeller	Stainless steel	
Impeller	1.4301	DIN W.-Nr.
Impeller	304	AISI
Impellers	9	
Insulation	F	
Liquid max temp	120	°C
Liquid min temp	-20	°C
Model	A	
Motor flange	56C	
Motor No	84Z04008	
Motor type	56C	
n	3450	rpm
Net weight	32.3	kg
p high-temp	25 / 120	bar / °C
P2	1.1	kW
Phase	3	
Pipe connection	1 1/4"	
Poles	2	
Pressure stage	Class 300	
Pump housing	Cast iron	
Pump housing	EN-JL1030	DIN W.-Nr.
Pump housing	25 B	ASTM
Rated flow	3.6	m^3/h
Rated head	61.3	m
Shipping volume	0.08	m^3
Stages	9	
t max amb	40	°C
f	60	Hz
n	3450	rpm
P2	1.1	kW
P2	1.1	kW
Rated current	5,00-4,60 / 2.3	A
Service factor	1,15	
U	208-230 / 460	V

GRUNDFOS

Vertical Multistage Centrifugal Pump
Type CR

Start-up

1 Close the isolating valve on the discharge side of the pump and open the isolating valve on the suction side.	2 Remove the priming plug from the pump head and slowly fill the pump with liquid. Replace the priming plug and tighten securely.
3 See the correct direction of rotation of the pump on the motor fan cover.	4 Start the pump und check the direction of rotation.
5 Vent the pump by means of the vent valve in the pump head. At the same time, open the discharge isolating valve a little.	6 Continue to vent the pump. At the same time, open the discharge isolating valve a little more.
7 Close the vent valve when steady stream of liquid runs out of it. Completely open the discharge isolating valve.	8 For further information, see next page.



GRUNDFOS

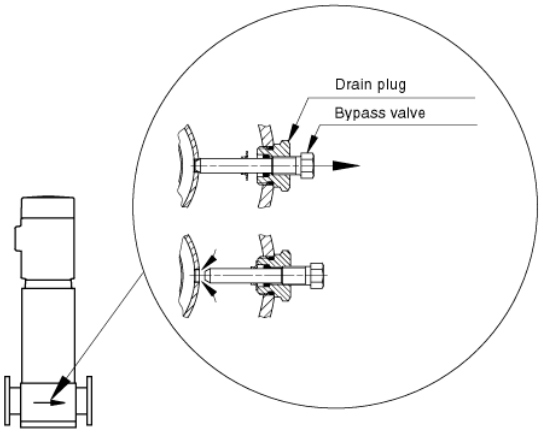
Vertical Multistage Centrifugal Pump
Type CR

Note: Do not start the pump until it has been filled with liquid and vented.

Pay attention to the direction of the vent hole and take care to ensure that the escaping water does not cause injury to persons or damage to the motor or other components.
In hot-water installations, special attention should be paid to the risk of injury caused by scalding hot water.

CR, CRI, CRN 1 to 5

For these pumps, it is advisable to open the bypass valve during start-up. The bypass valve connects the suction and discharge sides of the pump, thus making the filling procedure easier. When the operation is stable, the bypass valve can be closed. When pumping liquids containing air, it is advisable to leave the bypass valve open.



NOTE: Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.

REMINDER: Do not start the pump before priming or venting the pump. Never operate the pump dry.

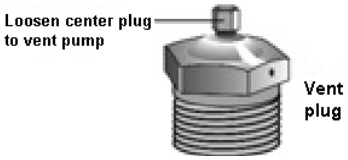
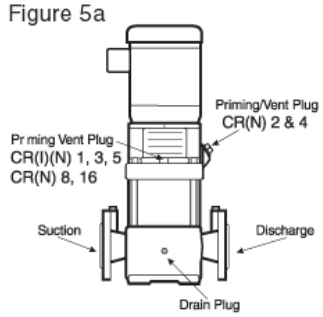


Figure 5a



Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and open the priming plug on the pump head. See Figures 5A and 5B. Gradually open the isolation valve in the suction line until a steady stream of airless water runs out the priming port. Close the plug and securely tighten. Completely open the isolation valves.

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of air before starting the pump. Close the discharge isolation valve and remove the priming plug. Pour water through the priming hole until the suction pipe and pump are completely filled with water. If the suction pipe does not slope downward from the pump toward the water level, the air must be purged while being filled. Replace the priming plug and securely tighten.

1. Switch power off.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to be certain it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch the power on and observe the direction of rotation. When viewed from the top, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch OFF the supply power.
7. On three-phase motors, interchange any two power leads at the load side of the starter. On single-phase motors, see connection diagram on nameplate. Change wiring as required.
8. Switch on the power and again check for proper motor rotation. Once rotation has been verified, switch off power again. Do not attempt to reinstall the coupling guards with the motor energized. Replace the coupling guard if the rotation is correct. After guards are in place the power can be reapplied.

GRUNDFOS

Vertical Multistage Centrifugal Pump
Type CR

SAFETY WARNING

Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Shock Hazard

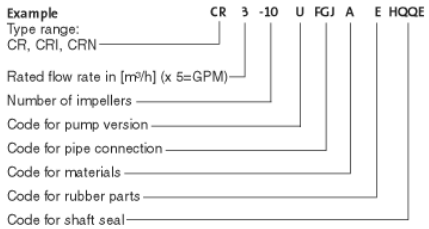
A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

Nameplate Data

Type key

CR, CRI, CRN 1s, 1, 3 and 5



Before starting work on the pump, make sure that all power supplies to the pump have been switched off and that they cannot be accidentally switched on.

Pump bearings and shaft seal are maintenance-free.

If the pump is to be drained for a long period of inactivity, remove one of the coupling guards to inject a few drops of silicone oil on the shaft between the pump head and the coupling. This will prevent the shaft seal faces from sticking.

Motor bearings:

Motors which are not fitted with grease nipples are maintenance-free.

Motors fitted with grease nipples should be lubricated with a high-temperature lithium-based grease, see the instructions on the fan cover.

