



Installation, Operation and Maintenance Manual

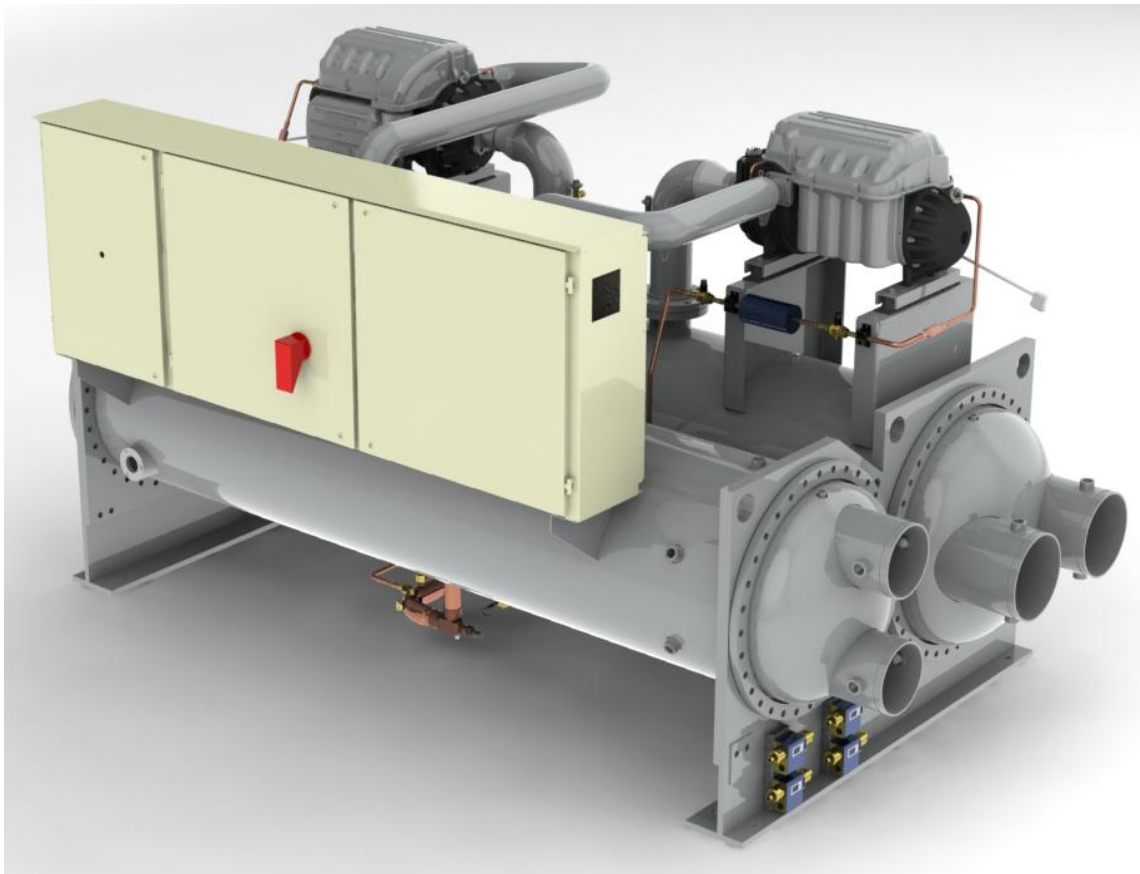
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Frictionless Centrifugal Chiller

EWWD320 ÷ C10FZXS

Cooling capacity from 114 to 1048 kW

Refrigerant: R-134a



Original Instructions



▲ IMPORTANT

This Manual is a technical aid and does not represent a binding offer for Daikin.

Daikin has drawn up this Manual to the best of its knowledge. The content cannot be held as explicitly or implicitly guaranteed as complete, precise or reliable.

All data and specifications contained herein may be modified without notice. The data communicated at the moment of the order shall hold firm.

Daikin shall assume no liability whatsoever for any direct or indirect damage, in the widest sense of the term, ensuing from or connected with the use and/or interpretation of this Manual.

The entire content is protected by Daikin copyright.

▲ WARNING

Before starting the installation of the unit, please read this manual carefully. Starting up the unit is absolutely forbidden if all instructions contained in this manual are not clear.

Key to symbols



Important note: failure to respect the instruction can damage the unit or compromise functioning

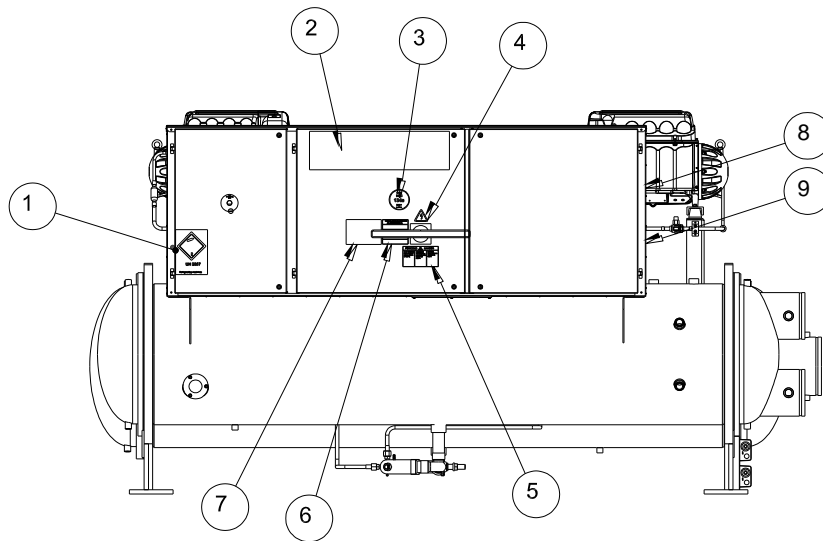


Note regarding safety in general or respect of laws and regulations



Note regarding electrical safety

**Description of the labels applied to the electrical panel for
1 and 2 compressors unit**



Label Identification

1 – Non flammable gas symbol	6 – Cable tightening warning
2 – Manufacturer's logo	7 – Water circuit filling warning
3 – Gas type	8 – Lifting instructions
4 – Electrical hazard symbol	9 – Unit nameplate data
5 – Hazardous Voltage warning	

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General information

▲ WARNING

The units described in the present manual represent a high value investment, maximum care should be taken to ensure correct installation and appropriate working conditions.
Installation and maintenance must be performed by qualified and specifically trained personnel only.
Correct maintenance of the unit is indispensable for its safety and reliability. Manufacturer's service centres are the only having adequate technical skill for maintenance.

▲ WARNING

This manual provides information about the features and standard procedures for the complete series.

All the units are delivered from factory as complete sets which include wiring diagrams, dimensional drawings with dimensions and weight, unit label with technical characteristics attached to the unit.

WIRING DIAGRAMS, DIMENSIONAL DRAWINGS AND UNIT LABEL MUST BE CONSIDERED ESSENTIAL DOCUMENTS AND AS A PART OF THIS MANUAL

In case of any discrepancy between this manual and the equipment's document refer to on board documents.
For any doubt ask Daikin or authorized centers

Compressor manuals may be downloaded from turbocor website www.turbocor.com
Compressor manuals are relevant documents to complete the information contained in this document

Purpose of this manual

The purpose of this manual is to allow the installer and the qualified operator to carry out required operations in order to ensure proper installation and maintenance of the machine, without any risk to people, animals and/or objects.
This manual is an important supporting document for qualified and trained personnel but it is not intended to replace such personnel.

All activities must be carried out in compliance with local laws and regulations.

General description

EWWD Frictionless Centrifugal Chillers are complete, self-contained, automatically controlled, fluid-chilling units featuring oil-free, magnetic bearing compressors. Each unit is completely assembled and factory tested before shipment.
Magnitude chillers are equipped with one or two compressors operating in parallel with a single evaporator and single condenser.

The chillers use refrigerant R-134a that operates at a positive pressure over the entire operation range, so no purge system is required.

The controls are pre-wired, adjusted and tested. Only normal field connections such as water piping, relief valve piping, electric power and control interlocks are required, thereby simplifying installation and increasing reliability. Necessary equipment protection and operating controls are included.

All chillers are factory-tested prior to shipment and must be commissioned by a trained service technician. Failure to follow this startup procedure can affect the equipment warranty.

Receiving the machine

The machine must be inspected for any possible damage immediately upon reaching its final place of installation. All components described in the delivery note must be carefully inspected and checked; any damage must be reported to the carrier. Before connecting the machine to earth, check that the model and power supply voltage shown on the nameplate are correct. Responsibility for any damage after acceptance of the machine cannot be attributed to the manufacturer.

Checks

To prevent the possibility of incomplete delivery (missing parts) or transportation damage, please perform the following checks upon receipt of the machine:

- a) Before accepting the machine, please verify shipment documents and check the number of shipped items
- b) Check every single component in the consignment for missing parts or for any damage.
- c) In the event that the machine has been damaged, do not remove the damaged material. A set of photographs are helpful in ascertaining responsibility.
- d) Immediately report the extent of the damage to the transportation company and request that they inspect the machine.

- e) Immediately report the extent of the damage to the manufacturer representative, so that arrangements can be made for the required repairs. In no case must the damage be repaired before the machine has been inspected by the representative of the transportation company.

Nomenclature

E	W	W	D	3	2	0	F	Z	X	S	0	0	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Machine type
EWA = Air-cooled chiller, cooling only
EWY = Air-cooled chiller, heat pump
EWL = Remote condenser chiller
ERA = Air cooled condensing unit
EWW = Water-cooled chiller, cooling only
EWC = Air-cooled chiller, cooling only with centrifugal fan
EWT = Air-cooled chiller, cooling only with heat recovery

Refrigerant
D = R-134a
P = R-407c
Q = R-410a

Capacity class in kW (Cooling)
Always 3-digit code

Model series
Letter A, B, ... : major modification

Inverter
- = Non-inverter
Z = Inverter

Efficiency level
S = Standard efficiency (N.A for this range)
X = High efficiency
P = Premium efficiency (N.A for this range)
H = High ambient (N.A for this range)

Sound level
S = Standard noise
L = Low noise (N.A for this range)
R = Reduced noise (N.A for this range)
X = Extra low noise (N.A for this range)
C = Cabinet (N.A for this range)

Warranty
0 = 1 year of warranty
B = 2 years of warranty
C = 3 years of warranty
... = ... years of warranty

Sequential number
000 = Base model
001 = First order for this model (1 or more units)
002 = Second order for this model (1 or more units)
... = ... order for this model
B01 = First order for this model + 1 year warranty
B02 = Second order for this model (1 or more units)
... = ... order for this model

Technical Specifications

			EWWD	320FZ	430FZ	520FZ	640FZ	660FZ	C10FZ
Cooling Capacity (1)	Min (2)	kW	114	128	172	114	128	172	
	Max	kW	317	429	521	635	856	1048	
Capacity control	Type	---	Variable speed centrifugal compressor						
	Minimum capacity (1)	%	36	30	33	18	15	16	
Unit power input (1)	At min capacity	kW	21.6	27.7	33.1	21.6	27.7	33.1	
	At max capacity	kW	65.9	85.7	104.2	132.3	171.1	205.5	
EER (1)	At min capacity	---	5.3	4.6	5.2	5.3	4.6	5.2	
	At max capacity	---	4.8	5.0	5.0	4.8	5.0	5.0	
ESEER (3)			8.4	8.6	9.2	8.6	8.5	9.3	
IPLV (3)			8.9	9.2	9.7	9.4	9.2	9.9	
Dimensions	Unit	Height	mm	1823	1823	1823	1755	1748	1794
		Width	mm	1276	1276	1276	1790	1853	1904
		Length	mm	3254	3254	3419	3441	3289	3401
Weight	Unit	kg	2360	2416	2546	3709	4095	4765	
	Operating Weight	kg	2520	2634	2812	4074	4548	5330	
Evaporator	Type	---	Flooded Shell&Tube – Two water passes in standard conditions (1 to 4 water passes available as option)						
	Water volume	l							
	Nominal water flow rate (4)	l/s	15.1	20.5	24.9	30.3	40.9	50.1	
	Nominal Water pressure drop (4)	kPa	30.1	30.5	23.3	18.3	20.9	11.3	
	Insulation material		Closed cell						
Condenser	Type	---	Flooded Shell&Tube – Two water passes in standard conditions (1 to 4 water passes available as option)						
	Water volume	l							
	Nominal water flow rate (4)	l/s	18.3	24.6	29.9	36.7	49.1	59.9	
	Nominal Water pressure drop (4)	kPa	24.3	24.5	28.2	23.7	25.3	29.3	
	Insulation material		None (available as an option)						
Compressor	Type	---	Frictionless Centrifugal Compressor Oil free						
Sound level	Sound Power	Cooling	dB(A)	89,0	90,1	91,2	92,4	93,6	94,6
	Sound Pressure (5)	Cooling	dB(A)	70,9	72,0	73,0	73,8	75,1	75,9
Refrigerant circuit	Refrigerant type	---	R-134a	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge	kg.	210	190	180	220	300	300	
	N. of circuits	No.	1	1	1	1	1	1	
Piping connections	Evaporator water inlet/outlet	mm	168.3	168.3	219.1	219.1	219.1	273.0	
	Condenser water inlet/outlet	mm	168.3	168.3	168.3	219.1	219.1	219.1	
Safety devices	Compressors integrate safety functions such as: <ul style="list-style-type: none"> - Low Suction and High Discharge Pressure - SurgeHigh Motor Temperature - Low Motor Current - Starter Fault - Sensor Fault - Evaporator – Condenser Water Flow Loss 								
Notes (1)	Minimu and maximum capacity, unit power input EER are based on the following nominal conditions: evaporator water temperature 12/7°C; condenser water temperature 30/35°C, unit at full load operation.								
Notes (2)	For two compressors unit minimum capacity is with one compressor only runnin								
Notes (3)	ESEER and IPLV are calculated with 100% load equal to maximum capacity								
Notes (4)	Nominal flow rate an pressure drop are at maximum capacity with two passes heat exchangers								
Notes (5)	The values are according to ISO 3744 and are referred to: evaporator water temperature 12/7°C; condenser water temperature 30/35°C, unit at full load operation at maximum capacity								

Operating limits

Storage

The environmental conditions must be within the following limits:

Minimum ambient temperature	:	-20°C
Maximum ambient temperature	:	50°C
Maximum R.H.	:	90% not condensing

▲ ATTENTION

Storing below the minimum temperature mentioned above may cause damage to components such as the electronic controller and its LCD display.

▲ WARNING

Storing above the maximum temperature may cause opening of the safety valves on the compressors' suction line.

▲ ATTENTION

Storing in condensing atmosphere may damage the electronic components.

Operation

▲ ATTENTION

Daikin EWWD FZ chillers are suitable for stationary installations only. For any moving or marine applications, contact the factory.

