Cardiff®
Air Conditioning

AIR COOLED WATER CHILLERS AND

HEAT PUMPS WITH AXIAL FANS

HCF Series

R-22

When installing or carrying out operations on the unit, closely follow the recommendations and procedure given in this manual, observe warnings on the machine and take all precautionary measures as required by the situation.
Failure to comply with the procedures recommended by this manual or unauthorized modification to the unit will automatically render the guarantee null and void.

COMPANY

WITH QUALITY SYSTEM

CERTIFIED BY NGV

===ISO 9001:2000

TECHNICAL BOOKLET

THE PICTURES FOR THE UNITS

Cardiff air cooled water chillers and heat pumps have been designed and constructed to satisfy small and medium sized cooling and heating applications in residential or commercial venues.

The machine is arranged for using both hydraulic circuits (evaporator and condensing unit), therefore it can be used both like water chiller and heat pump. The commutation between chiller and heat pump operation is obtained managing the chiller circuit. Available in 9 sizes, the units are characterised by their silent operation, high efficiency performance and reliability, thanks to the use of heat exchangers with a large exchange surface and high-efficiency silent scroll compressors.

The units can be arranged to satisfy a wide range of system requirements: with base or with integrated pump and storage tank. Condensing units without evaporator are also available.
The electric heaters of compressors are standard for chiller and heat pump models with refrigerant ***R22 or R407C.***

Small size units (include inner structure)

Big size units

UNIT DESCRIPTION AND TECHNICAL DATA

Unit description

Air Cooled Water Chiller and heat pump with axial fans, scroll compressors and storage tank is a new generation of modular units developed by Cardiff air conditioner. This unit is energy saving and convenient in use, which has the function of reverse cycle automatic defrosting, three-stage automatic anti-freezing, built-in self-diagnose system, and is controlled by microcomputer. Application to hotels, villas, hospitals, cinemas, stadiums, recreations, office blocks, factories and so on. It can also provide industrial cooled water and hypothermal water for the technical manufacture.
The unit is no using cooling water system such as cooling tower and cooling pump, this unit saves the water greatly and is easy to install, manage and maintain.

Nomenclature

12	3	45	6	7	8	9 10
Code	Model	Size	Refrigerant	Power supply	Storage tank	evaporator type

Code

HCF (Air Cooled Water chiller With Storage tank)

Model

- : cooling only **R**: heat pump

Size (kw)

08, 10, 14, 17, 22,

28, 35, 45, 50

Refrigerant

--: R22 **A:** R410a **B:** R134a **C:** R407c

Power supply

D—220/1/50

S---380/3/50

Storage tank ST:

With storage tank

Evaporator type

PC: plate coil exchanger

TT : tube in tube

Construction feature

- **Structure**

  Panels and base frame are made from galvanized steel protected with polyester powder painting to ensure total resistance to atmospheric agents.

- **Hermetic compressors**

  Single phase scroll type (mod. 8 and 10) compressor, 3-phase scroll compressor (mod.14 ~ 50), with thermal overload cut-out and crankcase heater, mounted on rubber vibration isolators. The compressor is located in a room separated from the condenser to reduce the noise level.

- **Axial fans**

  External rotor type axial fans, equipped with single phase direct drive motors, low noise 6 poles, protection level IP54, provided with a protective outlet grille.

- **Evaporator**

  High efficiency AISI 316 stainless steel brazed plate heat exchanger, insulated with flexible close cell material to reduce heat losses. (or tube in tube)

- **Condenser**

  Built with high efficiency internal screw threads red copper tube mechanically expanded into hydrophilic aluminum fins, provided with protective plastic grille.

- **Refrigerant circuit**

  Copper tube connected with charge valve, one way valve, filter drier (filter for mod.8), sight glass, thermal expansion valve (expansion capillary tubes for mod 8), gas-liquid separator, high pressure switch with manual reset and low pressure switch

with automatic reset.

The heat pump unit is completed also with 4-way valve, liquid receiver and one way valves.

- **Hydronic circuit**

  Built with air vent valve, water drain connection, safety valve, water pump, differential pressure switch, expansion vessel, female-threaded hydraulic connectors and inertial water storage tank (galvanized steel for mod. 8÷14). The hydronic circuit is protected also with anti-freezing electric heater to protect the circuit from freezing in low ambient temperature.

- **Power an delectrical control panel**

Electrical enclosure accessible from side panel, consist of:

- Main switch;
- Transformer 220V/24V for control panel;
- Compressor contactor;
- Water pump contactor;
- Compressor protection breaker;
- Water pump protection breaker;
- Fan motor protection breaker;
- Control circuit protection breaker;
- Phase sequence relay;
- Fan speed regulator;
- Programmable microprocessor controller;
- Potential free contact for remote line controller;
- Potential free contact for remote general alarm;
- Potential free contact for remote compressor running indicator.

- **Microprocessor control system**

Programmable electronic circuit board receives commands from the keypad control board installed on the units.

The microprocessor control can monitor the operating conditions of the critical parts to avoid the occurrence of the hazardous situations.

The electronic board controls:

- Digital input from a set of pushbuttons situated on the keypad control board:
- Regulation of temperature settings for water inlet/outlet,
- Management of defrosting (only for heat pump),
- Safety timers,
- Management of water pump;
- Compressor delay relay;
- Stepless fan speed control;
- Alarm management and signaling;
- Alarm reset;
- Visual signaling on display:
- Inlet and outlet water temperature;
- Set point and differential setting;
- Alarm decodification;
- Cooling and heating mode operation leds;
- Defrosting operation led (only for heat pump);
- Self diagnosis with continuous checks on machine operating status.

Technical data

model HCF(R)		*08*	*10*	*14*	*17*	*25*	*28*	*35*	*45*	*50*
Cooling capacity	kW	8.2	10.2	14.7	19.0	24.1	28.8	38	47	51
Heating capacity	kW	9.1	11.2	16.4	21.2	27.8	32.6	44	52	58
Compressor										
Qty/refrigerant circuit	Nr.	1/1	1/1	1/1	1/1	1/1	1/1	2/2	2/2	2/2
Cooling power input	kW	2.7	3.1	5.0	6.3	8.1	9.9	12.6	14.1	16.2
Heatingpower input	kW	2.8	3.3	5.5	7.1	9.2	11.3	14.2	16.3	18.4
Axial fans										
Quantity	Nr.	1	1	2	1	1	1	2	2	2
Airflow	m^3/h	3340	3810	6700	8200	10900	12500	16500	18700	21800
Evaporator										
Water flow	m^3/h	1.41	1.58	2.57	3.43	4.29	5.15	6.85	7.37	8.57
Water side pressure drop	kPa	17	19	56	26	30	55	62	66	71
Storage tank		15	15	18	75	75	75	80	80	80
Power supply		220V/1PH/50HZ			380V/3PH/50HZ					
Noise level	dB(A)	55	56	62	65	65	65	65	68	68
Dimensions										
Length	mm	1300	1300	1300	1200	1300	1300	2200	2200	2200
Width	mm	480	480	560	1000	1100	1100	1100	1100	1100
Height	mm	975	975	1275	1100	1100	1100	1100	1100	1100
Net weight	kg	136	138	150	222	248	251	134	136	138

* Ambient temperature 35ºC; evaporator water in/out 12/7 ºC;

** Ambient temperature DB 7 ºC, WB 6 ºC; condenser water in/out temperature 40/45 ºC;

*** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in a dear field.

Cooling performance (mod. 14 ÷ 28)