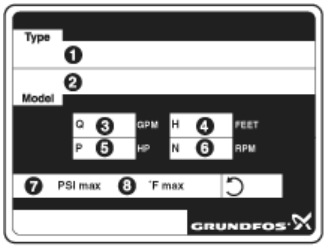
In the case of seasonal operation (motor is idle for more than 6 months of the year), it is recommended to grease the motor when the pump is taken out of operation.

Codes

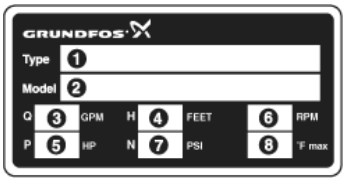
Example		U	FGJ	A	E	HQQE
Pump version						
U	NEMA pump					
A	Basic version					
B	Oversize motor, one flange size bigger					
F	CR pump for high temperatures (air-cooled top)					
H	Horizontal version.					
HS	Type J with reversed chamber stack/direction of rotation					
I	Different pressure rating					
J	Pump with different max. speed of rotation by means of MGE					
K	Low NPSH					
M	Magnetic drive					
P	Undersize motor, one flange size smaller					
R	Horizontal version with bearing bracket					
S	Pump without staybolts					
SF	High pressure pump without staybolts					
T	Oversize motor, two flange sizes bigger					
X	Special version					
Pipe connection						
A	Oval flange					
C	Clamp coupling					
CA	FlexiClamp					
FGJ	DIN/ANSI/JIS flange					
F	DIN flange					
G	ANSI flange					
J	JIS flange					
N	Changed diameter of ports					
O	Externally threaded, union					
P	PJE coupling					
Materials						
A	Basic version					
G	Stainless steel parts of 316 SS					
GI	Base plate and flanges of 316 SS					
I	Stainless steel parts of 304 SS					
S	SiC bearing ring + PTFE neck ring (only CR, CRN 32 to 90)					
T	Titanium					
Code for rubber parts						
E	EPDM					
F	FXM					
K	FFKM					
V	FKM					
Shaft seal						H Q Q
A	O-ring seal with fixed driver					
B	Rubber bellows seal					
D	Balanced seal					
E	Cartridge seal with O-ring					
H	Balanced cartridge seal					
K	Seal with metal bellows as cartridge seal					
R	O-ring balanced seal					
A	Carbon, synthetic metal-impregnated					
B	Carbon, synthetic resin-impregnated					
H	Cemented tungsten carbide, embedded hybrid					
Q	Silicon carbide					
U	Cemented tungsten carbide					
E	EPDM					
F	FXM					
K	FFKM					
V	FKM					

GRUNDFOS

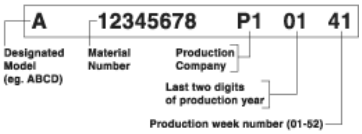
Vertical Multistage Centrifugal Pump
Type CR



1. Type designation
2. Model, material number, production code
3. Gallons per minute at rated RPM
4. Head in feet at nameplate flow
5. Pump horsepower
6. Rated RPM
7. Maximum PSI
8. Maximum fluid temperature



Model Key



WARNING

THE SAFE OPERATION OF THIS PUMP REQUIRES THAT IT BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL GOVERNING CODES OR REGULATIONS. CONNECT THE GROUND WIRE TO THE GROUNDING SCREW IN THE TERMINAL BOX AND THEN TO THE ACCEPTABLE GROUNDING POINT.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Preventative Maintenance

At regular intervals depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operation of all controls. Check unit control cycling twice and adjust, if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
8. To extend the pump life in severe duty applications, consider performing one of the following actions:
   - Drain the pump after each use.
   - Flush the pump , through system, with water or other fluid that is compatible with the pump materials and process liquid.
   - Disassemble the pump liquid components and thoroughly rinse or wash them with water or other fluid dthat is compatible with the pump materials and process liquid.

   If the pump fails to operate or there is a loss of performance, refer to the Troubleshooting Section

Procedure

CAUTION:

TO AVOID DAMAGE TO MOTOR BEARINGS, GREASE MUST BE KEPT FREE OF DIRT. FOR AN EXTREMELY DIRTY ENVIRONMENT, CONTACT YOUR BALDOR DISTRIBUTOR OR AN AUTHORIZED BALDOR SERVICE CENTER FOR ADDITIONAL INFORMATION.

1. Clean all grease fittings. If the motor does not have grease fittings, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease.
3. If the motor is stopped, add the recommended amount of grease. If the motor is to be greased while running, a slightly greater quantity of grease will have to be added.

   NOTE: If new grease does not appar at the shaft hole or grease outlet plug, the outlet passage may be blocked. At the next service interval the bearings must be repacked.

   Add grease SLOWLY until new grease appears at the shaft hole in the endplate or grease outlet plug. Never add more than 1-1/2 times the amount of grease shown in the lubrication schedule.
4. For motors equipped with a grease outlet plug, let the motor run for 20 minutes before replacing the plug.

GRUNDFOS

Vertical Multistage Centrifugal Pump
Type CR

Motor Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING:

DO NOT TOUCH ELECTRICAL CONNECTIONS BEFORE YOU FIRST ENSURE THAT POWER HAS BEEN DISCONNECTED. ELECTRICAL SHOCK CAN CAUSE SERIOUS OR FATAL INJURY. ONLY QUALIFED PERSONNEL SHOULD ATTEMPT INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT.

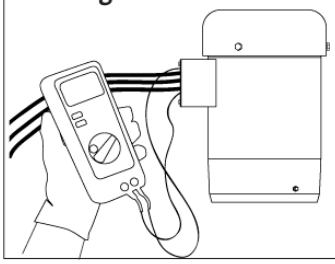
1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an Ohmmeter ("Megger") periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

WARNING:

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. IT IS RECOMMENDED THAT RUBBER GLOVES AND BOOTS BE WORN, AND METAL TERMINAL BOXES AND MOTORS ARE GROUNDED BEFORE ANY WORK IS DONE. FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER BEFORE HANDLING.

