



## Installation, Operation and Maintenance Manual

D-EIMHP00504-14EN



## Inverter air to water heat pumps

EWYD 250-580BZSS  
EWYD 250-570BZSL  
50Hz – Refrigerant: R-134<sup>a</sup>

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 operation

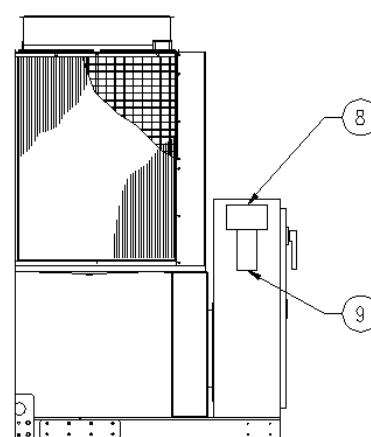
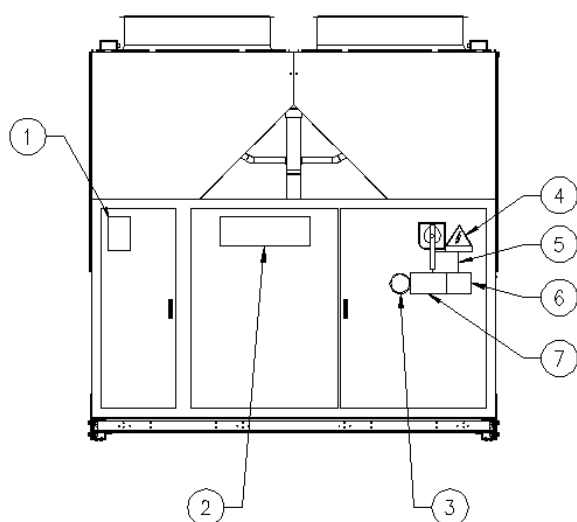


Note regarding safety in general or respect of laws and regulations



Note regarding electrical safety

### Description of the labels applied to the electrical panel



### 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	

# Index

---

<b>General information .....</b>	<b>5</b>
Purpose of this manual .....	5
Receiving the machine .....	5
Checks .....	5
Nomenclature .....	6
<b>Technical Specifications .....</b>	<b>7</b>
Storage .....	15
Operation .....	15
<b>Mechanical installation .....</b>	<b>17</b>
Shipping .....	17
Responsibility .....	17
Safety .....	17
Moving and lifting .....	17
Positioning and assembly .....	18
Minimum space requirements .....	19
Sound protection .....	20
Water piping .....	20
Water treatment .....	22
Evaporator and recovery exchangers anti-freeze protection .....	22
Installing the flow switch .....	22
Hydronic kit (optional) .....	23
<b>Electrical installation .....</b>	<b>28</b>
General specifications .....	28
Electrical components .....	28
Electrical wiring .....	28
Electrical heaters .....	28
Electrical power supply to the pumps .....	29
Water pump control .....	29
Alarm relays – Electrical wiring .....	30
Unit On/ Off remote control – Electrical wiring .....	30
Double Setpoint – Electrical wiring .....	30
External water Setpoint reset – Electrical wiring (Optional) .....	30
Unit limitation – Electrical wiring (Optional) .....	30
The VFD and related problems .....	31
The operating principle of the VFD .....	32
The problem with harmonics .....	32
<b>Operation .....</b>	<b>35</b>
Operator's responsibilities .....	35
Description of the machine .....	35
Description of the refrigeration cycle .....	35
Description of the refrigeration cycle with heat recovery .....	37
Controlling the heat recovery circuit and installation recommendations .....	37
Compressor .....	39
Compression process .....	39
Cooling capacity control .....	41
<b>Pre-startup checks .....</b>	<b>43</b>
Units with an external water pump .....	44
Units with a built-in water pump .....	44
Electrical power supply .....	44
Unbalance in power supply voltage .....	44
Power supply of electrical heaters .....	45
<b>Startup procedure .....</b>	<b>46</b>
Turning on the machine .....	46
Selecting an operating mode .....	47
Shutdown for a long time .....	47
Starting up after seasonal shutdown .....	47
<b>System maintenance .....</b>	<b>48</b>
General .....	48
Compressor maintenance .....	48
Lubrication .....	48
Routine maintenance .....	49
Replacement of filter dryer .....	50
Procedure to replace the filter dryer cartridge .....	50
Replacement of the oil filter .....	51
Procedure to replace oil filter .....	51
Procedure to replenish refrigerant .....	53
<b>Standard checks .....</b>	<b>54</b>

Temperature and pressure sensors.....	54
<b>Test sheet .....</b>	<b>55</b>
Water side measurements.....	55
Refrigerant side measurements .....	55
Electrical measurements .....	55
<b>Service and limited warranty.....</b>	<b>56</b>
<b>Periodic obligatory checks and starting up of appliances under pressure .....</b>	<b>57</b>
<b>Important information regarding the refrigerant used .....</b>	<b>58</b>
Disposal.....	58

#### **Index of tables**

Table 1 - Acceptable water quality limits.....	22
Table 2 - Electrical data of optional pumps.....	29
Table 3 - Typical working conditions with compressors at 100%.....	46
Table 4 - Routine maintenance programme.....	49
Table 5 - Pressure/ Temperature.....	53

#### **Index of figures**

Figure 1 - Operating limits in cooling mode - EWYD~BZSS / EWYD~BZSL.....	16
Figure 2 - Operating limits in heating mode - EWYD~BZSS / EWYD~BZSL.....	16
Figure 3 - Lifting the unit.....	18
Figure 4 - Minimum clearance requirements for machine maintenance .....	19
Figure 5 - Minimum recommended installation clearances.....	20
Figure 6 - Water piping connection for evaporator.....	21
Figure 7 - Water piping connection for heat recovery exchangers.....	21
Figure 8 - Adjusting the safety flow switch.....	23
Figure 9 - Single- and twin-pump hydronic kit.....	23
Figure 10 - Low lift water pumps kit (option on request) - Lift diagrams .....	24
Figure 11 - High lift water pumps kit (option on request) - Lift diagrams .....	25
Figure 12 - Evaporator pressure drop.....	26
Figure 13 - Partial heat recovery pressure drop.....	27
Figure 14 - User connection to the interface M3 terminal boards.....	31
Figure 15 - Power absorbed by the compressor depending on the load .....	32
Figure 16 - Typical diagram of a VFD.....	33
Figure 17 - Harmonics on the grid.....	33
Figure 18 - Harmonic content with and without line inductance .....	34
Figure 19 - Harmonic content varying according to the percentage of non-linear loads.....	34
Figure 20 - Refrigeration cycle.....	36
Figure 21 - Refrigeration cycle with partial heat recovery.....	38
Figure 22 - Picture of Fr3100 compressor.....	39
Figure 23 - Compression process.....	40
Figure 24 - Capacity control mechanism for Fr3100 compressor.....	41
Figure 25 - Continuously variable capacity control for Fr3100 compressor.....	42
Figure 26 - Installation of control devices for Fr3100 compressor.....	49
Figure 27 - Front and back views for Fr3100 .....	52

## General information

### ▲ ATTENTION

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.

### ▲ ATTENTION

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, inverter manuals, dimensional drawings with dimensions and weight, nameplate with technical characteristics attached to the unit.

**WIRING DIAGRAMS, INVERTER MANUALS, DIMENSIONAL DRAWINGS AND NAMEPLATE 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

### 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.

### 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	Y	D	2	0	0	B	Z	S	L
1	2	3	4	5	6	7	8	9	10	11

### 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  
 Idem as previous

### Model series

Letter A, B,... : major modification

### Inverter

- = Non-inverter  
 Z = Inverter

### Efficiency level

(McQuay code)

S	= Standard efficiency	(SE)	
X	= High efficiency	(XE)	(N.A for this range)
P	= Premium efficiency	(PE)	(N.A for this range)
H	= High ambient	(HA)	(N.A for this range)

### Sound level

(McQuay code)

S	= Standard noise	(ST)	
L	= Low noise	(LN)	
R	= Reduced noise	(XN)	(N.A for this range)
X	= Extra low noise	(XXN)	(N.A for this range)
C	= Cabinet	(CN)	(N.A for this range)

# Technical Specifications

TECHNICAL SPECIFICATIONS				EWYD-BZSS	250	270	290	320	340
Capacity (1) (2)	Cooling			kW	254	273	292	324	339
	Heating			kW	270	297	324	333	349
Capacity control	Type			---	Stepless				
	Minimum capacity			%	13	13	13	13	13
Unit power input (1) (2)	Cooling			kW	90.3	100	109	116	124
	Heating			kW	90.4	99	107	117	124
EER (1)				---	2.81	2.74	2.69	2.79	2.74
COP (2)				---	2.98	2.99	3.03	2.84	2.80
ESEER				---	4.05	4.04	4.01	4.07	4.01
IPLV				---	4.58	4.62	4.62	4.75	4.64
Casing	Colour			---	Ivory White				
	Material			---	Galvanized and painted steel sheet				
Dimensions	Unit	Height		mm	2335	2335	2335	2335	2335
		Width		mm	2254	2254	2254	2254	2254
		Length		mm	3547	3547	3547	4381	4381
Weight	Unit			kg	3410	3455	3500	3870	3870
	Operating Weight			kg	3550	3595	3640	4010	4010
Water heat exchanger	Type			---	Single Pass Shell&Tube				
	Water volume			l	138	138	138	133	133
	Nominal water flow rate		Cooling	l/s	12.12	13.03	13.94	15.46	16.21
	Nominal water flow rate		Heating	l/s	12.89	14.18	15.49	15.89	16.66
	Nominal Water pressure drop		Cooling	kPa	37	42	48	53	58
	Nominal Water pressure drop		Heating	kPa	42	49	58	55	60
	Insulation material				Closed cell				
Air heat exchanger	Type			---	High efficiency fin and tube type with integral subcooler				
Fan	Type			---	Direct propeller type				
	Drive			---	DOL				
	Diameter			mm	800	800	800	800	800
	Nominal air flow			l/s	31728	31728	31728	42304	42304
	Model	Quantity		No.	6	6	6	8	8
		Speed		rpm	920	920	920	920	920
		Motor input		W	1.75	1.75	1.75	1.75	1.75
Compressor	Type			---	Semi-hermetic single screw compressor Inverter driven				
	Oil charge			l	26	26	26	26	26
	Quantity			No.	2	2	2	2	2
Sound level	Sound Power	Cooling	dB(A)	100.5	100.5	100.5	101.2	101.2	
		Heating	dB(A)	100.5	100.5	100.5	101.2	101.2	
	Sound Pressure (3)	Cooling	dB(A)	82.1	82.1	82.1	82.3	82.3	
		Heating	dB(A)	82.1	82.1	82.3	82.3	82.3	
Refrigerant circuit	Refrigerant type			---	R-134a	R-134a	R-134a	R-134a	R-134a
	Refrigerant charge			kg.	88	94	100	118	118
	N. of circuits			No.	2	2	2	2	2
Piping connections	Evaporator water inlet/outlet			mm	139.7	139.7	139.7	139.7	139.7
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor overload (Kriwan)								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
Phase monitor									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	Heating capacity, unit power input in heating and COP are based on the following conditions: condenser 40/45°C; ambient 7°C DB, unit at full load operation.								
Notes (3)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								

TECHNICAL SPECIFICATIONS				EWYD-BZSS	370	380	410	440	460
Capacity (1)	Cooling		kW	365	382	413	436	457	
	Heating		kW	379	410	443	463	475	
Capacity control	Type		---	Stepless					
	Minimum capacity		%	13	13	13	13	9	
Unit power input (1)	Cooling		kW	134	142	152	163	161	
	Heating		kW	132	141	155	165	164	
EER (1)			---	2.73	2.68	2.72	2.68	2.83	
COP (2)			---	2.87	2.90	2.85	2.81	2.90	
ESEER			---	4.02	3.94	4.03	4.01	4.31	
IPLV			---	4.71	4.67	4.73	4.69	4.85	
Casing	Colour		---	Ivory White					
	Material		---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2335	2335	2335	2335	2335	
		Width	mm	2254	2254	2254	2254	2254	
		Length	mm	4381	4381	5281	5281	6583	
Weight	Unit		kg	3940	4010	4390	4390	5015	
	Operating Weight		kg	4068	4138	4518	4518	5255	
Water heat exchanger	Type		---	Single Pass Shell&Tube					
	Water volume		l	128	128	128	128	240	
	Nominal water flow rate	Cooling	l/s	17.42	18.25	19.72	20.81	21.83	
		Heating	l/s	18.11	19.57	21.15	22.14	22.68	
	Nominal Water pressure drop	Cooling	kPa	53	57	46	51	61	
		Heating	kPa	57	65	52	57	66	
Insulation material			Closed cell						
Air heat exchanger	Type		---	High efficiency fin and tube type with integral subcooler					
Fan	Type		---	Direct propeller type					
	Drive		---	DOL					
	Diameter		mm	800	800	800	800	800	
	Nominal air flow		l/s	42304	42304	52880	52880	63456	
	Model	Quantity	No.	8	8	10	10	12	
		Speed	rpm	920	920	920	920	920	
		Motor input	W	1.75	1.75	1.75	1.75	1.75	
Compressor	Type		---	Semi-hermetic single screw compressor Inverter driven					
	Oil charge		l	26	26	26	26	39	
	Quantity		No.	2	2	2	2	3	
Sound level	Sound Power	Cooling	dB(A)	101.2	101.2	101.8	101.8	103.6	
		Heating	dB(A)	101.2	101.2	101.8	101.8	103.6	
	Sound Pressure (3)	Cooling	dB(A)	82.3	82.3	82.5	82.5	83.7	
		Heating	dB(A)	82.3	82.5	82.5	83.7	83.7	
Refrigerant circuit	Refrigerant type		---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge		kg.	121	124	148	148	177	
	N. of circuits		No.	2	2	2	2	3	
Piping connections	Evaporator water inlet/outlet		mm	139.7	139.7	139.7	139.7	219.1	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor overload (Kriwan)								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
Phase monitor									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	Heating capacity, unit power input in heating and COP are based on the following conditions: condenser 40/45°C; ambient 7°C DB, unit at full load operation.								
Notes (3)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								



TECHNICAL SPECIFICATIONS				EWYD-BZSS	510	520	580
Capacity (1)	Cooling		kW	505	522	583	
	Heating		kW	530	558	615	
Capacity control	Type		---	Stepless			
	Minimum capacity		%	9	9	9	
Unit power input (1)	Cooling		kW	178	186	215	
	Heating		kW	176	184	205	
EER (1)			---	2.83	2.81	2.71	
COP (2)			---	3.02	3.04	3.00	
ESEER			---	4.13	4.13	4.05	
IPLV			---	4.89	4.85	4.78	
Casing	Colour		---	Ivory White			
	Material		---	Galvanized and painted steel sheet			
Dimensions	Unit	Height	mm	2335	2335	2335	
		Width	mm	2254	2254	2254	
		Length	mm	6583	6583	6583	
Weight	Unit		kg	5495	5735	5735	
	Operating Weight		kg	5724	5964	5953	
Water heat exchanger	Type		---	Single Pass Shell&Tube			
	Water volume		l	229	229	218	
	Nominal water flow rate	Cooling	l/s	24.11	24.92	27.87	
		Heating	l/s	25.33	26.65	29.39	
	Nominal Water pressure drop	Cooling	kPa	50	53	65	
		Heating	kPa	55	60	71	
Insulation material			Closed cell				
Air heat exchanger	Type		---	High efficiency fin and tube type with integral subcooler			
Fan	Type		---	Direct propeller type			
	Drive		---	DOL			
	Diameter		mm	800	800	800	
	Nominal air flow		l/s	63456	63456	63456	
	Model	Quantity	No.	12	12	12	
		Speed	rpm	920	920	920	
Motor input		W	1.75	1.75	1.75		
Compressor	Type		---	Semi-hermetic single screw compressor Inverter driven			
	Oil charge		l	39	39	39	
	Quantity		No.	3	3	3	
Sound level	Sound Power	Cooling	dB(A)	103.6	103.6	103.6	
		Heating	dB(A)	103.6	103.6	103.6	
	Sound Pressure (3)	Cooling	dB(A)	83.7	83.7	83.7	
		Heating	dB(A)	83.7	83.7	83.7	
Refrigerant circuit	Refrigerant type		---	R-134a	R-134a	R-134a	
	Refrigerant charge		kg.	183	186	186	
	N. of circuits		No.	3	3	3	
Piping connections	Evaporator water inlet/outlet		mm	219.1	219.1	219.1	
Safety devices	High discharge pressure (pressure switch)						
	High discharge pressure (pressure transducer)						
	Low suction pressure (pressure transducer)						
	Compressor overload (Kriwan)						
	High discharge temperature						
	Low oil pressure						
	Low pressure ratio						
	High oil filter pressure drop						
Phase monitor							
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.						
Notes (2)	Heating capacity, unit power input in heating and COP are based on the following conditions: condenser 40/45°C; ambient 7°C DB, unit at full load operation.						
Notes (3)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.						

ELECTRICAL SPECIFICATIONS			EWYD-BZSS	250	270	290	320	340
Power Supply	Phase		---	3	3	3	3	3
	Frequency		Hz	50	50	50	50	50
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current		A	217	217	217	264	296
	Nominal running current cooling		A	150	167	181	196	209
				153	167	178	197	210
	Maximum running current		A	238	238	238	285	324
	Maximum current for wires sizing		A	262	262	262	314	356
Fans	Nominal running current in cooling		A	4	4	4	4	4
	Nominal running current in heating		A	4	4	4	4	4
Compressor	Phase		No.	3	3	3	3	3
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current		A	107+107	107+107	107+107	107+146	146+146
	Starting method		---	VFD				

ELECTRICAL SPECIFICATIONS			EWYD-BZSS	370	380	410	440	460
Power Supply	Phase		---	3	3	3	3	3
	Frequency		Hz	50	50	50	50	50
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current		A	296	296	334	358	328
	Nominal running current cooling		A	224	237	255	273	271
				222	235	260	276	275
	Maximum running current		A	324	324	362	392	369
	Maximum current for wires sizing		A	356	356	398	431	406
Fans	Nominal running current in cooling		A	4	4	4	4	4
	Nominal running current in heating		A	4	4	4	4	4
Compressor	Phase		No.	3	3	3	3	3
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current		A	146+146	146+146	146+176	176+176	107+107+107
	Starting method		---	VFD				

ELECTRICAL SPECIFICATIONS				EWYD-BZSS	510	520	580
Power Supply	Phase		---	3	3	3	
	Frequency		Hz	50	50	50	
	Voltage		V	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	
		Maximum	%	+10%	+10%	+10%	
Unit	Maximum starting current		A	398	430	430	
	Nominal running current cooling		A	300	313	357	
				296	309	342	
	Maximum running current		A	447	486	486	
	Maximum current for wires sizing		A	492	535	535	
Fans	Nominal running current in cooling		A	4	4	4	
	Nominal running current in heating		A	4	4	4	
Compressor	Phase		No.	3	3	3	
	Voltage		V	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	
		Maximum	%	+10%	+10%	+10%	
	Maximum running current		A	146+146+107	146+146+146	146+146+146	
	Starting method		---	VFD			

Notes	Allowed voltage tolerance $\pm 10\%$ . Voltage unbalance between phases must be within $\pm 3\%$ .							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current for the circuit at 75%.							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Nominal current in heating mode is referred to installation with 25kA short circuit current and is based on the following conditions: condenser 40°C/45°C; ambient 7°C DB/6°C WB + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.							