MOD.	T_o	Ambient temperature [°C]													
		27		30		32		35		37		40		45	
	(°C)	kW_f	kW_e	kW_f	kW_e	kW_f	kW_e	kW_f	kW_f	kW_e	kW_f	kW_e	kW_f	kW_e	kW_f
14	5	15.34	3.5	14.49	4	13.97	4.41	13.54	4.8	12.95	5.07	12.53	5.37	11.52	6.03
	6	15.93	3.58	15.04	4.07	14.55	4.51	14.09	4.9	13.57	5.17	13.08	5.49	12.1	6.15
	7	16.38	3.65	15.59	4.14	15.1	4.61	14.7	5	14.21	5.29	13.75	5.59	12.83	6.27
	8	17	3.68	16.2	4.19	15.68	4.66	15.31	5.05	14.79	5.34	14.3	5.66	13.32	6.35
	9	17.55	3.73	16.78	4.24	16.29	4.68	15.96	5.1	15.47	5.39	14.98	5.71	14.09	6.4
	10	18.25	3.77	17.46	4.26	16.94	4.73	16.6	5.15	16.11	5.44	15.59	5.76	14.64	6.47
17	5	19.85	4.41	18.7	5.02	18.04	5.56	17.47	6.05	16.76	6.39	16.18	6.77	14.87	7.58
	6	20.59	4.5	19.44	5.13	18.81	5.67	18.23	6.17	17.52	6.53	16.89	6.91	15.66	7.76
	7	21.19	4.61	20.15	5.22	19.52	5.81	19	6.3	18.37	6.66	17.77	7.07	16.57	7.92
	8	21.95	4.66	20.91	5.29	20.26	5.85	19.79	6.37	19.11	6.73	18.48	7.13	17.22	7.99
	9	22.69	4.7	21.71	5.33	21.05	5.92	20.64	6.44	20.01	6.8	19.38	7.2	18.21	8.08
	10	23.59	4.75	22.58	5.38	21.87	5.96	21.46	6.48	20.8	6.86	20.15	7.27	18.95	8.15

22	5	25.18	5.67	23.72	6.46	22.88	7.15	22.18	7.77	21.24	8.22	20.52	8.72	18.85	9.77
	6	26.08	5.79	24.65	6.6	23.87	7.31	23.11	7.93	22.23	8.39	21.45	8.89	19.85	9.96
	7	26.87	5.91	25.56	6.72	24.77	7.46	24.1	8.1	23.31	8.55	22.53	9.08	21.04	10.17
	8	27.83	5.98	26.55	6.79	25.7	7.53	25.12	8.17	24.25	8.65	23.46	9.17	21.83	10.27
	9	28.76	6.03	27.54	6.86	26.69	7.6	26.17	8.27	25.38	8.74	24.57	9.24	23.08	10.36
	10	29.93	6.1	28.62	6.93	27.77	7.67	27.22	8.34	26.4	8.81	25.56	9.34	24.01	10.48
28	5	30.08	6.93	28.35	7.9	27.35	8.74	26.48	9.5	25.42	10.05	24.52	10.64	22.54	11.93
	6	31.18	7.08	29.48	8.04	28.5	8.93	27.61	9.7	26.57	10.25	25.62	10.87	23.72	12.18
	7	32.13	7.23	30.52	8.22	29.6	9.11	28.8	9.9	27.85	10.47	26.93	11.09	25.12	12.42
	8	33.28	7.3	31.71	8.29	30.7	9.21	30.02	10	28.98	10.57	28.03	11.19	26.1	12.55
	9	34.38	7.38	32.9	8.39	31.89	9.28	31.26	10.1	30.34	10.67	29.36	11.31	27.58	12.67
	10	35.75	7.45	34.2	8.46	33.16	9.38	32.51	10.2	31.53	10.79	30.52	11.43	28.71	12.8

kWf: Cooling capacity [kW]

kWe: Compressor power input [kW]

To: Evaporator leaving water temperature e [℃]*

*inlet/outlet evaporator water temperature difference: 5°C

Heating performance (mod.14 ÷ 28)

MODEL	T_a	RH	CONDENSER INLET/OUTLET WATER TEMPERATURE [°C]							
			30/35		35/40		40/45		45/50	
	[°C]	%	kW_r	kW_e	kW_r	kW_e	kW_r	kW_e	kW_r	kW_e
14	-12	90	10.35	3.92	10.05	4.4	9.41	4.58	---	---
	-8	90	11.38	3.97	11.18	4.46	10.76	4.76	10.14	4.86
	-4	90	12.56	4.05	12.43	4.55	12.19	4.94	11.81	5.23
	0	90	13.89	4.16	13.81	4.68	13.66	5.14	13.45	5.56
	4	75	15.38	4.3	15.3	4.83	15.2	5.34	15.09	5.85
	7	75	16.6	4.42	16.5	4.96	16.4	5.5	16.3	6.04
	15	70	20.25	4.83	20.02	5.4	19.78	5.94	19.48	6.45
	20	70	22.85	5.14	22.48	5.74	22.01	6.24	21.43	6.63
17	-12	90	13.38	5.06	13	5.68	12.17	5.91	---	---
	-8	90	14.71	5.13	14.46	5.76	13.91	6.14	13.1	6.27
	-4	90	16.24	5.23	16.07	5.88	15.75	6.38	15.26	6.75
	0	90	17.96	5.37	17.85	6.04	17.66	6.63	17.38	7.17
	4	75	19.89	5.55	19.78	6.23	19.65	6.89	19.5	7.55
	7	75	21.45	5.71	21.33	6.4	21.2	7.1	21.07	7.8
	15	70	26.18	6.23	25.89	6.97	25.57	7.67	25.19	8.33
	20	70	29.53	6.63	29.07	7.41	28.45	8.05	27.71	8.56
22	-12	90	17.54	6.56	17.04	7.36	15.96	7.65	---	---
	-8	90	19.29	6.64	18.96	7.46	18.24	7.96	17.18	8.12
	-4	90	21.29	6.78	21.07	7.62	20.66	8.27	20.02	8.74
	0	90	23.55	6.96	23.41	7.82	23.16	8.59	22.8	9.29
	4	75	26.08	7.19	25.94	8.08	25.77	8.93	25.58	9.78
	7	75	28.13	7.4	27.97	8.3	27.8	9.2	27.63	10.1
	15	70	34.33	8.08	33.94	9.03	33.53	9.94	33.03	10.79
	20	70	38.73	8.59	38.11	9.6	37.31	10.43	36.33	11.09
28	-12	90	20.57	8.06	19.98	9.04	18.71	9.4	---	---
	-8	90	22.62	8.16	22.23	9.16	21.39	9.77	20.15	9.98
	-4	90	24.97	8.33	24.71	9.36	24.22	10.16	23.47	10.74
	0	90	27.61	8.55	27.45	9.61	27.16	10.55	26.73	11.41

	4	75	30.58	8.84	30.42	9.92	30.22	10.97	29.99	12.01
	7	75	32.99	9.09	32.8	10.19	32.6	11.3	32.4	12.41
	15	70	40.26	9.92	39.8	11.1	39.32	12.2	38.73	13.25
	20	70	45.41	10.55	44.69	11.79	43.75	12.81	42.61	13.62

kW_r: Heating capacity [kW]

