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## **A COMPANY INFORMATION**

### **A.1 Introduction**

ERBAY Packaged type Water Chillers (PAKCOLD) are designed and manufactured to ensure high performance and reliable construction. Electronic Controller is used to ensure fine working tolerance, maximum level energy saving and good operating situation. This manual contains all the information required for montage, installation, commissioning and maintenance of the unit.

This manual should be read thoroughly before the montage of the unit and then it should be started up. Service instructions are stated in the manual, too. Packaged type Water Chillers (PAKCOLD) are designed to operate with water and glycol solutions and are not suitable for purposes other than those specified in this manual. All informations and operation details in the manual must only be performed by qualified personnel trained about cooling and air conditioning.

ERBAY; will not be liable for any injury or damage caused by a failure to follow the procedures and instructions detailed in the manuals.

### **A.2 About this Manual**

The manual is prepared with the aim for introducing the unit, stating the specifications and functions of the components and showing the best working practices. This manual and any other document given with the unit are the property of ERBAY which reserves all rights. They may not be reproduced, in whole or in part, without prior written authorisation from ERBAY.

### **A.3 Warranty**

ERBAY warrants all units and equipments against defects in manufacture, material and workmanship for eighteen months from delivery, or one year from initial start-up (whichever occurs first) unless there is a special condition in the contract about extending the warranty. All claims must be supported by evidence that the failure has occurred within the warranty period. The unit model, type and serial number must be notified while applying.

This warranty will not be valid concerning failures;

- Failures in installation or in subsequent modifications.
- Delaying the periodic maintenances specified in “Montage, Installation, Operation and Maintenance Manual”.
-

- Failures occurring in operating faults.
- Failures occurring because of missing phases, low voltage, high voltage and operating the unit with different voltage from unit label (burning of the motor coils...etc.).
- Damage or failure caused by fire or natural disasters.
- Failures occurring because of operating the unit, out of specified conditions in this manual.

Failure caused by any of these conditions will automatically void the warranty.

- If the initial start of the unit is not carried out by ERBAY personnel.
- If the periodic maintenances specified in “Montage, Installation, Operation and Maintenance Manual” are not carried out by ERBAY technical services or ERBAY approved technicians.
- If the unit is operated out of the limits stated in catalogues and contract conditions.
- If the modifications, repairs on the installation and the system are made without approval from ERBAY.
- If the ERBAY approved original spare parts, oils and refrigerants are not used.
- If the encoded parameters of Microprocessor Control System are changed by client.

In the case of any disagreements between ERBAY and client, “Istanbul / Büyükçekmece Law Court” will be authorized.

#### **A.4 Safety**

TS EN ISO 9001:2000 Quality Assurance System is carried out in process of the Management, Client Relationship, Project, Purchasing, Production, Control and After Sales Service in our company. The units are in conformity with health and safety requirements of the following European Union Directives:

Machinery Directive (MD)	: (98/37/EC)
Low Voltage Directive (LVD)	: (73/23/EEC)
Electromagnetic Compatibility Directive (EMC)	: (89/336/EEC)
Pressure Equipment Directive (PED)	: (97/23/EC)

### **A.5 User Responsibility for Safety**

Attention is paid during the design and manufacture of the units for satisfying the safety requirements listed in the previous paragraph. However, the user is responsible for the followings during the operation:

Personal safety, safety of other personnel and the machinery safety. Correct usage of the machinery suitable to procedures detailed in the manual.

### **A.6 Use of the Unit**

Packaged type Water Chiller (PAKCOLD) is designed and manufactured for cooling water or glycol brines and is not suitable for usage other than those. Operating the Water Chillers out of designed operation conditions and not satisfying the procedures may cause accidents, injuries or damages. Safety precautions should be taken while the unit is running; otherwise it may result to potential accidents.

The unit contains pressured refrigerant. Maintenance work should be done carefully and a qualified and trained technician must be used in order not to cause an injury to anybody.

The unit must be earthed. No maintenance work should be done before switching off the main switch and locking off the power supplies. No maintenance work should be made to electric control panel or electrical connection points connected with the wiring during the operation of the unit. Fan guards must not be removed unless the main power supply has been cut off.

Alternative safety precautions must be taken against the risk of injury from rotating fans. The finning on the air cooled condenser coils has sharp edges so care should be taken while touching these points and gloves should be used. Structural support of the unit must be provided as indicated in the instructions. Otherwise it may cause an injury to the operator, or damage to the equipment. High temperature and pressure cleaning methods (e.g. steam cleaning) should not be used on any part of the pressure system and also detergents and solvents which may cause corrosion should not be used.

Refrigerants and oils used in the unit are generally non-toxic, non-flammable and noncorrosive. It is recommended to use gloves and glasses while working on the unit. There may be a risk of asphyxiation because of a refrigerant leakage from units in enclosed spaces so correct ventilation is very important. Smoking may cause poisoning in enclosed spaces where refrigerant vapour exists.

The following symbols are used for warning the reader about areas of potential hazard:



**Warning:** To identify a hazard that may cause personal injury.



**Caution:** To identify a hazard that may cause damage to machine, other equipments and environmental pollution.



**Note:** To give additional information for help where there are no special safety explanations.

This manual contains suggested best working practices and procedures. These are issued for guidance only, they do not take precedence over the above stated individual responsibility and/or local safety regulations.

## A.7 Emergency Shutdown

In case of emergency, the main switch on the unit is turned to “0” position. So all the electricity in the system has been cut off.

## A.8 Safety Labels

The following labels are fixed to each unit to give instruction, or to indicate potential hazards which may exist.



White symbol on blue background  
Read the instructions first for safe operation.



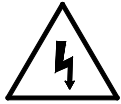
Black symbol on yellow background.  
Warning: This machine may start automatically without prior warning.



Black symbol on yellow background  
Warning: Hot surface



Black symbol on yellow background  
Warning: Safety relief valve may discharge gas or liquid without prior warning.



Black symbol on yellow background  
Warning: Isolate all electrical sources of supply before opening or removing the cover, as lethal voltages may exist.



Black symbol on yellow background  
General attention symbol

## A.9 Material Safety Data

### Refrigerant Data

The following information is given for HFC / HCFC

**Toxicity:** Low, toxicity value may be neglected.

**In Contact with Skin:** Liquid splashes or touch as liquid in contact with skin may cause freeze burns. Skin absorption of refrigerant is low, may be slightly irritant. Affected areas should be washed with warm water. Obtain medical assistance.

**In Contact with Eyes:** Refrigerant vapour in the surrounding has no effect on eyes. Liquid splashes may cause freeze burns. Eyes must be washed immediately with clean water for a suitable time and obtain medical assistance.