TECHNICAL SPECIFICATIONS				EWYD-BZSL	250	270	290	320	330
Capacity (1) (2)	Cooling			kW	248	266	291	316	331
	Heating			kW	270	297	324	333	349
Capacity control	Type			---	Stepless				
	Minimum capacity			%	13	13	13	13	13
Unit power input (1) (2)	Cooling			kW	88.5	98	109	113	122
	Heating			kW	90.4	99	107	117	124
EER (1)				---	2.80	2.70	2.66	2.79	2.72
COP (2)				---	2.98	2.99	3.03	2.84	2.80
ESEER				---	4.18	4.16	4.11	4.29	4.18
IPLV				---	4.84	4.86	4.80	4.97	4.87
Casing	Colour			---	Ivory White				
	Material			---	Galvanized and painted steel sheet				
Dimensions	Unit	Height	mm	2335	2335	2335	2335	2335	
		Width	mm	2254	2254	2254	2254	2254	
		Length	mm	3547	3547	3547	4381	4381	
Weight	Unit			kg	3750	3795	3840	4210	4210
	Operating Weight			kg	3888	3933	3978	4343	4343
Water heat exchanger	Type			---	Single Pass Shell&Tube				
	Water volume			l	138	138	138	133	133
	Nominal water flow rate	Cooling	l/s	11.83	12.70	13.89	15.12	15.83	
		Heating	l/s	12.89	14.18	15.49	15.89	16.66	
	Nominal Water pressure drop	Cooling	kPa	36	40	48	51	55	
		Heating	kPa	42	49	58	55	60	
Insulation material				Closed cell					
Air heat exchanger	Type			---	High efficiency fin and tube type with integral subcooler				
Fan	Type			---	Direct propeller type				
	Drive			---	DOL				
	Diameter			mm	800	800	800	800	800
	Nominal air flow	Cooling	l/s	24432	24432	24432	32576	32576	
		Heating	l/s	31728	31728	31728	42304	42304	
	Model	Quantity	No.	6	6	6	8	8	
		Speed - Cooling (Heating)		rpm	715 (920)	715 (920)	715 (920)	715 (920)	715 (920)
Motor input - Cooling (Heating)		W	0.78 (1.75)	0.78 (1.75)	0.78 (1.75)	0.78 (1.75)	0.78 (1.75)		
Compressor	Type			---	Semi-hermetic single screw compressor				
	Oil charge			l	26	26	26	26	26
	Quantity			No.	2	2	2	2	2
Sound level	Sound Power	Cooling	dB(A)	94.0	94.0	94.0	94.7	94.7	
		Heating	dB(A)	94.9	94.9	94.9	96.1	96.1	
	Sound Pressure (3)	Cooling	dB(A)	75.6	75.6	75.6	75.8	75.8	
		Heating	dB(A)	76.5	76.5	76.5	77.2	77.2	
Refrigerant circuit	Refrigerant type			---	R-134a	R-134a	R-134a	R-134a	R-134a
	Refrigerant charge			kg.	88	94	100	118	118
	N. of circuits			No.	2	2	2	2	2
Piping connections	Evaporator water inlet/outlet			mm	139.7	139.7	139.7	139.7	139.7
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor overload (Kriwan)								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
Phase monitor									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	Heating capacity, unit power input in heating and COP are based on the following conditions: condenser 40/45°C; ambient 7°C DB, unit at full load operation.								
Notes (3)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								

TECHNICAL SPECIFICATIONS				EWYD-BZSL	360	370	400	430	450
Capacity (1) (2)	Cooling		kW	355	372	403	425	448	
	Heating		kW	379	410	443	463	475	
Capacity control	Type		---	Stepless					
	Minimum capacity		%	13	13	13	13	9	
Unit power input (1) (2)	Cooling		kW	132	142	149	161	156	
	Heating		kW	132	141	155	165	164	
EER (1)			---	2.68	2.62	2.71	2.64	2.87	
COP (2)			---	2.87	2.90	2.85	2.81	2.90	
ESEER			---	4.16	4.13	4.19	4.14	4.31	
IPLV			---	4.87	4.84	4.91	4.86	5.04	
Casing	Colour		---	Ivory White					
	Material		---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2335	2335	2335	2335	2335	
		Width	mm	2254	2254	2254	2254	2254	
		Length	mm	4381	4381	5281	5281	6583	
Weight	Unit		kg	4280	4350	4730	4730	5525	
	Operating Weight		kg	4408	4478	4858	4858	5765	
Water heat exchanger	Type		---	Single Pass Shell&Tube					
	Water volume		l	128	128	128	128	240	
	Nominal water flow rate	Cooling	l/s	16.98	17.77	19.28	20.30	21.39	
		Heating	l/s	18.11	19.57	21.15	22.14	22.68	
	Nominal Water pressure drop	Cooling	kPa	50.32	54.62	44.07	48.40	59.16	
		Heating	kPa	57	65	52	57	66	
	Insulation material			Closed cell					
Air heat exchanger	Type		---	High efficiency fin and tube type with integral subcooler					
Fan	Type		---	Direct propeller type					
	Drive		---	DOL					
	Diameter		mm	800	800	800	800	800	
	Nominal air flow	Cooling	l/s	32576	32576	40720	40720	48864	
		Heating	l/s	42304	42304	52880	52880	63456	
	Model	Quantity	No.	8	8	10	10	12	
		Speed - Cooling (Heating)		rpm	715 (920)	715 (920)	715 (920)	715 (920)	715 (920)
Motor input - Cooling (Heating)		W	0.78 (1.75)	0.78 (1.75)	0.78 (1.75)	0.78 (1.75)	0.78 (1.75)		
Compressor	Type		---	Semi-hermetic single screw compressor					
	Oil charge		l	26	26	26	26	39	
	Quantity		No.	2	2	2	2	3	
Sound level	Sound Power	Cooling	dB(A)	94.7	94.7	95.3	95.3	97.0	
		Heating	dB(A)	96.1	96.1	96.7	96.7	98.4	
	Sound Pressure (3)	Cooling	dB(A)	75.8	75.8	76.0	76.0	77.2	
		Heating	dB(A)	77.2	77.2	77.4	77.4	78.6	
Refrigerant circuit	Refrigerant type		---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge		kg.	121	124	148	148	177	
	N. of circuits		No.	2	2	2	2	3	
Piping connections	Evaporator water inlet/outlet		mm	139.7	139.7	139.7	139.7	219.1	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor overload (Kriwan)								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
Phase monitor									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	Heating capacity, unit power input in heating and COP are based on the following conditions: condenser 40/45°C; ambient 7°C DB, unit at full load operation.								
Notes (3)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								

TECHNICAL SPECIFICATIONS				EWYD-BZSL	490	510	570
Capacity (1)	Cooling		kW	493	510	567	
	Heating		kW	530	558	615	
Capacity control	Type		---	Stepless			
	Minimum capacity		%	9	9	9	
Unit power input (1)	Cooling		kW	174	183	214	
	Heating		kW	176	184	205	
EER (1)			---	2.83	2.79	2.65	
COP (2)			---	3.02	3.04	3.00	
ESEER			---	4.29	4.23	4.10	
IPLV			---	5.01	4.96	4.83	
Casing	Colour		---	Ivory White			
	Material		---	Galvanized and painted steel sheet			
Dimensions	Unit	Height	mm	2335	2335	2335	
		Width	mm	2254	2254	2254	
		Length	mm	6583	6583	6583	
Weight	Unit		kg	6005	6245	6245	
	Operating Weight		kg	6234	6474	6463	
Water heat exchanger	Type		---	Single Pass Shell&Tube			
	Water volume		l	229	229	218	
	Nominal water flow rate	Cooling	l/s	23.56	24.34	27.11	
		Heating	l/s	25.33	26.65	29.39	
	Nominal Water pressure drop	Cooling	kPa	48	51	62	
		Heating	kPa	55	60	71	
Insulation material			Closed cell				
Air heat exchanger	Type		---	High efficiency fin and tube type with integral subcooler			
Fan	Type		---	Direct propeller type			
	Drive		---	DOL			
	Diameter		mm	800	800	800	
	Nominal air flow	Cooling	l/s	48864	48864	48864	
		Heating	l/s	63456	63456	63456	
	Model	Quantity	No.	12	12	12	
		Speed - Cooling (Heating)		rpm	715 (920)	715 (920)	715 (920)
		Motor input - Cooling (Heating)		W	0.78 (1.75)	0.78 (1.75)	0.78 (1.75)
Compressor	Type		---	Semi-hermetic single screw compressor			
	Oil charge		l	39	39	39	
	Quantity		No.	3	3	3	
Sound level	Sound Power	Cooling	dB(A)	97.0	97.0	97.0	
		Heating	dB(A)	98.4	98.4	98.4	
	Sound Pressure (3)	Cooling	dB(A)	77.2	77.2	77.2	
		Heating	dB(A)	78.6	78.6	78.6	
Refrigerant circuit	Refrigerant type		---	R-134a	R-134a	R-134a	
	Refrigerant charge		kg.	183	186	186	
	N. of circuits		No.	3	3	3	
Piping connections	Evaporator water inlet/outlet		mm	219.1	219.1	219.1	
Safety devices	High discharge pressure (pressure switch)						
	High discharge pressure (pressure transducer)						
	Low suction pressure (pressure transducer)						
	Compressor overload (Kriwan)						
	High discharge temperature						
	Low oil pressure						
	Low pressure ratio						
	High oil filter pressure drop						
Phase monitor							
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.						
Notes (2)	Heating capacity, unit power input in heating and COP are based on the following conditions: condenser 40/45°C; ambient 7°C DB, unit at full load operation.						
Notes (3)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.						

ELECTRICAL SPECIFICATIONS			EWYD-BZSL	250	270	290	320	330
Power Supply	Phase		---	3	3	3	3	3
	Frequency		Hz	50	50	50	50	50
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current		A	208	208	208	252	284
	Nominal running current cooling		A	149	160	147	153	167
	Nominal running current heating		A	153	167	178	197	210
	Maximum running current		A	238	238	238	285	324
	Maximum current for wires sizing		A	262	262	262	314	356
Fans	Nominal running current in cooling		A	3	3	3	3	3
	Nominal running current in heating		A	4	4	4	4	4
Compressor	Phase		No.	3	3	3	3	3
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current		A	107+107	107+107	107+107	107+146	146+146
	Starting method		---	VFD				

ELECTRICAL SPECIFICATIONS			EWYD-BZSL	360	370	400	430	450
Power Supply	Phase		---	3	3	3	3	3
	Frequency		Hz	50	50	50	50	50
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current		A	285	284	319	343	310
	Nominal running current cooling		A	178	192	200	219	232
	Nominal running current heating		A	222	235	260	276	275
	Maximum running current		A	324	324	362	392	369
	Maximum current for wires sizing		A	356	356	398	431	406
Fans	Nominal running current in cooling		A	3	3	3	3	3
	Nominal running current in heating		A	4	4	4	4	4
Compressor	Phase		No.	3	3	3	3	3
	Voltage		V	400	400	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current		A	146+146	146+146	146+176	176+176	107+107+107
	Starting method		---	VFD				

ELECTRICAL SPECIFICATIONS			EWYD-BZSL	490	510	570
Power Supply	Phase		---	3	3	3
	Frequency		Hz	50	50	50
	Voltage		V	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%
Unit	Maximum starting current		A	380	412	412
	Nominal running current cooling		A	255	269	311
	Nominal running current heating		A	296	309	342
	Maximum running current		A	447	486	486
	Maximum current for wires sizing		A	492	535	535
Fans	Nominal running current in cooling		A	3	3	3
	Nominal running current in heating		A	4	4	4
Compressor	Phase		No.	3	3	3
	Voltage		V	400	400	400
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%
	Maximum running current		A	146+146+107	146+146+146	146+146+146
	Starting method		---	VFD		

Notes	Allowed voltage tolerance $\pm 10\%$ . Voltage unbalance between phases must be within $\pm 3\%$ .							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current for the circuit at 75%.							
	Nominal current in cooling mode is referred to installation with 25kA short circuit current and is based on the following conditions: evaporator 12°C/7°C; ambient 35°C. compressor + fans current.							
	Nominal current in heating mode is referred to installation with 25kA short circuit current and is based on the following conditions: condenser 40°C / 45°C; ambient 7°C DB/6°C WB + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.							

# Operating limits

---

## Storage

The environmental conditions must be within the following limits:

Minimum ambient temperature	:	-20°C
Maximum ambient temperature	:	57°C
Maximum R.H.	:	95% 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

Operation is allowed within the limits mentioned in the following diagrams

### ▲ ATTENTION

Operation out of the mentioned limits may damage the unit.  
For any doubts contact the factory.

### ▲ 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.

Figure 1 - Operating limits in cooling mode - EWYD~BZSS / EWYD~BZSL

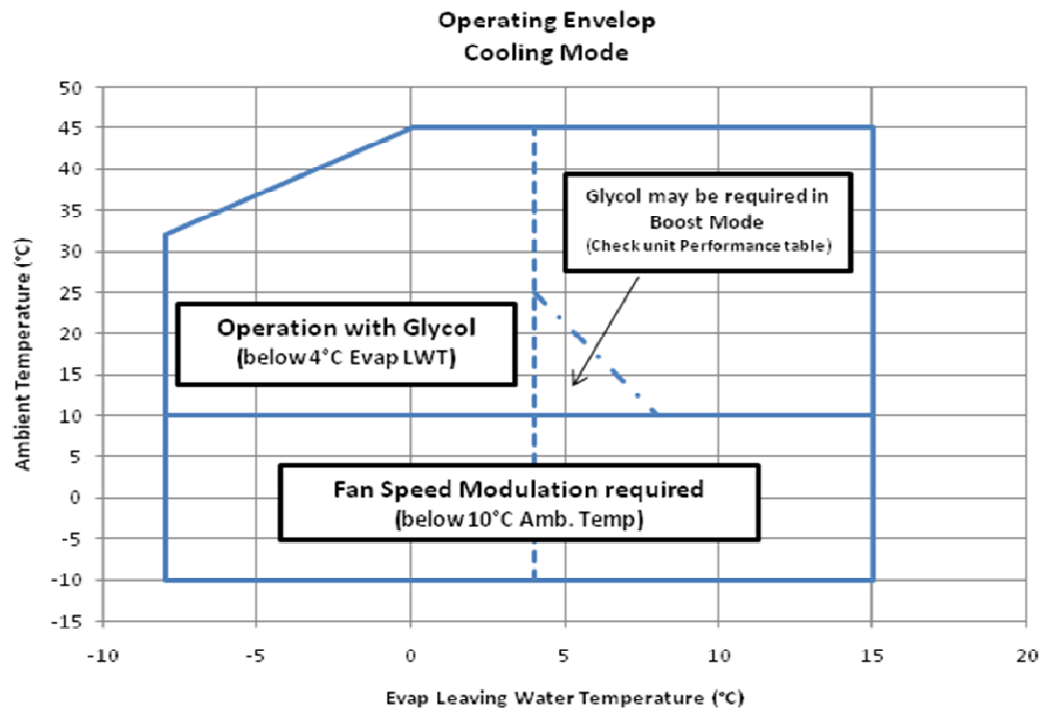
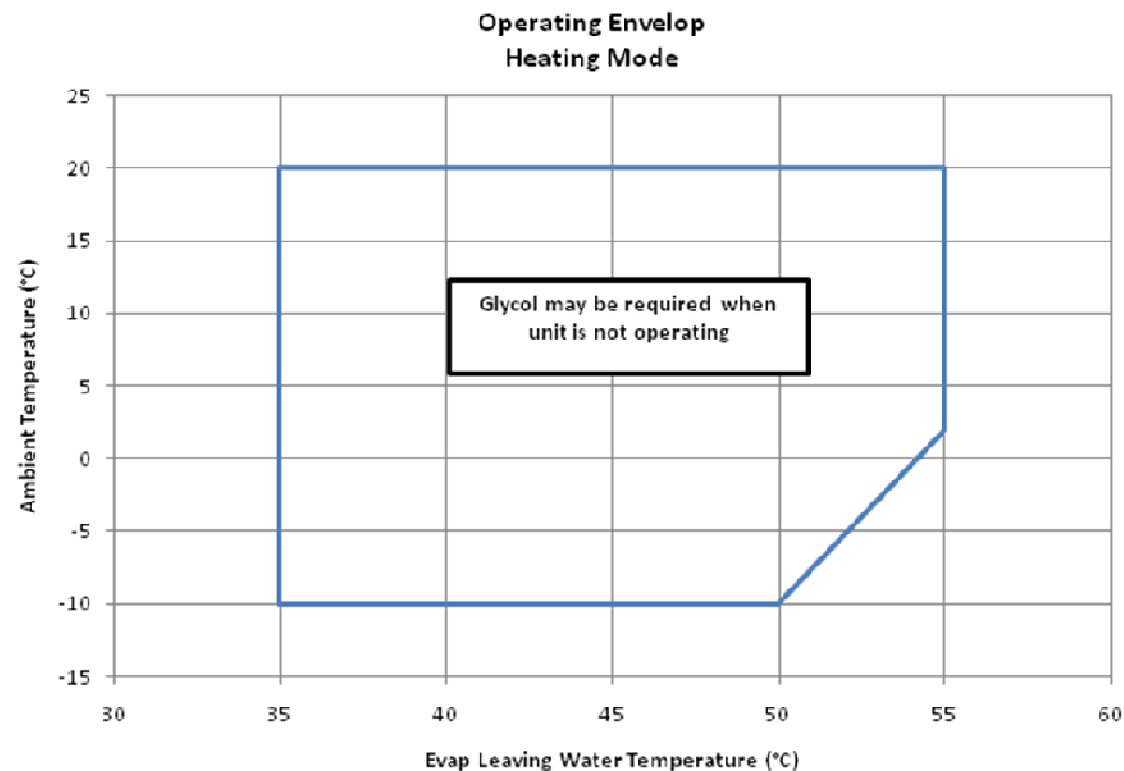


Figure 2 - Operating limits in heating mode - EWYD~BZSS / EWYD~BZSL





# 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 marked in yellow that are fixed to its base. 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 or addition of lubricating oil must be carried out by qualified personnel only.
- Sharp edges and the surface of the condenser section could cause injury. Avoid direct contact.
- Switch off the unit's power supply, by opening the main switch, before servicing the cooling fans and/or 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

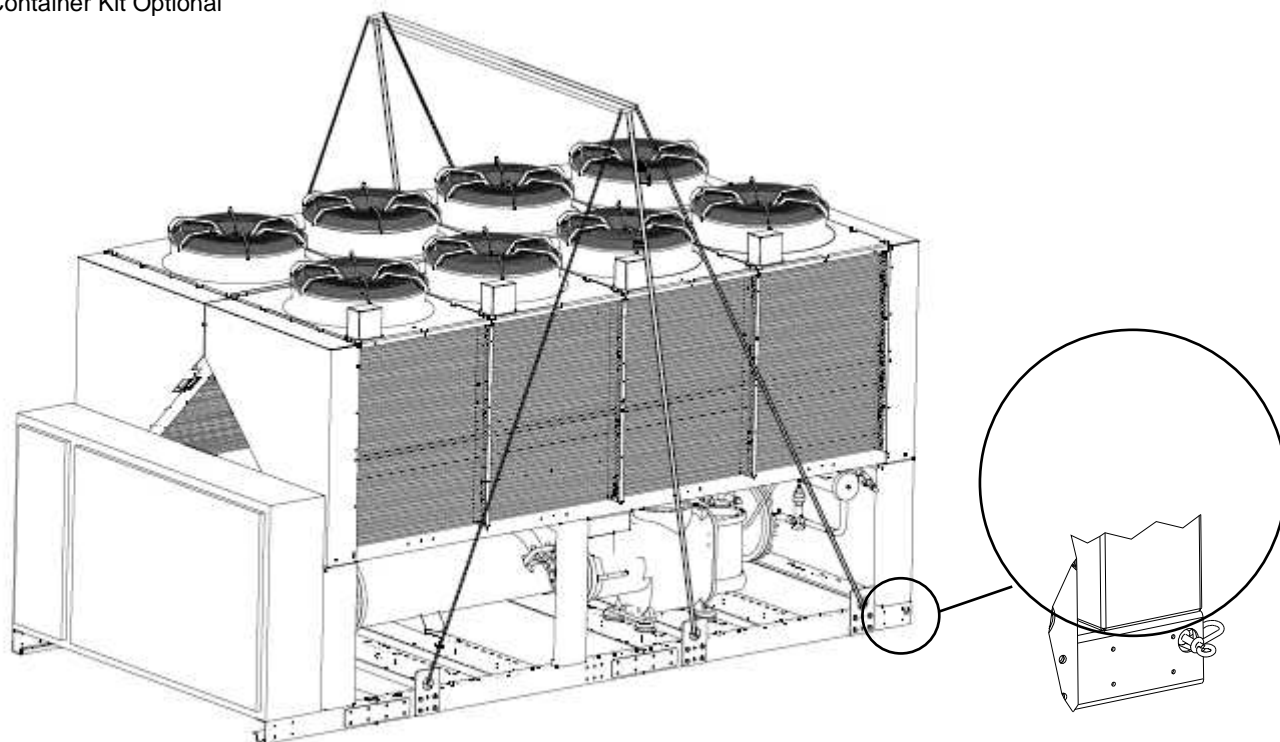
Avoid installing the chiller in areas that could be dangerous during maintenance operations, such as platforms without parapets or railings or areas not complying with the clearance requirements around the chiller.

