USER INSTRUCTIONS

Air-cooled Water chillers WBA/CFA and Heat Pump WHA/CHA

GENERAL TABLE OF CONTENTS

BICOLD Srl - Arzergrande (PD) - ITALY

WBA CHILLER _____ USER MANUAL **Release 110613**

Safety notices for use of the unit

Read this Manual carefully before using the unit!
Keep the manual safe and ready for consultation for all future requirements!

ALWAYS PROVIDE CUT-OUTS SO THAT THE POWER FEEDING LINE OF THE UNIT CAN BE DISCONNECTED FROM THE ELECTRICAL MAINS SUPPLY, EVEN IN THE PRESENCE OF A UNIT ON/OFF CONTROL TRANSMITTED FROM THE CUSTOMER'S REMOTE STATION.

ALWAYS DISCONNECT THE ELECTRICAL POWER SUPPLY BEFORE CARRYING OUT MAINTENANCE!
For details, refer to the unit's wiring diagrams.

(1) Keep the unit in a VERTICAL POSITION during loading and unloading procedures and check that installation surface is perfectly HORIZONTAL with a spirit level;
(2) Install the unit in a place that allows proper ventilation of the condensers! Do not install the unit indoors or in a poorly ventilated place!
(3) Do not inspect the unit electrical panel with wet or moist hands (risk of electric shock);
(4) When the unit is running do not place objects on the top (object may fall with resulting damage to the unit and injury to operators);
(5) Maintenance must be performed ONLY by skilled personnel. When the covers of the electrical panels or external condenser/fans compartment are opened by a maintenance technician, other maintenance personnel or other persons in the area must be notified of the potential hazard my means of specific warning notices!
(6) Do not use tools or objects to touch the fan impeller blades (risk of injury to persons or damage to property or the unit).

(7) **THE UNIT IS NOT SUITABLE FOR USE IN EXPLOSIVE ATMOSPHERES!**

(8) The chillers are designed and approved for operation in industrial and residential environments. For more information, consult the BICOLD Srl Engineering Department.
(9) BICOLD Srl provides one year of warranty from the date of shipment and the warranty will be held valid only if no repairs or modifications of the unit have been carried out by personnel not authorised by BICOLD Srl. To avoid problems, possible accidents, or injury to persons, consult our technical personnel for authorisations for possible alterations or refittings, repairs, removal of components or disassembly of the entire unit.

10) **THE UNIT CONTAINS FLUORINATED GASES (R410A) THE GREENHOUSE EFFECT OF WHICH IS REGULATED BY THE PROVISIONS OF THE KYOTO PROTOCOL! (REGULATION 842/2006/EC)**

3. SYMBOLS ON THE UNIT BODY

#	GRAFICA SYMBOL SYMBOL SÍMBOLO DESSIN	FUNZIONE FUNCTION FUNKTION FUNCIÓN FONCTION
1		Ingresso cavo elettrico Electric cable inlet Eingang Stromkabel Entrada cable eléctrico Entrée câble électrique
2		PERICOLO, PRESTARE ATTENZIONE! DANGER, PAY ATTENTION! GEFAHR, VORSICHT! ¡PELIGRO, PRESTAR ATENCIÓN! DANGER, FAIRE ATTENTION !
3		Pericolo ALTA TENSIONE sui componenenti! HIGH VOLTAGE on components! Gefahr HOCHSPANNUNG an den Bauteilen! ¡Peligro ALTA TENSIÓN en los componentes! Danger HAUTE TENSION sur les composants !
4		Senso di rotazione Rotation direction Drehrichtung Sentido de rotación Sens de rotation
5		Sollevamento (impiego dei golfari) Hoisting point (use eyebolts) Heben (Hebeösen verwenden) Elevación (uso de los cáncamos) Levage (emploi des anneaux)
6		«*Pulire la batteria di raffreddamento soffiando a macchina ferma con aria compressa a max 6 atm*» «*Clean the cooling coil using compressed air pressurized max 6 atm and carry out the operation when the machine is not running* » «*Kühlbatterie monatlich reinigen. Bei stehender Maschine mit Druckluft mit max. 6 atm ausblasen*» «*Limpiar mensualmente la batería de enfriamiento. Soplar con la máquina parada con aire comprimido como máx a 6 atm*» «*Nettoyer tous les mois la batterie de refroidissement.* *Souffler quand la machine est arrêtée avec air comprimé à 6 atm max*»

IMPORTANT WARNINGS
The indication IMPORTANT WARNINGS is used to focus attention on actions or hazards that could damage the unit or its equipment
ENVIRONMENTAL PROTECTION
The indication Environmental Protection supplies instructions for use of the machine.

4. USER INSTRUCTION MANUAL

CONTENTS OF THE MANUAL

1. Introduction to the BICOLD WBA range

1.1 Description of the units

The WBA series constitutes a range of air-cooled water chillers designed to meet the requirements of low and medium capacity air conditioning plants, operating with R410A, a non-flammable and non-toxic high efficiency refrigerant for optimal energy saving in operation of the unit.
The entire range is composed of 21 models characterised by the use of scroll compressors connected in tandem for each circuit, with the exception of the first two sizes of the unit, which are equipped with just one scroll compressor, by one or two separate refrigerant circuits, and plate evaporators in brazed AISI stainless steel.
The fans installed are of the axial low-noise type.
The basic version is equipped with exclusively the plate evaporator. The equipment can consist of a pump, pump with storage tank, dual pump, or dual pump with storage tank.
The pump and storage tank assembly is designated “hydronic unit”.
Control of the chillers is provided by an electronic microprocessor controller.
The refrigerant and hydraulic circuits comply with the PED directive.

Compressors
The compressors are of the hermetic scroll type with orbital scrolls. The rotating scroll is driven by a two-pole motor cooled by the refrigerant on the suction line. All the compressors are complete with a crankcase heater to prevent mixing of oil with the refrigerant during stoppages, electronic thermal protection (if part of the equipment) and thermal overload protection.
All models in the WBA range feature a high pressure unloading function. When a high condensing temperature is reached (as established by a pressure switch) due to abnormally high ambient temperature, one compressor stops on each circuit. This results in oversizing of the condensing coil surface area and dropping of the condensing temperature. Output in these conditions is slightly higher than 50% of total output but it becomes unnecessary to stop the unit so that cooling can continue throughout the critical period.
The compressors are filled with polyester oil, which is suitable for use in conjunction with R410A.

Water-refrigerant plate evaporator
The evaporators are composed of AISI 316 stainless steel brazed plate exchangers. The exchangers are clad externally with an anticondensation mat made of closed cell expanded foam.
The exchanger is protected by a series of temperature probes installed on the refrigerant discharge having an anti-freeze function, and by a pressure switch monitoring the pressure differential between refrigerant suction and discharge sides.

Air-cooled condenser
The air-cooled condenser is composed of a finned core coil made with copper tubes and high-efficiency corrugated aluminium fins adequately spaced in such a way as to ensure optimal heat exchange efficiency. The copper tubes are of sufficient diameter and wall thickness to withstand the highest R410A resign pressures.

Options:

- Metal mesh filters protecting the condensing coils.

Axial Fans

Axial fans with IP 54 protection rating, external rotor, with moulded blades made of fibreglass-reinforced plastic with a die cast aluminium core.
The fans are accommodated in dynamically profiled external ports complete with a safety mesh protecting the exterior side.

Electrical cabinet for power and control circuits

Electrical power and control cabinet, made in compliance with EN 60204-1/IEC 204-1 (Safety of Machinery), complete with:
- control circuit transformer;
- main door-lock circuit breaker;
- thermal-magnetic cut-outs or fuses protecting compressors, fans and pumps
- contractors controlling compressors, fans and pumps;
- terminals for common alarms block;
- terminals for remote On/Off input;
- control circuit terminal boards;
- exterior quality electrical cabinet with single door and weather seals;
- electronic controller;
- control circuit numbered cables;
- 400/3/50Hz power supply; 230 Vac and 24 Vac control circuits for the electronic controller.

Options:

- phase sequence monitoring;
- electrical cabinet fan;
- electrical cabinet anticondensation heater;
- remote keypad kit.

Microprocessor controller

All WBA series units are equipped with a microprocessor controller capable of managing the following functions:
-water temperature control in the traditional method with a probe on the system return line (especially suitable for applications in which an inertia storage tank is installed);
-fans ON-OFF control;
-freeze protection;
-automatic compressors start sequence rotation;
-compressor time intervals;
-alarms signalling and reset;
-presentation on the display of the programmed set-points and the values read by the probes.

1.2 Identification of the units in the range

BICOLD WBA WATER CHILLERS

WBA	2	220	VDS	MH
1 2	3	4	5	6

1 - MODEL
WB – Water chiller units with hermetic scroll compressors and plate evaporators.
WH – Heat pump version

2 - CONDENSATION
A = AIR-cooling with axial fans (suitable for outdoor installation);

3 – NUMBER of REFRIGERANT CIRCUITS
1 = one circuit
2 = two circuits

4 - SIZE
Numerical value denoting the cooping capacity in kW in nominal conditions (water 12/7 °C and ambient 35 °C)

5 - VERSION

STD = standard

6 – LAYOUT
SE = Unit with one evaporator. Including differential pressure switch to protect the evaporator.
MP = Unit with evaporator and **one centrifugal pump**. Including a differential pressure switch to protect the evaporator.
DP = Unit with evaporator and **two centrifugal pumps**. Differential pressure switch to protect the evaporator included.
MH = Unit with hydronic module; the layout includes **a centrifugal pump, storage tank,** water pressure relief valve and differential pressure switch to protect the evaporator.
MHD = Unit with hydronic module; the layout includes **two centrifugal pumps, storage tank**, water pressure relief valve and differential pressure switch to protect the evaporator.
MC = Condensing unit; unit **without evaporator** or expansion valve; supplied without refrigerant charge.
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1.3 Operating conditions and limits

Operating limits in Cooling Mode.

		MIN	MAX
Water inlet temperature	℃	9	17
Water outlet temperature	℃	5	13
Temperature gradient	℃	4	8
Ambient air temperature	℃	5 / -15 (*)	(**)

(*) First value refers to standard unit. Second value refers to unit with fans electronic control, antifreeze heater on pump and storage tank (when present).

(**) Value depends on size of chiller and operating conditions.

Operating limits in Heating Mode.