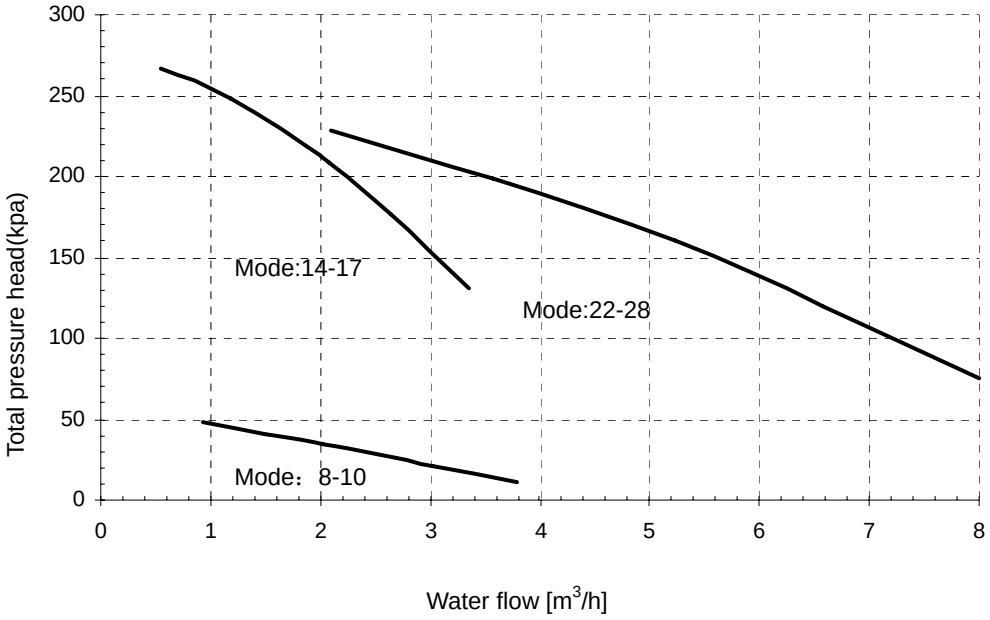
kW_e: Compressors power input [kW]

T_a: Evaporator inlet air temperature dry bulb [°C]

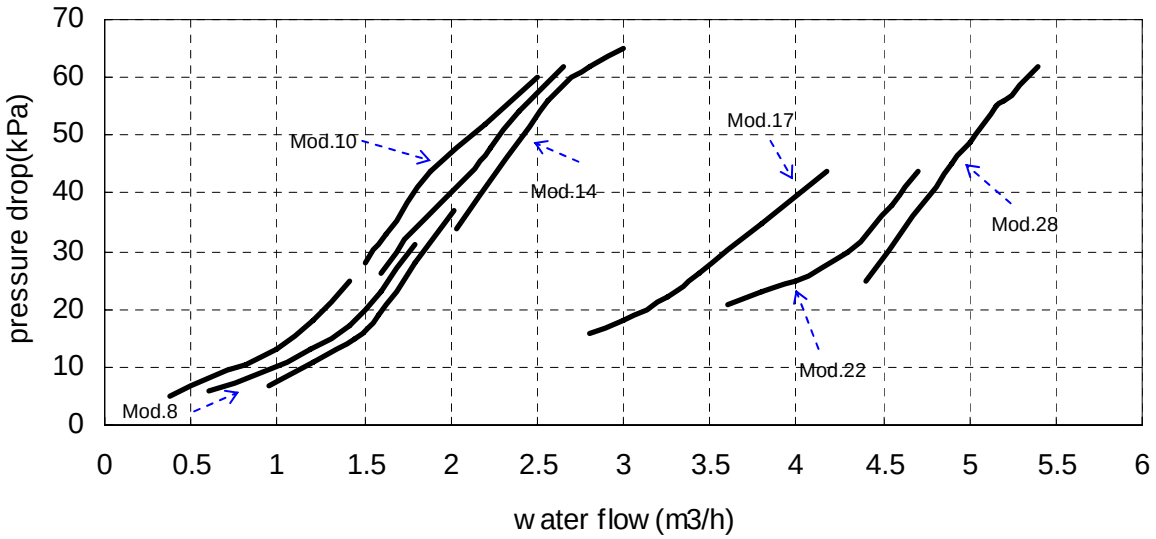
RH: Evaporator inlet air relative humidity [%]

Directions to use and calculation

Water pump curves



Water side pressure drop



Water temperature difference: min: 3 °C, max: 8°C

Available pump head pressure calculation

Example

Suppose we calculate the available head pressure of M.17 under the nominal condition (water inlet/outlet temperature 12/7 °C, ambient air temperature 35 °C).

Cooling capacity: 19 kW

Water flow: 19/ (1,1666×5)=2.3 m^3/h

Water pump total head pressure: 189 kPa

Unit hydraulic circuit pressure drop: 16 kPa

Available pump head pressure: 189-16=173 kPa

Fouling factor correction coefficient

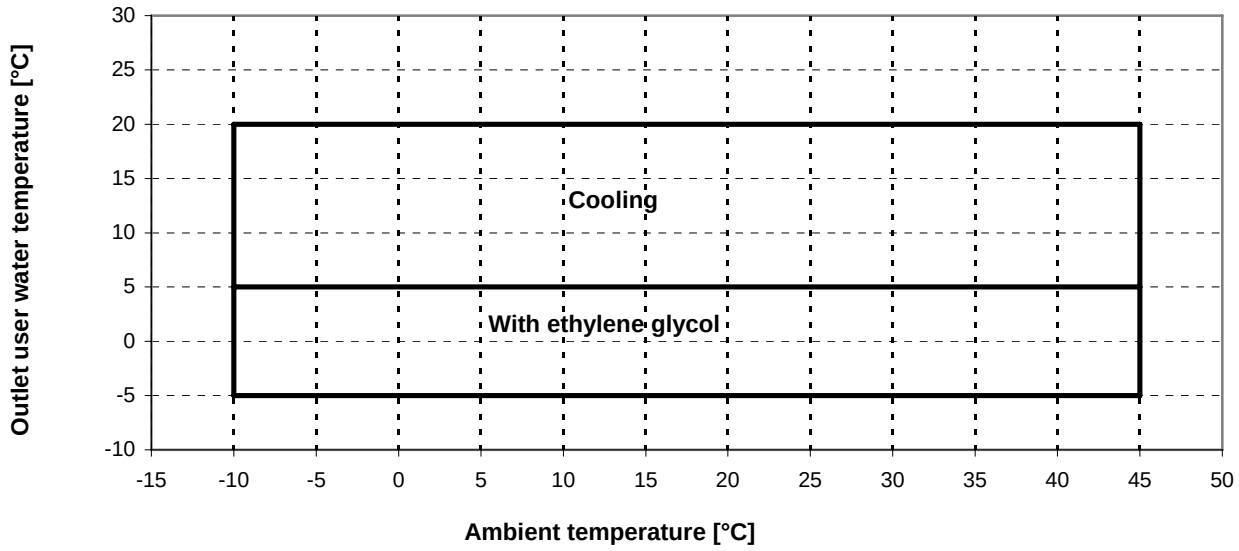
Fouling factor [m2°C / W]	Evaporator	
	F1	FP1
0 clean heat exchanger	1	1
4,4 × 10-5	0,98	0,99
8.8 × 10-5	0,96	0,99
17.6 × 10-5	0,93	0,98