## 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 marked in yellow. Only these points may be used for lifting the unit, as shown in the following figure.

Procedure for extracting the machine from the container.  
Container Kit Optional



**Figure 3 - Lifting the unit**

The number and the location of lifting points changes from model to model. 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 (pumps, heat recovery, copper condenser coils, etc.).

### **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 outdoors, either on roofs or on the ground, provided that the installation area is free of obstacles that could reduce air flow to the condensers bank.

The unit must be installed on a robust and perfectly plan foundation; should the machine be installed on balconies or roofs, it might be necessary to use weight distribution beams.

For installation on the ground, a strong cement base that is at least 250 mm wider and longer than the machine must be provided. Also, this base must be able 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 grids for the condenser and compressor sections.

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

- Avoid air flow recirculation.
- Make sure that there are no obstacles to hamper air flow.
- Air must circulate freely to ensure proper flow in and flow out.
- Make sure to provide a strong and solid foundation to reduce noise and vibrations as much as possible.
- Avoid installation in particularly dusty environments, in order to reduce soiling of condensers.
- The water in the system must be particularly clean and all traces of oil and rust must be removed. A mechanical water filter must be installed on the machine's inlet piping.

### Minimum space requirements

It is fundamental to respect minimum distances on all units in order to ensure optimum ventilation to the condenser. Limited installation space could reduce the normal air flow, thus significantly reducing the machine's performance and considerably increasing consumption of electrical energy.

When deciding where to position the machine and to ensure a proper air flow, the following factors must be taken into consideration: avoid any warm air recirculation and insufficient air supply to the air-cooled condenser.

Both these conditions can cause an increase of condensing pressure, which leads to a reduction in energy efficiency and refrigerating capacity. Thanks to the geometry of their air-cooled condensers, the units are less affected by poor air circulation conditions.

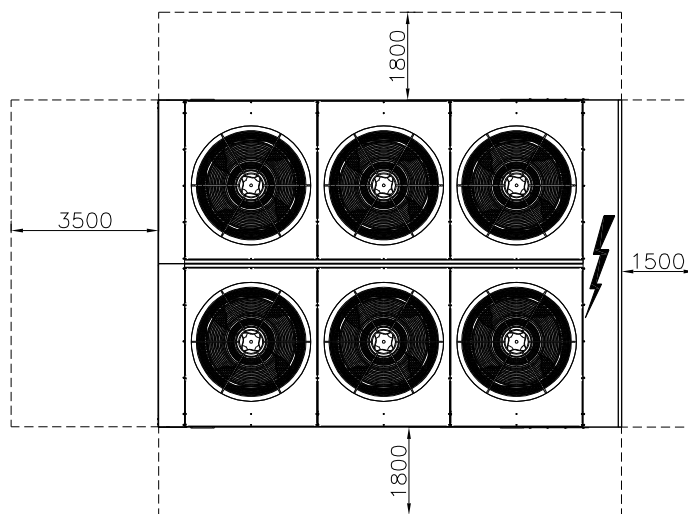
Also, the software has particularly the ability to compute the machine's operating conditions to optimise the load under abnormal operating circumstances.

Every side of the machine must be accessible for post-installation maintenance operations. Figure 4 shows the minimum space required.

Vertical air discharge must not be obstructed as this would significantly reduce capacity and efficiency.

If the machine is surrounded by walls or obstacles of the same height as the machine, it must be installed at a distance of at least 2500 mm. If these obstacles are higher, the machine must be installed at a distance of at least 3000 mm.

Should the machine be installed without observing the recommended minimum distances from walls and/or vertical obstacles, there could be a combination of warm air recirculation and/or insufficient supply to the air-cooled condenser which could cause a reduction of capacity and efficiency.

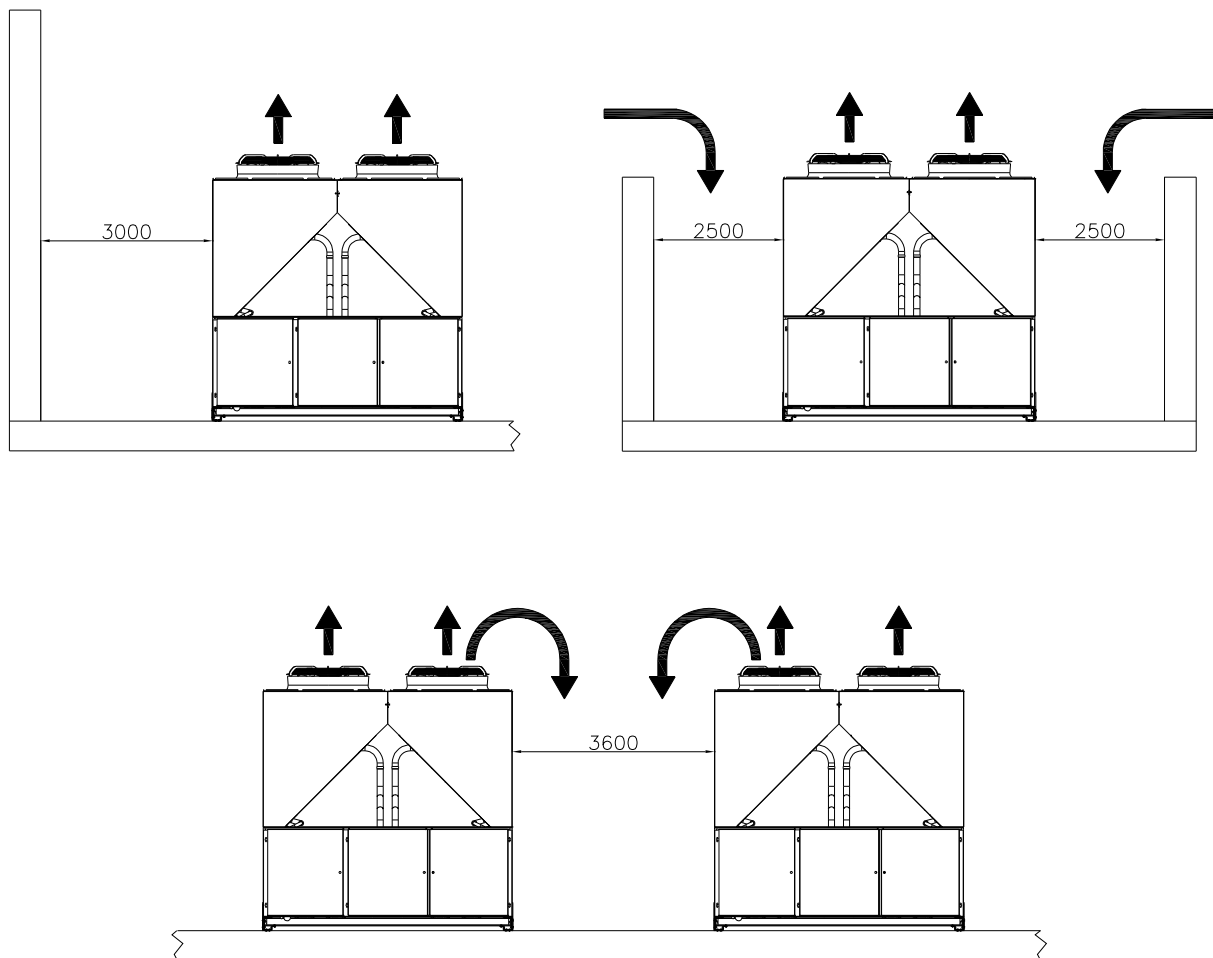


**Figure 4 - Minimum clearance requirements for machine maintenance**

In any case, the microprocessor will allow the machine to adapt itself to new operating conditions and deliver the maximum capacity available under any given circumstances, even if the lateral distance is lower than recommended.

When two or more machines are positioned side by side, a distance of at least 3600 mm between the respective condenser banks is recommended.

For further solutions, please consult Daikin technicians.



**Figure 5 - Minimum recommended installation clearances**

Distances shown in previous figures have not be considered a warranty for good installation; particular conditions (like venturi effects due to wind, very tall buildings, etc.) may cause air recirculation so affecting unit performances. It is a responsibility of the installer to assure that the unit condenser is fed with fresh air in any conditions

### 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.

### 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 should 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  $-25^{\circ}\text{C}$ . 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.

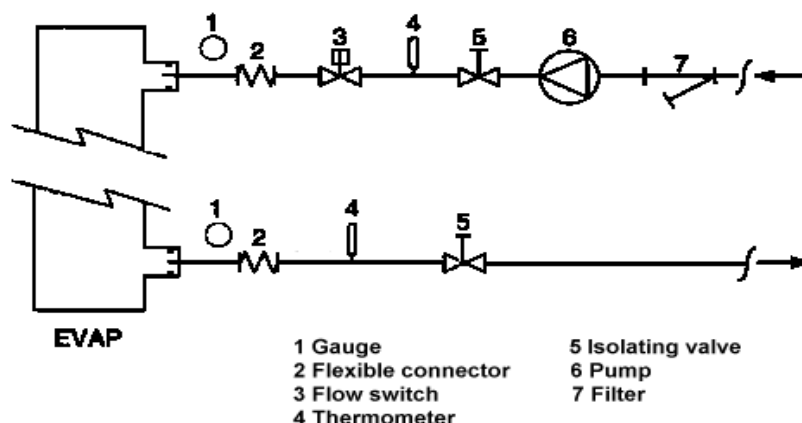


Figure 6 - Water piping connection for evaporator

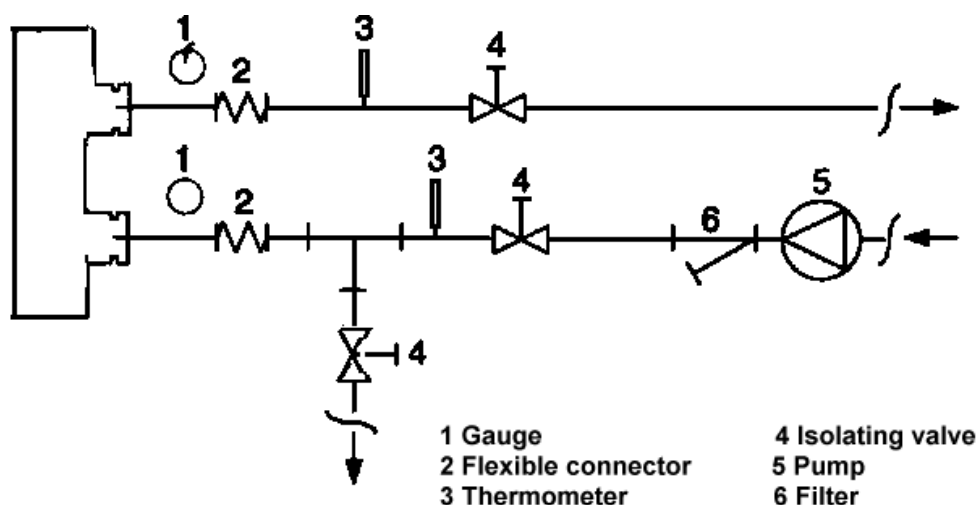


Figure 7 - Water piping connection for heat recovery exchangers

Legend translation

Gauge  
Flexible connector  
Flow switch  
Thermometer  
Isolating valve  
Pump  
Filter

Gauge  
Flexible connector  
Flow switch  
Thermometer  
Isolating valve  
Pump  
Filter

## ▲ 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.

**Table 1 - Acceptable water quality limits**

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

### Evaporator and recovery exchangers anti-freeze protection

All evaporators are supplied with a thermostatically controlled anti-freeze electrical resistance, which provides adequate anti-freeze protection at temperatures as low as –25°C. However, unless the heat exchangers are completely emptied and cleaned with anti-freeze solution, additional methods should also be used against freezing.

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

- 12 Continuous water flow circulation inside piping and exchangers
- 13 Addition of an appropriate amount of glycol inside the water circuit
- 14 Additional heat insulation and heating of exposed piping
- 15 Emptying and cleaning of the heat exchanger during the winter season

Partial heat recovery heat exchangers (desuperheaters) are not protected against freezing (no heater is installed).

## ▲ WARNING

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.

### Installing the flow switch

To ensure sufficient water flow through the evaporator, it is essential that a flow switch be installed on the water circuit. The flow switch can be installed either on the inlet or outlet water piping. The purpose of the flow switch is to stop the machine in the event of interrupted water flow, thus protecting the evaporator from freezing.

The flow switch on the heat recovery circuit prevents the machine from shutting down due to high pressure.

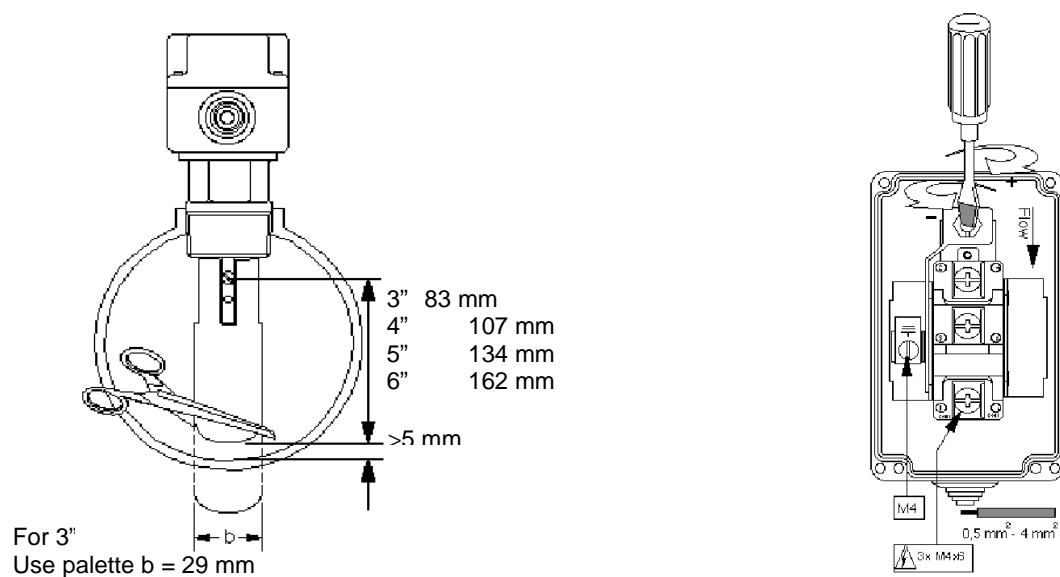
The flow switch must be a paddle-type flow switch that is suitable for heavy-duty outdoor applications (IP67) and pipe diameters in the range of 1" to 6".

The flow switch is provided with a clean contact which must be electrically connected to terminals 8 and 23 of terminal board M3 (check the machine's wiring diagram for further information).

The flow switch must be adjusted to intervene (switch off the unit) when the flow rate is lower than no less than 50% of nominal flow rate.

For further information regarding device installation and settings, please read the instruction leaflet in the device box.

## Adjusting the flow switch's trigger sensitivity

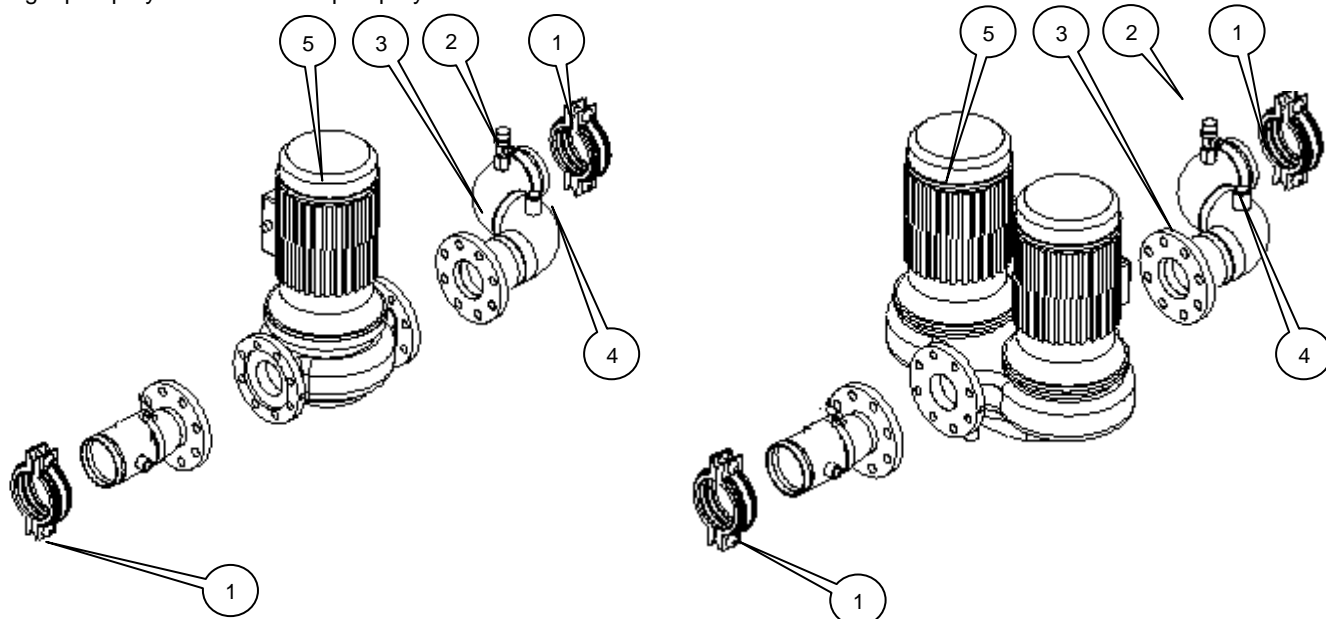


**Figure 8 - Adjusting the safety flow switch**

## Hydronic kit (optional)

The optional hydronic kit intended for use with this series of machines (except 072.2÷079.2 LN units) includes either a single in-line pump or a twin in-line pump. According to the choice made when ordering the machine, the kit could be configured as in the following figure.