		MIN	MAX
Water inlet temperature	℃	25	45
Water outlet temperature	℃	30	50 (***) / 40 (****)
Temperature gradient	℃	4	8
Ambient air temperature	℃	-5	20

(***) Max hot water outlet temperature with minimum ambient air temperature of +5 ℃
(****) Max hot water outlet temperature with minimum ambient air temperature of -5 ℃

In the presence of a risk of freezing of the fluid medium in the hydraulic circuit **antifreeze mixtures** are required; the following are guideline values of the freezing point for mixtures of water and ethylene glycol, withy glycol percentages expressed in weight. To avoid pump damage in the event of glycol percentages above 25%, consult the BICOLD Srl sales department.
The use of this type of mixture causes slight alterations in some of the thermodynamic parameters of the chillers. The new values can be established by multiplying the value of the required parameter in nominal operating conditions by the appropriate coefficients shown in the following table:

% GLYCOL by weight	**10**	**20**	**30**	**40**	**50**
Freezing temperature (℃)	-3.7	-8.7	-15.3	-23.5	-35 .6
Cooling capacity correction factor	0.99	0.98	0.97	0.96	0.93
Absorbed power correction factor	0.99	0.98	0.98	0.97	0.95
Mixture flow rate correction factor	1.02	1.05	1.07	1.11	1.13
Pressure drops correction factor	1.083	1.165	1.248	1.33	1.413

WARNING! WITHOUT GLYCOL IN THE SYSTEM:

IMPORTANT!
If the unit is not used in the winter the water in the circuit may freeze

IMPORTANT!
The use of mixtures of water with glycol affects performance characteristics of the unit

1-4 Unit performance

1.4.1 Cooling duty and electrical power consumption values

Performance values of the models in the WBA range of chillers are shown below referred to water inlet/outlet temperature of 12/7 ℃ and ambie nt temperature of 35 ℃.

Models	**WBA-1020**	**WBA-1026**	**WBA-1030**	**WBA-1034**	**WBA-1039**	**WBA-1045**
Cooling DUTY kW	19,7	26,1	30,2	33,2	39,3	43,3
Power CONS. kW	6,4	8,8	9,6	10,7	12,8	15,4

Models	**WBA-1053**	**WBA-1059**	**WBA-1066**	**WBA-1075**	**WBA-1090**	**WBA-1098**	**WBA-1110**
Cooling DUTY kW	52.7	58.3	66.1	75	89.1	97.4	110.0
Power CONS. kW	16.5	19.4	21.6	26.5	28.7	33.5	37.8

Models	**WBA-1126**	**WBA-1145**	**WBA-1158**	**WBA-2180**	**WBA-2195**	**WBA-2220**
Cooling DUTY kW	125.7	144.2	157.6	178.2	194.9	224.0
Power CONS. kW	40.8	46.5	54.5	57.4	67.0	75.7

Models	**WBA-2250**	**WBA-2290**	**WBA-2315**	**WBA-2376**	**WBA-2412**
Cooling DUTY kW	249.3	288.4	315.2	375.5	412.0
Power CONS. kW	82.3	92.2	109.0	116.0	135.2

1.4.2 Sound pressure level

The following table gives the noise data in Sound Pressure Lp(A) at 10 metres from the condensing coil and 1 metre height above ground in free field conditions (direction factor Q=2). The Sound Pressure level refers to the machine std layout with the compressors compartment insulated with sound absorbing matting.

Models	WBA-1020	WBA-1026	WBA-1030	WBA-1034	WBA-1039	WBA-1045
Lp(A) 10 m	47	48	48	48	49	49

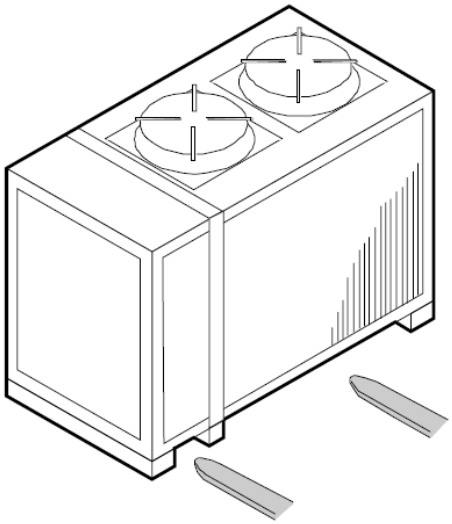
Models	WBA-1053	WBA-1059	WBA-1066	WBA-1075	WBA-1090	WBA-1098	WBA-1110
Lp(A) 10 m	47	48	49	49	52	54	56

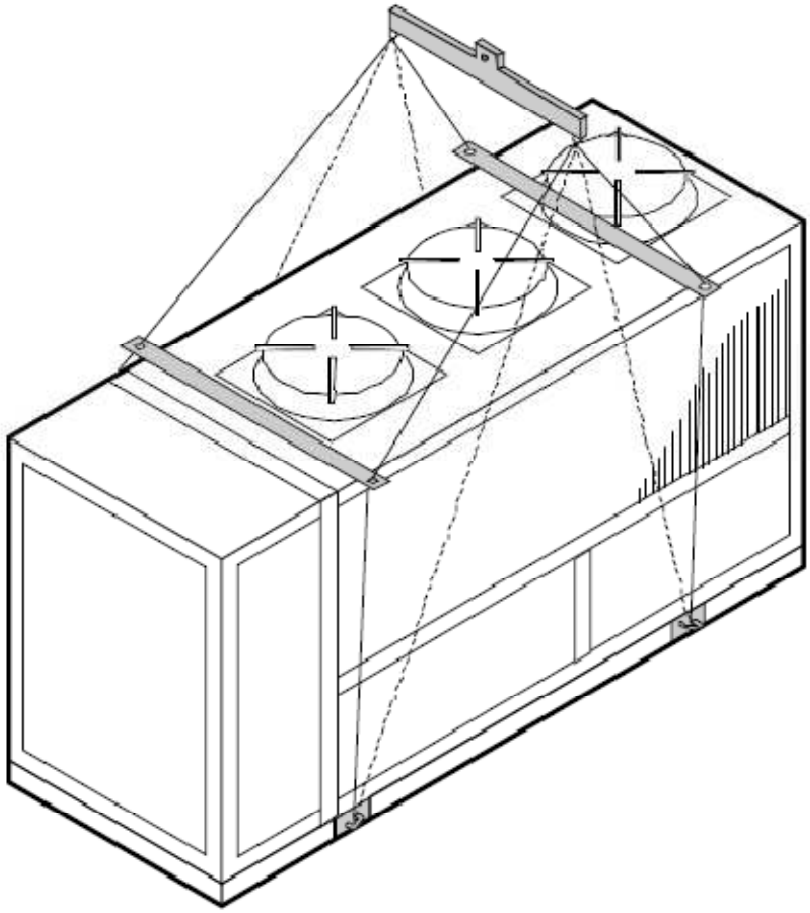
Models	WBA-1126	WBA-1145	WBA-1158	WBA-2180	WBA-2195	WBA-2220
Lp(A) 10 m	57	57	57	55	57	59

Models	WBA-2250	WBA-2290	WBA-2315	WBA-2376	WBA-2412
Lp(A) 10 m	60	60	60	63	63

2 – INSTALLATION REQUIREMENTS

2.1 Lifting and transport





Before lifting the unit refer to the following WEIGHTS table, wherein values are calculated without the hydronic unit:

Models	WBA-1020	WBA-1026	WBA-1030	WBA-1034	WBA-1039	WBA-1045
Weight kg	350	365	380	460	480	560

Models	WBA-1053	WBA-1059	WBA-1066	WBA-1075	WBA-1090	WBA-1098	WBA-1110
Weight kg	620	635	665	680	870	950	1020

Models	WBA-1126	WBA-1145	WBA-1158	WBA-2180	WBA-2195	WBA-2200
Weight kg	1100	1160	1180	1495	1665	1760

Models	WBA-2250	WBA-2290	WBA-2315	WBA-2376	WBA-2412
Weight kg	2050	2100	2210	2630	2680

Models	WHA-1020	WHA-1026	WHA-1030	WHA-1034	WHA-1039	WHA-1045
Weight kg	380	400	415	500	530	620

Models	WHA-1053	WHA-1059	WHA-1066	WHA-1075	WHA-1090	WHA-1098	WHA-1110
Weight kg	670	685	720	740	940	1030	1100

Models	WHA-1126	WHA-1145	WHA-1158	WHA-2180	WHA-2195	WHA-2200
Weight kg	1190	1255	1280	1620	1800	1930

Models	WHA-2250	WHA-2290	WHA-2315
Weight kg	2260	2310	2450

DANGER!

The unit must be handled with care to avoid damage to the external structure and the internal mechanical end electrical components. Also make sure that there are no obstacles or persons along the route, to avoid the risk of collision, crushing or overturning of the lifting and handling vehicle.

The unit can be handled and/or lifted exclusively using the specific lifting attachments incorporated in the frame.
Lifting of the unit is possible by means of textile webbing inserted in the channels in the base frame, or by means of the forks of a suitable lift truck.
Once the unit has been installed remove the protective film from the panelling and the shrink wrap plastic.

ENVIRONMENTAL PROTECTION
Dispose of the packing materials in compliance with national legislation and local bylaws in your country.
DANGER!
Keep packaging materials out of reach of children.

2-2 Installation and positioning

(1) The chiller must be installed in a site with good air quality without a corrosive or inflammable or exceptionally dusty atmosphere.

THE UNIT IS NOT SUITABLE FOR USE IN EXPLOSIVE ATMOSPHERES!