**Inhalation:** Nervous system is stimulated and then depression begins because of staying in high level refrigerant vapour concentration in air for a long time. Causes headaches and giddiness and then may lead to unconsciousness. If the exposure has been severe, may cause to death. Because of high concentration of refrigerant, oxygen content of atmosphere reduces and this may lead to asphyxiation. In this situation, the patient is removed to fresh air, kept warm and at rest. Oxygen is administered if necessary. Artificial respiration is applied if breathing has stopped or shows signs of failing. Obtain immediate medical assistance.

**Hazardous reactions:** May react violently with sodium, potassium, barium and other alkali metals.

**General Precautions:** Avoid inhalation at places where there is high concentration of vapour. Refrigerant concentration in the atmosphere should be minimized and reduced below the occupational exposure limit. Refrigerant vapour is heavier than air and collects at low levels so attention should be paid while ventilating. Breathing apparatus should be worn if doubt exists on atmospheric concentration. Refrigerant is not permanent. Use in presence of naked flames, red hot surfaces and high moisture levels should be avoided.

**Storage:** Refrigerant tubes are kept in dry and warm places away from fire risk and direct sunlight. Temperature should not exceed 45°C.

**Protective Clothing:** Overall, glove and glass is worn according to the conditions of the working place.

**Spill/Leak Procedure:** Evaporation of the spilled liquid is provided with suitable ventilation. If there is large spillage, area is ventilated and spillage is covered with sand, earth or any suitable absorbent material. Liquid entering in drains, sewers, basements and evaporation of this liquid to atmosphere should be prevented.

**Disposal:** It is best to recover and recycle. If this is not possible, disposal should be destroyed in an approved facility.

**Fire:** Refrigerant is normally non-flammable. Fire exposed refrigerant tubes should be kept cool with water sprays. Refrigerant tubes may burst if overheated. It is essential for personnel to wear breathing apparatus and protective clothing.

#### **Refrigerant Oil Data:**

Following information is given for special oils that are used in hermetic compressors.

**Classification:** Non-hazardous.

**In Contact with Skin:** Minimally irritating. Exposed skin areas should be washed with soap and water several times during a day. Dirty work clothes should be laundered regularly.



**In Contact with Eyes:** Eyes should be cleaned with eyewash solution or clean water. Then obtain medical assistance.

**Ingested:** It may cause nausea. Obtain immediate medical assistance. Do not induce vomiting.

**Inhalation:** If oil mist is inhaled, remove to fresh air and consult a physician.

**Occupational exposure limits:** Not determined.

**Stability:** Oils are stable but hygroscopic. Stored in tightly closed metal boxes.

**Conditions to avoid:** Strong oxidizers, caustic or acid solutions, excessive heat, some paints and rubber materials should be avoided at areas where oil is stored. Enclosed spaces should be ventilated. Do not pressurize, cut, weld, braze, drill, grind or expose such containers to heat, flame, sparks, and static electricity.

**Protective Clothing:** Goggles or face shield should be worn during the change of oil. Gloves are not necessary but recommended.

**Spill/Leak Procedure:** It is important to stop spilling of oil. Absorbent materials are poured on spilled oil.

**Disposal:** Wastes are destroyed in an approved facility in accordance with local laws and regulations governing oily wastes.

**Fire:** The flashpoint of oil is over 154°C. It does not catch fire easily and when it is burned, carbon dioxide and carbon monoxide releases. If there is fire, use dry chemical, carbon dioxide or foam. Fire exposed metal boxes should be kept cool with water sprays. Breathing apparatus and protective clothing should be worn in fire conditions.



There is special kind of their own oil in hermetic and scroll compressors. No need to change oil in normal conditions. In the situation of changing the oil, contact with ERBAY.

## **B PRODUCT DESCRIPTION**

### **B.1 Introduction**

ERBAY Packaged types Water Chillers (PAKCOLD) are designed for cooling of water or glycol brine solutions. Air Cooled Water Chillers are designed to be located inside or top covered places of a building. If these units are located in an enclosed space, air ducts must be built to ensure the air circulation condenser fans need. The concerning circulation air must be suctioned from outside or ambience and must be discharged out through air ducts. The unit consists of a certain number of coil type evaporator, compressor and refrigerant circuit, air cooled condenser, axial fan which is direct coupled with its motor, solenoid valve and expansion valve depending on model. Some evaporators may consist of double refrigerant circuit. The units are delivered in a completely assembled condition with all refrigerant circuits interconnected, electrical cables wired and refrigerant charged. Necessary operational tests are made for the manufactured unit before delivery.

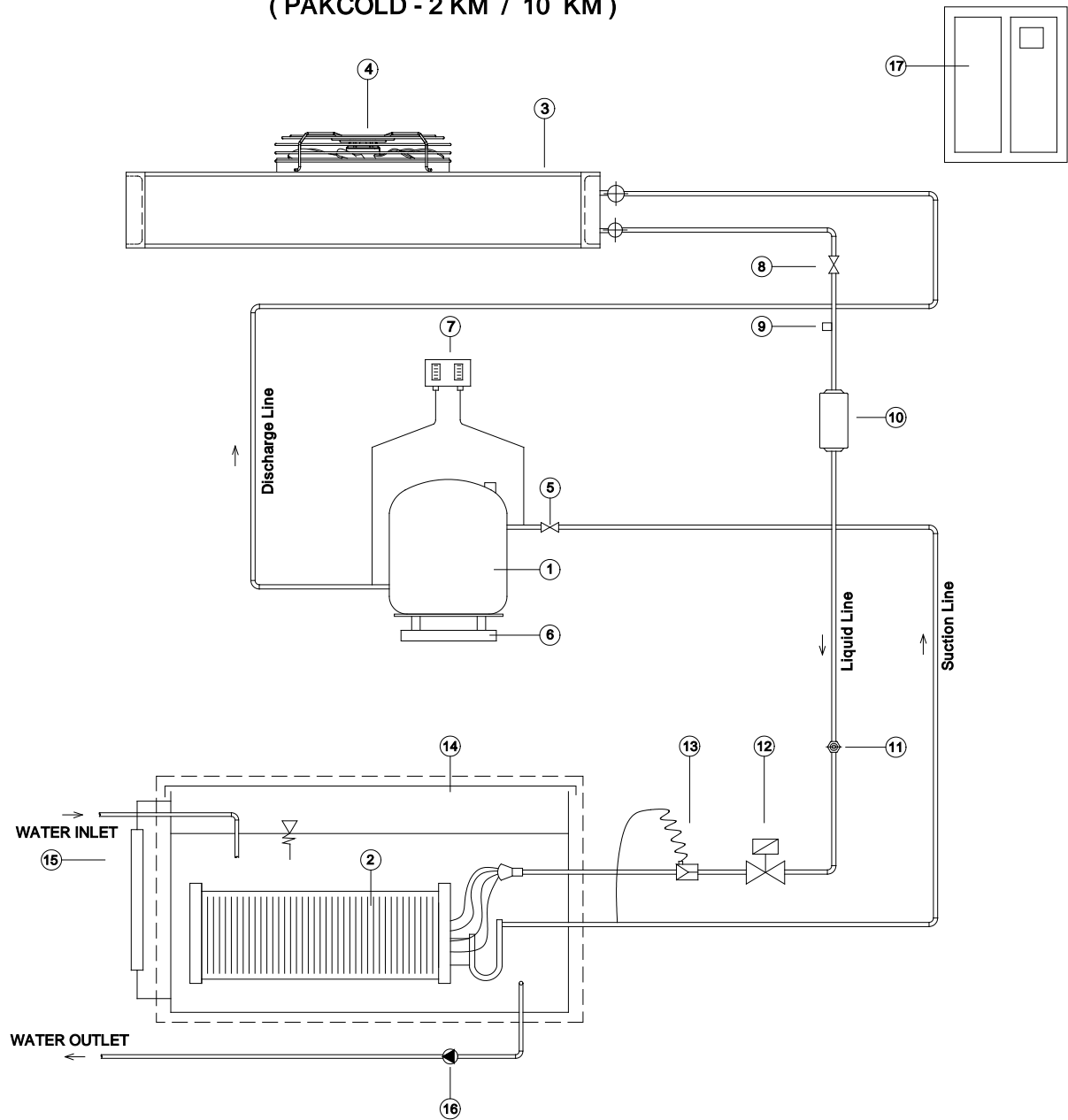
PAKCOLD body and cover are manufactured by steel sheet iron and painted with special paint.

