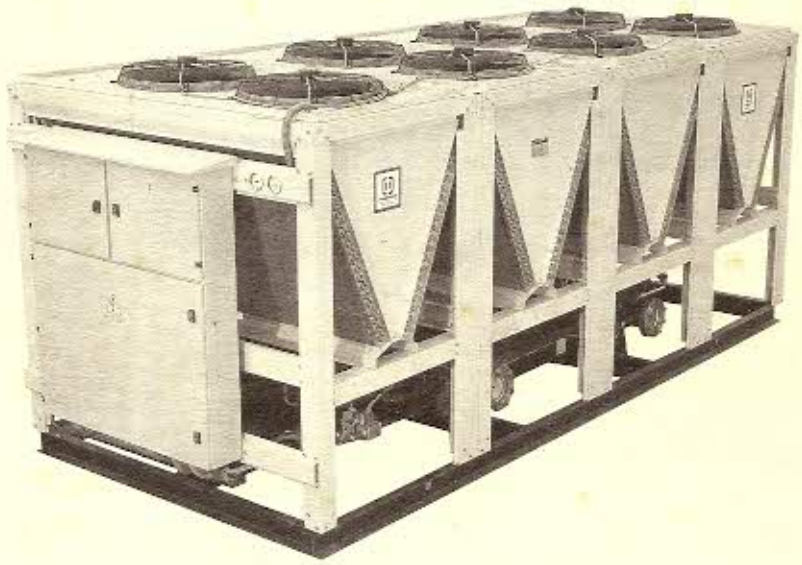
AIR COOLED WATER CHILLERS

FAWC SH 2070 - 4300

MANUAL

INSTRUCTIONS FOR USE, SERVICE & INSTALLATION



CE

INTERNATIONAL CERTIFICATE
ISO 9001

Now also with (ODP = 0) refrigerant 407 C, 134 a

FYROGENIS
We invest in quality

Contents

1. USE INSTRUCTIONS

1.1 GENERAL

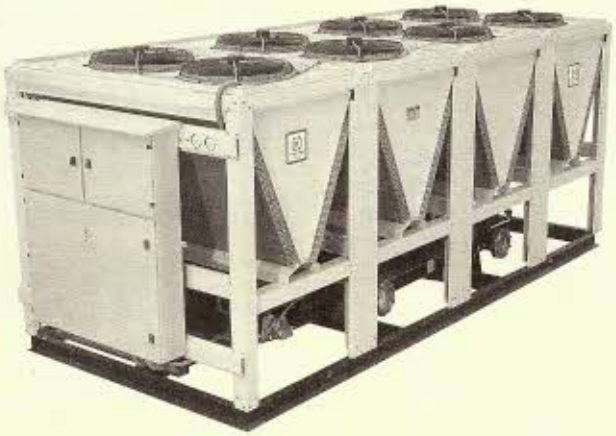
FYROGENIS air cooled water chillers described in this technical manual can be used for the cooling of water down to 5 °C for air conditioning applications and 4 °C for industrial processes.

They are ideally combined with Fan Coil Units or Air Handling Units for the air conditioning of offices, hotels, restaurants, hospitals, big residences, e.t.c.

Following the instructions of these manual you will be able to exploit the advantages of the unit, contributing to the reliable operation for many years.

Note that the installation must be performed according to the Installation instructions (chapter 3).

This manual also enables the service technicians to service, repair and maintain the chiller.



SAFETY RULES

- Service and repair of these units should be attempted only by qualified technicians familiar with FYROGENIS products and instructions.
- The majority of technical problems in a chiller involves electric power and controls; so a service technician must be primarily an electrician.
- Power must be switched off when servicing or repairing electrical components.
- Handling refrigerant circuits must be done with extreme caution. Wear safety glasses and gloves to prevent personal injury.

WARNING !