Single-pump hydronic kit    Twin-pump hydronic kit



- 1 Victaulic joint
- 2 Water safety valve
- 3 Connecting manifold
- 4 Anti-freeze electrical resistance connection (not supplied)
- 5 Water pump (single or twin)

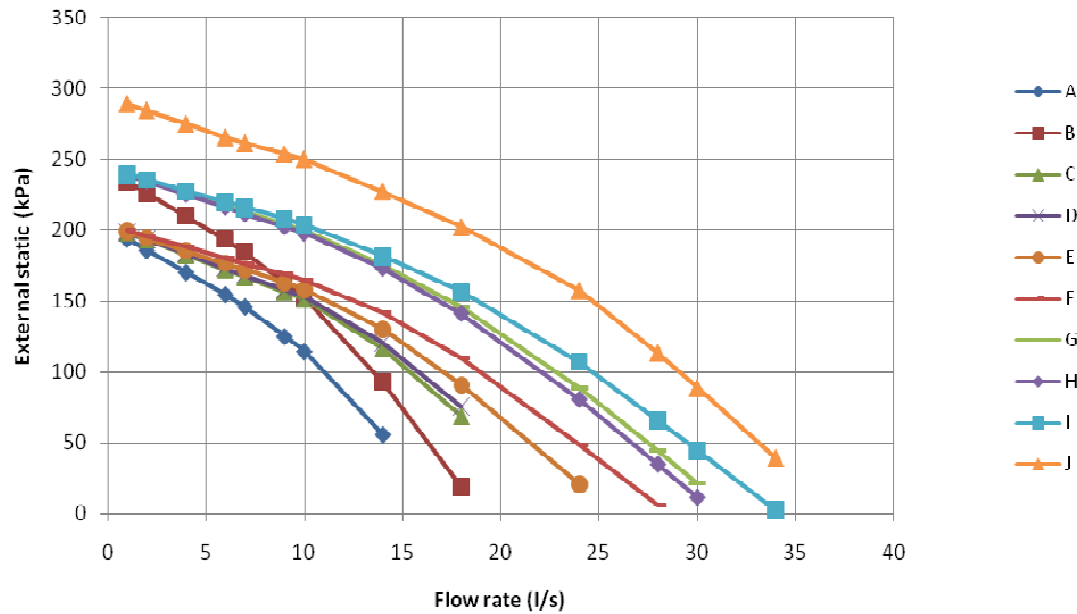
N.B.: Components on some machines could be arranged differently.

**Figure 9 - Single- and twin-pump hydronic kit**

Expansion tank and automatic water refilling group, mandatory in any water loop, are not supplied with the hydronic kit. It is a responsibility of the installer to size and install correctly these components

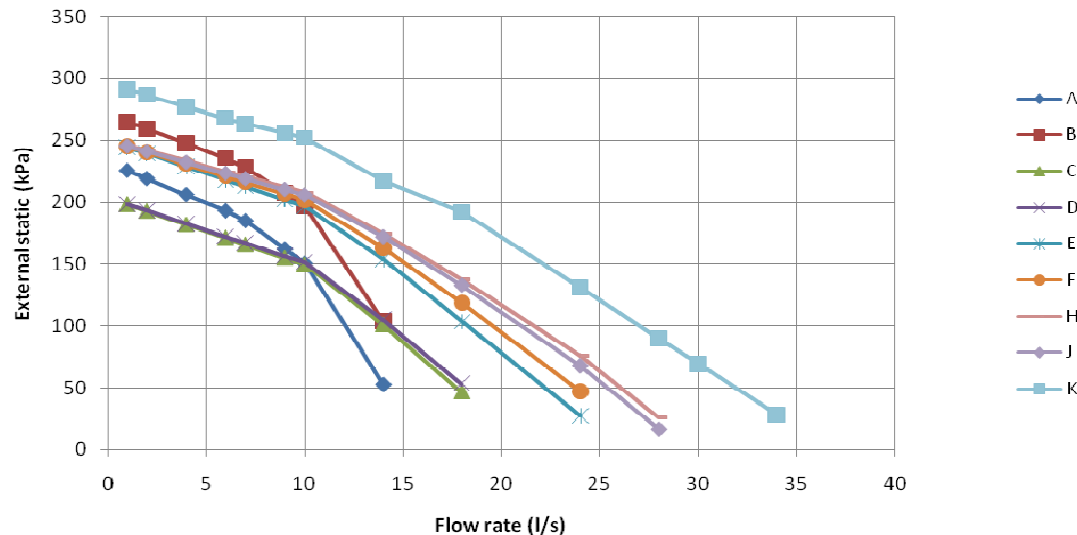
Figure 10 - Low lift water pumps kit (option on request) - Lift diagrams

EWYD~BZSS / EWYD~BZSL with low lift single pump



Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL
A	250	250	E	370	360	H	460	450
B	270	270		380	370	I	510	490
C	290	290	F	410	400	J	520	510
D	320	320	G	440	430		580	570
	340	330		370	360			

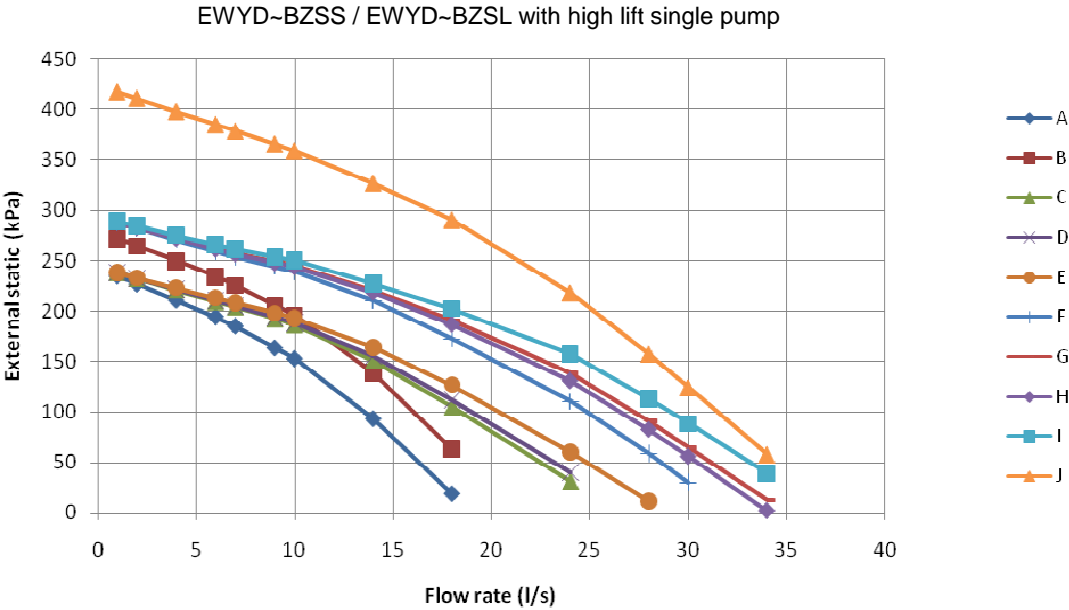
EWYD~BZSS / EWYD~BZSL with low lift twin pump



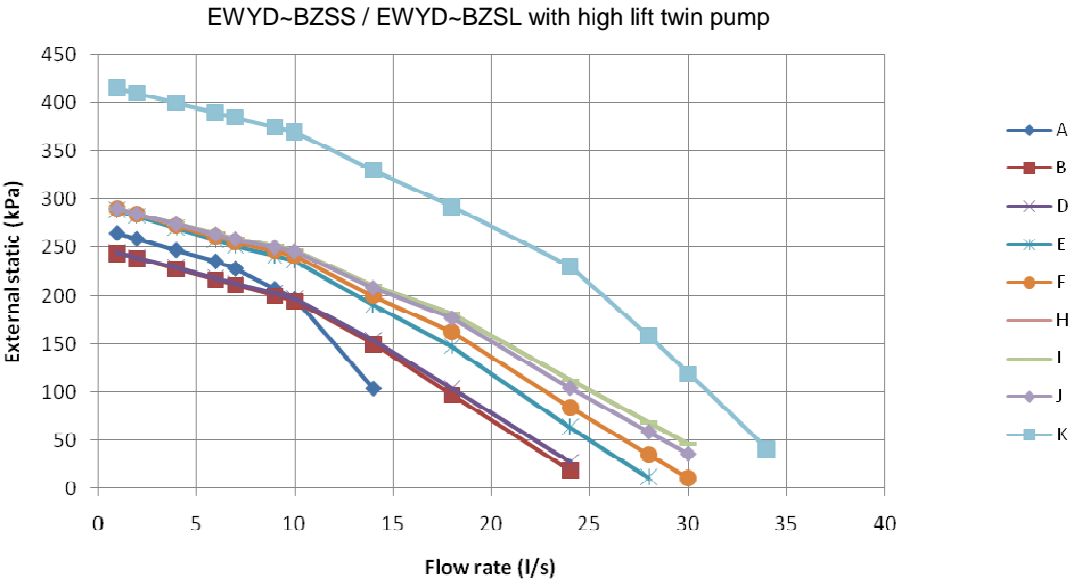
Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL
A	250	250	F	370	360	K	510	490
B	270	270		380	370		520	510
C	290	290	H	410	400		580	570
D	320	320		440	430			
E	340	330	J	460	450			



Figure 11 - High lift water pumps kit (option on request) - Lift diagrams



Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL
A	250	250	E	370	360	I	510	490
B	270	270	F	380	370	J	520	510
C	290	290	G	410	400		580	570
D	320	320		440	430			
	340	330	H	460	450			



Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL
A	250	250	F	370	360	K	510	490
B	270	270		380	370		520	510
	290	290	H	410	400		580	570
D	320	320	I	440	430			
E	340	330	J	460	450			

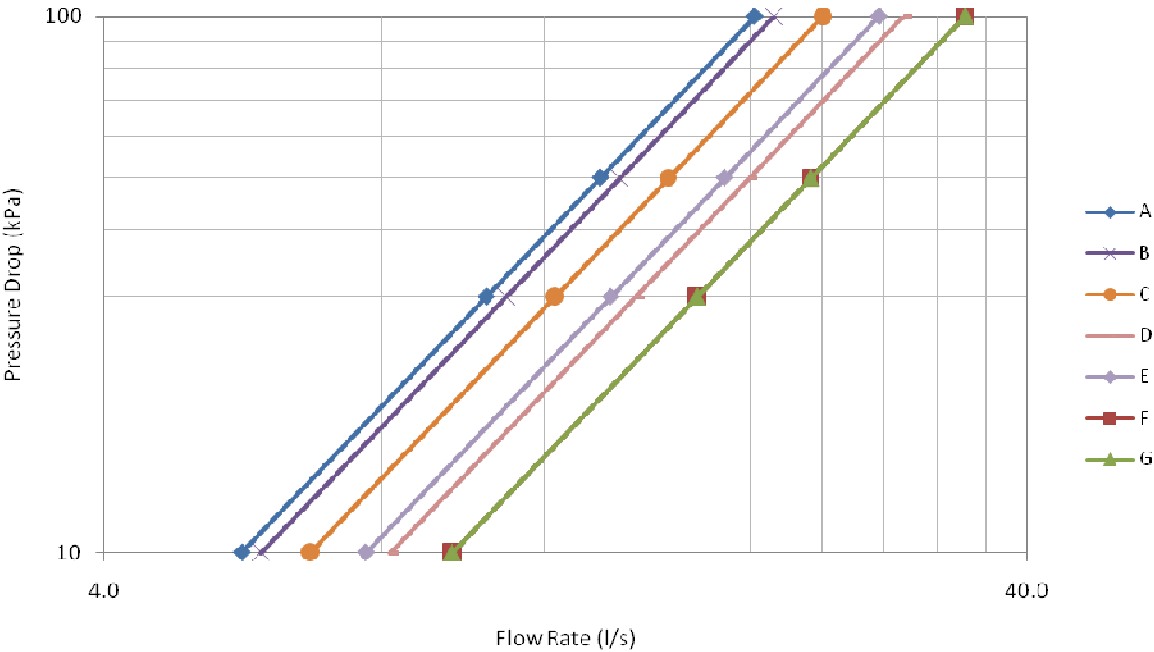
Refrigerating circuit safety valves

Each system comes with safety valves that are installed on each circuit, 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.

**⚠ WARNING**

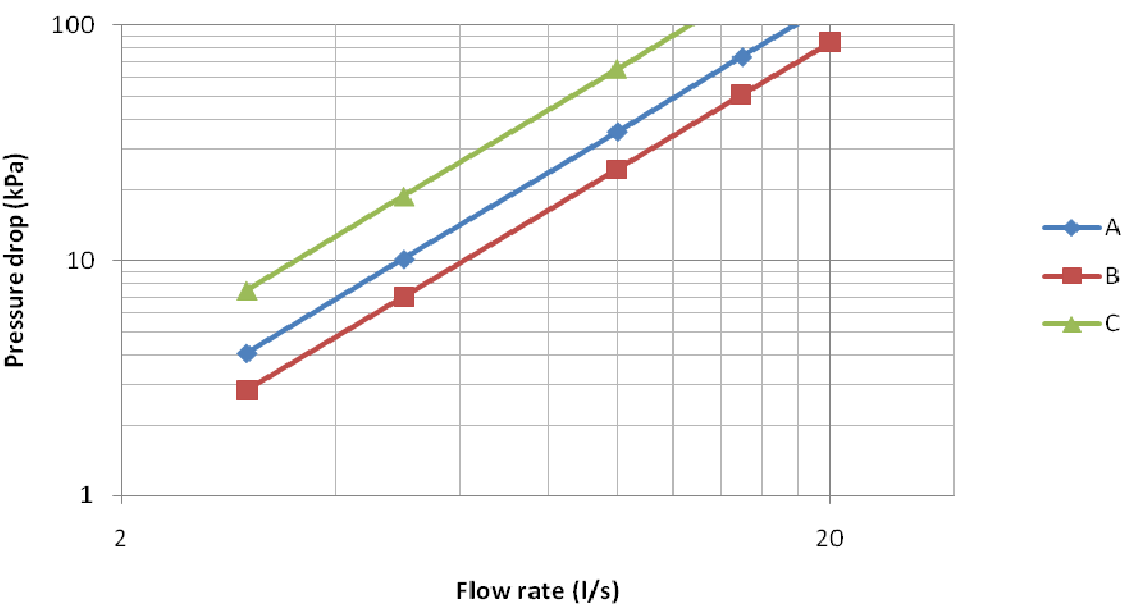
This unit is designed for installation outdoors. However, check that there is sufficient air circulation through the machine. If the machine is installed in closed or partly covered areas, possible damage from inhalation of refrigerant gases must be avoided. Avoid releasing the refrigerant into the atmosphere. 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.

Figure 12 - Evaporator pressure drop



Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL	Label	EWYD~BZSS	EWYD~BZSL
A	250	250	C	370	360	F	510	490
	270	270		380	370		520	510
	290	290	D	410	400	G	580	570
B	320	320		440	430			
	340	330	E	460	450			

Figure 13 - Partial heat recovery pressure drop



EWYD~ BZSS	EWYD~ BZSL	Circ #1	Circ #2	Circ #3
250	250	A	A	
270	270	A	A	
290	290	A	A	
320	320	A	B	
340	330	B	B	
370	360	B	B	
380	370	B	B	
410	400	B	C	
440	430	C	C	
460	450	A	A	A
510	490	B	B	A
520	510	B	B	B
580	570	B	B	B

# 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. 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 5 minutes.

### 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.

## 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)
- Thermal-magnetic circuit breaker of suitable size (please see electrical data)

## Electrical wiring

Power circuit:

Connect electrical power supply cables to the terminals of the general circuit breaker located on the machine's terminal board. The access panel must have a hole of appropriate diameter for the cable used and its cable gland. A flexible conduit can also be used, containing the three power phases plus ground.

In any case, absolute protection against any water penetrating through the connection point must be ensured.

Control circuit:

Every machine of the series is supplied with an auxiliary 400/ 230V control circuit transformer. No additional cable for the control system power supply is thus required.

Only if the optional separate accumulation tank is requested, the electrical anti-freeze resistance must have a separate power supply.

## Electrical heaters

The machine has an electrical anti-freeze heater that is installed directly in the evaporator. Each circuit also has an electrical heater installed in the compressor, whose purpose is to keep the oil warm thus preventing the presence of liquid refrigerant mixed with the oil in the compressor. Obviously, the operation of the electrical heaters is guaranteed only if there is a constant power supply. If it is not possible to keep the machine powered when inactive during winter, apply at least two of the procedures described in the "Mechanical installation" section under the paragraph "Antifreeze protection of evaporator and heat recovery exchangers".

### Electrical power supply to the pumps

On request, for versions where this is possible, a kit can be installed in the machine for fully-cabled, microprocessor-controlled pumping. No additional control is required in this case.

**Table 2 - Electrical data of optional pumps**

Single pump

Version	Unit model	Motor power KW		Current A	
		Low lif	High lif	Low lif	High lift
EWYD-BZSS	250	2.2	3.0	5.0	6.3
	270	3.0	4.0	6.3	7.7
	290	4.0	5.5	7.7	10.4
	320	4.0	5.5	7.7	10.4
	340	4.0	5.5	7.7	10.4
	370	4.0	5.5	7.7	10.4
	380	4.0	7.5	7.7	13.9
	410	4.0	7.5	7.7	13.9
	440	5.5	7.5	10.4	13.9
	460	5.5	7.5	10.4	13.9
	510	5.5	7.5	10.4	13.9
	520	7.5	11.0	13.9	20.2
	580	7.5	11.0	13.9	20.2

Twin pumps

Version	Unit model	Motor power KW		Current A	
		Low lif	High lif	Low lif	High lift
EWYD-BZSL	250	3.0	4.0	6.3	7.7
	270	4.0	5.5	7.7	10.4
	290	4.0	5.5	7.7	10.4
	320	4.0	5.5	7.7	10.4
	330	5.5	7.5	10.4	13.9
	360	5.5	7.5	10.4	13.9
	370	5.5	7.5	10.4	13.9
	400	5.5	7.5	10.4	13.9
	430	5.5	7.5	10.4	13.9
	450	5.5	7.5	10.4	13.9
	490	7.5	11.0	13.9	20.2
	510	7.5	11.0	13.9	20.2
	570	7.5	11.0	13.9	20.2

### Water pump control

Connect the control contactor coil power supply to terminals 27 and 28 (pump #1) and 401 and 402 (pump 2) located on terminal board M3, and install the contactor on a power supply having the same voltage as the pump contactor coil. The terminals are connected to a clean microprocessor contact.

The microprocessor contact has the following commutation capacity:

Maximum voltage: 250 Vac

Maximum current: 2A Resistive - 2A Inductive

Reference standard: EN 60730-1

The wiring described above allows the microprocessor to manage the water pump automatically. It is good practice to install a clean status contact on the pump's thermal-magnetic circuit breaker and to connect it in series with the flow switch.

**Alarm relays – Electrical wiring**

The unit has a clean-contact digital output that changes state whenever an alarm occurs in one of the refrigerant circuits. Connect this signal to an external visual, sound alarm or to the BMS in order to monitor its operation. See the machine's wiring diagram for wiring.

**Unit On/ Off remote control – Electrical wiring**

The machine has a digital input that allows remote control. A startup timer, a circuit breaker or a BMS can be connected to this input. Once the contact has been closed, the microprocessor launches the startup sequence by first turning on the first water pump and then the compressors. When the contact is opened the microprocessor launches the machine shutdown sequence. The contact must be clean.