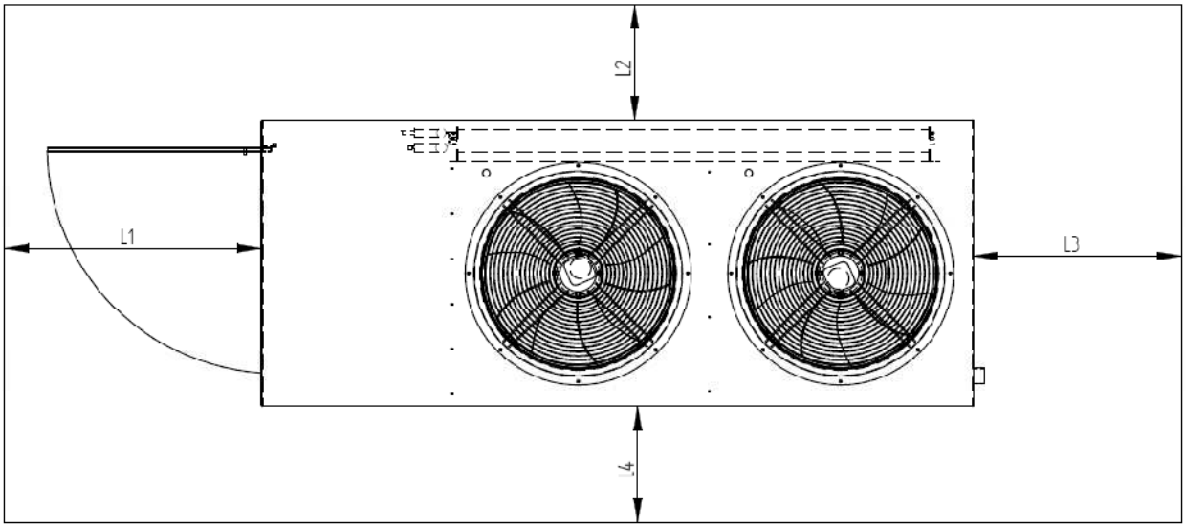
(2) The chiller must be installed in a site in which ventilation is sufficient and the heat release by the unit can be easily dispersed to the exterior. Considering that the chiller disperses heat to the exterior when it is running, if the place of installation is confined or lacks sufficient fresh air, the room temperature will rise progressively and the hot air, which will recirculate over the condenser, will cause rapid degradation of the performance to the point at which the unit shuts down due to high pressure.

IMPORTANT !

The unit must be sited taking account of the minimum recommended clearances, taking account of the position of the condensing coils and accessibility of the hydraulic and electrical connections.

An installation without the recommended clearances will cause poor operation of the unit with an increase in power consumption and a reduction in cooling capacity due to an increase in the condensing pressure.

The area above the unit must be completely free of obstacles in such a way as to guarantee unimpeded air flow from the condensing fans.
If the unit is surrounded by walls, the minimum clearances shown are still valid as long as at least the two adjoining walls closest to the unit are no higher than the total height of the unit.
Greater spaces than the spaces indicated must be provided to allow handling of any components to be replaced.



WBA MODELS		1020/1045	1053/1075	1090/1110	1126/1158	2180/2220
Installation clearances						
L1	mm	1000	1000	1000	1000	1000
L2	mm	1000	1000	1200	1200	1200
L3	mm	800	800	800	800	800
L4	mm	1000	1000	1000	1000	1000

WBA MODELS		2250/2315	2376/2412
Installation clearances			
L1	mm	1000	1000
L2	mm	1200	1200
L3	mm	800	800
L4	mm	1200	1200

(3) To ensure a sufficient air flow the condenser fins must NEVER be obstructed or excessively fouled;
(4) Free air circulation around the electrical cabinet must be guaranteed.
(5) It is mandatory to install an 0.5 / 0.8 mm mesh filter on the chiller water inlet

2-3 Installation of electrical parts

WBA chillers are completely wired in the factory. The only cable required is the connection to the electrical mains supply, the connection of the flow switch (optional) and the remote On/Off switch (ON-OFF jumpered by default). All operations described above must be carried out by qualified personnel in compliance with statutory legislation. For all electrical work refer to the wiring diagrams.

General warning or precautions to be strictly observed. Serious hazard.

Electric shock hazard

THE UNIT ELECTRICAL HOOK-UP MUST BE CARRIED OUT BY A LICENSED ELECTRICIAN WITH THE NECESSARY PROFESSIONAL SKILLS AND IN COMPLIANCE WITH STATUTORY REGULATIONS IN THE COUNTRY OF INSTALLATION !

IMPORTANT ! FOR INSTALLATION REFER TO THE UNIT WIRING DIAGRAMS SUPPLIED ON BOARD THE UNIT TOGETHER WITH THIS MANUAL, AND TO THE DATA ON THE CE RATING PLATE


(1) The unit must be connected to the power supply only when the installation work (mechanical, hydraulic and electrical) has been completed.


(2) The electronic control board is located in the chiller electrical cabinet.
Only qualified technicians must open the unit to perform work on it. To hook up the WBA unit to the mains electrical panel, for power feeding and for the signals input/output, always refer to the wiring diagram.


(3) Comply with the connection specifications for the phase and protective earth conductors. There must be a specific protection against short circuits and ground faults upline from the power feeding line, capable of disconnecting the plant from all other users.

(4) Install suitable protection on the WBA unit power feeding line in compliance with the regulations in force in the country in which the unit is installed.

(5) For the electrical connections use cables that comply with the statutory electrical regulations in force in the country of installation

(6) After installation, check that the mains power values are within a tolerance of ±10% of the nominal machine input voltage (unless otherwise specified on the electrical wiring diagram) with a maximum phase-to-phase imbalance of 3%. If these parameters are not present, contact your local electricity company.

(7) No external thermostat can be used to connect/disconnect the unit's power feeding line, or malfunctions and poor performance of the unit will result.

(8) Keep the power lines separate from the signal cables; signal cables must be shielded and connected to a voltage-free PE point at just one end of the shield.

(9) It is mandatory to make an efficient protective earth connection. The manufacture cannot be held liable for any damage caused by the omitted or inefficient connection of the unit to the earth system.

3. Commissioning and running the chiller

3-1 Commissioning and operation notes

Before starting up the unit check that the water circuit pipes have been correctly connected to the evaporator and that the electrical panels and condenser compartment doors are properly closed. At this point the chiller can be started.

Pay attention to moving parts if the panels or covers are raised or have been removed from the unit!
Access to the unit is permitted only to qualified technical personnel.

3-2 Description of the electrical panel and controller

The electrical panel is located inside the unit at the top of the technical compartment that houses the various refrigerant circuit components.
To gain access to the electrical panel open the front panel of the unit after setting the door lock breaker switch to 0 (OFF).

OPERATION AND ADJUSTMENT

The electrical cabinet is equipped with a main disconnect switch with door-lock device. Feeding of the 230Vac auxiliary circuits and the 24Vac control circuits is obtained internally from the three-phase power input. Adjustments can be carried out by means of a compact electronic controlled, of the size of a normal thermostat, which provides complete management of the chiller.

Unit regulation and switching-on of the external high and low prevalence pumps.

The water temperature probe which controls the thermoregulation of the machine, is positioned on the pipe that connects the water tank to the evaporator inlet.
The microprocessor switches on or off the compressor according to the temperature set.
The inner circulatory pump is always switched on. This pump makes the water flow circulate between the tank and the evaporator.
The 2 external pumps for the users pumping, are regulated by a 3-positions selector according to the following logic:

“Man” position: the pump is switched on
“0” position: the pump is switched off
“Auto” position: the pump is switched on by an external contact (at customer’s charge) as quoted on the electrical scheme.

1. USER INTERFACE

SYMBOL	COLOUR	MEANING		REFERENCE REFRIGERANT CIRCUIT
		WITH LED ON	WITH LED FLASHING	
1;2	amber	Compressor 1 and/or 2 running	Start request	1
3;4	amber	Compressor 3 and/or 4 running	Start request	2
A	amber	At least one compressor running		1/2
B	amber	Pump running	Start request	1/2
C	amber	Condenser fan running		1/2
D	amber	Defrost on	Defrost request	1/2
E	amber	Crankcase heater on		1/2
F	red	Active alarm		1/2
G	amber	Heat pump mode	Heat pump mode request	1/2
H	amber	Chiller mode	Chiller mode request	1/2

1. PARAMETERS PROGRAMMING AND SAVING PROCEDURE

- Press "Prg mute" and "Sel" for 5 s;
- The hot and cold symbol and the value "00" will appear;
- Use "▲" and "▼" to set the password and confirm with "Sel";
- Use "▲" and "▼" to select the parameters menu S-P and confirm with "Sel";

- Use "▲" and "▼" to select the parameters group and confirm with "Sel";
- Use "▲" and "▼" to select the parameter and confirm with "Sel";
- Once the parameter has been edited press "Sel" to confirm or "Prg/mute" to cancel your changes;
- Press "Prg/mute" to restore the previous menu;

NOTES:

- Parameters edited without confirmation by pressing "Sel" will simply revert to the previous value;
- If no keys are pressed for 60 s, the controller will quit the parameters editing menu due to time-out and the changes that have been made will be cancelled.

1. SWITCHING THE UNIT ON AND OFF

- Turn the main power switch to 1(ON).

CHILLER OPERATION

- To start the unit hold down the "▲" key for 5 seconds. The pump operating mode LEDs will light.
- Depending on the return temperature from the installation one or both compressors may be started.
- To stop the unit hold down the "▲" key for 5 seconds.

HEAT PUMP OPERATION

- To start the unit hold down the "▼" key for 5 seconds. The pump operating mode LEDs will light.
- Depending on the return temperature from the installation one or both compressors may be started.
- To stop the unit hold down the "▼" key for 5 seconds.

2. PROGRAMMING THE SET-POINT

CHILLER MODE OPERATION

The factory setting in cooling mode is 9.5°C.

To change the set point, proceed as follows:

- Press "Sel" for 5 sec to access the main parameters window.
- Use the "▲" or "▼" key to scroll to the  submenu.
- Press "Sel" to access submenu  and use the "▲" or "▼" key to scroll through the parameters accessible from said menu.
- To change the Set-point, parameter  , press "Sel"

- After displaying the value, use the "▲" or "▼" keys to change it.
- Thereafter, press "Prg/mute" to quit without saving your changes or press "Sel" to save your changes.
- Finally, press "Prg/mute" to return to the higher level and/or exit the configuration menu.

HEAT PUMP OPERATION

The factory setting in cooling mode is 42.5°C.

To change the set point, proceed as follows:

- Press "Sel" for 5 sec to access the main parameters window.
- Use the "▲" or "▼" key to scroll to the  submenu.
- Press "Sel" to access submenu  and use the "▲" or "▼" key to scroll through the parameters accessible from said menu.
- To change the Set-point, parameter c03, press "Sel"
- After displaying the value, use the "▲" or "▼" keys to change it.
- Thereafter, press "Prg/mute" to quit without saving your changes or press "Sel" to save your changes.
- Finally, press "Prg/mute" to return to the higher level and/or exit the configuration menu.