Preliminary tests

Supply voltage



How to measure

Use a voltmeter, (set to the proper scale) measure the voltage at the pump terminal box or starter.

On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

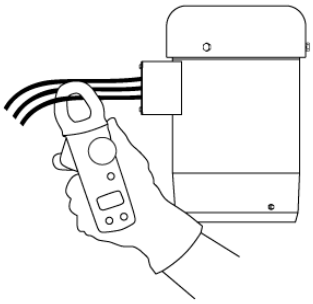
What it means

When the motor is under load, the voltage should be within ±10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

Current measurement



How to Measure

Use an ammeter, (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.

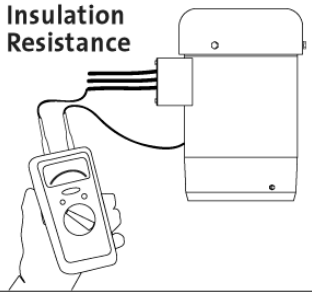
Current should be measured when the pump is operating at constant discharge pressure.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burned contacts on motor starter.
2. Loose terminals in starter or terminal box or possible wire defect.
3. Too high or too low supply voltage.
4. Motor windings are shorted or grounded. Check winding and insulation resistances.
5. Pump is damaged causing a motor overload.

Insulation Resistance



How to Measure

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to Rx 100K and zero adjust the meter.

Measure and record the resistance between each of the terminals and ground.

What it Means

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, motor should be repaired or replaced.

GRUNDFOS

Vertical Multistage Centrifugal Pump
Type CR

Trouble Shooting

Problem	Possible cause	Remedy
The pump does not run	1. No power at motor.	Check for voltage at motor teminal box. If no voltage at motor, check feeder panel for tripped circuits and reset circuit.
	2. Fuses are blown or circuit breakers are tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	3. Motor starter overloads are burned or have tripped out.	Check for voltage on line and load side of starter. Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	4. Starter does not energize.	Energize control circuit and check for voltage at the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil.
	5. Defective controls.	Check all safety and pressure switches for operation. Inspect contacts in control devices. Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace.
	7. Defective capacitor. (Single-phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
The pump runs but at reduced capacity or does not deliver water	1. Wrong rotation	Check wiring for proper connections. Correct wiring.
	2. Pump is not primed or is airbound.	Turn pump off, close isolation valve(s), remove priming plug. Check fluid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.
	3. Strainers, check or foot valves are clogged.	Remove strainer, screen or valve and inspect. Clean and replace. Reprime pump.
	4. Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	5. Suction and/or discharge piping leaks.	Pump runs backwards when turned off. Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	6. Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in PSI) to head (in feet): (Measured PSI x 2.31 ft./PSI = _____ ft.). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	7. Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.

GRUNDFOS

Vertical Multistage Centrifugal Pump
Type CR

Trouble Shooting

Problem	Possible cause	Remedy
The pump runs but at reduced capacity or does not deliver water (continued)	8. Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	9. Improper coupling setting.	Check/reset the coupling, see page 10.
Pump cycles too much	1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts. Readjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume. Repair as necessary.
	4. Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	5. Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert PSI to feet (Measured PSI x 2.31 ft./PSI = _____ ft.) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.
Fuses blow or circuit breakers or overload relays trip	1. Low voltage.	Check voltage at starter panel and motor. If voltage varies more than ±10%, contact power company. Check wire sizing.
	2. Motor overloads are set too low.	Cycle pump and measure amperage. Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current.
	3. Three-phase current is imbalanced.	Check current draw on each lead to the motor. Must be within ±5%. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	4. Motor is shorted or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	5. Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wire.
	6. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
	7. Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Motor overloads at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values. If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above +104°F (+40°C), ambient-compensated heaters should replace standard heaters.

11.14 Water heater

ELEKTRA-LINDAU
ELEKTRISCHE HEIZSYSTEME GMBH

Immersion Heater
1661/0101

Technical Data

Immersion heater type	1661/0101	dry operating limiter	55.11529.010
Commission number	56201	circuitry	1 group
drawing no.	A 02-018	case	IP 65
connection load	230 V 800 W	heating element	type 199N

1 Basically safety regulations

1.1 Using as directed

The immersion-heater is made for a machine arrangement to heat up a liquid medium.
The operating security is only guaranteed by directed installation and observance of the technical preconditions.
The immersion-heater is not suitable for using in explosive conditions
Unauthorized changes or reconstructions by the heater, the guarantee will be expire.

1.2 Wiring

The cable connections have to be in the right dimension (cable diameter), to prevent an overheating of the cable.
Voltage and wattage you can see on the type-plate.

Dangerous voltage.

By contact of parts with high voltage, there is the danger of hard injury and death.
All operations on electrical system are only allowed by trained electricians.

1.3 Operation

Avoid any kind of deposition on the surface of the heating-elements.

2 Safety directions

We took care against the following different risks:

2.1 Overheating

- heating-elements are unheated 50 mm to the connection
- connection case 34 mm high
- 1 dry operating limiter

2.2 Electrical power risks

- case and cable connection case are IP 65
- cable screws with relief tension

3 Operating Instruction

In case of the interruption by the temperature limiter the water heater electrical supply is interrupted but not voltage less. After the fault finding the function of the water heater must be restored due to reset button on place on the temperature limiter (see the following drawing).

Note!

If you load the heating element to high, the sediments, depending of the used medium, will possibly cove the heating element. In this case you have to clean the flat tube to get the perfect heat dissipation.