### **B.2 Functional Description**

ERBAY Packaged type Water Chillers operate according to the following principles:

The condensed refrigerant under pressure in the condenser enters into evaporator in an expanded form from expansion valve. It flows through the pipes in evaporator and evaporates by taking heat from the water circulating from inside of the fins that stringed on the pipes. This cooled water gets out of evaporator. When super-heated refrigerant vapour gets out of evaporator, it is suctioned and then discharged again to condenser by compressor. Refrigerant gas is cooled in condenser under high pressure and condenses. Liquid coming from condenser enters into electronic expansion valve again after passing through drier filter. (DIAGRAM 1)

**PACKAGED TYPE WATER CHILLER  
( PAKCOLD - 2 KM / 10 KM )**



- |                             |                                  |
|-----------------------------|----------------------------------|
| 1. Cooling Compressor       | 10. Drier Filter                 |
| 2. Coil Type Evaporator     | 11. Sight Glass                  |
| 3. Air Cooled Condenser     | 12. Solenoid Valve               |
| 4. Condenser Fan            | 13. Thermostatic Expansion Valve |
| 5. Compressor Suction Valve | 14. Cold Water Tank              |
| 6. Connection Chassis       | 15. Water Level Indicator        |
| 7. High-Low Pressure Switch | 16. Water Pump                   |
| 8. Liquid Valve             | 17. Electrical Control Panel     |
| 9. Charge point             |                                  |

**DIAGRAM 1 : System Principle Diagram**

### **B.3 Compressor**

1 piece of Hermetic reciprocating or Scroll compressor is used according to capacity in packaged type water chiller (PAKCOLD). These compressors are provided to get high efficiency and reliable performance.

Discharge valve of compressor in the units provide an easy access to compressors for maintenance and interference.

Compressors of Pakcold-2 KM and 3 KM work with 1 Phase - 230 V, 50 Hz. electrical supply. Compressors of Pakcold-4,5 KM, 6 KM, 8 KM and 10 KM work with 3 Phase - 400 V, 50 Hz. electrical supply. When compressor stops, the crankcase heater is put into use. It prevents the refrigerant to stay in the oil and the excessive increase of oil viscosity by heating oil. Compressor should always be turned in the same direction with its first turning direction. This is provided by a phase sequence relay in the electric panel. In the situation of changing the inlet tips of phases, phase sequence relay does not allow the unit to run.

Oil in compressor crankcase should not be mixed with another oil. Oil, which moves together with the suctioned gases, separates from those suction gases in the compressor and sinks to the bottom. While the compressor is running, necessary lubrication is made with the oil in the crankcase.

### **B. 4 Air Cooled Condenser and Condenser Fans:**

Designed and manufactured as air cooled, condenser consists of cooling coils and axial fans. Condenser coils are manufactured from aluminum fins arranged with definite spaces onto high efficient and corrosion resistant copper pipes. Then copper pipes are blown up in order to increase thermic conductivity between copper pipes and fins so that heat transfer reaches the maximum level. After the manufacture, a leakage test is done under 30 bars. Condenser fans are balanced as static and Dynamic. Corrosion resistant axial fans work at high efficiency and low noise levels. The fan motors are direct drive and monophase with noiseless bearings. The numbers of axial fans change in units according to condenser capacity. Numbers of fans according to unit types are given in TABLE-1.

### **B. 5 Coil Type Evaporator:**

Direct expansion evaporators are manufactured in copper pipes and aluminum fins. Refrigerant flows through the pipes and cooled water flows outside of pipes in the evaporators manufactured coil type evaporator. Evaporator is in the cold water tank which is in the unit. Coil type evaporator is manufactured that is high efficient and corrosion resistant. Copper pipes in the coil are fixed to aluminum fins with a special blowing system. Coil type evaporators are made leakage test after manufacturing

### **B. 6 Electrical Control Panel:**

For the machine to operate automatically, all control and motor starting equipment are mounted into the panel and factory wired. Electrical Control Panel contains contactors, thermic relays, fuses and main switch. Control circuits are fed with a different control transformer. There is 230 Volt in control circuits. Circuits, relevant with electronic controller on electrical control panel are 230 Volt in the body. Red cables are 230 Volt. The panel is designed to IP54. Cable end is used at the cable connections in the panel so there are not open parts on terminal block connections. The handle of the main switch is located outside and it cuts out the energy in the circuit when the panel doors are opened. There is no voltage on the electric control panel when its doors are open. Panel body is earthed and all equipments are connected to earth circuit separately so that necessary precautions are taken for dangerous conditions because of electric leakage.



**Caution!** Electrical Control Panel cover should not be opened before main switch on electrical control panel is turned to (0) position. If electrical control panel cover is forced, Main switch will be damaged.