▲ ATTENTION

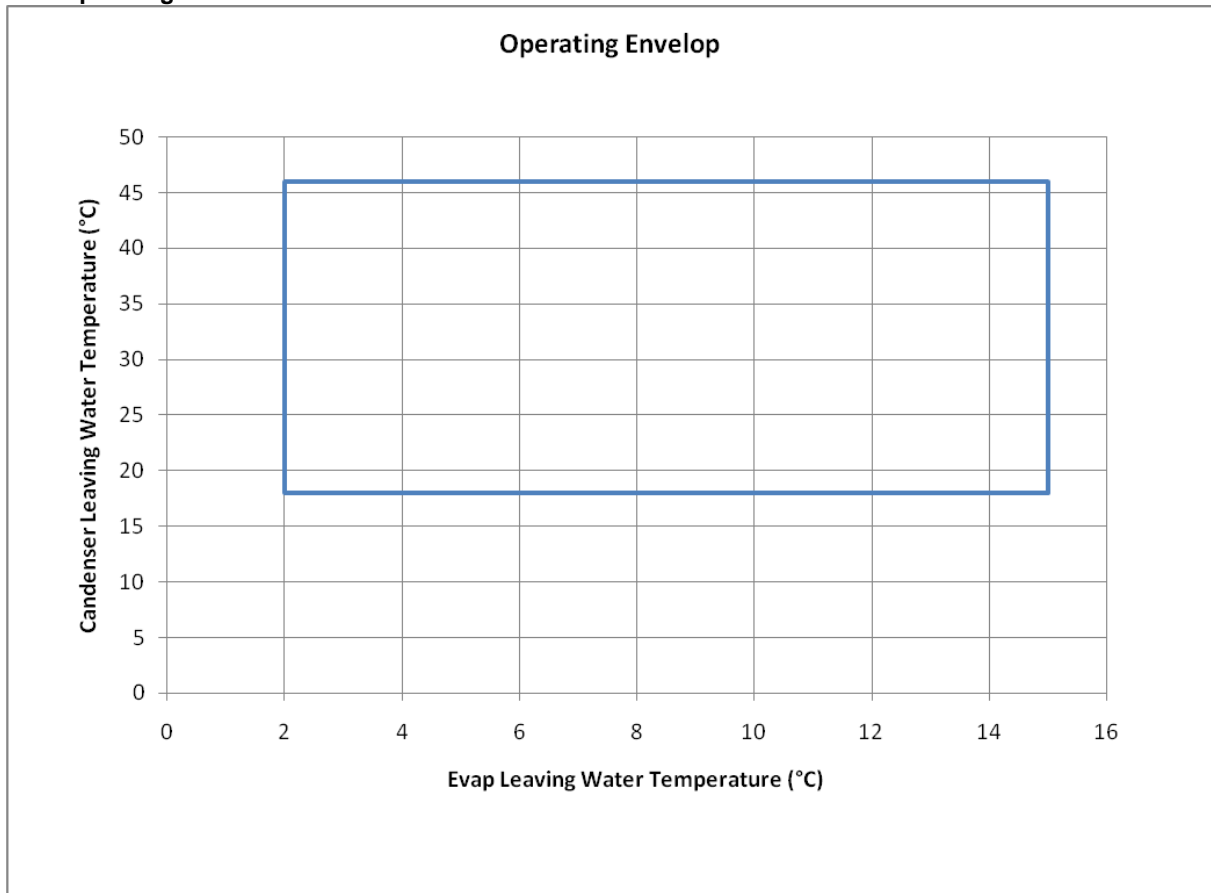
Operation limits of Frictionless Centrifugal compressor strongly depend from requested duty, so refer to selection tool to be sure unit can operate at requested condition.

▲ ATTENTION

The maximum operating altitude is 2,000 m above sea level.
Please contact the factory if the equipment is to be operated at altitudes of between 1,000 and 2,000 m above sea level.

As reference only, operation limits are shown in the following figure

Figure 1 - Operating limits



Other limits are:
Maximum startup evaporator inlet fluid temperature, 32°C
Maximum non-operating inlet fluid temperature, 38°C

Mechanical installation

Shipping

The stability and the absence of any kind of deformation of the unit during shipping must be ensured. If the machine is shipped with a wooden cross-plank on its base, this cross-plank must only be removed after the final destination has been reached.

Responsibility

The manufacturer declines all present and future responsibility for any damage to persons, animals or things caused by negligence of operators failing to follow the installation and maintenance instructions in this manual and/or the rules of good technical practice.

All safety equipment must be regularly and periodically checked in accordance with this manual and with local laws and regulations regarding safety and environment protection.

Safety

The machine must be secured to the ground.

It is essential to observe the following instructions:

- The machine can only be lifted using the lifting points indicated in Figure 2. These are the only points that can support the entire weight of the unit.
- Do not allow unauthorised and/or unqualified personnel to access the unit.
- It is forbidden to access the electrical components without having opened the unit's main switch and switched off the power supply.
- It is forbidden to access the electrical components without using an insulating platform. Do not access the electrical components if water and/or moisture are present.
- All operations on the refrigerant circuit and on components under pressure must be carried out by qualified personnel only.
- Replacement of a compressor must be carried out by qualified personnel only.
- Sharp edges could cause injury. Avoid direct contact.
- Switch off the unit's power supply, by opening the main switch, before servicing the compressors. Failure to observe this rule could result in serious personal injury.
- Avoid introducing solid objects into the water pipes while the machine is connected to the system.
- A mechanical filter must be installed on the water pipe connected to the heat exchanger inlet.
- The machine is supplied with safety valves, that are installed both on the high-pressure and on the low-pressure sides of the refrigerant circuit.

In case of sudden stop of the unit, follow the instructions on the **Control Panel Operating Manual** which is part of the on-board documentation delivered to the end user with this manual.

It is recommended to perform installation and maintenance with other people. In case of accidental injury or unease, it is necessary to:

- keep calm
- press the alarm button if present in the installation site
- move the injured person in a warm place far from the unit and in rest position
- contact immediately emergency rescue personnel of the building or if the Health Emergency Service
- wait without leaving the injured person alone until the rescue operators come
- give all necessary information to the the rescue operators

WARNING

Before carrying out any operation on the machine, please read carefully the instruction and operating manual. Installation and maintenance must be carried out by qualified personnel that is familiar with provisions of the law and local regulations and has been trained properly or has experience with this type of equipment.

WARNING

Avoid installing the chiller in areas that could be dangerous during maintenance operations, such as platforms without parapets or railings or areas not complying with the clearance requirements around the chiller.

Moving and lifting

Avoid bumping and/or jolting during unloading from the lorry and moving the unit. Do not push or pull the machine from any part other than the base frame. Secure the machine inside the lorry to prevent it from moving and causing damage to the panels and to the base frame. Do not allow any part of the unit to fall during transportation or unloading, as this could cause serious damage.

All units of the series are supplied with lifting points indicated in the figure below. Only these points may be used for lifting the unit, as shown in the following figure.

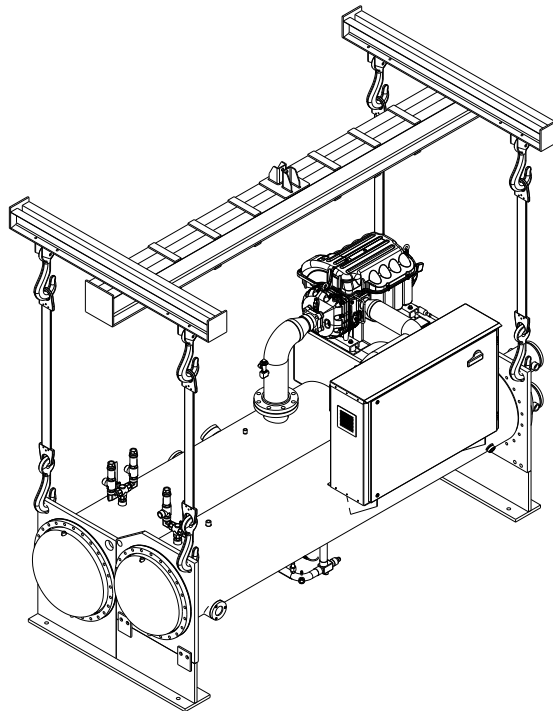


Figure 2 - Lifting the unit

This picture is for reference only. Lifting tools (bars, ropes, etc) are not supplied.

⚠ WARNING

Both the lifting ropes and the spacing bar and/or scales must be strong enough to support the machine safely. Please check the unit's weight on the machine's nameplate. The weights shown in the "Technical specifications" tables in the "Specifications" chapter refer to standard units. Specific units might have accessories that increase overall weight.

⚠ WARNING

The unit must be lifted with the utmost attention and care. Avoid jolting when lifting and lift unit very slowly, keeping it perfectly horizontal.

Positioning and assembly

All units are designed for installation indoors. The machine must be installed on a robust and perfectly level foundation; should the machine be installed on balconies or roofs, it might be necessary to use weight distribution beams. For installation on the ground, prepare a strong cement base that is at least 250 mm wider and longer than the machine. Also, this base must be strong enough to support the weight of the machine as stated in the technical specifications. If the machine is installed in places that are easily accessible to people and animals, it is advisable to install protection gratings for the compressor section.

To ensure the best possible performance on the installation site, the following precautions and instructions must be followed:

- Make sure to provide a strong and solid foundation to reduce noise and vibration as much as possible.
- The water in the system must be particularly clean and all traces of oil or rust must be removed. A mechanical water filter must be installed on the machine's inlet piping.

Minimum space requirements

Every side of the machine must be accessible for all post-installation maintenance activities.

In particular, service clearance has to be provided at one end of the unit for possible removal of evaporator and/or condenser tubes. Evaporator and condenser tubes are rolled into the tube sheets to permit replacement if necessary; the length of the vessel must be allowed at one end (doors or removable wall sections can be utilized).

Keep a free space to allow the opening of electrical panel doors.

Minimum clearance at all sides, including the top, is (1 meter); local regulation may require larger clearance.

Ventilation

The temperature of the room where the unit is placed should be always maintained between 0°C and 40°C.

Sound protection

When sound levels require special control, great care must be exercised to isolate the machine from its base by appropriately applying anti-vibration elements (supplied as an option). Flexible joints must be installed on the water connections, as well.

Vessel Drains at Start-up

The unit is tilted and drained of water in the factory and shipped with open drain valves in each head of the evaporator and condenser. Be sure to close the valves prior to filling the vessel with fluid.

Connections

All evaporators and condensers come standard with groove-type nozzles for Victaulic couplings (also suitable for welding), or optional flange connections. The installing contractor must provide matching mechanical connections of the size and type required.

Be sure that water inlet and outlet connections match certified drawings and stenciled nozzle markings.

Evaporator is totally symmetric with respect to the vertical plane, so inlet and outlet nozzles may be exchanged; in this case differential pressure switch connections have to be exchanged too.

Condenser has water inlet in the bottom nozzle and water outlet in the upper nozzle; exchanging this connection is not allowed (it will result in strong performance degradation, like subcooling reduction, up to real operation malfunctioning, like flash gas at the condenser outlet, or risks to the compressor due to insufficient motor cooling).

The water heads can be interchanged (end for end) so that the water connections can be made at either end of the unit. If this is done, use new head gaskets and relocate the control sensors.

Water piping

Piping must be designed with the lowest number of elbows and the lowest number of vertical changes of direction. In this way, installation costs are reduced considerably and system performance is improved.

The water system must have:

1. Anti-vibration mountings in order to reduce transmission of vibrations to the underlying structure.
2. Isolating valves to isolate the machine from the water system during service.
3. Manual or automatic air venting device at the system's highest point.; drain device at the system's lowest point. Neither the evaporator nor the heat recovery device must be positioned at the system's highest point.
4. A suitable device that can maintain the water system under pressure (expansion tank, etc.).
5. Water temperature and pressure indicators on the machine to assist the operator during service and maintenance.
6. A filter or device that can remove foreign particles from the water before it enters the pump (in order to prevent cavitation, please consult the pump manufacturer for the recommended type of filter). The use of a filter prolongs the life of the pump and helps keep the water system in a better condition.
7. Another filter must be installed on the machine inlet water pipe, near the evaporator and heat recovery (if installed). The filter prevents solid particles from entering the heat exchanger, as they could damage it or reduce its heat exchanging capacity.
8. The shell and tube heat exchanger has an electrical resistance with a thermostat that ensures protection against water freezing at ambient temperatures as low as -25°C. All the other water piping outside the machine must therefore be protected against freezing.
9. The heat recovery device must be emptied of water during the winter season, unless an ethylene glycol mixture in appropriate percentage is added to the water circuit.
10. If the machine is intended to replace another, the entire water system must be emptied and cleaned before the new unit is installed. Regular tests and proper chemical treatment of water are recommended before starting up the new machine.
11. In the event that glycol is added to the water system as anti-freeze protection, pay attention to the fact that suction pressure will be lower, the machine's performance will be lower and water pressure drops will be greater. All machine-protection systems, such as anti-freeze, and low-pressure protection will need to be readjusted.

Before insulating water piping, check that there are no leaks.

▲ ATTENTION

Install a mechanical filter on the inlet to each heat exchanger. Failure to install a mechanical filter allows solid particles and/or welding slag to enter the exchanger. Installation of a filter having a mesh size not exceeding 0,5 – 1 mm is advised.

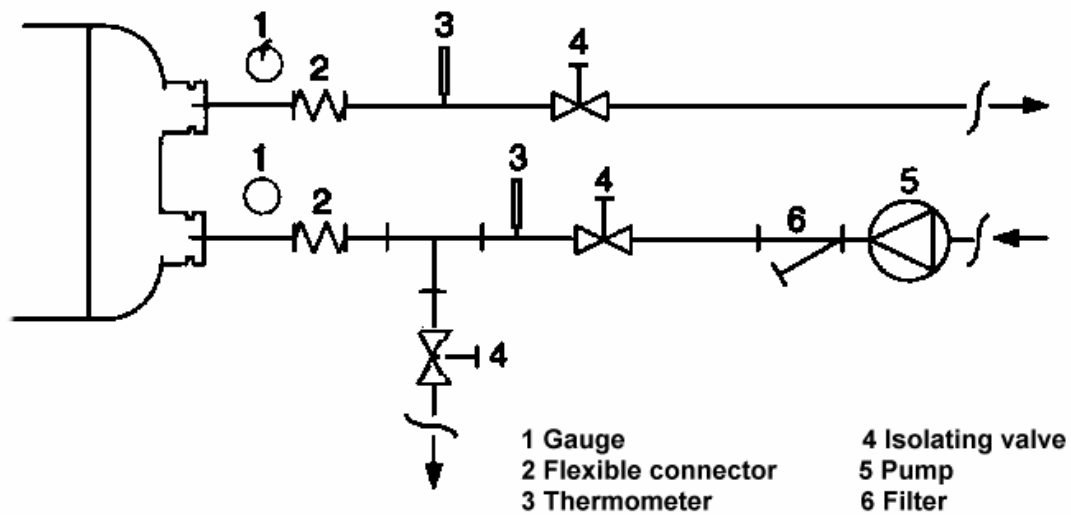
The manufacturer cannot be held responsible for any damage to exchangers ensuing from the lack of a mechanical filter.

Water treatment

Before putting the machine into operation, clean the water circuit. Dirt, scale, corrosion residue and other foreign material can accumulate inside the heat exchanger and reduce its heat exchanging capacity. Pressure drop can increase as well, thus reducing water flow. Proper water treatment therefore reduces the risk of corrosion, erosion, scaling, etc. The most appropriate water treatment must be determined locally, according to the type of system and local characteristics of the process water.

The manufacturer is not responsible for damage to or malfunctioning of equipment caused by failure to treat water or by improperly treated water.

Figure 3 - Water piping connection for evaporator and condenser



Legend translation

Gauge
Flexible connector
Flow switch
Thermometer
Isolating valve
Pump
Filter

Gauge
Flexible connector
Flow switch
Thermometer
Isolating valve
Pump
Filter

Table 1 - Acceptable water quality limits

pH (25°C)	6,8÷8,0	Total Hardness (mg CaCO ₃ / l)	< 200
Electrical conductivity μS/cm (25°C)	<800	Iron (mg Fe / l)	< 1.0
Chloride ion (mg Cl ⁻ / l)	<200	Sulphide ion (mg S ²⁻ / l)	None
Sulphate ion (mg SO ₄ ²⁻ / l)	<200	Ammonium ion (mg NH ₄ ⁺ / l)	< 1.0
Alkalinity (mg CaCO ₃ / l)	<100	Silica (mg SiO ₂ / l)	< 50

Evaporator exchangers anti-freeze protection

▲ ATTENTION

Neither the evaporator nor the condenser is self-draining and it has no heater installed. Both heat exchangers must be protected against freezing

Unless the heat exchangers are completely emptied and cleaned with anti-freeze solution, they have to be protected against freezing.