3. PROBES READING

Press "▲" for 1 second and use "▲" and/or "▼" to scroll until displaying the following values: Press "▲" and use "▲" and/or "▼" to scroll until displaying the following values:

- b01 Inlet water temperature (°C)
- b02 Outlet water temperature (°C)
- b04 Condensing pressure (bar)

4. ALARMS DISPLAY

Values display message HP1	Trip of high pressure switch 1	Check fault Reset manually
Values display message HP2	Trip of high pressure switch 2	Check fault Reset manually
Values display message LP1	Trip of low pressure switch 1	Check fault Reset manually
Values display message LP2	Trip of low pressure switch 2	Check fault Reset manually
Values display message A1	Anti-freeze trip (automatic reset)	Check water outlet temperature Check water flow rate Check set-point temperature
Values display message E1	Fault of water outlet probe BT1 (automatic reset)	Check electrical connections Replace component
Values display message E2	Fault of water outlet probe BT2 (automatic reset)	Check electrical connections Replace component
Values display message E4	Fault of water outlet probe BT4 (automatic reset)	Check electrical connections Replace component
Values display message E8	Fault of water outlet probe BT8 (automatic reset)	Check electrical connections Replace component
Values display message FL	Trip of differential pressure switch or flow switch	Check for insufficient water flow rate Check for presence of air in hydraulic circuit
Values display message CP2	Trip of compressor 2 thermal protection	Check fault Reset manually
Values display message CP3	Trip of compressor 3 thermal protection	Check fault Reset manually
Values display message CP4	Trip of compressor 4 thermal protection	Check fault Reset manually
Values display message EPr	EEPROM error in operation	Check electrical connections Renew component
Values display message EPb	EEPROM error at start-up	Check electrical connections Renew component
Values display message ESP	Expansion error	Check electrical connections Renew component

Values display message FLB	Trip of differential pressure switch or flow switch	Check for insufficient water flow rate Check for presence of air in hydraulic circuit
Values display message CP1	Trip of compressor 1 thermal protection	Check fault Reset manually
Values display message tC1	Trip of circuit 1 thermal protection(s)	Check fault Reset manually

5. ALARMS RESET

After resetting the alarm, to clear the message from the display proceed as follows:

- Press "▲" and "▼" for 5 seconds.

6. OPERATING CHARACTERISTICS

7.1.Cooling Mode Set-Point

Factory setting =9.5°C, differential =5°C.

For water temperatures above 12°C the 1st compressor will be started, while for temperatures above 14.5°C, the 2nd compressor will be started.

For water temperatures below 12°C the 1st compressor will be stopped, while for temperatures below 9.5°C, the 2nd compressor will be stopped.

7.2.Heating Mode Set-Point

Factory setting =42.5°C, differential =5°C.

For inlet water temperatures below 40°C the 1st compressor will be started, while for temperatures bellow 38.55°C, the 2nd compressor will be started.

For water temperatures above 40°C the 1st compressor will be stopped, while for temperatures above 42.5°C, the 2nd compressor will be stopped.

7.3.Compressor Start Time Lag

To prevent excessively close compressor starts the following functions are implemented:

- Compressor minimum run time
- Compressors minimum stop time
- Time lag between two starts of the same compressor

- Time lag between starts of 2 compressors
- Time lag of compressor start after pump start

7.4.Circulator / Backup Pump (optional)

The electronic control board has an output for control of a circulator that starts when the unit is switched on and stops 60 seconds after the unit is switched off.

After the first 20 seconds of pump operation, when the water flow rate is at steady-state operating conditions, the water flow rate alarm functions are enabled (differential pressure switch and flow switch).

If the system is equipped with a Backup pump, the two pumps are switched when the alarm trips:

- if the alarm is cleared, a message will be shown on the display, while
  the unit continues to run with the Backup pump.

The 2 pumps are never used simultaneously, but they are automatically switched every 24 hours. After a pump changeover due to a flow alarm, the 24 hours pump switch timer is reset.

7.5.Fan ON/OFF control

ON/OFF operation of the fans occurs in two steps. The steps are always managed by the controller and by a pressure switch for management of the second step.

7.6.Fan speed control (optional)

To allow correct operation of the unit at different ambient temperatures, the microprocessor reads the pressure value(s) by means of the transducers(s) and controls the fan speed accordingly, in such a way as to increase or decrease the heat exchange rate to keep the condensing and evaporation pressure values virtually constant.

7.7.Anti-freeze alarm

To prevent rupture of the plate exchanger due to possible freezing of its water contents, the microprocessor connects the antifreeze heater (if present) and the pump (if present) if the temperature read by the temperature probe at the exchanger outlet is below +4°C; the microprocessor can also shut down the compressors.
This antifreeze set-point temperature can be altered exclusively by an authorized service centre and only after having checked to ensure that the hydraulic circuit has been filled with an antifreeze solution.
Tripping of this alarm causes shutdown of the compressors; in contrast, the pump continues to run.

To restore normal operation the water outlet temperature must rise to above +9°C, at which point the alarm resets automatically.

7.8.Set-point compensation (optional)

This function enables an increase of the set-point with a rise in the ambient temperature.

3-3 Operative settings

IMPORTANT!

Modifications of the unit operating parameters must be carried out using the utmost caution to avoid creating situations of conflict with the other parameter settings.

2. PARAMETERS TABLE

The parameters are divided into 4 types depending on their password protection and function. The access to each level can be set to only the parameters of the level in question and lower levels.

- Factory Parameters: Password protected (issue of the password is at the discretion of BICOLD srl); all unit parameters can be configured from this level.
- Super User Parameters: Password protected (issue of the password is at the discretion of BICOLD srl); Super User, User and Direct parameters can be configured from this level.
- User Parameters: Protected by password **22**; configuration of typical user settable parameters (User only) and Direct parameters and the related options. Settable parameters and options:

PROBES SETTING PARAMETERS (/*)		
/21	Digital filter	4
/22	Input limitation	8
/23	Unit of measurement	0

- Digital filter

/21: Serves to set the coefficient used in digital filtration of the measured value. High values of this parameter make it possible to eliminate any continuous disturbances on the analog inputs (the measurement response is however reduced). The recommended parameter is 4 (default).

- Input limitation

/22: Serves to set the maximum detectable variation of the probes in a unit programming cycle; in practice, the maximum permissible variations for the measurement are between 0.1 and 1.5 units (bar, °C or °F depending on the probe and the unit of measurement) approximately per second. Low values of this parameter limit the effect of pulse type disturbances. The recommended value is 8 (default).

- Unit of measurement

/23: Selects the operating mode with Centigrade or Fahrenheit values. When the parameter is changed µC2SE automatically converts the values read by the temperature probes NTC B1, B2, B3 to the new unit of measurement while all the other programmed parameters (set-point, differential, etc.) remain unchanged.

ANTIFREEZE SET-UP PARAMETERS – ELECTRIC ANTIFREEZE HEATERS (A*)		
A10	Automatic antifreeze start	0*

* 0= No action
1= The antifreeze heaters and pump are switched on simultaneously on the basis of setting: A04.
3= Antifreeze heaters switched on according to setting A04.

NOTE:
If no pumps and no heaters are installed the parameter will be 0.
With one or two pumps installed the parameter will be 1.
With one or two pumps and the antifreeze heaters installed the parameter will be 1.
With the antifreeze heaters installed the parameter will be 3.

WARNING!
This parameter is effective if the unit is in stand-by (unit OFF from remote input or from keypad)
Therefore, in the case of units with pump(s) it is MANDATORY to leave the hydraulic circuit shut-off valves open in order to allow water to circulate.

PROBE PARAMETERS (B*)		
b00	Select the probe to be shown on the display	0

Set the probe to be shown on the display.
0= probe B1
1= probe B2
3= probe B4
7= probe B8

DEFROST SET-UP PARAMETERS (D*)		
d03	Defrost start pressure	**4**
d04	Defrost end pressure	**24**
d06	Defrost minimum duration	**60**
d07	Defrost maximum duration	**5**
d08	Time lag between two defrost requests on same circuit	**30**
d16	Forced ventilation time in defrost cycle	**0**

- Defrost start pressure
d03: In the case of heat pumps, this parameter sets the pressure below which the defrost cycle starts.
To start the defrost cycle this condition must persist for time d05.

- Defrost end pressure
d04: Sets the pressure above which the defrost cycle ends.

- Defrost minimum duration

d06: The minimum duration of the defrost cycle (the function continues even if the condensing probe exceeds the defrost end pressure).

- Defrost maximum duration
d07: Maximum duration (protection: causes display of message “dF1” or “dF2”).

- Delay between two defrost requests on the same circuit
d08: Minimum time lag between two successive defrost cycles

- Defrost end forced ventilation time
d16: As soon as the defrost end pressure is reached, the fans are started at maximum speed for the preset time, before changing state. The cycle returns to Heat Pump mode with normal fan control only once this time has elapsed.

COMPRESSORS SET-UP PARAMETERS (C*)		
c04	Starting time lag between the 2 compressors	30
c05	Stopping time lag between the two compressors	0
c06	Starting time lag	30
c07	Compressor start time lag after starting of delivery pump / fan	120
c09	Maximum operating time of compressor in tandem mode	25
c14	Running hours counter threshold	0

- Starting time lag between the compressors
c04: Sets the starting time lag between the two compressors in order to reduce power consumption at start-up and make compressor starts less frequent.
During this stage the compressor LED flashes.

- Stopping time lag between the compressors
c05: Sets the stopping time lag between the compressors

- Starting time lag (reconnection of power supply)
c06: When the unit is powered on (physical power connection to the controller) this time lag delays activation of all the outputs in order to distribute mains loads and to protect the compressor from repeated starts in the event of frequent power outages.
This means that once this time interval has elapsed, the controlled will start managing the outputs on the basis of the other time intervals and the normal operative functions.

- Compressor start time lag after pump start
c07: The compressor is started once the set time has elapsed since starting of the pump.

- Maximum operating time of compressor in tandem mode
c09: In the event of 2 tandem compressors per circuit, it is necessary to prevent one compressor on the same circuit from running for more than the preset time (c09) if the other compressor remains off.
This prevents the common oil from migrating further than permitted towards the running compressor, this avoiding a situation wherein the next time the currently idle compressor is

started (FIFO logic) it lacks the necessary level of lubrication to protect its components, with resulting damage.
Therefore, compressor 1 (or 2) of circuit 1, if it is obliged to run constantly, will switch off after time c09 to allow compressor 2 (or 1), which was previously stopped, to take over.
This function will always take account of the compressor run and idle times.
c09=0, the function is inhibited (no compressor changeover).

- Compressor running hours counter threshold
c14: Establishes the number of compressor run hours, expressed in hundreds of hours, after which the maintenance request warning is tripped.

c14= 0: function disabled.