- The external main switch (provided by the installer) must be turned on at least 12 hours before operation.
  In that way crankcase heater of the compressor is powered in order to prevent migration of the refrigerant to the compressor oil.
- When the unit is used for winter operation, it must be protected against frost conditions, using a suitable non-freezing mixture (brine) instead of water.
  In case of summer operation only, it is recommended to empty the chiller from the water, after the end of the summer season.

1.2 UNIT DESCRIPTION

1.2.1 MAIN COMPONENTS

Unit housing

It consists of:

- a steel construction CAD / CAM produced, adequately thick, assembled with bolts and cast aluminium corner joints.

Additional corrosion protection is achieved by a durable external finishing of dry powder epoxy resin paint, baked at 180 °C.

Compressors

They are semi hermetically sealed, reciprocating, of a high volumetric efficiency, with 4-pole motors.
The whole compressor is installed on the unit base using vibration absorbers (rubber in shear) for vibration reduction and reduced noise operation.

Safety controls

A complete set of safety features, i.e. high and low pressure switch, oil pressure switch, phase asymmetry and under-voltage relay, compressor starting delay, thermal contacts of compressors and fans, and compressor crankcase electric heater ensures many years trouble-free operation of the Unit.

Water to refrigerant heat exchanger (Evaporator)

High efficiency, Shell and tube type heat exchangers are used, covered with strong thermal insulation.

Air to refrigerant heat exchanger (Condenser)

It is manufactured from seamless copper tubes mechanically expanded into aluminium fins formed properly for maximum heat transfer between refrigerant and air.

Fans

They are equipped with 3-phase (6-pole) motors of weather-proof type (IP 54) with internal thermal contacts for winding protection.

Motors are equipped with special pre-lubricated bearings which do not need any maintenance and ensure noise-free operation.

Fan wheels are aerodynamically designed for high efficiency and noiseless operation.

Each fan is covered with steel guards for protection against contact.

They operate in steps according to the load demand and the ambient air temperature in order to meet always the required refrigerant pressure in the inlet of the expansion device, thus providing the unit with the capability of operating in a large range of ambient temperatures.

1.2.2 ELECTRICAL BOARD

The electrical board is conveniently located on the facia of the Unit and contains contactors for compressors and fans as well as the microprocessor based controller of the Unit. The Board contains 3 parts with IP 44 protection.

- The **1st part** contains the 230/400 V power circuit, including connection to the mains and Electromagnetic Contactors for compressors and fans (see also ELECTRICAL DIAGRAM).
- The **2nd part** contains the 24 V electronic control of the power circuit.
- The **3rd part** includes the digital monitoring of the operating parameters of the chiller. In case of trouble the signal ALARM appears on the screen and the LED of the corresponding key turns ON, while a continuous high frequency alarm sound (if an optional SIRENE is connected) calls for diagnosis and problem's solution. (For Troubleshooting see parag. 2.3).

1.2.3 REMOTE CONTROL

The unit must be controlled via a remote control as shown in *Figure 1*. The remote control includes :

- ON - OFF switch
- Alarm lamp. This lamp (red coloured) turns on when any fault occurs.

Note : It is possible to connect a remote control with microprocessor (see *page 5*).

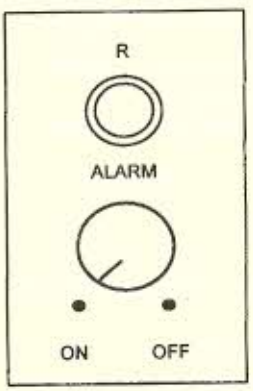


***Figure 1** : Remote control*

1.2.4 MICROPROCESSOR CONTROLLER

The microprocessor controller, controls the functions of the unit and protects it by cancelling the operation when required.