4 Maintenance

A special maintenance is not necessary. Check by servicing following points:

- check the connecting cable if it is still connected tight enough

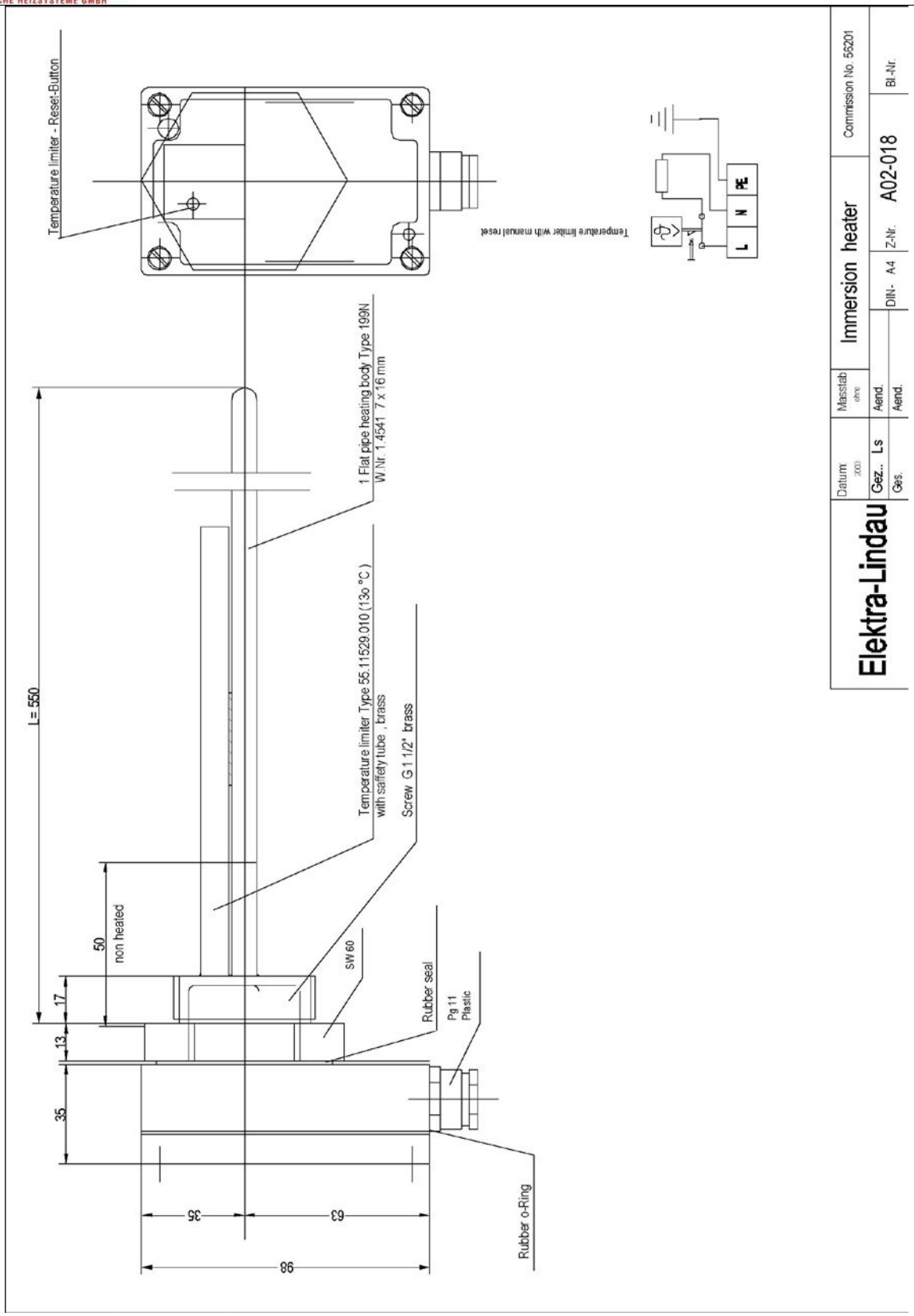
- check the cable screwing
- check the connecting cable for brittleness

5 Spare parts

Tell us the commission number, we can send you spare parts every time.

ELEKTRA-LINDAU
ELEKTRISCHE HEIZSYSTEME GMBH

Immersion Heater
1661/0101



11.15 Air vent

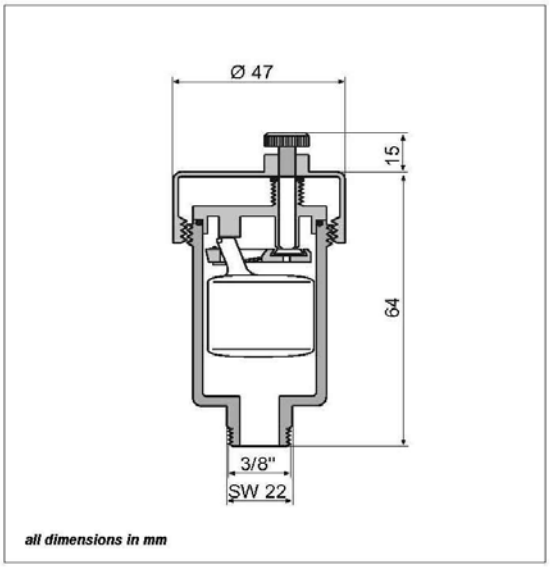
Honeywell
Braukmann

Automatic Air Vent
E121 and Z 121

Honeywell

E121
Automatic Air Vent

PRODUCT DATA



Application

The E121 Air Vent is a reliable automatic venting device and is suitable for venting of air or gas from heating systems or heat process installations.

Features

- **With the Z121 A shutoff valve fitted, cleaning or replacement of the seal and inner components can be carried out without draining the system.**

Specifications

Operating temperature	max. 110°C (230°F)
Operating pressure	max. 10 bar (145 P.S.I.)
Connection sizes	R 3/8" and R 1/2"

Design

The automatic air vent comprises:

- Housing
- Lid
- Float
- Valve seat seals

Materials

- Brass housing
- Brass lid
- High grade, heat-resistant synthetic material float
- Heat-resistant elastomer seal components

Accessories

Shutoff valve

Brass housing, high-grade temperature-resistant synthetic material inner components, hot-water-resistant elastomer seal ring — Z121-3/8A

Function

Inside the automatic air vent there is a float which operates a lever according to the water level. When there is no water in the housing, then the float opens the valve. Air can therefore be vented from the heating system during filling. When the heating system has been filled, the inflowing water closes the valve and the vent is shut off. Water usually contains oxygen which bubbles off during operation of the system and collects at the highest point. The automatic air vent must therefore be fitted at the air collection position (highest point on a boiler or pipework circuit).