## B. 7 Electronic Controller (Microprocessor Control System)

Microprocessor Control System is located in the electrical control panel of water chillers. Concerning Microprocessor provides the chiller to work safely and in required limits. Microprocessor makes the following adjustments and controls during the operation ; Controls water temperature, controls the condensation temperature of the system, adjusts the fan turning proportionally according to the needs, sends a run signal to evaporator pump, displays water inlet temperature, displays water outlet temperature, displays condenser outlet temperature of liquid and displays the total working time of compressor.

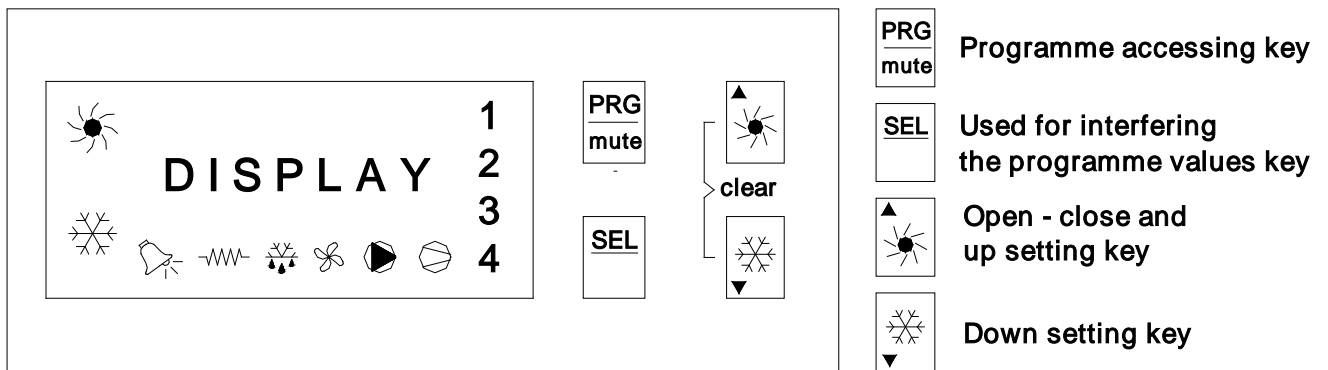
### Kinds of failures are displayed in the situation of failure:

- High Pressure Failure (It comes from high pressure switch) **(HP)**
- Low Pressure Failure (It comes from low pressure switch) **(LP)**  
After the failures are corrected, the unit is run by automatically.
- Thermic Failure (Thermic of any of the motors blows) **(tP)**  
(Pump thermic, compressor thermic and condenser fans thermic had blown or there is phase sequence failure. If it is first running, Phase sequences may be connected wrong or one of the phases is missing. )

NOTE: After above failures has corrected, display became normal by resetting. For resetting, press up and down keys in same time. If there is one of the “LP” or “HP” failures, press related reset key on related high-low pressure switch. If thermic has blow, press reset key of thermic.



- Probe Connection Failure, **(E1-E2-E3)**
- Freezing Failure, **(A1)**
- High Temperature Failure, **(Ht)**
- Low Voltage Failure, **(ELS)**
- High Voltage Failure, **(EHS)**
- EPROM Failure, **(Epb-Epr)**

**The Display becomes automatically normal, when those failures are corrected.**



PICTURE 1 : View of microprocessor display and functions of the keys

### Operating Microprocessor:

- Main switch on the unit is turned to “1” position before operating the microprocessor. Wait for some minutes for opening the microprocessor.
- The display is opened and temperature value is read on display.
- Press Up-setting key for 5 seconds. For operating the compressor, temperature of water should be above the set value. Otherwise cooling system waits for warming the water.
- Firstly, the pump light  is lit and pump is run, then compressor light  is lit. So the compressor is run. These lights show that compressor and pump are running.
- For adjusting the temperature value; Press SEL key for 5 seconds and wait. “/” sign” appears on display. Remove SEL key and press up setting key until “r sign” appears on display. When “r sign” appears on display, press SEL key. Press up – down key until “r1 sign” appears on display. Then press SEL key again so that temperature set value is displayed. If it is needed to change the temperature, Up-Down setting keys are used to adjust the value. After that press SEL key again and so that the set value has changed. In this period the display is a light and out for a few seconds and then it becomes normal, unless there is no need to change the set value, press PRG key until display becomes normal.
- For adjusting the temperature difference value; All the operations for adjusting the temperature value are done and only “r2 sign” is used.



**ALL ADJUSTMENTS DONE BY ERBAY AND THEY SHOULD NOT BE CHANGED.**

**B. 8 Evaporator Pump:**

Ensures the water circulation by discharging water in the water tank to the system. Chosen as centrifugal type, these pumps must have the pressure which can defeat the resistances in the circuit.

**B. 9 Cold Water Tank:**

Cold water tank made of stainless steel sheet with suitable volume is put in the unit to balance the water in the system and to increase the thermal inertia of the circuit. Evaporator pump suctions this tank water and discharges it to the circuit. Returning hotter water from circuit firstly enters into tank and after cooling in it, discharged to the system. Concerning surfaces of cold water tank are insulated with insulation material with suitable thickness.

**B. 10 Cooling Components:**

**Thermostatic Expansion Valve:** It contains thermostatic control mechanism; it provides the access according to working conditions of evaporator. Conveys the temperature signal from sensing bulb that is connected to evaporator suction pipe, to valve. Suction pressure warning coming from the suction pressure connection pipe on expansion valve body and temperature warning coming from sensing bulb are compared in the expansion valve. The amount of refrigerant is checked in a way that super heat difference is 5°C.

By this way the evaporation in the evaporator is kept under control and accessing of liquid into the compressor pipe is prevented.

**Solenoid Valve:** Solenoid valve is put on the liquid circuit coming to expansion valve and it opens and closes the liquid circuit according to the given electrical warning. Solenoid valve opens the circuit when current is given to bobbin. Solenoid valves, whose bobbins have no current, are close; they do not permit the liquid to pass.

**High-Low Pressure Switch:** Controls the pressures in the cooling cycle.

Mechanically adjusted according to up and down pressure limit, this switch cuts out the circuit and stops the compressor. High and low pressure part of high-low pressure



switch contains reset. Although the condition gets better, it does not allow the unit to run.

**Sight Glass:** Provides the liquid flow in the circuit to be seen with eyes and gives information about the sufficiency of gas amount in the circuits. If there is not enough refrigerant circulation in the circuit, air bubbles are seen in sight glass. Besides, we can have information about the humidity rate in the circuit with the help of the colour at the display on the sight glass. Refrigerant flow must be controlled from sight glass after a certain period of working time of the unit.