**Double Setpoint – Electrical wiring**

The Double Setpoint function allows to change over the unit setpoint between two predefined values in the unit controller by interposing a circuit breaker. An example of an application is ice production during the night and standard operation during the day. Connect a circuit breaker or timer between terminals 5 and 21 of terminal board M3. The contact must be clean.

**External water Setpoint reset – Electrical wiring (Optional)**

The machine's local setpoint can be modified by means of an external analogue 4-20mA signal. Once this function has been enabled, the microprocessor allows to modify the setpoint from the set local value up to a differential of 3°C. 4 mA correspond to 0°C differential, 20mA correspond to the setpoint plus the maximum differential.

The signal cable must be directly connected to terminals 35 and 36 of the M3 terminal board.

The signal cable must be of the shielded type and must not be laid in the vicinity of power cables, so as not to induce interference with the electronic controller.

**Unit limitation – Electrical wiring (Optional)**

The machine's microprocessor allows to limit the capacity according to two different criteria:

- Load limitation: The load can be varied by means of a 4-20mA external signal from a BMS.

The signal cable must be directly connected to terminals 36 and 37 of the M3 terminal board.

The signal cable must be of the shielded type and must not be laid in the vicinity of the power cables, so as not to induce interference with the electronic controller.

- Current limitation: The machine's load can be varied by means of a 4-20mA signal from an external device. In this case, current control limits must be set on the microprocessor so that the microprocessor transmits the value of the measured current and limits it.

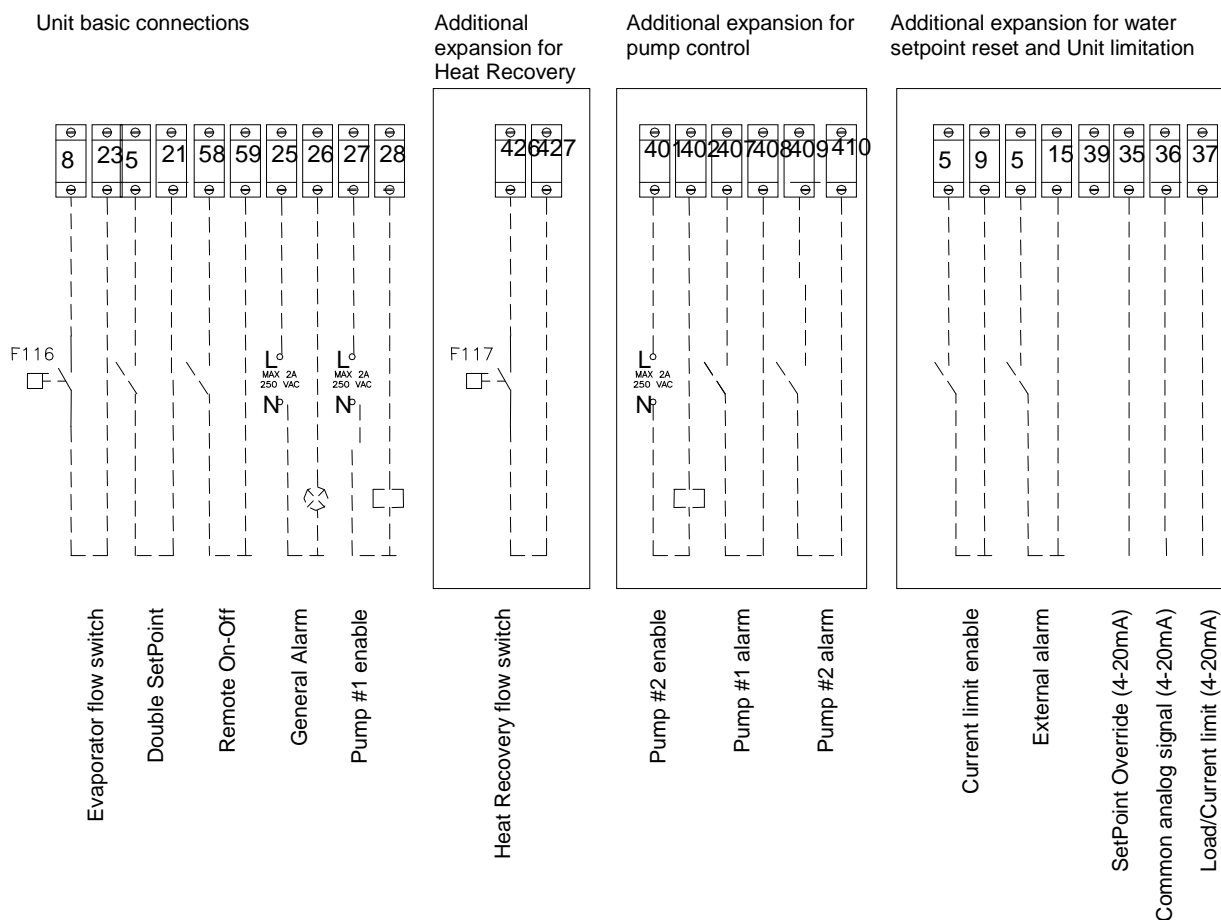
The signal cable must be directly connected to terminals 36 and 37 of the M3 terminal board.

The signal cable must be of the shielded type and must not be laid in the vicinity of the power cables, so as not to induce interference with the electronic controller.

A digital input allows to enable the current limitation at the desired time. Connect the enabling switch or the timer (clean contact) to terminals 5 and 9.

Attention: the two options cannot be enabled simultaneously. Setting one function excludes the other.

**Figure 14 - User connection to the interface M3 terminal boards**



### The VFD and related problems

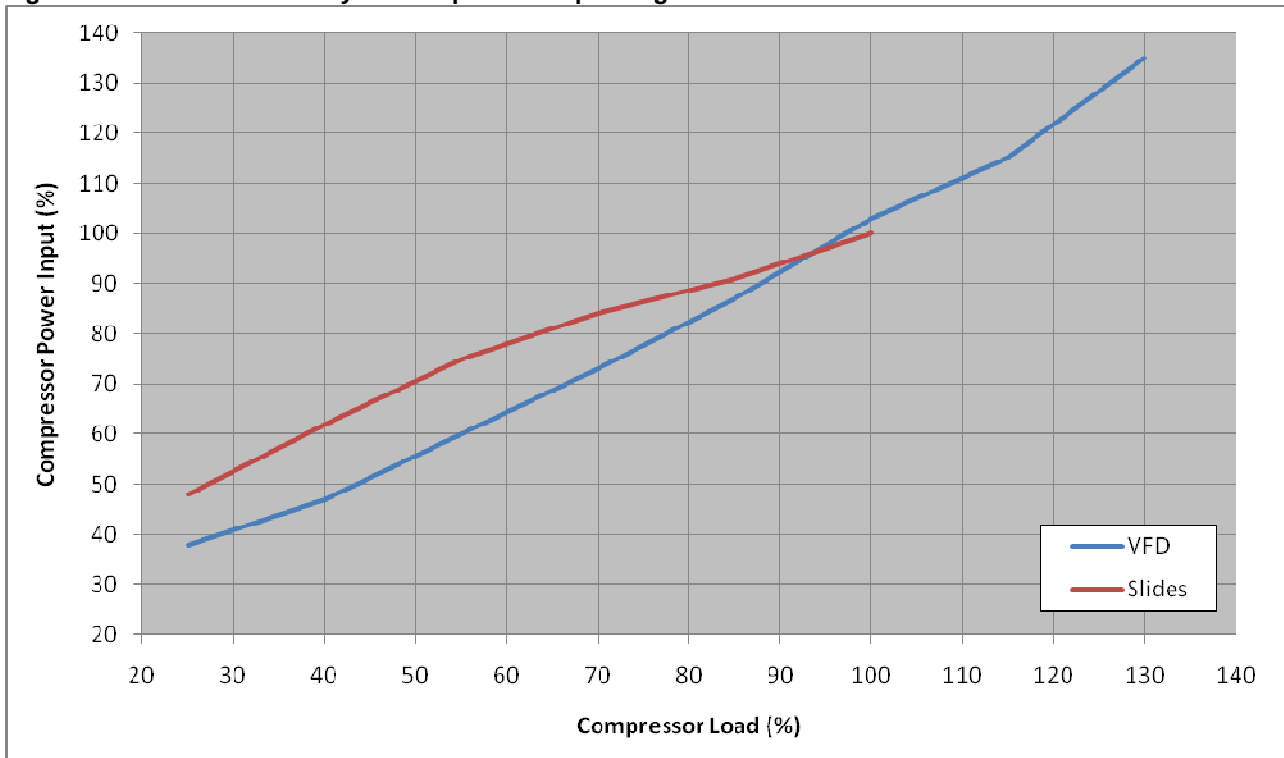
The units described in this manual use a VFD (Variable Frequency Driver) to vary the compressor rotation speed and consequently the refrigerant charge generated, maintaining the efficiency of the compressor itself at extremely high levels compared to other methods of capacity unloading.

Fig. 12 illustrates the power absorbed by a typical single-screw compressor, depending on the load developed by the compressor, in the classic solution of unloading using slides and with speed variation

Notice how the input power is always lower (by up to 30%) in the case of speed variation compared to the use of unloading slides.

Furthermore, in the case of speed variation, the compressor can rotate faster than its nominal speed and thus develop a load greater than 100%, which is obviously impossible with a fixed speed rotation, thus recovering loss in capacity due to unfavourable environmental conditions, such as low ambient temperature.

**Figure 15 - Power absorbed by the compressor depending on the load**



### The operating principle of the VFD

The VFD (also known as an “inverter”) is an electronic power device designed to vary the speed of rotation of induction motors.

The motors revolve at a practically fixed rpm speed which depends only on the frequency of the power supply ( $f$ ) and on the number of poles ( $p$ ), as per the following formula:

$$rpm = \frac{f \cdot 60}{p}$$

(In fact, for the motor to produce torque, the rotation speed, known as the speed of synchronism, must be slightly less than that calculated above.)

To vary the speed of rotation of an induction motor, the supply frequency of the same therefore needs to vary.

The VFD does this, starting with a fixed grid frequency (50 Hz for European power grid, 60 Hz for the US) operating in three steps:

step one involves a rectifier to transform the alternating current into direct current, which is typically achieved using a diode rectifier bridge (leading solutions use bridges with SCR)

step two involves charging the capacitors (direct current bus, also known as a DC-Link)

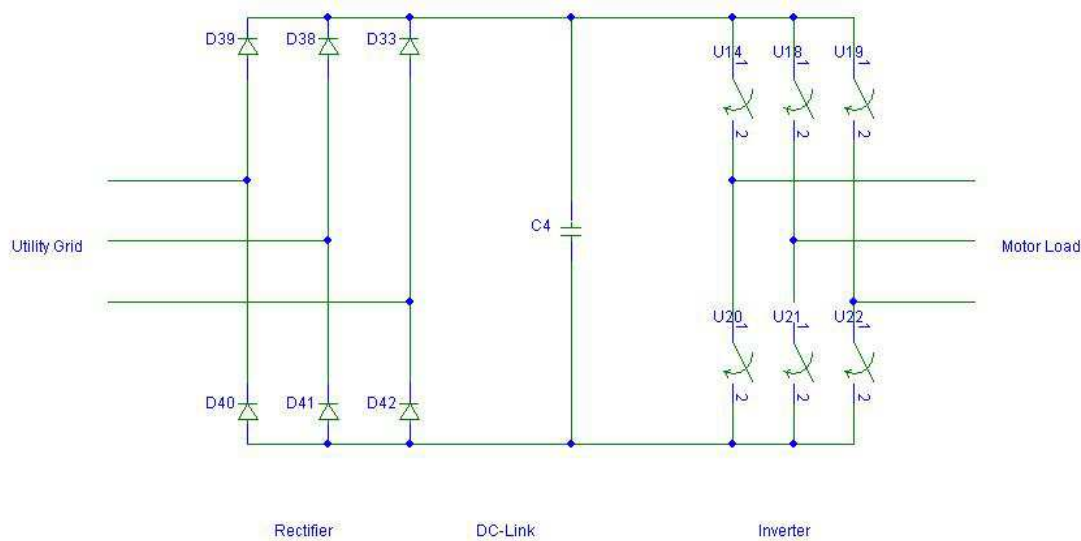
step three involves the reconstruction of the alternating current (a genuine inverter) by means of a transistor bridge (normally IGBT) with variable voltage and frequency values, set by the control system. The voltage is in fact the result of a high-frequency PWM modulation (in the range of a few kHz) from which the fundamental variable frequency component is taken (typically 0-100 Hz).

### The problem with harmonics

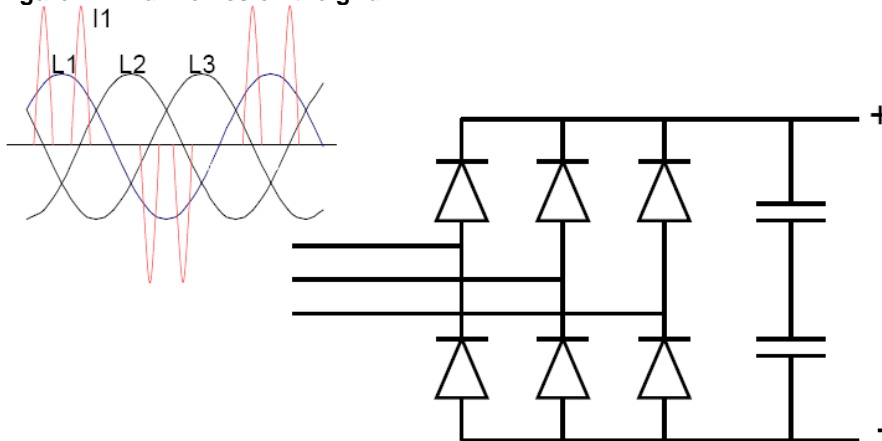
The rectifier bridge of a VFD requires current from the grid that is not purely sinusoidal. Indeed, due to the presence of diodes, which are non-linear components, the current absorbed by a rectifier bridge has a higher frequency than the frequency of the power grid. Such components are known as harmonics: in the case of a power supply at 50 Hz, the component at 50 Hz is defined as the fundamental harmonic, while the second harmonic is the component at 100 Hz, the third harmonic is the component at 150 Hz, and so on. (In the case of a power supply at 60 Hz, the fundamental component is that at 60 Hz, the second that at 120 Hz, the third is that at 180 Hz, and so on.)



**Figure 16 - Typical diagram of a VFD**



**Figure 17 - Harmonics on the grid**



Since the rectifier bridge sees before it a direct current stage, the current taken is practically in phase with the voltage. However, the formula below no longer applies

$$P_{act} = \sqrt{3} \cdot V \cdot I \cdot \cos \varphi \quad \text{NO}$$

because the harmonic components in excess of the fundamental harmonic do not contribute to the active power. Several values therefore need to be defined:

Displacement Power Factor

$$DPF = \cos \varphi$$

Power Factor (total power)

$$PF = \frac{I_1}{I} \cdot DPF$$

The Power Factor takes into account both phase displacement as well as harmonic content, expressed as a ratio of the fundamental component  $I_1$  to the current and the overall effective value. It actually expresses which part of the input current is converted into active power. It is worth mentioning that in the absence of an inverter or electronic devices in general, the DPF and PF are the same.

Moreover, many electricity boards only take into account the DPF, since the harmonic content is not measured, but only the absorption of active and reactive power.

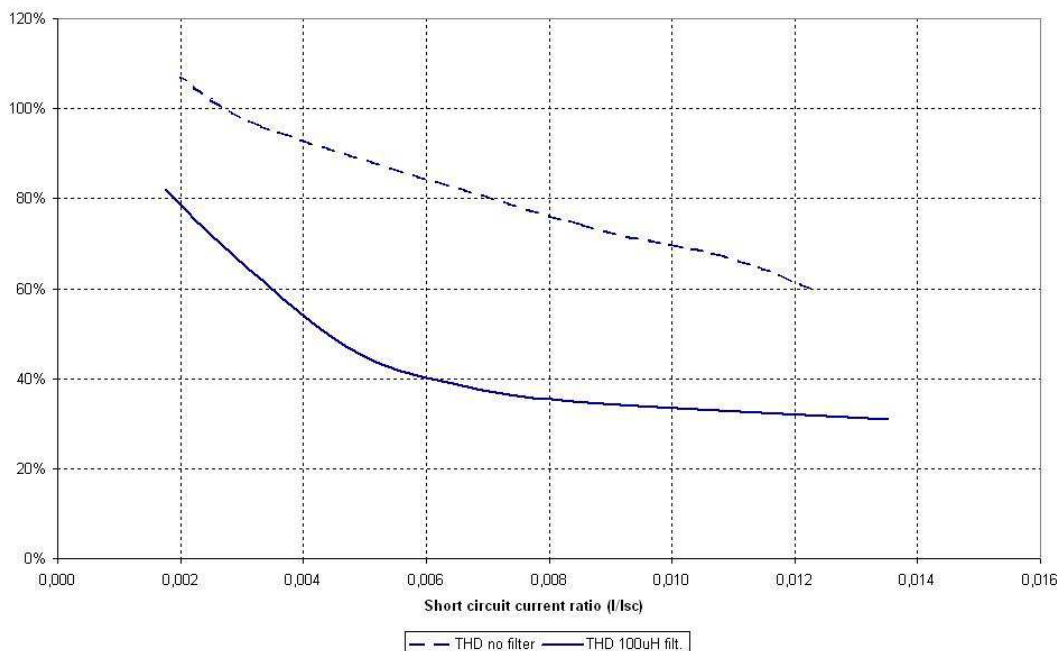
Another measuring index for the harmonics in the grid is provided by the harmonic distortion coefficient  $THD_i$  (Total Harmonic Distortion):

$$THD_i = \sqrt{\frac{I^2 - I_1^2}{I_1^2}}$$

In a VFD without remedial devices, harmonic distortion can reach values of more than 100% (i.e. the harmonic components can, all together, reach more than the fundamental component).

To reduce the harmonic content of the current (and so the THD), the units illustrated in this manual are equipped with line inductance. Since the harmonic content depends on the ratio of the current required by the VFD to the short-circuit current in the wiring point, for a given plant, the THD varies according to the machine absorption. For example, fig. 14 illustrates the value of the THD with or without a filter inductance, for different values of the ratio of VFD current to the short-circuit current in the wiring point.

**Figure 18 - Harmonic content with and without line inductance**

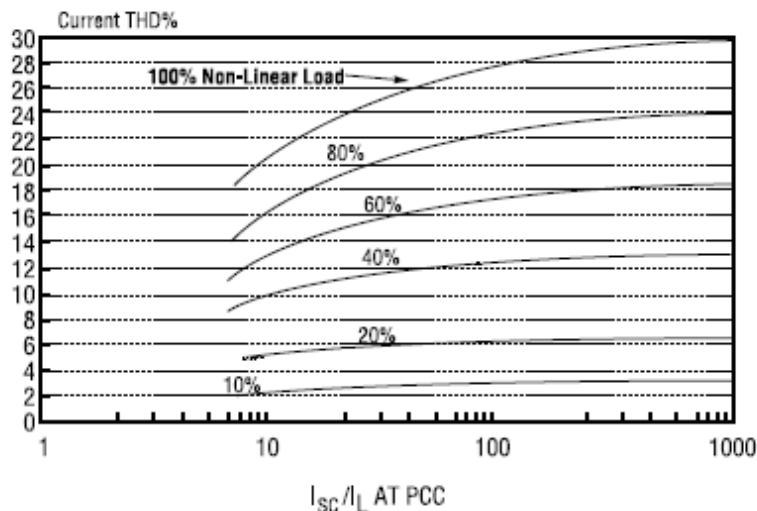


It must however be mentioned that the harmonic distortion drops in value if other utilities are connected at the connection point (PCC): the greater the weight of these utilities, the smaller the current distortion will be. Fig. 16 illustrates the total harmonic distortion in the point where the unit is wired to the grid, according to the ratio between the short circuit current in the connection point ( $I_{sc}$ ) and the current drawn by the unit ( $I_L$ ) and the percentage power absorbed by the unit compared to the total power supplied by the grid at the connection point.