FANS SET-UP PARAMETERS (F*)		
F05	Minimum speed pressure in Summer mode	22
F06	Maximum speed pressure differential in Summer mode	8
F07	Fans off pressure differential in Summer mode	0
F08	Minimum speed temperature / pressure in Winter mode	22.0
F09	Maximum speed temperature / pressure differential in Winter mode	84.0
F10	Fans off temperature / pressure differential Winter mode	0
F11	Start-up time	0

- Minimum speed pressure set in Summer mode (cooling)
F05: Establishes the pressure below which the fans remain at minimum speed.
In the presence of ON/OFF fans control, this value is the temperature or pressure below which the fans are switched off.

- Maximum speed pressure differential in Summer mode (cooling)
F06: When the speed controller is utilised, this value is the differential with respect to F05 of the pressure above which the fans must be started at maximum speed;
In the presence of ON/OFF fans control, this value is the temperature or pressure below which the fans are switched off.

- Fans off pressure differential in Summer mode (cooling)
F07: When the speed controller is utilised, this value is the differential with respect to F05, for the pressure below which the fans are stopped

- Minimum speed pressure set in Winter mode (heating)
F08: Establishes the pressure above which the fans must run at minimum speed. In the presence of ON/OFF fans control, this value is the temperature or pressure above which the fans are switched off.

- Fans maximum speed pressure differential in Winter mode (heating)
F09: When the speed controller is utilised, this value is the differential with respect to F08, for the pressure below which the fans must be started at maximum speed. In the presence of ON/OFF fans control, this value is the differential below which the fans are switched on.

- Fans off pressure differential in Winter mode (heating)
F10: When the speed controller is utilised, this value is the differential with respect to F08, for the pressure above which the fans are switched off.

UNIT SET-UP PARAMETERS (H*)		
H07	ON-OFF digital input	1
H09	Enable keypad	1
H10	Serial address	1

- ON-OFF digital input
H07: Establishes whether the ON/OFF selection from digital input is enabled or not. If the selection is enabled (H07= 1) the “open” status forces the unit to switch off while the in “closed” status the unit can be switched on or off also from the keypad.

- Enable keypad
H09: Makes it possible to disable editing of DIRECT and USER parameters from the keypad but allows display of the parameters value.
Keypad Status:
0: disabled
1: enabled (default)

- Serial address
H10: Establishes the address of the instrument for the serial connection by means of an optional board, to a supervision and/or remote diagnostic system.

ALARMS SET-UP PARAMETERS (P*)		
P01	Flow switch alarm delay at pump start-up	20
P02	Flow switch alarm delay at steady-state	5
P03	Low pressure alarm delay at start-up	40
P04	Enable capacity control in high pressure	1
P21	Alarms relay management	0

- Flow switch alarm delay at pump start-up
P01: Establishes a delay in recognising the flow-switch alarm at pump start (wait for flow rate to reach steady state condition).
In the event of an alarm the compressors must be switched off immediately, disregarding the time intervals.

- Flow switch alarm delay at steady-state
P02: Establishes a delay in recognising the flow switch alarm in steady state conditions in order to filter out any flow rate fluctuations or air pockets in the water circuit. In the event of an alarm the compressors must be switched off immediately, disregarding the time intervals.

- Low pressure alarm delay at compressor start-up
P03: Establishes a delay in recognising the low pressure alarm at start-up of the compressor to allow a steady-state situation to be reached.

- Capacity control in high pressure
P04: enable or disable capacity control of the high pressure circuit.

The function is valid if the unit is equipped with tandem compressors and pressure transducers. In the event of a high pressure alarm, i.e. alarm for values above P18 (with hysteresis of 0.5 bar), the controller disabled one capacity step of the circuit in question and waits for 10 seconds.
After this interval, if the alarm is still active the unit is stopped, otherwise it continues to run with a capacity step active. In this condition the display shows the message PH1 and/or PH2 depending on the affected circuit. This condition remains active as long as the pressure does not fall below the value corresponding to the maximum condensing fan speed (F05+F06). Below this value the unit re-enables the previously inhibited capacity step.
P04=0: capacity step not activated
P04=1: high pressure capacity step activated
P04=2: low pressure capacity step activated
P04=3: high and low pressure capacity control activated

TEMPERATURE CONTROL SET-UP PARAMETERS (r*)		
r17	Summer offset Constant	0
r18	Maximum distance from set-point	3
r19	Compensation start temperature in Summer	30.0
r20	Compensation start temperature in Winter	0.0

- Summer compensation Constant (Chiller mode):
r17: Sets the coefficient that regulates the summer compensation algorithm.
In cooling mode, if r17 is positive, the set point increases as the ambient temperature rises (as detected by the external temperature probe); in contrast, if r17 is negative, the set point decreases as the ambient temperature rises. This difference of the set-point compared to the set value can assume a maximum absolute value equal to the value of parameter r18.

- Maximum distance from set-point
r18: Denotes the maximum distance from the set point beyond which compensation is suspended (maximum and minimum limit values with respect to the programmed set-point).

- Compensation start temperature in Summer (ambient probe)
r19: Sets the temperature (measured by the ambient probe) above which the compensation effect starts (cooling).

- Compensation start temperature in Winter (ambient probe)
r20: Sets the temperature (measured by the ambient probe) below which the compensation effect starts (heating).

- Direct Parameters: Accessible without password, direct parameters allow reading of probes and any data that can be interrogated freely with no risk of impairing operation of the unit.

PROBE PARAMETERS (B*)		
b01	Value read by probe B1	-
b02	Value read by probe B2	-
b04	Value read by probe B4	-
b08	Value read by probe B8	-

See “Reading probes” heading

COMPRESSORS SET-UP PARAMETERS (C*)		
c10	Compressor 1 hour meter	0
c11	Compressor 2 hour meter	0
c12	Compressor 3 hour meter	0
c13	Compressor 4 hour meter	0
c15	Evaporator pump hour meter	0
c16	Back up condenser pump hour meter	0

- Compressor 1-2-3-4 hour meter
c10, c11, c12, c13: Shows the number of running hours of compressor 1, 2, 3, 4 expressed in hundreds of hours.

Simultaneous pressure of “▲” and “▼”, at the time of display of the meter value leads to reset of the hour meter and consequently to cancellation of any pending maintenance requests.

- Evaporator pump hour meter
c15: Shows the number of running hours of the evaporator pump, expressed in hundreds of hours.

Simultaneous pressure of “▲” and “▼”, at the time of display of the meter value leads to reset of the hour meter and consequently to cancellation of the pending maintenance requests.

- Condenser pump or back-up pump hour meter
c16: Shows the number of running hours of the evaporator pump (or back-up pump), expressed in hundreds of hours.

Simultaneous pressure of “▲” and “▼”, at the time of display of the meter value leads to reset of the hour meter and consequently to cancellation of any pending maintenance requests.

UNIT SET-UP PARAMETERS (H*)		
H97	Expansion software version	
H96	Software version (displayed on instrument start-up)	

ALARMS SET-UP PARAMETERS (P*)		
P24	Compressors deactivation in HP and LP capacity control	1

- Compressors deactivation in HP and LP capacity control
P24: Set which compressor of each circuit must be stopped during capacity control operation

P24= 0 stop compressors 1 and 3
P24= 1 stop compressors 2 and 4

CONTROL SET-UP PARAMETERS (r*)		
r01	Summer Set point	**9,5**
r02	Summer Differential.	**5**
r03	Winter Set point	**42.5**
r04	Winter differential.	**5.0**

See “Set Point Programming” heading.

N.B.: Editing parameters concerning unit configuration must be carried out with the controller on Stand-by.

3-4 Troubleshooting

Problem	Recommended corrective action
1 – PRIMARY CIRCULATOR FAILS TO START (IF CONNECTED): water differential pressure switch alarm	
No power to pumping unit	Check electrical connections and auxiliary fuses
No signal control board signal	Check, contact authorised service centre
Pump jammed	Check and free if necessary
Pump motor fault	Overhaul or renew pump
Pump speed selector fault	Check, renew component
Working set point is fulfilled	Check
2 – COMPRESSOR: FAILS TO START	
Microprocessor board in alarm status	Identify alarm and take action if necessary
No power, main door lock breaker switch open	Close breaker switch
Overload protection tripped	1. Reset protection
	2. check unit on start-up
No cooling demand (heating in operation as heat pump) in service with working set-point correctly programmed	Check and wait for cooling (heating) request, if necessary
Working set-point programmed too high (too low in heat pump mode)	Check and reprogram set point if necessary
Faulty contactors	Renew contactors or repair
Compressor motor fault	Check for short circuit
3 – COMPRESSOR FAILS TO START: HUMMING NOISE	
Incorrect power supply voltage	Check voltage and correct phase sequence, identify causes
Compressor contactors malfunctioning	Renew contactor
Mechanical problems in compressor	Overhaul compressor
4 – COMPRESSOR RUNS INTERMITTENTLY: low pressure switch alarm	
Malfunctioning of low pressure switch	Check calibration and operation of pressure switch
Insufficient refrigerant charge	1. Find and repair any leaks
	2. replenish refrigerant
Refrigerant liquid line filter clogged (iced up)	Renew filter
Irregular operation of expansion valve	Check calibration, record superheating, replace if necessary
5 – COMPRESSOR STOPS: high pressure switch alarm	
High pressure switch fault	Check calibration and operation of pressure switch
Insufficient cooling air reaching the coils (in chiller mode)	1. Check technical clearances and possible obstruction of the coils
	2. Check operation of the fan
High ambient temperature	Check unit's functional limits
Insufficient circulation of water on plate exchanger (in heat pump mode)	Check and adjust if necessary
Presence of air in water circuit (operating in heat pump mode).	Bleed water circuit of air
Excessive refrigerant charge	Discharge excess refrigerant
6 – EXCESSIVE COMPRESSOR NOISE - EXCESSIVE VIBRATION	
The compressor is pumping liquid, excessive increase of refrigerant in the crankcase	1. Check operation of the expansion valve;
	2. Check superheating
	3. Adjust Superheating and, if necessary, renew the expansion valve
Mechanical problems in compressor	Overhaul compressor
Unit operating at limit of envisaged conditions of use	Check efficiency levels against declared limits
7 – COMPRESSOR RUNS CONSTANTLY	
Excessive thermal load	Check sizing of plant, infiltrations and insulation
Working set point is too low in cooling cycle (too high in heating cycle)	Check setting and alter if necessary
Poor ventilation of coils (in chiller mode)	1. Check technical clearances and possible obstructions of the coils;
	2. Check operation of the fans.
Poor circulation of air on plate exchanger (in heat pump mode)	Check and adjust if necessary
Presence of air in the water circuit (when operating in heat pump mode)	Bleed plant
Insufficient refrigerant fluid charge	1. Identify and repair any leaks
	2. Replenish correct charge
Refrigerant liquid line filter clogged (iced up)	Renew filter
Faulty control board	Renew board and check
Irregular operation of expansion valve	Check calibration, record operation, replace if necessary
Irregular operation of contactors	Check operation
8 – HIGH DISCHARGE PRESSURE AT NOMINAL CONDITIONS	
Insufficient cooling air to coils (in chiller mode)	Check operation of fans, compliance with technical clearances and possible obstruction of coils
Insufficient water circulation on plate exchanger (in heat pump mode)	Check and adjust if necessary
Presence of air in water circuit (in heat pump mode)	Bleed air from the circuit
Excessive refrigerant charge	Discharge excess refrigerant
9 – LOW DISCHARGE PRESSURE AT NOMINAL CONDITIONS	
Insufficient refrigerant charge	1. Identify and repair any leaks;
	2. restore correct charge
Presence of air in water circuit (in chiller mode)	Bleed air from the circuit
Insufficient water flow rate to evaporator (in chiller mode)	Check and adjust if necessary
Mechanical problems in compressor	Overhaul compressor
Excessive thermal load (in heat pump mode)	Check sizing of plant, infiltrations and insulation
Irregular operation of accessory KFI (if installed)	Check calibration and adjust if necessary
10 – HIGH SUCTION PRESSURE AT NOMINAL CONDITIONS	
Excessive thermal load (in CHILLER mode)	Check sizing of plant, infiltrations and insulation
High ambient temperature (operation in heat pump mode)	Check operating limits of the unit
Irregular operation of the expansion valve	Check operation, clean nozzle, record superheating, renew if necessary
Mechanical problems in compressor	Overhaul compressor