Two or more of below protection methods should be considered when designing the system as a whole:

1. Continuous water flow circulation inside piping and exchangers
2. Addition of an appropriate amount of glycol inside the water circuit
3. Additional heat insulation and heating of exposed piping
4. Emptying and cleaning of the heat exchanger during the winter season

ATTENTION

It is the responsibility of the installer and/or of local maintenance personnel to ensure that two or more of the described anti-freeze methods are used. Make sure that appropriate anti-freeze protection is maintained at all times. Failure to follow the instructions above could result in damage to some of the machine's components. Damage caused by freezing is not covered by the warranty.

Loss of flow protection

All chiller are equipped with redundant differential pressure switches factory mounted to protect evaporator and condenser from loss of flow

Cooling Towers

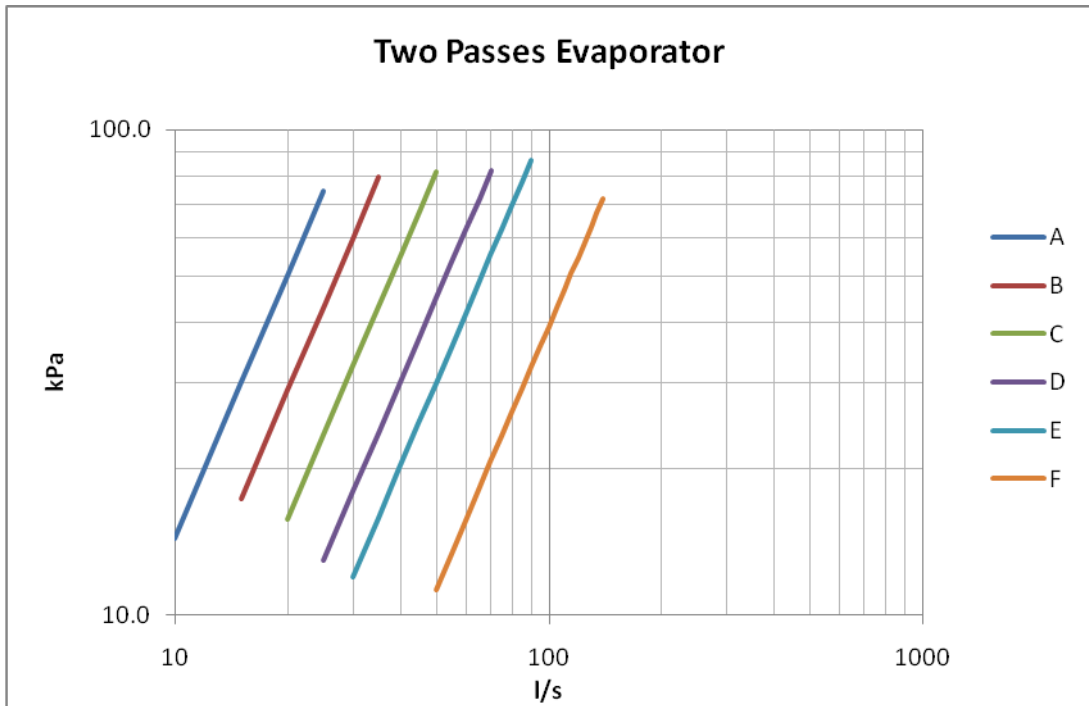
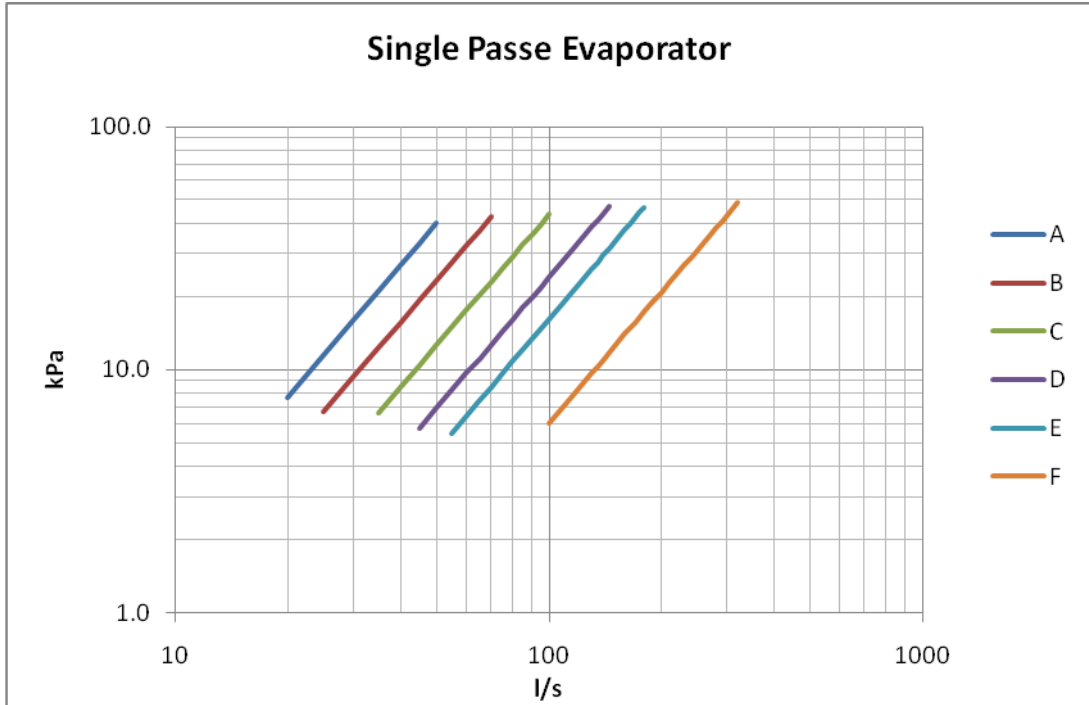
The condenser water flow rate must be checked to be sure that it conforms to the system design. A tower bypass valve, controlled by the unit controller, is required to control the minimum condenser entering temperature. Unless the system and chiller unit are specifically designed for them, *condenser bypass* or variable condenser flow is not recommended, since low condenser flow rates can cause unstable operation and excessive tube fouling.

Cooling towers are normally selected for condenser water inlet water temperatures between 24°C and 32°C.

ATTENTION

Tower water treatment is essential for continued efficient and reliable unit operation. If not available in-house, competent water treatment specialists should be contracted.

Figure 4 - Evaporator pressure drop



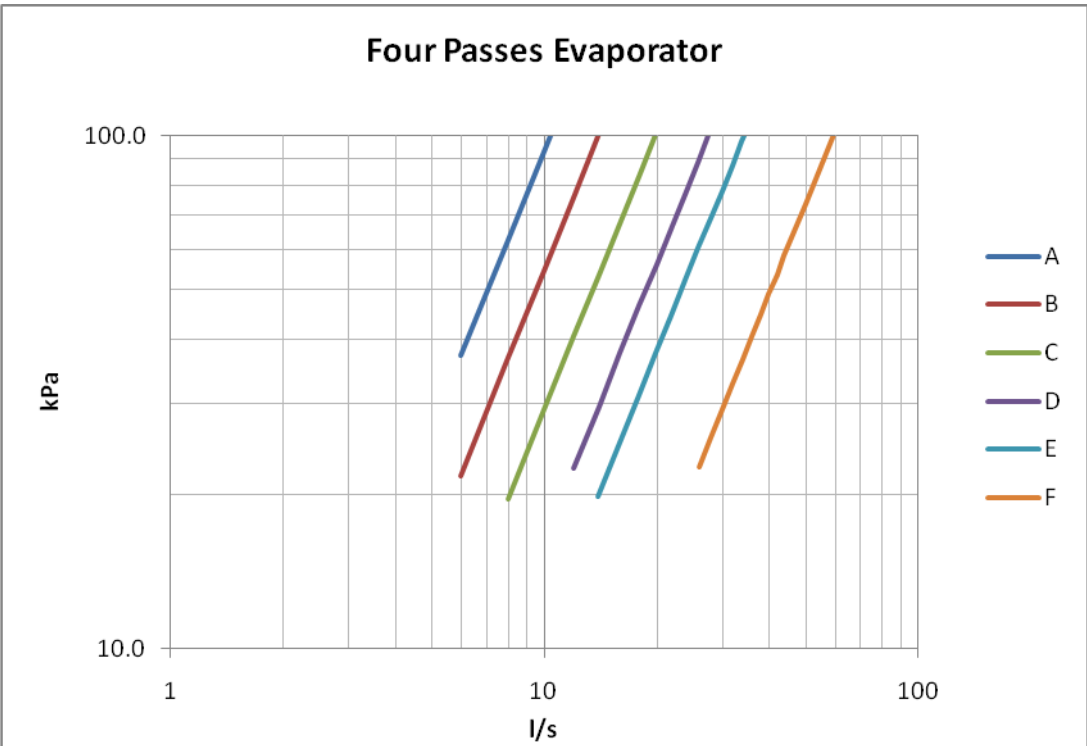
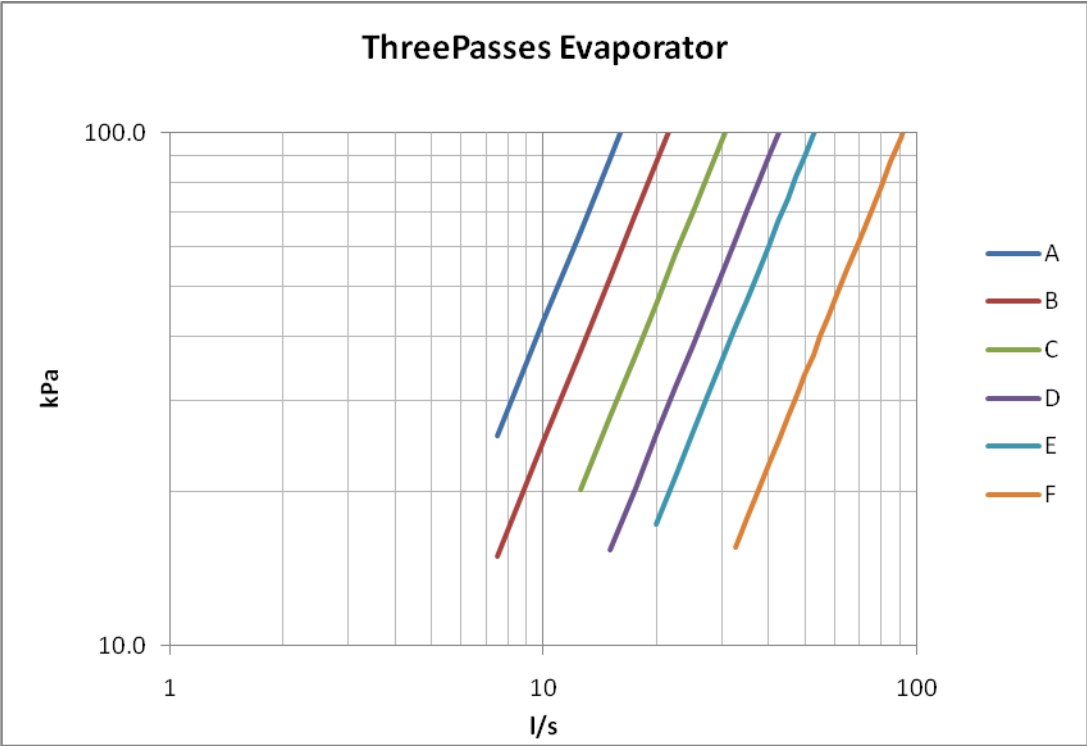
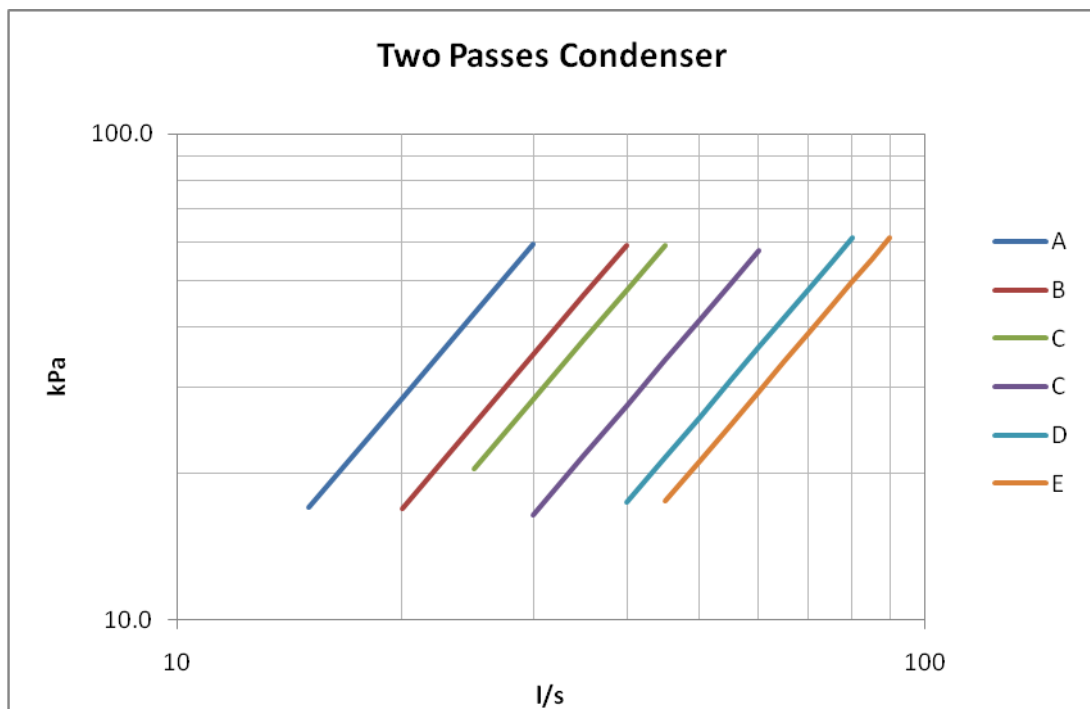
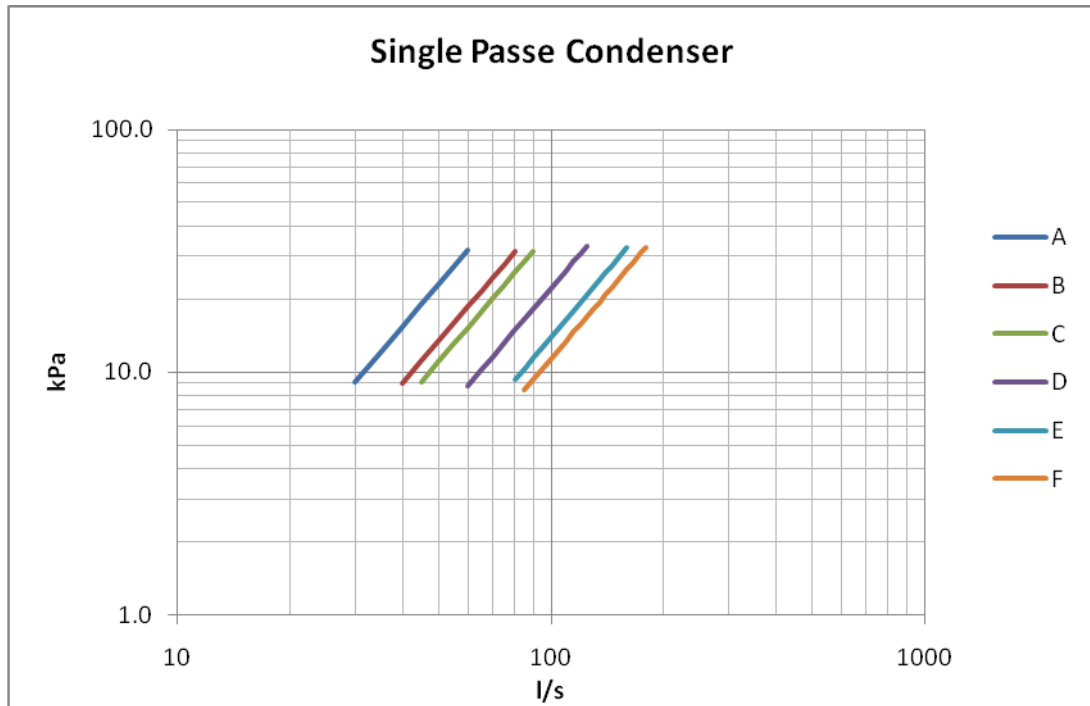