Version

E121-3/8A = Standard version, Connection size R 3/8"

11.16 Safety valve

CALEFFI

Diaphragm safety relief valve
531 series ¾" - 1"

Diaphragm safety relief valve for potable water systems, with female-female connections.

Factory set at: 6 bar.

Maximum opening pressure: +10%.

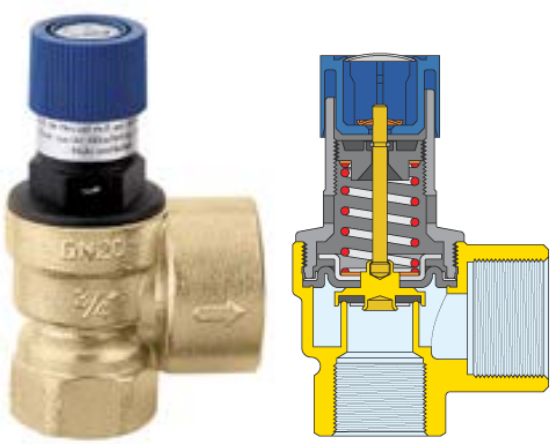
Minimum reseating pressure: -20%.

Maximum temperature: 100°C.

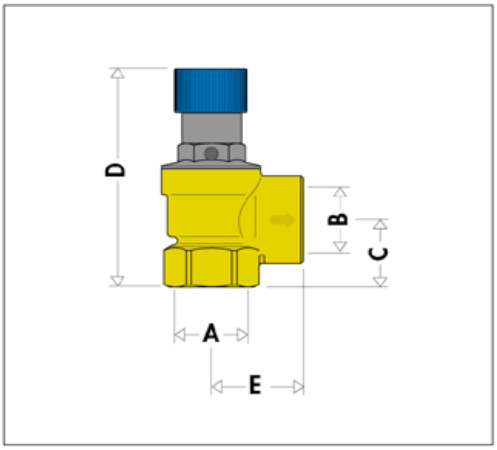
Brass body.

Diaphragm and seal in EPDM.

Cover and handle in glass reinforced nylon.



531



A	B	C	D	E
3/4"	1"	30	92	40,5
1"	1 1/4"	38	144	48
1 1/4"	1 1/2"	44	185	57,5

11.17 Expansion vessel

Flamco

Expansion Vessel Airfix A 25

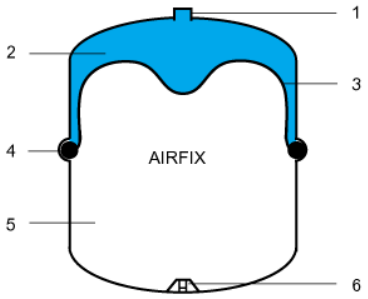
For use on hot and cold water supplies including pump control, unvented HWS systems and water boosting sets.

The Flexcon clench ring construction allows the water section to be coated before assembly.

The inside and outside of these expansion vessels are corrosion resistant coated, both on the water side and the gas side.

SPECIFICATION

Capacity:	25 litre
Maximum Working Pressure:	10 bar
Maximum Operating Temperature:	70 °C (343K).
Diaphragm:	Flexible rubber with rolling action.
Clamp Ring:	Separate, zinc plated.
Certification:	WRC listed and approved



1. System connection.
2. Water from system.
3. Diaphragm.
4. Clamp ring clamps diaphragm between the two vessel halves.
5. Gas charge.
6. Gas filler valve.

The inside and outside of the Airfix expansion vessels have a corrosion resistant coating on both the water and gas side of the vessel, with the exception of the 2 and 4 litres. This makes the Airfix vessel fully corrosion resistant. The plastic coating is resistant to 70°C and does not impart any odour. colour or taste to the water.

Maintenance and servicing

The Airfix A expansion vessel is maintenance-free. If local laws and regulations require the initial pressure to be checked regularly, this should be done. If water has been lost via the safety valve, the initial pressure may be too low. This can only be checked by first depressurizing the system. Shut off the cold water feed pipe and drain the boiler until the pressure is 0 bar. Check the initial pressure (see under "Commissioning"). If the initial pressure is too low, it should be raised with compressed air. Take care that the pressure does not exceed the maximum operating pressure. If it is no longer possible to set the correct initial pressure, the membrane may be leaking; in that case, the entire vessel should be replaced.

Commissioning

The initial pressure of the Airfix A expansion vessel should correspond to the pressure in the potable water system, i.e. it should be 0.2 bar higher than the minimum water pipe pressure at the expansion vessel. This ensures that the vessel is completely emptied by pressure before mains water flows to the boiler.
The initial pressure is shown on the vessel's sticker. The correct initial pressure is set by releasing nitrogen. To lower the initial pressure, proceed as follows: pull off the cap on the bottom of the expansion vessel from the filling valve. Remove the plug and push the internal valve in slightly to cause nitrogen to be released. Measure the pressure in the expansion vessel at regular intervals in order to set the correct value. Re-insert the plug and screw it in tightly to prevent leakage. Then push the cap onto the plug. Correct fitting is indicated by an audible click.

11.18 Manometers

Manometers in the refrigeration cycle

These gauges serve for performing maintenance work and testing the optimal running of the refrigeration system.
They can be read off in order to quickly check the system against the factory settings, according to 4.3.

Manometers in the water circuit

These allow the pressure values of the pumps and the cooling medium system to be checked.

Min. System pressure	suction end		pump	1,0 bar
Max. System pressure	delivery end		pump	5,0 bar
Differential pressure	pump	approx		2,5 bar

11.19 Flow switch

Monitors the water flow volume through the evaporator and shuts the device down completely if the min. water quantity is reached.

Flow switch VHS07 M2 KKTKR01

SIKA flow switches are designed for minimum or maximum monitoring of fluid flows.