11 – LOW SUCTION PRESSURE AT NOMINAL CONDITIONS	
Insufficient refrigerant fluid charge	1. Identify and repair any leaks;
	2. restore correct charge
Plate exchanger (finned coil in operation as heat pump) fouled	Check, flush
Filter partially clogged	Renew
Irregular operation of expansion valve	Check operation, clean nozzle, record superheating, renew if necessary
Insufficient ventilation of evaporator coils (in heat pump mode)	Check operation of fans, compliance with technical clearances and possible obstruction of coils
Presence of air in water circuit (in chiller mode)	Bleed air from the circuit
Insufficient water flow rate (in chiller mode)	Check, adjust if necessary.
12 – ONE OF THE FANS FAILS TO START OR STARTS AND STOPS	
Damaged switch or contactor, interruption on auxiliary circuit	Check, renew if necessary
Thermal protection tripped	Check for the presence of short circuits, renew motor
13 – UNIT FAILS TO PERFORM DEFROST CYCLES (COILS ICED UP) – operation in heat pump mode	
4-way valve damaged	Check, renew if necessary
Defrost probe open circuit	Check for presence of faulty coil probe alarm, renew probe if necessary

4. Maintenance

The frequency of cleaning procedures depends on the quality of the ambient air. The operations described below must be carried out once every 6 months on average.

IMPORTANT!
Maintenance work must be carried out by expert technicians, authorised to work on air conditioning and refrigeration appliances.
DANGER!
Do not insert pointed objects through the air intake and outlet grilles
DANGER!
Always set the main door lock/disconnect switch to OFF to isolate the unit from the electrical supply before performing any work on it, even merely inspection tasks.

4-1 Periodic cleaning of the unit

4.1.1 Periodic inspection and cleaning of the condensing coils

The following operations must be carried out with the unit stopped and taking are not to damage the fins during the cleaning procedures:

- remove all foreign debris from the condensing coils that may obstruct the free flow of air: leaves, paper, debris, etc;
- remove deposited dust by means of a jet of compressed air;
- wash gently with water and simultaneously brush;
- dry with compressed air.

To better protect the coils it is advisable to fit the “coils protective mesh” accessory.

4.1.2 Inspection and washing of the water-cooled exchanger

Plate exchanger do not foul greatly in normal operating conditions in the presence of adequate water filtration and suitable filter maintenance procedures.
The working temperatures of the unit, the velocity of water flow in the waterways, and suitable finishing of the heat transfer surfaces combine to minimise fouling of the exchanger.
Any sludge that accumulates in the water system, sand that is not removed by the filter, and conditions of extreme water hardness or concentration of the antifreeze solution, if present,

can foul the exchanger with a resulting impairment in heat exchange efficiency.
In this case the exchanger must be flushed with chemical detergents, equipping the existing plant with suitable filling and drainage connections or taking alternative action.
Use a tank containing weak acid composed of 5% phosphoric acid solution or, if the exchanger must be cleaned frequently, 5% oxalic acid solution. The detergent liquid must be caused to circulate in the exchanger at a flow rate of at least 1.5 times the nominal working flow rate in order to achieve a high level of turbulence.
With the first detergent circulation the bulk of the debris is removed from the interior of the exchanger, after which the exchanger should be flushed with clean detergent to complete the cleaning procedure. Before restarting the system, flush out the exchanger with plenty of clean water to remove all traces of acid and then bleed the air from the circuit, restarting the service pump if necessary.

4.2 Compressor damage

If you suspect that the machine has operated for a period with a compressor with overheated windings or approaching short-circuit conditions (e.g.: due to inadequate lubrication or excessive operating temperature or due to bearing damage), take action to evaluate the condition of the fluids in the refrigerant circuit. At this point 1) remove the refrigerant with a suitable recovery system and 2) assess the condition of the oil in the compressors.

If the oil shows signs of overheating (cracking), perform the following procedure.

4.2.1 Replacing a scroll compressor

Contact a BICOLD Srl Service Centre, which will perform the following operations.
- Replacement of the compressor in accordance with the prescriptions given in the manufacturer’s manual
- Cleaning of the refrigerant circuit with specific products, because the orifice of the TXV for return of the oil from the accumulator and the filters may become clogged due to the presence of small metal particles. This would result in insufficient oil in the new compressor and hence lead to the risk of another breakage.
- Change the accumulator (inlet liquid separator) after changing a compressor with a burnt-out motor
- Fit a filter with isolator valve on the compressor suction and then remove the filter after one week of operation of the unit with the new compressor.

If the motor has burnt out, most of the contaminated oil will be removed when the original compressor is disassembled and removed. The remaining oil is cleaned by means of the filter-dryers on the suction line and liquid line. Always use a 100% activated alumina filter-dryer, but ensure it is removed after 72 hours. When a single compressor or a tandem compressor is replaced in situ, a significant part of the oil may remain in the circuit. Although this will not affect the reliability of the new compressor, the extra oil will tend to slow the compressor rotor and hence increase power consumption.

4.2.2. Starting a new scroll compressor

The refrigerant charge only on the suction side in a system in which a Scroll compressor is installed can cause starting difficulties at times.
This is because, if the scrolls tend to adhere together, rapid pressurisation of the low pressure side without opposing with high pressure can lead the scrolls to seal together. Therefore, until

the pressure values converge, the scrolls may remain joined thus preventing rotation. To avoid this phenomenon, charge the system simultaneously from the high and low pressure sides, taking are to avoid loading the scrolls.
During the charging procedure maintain constant suction pressure of at least 1.75 bar. If the pressure is allowed to fall below 0.5 bar for just a few seconds, the overheating of the scrolls can result in damage to the main bearing. Do not leave the system unattended without a refrigerant charge, inertial loads or with the service valves closed and without installing a lock-out. It is important to prevent the system from being inadvertently started up by unauthorised persons: operation of the compressor without fluids would produce irreversible damage. **Do not start the compressor while the circuit is under vacuum conditions**. If a Scroll compressor is started in a vacuum, internal electrical arcs may be produced resulting in burn-out of the electrical connections.

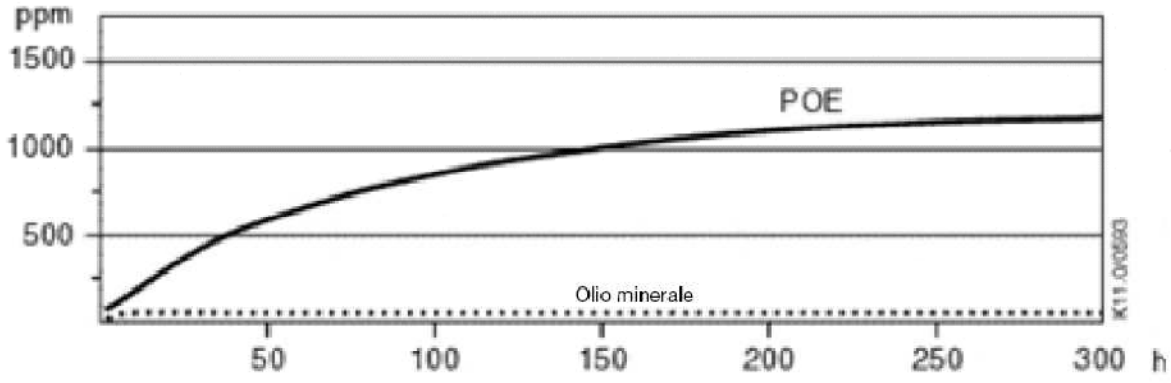
4.2.3 Lubrication and removal of the oil

Do not mix ester oils with mineral oils and/or alkyl-benzene when using HFC refrigerants..

The compressor is supplied with an initial oil fill. Scroll compressors for R410A are supplied with standard contents of Emkarate RL32 3MAF polyolester oil (POE).

In service the compressor can be replenished with Mobil EAL Arctic 22 CC oil if 3MAF oil is not available. The number of litres of the initial oil fill is shown on the compressor rating plate.
For field top-ups consider a value from less than 0.05 up to 0.1 litres.
One disadvantage of POE oils is that they are far more hygroscopic than mineral oils (**Figure xx)**. Short exposure of POE oil to ambient air is sufficient to absorb an unacceptable quantity of moisture. Since POE oils absorb moisture faster than mineral oils, it is more difficult to evacuate them from the circuit by means of vacuum. Even if the new refrigerant circuit is filled with oil with low moisture contents, the amount of moisture can increase during the plant construction procedures. Therefore, if the refrigerant filter is changed, it is advisable to install a suitably sized filter-dryer in all plants in which POE oils are utilised.
The filter must maintain the moisture level in the circuit below 50 ppm. If the plant is replenished with oil, use POE oil having moisture contents no higher than 50 ppm. This will maintain the moisture level in the circuit below 50 ppm.