Figure 5 - Condenser pressure drop



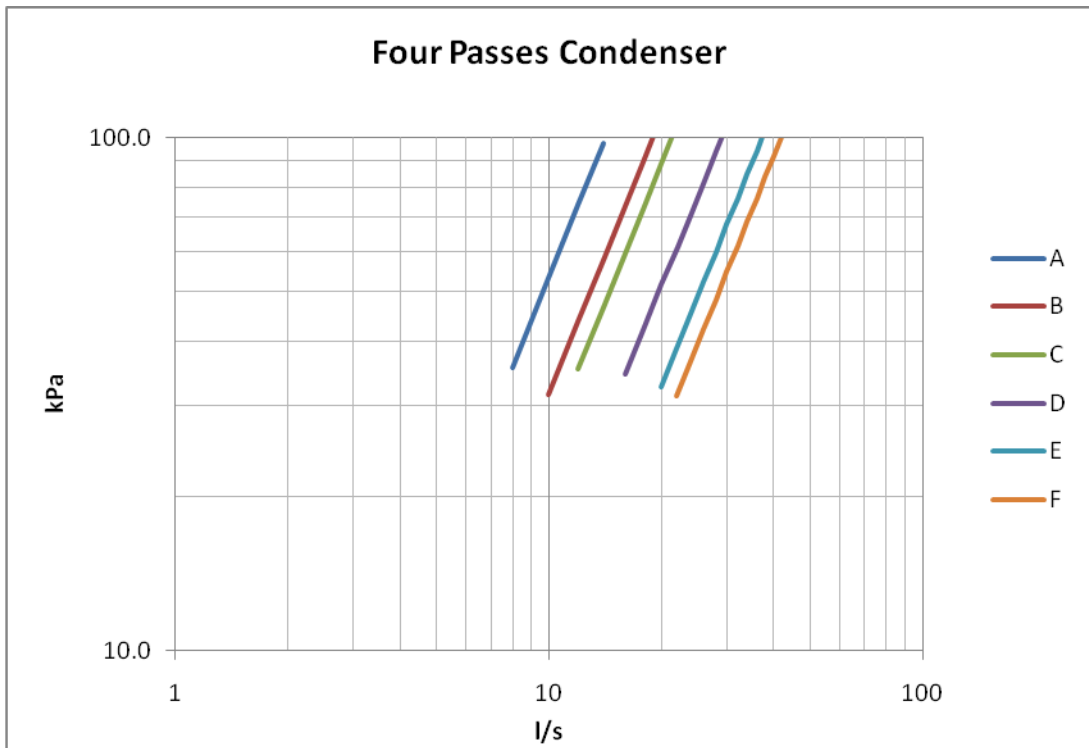
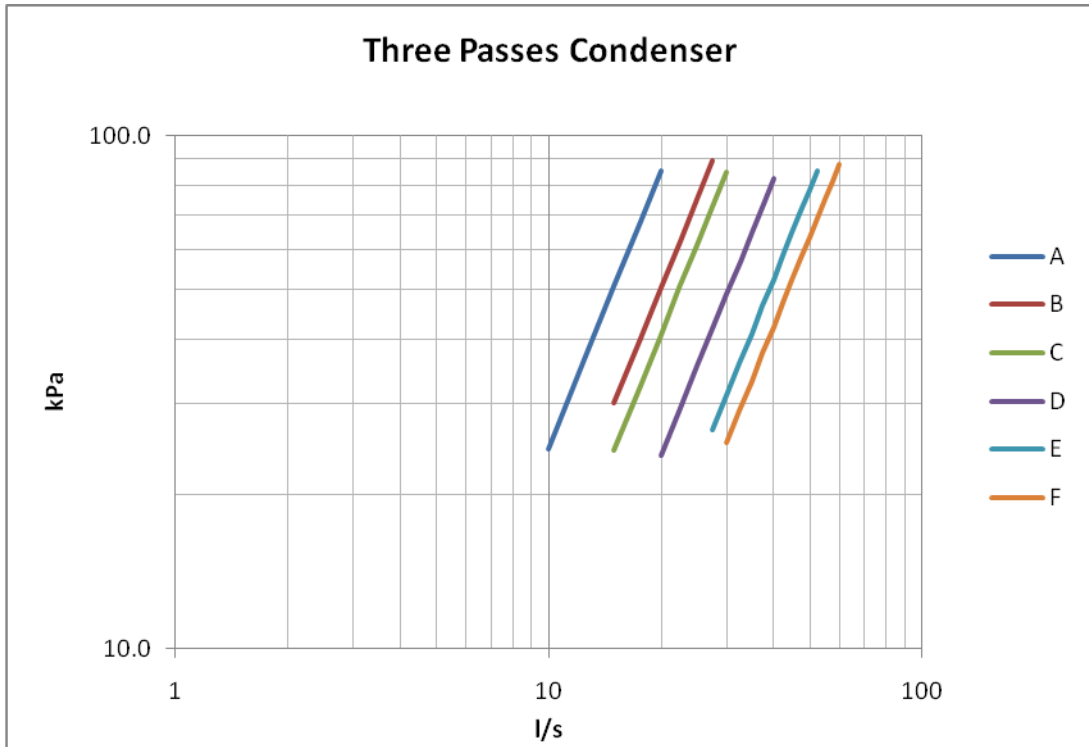


Figure 4 and 5 legend

Label	Size	Label	Size
A	320FZ	D	640FZ
B	430FZ	E	860FZ
C	520FZ	F	C10FZ

Refrigerating circuit safety valves

Each system comes with safety valves that are installed, both on the evaporator and on the condenser.
The purpose of the valves is to release the refrigerant inside the refrigerating circuit in the event of certain malfunctions.

⚠ ATTENTION

This unit is designed for indoor installation.

Check that there is sufficient air circulation through the machine.

Possible damage from inhalation of refrigerant gases must be avoided. Avoid releasing the refrigerant into the atmosphere.

The safety valves must be so connected to discharge outdoors. The installer is responsible for connecting the safety valves to the discharge piping and for establishing their size.

Electrical installation

General specifications

CAUTION

All electrical connections to the machine must be carried out in compliance with laws and regulations in force. All installation, management and maintenance activities must be carried out by qualified personnel. Refer to the specific wiring diagram for the machine that you have purchased and which was sent with the unit. Should the wiring diagram not appear on the machine or should it have been lost, please contact your nearest manufacturer office, who will send you a copy.

CAUTION

Only use copper conductors. Failure to use copper conductors could result in overheating or corrosion at connection points and could damage the unit. To avoid interference, all control wires must be installed separately from the power cables. Use separate electrical conduits for this purpose.

CAUTION

Before any installation and connection work, the system must be switched off and secured. The presence of capacitors within the VFD ensures there is voltage downstream of the inverters, even if the disconnecting switch is open, for several minutes. After switching off the unit, the intermediate circuit capacitors of the inverter are still charged with high voltage for a short period of time. The unit can be worked on again after it has been switched off for 10 minutes. Please consult the compressor manual for further details.

CAUTION

The units of the series are provided with non-linear high power electrical components (compressor VFD, which introduce higher harmonics) can cause considerable dispersion to earth, of about 2 A.

The electricity supply system protection must take the above values into account.

Table 2 - Electrical data

			320FZ	430FZ	520FZ	640FZ	860FZ	C10FZ	
Power Supply	Phase	---	3	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current	A	135	231	176	270	420	352	
	Nominal running current (1)	A	104	142	168	207	285	335	
	Maximum running current (2)	A	135	210	176	270	420	352	
	Maximum current for wires sizing	A	149	231	194	297	462	385	
Compressor	Phase	No.	3	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%	+10%
	Maximum running current (2)	A	135	210	176	135+135	210+210	176+176	
	Starting method	---	VFD						
Notes (1)	Unit absorbed current at the following nominal conditions: evaporator water temperature 12/7°C; condenser water temperature 30/35°C, unit at full load operation with maximum capacity								
Notes (2)	Unit maximum absorbed current regardless operating conditions								

EWWD FZ units use variable speed compressors that may operate at different rated conditions; the above listed electrical data are for reference only, please refer to selection to to have specific unit electrical data.

Electrical components

All power and interface electrical connections are specified in the wiring diagram that is shipped with the machine.

The installer must supply the following components:

- Power supply cables (dedicated conduit)
- Interconnection and interface cables (dedicated conduit)
- Suitable line protection devices (fuses or circuit breakers, please see electrical data)

Power Wiring

The standard power wiring connection to chillers is single-point. The electrical panel contains the main disconnect switch that isolates power to the unit when switched off. Compressor overload and short-circuit protection is accomplished by fuses installed in the electrical panel.

Proper phase sequence to the unit is not required as far as the unit operation is concerned. Correct motor rotation is established by the chiller control system regardless of the connected phase sequence.

All line-side wiring must be in accordance with local regulation and be made with copper wire and copper lugs only. The table below is a reference only for dimensioning protection devices and wiring. Due to different needs and local codes, the customer may select different components.

⚠ CAUTION

In installations with power supply lines longer than 50 metres, phase-to-phase and phase-to-earth inductive couplings between phases generate significant phenomena, namely:

- unbalancing of phase currents
- excessive voltage drop

In order to limit this phenomena, it is good practise to lay out the phase wires symmetrically, as described in the figure.



Fig. 1 - Installation of long power supply wires

Table 3 – Power Wiring recommended fuses and cables

Model	320FZ	430FZ	520FZ	640FZ	860FZ	C10FZ
Disconnect Switch Size	400 A	400 A	400 A	400 A	630 A	630 A
Short circuit rating (note 1)	10 kA	10 kA	10 kA	25 kA	25 kA	25 kA
Recommended Fuses	250 A gG	250 A gG	250 A gG	355 A gG	500 A gG	500 A gG
Maximum Wire Size (note 2)	2x150 mm ²	2x150 mm ²	2x150 mm ²	2x150 mm ²	2x240 mm ²	2x240 mm ²

Note 1:

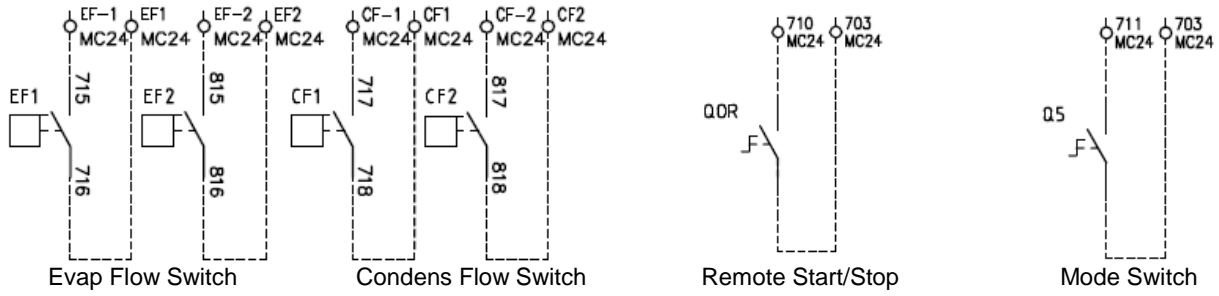
Short-circuit current ratings are referred to 0.25 s duration of short circuit. In case recommended fuses are installed on site for chiller protection, higher short circuit ratings can be achieved as they have a limiting effect.

Note 2:

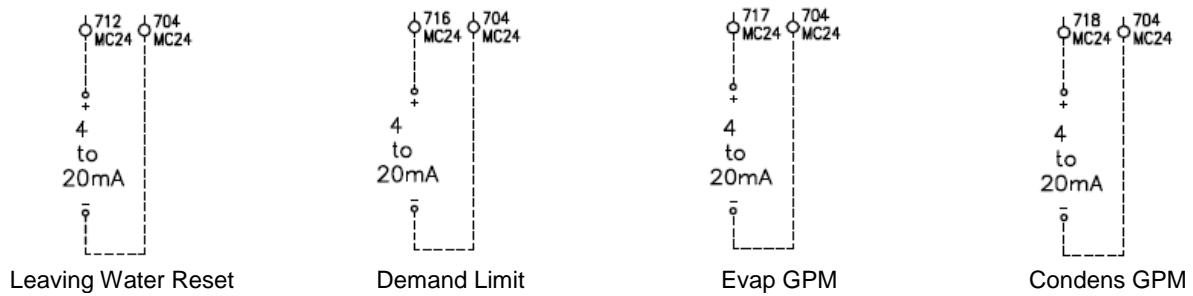
Maximum wire size is the maximum allowed by the disconnect switch terminals. In case a larger conductor size is needed, contact factory for asking special incoming lugs.