The designation of the flow switches consists of the name of product lines VHS and type marking 01, 05, 06, and 07 for direct installation (insertion type) into existing piping systems.

Flow switches of the product lines VHS... are technically advanced with time. This applies to switching accuracy, function, and safe operation of the instrument.

To ensure safe operation of the instrument requires competent and safety-observing personnel.

Caution: **Danger to life through electrical voltage !**

Switch off the voltage supply before you connect leads of the mains cable.

ATTENTION: The maximum electrical contact capacity indicated onto the type shield must not be exceeded, otherwise the reed contact, which is integrated in the switching unit, will be damaged.
The switching capacity is reduced with inductive loads.

General Installation Instructions

- At first clean the piping system where the flow switch should be installed and remove any magnetic particles such as weld spatters.
- Install the switch only vertically, max. deviation is 45° (fig.1).
- There is an arrow on the flow switch. Make absolutely sure that this arrow is parallel with the pipe axis and points into flow direction (fig.2).
- Make sure that there are no magnetic fields close to the flow switch. Such fields can affect the proper function of the instrument.
- Screw on the union nut made of brass or stainless steel (version VHS) with a maximum torque of 30 Nm.

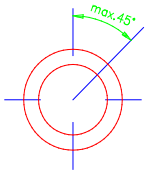
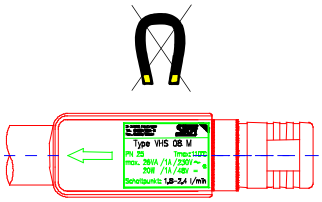


Fig. 1

Fig. 2



SIKA

Flow switch VHS07 M2 KKTKR01

Type of Contact

The reed switch unit of the switch provides 2 different types of contact:

1. working contact (make contact): „RED“ arrow to switch unit
2. break contact (breaker): „WHITE“ arrow to switch unit

The following table explains the two types of contacts:

type of contact	flow volume	electrical contact
working contact (RED arrow)	increasing	making
	decreasing	breaking
break contact (WHITE arrow)	increasing	breaking
	decreasing	making

If not requested otherwise, the switch unit is set to 'working contact' on delivery, i.e. the reed contact breaks when the flow rate decreases under the adjusted set point.

Adjusting the Reed Switch Unit

To adjust the reed switch unit, open the junction box of the switch head (fig. 3).

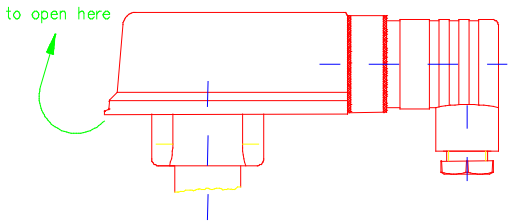


Fig. 3

Then loosen the locking screw (Allen screw 2,5 across flats with brass or stainless steel version and cross head with plastic version) and move the reed switch unit so far that with set 'working contact' (fig. 4) the red arrow (or with set 'break contact' the white arrow, fig. 5) is visible at the entry of the switch units guiding.

After adjustment tighten the locking screw again.

Close the snap-in cover.

When a fixed switch point was set at work, then there is no adjustment of switch unit.

working contact
(red arrow)

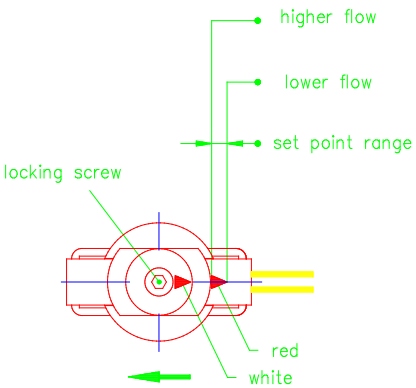


Fig. 4

break contact
(white arrow)

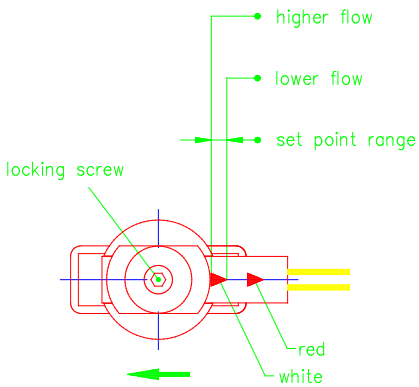


Fig. 5

Flow switch VHS07 M2 KKTKR01

Electrical Connection

Plug connector square type DIN 43650, type A / ISO 4400

Caution: **Risk to life through electrical voltage !**

Switch off the electrical system before you connect leads of the supply cable.

Make sure that the flow switch (brass and stainless steel version) is properly earthed through the piping system.

Loosen the central screw (6) M3x35 and pull the cable socket DIN 43650 (2) off the applience connector (1) (fig. 6).

Press out the insert (8) of the cable socket by means or a screw driver or a similar tool (fig. 7).

Loosen the screwed union PG 9 (5), (fig. 8).

Insert the supply cable through the screwed union (5), the pressure ring (10) and the rubber insert (9) into the plug and connect the leads to the clamps 1 and 2 of the insert.

Press the insert (8) into the cable socket until it snaps-in (2).

Screw on cable union PG 9 (fig. 10).

Push the cable socket (2) into the appliance connector (1) and tighten the central screw (6).