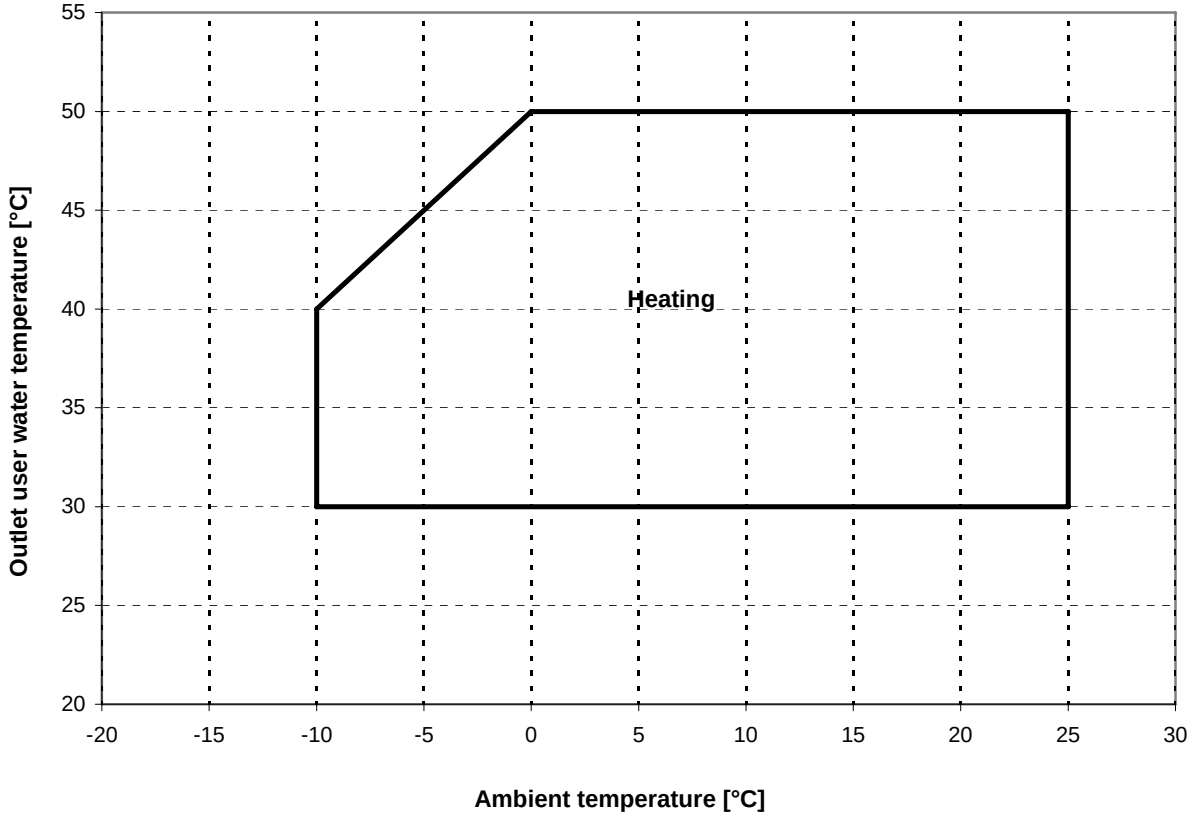
F_1 = capacity correction factors

FP_1 = compressor power input correction factor

The performance data given refer to conditions with clean heat exchangers (fouling factor =1). For different fouling factors, unit performances should be adjusted with the correction factors shown above.

Operation range





Water thermal difference for all versions: min. 3 , max 8 .

Sound pressure level

MODEL	Octave band [Hz]								TOTAL
	63	125	250	500	1000	2000	4000	8000	
	dB	dB	dB	dB	dB	dB	dB	dB	dB(A)
8	64	62	58	55	52	42	40	24	55
10	64	62	58	55	52	42	41	24	56
14	68	58	63	57	58	53	51	31	62
17	74	68	67	63	60	52	50	32	65
22	74	68	67	63	60	52	50	32	65
28	74	67	67	63	60	51	50	32	65

Note: sound pressure level measured in free field conditions, at 1 m from the unit and 1.5 m from the floor level of condensing coil side.

Theoretical sound reducing values with distance variation in free field

Distance	m	1	2	3	4	5	6	7	8	9	10
Attenuation	dB	0	6	9.5	12	14	15.5	17	18	19	20

Ethylene glycol solutions

The use of ethylene glycol mixtures is intended to prevent freezing in chiller heat exchangers. The use of low freezing point mixtures causes changes in the main thermodynamic properties of the units. The major parameters affected by the use of glycol

mixtures are the following:

Cooling capacity

Power input

Mixture rate

Pressure drop

Table below lists correction factors applied to the most common ethylene glycol mixtures.

Glycol percentage [%]	**10**	**20**	**30**	**40**	**50**
Freezing point [°C]	-3,20	-7,80	-14,10	-22,30	-33,80
Cooling capacity corr. factor	0,986	0,980	0,973	0,966	0,960
Power input corr. factor	1,000	0,995	0,990	0,985	0,975
Mixture flow corr. factor	1,023	1,054	1,092	1,140	1,200
Pressure drop corr. factor	1,061	1,114	1,190	1,244	1,310

Calculation example

An example can help to use properly the coefficients reported in the table.

Water chiller FL-17 presents the following performances at the nominal working conditions:

Cooling capacity: 19 kW

Power Input: 6.3 kW

Evap. in/outlet temp.: 12/7°C

Water flow: 3.43m^3/h

Pressure drops: 26 kPa

With 30% glycol mixture, the parameters will change to following values according to the correction factors:

Cooling capacity: 19×0,973 = 18.487 kW

Power input: 6.3×0,990 = 6.24 kW

Evap. mixture flow: 18.487 / (1.166×5) ×1,092 = 3.46 m^3/h

From the pressure drop, the value corresponding to the new mixture flow (3.46m^3/h==>29kPa) can be read.

The correct pressure drop corresponding to a 30% glycol mixture will be: 62x1.190=34.5kPa

Low temperature correction factors

Outlet water temperature	2 ºC	0 ºC	-2 ºC	-4 ºC	-6 ºC
Cooling capacity	0,628	0,569	0,510	0,459	0,410
Compressor power input	0,868	0,830	0,802	0,774	0,745
Minimum glycol percentage	10%	20%	20%	30%	30%

Calculation example

Supposing the performances of a FL-17 unit should be at following conditions:

- Evaporator inlet/outlet water temperature: 0/-4°C
- Glycol: 30%
- Ambient air temperature: 35°C

For this unit, the nominal performances (inlet/outlet water temp.12/7°C, ambient air temp. 35°C) are:

- Cooling capacity: 19kW
- Compressor power input: 6.3 kW

Performances at the required conditions can be calculated as followings:

1a step.

Performances are calculated without taking in account the use of glycol mixtures:

- Cooling capacity: 19 x 0.569 = 10.811kW
- Power input: 6.3 x 0.830 = 5.23 kW

2a step.

The use of glycol mixtures is taken in account (please refer to glycol correction factor tables). In our case we have (30% glycol):

- Cooling capacity: 10.811 x 0.973 = 10.519 kW
- Power input: 5.23 x 0.990 = 5.178 kW
- Mixture flow: 10.519/(1.166x4) x 1.092 = 2.46 m^3/h