**Drier Filter:** Mounted onto the liquid circuit, the drier filter is selected in suitable diameters and dimensions according to unit capacity. After the first start, it absorbs the moisture in the circuit and provides the working without moisture. Plugged drier filters because of moisture are changed.

**Receiver:** Condensed refrigerant first gathers in the receiver and then goes to the cooling circuit. Receiver provides the liquid to be given to system regularly.

## B. 11 Technical Specifications of Packaged Type Water Chillers:

Technical specifications of packaged type, air cooled water chillers (PAKCOLD) are given at Table-1.

TYPE			PAKCOLD 2 KM	PAKCOLD 3 KM	PAKCOLD 4,5 KM	PAKCOLD 6 KM	PAKCOLD 8 KM	PAKCOLD 10 KM
Nominal Capacity	R407C(3)	(1)	2,32	3,56	5,20	7,39	10,0	13,8
		(2)	2,04	3,19	4,70	6,41	9,1	12,6
	R22	(1)	2,4	3,68	5,38	7,64	10,1	13,8
		(2)	2,14	3,35	4,93	6,72	9,3	12,9
Compressor Type			Hermetic Reciprocating			Scroll		
Nominal Compressor Motor Power	R407C(3)	(1)	0,56	0,88	1,52	1,77	2,1	2,5
		(2)	0,62	0,98	1,65	1,90	2,3	3,0
	R22	(1)	0,58	0,91	1,57	1,82	2,1	2,5
		(2)	0,65	1,03	1,73	1,97	2,4	3,1
Number of Fan x Power			1x0,07	1x0,16	1x0,35	1x0,35	1x0,35	1x0,75
Number of Pump x Power			1x0,33	1x0,33	1x0,33	1x0,75	1x0,75	1x0,75
Pump	Flow		400	612	895	1271	1720	2373
	Pressure		41	38,5	32	33	32	31,5
Capacity of the Reservoir			75	75	75	110	110	140
Sound Pressure Level			50	51	53	53	53	54
Operating Weight			230	240	260	350	375	425

- (1) Nominal capacity is based on 15°C chilled water leaving temp. and 25°C ambient temp.
- (2) Nominal capacity is based on 15°C chilled water leaving temp. and 33°C ambient temp.
- (3) Values are based on the Dew Point of evaporating and condensing temperatures.
- (4) Values are based on freefield conditions in 10 meter distance.

**TABLE 1 :** Technical specification table of packaged type water chillers

### B.12 Physical Characteristics of Monoethylene Glycol Brine

DENSITY (15°C) kg / lt	AMOUNT OF GLYCOL IN 100 KG. BRINE Kg	TEMPERATURE OF BEGINNING OF FREEZING °C	Specific heat Kcal / KgC			
			+ 20°	0 °	— 10°	— 20°
1,005	4,6	— 2	0,990	0,980	—	—
1,007	6,5	— 3	0,982	0,975	—	—
1,010	8,4	— 4	0,970	0,970	—	—
1,015	12,2	— 5	0,960	0,950	—	—
1,017	14,1	— 6	0,950	0,940	—	—
1,020	16,0	— 7	0,940	0,930	—	—
1,022	17,9	— 8	0,936	0,927	—	—
1,023	18,8	— 9	0,931	0,924	—	—
1,025	19,8	— 10	0,930	0,920	—	—
1,027	21,0	— 11	0,926	0,913	—	—
1,028	22,3	— 12	0,923	0,906	—	—
1,030	23,6	— 13	0,920	0,900	0,900	—
1,033	25,5	— 14	0,908	0,894	0,896	—
1,035	27,4	— 15	0,900	0,890	0,880	—
1,038	29,3	— 16	0,894	0,878	0,874	—
1,040	31,2	— 17	0,890	0,870	0,870	—
1,041	32,1	— 18	0,885	0,866	0,866	—
1,043	33,0	— 19	0,882	0,860	0,858	—
1,044	34,0	— 20	0,880	0,854	0,854	—
1,045	35,0	— 21	0,870	0,850	0,850	—
1,046	35,7	— 22	0,886	0,848	0,846	—
1,047	36,5	— 23	0,877	0,846	0,842	—
1,048	37,2	— 24	0,854	0,844	0,839	—
1,049	38,0	— 25	0,851	0,842	0,837	—
1,050	38,8	— 26	0,850	0,840	0,830	0,820
1,052	40,0	— 27	0,842	0,833	0,822	0,812
1,054	41,2	— 28	0,834	0,823	0,814	0,804
1,055	42,6	— 29	0,830	0,820	0,810	0,800
1,057	43,5	— 30	0,8220	0,815	0,806	0,792
1,058	44,4	— 31	0,818	0,810	0,800	0,788
1,059	45,3	— 32	0,814	0,805	0,798	0,784
1,060	46,4	— 33	0,810	0,800	0,790	0,780

TABLE 2 : Physical Characteristics of Monoethylene Glycol Brine



## **C TRANSPORTATION AND STORAGE**

### **C.1 Delivery and Storage:**

All units are tested before leaving the factory. Units are shipped completely assembled and charged with refrigerant and oil. Units are shipped without package unless this has been demanded.

**Pay attention to the following conditions if the unit will be put into storage before installation.**

All water connections and other open - close valves etc. are safely closed. Unit and especially condenser fins should be protected against damage from working place conditions.

Units should be put on a place where the activity is minimum.

Ensure that condenser coil fins have no damage while cleaning.

All precautions must be taken to prevent damage to the unit during storage.