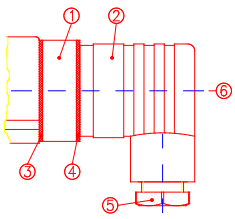


Fig. 6

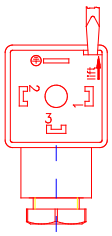


Fig. 7

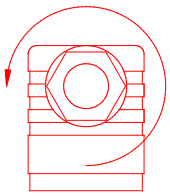


Fig.8

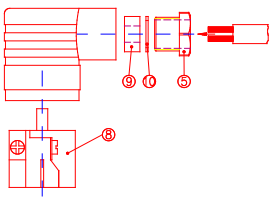


Fig. 9

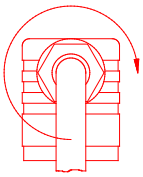


Fig. 10

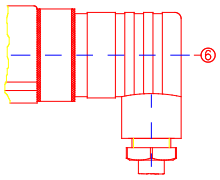


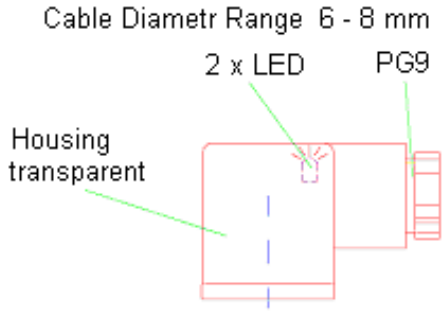
Fig. 11

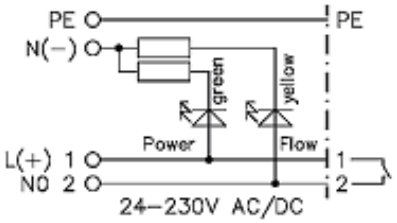
To meet the requirements of protection class IP 65 to EN 60529, the supply cable must have a jacket diameter of 4,5 to 7 mm.

In addition make sure that all seals of the cable socket (3), (4), (9) are properly inserted.

Installation Instruction cable box DIN 43650 / ISO 4400 Type A with 2 LED-displays

Please check if the instruction cable box is suitable concerning the material for the medium that has to be measured!





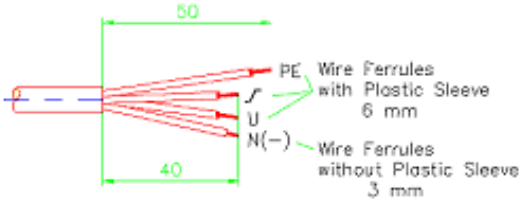
1. displays **LED green = power supply**
LED yellow = flow switching contact of the flow switch is closed *)

***)**
In special circumstances the switching function can be changed on customer request; contact opens with flow contact is closed in non-operating condition. In these cases the yellow LED lightens in the non-operating condition and extinguishes in case of flow.
The technical data of products in special designs (special designs on customer request) can differ from the data in this instruction. Please read the instructions on the type sign.

2. Technical data

Electrical data	power	24...230 V AC/DC ± 20%
	protection	IP 65 in mounted condition
	number of pols	2 and earthing
Cable connection	cable screwing	PG 9
	clamp area	outer cable diameter 6...8 mm
	wire cross section	max 1 mm^2
Materials	housing	transparent polyamides
	seal	gum thermoplastic
	contact carrier	PA + 30% GF
	contacts	CuZn(Ag)
Temperature range		- 20... + 70°C

3. Installation



a.) Preparation of connection cable according to dr
b.) When squeezing on according to connection sc pay attention to only tighten the binder N(-) with little impuls.
c.) The contact of the housing and the contact carri be varied on steps of 90°. Thus the direction is determined.
Press connection cable gently in cable box and tighten PG-screwing.
d.) Install seal (enclosed in delivery) in cable box and tighten with delivered central screw.

11.20 Flow control valve

TA HYDRONICS

STAD: Balancing, pre-setting, measuring, shut-off, draining

Pressure class: PN 20

Temperature:

Max. working temperature: 120°C
Min. working temperature: -20°C

Material:

The valves are made of AMETAL ® .
Seat seal: Stem with EPDM O-ring
Spindle seal: EPDM O-ring
Handwheel: Polyamide

AMETAL ®is the dezincification resistant alloy of TA.

→ = Flow direction

Marking:

Body: PN 20/150, DN and inch size.

Handwheel: Valve type and DN.

Setting STAD

Setting of a valve for a particular pressure drop, e g corresponding to 2.3 turns on the graph, is carried out as follows:

1. Close the valve fully (Fig 1).
2. Open the valve 2.3 turns (Fig. 2).
3. Using a 3 mm Allen key, turn the inner spindle clockwise until stop.
4. The valve is now set.

Fig. 1. Valve closed

Fig. 2. The valve is set at 2.3

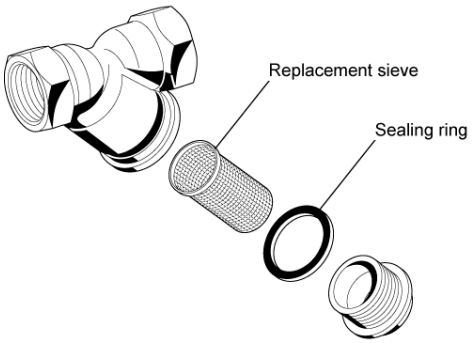
Fig. 3. Fully open valve

To check the setting: Close the valve, the indicator shows 0.0.

Open it to the stop position.
The indicator then shows the set value, in this case 2.3 (Fig. 2).

11.21 Dirt trap

The dirt trap in form of Y-Strainer is fully installed (see 4.10 in Water chiller control scheme (122)) and protects the evaporator from dirt.
As a matter of principle the plant is to be operated with clean water. With that regular servicing of the filter is unnecessary.



	Operation	Interval	Carried out by
Inspection	Inspection of the location and water tightness of sieve insert and seal ring	According to operating conditions	User or specialist
Inspection and Maintenance	Cleaning or if necessary replacement of sieve Cleaning and if necessary replacement of the sealing ring	According to operating conditions	User or specialist

Caution! Work on electric and refrigerant circuits should only be performed by qualified operatives. Observe the safety rules!

11.22 Remote control 24 V DC control panel

See Circuit Diagram

11.22.1 Collective alarm

The red warning lamp in the door of the switch cabinet lights up when one of the safety sensors has been triggered. The cause of the error can be identified more exactly by means of the LEDs in the switch cabinet. For the purpose of external evaluation of the error signal, the collective alarm message can be accessed, potential-free, from the terminal. (See also circuit diagram)

11.23 Switch cabinet

The switch cabinet is fully installed, connected and complies with the technical requirements of the VDE 0113.