Notice how the harmonic distortion at the connection point can feature very low values (below 5%) when the short circuit current is less than 20 times the unit current and this makes up a percentage of no more than 20% of the total load of the grid.

In any case, the harmonic distortion introduced by the unit must be evaluated in relation to the specific application, subject to a detailed analysis of the entire grid and of the loads powered.

**Figure 19 - Harmonic content varying according to the percentage of non-linear loads**



# 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. Read the VFD manual carefully.

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.

## Description of the machine

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

- **Compressor:** The state-of-the-art single-screw compressor of the Fr3100 series is of the semi-hermetic type and utilises gas from the evaporator to cool the motor and allow optimal operation under any expected load conditions. The oil-injection lubrication system does not require an oil pump as oil flow is ensured by the pressure difference between delivery and suction. In addition to ensuring lubrication of ball bearings, oil injection dynamically seals the screw, thus enabling the compression process.

- **Water heat exchanger:** Direct-expansion shell and tube heat exchanger for all models, it works as an evaporator when the machine is in chiller mode and as a condenser when it is in heat pump mode.

- **Air heat exchanger:** Finned-pack type with internally micro-finned tubes, that expand directly on the high-efficiency open fin; it works as an evaporator when the machine is in chiller mode and as a condenser when it is in heat pump mode.

- **Fan:** High-efficiency axial type. Allows quiet operation of the system, even during adjustment.

- **Expansion valve:** The standard machine has an electronic expansion valve, which is controlled by an electronic device called a Driver that optimises its operation.

- **4-way valve:** Allows the compressor delivery to be shunted towards the air heat exchanger for water chiller mode or towards the water heat exchanger for water heater mode.

- **VFD:** This is an electronic power device that allows the continuous variation of the compressor rotation speed, ensuring the modulation of the load provided with the utmost efficiency.

## Description of the refrigeration cycle

The low-temperature refrigerant gas from the evaporator is drawn by the compressor through the electric motor, which gets cooled by the refrigerant. It is subsequently compressed and during this process the refrigerant mixes with the oil from the oil separator. The oil introduced is used to lubricate both the seal between the screw and the shell as well as between the screw and the star.

The high-pressure oil-refrigerant mixture is introduced into the centrifuge-type high-efficiency oil separator, where the oil is separated from the refrigerant. The oil accumulated on the bottom of the separator is forced by the pressure difference back into the compressor while the oil-free refrigerant is sent to the condenser where the superheated refrigerant vapour cools down and starts to condense and then the refrigerant subcools.

The heat taken from the fluid during the de-superheating, condensation and subcooling phase is transferred to the outside air in chiller mode or to the water – which is thus heated - in heat pump mode.

The subcooled fluid flows through the high-efficiency filter dryer and then it reaches the expansion element (expansion valve) through which a pressure drop takes place resulting in the vaporisation of part of the refrigerant liquid.

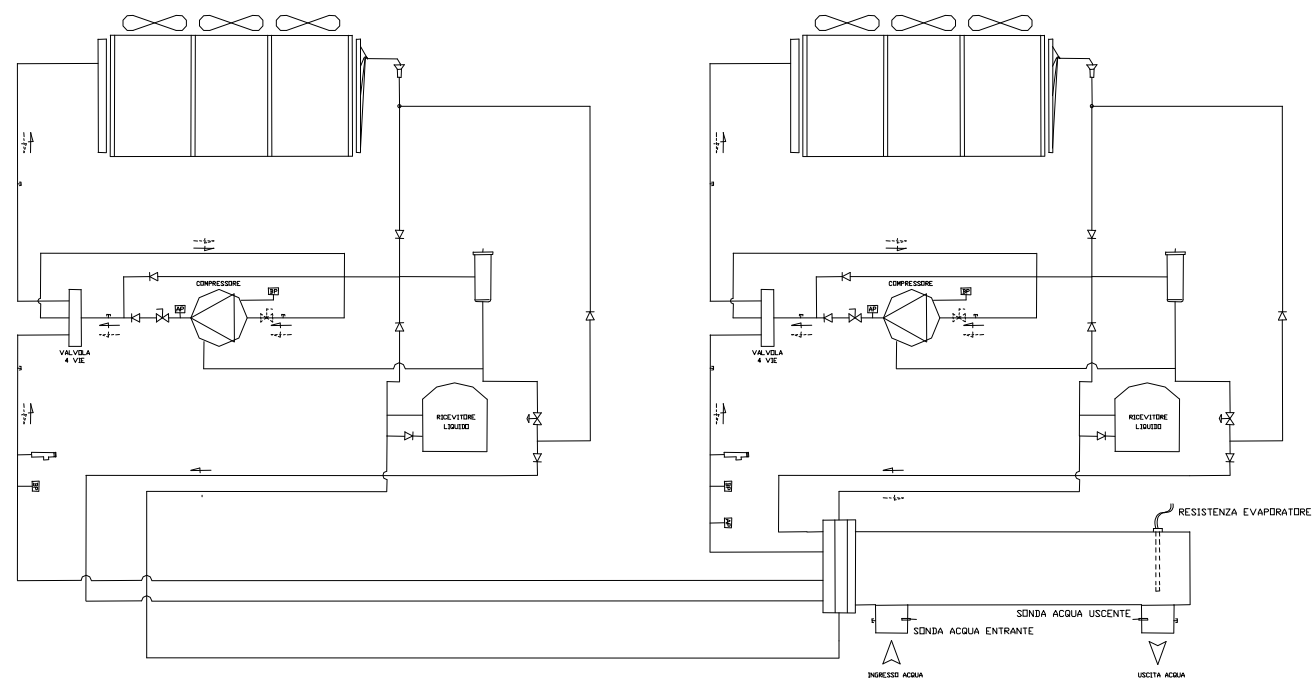
The result at this point is a low-pressure and low-temperature liquid-gas mixture entering the evaporator, where it takes the heat required for vaporisation.

After the liquid-vapour refrigerant has been evenly distributed into the evaporator tubes, it exchanges heat with the water to be cooled (in chiller mode), thus reducing the water temperature, or with the outside air (in heat pump mode) while it gradually gets completely vaporised and then superheated.

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.

In the heat pump unit, the water heat exchanger can be used to cool (chiller mode) or heat (heat pump mode) the water that flows through it. To perform both functions (which obviously cannot be carried out simultaneously, and so the desired operating mode needs to be selected), the water heat exchanger needs to be able to work as an evaporator (chiller mode) or as a condenser (heat pump mode). This is accomplished thanks to a special valve (4-way valve) designed to shunt the fluid on the oil separator outlet towards the water heat exchanger (in chiller mode) or towards the water heat exchanger (in heat pump mode), making it work as a condenser and connecting the other heat exchanger (water heat exchanger in chiller mode and air heat exchanger in heat pump mode) onto the compressor suction, making it work as an evaporator. The difference in internal volume between an air heat exchanger and a water heat exchanger makes it necessary for the circuit to feature an element (liquid receiver) designed to house the difference in liquid in both operating modes.

Figure 20 - Refrigeration cycle



### LEGENDA

	VALVOLA RITEGNO		PRESSOSTATO BASSA PRESSIONE
	ATTACCO 1/4" SAE		TRASDUTTORE ALTA PRESSIONE
	VALVOLA DI SICUREZZA		RUBINETTO LINEA LIQUIDO
	VALVOLA DI ESPANSIONE		RUBINETTO DI ASPIRAZIONE (OPTIONAL)
	PRESSOSTATO ALTA PRESSIONE		RUBINETTO DI MANDATA
	SPIA PASSAGGIO LIQUIDO		RUBINETTO DI CARICA 1/4" SAE
			DIREZIONE FLUIDO IN REFRIGERAZIONE
			DIREZIONE FLUIDO IN RISCALDAMENTO

Valvola ritegno	Check valve
Attacco 1/4" SAE	1/4" SAE connection
Valvola di sicurezza	Safety valve
Valvola di espansione	Expansion valve
Pressostato alta pressione	High-pressure switch
Spia passaggio liquido	Liquid flow sight glass
Pressostato bassa pressione	Low-pressure switch
Trasduttore alta pressione	High pressure transducer
Rubinetto linea liquido	Liquid line valve
Rubinetto di aspirazione (optional)	Suction valve (optional)
Rubinetto di mandata	Delivery valve
Rubinetto di carica 1/4" SAE	1/4" SAE charge valve
Direzione fluido in refrigerazione	Direction of fluid for cooling
Direzione fluido in riscaldamento	Direction of fluid for heating

Figure shows two circuits unit. For thre circuit units the third circuit is identical to the first two and the evaporator has one gas line and one liquid line more.

### Description of the refrigeration cycle with heat recovery

The low-temperature refrigerant gas from the evaporator is drawn by the compressor through the electric motor, which gets cooled by the refrigerant. It is subsequently compressed and during this process the refrigerant mixes with the oil from the oil separator.

The high-pressure oil-refrigerant mixture is introduced into the centrifuge-type high-efficiency oil separator, where the oil is separated from the refrigerant. The oil accumulated on the bottom of the separator is forced by the pressure difference back into the compressor while the oil-free refrigerant is sent to the partial recovery heat exchanger where it cools down by reducing its superheat temperature while warming the water which travels through the heat exchanger. From the outlet of the heat exchanger, the refrigerant fluid first passes through the 4-way valve, then it enters the air heat exchanger (in chiller mode) or the water heat exchanger (in heat pump mode), where it is condensed and subcooled while heating the outside air (forced ventilation) or the water respectively.

The subcooled fluid flows through the high-efficiency filter dryer and then it reaches the expansion element through which a pressure drop takes place 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 that is introduced into the water heat exchanger (chiller mode) or air heat exchanger (heat pump mode), where it takes the heat required for vaporisation.

After the liquid-vapour refrigerant has been evenly distributed into the tubes of the heat exchanger, it exchanges heat with the water to be cooled (in chiller mode), thus reducing the water temperature, or with the outside air (in heat pump mode) while it gradually gets completely vaporised and then superheated.

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

### Controlling the heat recovery circuit and installation recommendations

The partial heat recovery system is available in both chiller and heat pump mode and is not managed and/or controlled by the machine. The installer should follow the suggestions below for best system performance and reliability:

1. Install a mechanical filter on the heat exchanger inlet pipe.
2. Install shut-off valves to isolate the heat exchanger from the water system during periods of inactivity or system maintenance.
3. Install a drain valve that allow the heat exchanger to be emptied in the event that air temperature is expected to fall below 0°C during periods of inactivity of the machine.
4. Install flexible anti-vibration joints on the heat recovery water inlet and outlet piping, so that transmission of vibrations, and therefore of noise, to the water system is kept as low as possible.
5. Do not load exchanger joints with the weight of the heat recovery piping. The water joints of the exchangers are not designed to support the weight of the piping.
6. Should heat recovery water temperature be lower than ambient temperature, it is advised to switch off the heat recovery water pump 3 minutes after having switched off the last compressor.

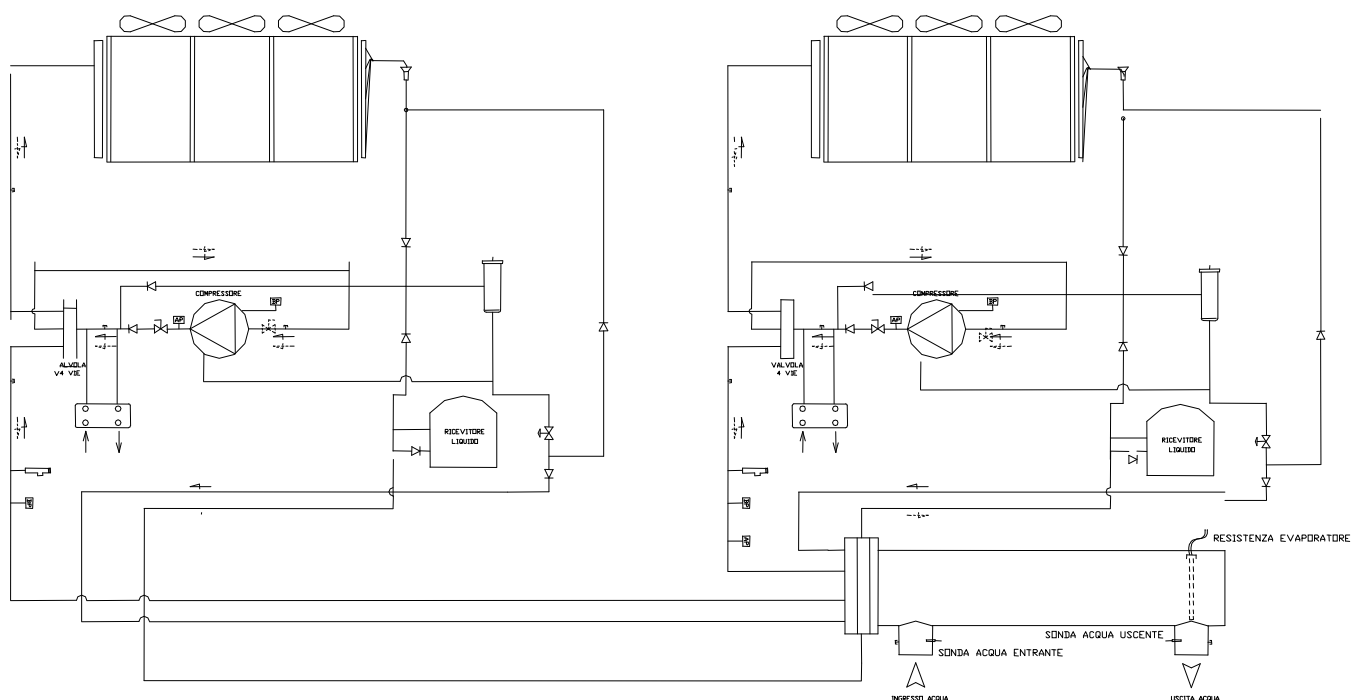
### ▲ ATTENTION

Heat recovery has been designed as an additional source of external heat; in fact, the availability of recovered heat is guaranteed only with a cooling circuit which functions when cooled water is requested.

In particular, it cannot function correctly if the water entering the exchanger is cooler than 35°C for periods exceeding the normal time needed for the system to reach normal running conditions (about 15 minutes): functioning for prolonged periods under such conditions can cause malfunctions in the cooling circuit and will trigger off the protective devices. The installer must also ensure that the temperature of the water in the recovery circuit reaches the minimum value allowed as soon as possible.

For the same reasons, there must be no water flowing through the exchanger when the cooling circuit is switched off.

**Figure 21 - Refrigeration cycle with partial heat recovery**



### LEGENDA

	VALVOLA RITEGNO		PRESSOSTATO BASSA PRESSIONE
	ATTACCO 1/4" SAE		TRASDUTTORE ALTA PRESSIONE
	VALVOLA DI SICUREZZA		RUBINETTO LINEA LIQUIDO
	VALVOLA DI ESPANSIONE		RUBINETTO DI ASPIRAZIONE (OPTIONAL)
	PRESSOSTATO ALTA PRESSIONE		RUBINETTO DI MANDATA
	SPIA PASSAGGIO LIQUIDO		RUBINETTO DI CARICA 1/4" SAE
			DIREZIONE FLUIDO IN REFRIGERAZIONE
			DIREZIONE FLUIDO IN RISCALDAMENTO

Valvola ritegno	Check valve
Attacco 1/4" SAE	1/4" SAE connection
Valvola di sicurezza	Safety valve
Valvola di espansione	Expansion valve
Pressostato alta pressione	High-pressure switch
Spia passaggio liquido	Liquid flow sight glass
Pressostato bassa pressione	Low-pressure switch
Trasduttore alta pressione	High pressure transducer
Rubinetto linea liquido	Liquid line valve
Rubinetto di aspirazione (optional)	Suction valve (optional)
Rubinetto di mandata	Delivery valve
Rubinetto di carica 1/4" SAE	1/4" SAE charge valve
Direzione fluido in refrigerazione	Direction of fluid for cooling
Direzione fluido in riscaldamento	Direction of fluid for heating

(\*) Water inlet and outlet data are given for indication only. Refer to the dimensional diagram of the machine for the exact water connection of the partial recovery exchangers.

Figure shows two circuits unit. For three circuit units the third circuit is identical to the first two and the evaporator has one gas line and one liquid line more.

## Compressor

The single-screw compressor is of the semi-hermetic type with an asynchronous three-phase, two-pole motor which is directly splined on the main shaft. The suction gas from the evaporator cools the electric motor before entering the suction ports. There are temperature sensors inside the electric motor which are completely covered by the coil winding and constantly monitor motor temperature. Should the coil winding temperature become very high (120°C), a special external device connected to the sensors and to the electronic controller will de-activate the corresponding compressor. There are only two moving rotating parts and there are no other parts in the compressor with an eccentric and/or alternative movement.

The basic components are therefore only the main rotor and the satellite that carry out the compression process, meshing perfectly together.

The compressors of all models of the series are Fr3100. The Fr3100 compressor has one single satellite on the upper section of the screw.

Compression sealing is done thanks to a suitably shaped special composite material that is interposed between the main screw and the satellite. The main shaft on which the main rotor is splined is supported by 2 ball bearings. The system made up in this way is both statically and dynamically balanced before assembly.

**Figure 22 - Picture of Fr3100 compressor**



A large access cover on the upper part of Fr3100 compressor allows for quick and easy maintenance.

## Compression process

With the single-screw compressor the suction, compression and discharge process takes place in a continuous manner thanks to the upper satellite. In this process the suction gas penetrates into the profile between the rotor, the teeth of the upper satellite and the compressor body. The volume is gradually reduced by compression of the refrigerant. The compressed gas under high pressure is thus discharged into the built-in oil separator. In the oil separator the gas/ oil mixture and the oil are collected in a cavity in the lower part of the compressor, where they are injected into the compression mechanisms in order to ensure the compression's sealing and lubrication of the ball bearings.

**Figure 23 - Compression process**

**1. and 2. Suction**

Main rotor flutes 'a', 'b' and 'c' are in communication at one end with the suction chamber via the bevelled rotor end face, and are sealed at the other end by the star rotor teeth. As the main rotor turns, the effective length of the flutes increases with a corresponding increase in the volume open to the suction chamber: Diagram 1 clearly shows this process. As flute 'a' assumes the position of flutes 'b' and 'c' its volume increases, inducing suction vapour to enter the flute.

Upon further rotation of the main rotor, the flutes which have been open to the suction chamber engage with the star teeth. This coincides with each flute being progressively sealed by the main rotor. Once the flute volume is closed off from the suction chamber, the suction stage of the compression cycle is complete.