Figure xx



Absorption of moisture by ester oil compared to mineral oil (ppm) on a weight basis at 25℃ and 50% R. H.

If the moisture contents of the oil on a refrigerant circuit reaches unacceptable levels corrosion in the plant may result. A vacuum of 0.3 bar or lower must be created in the circuit. In the event of uncertainty concerning the moisture contents in the circuit, remove a sample of oil and analyse it. Sight glasses and moisture indicators available on the market can be used with HFC refrigerants and the relative lubricating oils. However, the moisture indicator shows only the moisture contained in the refrigerant. The real level of moisture in POE oil is higher than that shown in the gauge. This is because of the high hydroscopic characteristic of POE oils. To measure the effective moisture contents in the lubricant take a sample and have it analysed.

4-3 Procedures in the event of prolonged inactivity of installed units

To avoid migration of refrigerant in the compressor when the unit is stopped, it is good practice to store the refrigerant fluid charge in the condensing coils by means of a pump-down procedure.

Disconnect the start and safety breaker switch on the unit's power feeding line.

Power on the unit at least 8-10 hours before starting it up (feed power to the compressor crankcase heaters)

(2) Before restarting, clean the condenser, the electrical cabinet air filter, and check for possible oil leaks in the compressors compartment.
(3) Use dust and water protections for the electrical cabinet in order to increase the unit's working life and facilitate operations required to restore normal operation.

4.4.1 Preliminary check – Pre-start-up

When starting up the unit refer to a checklist of the operations required. The following minimum checklist shows the basic operations:

- Visual inspection of electrical section, electrical wiring, fuses, etc.
- Visually check the liquid tightness of the system, especially the connections
- Check the oil level
- Calibrate the high and low pressure switches and all components controlled by pressure
- Check operation of all the safety devices
- Check correct operation of all the valves
- Check correct fixing of the pressure switches and other components

5. WARRANTY

BICOLD Srl, supplier of the units, guarantees high quality materials and workmanship of its equipment and undertakes, during the warranty period specified below, to repair or replace, free of charge in the shortest possible time, any parts that due to material defects or bad workmanship or incorrect assembly, are found to be faulty, on the condition that such faults are not caused by natural WEAR AND TEAR or by carelessness or negligence of the Customer, by unauthorised repairs or alterations, by tampering conducted by the Customer or commissioned by the Customer, due to CONTACT WITH CORROSIVE OR UNSUITABLE ELEMENTS, by galvanic corrosion or natural deterioration, and by incorrect storage and/or PRESERVATION, by fortuitous circumstances of force majeure.

The warranty runs for 12 months from the date of delivery of the unit and it expires when said term expires even if the materials have not been commissioned , irrespective of the reason for said omission.

Note that the warranty expires if:

- the product has been repaired or tampered with by personnel not authorised by BICOLD Srl;
- the fault is caused by incorrect electrical connections or inadequate protections;
- installation has not been carried out correctly or the prescribed maintenance work has not been carried out;
- the product has developed a fault due to contact with corrosive or galvanic agents or due to natural wear and tear, etc.

6. SCRAPPING / DISPOSAL OF THE UNIT AT THE END OF ITS WORKING LIFE

The waste codes listed below (European Waste Catalogue, EWC) are supplied in accordance with legal definitions (European directives 91/156/CE, 91/689/CE, 94/62/CE concerning wastes, hazardous wastes and packaging materials) with the aim of providing guidelines for users seeking details of their waste disposal obligations.

6.1 DISPOSAL OF FLUIDS

6.1.1 Emptying of refrigerant

Take prior precautions (suitable containers, flexible hoses, etc) to avoid the dispersal of refrigerant fluids during this operation.
There is only one refrigerant fluid utilised, designated R410A, of the HFC type (fluoride gas) and only one type of POE (polyolester oil), both of which are present in a single circuit made of copper pipes, isolated with respect to the environment.

Despite the good level of efficiency and environment impact in respect of the ozone layer of the R410A HFC refrigerant (classified in group 2 in accordance with EN 378-1, non toxic and non-hazardous and with ODP=0) utilised by BICOLD Srl in its appliances, in compliance with legal requirements we hereby specify that:

THE UNIT CONTAINS FLUORIDE GAS WITH GREENHOUSE EFFECTS REGULATED BY THE KYOTO PROTOCOL ! (IN COMPLIANCE WITH REGULATION 842/2006/EC)

Therefore, all operations concerning refrigerant (even if of the ecological HFC type) and the refrigerant circuit, including evacuation, must by obligation be carried out by a qualified HVAC engineer suitably equipped to evacuate the fluid and dispose of it correctly, simultaneously filling in and annotating the operations performed in the plant log book in compliance with the rules imposed by Regulation 842/2006/EC.
In any event, in accordance with the regulation the fluid in question is environmentally hazardous, and it is classified with EWC 140601 (HFC fluids...), and the removal of the fluid from the unit and relative disposal must be carried out in compliance with the indications given in the manual for routine emptying of the refrigerant circuit.

6.1.2 Compressor lubricating oil

As indicated in heading 4.2.3 with regard to the compressor, the refrigerant circuit always contains a certain amount of oil for compressor lubrication purposes.
Scroll compressors for R410A are supplied with standard contents of Emkarate RL32 3MAF polyolester oil (POE). Note that also in the field the circuit can be topped up with Mobil EAL Arctic 22 CC if 3MAF oil is not available, and if the number of litres of oil supplied initially is marked on the compressor rating plate.

This fluid is entirely similar to spent industrial oils (EWR code 30202, for spent oils that DO NOT contain chlorinated organic compounds). It must be consigned, together with any other analogous wastes, to an authorised disposal centre in compliance with statutory regulations.
The refrigerant circuit must be emptied working in compliance with the information given in heading 7.1.1. Therefore, also merely the operations of cleaning the refrigerant circuit from spent oil must be carried out by a qualified and experienced HVAC engineers.

6.2 SCRAPPING OF THE UNIT

Once the unit has been taken out of service, it constitutes a special waste in accordance with the directives quoted in heading 6.1.1, with EWR code 160211 (decommissioned appliance containing…omissis…HFC).
The appliance must be disposed of by consigning it to a specialised company authorised to collect hazardous wastes and specialised in the recovery and recycling of parts and materials in compliance with local bylaws.
Depending on the operational characteristics of the disposal centre, the unit may be consigned either empty of refrigerant or still containing the refrigerant charge. If the refrigerant circuit must be evacuated, follow the instructions given in heading 7.1.1
Other waste codes to be used: EWC 200124 for electronic circuit boards, EWC 200103 for plastic components, EWR 200106 for structural parts and metal components.

Appendix I

HFC R410A: R410A TECHNICAL DATA SHEET

Introduction

R-410A – an azeotropic mixture of HFC-32/HFC-125 developed by Honeywell as a long term substitute product, efficient from the energy standpoint and harmless in relation to the ozone layer, to replace R-22 (HCFC-22) in new appliances.
R-410A features higher cooling capacity and pressure values than R-22, combined with lower toxicity.
Since R-410A behaves in the manner of an azeotrope, its use is facilitated.
R-410A is a Honeywell patent that is recognised as non flammable by Underwriters' Laboratory (UL).

Applications

Air conditioning

R-410A represents the optimal long-term alternative to R-22, non polluting and harmless to the ozone layer, for new small size residential and commercial air conditioning systems. Tests have shown that in new air conditioning units specifically designed to use R-410A, equipped with scroll compressors or reciprocating compressors, the refrigerant provides an energy efficiency index that is 5-6 % higher than that of R-22. The characteristics of the new refrigerant make it possible to build more compact air conditioning units.

Water chillers

R-410A constitutes an excellent replacement product for R-22 in new chillers that are not equipped with centrifugal compressors.

Commercial refrigeration

R-410A can be used as a replacement product for R-22 in new medium and low temperature refrigeration plants, including refrigerated counters for supermarkets and refrigerated freight. R-410A can replace fluids such as R-13B1 both in new very low temperature industrial refrigeration, and for the conversion of existing systems containing R-13B1.

Physical properties

Components: Chemical name: Molecular formula: Weight %:
HFC-32 Difluoromethane CH2F2 50%
HFC-125 Pentafluoroethane CHF2CF3 50%
Molecular weight 72.6
Boiling point (℃) (101.3 kPa) -52.7
Solidification point (℃) -155
Critical temperature (℃) 72.5
Critical pressure (bar) 49.50
Critical volume (m3/kg) 0.0020
Critical density (kg/m3) 500.00
Vapour density at boiling point (kg/m3) 4.19
Liquid density † (kg/m3) 1063.38
Liquid thermal capacity † (kJ/kg·℃) 1.67
Vapour thermal capacity † (kJ/kg·℃) 0.84
Evaporation latent heat at boiling point (kJ/kg) 256.68
Vapour pressure † (bar) 16.49
Liquid heat conductivity † (W/m·℃) 0.0794(*)
Vapour thermal conductivity † (W/m·℃) 0.0154(*)
Liquid viscosity † (µPa·sec) 121.23
Vapour viscosity † (µPa·sec) 13.85(*)
% Volatiles per volume 99.99
Water solubility in R-410A (% weight) 0.28
Limits of flammability in air (vol. %) (**) None
Ozone depletion potential ODP (CFC-11=1) 0.00
ASHRAE refrigerants safety classification A1/A1
(*) Information based on estimated properties.

(**) ASTM E681-85 standard, match ignition, room temperature.
† All measurements made at 25℃ unless otherwise spe cified.