Figure 6 – Field wiring diagram

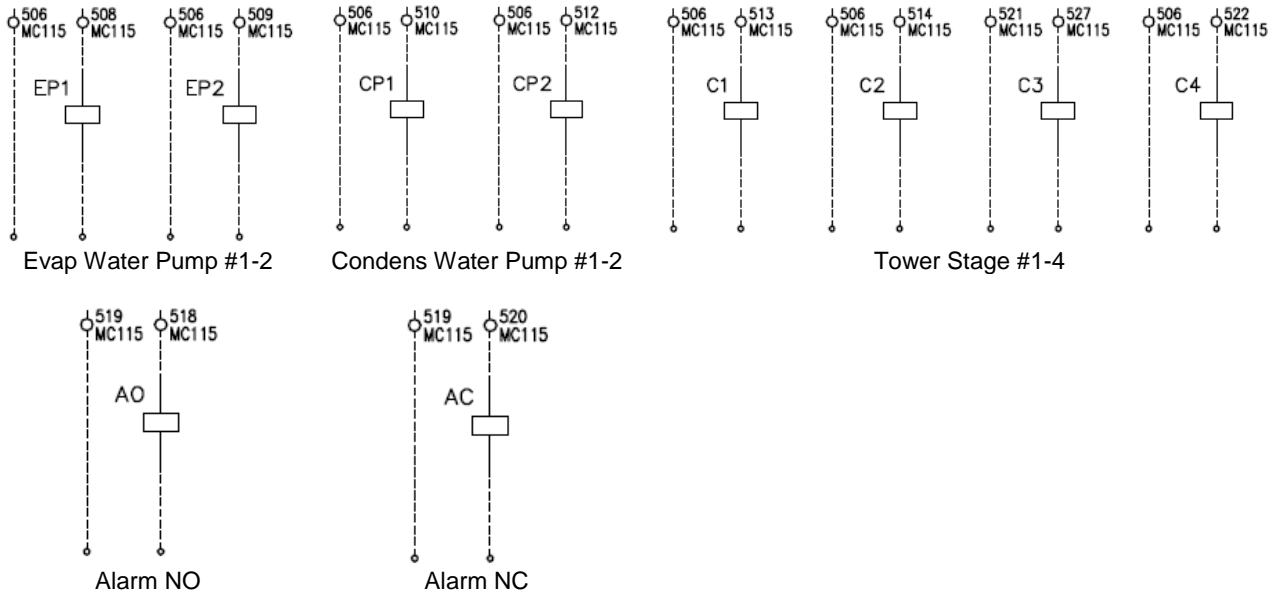
Digital Input Terminals



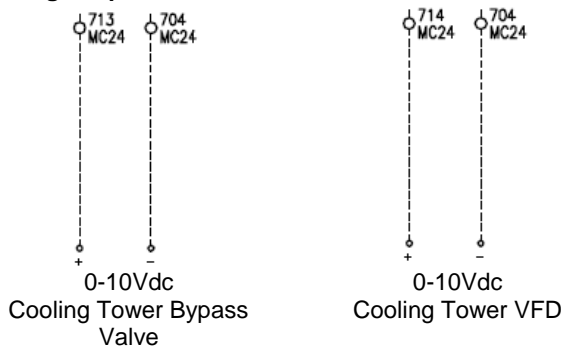
Analog Input Terminals



Digital Output Terminals



Analog Output Terminals



Field Wiring Diagram Notes

1. Power wiring between the terminal box and compressor terminals is factory installed.
2. Voltage unbalance not to exceed 2% with a resultant current unbalance of 6 to 10 times the voltage unbalance. Standard. Supply voltage must be +/- 10% of compressor nameplate voltage.
3. A customer furnished 115 Vac power for alarm relay coil may be connected between MC115 terminals 519 power and 506 neutral of the control panel. For normally open contacts wire between 518 and 519. For normally closed wire between 520 and 519. The alarm is operator programmable. Maximum rating of the alarm relay coil is 25VA.
4. Remote on/off control of unit can be accomplished by installing a set of dry contacts between MC24 terminals 710 and 703.
5. Customer supplied 115 VAC 20 amp power for optional evaporator and condenser water pump control power and tower fans is supplied to unit control terminals MC115 terminals 505 power and 506 neutral, PE equipment ground.
6. Optional customer supplied 115 VAC, 25-VA maximum coil rated, chilled water pump relay (EP1 & 2) may be wired as shown. This option will cycle the chilled water pump in response to chiller demand.
7. The condenser water pump must cycle with the unit. A customer supplied 115 VAC 25 VA maximum coil rated, condenser water pump relay (CP1 & 2) is to be wired as shown.
8. Optional customer supplied 115 VAC 25 VA maximum coil rated cooling tower fan relays (C1 - C4 optional) may be wired as shown. This option will cycle the cooling tower fans in order to maintain unit head pressure.
9. Optional Control Inputs. The following 4-20 mA optional inputs are connected as shown on MC24 terminals:
 - Demand Limit; Terminals 716 and 704 common
 - Chilled Water Reset; Terminals 712 and 704 common
 - Evaporator Water Flow; Terminals 717 and 704 common
 - Condenser Water Flow; Terminals 718 and 704 common
10. Optional Control Power Source. 115 Volt control power can be supplied from a separate circuit and fused at 20 A inductive load. Connection is to terminals 519 and 506 common on MC115.

Control Wiring

The control circuit on the is designed for 115 V. Control power is supplied from a factory-wired transformer located in the electrical box. Control wiring must be of suitable size in accordance with local regulations.

VFD Line Harmonics

Despite their many benefits, care must be taken when applying VFDs due to the effect of line harmonics on the building electric system. VFDs cause distortion of the AC line because they are nonlinear loads, that is, they don't draw sinusoidal current from the line. They draw their current from only the peaks of the AC line, thereby flattening the top of the voltage waveform. Some other nonlinear loads are electronic ballasts and uninterruptible power supplies.

Line harmonics and their associated distortion can be critical to ac-drives for three reasons:

1. Current harmonics can cause additional heating to transformers, conductors, and switchgear.
2. Voltage harmonics upset the smooth voltage sinusoidal waveform.
3. High-frequency components of voltage distortion can interfere with signals transmitted on the AC line for some control systems.

The harmonics of concern are the 5th, 7th, 11th, and 13th. Even harmonics, harmonics divisible by three, and high magnitude harmonics are usually not a problem.

Current Harmonics

An increase in reactive impedance in front of the VFD helps reduce the harmonic currents. Reactive impedance can be added in the following ways:

1. Mount the drive far from the source transformer.
2. Add line reactors. They are standard equipment on EWWF FZ chillers.
3. Use an isolation transformer.
4. Use a harmonic filter.

Voltage Harmonics

Voltage distortion is caused by the flow of harmonic currents through a source impedance. A reduction in source impedance to the point of common coupling (PCC) will result in a reduction in voltage harmonics. This can be done in the following ways:

1. Keep the PCC as far from the drives (close to the power source) as possible.
2. Increase the size (decrease the impedance) of the source transformer.
3. Increase the capacity (decrease the impedance) of the busway or cables from the source to the PCC.
4. Make sure that added reactance is "downstream" (closer to the VFD than the source) from the PCC.

Line Reactors

Five-percent line reactors are standard equipment on Magnitude chillers and located in each compressors power panel. They are employed to improve the power factor by reducing the effects of harmonics.

Harmonic Filter

The harmonic filter is an option for field mounting and wiring outside of the power panel. It works in conjunction with the line reactor to further minimize harmonic distortion. It is wired between a compressor's power supply and the circuit breaker (manual disconnect).

EMI (Electro Magnetic Interference) and RFI (Radio Frequency Interference) Filter

This filter is factory-installed. The terms EMI and RFI are often used interchangeably. EMI is actually any frequency of electrical noise, whereas RFI is a specific subset of electrical noise on the EMI spectrum. There are two types of EMI. Conducted EMI is unwanted high frequencies that ride on the AC wave form.

EMI

Radiated EMI is similar to an unwanted radio broadcast being emitted from the power lines. There are many pieces of equipment that can generate EMI, variable frequency drives included. In the case of variable frequency drives, the electrical noise produced is primarily contained in the switching edges of the pulse width modulation (PWM) controller.

As the technology of drives evolves, switching frequencies increase. These increases also increase the effective edge frequencies produced, thereby increasing the amount of electrical noise.

The power line noise emissions associated with variable frequency and variable speed drives can cause disturbances in nearby equipment. Typical disturbances include:

- Dimmer and ballast instability
- Lighting disturbances such as flashing
- Poor radio reception
- Poor television reception
- Instability of control systems
- Flow meter totalizing
- Flow metering fluctuation
- Computer system failures including the loss of data
- Thermostat control problems
- Radar disruption
- Sonar disruption

RFI

Three-phase filters are factory installed in the chiller electrical panel. They use a combination of high frequency inductors and capacitors to reduce noise in the critical 150 kHz to 30 MHz frequency range. The inductors act as open circuits and the capacitors act as short circuits at high frequencies while allowing the lower power line frequencies to pass untouched. The filters assist with cost effective compliance to Electro Magnetic Compatibility (EMC) directives, in a compact, efficient, light-weight design. The high common mode and differential mode reduction in the critical 150kHz to 30MHz frequencies assures that potential interference from AC drives is reduced or eliminated.

The filters are current-rated devices. In order to properly size a filter, it is necessary to know the operating voltage and the input current rating of the drive. No derating or re-rating is necessary when applying the filter at voltages that are less than or equal to the maximum voltage listed on the filter.

System Pumps

Operation of the chilled water pump can be to 1) cycle the pump with the compressor, 2) operate continuously, or 3) start automatically by a remote source.

The cooling tower pump must cycle with the machine. The holding coil of the cooling tower pump motor starter must be rated at 115 volts, 60 Hz, with a maximum volt-ampere rating of 100. A control relay is required if the voltage-ampere rating is exceeded. See the Field Wiring Diagram on page 30 or in the cover of control panel for proper connections.

All interlock contacts must be rated for no less than 10 inductive amps. The alarm circuit provided in the control center utilizes 115-volts AC. The alarms must not draw more than 10-volt amperes.

Multiple Chiller Setup

Dual compressor units have their main control components factory wired to an internal network so that the components can communicate with each other, within the chiller itself.

On multi-chiller applications, two chillers can be interconnected by simple field RS485 interconnecting wiring, the addition of an accessory communication isolation board(s) 485OPDR, and some MicroTech II control settings. The 485OPDR isolation board can be purchased with the unit or separately, during or after chiller installation. Only one board is required. Chillers cannot be interconnected with WSC, WDC, or WCC chillers.

Communication Setup

Interconnecting MicroTech II pLAN RS485 wiring should be installed by the installing contractor prior to start-up. The start-up technician will check the connections and make the necessary set point settings.

1. With no pLAN connections between chillers, disconnect chiller control power and set the DIP switches as shown in Table 3.
2. With all manual switches off, turn on control power to each chiller and set each OITS address.
3. Verify correct nodes on each OITS Service Screen.

- Connect chillers together (RS485 wiring) as shown in Figure 7. The first chiller in the connection can be designated as Chiller A. The isolation board is attached to the DIN rail adjacent to the Chiller A unit controller. The isolation board has a pigtail that is plugged into J10 on the controller. Most chillers will already have a universal communication module (UCM) that connects the controller to the touchscreen already plugged onto J10. If this is the case, plug the isolation module pigtail into the empty RJ11 pLAN port on the UCM. This is equivalent to plugging into the unit controller directly.

Next, interconnecting wiring is needed between Chiller A and Chiller B.

Interconnection: Belden M9841 (RS 485 Spec Cable) is wired from the 485OPDR isolation board (terminals A, B, and C) on Chiller A to the J11 port on the unit controller of Chiller B. At J11, the shield connects to GND, the blue/white wire to the (+) connection, and the white/blue to the (-) connection.

Note that Chiller B does not have, or need, an isolation board.

- Verify correct nodes on each OITS Service Screen.

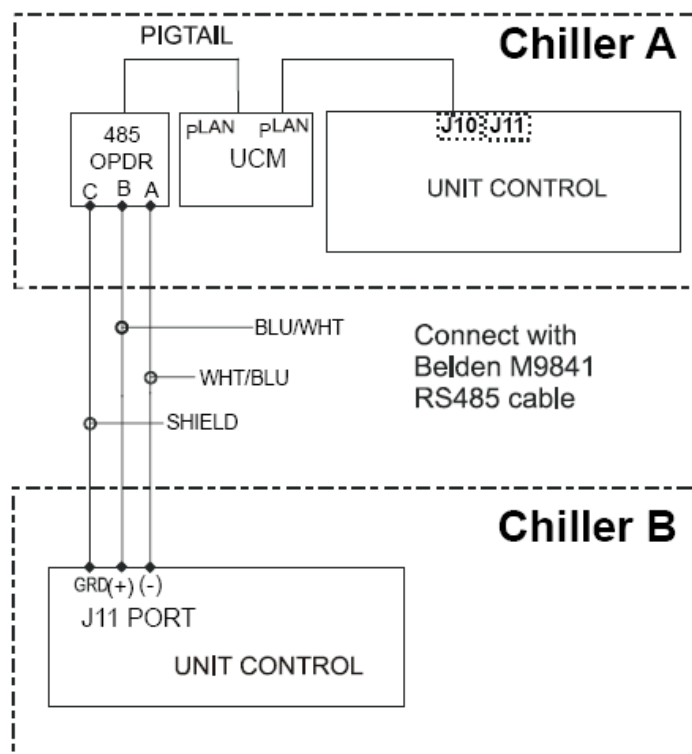
Table 4 - Electrical data

Chiller (1)	Comp 1 Controller	Comp 2 Controller	Unit Controller	Reserved	Operator Interface (2)	Reserved
A	1	2	5	6	7	8
	100000	010000	101000	011000	111000	000100
B	9	10	13	14	15	16
	100100	010100	101100	011100	111100	000010

Notes:

- Up to four single or dual compressors can be interconnected.
- The Operator Interface Touch Screen (OITS) setting is not a DIP switch setting. The OITS address is selected by selecting the 'service' set screen. Then, with the Technician level password active, select the 'pLAN Comm' button. Buttons A(7), B(15), C(23), D(31) will appear in the middle of the screen, then select the letter for the OITS address for the chiller that it is on. Then close the screen. Note that A is the default setting from the factory.
- Six Binary Switches: Up is 'On', indicated by '1'. Down is 'Off', indicated by '0'.

Figure 7 – Field wiring diagram



MicroTech II Operator Interface Touch Screen (OITS) Settings

Settings for any type of linked multiple compressor operation must be made to the MicroTech II controller. Settings on a dual compressor unit are made in the factory prior to shipment, but must be verified in the field before startup. Settings for multiple chiller installations are set in the field on the Operator Interface Touch Screen as follows:

Maximum Compressors ON – SETPOINTS - MODES screen, Selection #10 '= 2 for a dual, 4 for 2 duals, 3 for three separate, single compressor chillers, etc. If all compressors in the system are to be available as normal running compressors, then the value entered in #10 should equal the total number of compressors. If any compressors are for standby and not operated in normal rotation, they should not be included in the compressor count in Selection #10. The Max Comp ON setting can be made in only one touchscreen, the system will observe the highest number set on all chillers-it is a global setting.

Sequence and Staging – SETPOINTS - MODES screen, Selection #12 & #14; #11 & #13. Sequence sets the sequence in which compressors will start. Setting one or more compressors to "1" evokes the automatic lead/lag feature and is the normal setting. The compressor with least starts will start first and the compressor with maximum hours will stop first, and so on. Units with higher numbers will stage on in sequence.

The Modes setpoints will do several different types of operation (Normal, Efficiency, Standby, etc.) as described in the operating manual.

The same Modes setting must be replicated on each chiller in the system.

Nominal Capacity – SETPOINTS - MOTOR screen, Selection #14. The setting is the compressor design tons. Compressors on dual units are always of equal capacity.

Operating Sequence

For multiple-chiller, parallel operation, the MicroTech II controllers are tied together by a communications network and stage and control compressor loading among the chillers. Each compressor, single or dual compressor chiller, will stage on or off depending on the sequence number programmed into it. For example, if all are set to "1", the automatic lead/lag will be in effect.

When chiller #1 is fully loaded, the leaving chilled water temperature will rise slightly. When the Delta-T above setpoint reaches the Staging Delta-T, the next chiller scheduled to start will receive a start signal and start its pumps if they are set up to be controlled by the MicroTech II® controller. This procedure is repeated until all chillers are running. The compressors will load-balance themselves.

If any of the chillers in the group are dual compressor, they will stage and load according to the staging instructions.

See *Operating Manual (current edition)* for a complete description of the various staging sequences available.

Operation

Operator's responsibilities

It is important that the operator is appropriately trained and becomes familiar with the system before operating the machine. In addition to reading this manual, the operator must study the microprocessor operating manual and the wiring diagram in order to understand start-up sequence, operation, shutdown sequence and operation of all the safety devices. During the machine's initial start-up phase, a technician authorized by the manufacturer is available to answer any questions and to give instructions as to the correct operating procedures.

The operator is advised to keep a record of operating data for every installed machine. Another record should also be kept of all the periodical maintenance and servicing activities.

If the operator notes abnormal or unusual operating conditions, he is advised to consult the technical service authorized by the manufacturer.

Compressor Operation

The EEWD FZ compressors are two-stage. Suction gas enters the compressor through inlet guide vanes that can be opened and closed to control refrigerant flow as the cooling load changes. The suction gas enters the first stage impeller, is compressed, and travels through the vaned radial diffuser to the second stage impeller where compression is completed. The gas travels to the condenser via the discharge volute, which converts any remaining velocity pressure to static pressure.