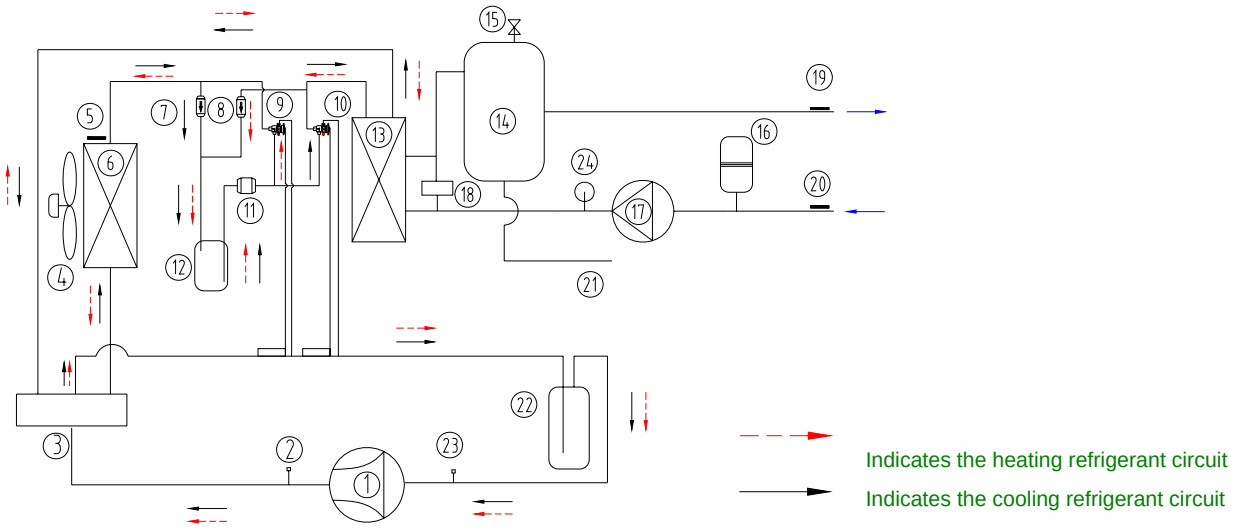
From the pressure drop the value corresponding to the new mixture flow (2.46 m^3/h=>18kPa) can be read.

Pressure drop: 18 x 1.190 = 21.42 kPa

System drawing

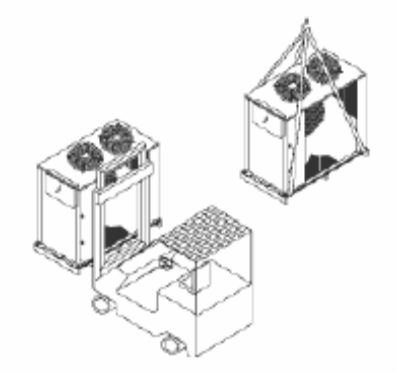
SYSTEM DRAWING

HCF17-22-28



1	Compressor	7	Heating 1-way valve	13	Plate heat exchanger	19	Water outlet temperature sensor
2	High pressure switch	8	Cooling 1-way valve	14	Water storage tank	20	Water inlet temperature sensor
3	4-way valve	9	Thermal expansion valve(heating)	15	Air vent valve	21	Drain pipe
4	Axial fan	10	Thermal expansion valve(cooling)	16	Expansion tank	22	Liquid separator
5	Condensing pressure sensor	11	Dry filter	17	Water pump	23	Low pressure protection
6	Fin heat exchanger	12	Liquid receiver	18	Paddle flow switch	24	Water pressure gauge

During lifting, make sure you have securely anchored the unit, to prevent it from accidentally tipping over or falling.



Storage

Store in a clean,dry and protected area.

Do not stack more than two packed units for storage.

Unpacking

The unit's packing must be removed carefully without causing any damage to the machine.

INSTALLATION

Installation may only be done by experienced technicians, qualified to work with conditioning and cooling systems.

Installation personnel must respect all applicable local or national legislation in effect at the time of machine commissioning.

Technical spaces and positioning

It is obligatory to pay attention to following points and determine the best location for installing the unit and its connections:

- Size and origin of water pipes;
- Location of power supply;
- Accessibility for maintenance or repairs;
- Solidity of the supporting surface;
- Ventilation of air-cooled condenser and necessary clearance;
- Direction of prevalent winds: avoid positing the unit in such a way that the prevalent winds favour the backflow of air to the condenser coil; a speed of 8 m/s (28.8km/h) already generates a sufficent stagnation pressure to guarantee 60% of the nominal air flow rate. .
- Possible reverberation of sound waves.

All the HCF models are designed and built for outdoor installation: avoid covering them with roof structures or positioning them near plants (even if they only partly cover the unit) which may interfere with the regular ventilation of the unit condenser.

It is a good idea to create a base of adequate dimensions to support the unit. This precaution becomes essential when the unit is to be installed on unstable ground (various types of soil, gardens, etc.)

It is advisable to place a rigid rubber strip between the base frame and the supporting surface.

Whenever more effective insulation is required, it is recommended to use vibrating-damping spring support.

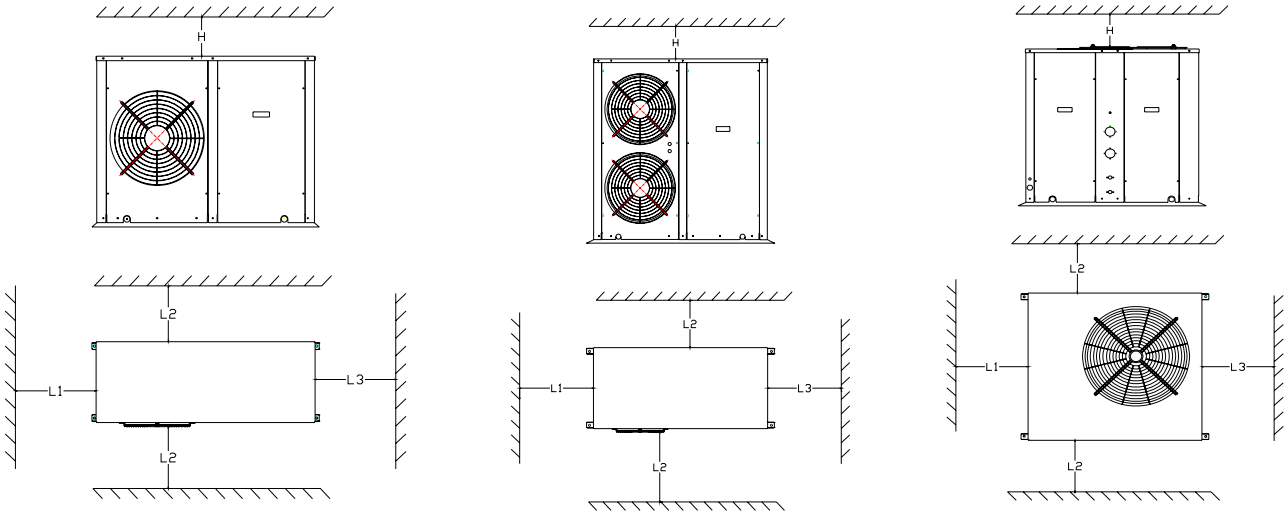
In the case of installation on roofs or intermediate storey, the unit and pipes must be insulated from walls and ceilings by placing rigid rubber joints in between and using supports that are not rigidly anchored to the walls.

If the unit is installed in proximity to private offices, bedrooms or areas where noise levels must be kept down, it is advisable to conduct a thorough analysis of the sound field generated and verify its compatibility with the local laws in force.

It is of fundamental importance to ensure an adequate volume of air both on the intake and outlet sides of the condenser coils; it is very important to prevent the air delivered from being re-aspirated as this may impair the performance of the unit or even cause an interruption in normal operation.

Installation space

To guarantee the proper functioning of the unit and access for maintenance purposes, it's necessary to comply with the minimum installation clearance requirements (refer to the dimensional drawings below).