WARNING

1. The controller is located in the Electrical Switch Board.
2. The controller's user should be a qualified technician.

Control functions

The microprocessor controller, performs the following functions:

- Display of water temperatures (Operation thermostat).
- Outlet water temperature adjustment (by the user).
- Anti-freezing protection of the water-refrigerant Heat Exchanger (Safety thermostat).
- Control of the fans operation (when inverter is used).
- Control of the water pump.
- Control of the compressor's start delay
- Overload and damage protection of the compressors. (Delay between the start of individual compressors prevents start-up overloading - high start current).
- Automatic reverse of the compressors' start sequence. (This improves the uniform operation of the compressors).
- Protection against high or low refrigerant pressure.
- Protection against low oil dif. pressure. (Connection to the corresp. pressostat).
- Protection against low water flow rate, by activating the water flow switch (to be installed by the contractor).
- Code numbers display which give information about normal or eventual faulty operation. (This allows troubleshooting action).
- Potential cooperation with a Building Management System (BMS), (Modebus Protocol, RS 422).

Description of the system

The controller, located in the Electrical Switchboard includes the following components:

- The basic unit which controls the first refrigerant circuit.
- The extension unit which controls the second refrigerant circuit.
- The terminal unit including digital display with symbols and buttons for user's convenience. (*Figure 2*)

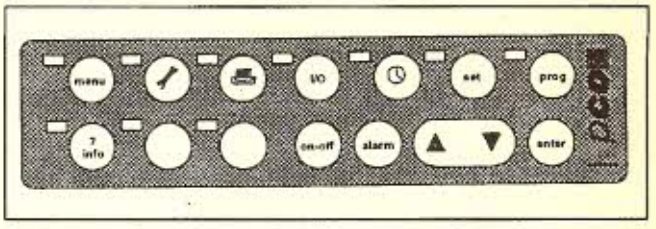


Figure 2

Symbols explanation on buttons and Indications :

menu : Inlet / Outlet temperatures display, Alarm Indicator, Summer (SUM) or Winter (WIN) operation Indicator.

I/O : Inlet / Outlet digital of analogue, activated or not indication of the system.

set : Setting of the required inlet water temperature.

info : Program edition and FINAL TEST of the unit indicator.

on-off : ON (operation) - OFF (non operation) indicator.

alarm : Alarm list. Pressing twice Reset is obtained.

▲▼ : Parameter (▲ : Next, ▼ : Previous) and corresponding numerical values selection.

enter : To memorise above value.

: Operating time indicator for each compressor.

prog : Programming of the system through an ACCESS CODE.

: Printing button. Activates (if any) the printer. Otherwise not in use.

Adjustment of : - Date, - Daily and Weekly Operation Hours, - Time zones with corresponding Set Points.
The button is active only when there is a Real - Time Clock connected to the Central Processing Unit of the System.

Operating Temperature Setting (Outlet Water Temperature)

- Press button SET. Two set points appear for Winter & Summer operation.
- Using ENTER button move the cursor [flashing (-)] to the value next to Summer.
- Press ▼ : To decrease the temperature value.
- Press ▲ : To increase temperature value.
- Using ENTER button to save this value.
- Press MENU to return to the previous screen.

Connection to Building Management System (BMS)

This connection should be done using a signal transformer between Microprocessor and PC (Terminal station) of the BMS. This unit (GATEWAY for PC or MODEM) transforms the signal of the Microprocessor to data recognisable by the PC of the BMS System.
FYROGENIS could supply the respective signal transformers on request.

Connection to a second Terminal station

The maximum allowable cable length is 1 km, **under** which a control unit can be installed similar to that installed in the switchboard of the chiller.

1.2.5 FUNCTION OF CONTROLS

(see electrical diagram)

External main switch

Powers the unit with high voltage. When it is switched ON, the crankcase heater of the compressors operates (provided that internal main switch of the Unit is ON), keeping the oil warm. (External main switch is provided by the installer).

Main switch of the Unit

Internal switch on the electrical board of the Unit. Normally this switch is in ON position. To be OFF during maintenance works.

High Pressure Switch (HP1, HP2)

Senses discharge pressure, and transmits a signal to the microprocessor controller which shuts down the unit when the pressure exceeds 27 bar. After the problem is solved, the system must be reset (see *page 5*).