Motor cooling is accomplished by utilizing the refrigerant effect of high-pressure liquid refrigerant from the condenser expanded to a gas within the compressor. The refrigerant cools VFD heat sinks and the motor.

A five-axis magnetic bearing system supports the motor/compressor shaft, resisting radial and thrust forces. The bearing control system uses shaft position feedback to continually adjust the bearing to keep the shaft in the correct position. In the event of a power failure, the compressor motor acts as a generator and powers the bearing support system during coastdown. There is also a system to gently de-levitate the shaft.

Many controls are mounted directly on the compressor where they monitor and control compressor operation. These compressor controls are interfaced with the conventional MicroTech II controls to provide a complete chiller control system.

System Water Volume

It is important to have adequate water volume in the system to provide an opportunity for the chiller to sense a load change, adjust to the change, and stabilize. As the expected load change becomes more rapid, a greater water volume is needed. The system water volume is the total amount of water in the evaporator, air handling products and associated piping. If the water volume is too low, operational problems can occur including rapid compressor cycling, rapid loading and unloading of compressors, erratic refrigerant flow in the chiller, improper motor cooling, shortened equipment life and other undesirable consequences.

Some of the things the designer should consider when looking at water volume are the minimum cooling load, the minimum chiller plant capacity during the low load period and the desired cycle time for the compressors.

Assuming that there are no sudden load changes and that the chiller plant has reasonable turndown, a rule of thumb of "liters of water volume equal to 120 to 180 times the chilled water flow rate in liter/sec" is often used.

For process applications where the cooling load can change rapidly, additional system water volume is needed. A process example would be a quenching tank. The load would be very stable until the hot material is immersed in the water tank. Then, the load would increase drastically. For this type of application, system volume may need to be increased.

Since there are many other factors that can influence performance, systems may successfully operate below these suggestions. However, as the water volume decreases below these suggestions, the possibility of problems increases.

Variable Speed Pumping

Variable water flow involves inversely changing the water flow through the evaporator as the load changes. Chillers are designed for this duty provided that the rate of change in water flow is slow and the minimum and maximum flow rates for the vessel, as shown in the vessel pressure drops figures, are not exceeded.

The recommended maximum change in water flow is 5% of the allowable flow change per minute. Flow is usually not reduced below 50 percent of design flow (provided vessel minimum flow rates are not exceeded).

MicroTech II Control

Chillers are equipped with the MicroTech II control system consisting of:

- Operator interface touchscreen panel with a 15-inch Super VGA color screen.
- Control Panel containing the MicroTech II unit controller, two MicroTech II compressor controllers with connections to the compressor-mounted controls, and various switches and field connection terminals.

Operating instructions for the MicroTech II controller are contained in Operating Manual.

Use with On-Site Generators

Chillers are operated with variable frequency drives. These features make them especially appropriate for use in applications where they may be required to run with on-site electrical generators. This is particularly true when the generators are used for temporary power when the utility power is lost.

Generator Sizing: Gas and diesel generators are sensitive to the compressor's locked-rotor characteristics when the chillers start up. Use the electrical data supplied with the performance output sheet for generator sizing purposes. The chiller data sheet will show the RLA, which is for both compressors. Refer to Electrical Data to determine the LRA, based on the RLA. It is important to size the generator to handle the LRA at start up.

Starting/Stopping Procedure: The stopping of the chiller in the event of a power failure should be uneventful. The chiller will sense a loss of voltage and the compressors will stop, coasting down using power generated from their dynamic braking to maintain the bearing magnetic field. The stop signal will initiate a three-minute stop-to-start timer, effectively preventing compressor restart for three minutes. The timer is adjustable from three to fifteen minutes; the recommended default value is three minutes. This interval allows the generator sufficient time to get up to speed and stabilize. The chiller will restart automatically when the start-to-start timer expires.

Transfer Back to Grid Power: Proper transfer from stand-by generator power back to grid power is essential to avoid compressor damage.

⚠ ATTENTION

Stop the chiller before transferring supply power from the generator back to the utility power grid. Transferring power while the chiller is running can cause severe compressor damage.

The necessary procedure for reconnecting power from the generator back to the utility grid is shown below. These procedures are not peculiar to Daikin units only, but should be observed for any chiller manufacturer.

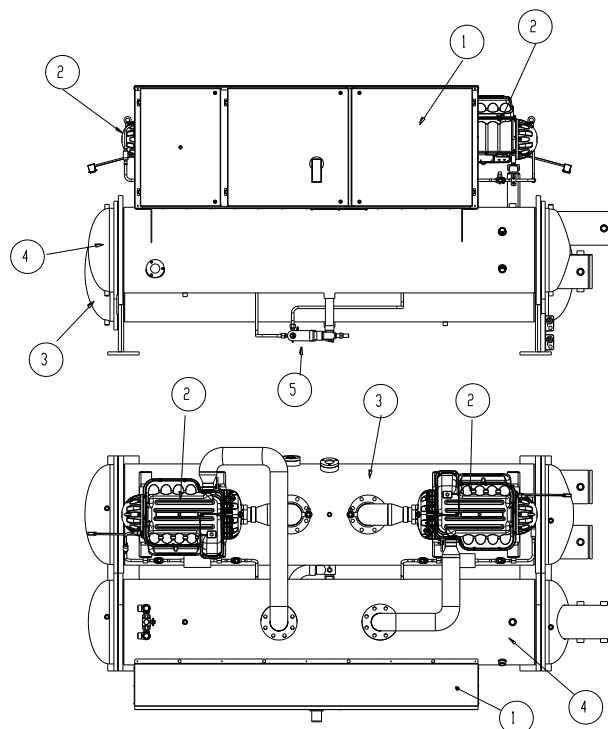
1. Set the generator to always run five minutes longer than the unit start-to-start timer, which could be set from 15 to 60 minutes. The actual setting can be viewed on the operator interface panel on the Setpoint/Timer screen.
2. Configure the transfer switch, provided with the generator, to automatically shut down the chiller before transfer is made. The automatic shut-off function can be accomplished through a BAS interface or with the "remote on/off" wiring connection. A start signal can be given anytime after the stop signal since the three-minute start-to-start timer will be in effect.

Chiller Control Power: For proper operation on standby power, the chiller control power must remain as factory-wired from a unit-mounted transformer. Do not supply chiller control power from an external power source because the chiller may not sense a loss of power and do a normal shutdown sequence.

Unit description

This machine, of the water-cooled condenser type, is made up of the following main components:

Figure 8 – Unit main components



1. **Electrical panel:** Contains all electrical (main disconnect, inductances, filters, fuses) and electronic components.
2. **Compressors:** State of the art frictionless two-stages centrifugal compressor, magnetic bearing, of the Dafoos Turbocor series
3. **Evaporator:** Flooded shell and tube heat exchanger for all models, with chilled water flowing inside tubes and refrigerant changing phase from liquid to vapour shellside.
4. **Condenser:** Flooded shell and tube heat exchanger for all models, with cooling water flowing inside tubes and refrigerant changing phase from vapour to liquid shellside.
5. **Expansion valve:** An electronic expansion valve, which is controlled by an electronic device, that optimises its operation keeping the refrigerant mass flow at the right value

Description of the refrigeration cycle

The low-temperature refrigerant gas from the evaporator is drawn by one or two centrifugal compressors and compressed. The high-pressure refrigerant gas is sent to the condenser where, flowing shell-side, the superheated refrigerant vapour cools down and starts to condense and then the liquid is subcooled in the lower part of the condenser.

The heat taken from the fluid during the de-superheating, condensation and subcooling phase is transferred to the cooling water.

The subcooled fluid flows the expansion element valve and pressure drops resulting in the vaporisation of part of the refrigerant liquid.

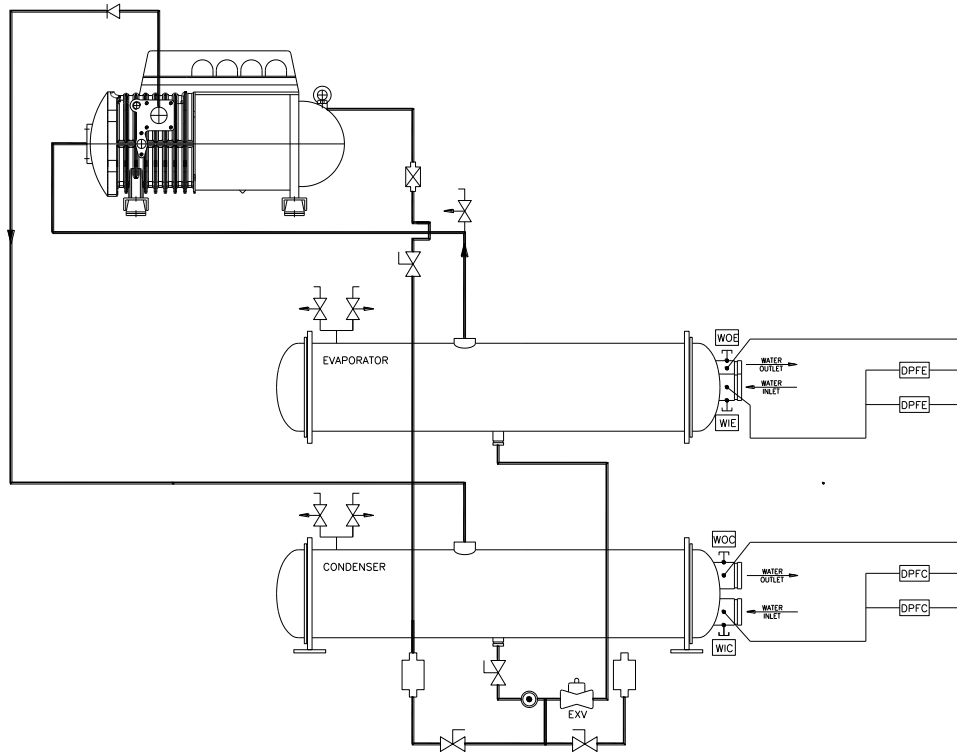
The result at this point is a low-pressure and low-temperature liquid-gas mixture entering the evaporator, where, flowing shell-side, it takes the heat required for vaporisation exchanging heat with the water to be cooled, thus reducing the water temperature.

Once it has reached the superheated-vapour state, the refrigerant leaves the evaporator and is once again taken into the compressor to repeat the cycle.

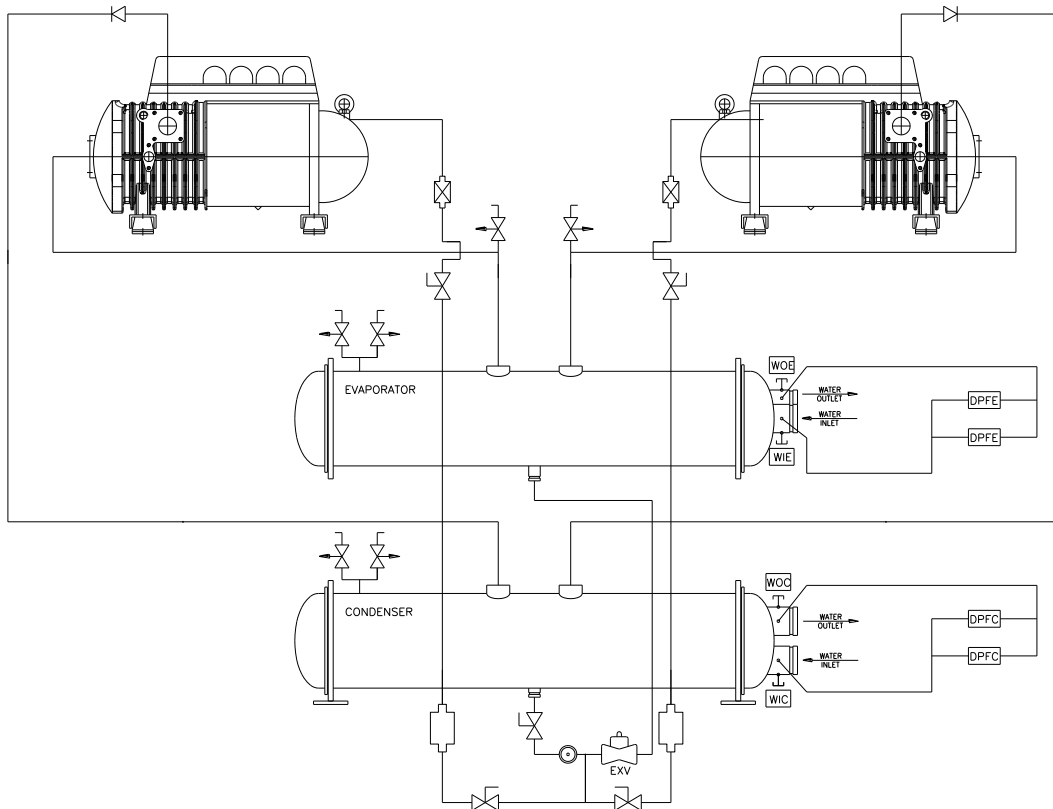
A small amount of liquid refrigerant is drawn by the condenser and sent to the compressor for the cooling of the motor; to valves located in the compressor motor control the motor temperature

Figure 9 - Refrigeration cycle


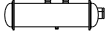
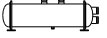









a) Single compressor unit



b) Dual compressor unit



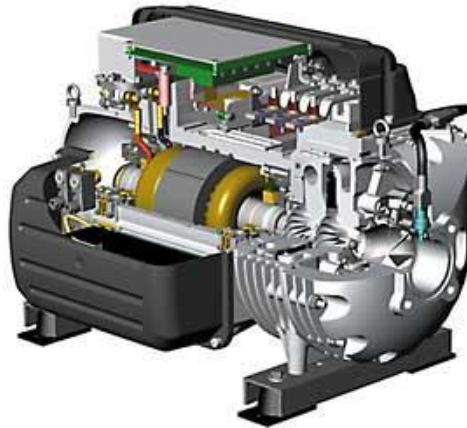
Legend

	Compressor
	Evaporator
	Condenser
	Drier filter
	Electronic expansion valve
	Sight glass
	Evaporator and condenser differential pressure switches
	Safety valve
	Valve
	Mechanical filter
	1/4 flare connection
	Check valve
WOC	Condenser leaving water centerature sensor
WIC	Condenser water inlet temperature sensor
WOE	Evaporator leaving water centerature sensor
WIE	Evaporator water inlet temperature sensor

Compressor

Daikin EWWD FZXS chiller use Danfoss Turbocor family of compressors (TT300, TT350 and TT400), a totally oil-free compressors, specifically designed HVAC industry. The convergence of proven magnetic bearing, variable-speed centrifugal compression and digital electronic technologies enables the Turbocor family of compressors to achieve the highest compressor efficiencies for middle-market chillers.

Figure 10 – Turbocor compressor

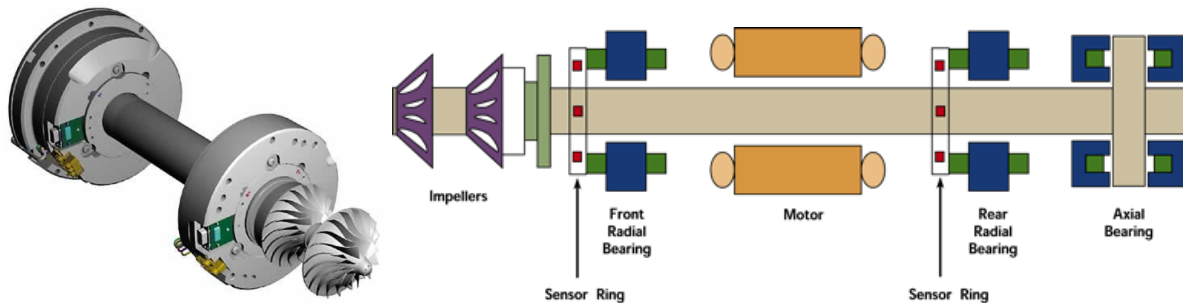


The Danfoss Turbocor family of compressors' rotor shafts and impellers levitate during rotation and float on a magnetic cushion.