### **C.2 Moving of the Unit:**

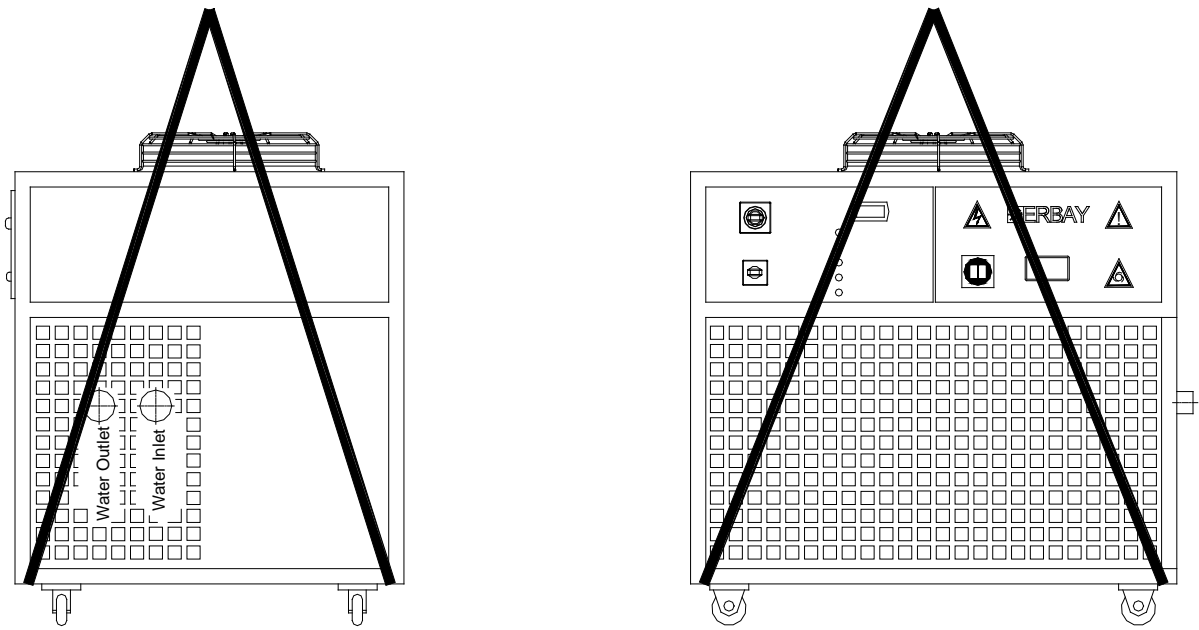
The location of the unit must be ready before moving of the unit. Lifting equipment used for installing the unit must have the capacity to support these weights.



To avoid injury and damage to the unit. Unit must be lifted in accordance with the instructions in the manual.



For lifting, rope that will not damage the unit must be used. The units must not be moved on rollers. Condenser coil fins must not be damaged while moving the unit.



PICTURE - 2 : Use of lifting rope

### C. 3 Inspection and Control:

The unit and the equipment on the unit are inspected at delivery time if there is damage during transportation. If there is any damage, this condition must be noted on shipment documentation and it must be reported immediately to ERBAY.

## **D INSTALLATION AND MONTAGE**

### **D.1 Location Requirements:**

Location and the spaces around the unit should be fixed correctly to ensure high performance and good service. Dimensions of spaces are important for ensuring an access of cleaning and maintenance vehicle, a place for removed components. Dimensions about spaces and service details are told in "D.2 Location Clearances" section.

The units should be located at suitable height from ground level or on a rooftop location. Air circulation is very important for both of the cases. The selected location should be away from boiler flues and other sources of airborne chemicals that could have a bad effect for condenser coils and steel parts of the unit. The unit should not be exposed to sun. A protective obstruction should be made to prevent access to the unit if it is located on an area that is accessible to unauthorized persons. By this way, accidental damage and injury can be prevented.

Base with suitable dimension for the chassis is made for ground level locations. The surface of concrete base must be in balance. Concrete bases are built minimum 20 cm higher than the ground level to prevent the effect of water and snow. Surface of the place which unit is stated should be covered with a shelter.

Operating weight of the unit should be considered for rooftop locations and the unit must be mounted to a place that could support this weight.

The important case about the indoor installation is to ensure the necessary fresh air for condenser and the discharge air from top of the unit must be ducted away to prevent recirculation of air. To ensure these conditions, grills with suitable dimensions must be fixed to the concerning location and for exhausting the air released from condenser fans, air duct must be installed from the exit of fans. The calculation of air duct should be made in such a way that will not decrease the air flow, considering the total pressure of condenser fans. Exhaust air is sometimes discharged through ventilation space. The blocking of fresh air by exhaust air during the discharging period of exhaust air must be prevented. Exhaust ducts may be extended through the ventilation hole passing out of the building.

## D. 2 Location Clearances

For comfortable operating of air cooled condensers, an easy access of air flow must be provided to the condenser coils and recirculation of warm discharge air back onto the condenser coils should not be allowed. For that reason there must be a suitable distance between the walls enclosing the unit and condenser coils. This distance should not be below 500mm, otherwise unit performance decreases and power consumption increase.



If there are adjacent buildings not allowing the air flow around the location of unit, it must be considered and fresh air circulation for condenser coils must be provided.

## D. 3 Pipework Installation



The faults made in pipework installation may cause failures, damage to the unit and may even cause the warranty to be void. So pipework installation is very important.

Maximum water velocity allowed in pipes should not be exceeded and pressure loss in evaporators should be considered. Flow switch has been mounted on a suitable place on water pipe in the unit, so that the circulation of water is controlled.

Weights of pipes and armatures (valves, filters etc) mounted onto pipes should be loaded onto supports. Pipe installation must be removable in order to be cleaned. A water filter should be put on the water circuit.

Air and water discharge valves must be put on the highest and lowest points of pipe installation. Unless PAKCOLD unit will be operated during winter, water inside the unit and pipe circuits must definitely be discharged and if the water will not be discharged, pipe installation must be insulated with cold circuit insulation material for freezing in winter and heat loss. A heater band is put under the insulation or glycol is added to water when insulation is not enough.





Water used in installation must be cleaned from solutions that damage the pipes and hardness removed type. PH value of water must be between 7.5-8.

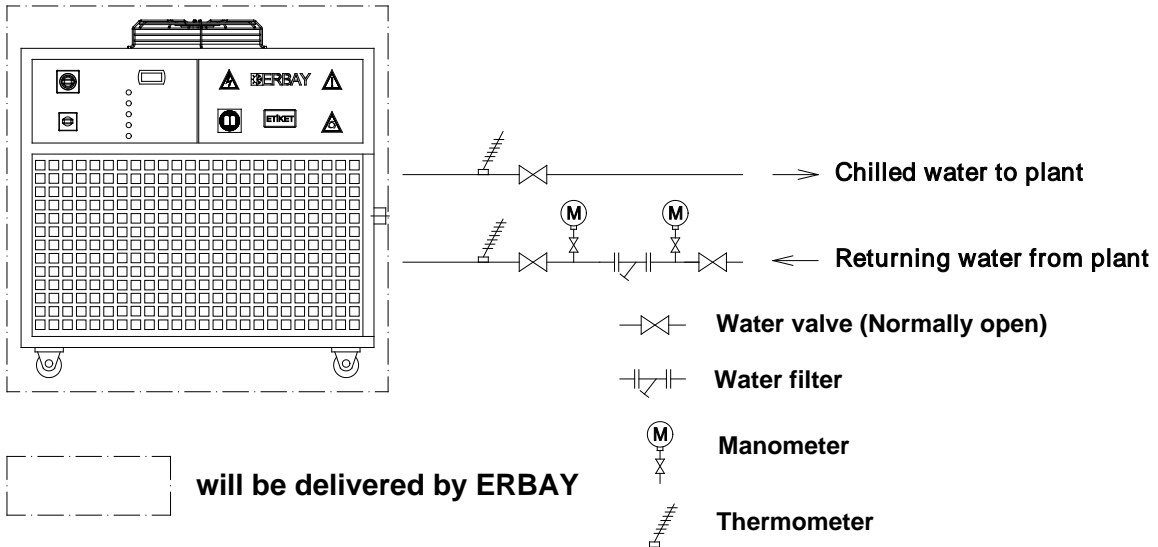


DIAGRAM 2 : Pakcold water connection diagram

#### D.4 Ductwork Installation

It is important for operation of the unit without problems and to prevent performance loss. Mistakes made in ductwork installation may cause failures and damage to the unit. It may even affect the validity of the warranty.