Pressure / Temperature Table

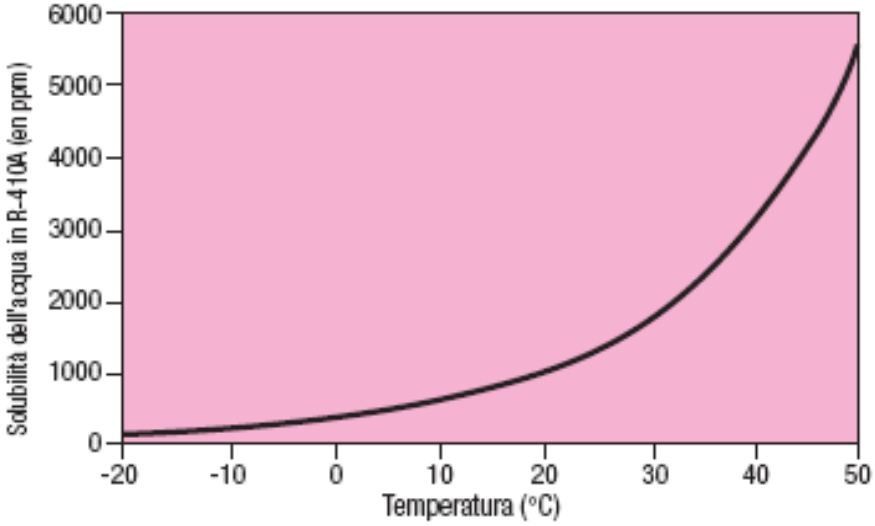
Temperature (℃)	Pressure (kPa)
-50.0	110
-45.0	140
-40.0	176
-35.0	220
-30.0	271
-25.0	331
-20.0	401
-15.0	482
-10.0	574
-5.0	680
0.0	799
5.0	934
10.0	1085
15.0	1254
20.0	1443
25.0	1652
30.0	1883
35.0	2137
40.0	2417
45.0	2724
50.0	3061
55.0	3429
60.0	3833

Lubricants

With R-410A the lubricants to use are polyol esters (POE), because the refrigerant cannot mix with mineral oil or alkylbenzene lubricants. The majority of compressor manufacturers recommend the use of specific POE lubricants. The user should therefore check the specific lubricant recommended by the manufacturer.

Solubility of water in R-410A

The solubility of water in R-410A is illustrated in the following graph.



Solubility of water in R-410A (in ppm)
Temperature (℃)

Compatibility of materials

Compatibility: plastics/elastomers vs R-410A

C: Compatible CE: Compatible with exceptions NC Non-compatible

Ethylene-propylene-diene terpolymer C
Ethylene-propylene copolymer C
Chlorosulphonated polyethylene C
Chlorinated polyethylene CE
Neoprene (Chloroprene) C
Epichlorohydrin CE:
Fluorinated rubbers NC
Silicone CE
Polyurethane CE
Nitriles CE
H-NBR CE
Butyl rubber CE
Polysulphides C
Nylon C
Polytetrafluoroethylene C
PEEK C
ABS NC
Polypropylene CE
Polyphenylene sulphide NC
Polyethylene terephthalate CE
Polysulphone CE
Polyamide C
Polyetherimide C
Polyphthalamide CE
Polyamide-imide C
Acetyl resin CE
Phenol resin C

The above table includes data concerning the compatibility of the materials, as measured in tests performed by Honeywell and other industrial concerns worldwide. Therefore, it is of a guideline nature and must be used with due caution. Customers should consult the manufacturer of the materials in question or perform independent testing. Since different grades and formulations exist, perform compatibility tests on the material of the specific grade selected during the design of new installations.

Safety

Read the Material Safety Data Sheet (MSDS) before using R-410A.

Toxicity

R-410A can be utilised safely in all the applications for which it was designed, on the basis of the data calculated by the “Program for Alternative Fluorocarbon Toxicity Testing” (PAFT1).

Release of refrigerant

If a large amount of R-410A gas is released into the atmosphere the area must be evacuated immediately. The vapours collect at floor level and replace the oxygen in the air. Once the building has been evacuated use fans and lowers in order to circulate the air at floor level.

FFlammability

According to ASHRAE 34, R-410A is classified in safety group A1, i.e. non-flammable at 1 atm pressure (101.3 kPa) and 18°C.

Leak detection

Use gas detectors to find leaks or to keep an enclosed space constantly monitored for the presence of gas. Leak detection is important to preserve the refrigerant, and the performance and good condition of the system, while simultaneously reducing emissions and protecting persons working in contact with the system. Do not check

for leaks with pressurised mixtures of air and R-410A. Since R-410A is a mixture of HFCs, leaks must be detected with a device capable of detecting HFC based gases.

Conversion of existing systems

The superior properties – capacities and pressures – that make R-410A a more valid alternative to R22 in new appliances **constitute a problem when R410A is to be used in existing plants that were designed for use with R-22**. In the majority of cases the compressors, thermostatic expansion valve, condensers and other pressurised components must all be replaced. Sometimes it may be necessary to renew also low pressure components of the plant. Manometric assemblies and flexible hoses must be of the high pressure category (55bar on the high pressure side, of the plant and 35bar on the low pressure side).

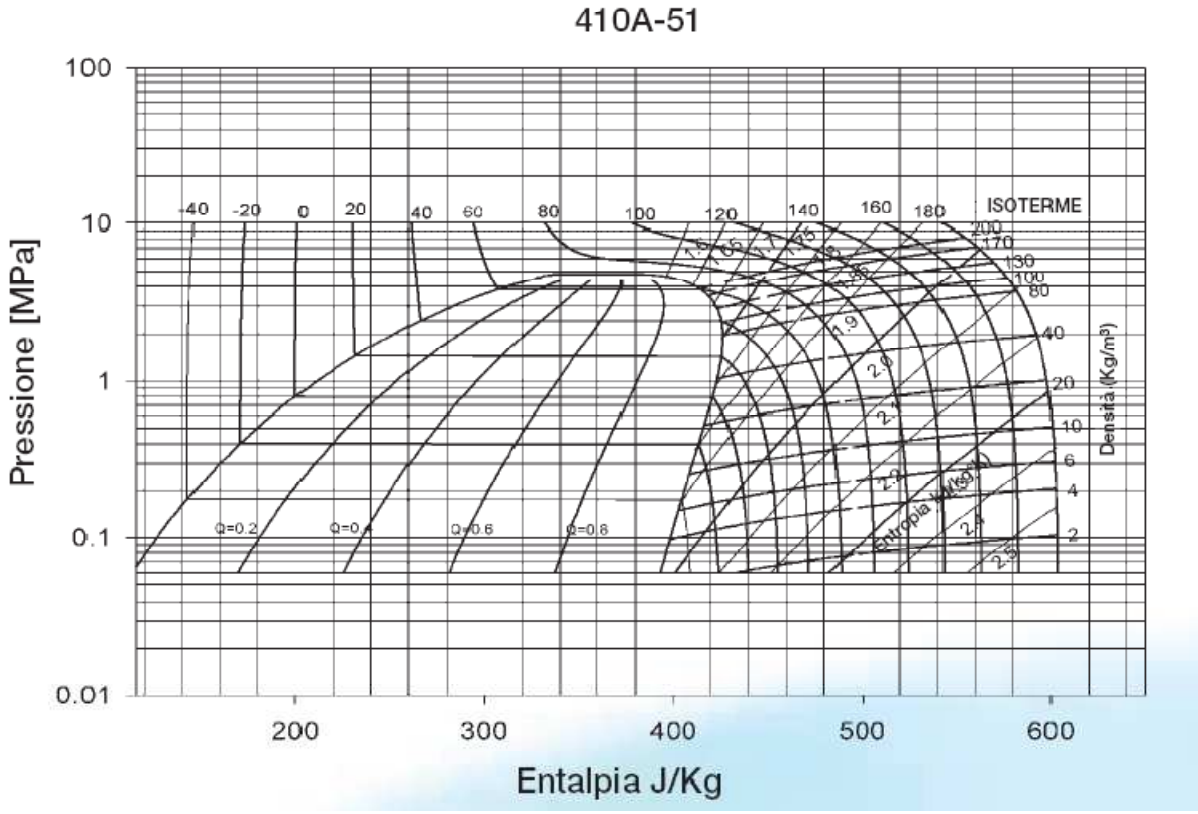
Environmental considerations

R-410A is a halogenated hydrocarbon. The treatment or disposal of wastes deriving from the use of this product calls for special attention, in accordance with the nature of the wastes and the means used for the relative recovery, treatment or disposal. For more information consult the material safety data sheet (MSDS).

Storage and handling

Bulk product and product in gas bottles

The vapour pressure of R-410A is higher than that of the majority of commercial refrigerants, notably R22. Therefore, R-410A must be handled paying attention to the design pressure of the equipment to be used for handling the product.
It is good practice to transfer R-410A in the liquid rather than gaseous phase, to minimise the risk of changes in its composition. To facilitate liquid filling, all gas bottles are equipped with a suction pipe.



Pressure [MPa]
Enthalpy K/kg

Bottles for R-410A must be clearly marked, stored in a cool, dry and well-ventilated place, well away from heat sources, flames, corrosive chemicals, fumes, explosives and anyway protected from impact and other types of damage. **Empty gas bottles must not be filled with substances other than the virgin product**. When the bottle is empty, close the valve securely and refit the cap over the threaded connection. Empty cylinders must be returned to your local Honeywell distributor.

Bottles containing R-410A must be stored away from direct sunlight, especially in hot climates. In the liquid phase R-410A in the liquid phase expands very significantly when heated, thus reducing the space available for the vapour inside the bottle. If the bottle is saturated with liquid, any further temperature increase can cause it to burst, with the risk of serious injury of persons in the area. **The temperature of the gas bottle must never exceed 52℃.**

Containers, piping, pumps and all other components utilised with R-410A must not be exposed to high temperature heat sources (welding, open flame brazing) until they have been carefully cleaned so that all residues of liquid or gas have been removed. Gas cylinders must never come into contact with welding torches, brazing torches or open flames. Exposure to high temperatures can result in fire, explosion and decomposition of R-410A with the production of toxic and corrosive substances.

Transport information

Appropriate freight designation: R410A refrigerant gas
CE number: 200-839-4 HFC32, 206-557-8 HFC125
ADR REGULATION: label 2.2: non-flammable and non-toxic gas
Class: 2
UN Number:

Hazardous components	No. CAS	%Composit.	Symbol	R Phrases
DIFLUOROMETHANE (HFC32)	000075-10-5	50	F^+	R12
PENTAFLUOROETHANE (HFC125)	000354-33-6	50		

Disclaimer

All the information and data presented in this document to be accurate and reliable to the best of our knowledge. However, BICOLD Srl cannot assume any measure of liability and does not provide any express or implicit guarantee in this respect. Assertions or suggestions relative to the use of our products are not supplied in the name of or on behalf of third parties, and do not constitute incitements to infringe the rights of any patents.
Likewise, no guarantee is provided that said use is not covered by the patents of others.
Therefore, users should not presume that all safety measures have been indicated or that possible additional measures are unnecessary.

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