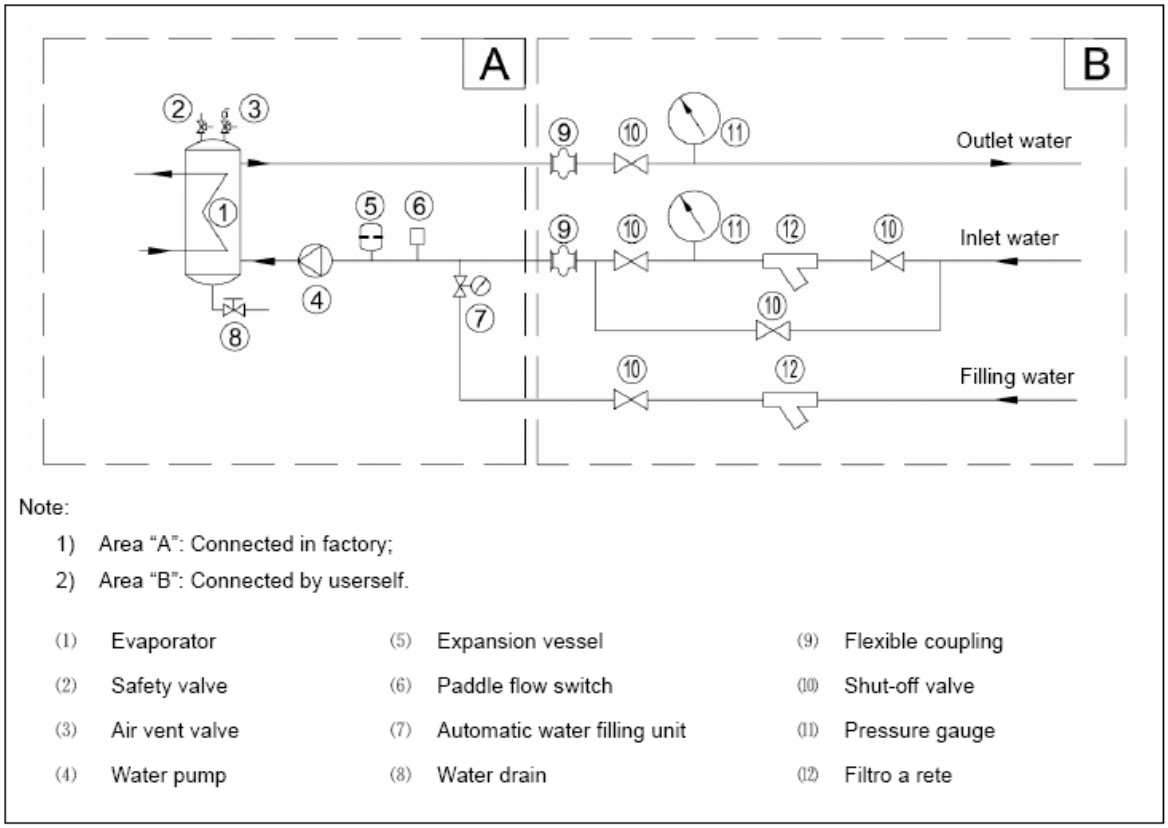


	8	10	14	17	22	28
H	500	500	500	1500	1500	1500
L1	1000	1000	1000	1000	1000	1000
L2	1000	1000	1000	1000	1000	1000
L3	1000	1000	1000	1000	1000	1000
L4	1500	1500	1500	1000	1000	1000

Verify no obstacole in front of the air outlet of the fans

Water circuit connections

Water circuit diagram



Note:

1) Area "A": Connected in factory;
2) Area "B": Connected by userself.

(1)	Evaporator	(5)	Expansion vessel	(9)	Flexible coupling
(2)	Safety valve	(6)	Paddle flow switch	(10)	Shut-off valve
(3)	Air vent valve	(7)	Automatic water filling unit	(11)	Pressure gauge
(4)	Water pump	(8)	Water drain	(12)	Filtro a rete

When setting up the water circuit of the unit, it is advisable to follow the instruction below and in any case comply with local or national regulations.


Before connecting the pipes, make sure there are not stones, sand, rust, dross or other foreign bodies which might damage the unit inside of the pipes.


It's recommended to install a by-pass valve to enable the pipes to be washed through without having to disconnect the unit.


The connection piping should be supported in such a way as to avoid it weighing on the unit.

It's recommended that the following devices are installed in the hydraulic circuit:

- 2 pressure gauges with a suitable scale (water inlet/out);
- 2 vibration dampers joint (water inlet/out);
- 3 shut-off valves (normal ones for water inlet and filling, calibrating one for water outlet)
- 1 drainage valve and, where necessary, a drainage tank for empting out the hydraulic circuit for maintenance
- purposes or when the unit is taken out of service at the end of season. (This operation may only be carried
- out when the unit is disconnected from the power supply).
- 2 thermometers (water inlet/outlet)
- 2 metal mesh filters (with a mesh not to exceed 1 mm) as close as possible to the evaporator and positioned to allow easy access for routine maintenance, to protect the exchanger from scale or impurities present in the pipes (water inlet/filling).
- air vent valves, to be placed at the highest points of the hydraulic circuit for the purpose of venting air.


Connect the unit to the water circuit using the inlet/outlet female-threaded connectors on side of the unit. Connect the water filling unit to the water circuit using the dedicated male-threaded connector located on side of the unit.

The water circuit must be set up in such a way as to guarantee that the nominal flow rate of the water supplied to the evaporator remains constant (+/- 15%) in all operating conditions.


Ensure correct insulation as with all water circuit pipes to avoid the formation of condensate and maintain optimal system performance.


Connect the pipes to the chiller using flexible coupling joints to prevent the transmission of vibration and to compensate thermal expansions.

Once the unit has been completely connected, check for leaks in the lines and bleed the air contained in the circuitusing the manual vent valve located on side of the unit.

Filling the circuit

- Before fiiling, check that the water drain valve is closed.
- Open all the air vent valves located on the water circuit and terminals.
- Open the shut-off valves outside the unit.
- Begin filling, open slowly the shut-off valve connected to the water filling unit.
- When water begins to leak out of the air vent valves of the terminals, close them and continue filling until the pressure gauge indicates a pressure of 1.5 bar.
- The water filling unit will automatically fills up water to the unit in case the pressure gauge near itself indicates
- a pressure lower than 1.5 bar.


Carefully bleed the hydraulic circuit, with pump turned off, by acting on the vent valves. This procedure is fundamental: littler air bubbles can freeze the evaporator causing the general failure of the system.


It's recommended that this operation be repeated after the unit has been operating for several hours. The pressure of the water circuit should be checked regularly and if it drops below 1.5 bar, the water content should be filled up.


Check the hydraulic connections for tightness

Emptying the circuit

When the unit is out of service, for maintenance or seasonal shutdown purpose, it's recommended to drain completely the water

contained in the circuit through the discharge device located at the lowest point of the circuit to ensure complete draining of all the water out the unit.

Before emptying, place the main switch in the OFF position to disconnect the unit form power mains.

Make sure the shut-off valves of the water circuit are all closed.

Open the drain valve outside the unit and all the air vent valves located on the water ciruit and terminals.

This operation is indispensable if ambient temperatures fall below the fluid freezing point used during the period of disuse (in general for seasonal shutdown).

ELECTRICAL DATA AND OPERATION

Electrical connections

The chillers leave the fa ctory completely cabled and ready for connection to the power supply and for the external interlocks to be connected to the terminals provided inside the electrical box.

Electrical connections must be carried out by qualified personnel in respect of current legislation.

For all electrical work refer to the electrical wiring diagrams in this manual.

You are also recommended to check that the characteristics of the power mains are adequate for the absorptions indicated in the electrical data table below, also bearing in mind the possible of other equipments being used at the same time.

Power to the unit must be turned on only after installation work (mechanical, hydraulic and electrical) has been completed.

Ensure that power supply voltage corresponds to unit ratings (voltage, number of phases, frequency) as specified on the unit dataplate.

The cross section of the cable must correspond to the maximum absorbed current to avoid cable overheating and the length must prevent excessive voltage drops.