Pay attention to the following conditions about ductworks made to ensure the air circulation in condenser coils.

When ducting is fitted to the fan discharge, duct should be the same cross sectional area as fan outlet and straight for at least one meter. The length of the duct should not be so long that can affect the air flow.

Flexible duct connection must be made to prevent noise and vibration being transmitted to the structure. These ducts should be hung from suitable locations. Duct weight should not be put on the unit. Ductwork must be supported to prevent side loading on the unit where crosswinds may occur.

If two or more fans discharge into the same duct, back-flow dampers should be fitted in the ducts. This prevents the recirculation of air through the unoperating fan. Ducts should not block the removal of the fans.



Protective guards put on the fan blades should never be removed for making duct connection; rotating blades may cause injury for persons.

## D.5 Electrical Connections

To ensure a safe operation of the unit, take care of the following conditions. Otherwise there may be some problems, damages or injuries during the operation and this may cause the warranty to be void.



So many supplement equipment (Relay, signal lamp, contactor etc.) should not be mounted on control panel of unit. Cables, coming from other control panels and for the use of facility, should never be passed through the electrical control panel of the unit. It may cause electric shock and death. The electrical noise in the control panel may cause incorrect operation and interference and may increase the probability of damaging the unit.



After completion of cable connections, no electricity should be given to the system by unauthorized persons opening the main switch.

Open / Close (1/0) positioned main switch on electric panel is turned to “0” position at the factory. Before the unit is prepared to operate by ERBAY authorized operators, main switch is not turned to “1” position.

## D. 6 Power Wiring



Packaged type water chillers are suitable for 3 Phase – 400 Volt 50 Hz and 1 Phase – 230Volt 50 Hz. nominal supplies only. Deviation of  $\pm$  %10 may be acceptable in voltage values. Hazardous for the unit for more deviation in voltage values.



All electrical connections of the unit must be made in accordance with the local instructions. Cables with suitable diameters should be brought to cable inlets on the unit in a tidy condition. It is client's responsibility to put a protective device in the cable installation for excessive current. Cables should be suitable to TSE and/or CE norms. Power and control cables should be laid completely separate so that induction current on electric panel may be prevented.

Main power supply cable must be 3 Phase + Neutral line or 1 Phase + Neutral line and it must be connected to terminal blocks.

Earth cable should be connected to the main protector earth terminal block on the panel. Emergency stop device may be connected to this unit when needed and in hazardous conditions it stops the unit. If this system is desired to be made, it must be reported to ERBAY

All cables that will be connected to terminal block group in control panel should be armoured cables. Empty blocks are left in terminal block for the connection of auxiliary components out of the table. Another block is left for those to give failure signal. All auxiliary components out of the table are connected to the panel through earth terminal block so that electric shock hazard is prevented.

## E COMMISSIONING

### E.1 Preparation:

Installation and montage of the unit should be done in accordance with the drawings and dimensions ERBAY gives. After completing the montage of the unit, ERBAY technicians control the unit, pipe and cable installations. In case there is failure or damage on the unit, everything must be arranged. If there is no problem, commissioning operation can be carried out.



Commissioning of the unit should be carried out only by ERBAY technicians.

### E.2 Commissioning:

The following processes and controls are made before commissioning.

- Units are normally shipped to client charged with refrigerant. Refrigerant pressure of all system is checked; if refrigerant pressure has decreased, a leakage control in the circuit is made with eyes. Unless it can be observed with eyes, a pressure test is made. Leakage location is found and after the repair of the unit, system should be vacuumed for at least 2 hours. Before beginning to vacuum, all water in the unit must be discharged or evaporator should be get out from the tank.
- There should not be water in the evaporator while refrigerant is being charged. Refrigerant charge should be made slowly from the charge point in order to make less thermal stress at the load point. (DIAGRAM-1)

Compressor discharge valve must be controlled if they are completely open. If there is connection between high-low pressure switch connections and 1/4" connectors on those valves, those valves are turned up one time. All other valves must be open.

- Check that condenser fans can rotate freely and are not damaged. Ensure fan guard is completely fixed.

- Check that there are not any strange materials in the electric panel such as cable, metal parts etc. Clean it if so.
  
- Check that the cable ends of main power supply cable are connected correctly by the client. The connections of terminal block, circuit cut-outs and other armatures are checked for their tightness.
  
- Check that unit protecting terminals put for earthing are connected to earthing circuit. All earthing connections should be tightened well.
  
- Thermic settings of each motor are checked if it is correct. (Thermic settings are made according to the label values of the motor)
  
- Check if water circuits have been connected correctly to the unit.
  
- Correctness of high and low pressure settings of High-low pressure switch mounted on compressors is checked. Both of the resets are pressed only once.
  
- Water temperature and flow must be at suitable levels for the operating of control components in the circuit during montage period. There should be opposite heat load in the system for heating of cooled water during first start-up. Returning water should directly enter into the chiller and heat loading should be made to the system.
  
- If there is a remote control, its switch must be turned to "RUN" position.
  
- After the completion of these operations, the unit is run by Electrical Controller on electrical control panel.
  
- Abnormal noises should not be heard from the unit. These abnormal voices may be a signal of failures. So concerning voices should be tracked and observed if it can cause failure. Noises resulting from simple reasons must be removed. For example, resonance, loosen screw etc.

- There should not be any bubbles in sight glass in liquid circuit during the operating of compressor, liquid flow should fill down part of glass.
- Fan rotating directions must be certainly the correct direction.
- Control components on the circuit provide the necessary operations to keep the chilled water temperature in desired limits during the operation of the system.



**Caution:** Water level should be above the evaporator fins, while unit is working. Water level should be controlled by water level indicator which on the water tank.



**Caution:** A water valve should be put on the water circuit. So it is prevented to damage of the evaporator pipes and fins.