Low Pressure Switch (LP1, LP2)

Senses suction pressure, and transmits a signal to the microprocessor controller which shuts down the unit when the pressure is less than 2 bar. After the problem is solved, the system must be reset (see *page 5*).

Lubricating oil, Dif. Pressure Switch

There is one for each refrigerant circuit. This switch checks the pressure difference between oil and low refrigerant pressure. If this difference drops below ~ 3 bar, the switch is activated giving a corresponding indication to the LCD display for solving the problem.

Voltage Relay (ET)

Monitors incoming electrical power supply and shuts down the control circuit, in the event of under-voltage or phase-failure.

Microprocessor Controller

Programmable controller which controls the unit. (See paragraph 1.2.4)

Fan Thermal Contact

Senses the temperature of the fan motor winding and shuts down the operation of the system.

Compressor Thermal Contact

Senses the temperature of the compressor motor winding and cuts off the operation of the corresponding compressor.

Operation Thermostat

Via a temperature sensor in the water inlet, the controller decides for starts or capacity steps of the Unit.

Anti-Freeze Thermostat

Via a temperature sensor in the water outlet, the controller shuts down the unit when the temperature in the water outlet falls below 4°C. After the problem is solved, the system must be reset (see *page 5*).

Flow Switch

Must be field mounted by the installer in the water leaving pipe to sense the flow and to shut down the unit's operation at a low flow condition.

Pump Interlock

Field wiring interlock via auxiliary contact of the chilled water pump contactor.

Crankcase Heater

Located in the compressor crankcase and activated when main switch is ON to drive off the refrigerant from the lubricating oil. This is shown by the orange lamps. (One for each circuit).

1.2.6 REFRIGERANT PRESSURE GAUGES

The unit is equipped with refrigerant pressure gauges, two for each refr. circuit showing suction and discharge pressure of the compressor.

These pressure gauges give information for the proper operation of the unit. The following table gives the range of the pressure values for various operation conditions.

Table 1 : Typical pressure values in refrigerant circuits.

Water inlet temperature 12 ° C - 15 ° C				
Ambient temperature (°C)		25	35	45
R22	High pressure (bar)	14 - 17	19 - 22	22 - 25
	Low pressure (bar)	4 - 6	4 - 6	4 - 6
R134a	High pressure (bar)	9 - 11	12 - 14	14 - 16
	Low pressure (bar)	2 - 3	2 - 3	2 - 3
R407c	High pressure (bar)	15 - 18	20 - 23	23 - 26
	Low pressure (bar)	3,6 - 5,5	3,6 - 5,5	3,6 - 5,5

1.3 OPERATION

1.3.1 OPERATION INSTRUCTIONS

CAUTION

The external main switch of the unit must be turned on at least 12 hours before operation. In that way the crankcase heater of the compressor is powered in order to prevent migration of the refrigerant to the compressor oil.

- Check that the crankcase heater is powered ; the corresponding indicating lamp (orange coloured) is ON.
- Operate the unit by turning ON the remote control.
- The unit will start (after 4 min).

1.3.2 SEQUENCE OF OPERATION

Pre-start

1. Main switch of the unit is closed.
2. It is necessary that the power supply has been switched ON for 12 hours beforehand to energize the compressor's crankcase heater.
3. All external controls and interlocks are connected and operational.

Start / Loading

1. The ON/OFF button on the remote control is switched ON activating the chilled water circulating pump and establishing flow.
2. The pump activating auxiliary and flow switch contacts will close.
3. The control circuit is energised.
4. Operation thermostat will signal required cooling.
5. After a time delay, compressor No1 will start.
6. After a time delay, compressor No2 will start and compressors No3 & No4 will follow in the same way (if the unit has more than 2 compressors).
7. As each compressor starts, its anti-recycle timer starts timing so that the compressor cannot restart within a 4-minute period.

Unloading

1. As the entering water temperature decreases, the operation of compressor No1 stops.
2. If the entering water temperature continues decreasing, the operation of compressor No2 will stop, and with further temperature the No3 & No4 will stop.