The power line should be fitted upstream with a suitable device to protect against short-circuits and leakage to earth, isolating the unit from other equipments.

An efficient grounding connection is obligatory. Failure to grounding the appliance absolves the manufacturer of all liability for damage.

It's forbiddent to use the water pipes as grounding.

Voltage must be within a tolerance of ±10% of the rated power supply voltage for the unit, for 3-phase unit the unbalance between the phases must not exceed 3%.

For electrical connections use double insulation cable in conformity with current legislation in the country concerned.

In case of 3-phase units ensure the phases are connected correctly.

Electric box

The electrical box is inside the unit.

To access the electrical box, remove the panel of the unit which protects the electrical switch board by undoing the metric screws.

After removing the panel, bring the power supply cables into the unit through the proper inlet hole.

It is forbidden that the power supply cables enters panel from where not specified in the manual.

It is forbidden that the cables contact non-insulated copper pipes and the surface of the compressors directely.

Electrical power connections

For the functional connection of the unit, bring the power supply cable to the electrical box and connect it to terminals L-N and PE, respecting the (L) phase, (N) neutral and (PE) grounding in the case of single phase units (220~230V/50Hz) and L1-L2-L3 phases, N neutral e PE grounding in three phase units (380~400/3N/ 50Hz).

The section of the cable must correspond to the maximum absorbed current to avoid cable overheating and the length must prevent excessive voltage drops.

Cable sections and electrical line protections must comply with indications in the Electrical Data table of the manual.

External interlocks connections

In the electrical box, the manufacturer provides the necessary terminals (installer terminals XT2) for the following optional functions which will be connected by the installer if needed.

- ✧ Remote alarm warning light;
- ✧ Remote compressor running light;
- ✧ Remote control panel.

Strictly follow all instructions on the wiring diagram when making connections

All the necessary components and connection cables for the external interlocks will be provided by the userself.

The external interlock connection cables must be positioned at a safe distance from the power supply lines or must be adequately insulated to prevent interference with the electronic controller. or less than its set point, and after a minimum delay-time (defrost call time), at this point:

Start the unit

Preliminary checks

Before starting up the unit, make the following checks:

- ✧ Power supply voltage must comply with specifications reported on the serial plate. Admitted tolerance 10%, phase voltage unbalance variation 3%;
- ✧ Power supply must provide adequate current;
- ✧ Check in the electrical enclosure that the power supply terminals and contactors are tight (since they may have loosened during transport, which could lead to malfunctioning);
- ✧ Check that the water system supply and delivery lines are connected according to the marks placed at machine inlet and outlet;
- ✧ Eensure there are no refrigerant leakages, using a leak detector if required.
- ✧ Check the air heat exchanger is well ventilated and clean.
- ✧ Ensure correct power supply on the compressor crankcase heater.

⚠ - the heater must be activated at least 8 hours before start-up, and is activated automatically when the main switch is turned on.

- to ensure correct operation of the heaters, check that the lower section of the compressor is warm and in any event that it remains 10 ÷ 15 °C above the normal ambient temperature.
- to shut down the unit, do not turn off by means of the main switch: in this case the crankcase heaters would not be powered thereby impairing compressor operation on restart.

Check that the hydraulic circuit has been vented to remove all residual air and charge gradually while keeping the upper vent valves open which should be fitted by the installer.

Phase sequence relay

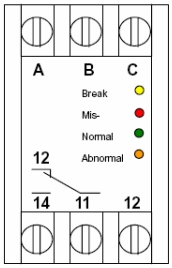
To avoid damage to the scroll compressor if the impeller rotates in the opposite direction (indicated on the phase sequence relay), all units with 3-phase power supply are equipped with a phase sequence relay, which prevents inverted rotation of the compressor by shutting off power supply to the microprocessor in the event of incorrect phase sequence. The start command supplied by the relay (on the electrical panel) is indicated by the illumination of the green led; if this does not occur, the any two of three phases on the terminal board must be inverted.

Break (Yellow Led): lack phase

Mis- (Red Led): incorrect phase sequence;

Normal (Green Led): normal;

Abnormal (Orange Led): over or low voltage



Switch on the unit

- ✧ Place the main switch on ON position to connect the unit to power mains.
- ✧ Press the RESET key for 5 second to turn on the unit.
- ✧ Use the MODE-UP key to select type of operation (Summer mode or Winter mode).
- ✧ Any irregularities will be immediately displayed by the leds in the control panel.
- ✧ When the unit is switched on, the first device to start up is the water pump, which has priority over all other machine components.
- ✧ When the set delay time is up, definitive machine start-up is enabled and the fan starts up. After another safety interval, the compressor is activated as well.

Switch off the unit

Press the RESET for 5 second to turn on the unit.

For short term shutdown (e.g. weekends), do not turn off by means of the main switch: in this case the crankcase heaters would not be powered thereby impairing compressor operation on restart. Follow the instructions above to switch off the unit temporarily.

The unit must be disconnected from power supply only in the event of prolonged periods of disuse (e.g. seasonal shutdowns). It is recommended to prevent excessively frequent compressor start-ups and shutdowns due to fluctuations of specific components in the hydraulic circuit. The electronic control enables compressor start-up following shutdown, only if a specific time interval has elapsed (approx. 3 minutes).

Long term shutdown

When a long shutdown period is scheduled, the unit must be cut off from power supply by means of the main switch located in the electrical box.

Starting up after prolonged shutdown

Before starting up the unit again:

Check that the air heat exchanger is in good condition, ventilated well and clean.

Vent the air from the water circuit.

Check that the water pump is not jammed. Repair it if necessary using a screwdriver to turn the rotor.

Frost protection

While the unit is running, the control circuit protects the main heat exchanger from freezing by tripping the antifreeze alarm which stops the machine if the temperature of the probe placed on the heat exchanger reaches the set point.

Non-use of the unit during the winter can lead to freezing of the water in the circuit. If the water is put out of service in winter (specially cooling only units), the unit must be disconnected from power mains, and all the water contained in the circuit must be emptied completely. To avoid draining the whole system, the water may be mixed with the correct proportion of ethylene glycol (antifreeze) which will ensure frost protection. Keep in mind that mixing the water with glycol will modify unit performance.

Defrosting (on heat pump models only）

All heat pump units are equipped with the function that automatically defrosts the coil if necessary. This electrical controller has a temperature probe fitted on the finned coil. When the air temperature measured by this probe is equal

- ◆ The compressor and the fan motor stop running.
- ◆ The 4-way valve is energized, after a delay-time, the compressor restart, and fan motor is still off. The cycle is reversed and so the finned coil now acts as a condenser. The condensing heat melts the frost on the coil;
- ◆ When the temperature of the probe located on the coil reaches the set-point of the defrosting end temperature, the diversion valve is again energized and heating mode (winter operation) is restored.
- ◆ Then restart the fan, and after a period time delay, restart the compressor.

Refrigerant charge check

- ✧ After a few hours of operation, check that the fluid led shows the green crown: if the led is yellow this indicates humidity in the circuit. In this case, the circuit must be dried by qualified personnel.
- ✧ Check that no bubbles appear on the fluid gauge. Continuous transfer of bubbles may indicate a low refrigerant level and need for replenishment. Occasional bubbles are considered normal.