A Suction gas

**3. Compression**

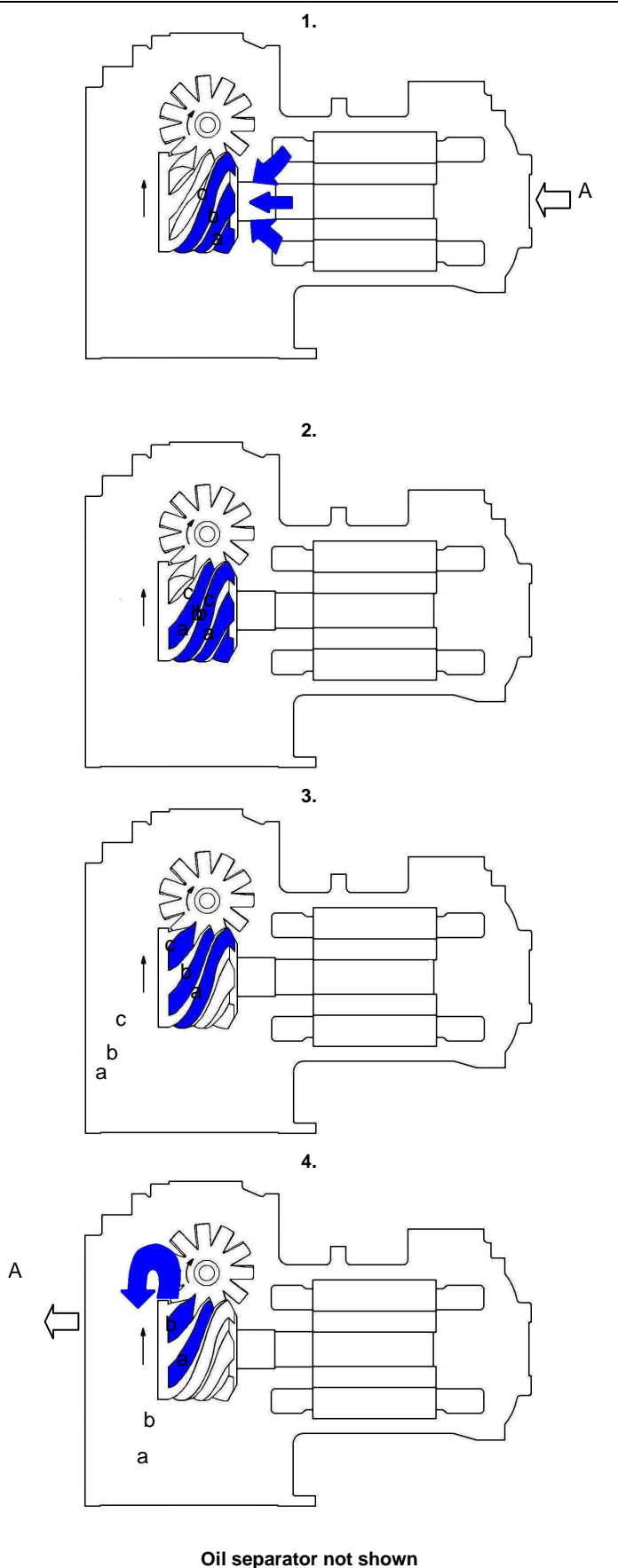
As the main rotor turns, the volume of gas trapped within the flute is reduced as the length of the flute shortens and compression occurs.

**4. Discharge**

As the star rotor tooth approaches the end of a flute, the pressure of the trapped vapour reaches a maximum value occurring when the leading edge of the flute begins to overlap the triangular shaped discharge port.

Compression immediately ceases as the gas is delivered into the discharge manifold. The star rotor tooth continues to scavenge the flute until the flute volume is reduced to zero. This compression process is repeated for each flute/star tooth in turn.

A Discharge gas





### Cooling capacity control

The compressors are factory-equipped with a stepless cooling capacity control system.

An unloading slide reduces the intake groove volume and its actual length. This slide is used to operate the compressor at minimum and maximum load, and as in all other conditions the cooling capacity is adjusted by the inverter, which modulates the speed of the screw (for further details on how the inverter works, please refer to the enclosed Combivert manual).

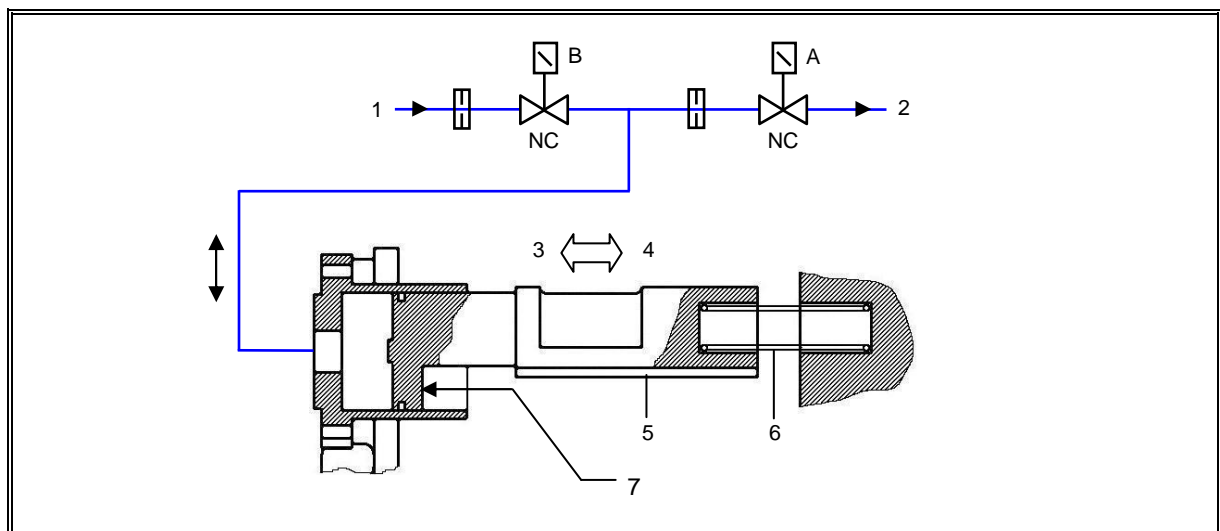
The unloading slide is controlled by the pressure of the oil coming from the separator or by the effect of oil released to the compressor suction; a spring provides the balancing force needed to move the slide.

The oil flow is controlled by two different solenoid valves 'A' and 'B', according to inputs from the unit controller. The solenoids are normally-closed (NC) and they open when powered.

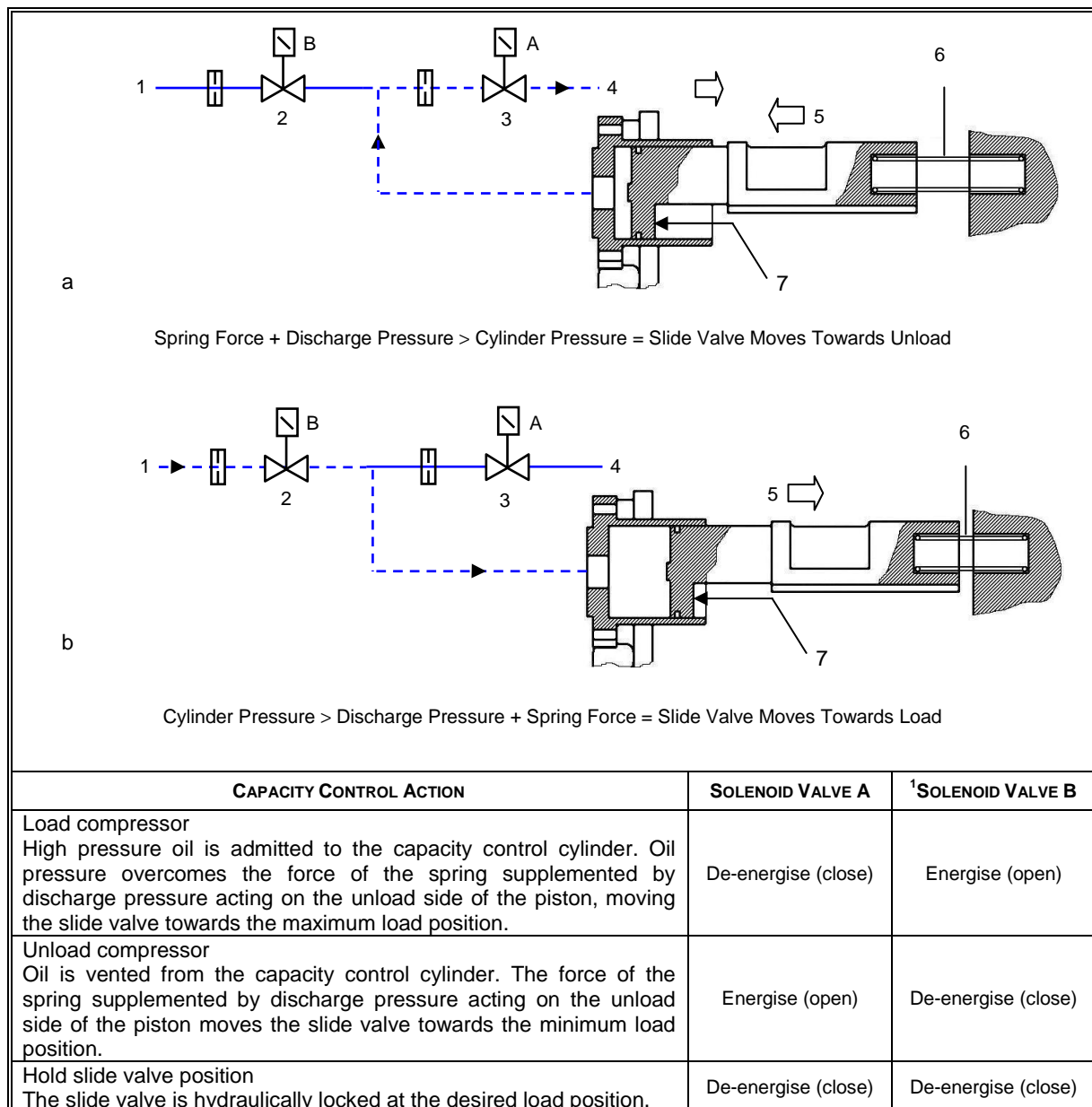
During the compressor operation, the valve position is controlled by the pressure inside the cylinder.

In the EWYD-BZ- heat pump, the unloading slide is only used to keep the compressor at minimum load upon start-up. This, together with a start-up at reduced speed, prevents the compressor from taking in liquid, which could damage it, even under extremely severe conditions such as when the operating mode is changed from chiller to heat pump or vice versa.

**Figure 24 - Capacity control mechanism for Fr3100 compressor**



- 1 Oil supply
- 2 Oil vent to suction
- 3 Unload
- 4 Load
- 5 Slide
- 6 Spring
- 7 Discharge pressure acts on this side of piston



**Figure 25 - Continuously variable capacity control for Fr3100 compressor**

- a** Compressor unloading
- 1 Oil supply
  - 2 De-energised (closed)
  - 3 Energised (open)
  - 4 Oil vent
  - 5 Unload
  - 6 Spring expands
  - 7 Discharge pressure acts on this side of piston
- b** Compressor loading
- 1 Oil supply
  - 2 Energised (open)
  - 3 De-energised (closed)
  - 4 Oil vent
  - 5 Load
  - 6 Spring compressed
  - 7 Discharge pressure acts on this side of piston

## Pre-startup checks

### General

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

#### CAUTION

Before servicing the machine in any way, open the general disconnect switch on the machine main power supply. When the machine is off but the disconnect switch is in the closed position, unused circuits are live, as well. Never open the terminal board box of the compressors before having opened the unit's general disconnecting switch.

#### CAUTION

After switching off the unit, the intermediate circuit capacitors are still charged with high voltage for a short period of time. Capacitor full discharge takes approximately 5 minutes. Wait for the LEDs on the inverter to turn off before attempting to access parts which could potentially be live. Please consult the inverter manual for further details.

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.

#### CAUTION

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.

Put all the fan circuit breakers (from F16 through F20 and from F26 through F30) on the On position.

#### IMPORTANT

If the fan circuit breakers are forgotten open, both compressors will trip due to high pressure (chiller mode) or low pressure (heat pump mode) when the machine is started up for the first time. Resetting the high-pressure alarm requires opening the compressor compartment and resetting the mechanical high-pressure switch.

Check the power supply voltage at the general door-handle 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  $\pm 3\%$ .

The unit comes with a factory-supplied phase monitor that prevents compressors and fans from starting in the event of wrong phase sequence. Properly connect the electrical terminals to the disconnect switch so as to ensure alarm-free operation. If the phase monitor triggers an alarm once the machine has been powered, just invert two phases at the general disconnect switch supply (unit power supply). Never reverse the electrical wiring on the motor.

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.

### Units with an external water pump

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. Adjust the flow switch trigger point (not factory-supplied), to ensure operation of the machine within a  $\pm 20\%$  flow range.

### Units with a built-in water pump

This procedure foresees factory installation of the optional single -or twin- water pump kit.

Check that switches Q0, Q1 and Q2 are in the open position (Off or 0). Also check that the thermal-magnetic switch Q12 in the electrical panel control area, is in the Off position.

Close the general Q10 door-block switch on the main board and move the Q12 switch to the On position.

## ⚠ CAUTION

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.

**Single pump** To start the water pump, turn the Q0 switch to the On (or 1) position and wait for the unit On message to appear on the display. Adjust the water flow until the evaporator design pressure drop is reached. Adjust the flow switch (not included) at this point, to ensure that the machine operates within a  $\pm 20\%$  flow range.

**Twin pump** The system foresees the use of a twin pump having two motors, each as a backup to the other. The microprocessor enables one of the two pumps with a view to minimising the number of hours and start-ups. To start one of the two water pumps, turn the Q0 switch to the On (or 1) position and wait for the unit On message to appear on the display. Adjust the water flow until the evaporator design pressure drop is reached. Adjust the flow switch (not included) at this point, to ensure that the machine operates within a  $\pm 20\%$  flow range. To start the second pump, keep the first one on for at least 5 minutes, then open the Q0 switch, wait for the first pump to turn off. Close the Q0 switch again to start the second pump.

Using the microprocessor keypad it is possible, however, to set pump start-up priorities. Please see the microprocessor manual for the relevant procedure.

### 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:

Unbalance %:  $\frac{V_{MAX} - V_{AVG}}{V_{AVG}} \times 100 = \underline{\hspace{2cm}} \%$

AVG = average

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

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

thus the unbalance percentage is

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

#### **Power supply of electrical heaters**

Each compressor comes with an electrical heater located at the bottom of the compressor. Its purpose is to warm up the lubricating oil and thus avoid the mixing of refrigerant fluid within.

It is therefore necessary to ensure that the heaters are powered at least 24 hours before the planned start-up time. To ensure that they are activated, it is sufficient to keep the machine on by closing the general disconnecting switch Q10.

The microprocessor, however, has a series of sensors that prevent the compressor from being started up when the oil temperature is not at least 5°C above the saturation temperature corresponding to the current pressure.

Keep the Q0, Q1, Q2, Q3 and Q12 switches in the Off (or 0) position until the machine is to be started up.

# Startup procedure

## Turning on the machine

1. With the general switch Q10 closed, check that switches Q0, Q1, Q2 and Q12 are in the Off (or 0) position and the Q8 switch is in the requested position.
  2. Close the thermal-magnetic switch Q12 and wait for the microprocessor and the control to start. Check that the oil temperature is warm enough. The oil temperature must be at least 5 °C above the saturation temperature of the refrigerant in the compressor.
  3. If the oil is not warm enough, it will not be possible to start the compressors and the phrase "Oil Heating" will appear on the microprocessor display.
  4. Start the water pump should the machine not be supplied with one.
  5. Put the Q0 switch on the On position and wait for "Unit-On/ Compressor Stand-By" to appear on the display.
  6. If the water pump is supplied with the machine, the microprocessor should start it at this point.
  7. Check that the water heat exchanger pressure drop is the same as the design pressure drop and correct if necessary. The pressure drop must be measured at the factory-supplied charge connections placed on the evaporator nozzles. Do not measure the pressure drops at points where any valves and/or filters are interposed.
  8. Only at the first start-up, put the Q0 switch in Off position to check that the water pump stays on for three minutes before it stops (this applies to the built-in pump and any external pump).
  9. Put the Q0 switch in On position once again.
  10. Check that the local temperature setpoint is set to the required value by pressing the Set button.
  11. Turn the Q1 switch to On (or 1) to start compressor #1.
  12. Once the compressor has started, wait for at least 1 minute for the system to stabilise. During this time the controller will perform a series of operations to empty the evaporator (Pre-Purge) to ensure a safe start-up.
  13. At the end of the Pre-Purge, the microprocessor will start loading the compressor, now running, in order to reduce the outlet water temperature. The correct functioning can be verified by checking the supply frequency and the current supplied by the VFD.
  14. Check refrigerant evaporation and condensation pressure.
  15. Check that the cooling fans have started, as a response to an increase in condensation pressure (chiller mode).
  16. Check the circuit operating parameters by verifying:
    - Superheating of refrigerant at compressor suction
    - Superheating of refrigerant at compressor discharge
    - Subcooling of liquid coming out of the condenser banks
    - Evaporation pressure
    - Condensation pressure
- Except for liquid temperature, which requires the use of an external thermometer, all other measurements can be carried out by reading the relevant values directly on the on-board microprocessor display.
17. Turn the Q2 switch to On (or 1) to start compressor #2.
  18. Repeat steps 10 through 15 for the second circuit.

**Table 3 - Typical working conditions with compressors at 100%**

Mode	Suction superheating	Discharge superheating	Liquid subcooling
Chiller	$4 \pm 6$ °C	$20 \pm 25$ °C	$3 \pm 6$ °C
Heat pump	$6 \pm 9$ °C	$25 \pm 30$ °C	$2 \pm 5$ °C

## ▲ IMPORTANT

The symptoms of a low refrigerant charge are:

- low evaporation pressure
- high suction and discharge superheating (outside the aforesaid limits)
- Low super-cooling value

In this case, add R134a refrigerant to the relevant circuit. 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.

19. To turn off the machine temporarily (daily or weekend shutdown) turn the Q0 switch to Off (or 0) or open the remote contact between terminals 58 and 59 on terminal board M3 (Installation of remote switch to be carried out by the customer). The microprocessor will activate the shutdown procedure, which requires several seconds. Three minutes after the compressors have been shut down, the microprocessor will shut down the pump. Do not switch off the main power supply so as not to de-activate the electrical resistances of the compressors and the evaporator.

## ▲ IMPORTANT

If the machine is not supplied with a built-in pump, do not shut down the external pump before 3 minutes have elapsed after the last compressor has shut down. Early shutdown of the pump triggers a water-flow failure alarm.

### Selecting an operating mode

The chiller operating mode (water cooling) is selected by setting the Q8 switch in 0 (or off) position, while the heat pump operating mode (water heating) is selected by setting the Q8 switch in 1 (or on) position.

The switch can be made either with the compressors in motion or turned off with the unit on or off (Q0 switch on 0 or off). In the first two instances, the unit will be turned off by the controller and kept turned off for an amount of time that can be set, to be checked (factory-setting 5 minutes) and then restarted in the desired operating mode.

### Shutdown for a long time

1. Turn switches Q1 and Q2 to the Off (or 0) position to shut down the compressors, using the normal pump-down procedure.
2. After the compressors have been shut down, turn switch Q0 to Off (or 0) and wait for the built-in water pump to shut down. If the water pump is managed externally, wait for 3 minutes after the compressors have shut down before turning off the pump.
3. Open the Q12 (Off position) thermal magnetic switch inside the control section of the electrical board then open the general disconnect switch Q10 to cut off the machine's power supply entirely.
4. Close the compressor intake valves (if any) and delivery valves and also the valves located on the liquid and liquid injection line.
5. Place a warning sign on every switch that has been opened, advising to open all the valves before starting the compressors.
6. If no water and glycol mixture has been introduced into the system, discharge all the water from the evaporator and from the connected piping if the machine is to remain inactive during the winter season. One must remember that once the machine's power supply has been cut off, the antifreeze electrical resistance cannot function. Do not leave the evaporator and piping exposed to the atmosphere during the entire period of inactivity.