Two radial and one axial magnetic bearing are employed. Bearing sensors feed back real-time orbit information to digitally controlled bearings. Centered rotation is instantaneously self-corrected and maintained.

When not powered, the rotor is supported by carbon composite, touchdown bearings designed for years of use.

Figure 11 – Turbocor shaft and magnetic bearing



The compressor speed adjusts to changes in load and/or condensing temperature. As compressor speed reduces due to lower loads and /or condensing temperatures, energy consumption dramatically reduces. Part load energy efficiency is outstanding.

Turbocor family of compressors are the world's first "smart" compressors. Microprocessors proactively manage compressor operation, self-diagnosis and correction are built in.

Centrifugal compression offers higher aerodynamic efficiency compared to any other compressor designs.

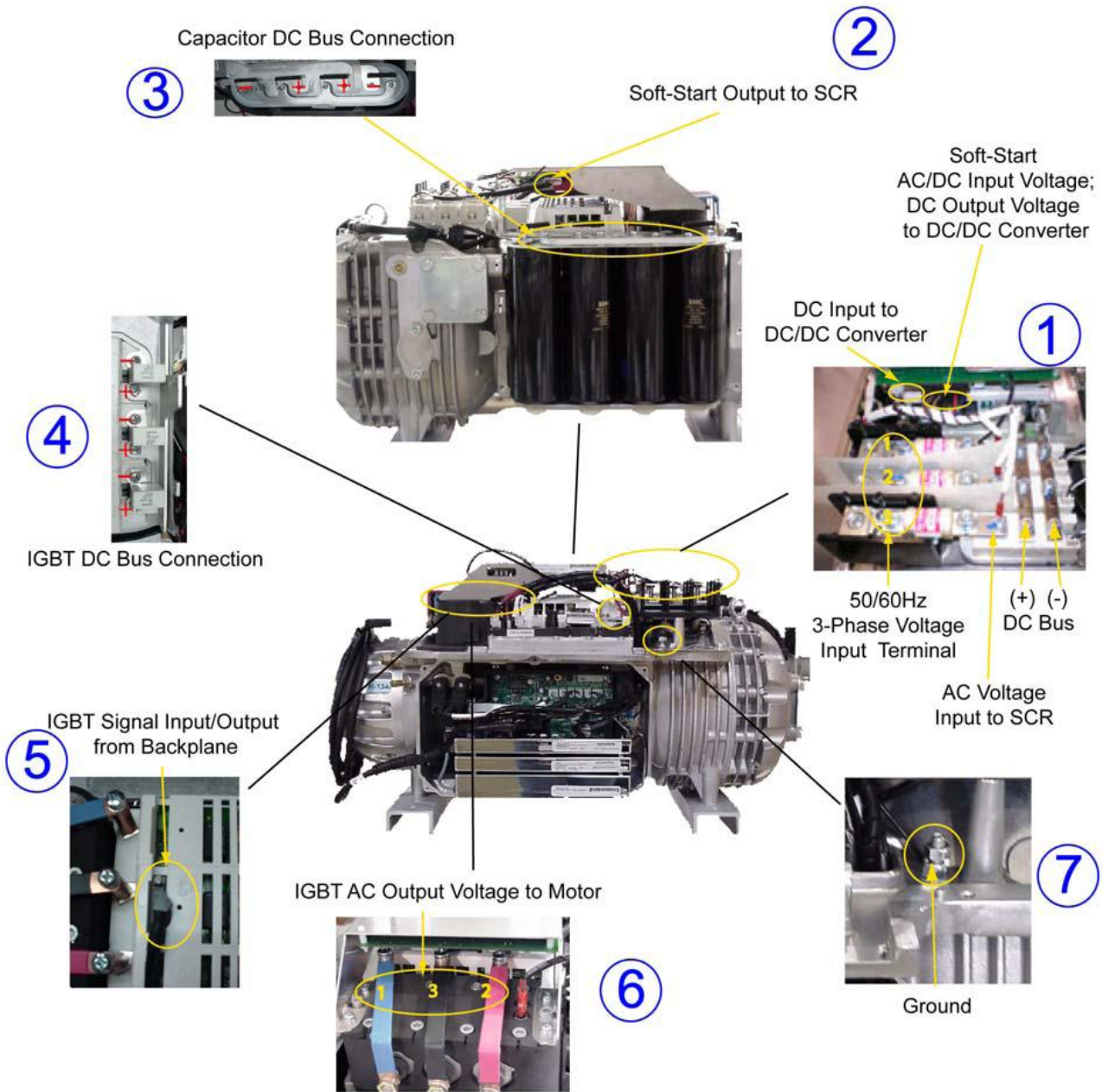
Variable-speed drive provides best part load efficiency, and operates most effectively with centrifugal compression.

Compressor has one main moving part, the two impellers are keyed directly to the motor rotor.

Compressor has two stages of centrifugal with the potential to incorporate an economizer cycle.

- **Compressor** - Semi-hermetic design.
- **Main Housing** - Dimensionally-stabilized aluminum.
- **Covers** - High-impact, UV-stabilized, flame-resistant polymer.
- **Shaft** - High-strength alloy.
- **Impellers** - High-strength aluminum.
- **Motor** - Permanent magnet, synchronous.
- **Bearings** - Integrated, digitally-controlled, magnetic.
- **Compressor Control** - Integrated, digital capacity control.
- **Enclosure** - IP54 rating.

Figure 12 – Compressor overview



Pre-startup checks

General

Once the machine has been installed, use the following procedure to check that it has been done properly:

ATTENTION

Switch off the power supply of the machine before performing any checks.

Since there are dc link electrolytic capacitors inside the VFD, there is voltage downstream of the inverter for several minutes after the electricity supply has been switched off. Wait at least 10 minutes before working on the unit. In case of doubt, consult the compressor manual instructions.

Failure to respect these rules (cutting off power and failing to wait) can cause the operator serious harm or even death.

Inspect all the electrical connections to the power circuits and to the compressors including the contactors, fuse carriers and electrical terminals and check that they are clean and well secured. Even though these checks are carried out at the factory on every machine that is shipped, vibrations during transportation may loosen some electrical connections.

ATTENTION

Check that the electrical terminals of cables are well tightened. A loose cable can overheat and give rise to problems with the compressors.

Open discharge, liquid, liquid injection and suction (if installed) valves.

ATTENTION

Do not start up the compressors if the delivery, liquid, liquid injection or suction valves are closed. Failure to open these valves may cause serious damage to the compressor.

Check the power supply voltage at the general door-block disconnect switch terminals. The power supply voltage must be the same as that on the nameplate. Maximum allowed tolerance $\pm 10\%$.

Voltage unbalance between the three phases must not exceed $\pm 3\%$.

Fill the water circuit and remove air from the system's highest point and open the air valve above the evaporator shell. Remember to close it again after filling. The design pressure on the water side of the evaporator is 10.0 bar. Never exceed this pressure at any time during the life of the machine.

IMPORTANT

Before putting the machine into operation, clean the water circuit. Dirt, scaling, corrosion residue and other foreign material can accumulate in the heat exchanger and reduce heat transfer capacity. Pressure drops can also increase, consequently reducing water flow. Thus, correct water treatment reduces the risk of corrosion, erosion, scaling, etc. The most appropriate water treatment must be established locally according to the type of installation and local characteristics of the process water.

The manufacturer is not responsible for damage or bad operation of the apparatus resulting from failure to treat water or from incorrectly treated water.

Start the water pump and check the water system for any leaks; repair these if necessary. While the water pump is in operation, adjust the water flow until the design pressure drop for the evaporator is reached.

Switch off the main Q10 door-lock switch on the front door and move the Q12 switch to the On position.

ATTENTION

From this moment onwards, the machine will be under electrical power. Use extreme caution during subsequent operation.

A lack of attention during subsequent operation may cause serious personal injury.

Electrical power supply

The machine's power supply voltage must be the same as that specified on the nameplate $\pm 10\%$ while the voltage unbalance between phases must not be in excess of $\pm 3\%$. Measure the voltage between phases and if the value does not fall within the established limits, correct it before starting the machine.

▲ ATTENTION

Provide suitable power supply voltage. Unsuitable power supply voltage could cause malfunction of the control components and undesired triggering of the thermal protection devices, along with a considerable reduction in the life of the contactors and electric motors.

Unbalance in power supply voltage

In a three-phase system, excessive unbalance between the phases causes overheating of the motor. The maximum allowed voltage unbalance is 3%, calculated as follows:

$$\text{Unbalance \%: } \frac{V_{MAX} - V_{AVG}}{V_{AVG}} \cdot 100 = \text{ _____\%}$$

AVG = average

Example: the three phases measure respectively 383, 386 and 392V, the average is:

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

thus the unbalance percentage is

$$\frac{392-387}{387} \cdot 100 = 1,29\% \quad \text{below the maximum allowed (3\%)}$$

Prestart System Checklist

Chilled Water

- Piping complete.....
- Water system filled, vented.....
- Pumps installed, (rotation checked), strainers cleaned.....
- Controls (3-way, face and bypass dampers, bypass valves, etc.) operable
- Strainer installed at evaporator inlet.....
- Water system operated and flow balanced to meet unit design requirements

Condenser Water

- Cooling tower flushed, filled and vented
- Pumps installed, (rotation checked), strainers cleaned
- Strainer installed at condenser inlet.....
- Controls (3-way, bypass valves, etc.) operable
- Water system operated and flow-balanced to meet unit requirements

Electrical

- Power leads connected to the unit power panel(s)
- All interlock wiring complete between control panel and complies with specifications
- Pump starters and interlock wired
- Cooling tower fans and controls wired
- Wiring complies with local codes
- Condenser pump starting relay (CWR) installed and wired

Miscellaneous

- Relief valve piping complete
- Thermometer wells, thermometers, gauges, control wells, controls, etc., installed
- Minimum system load of 80% of machine capacity available for testing and adjusting controls
- Control wiring between multiple units, if applicable.....

Note: This checklist must be completed and sent to the local Factory Service location two weeks prior to start-up.

Operation

Capacity Control System

The capacity of the chiller is controlled by:

1. Staging the compressors on and off;
2. By adjusting the capacity of each compressor by opening or closing the inlet vanes to control the quantity of refrigerant entering the impeller; and,
3. Varying compressor speed to change capacity.

The speed control and vane control work in conjunction. As load decreases, compressor speed is reduced as low as possible but above the point where stall might begin. If further capacity reduction is required, the guide vanes will close to whatever position is required to match the compressor capacity to the load.

Surge and Stall

Stall and surge are a characteristic of all centrifugal compressors. These conditions can occur at low load conditions when the operating point moves to the left of the compressor surge line on the performance curve.

In surge, the discharge gas alternately flows backward and forward through the impeller reversing about every two seconds. Increased noise, vibration and heat occur and motor current varies widely. Surge can damage a compressor. The compressors are equipped with safety features that help prevent surge from occurring.

Another instability is stall or incipient surge, which occurs a little to the left, or before, the surge condition. Discharge gas in the diffuser forms rotating stall pockets or cells. The compressor sound level will change and the impeller starts to heat up. Motor current remains steady.

Normal Unit Startup/Shutdown

Startup and shutdown, other than seasonal shutdowns, are considered to be normal operation and the following procedures apply (assuming that the equipment room temperature are above freezing). The procedures would be used for a weekend shutdown, for example.

Note that the chiller is part of an entire building heating and cooling system that are usually unique to a particular site. For example, the chilled water loop and chilled water pump can also be used for heating and therefore must be operational year-around. The cooling tower can be used for other equipment besides the chiller and may have to remain functional even though the chiller is not. The following procedures, therefore, must take the peculiarities of the entire system into account.

Shutdown

If the unit is to be secured for several days, and is already off due to lack of load, the UNIT switch in the Unit Control Panel (and the remote Start/Stop switch, if used) should be placed in the OFF position. If the chilled water pump and cooling tower are not required for other purposes, they too can be turned off. If the pumps are controlled by the unit controller, they will shut down after the compressors.

If the chiller is running, the chilled water and condenser water pumps must remain on until the compressors are stopped. This is true regardless of how the unit is turned off, whether by the local switches or through a remote signal. The compressors go through a short shutdown sequence, shutting guide vanes and performing other functions, before it finally stops. The pumps must remain on during this shutdown period.

Once the compressors and pumps have stopped, no further action is required other than opening disconnects, if so desired.

Startup

Any disconnects that were opened must be closed. The chilled water pump and cooling tower should be turned on and flow verified. The chiller can then be started by placing the UNIT switch (and the remote Start/Stop switch, if used) in the ON position. There is no lube warm-up period required. The compressors go through a starting sequence and may not start immediately. Once started, it is prudent to observe unit operation on the operator interface screen for several minutes to check for normal functioning.

Start/Stop Switching

There are four ways to start/stop the chiller. Three are selected in SETPOINT\ MODE\SP3, the fourth way is through panel-mounted switches:

1. **Operator Interface Panel**, (LOCAL) Home Screen 1 has AUTO and STOP buttons that are only active when the unit is in "LOCAL CONTROL". This prevents the unit from being accidentally started or stopped when it is under control from a remote switch or BAS. When these buttons are pressed, the unit will cycle through its normal starting or stopping sequence, both compressors will be stopped and normal dual compressor starting procedure will be in effect.
2. **Remote SWITCH**, Selecting SWITCH in SP3 will put the unit under the control of a remote switch that must be wired into the control (see Field Wiring Diagram)

3. **BAS**, BAS input is field-wired into a communication module that is factory-installed on the unit controller.
4. **Control Panel Switches** Three On/Off switches are located in the main Control Panel and have the following function:
 - UNIT shuts down the chiller through the normal shutdown cycle of unloading the compressors.
 - COMPRESSOR one switch for each compressor on the unit, executes an immediate shutdown without the normal shutdown cycle.
 - CIRCUIT BREAKER disconnects optional external power to system pumps and tower fans.

A fourth switch located on the left outside of the Unit Control Panel and labeled EMERGENCY STOP SWITCH stops the compressor immediately. It is wired in series with the COMPRESSOR On/Off switches.

Annual Unit Startup/Shutdown

Annual Shutdown

Where the chiller can be subject to freezing temperatures, the condenser and chiller must be drained of all water. Dry air blown through the condenser will aid in forcing all water out. Removal of condenser heads is also recommended. The condenser and evaporator are not self-draining and tubes must be blown out. Water permitted to remain in the piping and vessels can rupture these parts if subjected to freezing temperature.

Forced circulation of antifreeze through the water circuits is one method of avoiding freeze up.

1. Take measures to prevent the shutoff valve in the water supply line from being accidentally turned on.
2. If a cooling tower is used and if the water pump will be exposed to freezing temperatures, be sure to remove the pump drain plug and leave it out so any water that can accumulate will drain away.
3. Open the compressor disconnect switch. Set the manual COMPRESSOR and UNIT ON/OFF switches in the Unit Control Panel to the OFF position.
4. Check for corrosion and clean and paint rusted surfaces.
5. Clean and flush water tower for all units operating on a water tower.
6. Remove condenser heads at least once a year to inspect the condenser tubes and clean if required.

Annual Startup

1. Check and tighten all electrical connections.
2. Replace the drain plug in the cooling tower pump if it was removed at shutdown time the previous season.
3. Install fuses in main disconnect switch (if removed).
4. Reconnect water lines and turn on supply water. Flush condenser and check for leaks.