- ✧ A few minutes after compressor start-up, in the summer cooling mode, check that the condensate temperature reading on the gauge is approximately 15 °C above the temperature of air on input to the condenser. Also check that the evaporation temperature reading on the pressure gauge is approx. 5°C lower than the temperature of the water on output from the evaporator.
- ✧ Check that refrigerant superheating remains between 5 and 7 °C: to check, read a contact thermometer placed on the compressor intake line and on a pressure gauge connected to the intake line (saturation temperature corresponding to the suction pressure); the difference between the two readings is the superheating value.
- ✧ Check that sub-cooling of the refrigerant remains between 5 and 7 °C: to check, read the temperature indicated on a contact thermometer placed on the condenser outlet line and the value on a pressure gauge connected to the fluid outlet of the condenser (saturation temperature corresponding to the pressure on output from the condenser); the difference is the sub-cooling value.

Maintenance

MAINTENANCE

Type and frequence of scheduled maintenance

All maintenance operations must be done by experienced personnel, qualified to work with conditioning and cooling systems. Always switch off the unit to cut off power supply before any maintenance work, even if only inspection is involved. In order to guarantee regular, efficient unit operation, it is advisable to schedule an overall inspection at regular intervals, in order to prevent irregular functioning which could damage the machine's main components

Periodic checks and list

Subject	**Every month**	**Every 4 months**
Check the charged refrigerant and humidity via the sight glass		×
Ensure all electrical terminals are tightened firmly in the electrical panel and on the compressor terminal boards.		×
Ensure there is no refrigerant leak from the cooling circuit	×	
Ensure there is no leak from the hydraulic circuit	×	
Ensure correct operation of the high and low pressure switches		×
Ensure correct operation of the flow switch	×	
Clean the metal filters of the water pipes		×
Check compressor , crankcase heaters	×	
Check the noise level of the unit		×
Check correct operation of all control equipments		×
Check the air heat exchanger is clean		×

Cooling circuit

- ◆ Check gas charge

  Fit a pressure gauge to the pressure outlet on the discharge side and another on the suction side. Start up the unit and check both sides'pressure values once pressure is stabilized.
- ◆ Check for gas leaks

  Use a leaking detector to check the cooling circuit.
- ◆ Check air heat-exchanger condition

  After switched off the unit, check the finned coil and, depending on its condition:
- ◆ Remove any obstruction from the finned surface which could interfere with air passage,
- ◆ Veliminate any dust which has deposited using a jet of compressed air,
- ◆ Wash with water, brushing surfaces lightly,

◆ Dry using compressed air.

Water circuit

✧ **Check paddle flow pressure switch**

While the unit is running normally, close the on-off valve placed on the line which supplies water to the unit slowly. If during this testing stage, the service valve can be closed completely without activating the pressure switch, turn the unit off immediately by using the ON/OFF key on the control panel. Proceed to replace the component.

✧ **Air vent valve in chilled water circuit**

Use the air vent valve located inside the unit near the water outlet line, accessible by removing the protective cap located on the unit's right side

✧ **Draining water circuit**

The system may be completely drained through the cock located on the bottom of the accumulation tank.

Electric circuit

The following procedures are important:

✧ Check electrical absorption of the unit using a current gun, and compare with ratings reported in the technical table;

✧ inspect and check that electrical contacts and relative terminals are tight.

Extraordinary maintenance

If the unit requires repairs, it is advisable to discharge the refrigerante from both high and low pressure sides. If refrigerante is discharged from the high pressure side alone, compressor wirings could close up, preventing equalization of pressures in the compressor. In this way, the low pressure part of the casing and the suction line could emain pressurized. In this case, if a brazing torch is applied to one of the unit's low pressure components, the pressurized mix of refrigerant and oil could be discharged from the circuit and burst into flame in contact with the torch.

To prevent this risk, check that pressure has been released through both the high pressure and low pressure sides before unsoldering.

It is recommended to use the spare parts supplied or autorizied by the manufacturer in case of replacement.

Refrigerant circuit repairs

In the event of repairs to the refrigerant circuit, the following operations must be performed:

- sealing efficiency test;
- draining and drying of refrigerant circuit;
- refrigerant charge.

Trouble shouting

The following list the most common causes of unit malfunctions or shutdowns. As regards possible remedies take great care in the operations involved: lack of caution could cause serious injury to unskilled personnel. Therefore once the cause has been identified, contact our technical assistance service or other suitably qualified personnel to perform maintenance.

Trouble shooting checklist

Inconvenience:	**Suggested action**
1-HIGH DISCHARGE PRESSURE	
Insufficient cooling air at air side heat exchanger	Check for adequate service spaces or obstruction in the coils
Fan not running	Check fan operation
Excessive coolant gas charge	Discharge excess coolant gas
2-LOW DISCHARGE PRESSURE	
Insufficient coolant gas charge	① Find and repair leak

	② Recharge
Mechanical problems in the compressor	Replace compressor
3-HIGH SUCTION PRESSURE	
Excessive thermal load	Check system sizing, possible inflation or insulation problems
Irregular expansion valve operation	Check expansion valve operation
Mechanical problems in compressor	Replace compressor
4.LOW SUCTION PRESSURE	
Insufficient coolant gas charge	① Find and repair leak ② Recharge
Filter partially clogged(looks frosted)	Replace filter
Irregular expansion valve operation	Check expansion valve operation
Air present in water circuit	Bleed air from hydraulic system
Insufficient water flow capacity	Check water pump operation
5- COMPRESSOR DOES NOT START	
Alarm in microprocessor board	Identify alarm and correct condition
No power, switch off	Switch on
Thermal-protection cut-out tripped due to overload	① Reset switch ② Check unit at start-up
No refrigeration request from user with correct operation setting	Check wait for refrigeration request
Operation setting too high	Check and correct setting if necessary
Defective contactor	Replace contactor
Electrical fault in compressor motor	Check for short circuit
6-COMPRESSOR BUZZING SOUND	
Incorrect power supply voltage	Check power supply, identify cause
Compressor contactor malfunction	Replace contactor
Mechanical problems in compressor	Replace compressor
7-COMPRESSOR INTERMITTENT OPERATION	
Low pressure switch malfunction	Check pressure switch settings and operation
Insufficient coolant gas charge	① Find and repair leak ② Recharge
Refrigerant line filter clogged(looks frosted)	Replace filter
Irregular expansion valve operation	Check expansion valve operation
8-COMPRESSOR STOPS	
High pressure switch malfunction	Check pressure switch operation and setting
Insufficient cooling air at air side heat exchanger	① Check for adequate service spaces or obstruction in the coils ② Check correct fan operation
Ambient temperature too high	Check operation limits
Excessive coolant gas charge	Discharge excess
9-COMPRESSOR NOISY OPERATION-VIBRATIONS	
Compressor is pumping liquid, excessive increase of coolant gas fluid in crankcase	① Check expansion valve operation ② Check overheating ③ Correct overheating, replace expansion valve if necessary
Mechanical problems in compressor	Replace compressor
Unit operating at extreme conditions of use	Check operation limits
10-COMPRESSOR CONTINUOUS OPERATION	
Excessive thermal load	Check system sizing, possible infiltration or insulation problems
Operation setting too low for cooling cycle (or too high for heating cycle)	Check setting and correct if necessary
Insufficient coolant gas charge	① Check for and repair leaks

	② Recharge
Refrigerant line filter clogged(looks frosted)	Replace filter
Control board malfunction	Replace board
Irregular expansion valve operation	Check expansion valve operation
Compressor contactor malfunction	Replace contactor
Poor fined coil ventilation	① Check for adequate service spaces or fined coil obstructions ② Check fan operation
11-FAN WILL NOT START; STARTS AND STOPS	
Contactor burnt out	Replace contactor
Thermal protection tripped	① Check for short circuit ② Replace motor
12-WATER PUMP WILL NOT START	
Pumping no power	Check electrical connections
Control board no signal	Check control board
Pump jammed	Repair pump
Pump motor malfunction	Replace pump