### Starting up after seasonal shutdown

1. With the general disconnect switch open, make sure that all the electrical connections, cables, terminals and screws are well tightened to ensure good electrical contact.
2. Verify that the power supply voltage applied to the machine is within  $\pm 10\%$  of the nominal nameplate voltage and that the voltage unbalance between phases is within  $\pm 3\%$  range.
3. Verify that all control devices are in good condition and functioning and that there is a suitable thermal load for start-up.
4. Verify that all the connection valves are well tightened and that there are no refrigerant leaks. Always reposition the valve covers.
5. Verify that switches Q0, Q1, Q2 and Q12 are in the open position (Off). Turn the general disconnect switch Q10 to the On position. Doing this will allow to turn on the electrical resistances of the compressors. Wait at least 12 hours for them to warm up the oil.
6. Open all suction, delivery, liquid and liquid injection valves. Always reposition valve covers.
7. Open the water valves to fill the system and vent the air from the evaporator through the vent valve installed on its shell. Verify that there are no water leaks from the piping.

# System maintenance

## WARNING

All routine and extraordinary maintenance activities on the machine must be carried out solely 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 and oil charge is essential for optimal operation of the machine and for environmental protection. Any oil and 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 suction and condensation pressure. Verify through the built-in microprocessor 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 for wear in the satellite and clearances between main screw and the satellite is carried out 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.

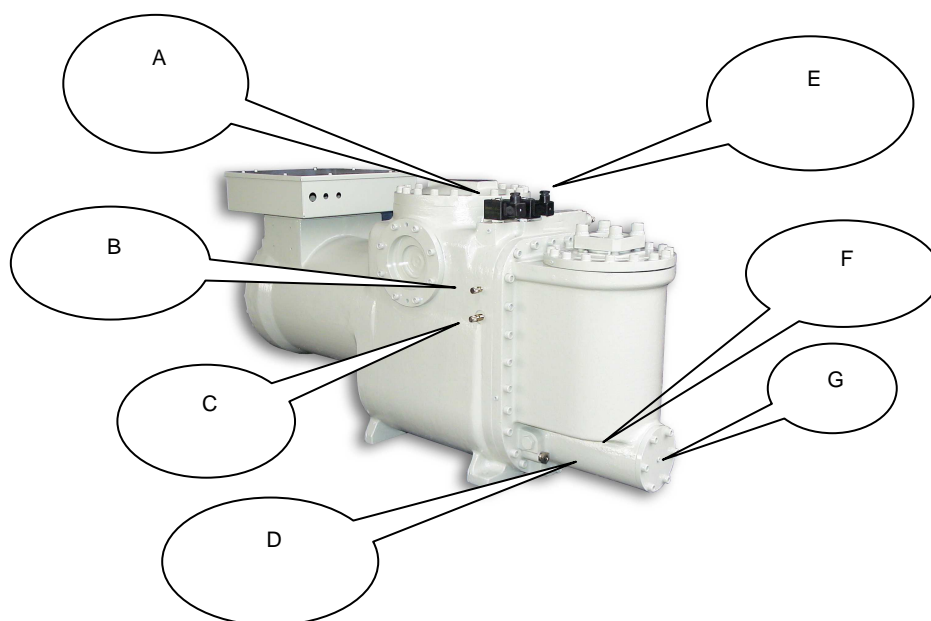
### Lubrication

The units do not require a routine procedure for lubrication of components. The fan bearings have permanent lubrication and no additional lubrication is therefore required.

Compressor oil is of the synthetic type and is highly hygroscopic. It is therefore advised to limit its exposure to the atmosphere during storage and filling. It is recommended that the oil be exposed to the atmosphere for no more than 10 minutes.

The compressor oil filter is located under the oil separator (delivery side). Its replacement is advised when its pressure drop exceeds 2.0 bar. The pressure drop across the oil filter is the difference between the compressor discharge pressure and the oil pressure. Both these pressures can be monitored through the microprocessor for both compressors.





- A "A" unloading solenoid valve
- B High pressure switch
- C High pressure transducer
- D Oil/discharge temperature sensor
- E "B" loading solenoid valve
- F Oil transducer (hidden side)
- G Oil filter

**Figure 26 - Installation of control devices for Fr3100 compressor**

#### Routine maintenance

**Table 4 - 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 (6)			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	
Verify filter dryer pressure drop		X	
Verify oil filter pressure drop (Note 5)		X	
Analyse compressor vibrations			X
Analyse compressor oil acidity (7)			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 In environments with a high concentration of air-borne particles, it might be necessary to clean the condenser bank more often.
- 5 Replace the oil filter when the pressure drop across it reaches 2.0 bar.
- 6 Check for any dissolved metals.
- 7 TAN (Total Acid Number) :
  - $\leq 0,10$  : No action
  - Between 0.10 and 0.19 : Replace anti-acid filters and re-check after 1000 running hours. Continue to replace filters until the TAN is lower than 0.10.
  - $> 0,19$  : Replace oil, oil filter and filter dryer. Verify at regular intervals.

### Replacement of filter dryer

It is strongly advised that the filter dryer cartridges be replaced in the event of a considerable pressure drop across the filter or if bubbles are observed through the liquid sight glass while the subcooling value is within the accepted limits.

Replacement of the cartridges is advised when the pressure drop across the filter reaches 50 kPa with the compressor under full load.

The cartridges must also be replaced when the humidity indicator in the liquid sight glass changes colour and shows excessive humidity, or when the periodic oil test reveals the presence of acidity (TAN is too high).

### Procedure to replace the filter dryer cartridge

#### ▲ ATTENTION

Ensure proper water flow through the evaporator during the entire servicing period. Interrupting the water flow during this procedure would cause the evaporator to freeze, with consequent breakage of internal piping.

1. Shut down the relevant compressor by turning the Q1 or Q2 switch to Off.
2. Wait until the compressor has stopped and close the valve located on the liquid line.
3. Start the relevant compressor by turning the Q1 or Q2 switch to On.
4. Check the relevant evaporation pressure on the microprocessor display.
5. When the evaporation pressure reaches 100 kPa turn the Q1 or Q2 switch again to turn off the compressor.
6. Once the compressor has stopped, place a label on the compressor start-up switch that is under maintenance, to prevent undesired start-ups.
7. Close the compressor suction valve (if any).
8. Using a recovery unit, remove surplus refrigerant from the liquid filter until atmospheric pressure is reached. The refrigerant must be stored in a suitable and clean container.

#### ⚠ ATTENTION

To protect the environment, do not release removed refrigerant into the atmosphere. Always use a recovery and storage device.

9. Balance internal pressure with external pressure by pressing the vacuum pump valve installed on the filter cover.
10. Remove the filter dryer cover.
11. Remove the filter elements.
12. Install the new filter elements in the filter.
13. Replace the cover gasket. Do not allow any mineral oil onto the filter gasket so as not to contaminate the circuit.  
Use only compatible oil for this purpose (POE).
14. Close the filter cover.
15. Connect the vacuum pump to the filter and pull vacuum to 230 Pa.
16. Close the vacuum pump valve.
17. Recharge the filter with the refrigerant recovered during emptying.
18. Open the liquid line valve.
19. Open the suction valve (if any).
20. Start the compressor by turning switch Q1 or Q2.

## Replacement of the oil filter

### ▲ ATTENTION

The lubrication system has been designed to keep most of the oil charge inside the compressor. During operation, however, a small amount of oil circulates freely in the system, conveyed by the refrigerant. The amount of replacement oil going into the compressor should therefore be equal to the quantity removed rather than the amount stated on the nameplate; this will avoid excess of oil during the following start-up.

The quantity of oil removed from the compressor must be measured after having allowed the refrigerant present in the oil to evaporate for a suitable amount of time. To reduce the refrigerant content in the oil to a minimum, it is advised that the electrical resistances be kept on and that the oil be removed only when it has reached a temperature of 35÷45°C.

### ▲ ATTENTION

The replacement of the oil filter requires careful attention with regard to oil recovering; the oil must not be exposed to air for more than about 30 minutes (at temperatures higher than -40°C).

In case of doubts, verify oil acidity or, if it is not possible to carry out the measurement, replace the charge of lubricant with fresh oil stored in sealed tanks or in a way that meet supplier specifications.

The compressor oil filter is located under the oil separator (discharge side). It is strongly advised that it be replaced when its pressure drop exceeds 2.0 bar. The pressure drop across the oil filter is the difference between the compressor delivery pressure minus oil pressure. Both pressures can be controlled through the microprocessor for both compressors.

Required materials:

Oil filter Code 7384-188 for Fr3100 compressor	– Quantity 1
Gaskets kit Code 128810988	– Quantity 1

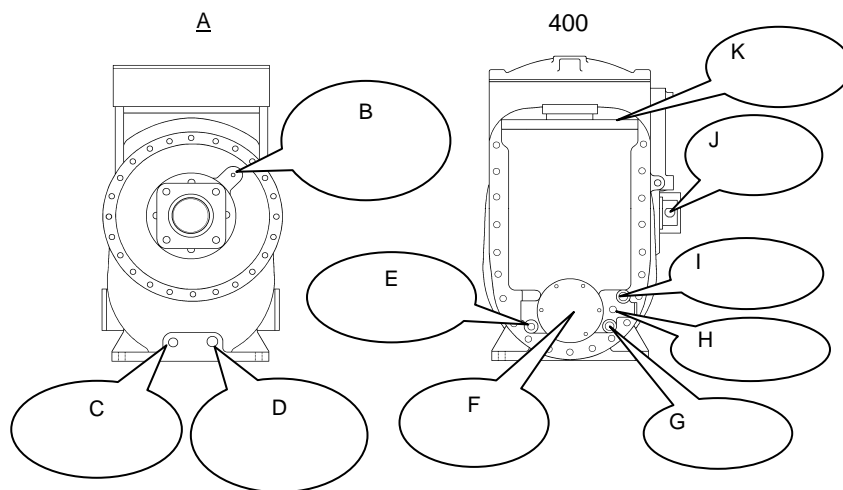
Compatible oils:

Mobile Eal Arctic 68  
ICI Emkarate RL 68H

The standard oil charge for a compressor is 13 litres.

### Procedure to replace oil filter

1. Shut down both compressors by turning the Q1 and Q2 switches to the Off position.
2. Turn the Q0 switch to Off, wait for the circulation pump to turn off and open the general disconnect switch Q10 to cut off the machine's electrical power supply.
3. Place a label on the handle of the general disconnect switch in order to prevent accidental start-up.
4. Close the suction, discharge and liquid injection valves.
5. Connect the recovery unit to the compressor and recover the refrigerant in a suitable and clean container.
6. Evacuate the refrigerant until the internal pressure has turned negative (compared to atmospheric pressure). The amount of refrigerant dissolved in the oil is reduced to a minimum in this way.
7. Drain the oil in the compressor by opening the drain valve located under the motor.
8. Remove the oil filter cover and remove the internal filter element.
9. Replace the cover and internal sleeve gasket. Do not lubricate the gaskets with mineral oil in order not to contaminate the system.
10. Insert the new filter element.
11. Reposition the filter cover and tighten the screws. The screws must be tightened alternately and progressively setting the torque wrench at 60Nm.
12. Charge the oil from the upper valve located on the oil separator. Considering the high hygroscopy of ester oil, it should be charged as quickly as possible. Do not expose ester oil to the atmosphere for more than 10 minutes.
13. Close the oil charging valve.
14. Connect the vacuum pump and evacuate the compressor up to a vacuum of 230 Pa.
15. On reaching the above vacuum level, close the vacuum pump valve.
16. Open the system's delivery, suction and liquid injection valves.
17. Disconnect the vacuum pump from the compressor.
18. Remove the warning label from the general disconnect switch.
19. Close the general disconnecting switch Q10 to supply power to the machine.
20. Start the machine by following the start-up procedure described above.



- A Suction side
- B Low pressure measurement point
- C Oil drainage tap position
- D Position of oil-heating electrical resistance
- E Oil temperature sensor
- F Oil filter cover
- G Minimum oil level
- H Oil transducer
- I Maximum oil level
- J Liquid injection
- K Oil loading plug

**Figure 27 - Front and back views for Fr3100**

#### 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 exchanger for the entire charge/discharge time. Interrupting the water flow during this procedure would cause the evaporator to freeze with consequent breakage of its internal piping. 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 replenish 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 condition (preferably above 20°C). The machine should be kept running for at least 5 minutes to allow the fan steps, and thus the condensation pressure, to stabilise.

**Note:** When the load and the number of active fans vary, 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 water temperature and the suction superheating 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.

**Note:** The liquid receiver must be completely full in heat pump mode when the machine contains the correct charge.

#### Procedure to replenish refrigerant

1. If the machine has lost refrigerant, it is necessary to first establish the causes before carrying out any replenishment operation. The leak must be found and repaired. Oil stains are a good indicator, as they can appear in the vicinity of a leak. However, this is not necessarily always a good search criterion. Searching with soap and water can be a good 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 between 25 and 100% of the system capacity. Suction superheating must be between 4 and 6°C.
4. Add enough refrigerant to fill the liquid receiver completely in heat pump mode.
5. Check the subcooling value by reading the liquid pressure and the liquid temperature near the expansion valve. The subcooling value must be between 4 and 8°C and between 10 and 15°C for the machines with an economiser. With reference to the above mentioned values, the subcooling will be lower at 75÷100% load and higher at 50% load.
6. When the ambient temperature is above 16°C, all fans should be on.

Overcharging the system will entail a rise in the compressor's discharge pressure, owing to excessive filling of the condenser section pipes.

**Table 5 - Pressure/ Temperature**

Pressure/Temperature table for R-134a					
°C	bar	°C	bar	°C	bar
-14	0,71	12	3,43	38	8,63
-12	0,85	14	3,73	40	9,17
-10	1,01	16	4,04	42	9,72
-8	1,17	18	4,37	44	10,30
-6	1,34	20	4,72	46	10,90
-4	1,53	22	5,08	48	11,53
-2	1,72	24	5,46	50	12,18
0	1,93	26	5,85	52	13,85
2	2,15	28	6,27	54	13,56
4	2,38	30	6,70	56	14,28
6	2,62	32	7,15	58	15,04
8	2,88	34	7,63	60	15,82
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 microprocessor keypad. Well-calibrated sensors ensure better efficiency for the machine and a longer lifetime.

Note: refer to the microprocessor use and maintenance 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:

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

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

**External air temperature sensor** – Optional. This sensor allows to monitor the external air temperature on the microprocessor display. It is also used in the "OAT setpoint override".

**Compressor discharge pressure transducer** – This is installed on every compressor and allows to monitor the discharge pressure and to control the fans. Should the condensation pressure increase, the microprocessor will control the compressor load in order to allow it to function even if the compressor gas flow must be reduced. It also contributes to the oil control logic.

**Oil pressure transducer** - This is installed on every compressor and allows to monitor the oil pressure. The microprocessor uses this sensor to inform the operator on the conditions of the oil filter and on how the lubrication system is functioning. By working together with the high- and low-pressure transducers, it protects the compressor from problems deriving from poor lubrication.

**Low-pressure transducer** – This is installed on every compressor and allows to monitor the compressor suction pressure along with low pressure alarms. It contributes to complementing the oil control logic.

**Suction sensor** – This is installed on each compressor and allows to monitor the suction temperature. The microprocessor uses the signal from this sensor to control the electronic expansion valve.

**Compressor discharge temperature sensor** – This is installed on each compressor and allows to monitor compressor discharge temperature and oil temperature. The microprocessor uses the signal from this sensor to control the liquid injection and to shut down the compressor in case that the discharge temperature reaches 110°C. It also protects the compressor from pumping liquid refrigerant at start-up.

# 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

Mode	Chiller	Heat pump
Chilled water setpoint	°C _____	_____
Leaving water temperature	°C _____	_____
Entering water temperature	°C _____	_____
Pressure drop	kPa _____	_____
Water flow rate	m <sup>3</sup> /h _____	_____

## Refrigerant side measurements

Circuit #1	Compressor Load	_____	%
	N° of active Fans	_____	
	N° of expansion valve cycles	_____	
Refrigerant/ Oils pressure	Evaporation pressure	_____	bar
	Condensation pressure	_____	bar
	Oil pressure	_____	bar
Refrigerant temperature	Evaporation saturated temperature	_____	°C
	Suction gas pressure	_____	°C
	Suction superheating	_____	°C
	Condensation saturated temperature	_____	°C
	Discharge superheating	_____	°C
	Liquid temperature	_____	°C
	Subcooling	_____	°C
Circuit #2	Compressor Load	_____	%
	N° of active Fans	_____	
	N° of expansion valve cycles	_____	
Refrigerant/ Oils pressure	Evaporation pressure	_____	bar
	Condensation pressure	_____	bar
	Oil pressure	_____	bar
Refrigerant temperature	Evaporation saturated temperature	_____	°C
	Suction gas pressure	_____	°C
	Suction superheating	_____	°C
	Condensation saturated temperature	_____	°C
	Discharge superheating	_____	°C
	Liquid temperature	_____	°C
	Subcooling	_____	°C
External air temperature		_____	°C

## Electrical measurements

Analysis of the unit's voltage unbalance:

Phases:	RS	ST	RT
	_____ V	_____ V	_____ V

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

AVG = average

Compressors current – Phases:		<b>R</b>	<b>S</b>	<b>T</b>
Compressor #1		_____ A	_____ A	_____ A
Compressor #2		_____ A	_____ A	_____ A
Fans current:		#1 _____ A	#2 _____ A	
		#3 _____ A	#4 _____ A	
		#5 _____ A	#6 _____ A	
		#7 _____ A	#8 _____ 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 cannot function beyond the specified limits
2. The electrical power supply must be within the voltage limits and without voltage harmonics or sudden changes.
3. 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.
4. No safety device, either mechanical, electrical or electronic must be disabled or overridden.
5. The water used for filling the water circuit must be clean and suitably treated. A mechanical filter must be installed at the point closest to the evaporator inlet.
6. Unless there is a specific agreement at the time of ordering, the evaporator 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 III of the classification established by the European Directive PED 97/23/EC.

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 covered by the Kyoto Protocol. Do not vent gases into the atmosphere.

Refrigerant type: R134a  
GWP(1) value: 1300

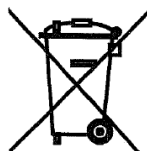
(1)GWP = Global Warming Potential

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.

### 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.





The present publication is drawn up by of information only and does not constitute an offer binding upon Daikin Applied Europe S.p.A.. Daikin Applied Europe S.p.A. has compiled the content of this publication to the best of its knowledge. No express or implied warranty is given for the completeness, accuracy, reliability or fitness for particular purpose of its content, and the products and services presented therein. Specification are subject to change without prior notice. Refer to the data communicated at the time of the order. Daikin Applied Europe S.p.A. explicitly rejects any liability for any direct or indirect damage, in the broadest sense, arising from or related to the use and/or interpretation of this publication. All content is copyrighted by Daikin Applied Europe S.p.A..

**DAIKIN APPLIED EUROPE S.p.A.**

Via Piani di Santa Maria, 72 - 00040 Ariccia (Roma) - Italia

Tel: (+39) 06 93 73 11 - Fax: (+39) 06 93 74 014

<http://www.daikinapplied.eu>