Operating parameters

It is a responsibility of the technical executing the first or annual startup, to check chiller operating parameters to assure the correct operation of the chiller (e.g. to be sure there was no refrigerant leak during transportation, installation or long shutdown period).

Main operating parameters to be checked are:

1. Evaporating pressure.
2. Condensing pressure.
3. Refrigerant superheat at compressor suction
4. Refrigerant superheat at compressor discharge
5. Subcooling of liquid coming out of the condenser banks

All these parameters can be read directly on the operator interface panel

Correct values for these parameters at any allowed operating condition have be obtained using the chiller selection tool.
For reference only, for chiller at full load at standard conditions with no specific reference to chiller size, the allowable range operating parameters is:

Table 5 - Typical working conditions with unit at 100%
(Evap Water Temp 12/7°C – Cond Water Temp 30/35°C)

Evaporating pressure	350 ÷ 360	kPa
Condensing pressure	915 ÷ 935	kPa
Suction superheat	0.5 ÷ 1.0	°C
Discharge superheat	9 ÷ 12	°C
Liquid subcooling	4 ÷ 6	°C

▲ IMPORTANT

The symptoms of a low refrigerant charge, that may be due to refrigerant leak, are:

- low evaporation pressure
- high suction and discharge superheat
- low super-cooling value

Additionally a low level of liquid refrigerant inside the evaporator may be recognized.

In this case, add R134a refrigerant only. The system has been provided with a charge connection between the expansion valve and the evaporator. Charge refrigerant until working conditions return to normal. Remember to reposition the valve cover when finished.

System maintenance

▲ WARNING

All routine and extraordinary maintenance activities on the machine must be carried out only by qualified personnel who are familiar with the machine characteristics, operation and maintenance procedures, and who are aware of the safety requirements and risks involved.

▲ WARNING

The causes of repeated shutdowns deriving from triggering of safety devices must be investigated and corrected. Re-starting the unit after simply resetting the alarm can seriously damage the equipment.

▲ WARNING

A correct refrigerant is essential for optimal operation of the unit and for environmental protection.

To protect the environment, do not release refrigerant into the atmosphere. Always use a recovery and storage device. Any refrigerant recovery must conform to legislation in force.

General

▲ IMPORTANT

Besides the checks suggested in the routine maintenance program, it is recommended to schedule periodical inspections, to be carried out by qualified personnel, as follows:

4 inspections per year (1 every 3 months) for units running about 365 days per year;

2 inspections per year (1 at seasonal start-up and the second one in the middle of the season) for units running about 180 days per year with seasonal operation.

1 inspection per year for units that run for a season of approximately 90 days/year (at seasonal start-up).

It is important that during initial start-up and periodically during operation, routine verifications and checks are performed. These must also include verification of evaporation and condensation pressure. Verify through operator interface panel that the machine operates within the normal superheating and subcooling values. A recommended routine maintenance programme is shown at the end of this chapter while a form for collecting operational data can be found at the end of this manual. Weekly recording of all the machine's operating parameters is recommended. Collecting this data will be very useful to the technicians in the event that technical assistance is called for.

Compressor maintenance

▲ IMPORTANT

Since the compressor is of the semi-hermetic type, it requires no scheduled maintenance. However, for granting the highest levels of performance and efficiency and for preventing malfunctions, it is recommended that a visual check is carried out at least every 10.000 running hours.

Such inspection has to be carried out by qualified and trained personnel.

The analysis of vibrations is a good method for verifying the mechanical conditions of the compressor. Verification of vibration readings immediately after start-up and periodically on an annual basis is recommended. The compressor load must be similar to the previous measurement's load to ensure measurement reliability.

Routine maintenance

Table 6 - Routine maintenance programme

List of Activities	Weekly	Monthly (Note 1)	Yearly (Note 2)
General:			
Reading of operating data (Note 3)	X		
Visual inspection of machine for any damage and/or loosening		X	
Verification of thermal insulation integrity			X
Clean and paint where necessary			X
Analysis of water (5)			X
Electrical:			
Verification of control sequence			X
Verify contactor wear – Replace if necessary			X
Verify that all electrical terminals are tight – Tighten if necessary			X
Clean inside the electrical control board			X
Visual inspection of components for any signs of overheating		X	
Verify operation of compressor and electrical resistance		X	
Measure compressor motor insulation using the Megger			X
Refrigeration circuit:			
Check for any refrigerant leakage		X	
Analyse compressor vibrations			X
Condenser section:			
Clean condenser banks (Note 4)			X
Verify that fans are well tightened			X
Verify condenser bank fins – Comb if necessary			X

Notes:

1. Monthly activities include all the weekly ones.
2. The annual (or early season) activities include all weekly and monthly activities.
3. Machine operating values should be read on a daily basis thus keeping high observation standards.
4. Periodicity of condenser cleaning strongly depend from cooling water characteristics, the annual cleaning proposed is just for reference. "dirty" cooling water, may require to clean the condenser more often.
5. Check for any dissolved metals.

Refrigerant charge

▲ ATTENTION

The units have been designed to operate with R134a refrigerant. So DO NOT USE refrigerants other than R134a.

▲ ATTENTION

The addition or removal of refrigerant gas must be carried out in compliance with the laws and regulations in force.

▲ ATTENTION

When refrigerant gas is added to or removed from the system, ensure proper water flow through the water heat exchangers for the entire charge/discharge time. Interrupting the water flow during this procedure would cause the exchangers to freeze with consequent breakage of internal tubes.
Damage caused by freezing makes the warranty void.

▲ ATTENTION

Removal of the refrigerant and replenishing operations must be performed by technicians who are qualified to use the

appropriate materials for this unit. Unsuitable maintenance can result in uncontrolled losses in pressure and fluid. Do not disperse the refrigerant and lubricating oil in the environment. Always be equipped with a suitable recovery system.

The units ship with a full refrigerant charge, but in some cases it might be necessary to adjust the machine in the field.

▲ ATTENTION

Always verify the causes of a loss of refrigerant. Repair the system if necessary then recharge it.

The machine can be replenished under any stable load condition (preferably between 70 and 100%) and under any ambient temperature (preferably above 20°C), evaporator and condenser water temperature should be close (even if it is not necessary to be exactly) at the rated conditions

Note: When the load or the cooling water temperature vary (for example due to cooling tower fans starting/stopping), so does the subcooling and it requires several minutes to stabilise again. However, the subcooling should not come below 3°C under any condition. Also, the subcooling value can change slightly as the evaporator water temperature and the suction superheat vary. As the suction superheating value decreases, there is a corresponding decrease in subcooling.

One of the following two scenarios can arise in a machine without refrigerant:

1. If the refrigerant level is slightly low, suction superheating is always higher than normal and the valve is wide open. Replenish the circuit as described in the replenishment procedure.
2. If the gas level in the machine is moderately low, the corresponding circuit could have some low-pressure stops. Replenish the corresponding circuit as described in the replenishment procedure.

Procedure to replenish refrigerant

1. If the machine has lost refrigerant, it is necessary to first find the causes before carrying out any replenishment operation. The leak must be found and repaired.
Searching with soap/water solution is a good method and simple method for medium to large leaks, while an electronic leak detector is required to find small leaks.
2. Add refrigerant to the system through the service valve located on the suction pipe or through the Schrader valve located on the water heat exchanger inlet pipe.
3. The refrigerant can be added under any load condition (better between 70 and 100%). Suction superheating must be between 0.5 and 1°C.
4. Check the subcooling value. The subcooling value must be between 4 and 6°C. With reference to the above mentioned values, the subcooling will be lower at 70÷100% load and higher at lower load.
5. Overcharging the system will entail a rise in the compressor's discharge pressure, owing to excessive filling of the condenser.

Table 7 - Pressure/ Temperature

Pressure/Temperature table for R-134a							
°C	bar	°C	bar	°C	bar	°C	bar
-14	0,71	12	3,43	38	8,63	64	17,47
-12	0,85	14	3,73	40	9,17	66	18,34
-10	1,01	16	4,04	42	9,72	68	19,24
-8	1,17	18	4,37	44	10,30	70	20,17
-6	1,34	20	4,72	46	10,90	72	21,13
-4	1,53	22	5,08	48	11,53	74	22,13
-2	1,72	24	5,46	50	12,18	76	23,16
0	1,93	26	5,85	52	13,85	78	24,23
2	2,15	28	6,27	54	13,56	80	25,33
4	2,38	30	6,70	56	14,28	82	26,48
6	2,62	32	7,15	58	15,04	84	27,66
8	2,88	34	7,63	60	15,82	86	28,88
10	3,15	36	8,12	62	16,63	88	30,14

Standard checks

Temperature and pressure sensors

The unit comes factory-equipped with all the sensors listed below. Periodically check that their measurements are correct by means of reference instruments (manometers, thermometers); correct the wrong readings as necessary using the operator interface panel. Well-calibrated sensors ensure better efficiency for the machine and a longer lifetime.

Note: refer to operating manual for a complete description of applications, settings and adjustments.

All sensors are preassembled and connected to the microprocessor. The descriptions of each sensor are listed below:

Evaporator outlet water temperature sensor – This sensor is located on the evaporator outlet water connection and is used by the controller to control the unit load depending on the system's thermal load. It also helps control the evaporator's antifreeze protection.

Evaporator inlet water temperature sensor – This sensor is located on the evaporator inlet water connection and is used for monitoring the return water temperature.

Evaporator differential pressure switches – Two sensors are located between the evaporator inlet and outlet water connections and is used to protect evaporator against loss of water flow

Condenser inlet water temperature sensor – This sensor is located on the condenser inlet water connection and is used by the controller to control the tower bypass valve depending on the system's thermal load.

Condenser outlet water temperature sensor – This sensor is located on the condenser outlet water connection and is used for monitoring the leaving water temperature.

Condenser differential pressure switches – Two sensors are located between the condenser inlet and outlet water connections and is used to protect condenser against loss of water flow

The following sensors are located inside the compressor and managed by the compressor integrated electronic controller:

- Compressor discharge pressure transducer
- Compressor discharge temperature sensor
- Compressor suction pressure transducer
- Compressor suction temperature sensor

Test sheet

It is recommended that the following operation data are recorded periodically in order to verify the correct function of the machine over the time. These data will also be extremely useful to the technicians who will be performing routine and/or extraordinary maintenance on the machine.

Water side measurements

Chilled water setpoint	°C	_____
Evaporator Leaving water temperature	°C	_____
Evaporator Entering water temperature	°C	_____
Evaporator Pressure drop	kPa	_____
Evaporator Water flow rate	m ³ /h	_____
Condenser Leaving water temperature	°C	_____
Condenser Entering water temperature	°C	_____
Condenser Pressure drop	kPa	_____
Condenser Water flow rate	m ³ /h	_____

Refrigerant side measurements

Compressors	Compressor #1 Load	_____	%
	Compressor #2 Load	_____	%
Expansion valve	N° of expansion valve steps	_____	
Refrigerant pressure	Evaporating pressure	_____	bar
	Condensating pressure	_____	bar
Refrigerant temperature	Evaporation saturated temperature	_____	°C
	Suction gas pressure	_____	°C
	Suction superheat	_____	°C
	Condensation saturated temperature	_____	°C
	Discharge superheating	_____	°C
	Liquid temperature	_____	°C
	Subcooling	_____	°C
Environment temperature		_____	°C

Electrical measurements

Analysis of the unit's voltage unbalance:

Phases:	RS	ST	RT
	_____ V	_____ V	_____ V

Unbalance %: $\frac{V_{\max} - V_{\text{avg}}}{V_{\text{avg}}} \times 100 = \text{_____} \%$

avg = average

Current – Phases:	R	S	T
	_____ A	_____ A	_____ A

Service and limited warranty

All machines are factory-tested and guaranteed for 12 months as of the first start-up or 18 months as of delivery. These machines have been developed and constructed according to high quality standards ensuring years of failure-free operation. It is important, however, to ensure proper and periodical maintenance in accordance with all the procedures listed in this manual.

We strongly advise stipulating a maintenance contract with a service authorized by the manufacturer in order to ensure efficient and problem-free service, thanks to the expertise and experience of our personnel.

It must also be taken into consideration that the unit requires maintenance also during the warranty period.

It must be borne in mind that operating the machine in an inappropriate manner, beyond its operating limits or not performing proper maintenance according to this manual can void the warranty.

Observe the following points in particular, in order to conform to warranty limits:

1. The machine must be installed accordingly to the requirements of this manual
2. The machine must be started accordingly to the requirements of this manual
3. The machine cannot function beyond the specified limits
4. The electrical power supply must be within the voltage limits and without voltage harmonics or sudden changes.
5. The three-phase power supply must not have an unbalance between phases exceeding 3%. The machine must stay turned off until the electrical problem has been solved.
6. No safety device, either mechanical, electrical or electronic must be disabled or overridden.
7. The water used for filling the water circuits must be clean and suitably treated. A mechanical filter must be installed at the point closest to the Condenser inlet.
8. Unless there is a specific agreement at the time of ordering, the Condenser water flow rate must never be above 120% and below 80% of the nominal flow rate.

Periodic obligatory checks and starting up of appliances under Pressure

The units are included in category IV of the classification according to European Directive PED 2014/68/EU. For chillers belonging to this category, some local regulations require a periodic inspection by an authorized agency. Please check with your local requirements.

Important information regarding the refrigerant used

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

Refrigerant type: R134a
GWP(1) value: 1430

(1) GWP = Global Warming Potential

The refrigerant quantity is indicated on the unit name plate.

Periodical inspections for refrigerant leaks may be required depending on European or local legislation. Please contact your local dealer for more information.

Factory and Field charged units instructions

(Important information regarding the refrigerant used)

The refrigerant system will be charged with fluorinated greenhouse gases.
Do not vent gases into the atmosphere.

1 Fill in with indelible ink the refrigerant charge label supplied with the product as following instructions:

- the refrigerant charge for each circuit (1; 2; 3)
- the total refrigerant charge (1 + 2 + 3)
- **calculate the greenhouse gas emission with the following formula:**
GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000

	a		b	c	p	
	a	Contains fluorinated greenhouse gases		b	c	p
			Factory charge	+	Field charge	d
m	R134a	1		+		e
	GWP: 1430	2		+		e
n		3		+		e
		1 + 2 + 3		+		f
	Total refrigerant charge Factory + Field			kg		g
	GWP x kg/1000			tCO ₂ eq		h

- a Contains fluorinated greenhouse gases
- b Circuit number
- c Factory charge
- d Field charge
- e Refrigerant charge for each circuit (according to the number of circuits)
- f Total refrigerant charge
- g Total refrigerant charge (Factory + Field)
- h **Greenhouse gas emission** of the total refrigerant charge expressed as tonnes of CO₂ equivalent
- m Refrigerant type
- n GWP = Global Warming Potential
- p Unit serial number

2 The filled out label must be adhered inside the electrical panel.

Periodical inspections for refrigerant leaks may be required depending on European or local legislation. Please contact your local dealer for more information.



NOTICE

In Europe, the **greenhouse gas emission** of the total refrigerant charge in the system (expressed as tonnes CO₂ equivalent) is used to determine the maintenance intervals. Follow the applicable legislation.

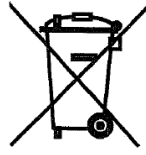
Formula to calculate the greenhouse gas emission:

GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000

Use the GWP value mentioned on the greenhouse gases label. This GWP value is based on the 4th IPCC Assessment Report. The GWP value mentioned in the manual might be outdated (i.e. based on the 3rd IPCC Assessment Report)

Disposal

The unit is made of metal and plastic parts. All these parts must be disposed of in accordance with the local regulations in terms of disposal. Lead batteries must be collected and taken to specific refuse collection centres.



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