For parts see circuit diagram.

The unit is switched on by means of the master switch.

When the master switch is turned to Pos. 1 the water pump is started and, should the thermostat require cooling, the compressor is turned on.

In order to prevent the compressor from being switched on for short intervals, the time-delay relay hinders the start procedure. After the time has passed by and the compressor has been at a standstill, i.e. after a pause of approx. 1 minute, the refrigeration process will commence immediately if the thermostat has switched it on.

12 Safety notes

Notes for refrigerant

R 134a	R 407C	R 404A
1,1,1,2 Tetraflourethane F3C-CH2F ≥99 %	1,1,1,2 Tetraflourethane F3C-CH2F 52 % Pentafluorethane F3C- CHF2 25 % Difluormethane CH2F2 23 %	1,1,1 Trifluorethane F3C- CH3 52 % Pentafluorethane F3C- CHF2 44 % 1,1,1,2 Tetraflourethane F3C-CH2F 4 %
Possible dangers Pyrolysis in poisonous and corrosive products:		
Hydrogen fluoride, fluorphosgene	Hydrogen fluoride, fluorphosgene possible in traces	Hydrogen fluoride, carbon dioxide, fluorphosgene possible in traces
Discharged gas: Emerging liquid can cause freezing		

First-aid measures

- After inhalation: Bring the afflicted person into fresh air and position them comfortably while protecting yourself. Call doctor. Commence mouth-to-mouth resuscitation if breathing has stopped.
- After skin contact: First leave the caked clothing on the skin. Rinse the cold-damaged areas with lukewarm (never hot) water. Do not rub! Cover sterilely. Seek medical treatment.
- After contact with eyes: With splashed eyes, rinse out at least 15 minutes with clean water or eyewash solution. Consult an ophthalmologist.
- After ingestion: Ingestion is not considered a potential means of exposure (gas).
- Notes for the doctor: Do not administer catecholamine or adrenaline-ephedrine medications.

Measures for fire-fighting

- Suitable extinguishing agent: Product that does not burn itself. Coordinate extinguishing measures to surrounding fire. Cool containers by spraying with water.
- Special dangers from the material, its combustion products or emerging gases: Dangerous gases and vapours build during pyrolysis.
- Special protective equipment for fire fighting: Independent breathing apparatus and acid-resistant protective suit with deployment in the immediate vicinity.
- Further information: The effect of fire can cause bursting or exploding of the container. Flammable gas-air mixture possible under certain conditions.

Measures upon accidental release

- Environmental protective measures: Do not allow to penetrate into the environment if possible.
- Procedure for cleaning: Allow product to evaporate
- Further information: Avoid allowing the product to get into the drain or closed spaces.

Handling and storage

- Handling: Protection against fire and explosion: Heating leads to increased pressure and risk of bursting. Cool endangered containers with water. Open containers slowly and carefully.
- Storage: Containers can be stored outside. Provide sufficient ventilation in closed rooms. Avoid strong sources of heat – danger of bursting. Keep containers tightly closed. Storage class: 2A

Personal protective gear

- Respiratory protection: Omitted with sufficient ventilation. Independent breathing apparatus within closed spaces, with insufficient oxygen supply, with considerable or uncontrollable release. Only use respiratory protection in accordance with international / national norms. Only use insulating devices, no filter devices.
- Protective gloves: Chemical-resistance protective gloves. Recommended material: Polyvinylalcohol.
- Protective eyewear: Close-fitting protective eyewear.

General safety and hygiene measures

- Do not inhale vapours/aerosols.
- Do not eat, drink or smoke while working.

12.1 Instructions regarding machine oil

First aid measures

- After inhalation: While protecting yourself, take the affected person to where there is fresh air and keep them calm. Fetch a doctor.
- After skin contact: Remove contaminated, soaked clothing. Wash down skin with water. If symptoms occur, seek medical attention.
- After eye contact: Rinse with eyelids held open for at least 10 minutes using clean water or an eyewash solution. Seek the advice on an eye specialist.
- After swallowing: Do not induce vomiting. Rinse mouth with water and drink two glasses of water. Seek the advice of a doctor.
- Instructions for the doctor: Symptomatic treatment and supportive therapy as indicated.

Fire-fighting measures

Minimal fire risk. Product only ignites at very high temperatures.

- Suitable extinguishing materials: Adapt to the environment. Carbon dioxide, powder and foam extinguishers. Use water only with caution in order to avoid any potentially severe generation of vapours.
- Particular hazards from the material, its combustion products or any gases issuing from it: Irritating vapours can be released in the event of thermal decomposition.
- Special safety equipment for fighting fires: Respiratory equipment independent of circulating air and acid-resistant protective suit for use in close proximity.
- Further information: The effect of fire can lead to the container bursting or exploding. Ignitable gas/air mixtures are possible under certain conditions.

Measures for unintentional release

- Environmental measures: Do not allow to enter the drainage system or any bodies of water. Absorb with sand, earth or other similarly absorbent material. Fill a container for correct waste disposal.
- Cleaning procedure: Clean contaminated areas with water.

- Further information: Inform the police or authorities in charge in the event of penetration into bodies of water or the drainage system.

Personal safety equipment

- Respiratory protection: Unnecessary if there is sufficient ventilation. Respiratory equipment independent of circulating air for use within enclosed rooms, with insufficient oxygen supply, with considerable or uncontrollable release. Only use respiratory protection according to international/national norms. Only use insulation devices, no filter devices.
- Hand protection: Safety gloves. Recommended material: Nitrile rubber.
- Eye protection: Tight-fitting protective goggles.

Handling and storage

- Handling: Avoid longer periods of skin contact. Avoid inhalation of high mist concentrations. Avoid inhalation of high vapour concentrations.
- Storage: Suitable material for packing drum: Mild steel. Securely seal unused containers to prevent penetration by moisture. Keep away from strong oxidising agents.

13 Circuit diagram

Circuit diagram see the next pages or in switch cabinet