**Caution:** Unit should be taken out of the tank in periodic times. Tank and evaporator should be cleaned.

### E.3 Normal Operation:

When the unit starts to operate, all controls and operations are carried out automatically. Control system in the electrical control panel will de-energize the compressor to adjust the unit capacity to bring chilled water temperature to the desired values after the compressor energizes. As heat load increases, compressor will run again.

When compressors start to operate, refrigerant in the circuit will be discharged to air cooled condenser. This pressure should be kept stable to provide a fine operation of expansion valves in the system. Condensation pressure affects the efficiency of unit and is kept stable by High Pressure Switch let the condenser fans in on-off mode.

While compressor is operating, the operator should follow the current motor input, condenser pressure, water temperature and other parameters.

### E. 4 Shutdown

The unit can be stopped at any time by using the “Electrical Controller” on the Electrical Control Panel. If the unit will be stopped for a long time, the main switch is turned to “0” position. The main switch of the unit must not be turned off at short term stops.



If system will be closed for a long time, it may be useful to discharge the water inside the unit, especially in winter against the risk of freezing.





## F MAINTENANCE AND TROUBLE SHOOTING

### F.1 General Requirements:

Units are designed to operate continuously, so they should be maintained periodically and operated within the limits given in the instructions. Maintenance of each unit is made by the operator who operates the unit. To ensure the operation of the unit without failure, conformity to ERBAY maintenance instructions must be provided. If damage or system failures because of wrong maintenance occur during the warranty period, ERBAY will not be liable for the costs to provide the correct operation of the unit. This maintenance is in use for only main units. If some changes occur due to contracts between the client and other companies, or equipment is added to system, concerning conditions must be supplemented to maintenance instructions.



Before any maintenance work on the unit, safety section in this manual must be read carefully.

### F. 2 Daily Maintenance

Maintenance checks should be made by the operator regularly. Daily maintenance process is mentioned below:

Refrigerant leakage in the circuits is controlled by eyes. If the connection parts of heat exchangers, compressors, pipe circuits are oiled, there may be refrigerant leakage on those parts. Condenser coil fins must be cleaned from dust, leaf, paper etc.

Working temperature values are read and observed if they are in normal limits from the display on the panel.

The amount of refrigerant is understood through the condition of liquid passing through sight glass on the liquid line of the circuit. Small air bubbles should not be seen during the operation of the unit. Down part of the glass must be full of liquid.

Water chillers (PAKCOLD) are usually not suitable for interference of the user. When some problems are fixed during checks, there should not be any interference to the unit and the problem must be reported to ERBAY immediately.

Water level of the water tank should be controlled.

### **F. 3 Periodic Maintenance**

Maintenance operations specified above should be carried out by a qualified service technician or engineer. The difference between major and minor service depends on demand, location conditions and desired operation schedule. Normal service is carried out once a month, three months, six months and a year. It is recommended to use ERBAY service for periodic maintenance.

#### **The following checks are made during a periodic maintenance:**

- Vibration of the unit is controlled.
- Heat insulation of the unit is controlled,
- Compressor body temperature is observed.
- Refrigerant leakage is controlled.
- Humidity level of the refrigerant in the circuit is controlled through sight glass.
- Sub cooling is controlled.
- Pipes are controlled if there is damage
- Water circulation in evaporator is controlled. ( Water filter etc. )
- Water pressure loss in evaporator is controlled
- Condenser coil fins are controlled if the air flow is normal.
- Blades of the fans are controlled.
- Fan motor and guards are controlled.
- Sensor locations are controlled.
- LP / HP cut-outs are controlled.
- Heat isolation material is controlled.
- Pump-down function of the compressor is controlled.
- All electrical wiring is controlled.
- All contactors, thermics and relays are controlled.
- Cold Water Tank and water circuits are controlled. It should be cleaned if they are dirty.
- Full water level of the water tank is controlled

## F. 4 Trouble Shooting

Failures, possible causes and solutions of these failures are mentioned below:

FAILURE	POSSIBLE CAUSE	ACTION
No display on panel although open-close key is pressed.	Phase sequence relay doesn't allow running. There is excessive voltage difference. No current to the panel Main switch is on (0) position One of inlet or outlet fuses of 24 V Transformer blown.	Ensure the access of three phases Correct the voltage difference.  Check mains supply Turn to (1) position V - Automat fuse blown - Call the service
High Pressure Alarm HP displayed	One of condenser fans does not operate. Condenser coil is dirty, no air flow. Ambient temperature is high. Excessive amount of refrigerant is charged. Measured pressure is incorrect.	Operation of fan or fans must be provided. Clean the condenser coil. Take precaution to decrease the temperature Discharge the excessive amount. Check the pressure switch and connections.
Low Pressure Alarm LP displayed	Expansion Valve is out of order Drier filter is plugged. Refrigerant has decreased. Water filter is dirty. Poor water flow in the circuit. Evaporator is dirty. Measured pressure is incorrect	Change with a new one. Change with a new one. Charge refrigerant of decreased amount Clean the filter. Check water circuit and pump. Call the service. Check pressure switch and connection.
Thermic Alarm tP displayed	Compressor thermic blown. Condenser fans thermic blown. Pump thermic blown	Find out why thermic pulls much current in. Find out the reason Find out the reason

## G DECOMMISSIONING, DISMANTLING AND DISPOSAL

Pay attention to the following conditions during decommissioning, dismantle and disposal of packaged type water chillers (PAKCOLD).



Refrigerant is never released to atmosphere when the circuits are discharged. Suitable equipment must be used for that. Discharged refrigerants from the circuit are not used again. These gases are sent back to the manufacturer if it is possible.



Used Compressor oils are not thrown away; there is melted refrigerant in that oil. Used oil is given back to its manufacturer.

Before beginning to dismantle the unit, the main switch is turned to “0” position; all electric circuits feeding the system are cut out. All cable wiring is dismantled after ensuring that there is no electricity in the cable installation. Water inlet and outlet valves are closed. Then the water inside the unit is discharged and the unit can be dismantled from its location. Unless valve is put on the water circuit, all water in the system is discharged. The unit can be dismantled in one piece. Firstly the anchor bolts are dismantled, and then the unit is lifted and transported to the required location by connecting it to an equipment having a suitable capacity.



If there are mixtures containing some chemicals or glycol instead of water in the evaporator circuit, these mixtures must be taken outside safely. They should never be discharged to sewer or natural water systems. ( Rivers, streams e.g. )

After the discharge of water circuit, all pipe installation can be dismantled.

According to the condition of the system; refrigerant oil, glycol or similar mixtures may remain in some parts of the system. These must be mopped up and disposed of as mentioned before.



Pay attention to use devices having suitable lifting capacity during dismantling. Dismantled components are disposed or destroyed according to local laws and regulations.