Fan Operation

The fans of the unit are divided in two groups. The first group operates continuously while at least one compressor operates. The second group of fans operates when the high pressure is, at least, in one refrigerant circuit greater than 17 bar.

2. MAINTENANCE INSTRUCTIONS

2.1 GENERAL

The air cooled water chillers of the series FAWC need a minimum service on a standard basis, which contributes to high performance output and economical operation of the units, as well as to long life operation without problems.

The annual services suggested from the manufacturer are at least two; one at the beginning and one in the middle of the cooling period.

WARNING

The service of the unit must be performed ONLY by qualified technicians.

SAFETY RULES

- Switching off by ON/OFF button on the remote control is not enough for power shut off. To remove power from all terminals, switch OFF the internal power switch.
- High pressure refrigerant gas and liquid are present in the Unit. Liquid refrigerant can cause severe burns to exposed skin areas. Wear safety glasses to protect the eyes. If liquid refrigerant contacts the eyes, it can cause loss of sight.

2.2 SERVICE PROCEDURES

CAUTION

The external and internal switches of the unit must be turned on, at least 12 hours before operation. In that way the crankcase heater of the compressor is powered in order to prevent migration of the refrigerant to the compressor oil.

Before starting the unit it is very important to check, with the use of a voltmeter, across crankcase heater leads that the heater is ON. Additionally, CAREFULLY feel the bottom area around the heater to check if it is warm, by hand.

The following works must be done with the unit disconnected from the mains:

- Switch OFF the external main switch of the unit (3-phase switch).
- Check that all electrical connections on contactors and terminals of the electrical board are tight.
- Check refrigerant circuits leakage. The low pressure in the manometer must be over 2 bar.
- Check the water circuit for leakage.
- Clean the water strainer.

The following inspections/works demand the unit to operate with at least 50% of the cooling load.

- Switch ON the external main switch of the unit. Press the ON/OFF button of the remote control.
- Check the function of the flow switch. By closing gradually one valve in the water circuit, the unit must stop its operation *before* the valve is fully closed. In order to restart the Unit reset the system (see *page 5*). Do not forget to open the valve again.

After 20 minutes of operation proceed to the following:

- Check that oil level in sight glass of the compressor is in the middle.
- Check the low and high pressure values on the manometers of the refrigerant circuits and compare with the values given in Table 1.
- Check the different pressure of the oil.
- Read the values of water inlet and outlet temperatures given by the microprocessor control. The temperature difference between water inlet and outlet of the unit must be 4 °C - 6 °C. If the temperature difference is greater than this, increase the water flow, if lower, decrease it.
- Check the inlet water temperature to be at least 10,5 °C (Adjustment see *page 6*)
- Check the water pressure drop, for a further estimation of water flow. The relation between water flow and pressure drop is given in the Table 2.
- Check that the condensers (fin-tube heat exchangers) are clean. Dust will impair the heat transfer and may cause problems in operation.

Cleaning of the condensers

Cleaning should be carried out by use of blowing air from the inside of the unit, and vacuum cleaner from the outside. During the cleaning procedure, deformation of the fins must be avoided.

Table 2 : Water Pressure Drop through FAWC SH Units

SIZE	FAWC-SH		2070	2080	2100	2120	2150	3150	3180	4200	4240	4300
WATER FLOW RATE	MINIMUM	(m^3/h)	20	22,2	27,1	32	35,5	41	49	54,3	65,2	71
	NOMINAL	(m^3/h)	31	35,6	43,4	51	56,7	65,4	78,1	86,8	104,2	113
	MAXIMUM	(m^3/h)	38	43	65	68	70	100	100	105	140	148
Water pressure drop *		(bar)	0,3	0,41	0,45	0,51	0,53	0,70	0,79	0,83	0,47	0,50

*** For the Nominal Flow Rate**

2.3 TROUBLESHOOTING

In case of malfunction, the controller switches to an Alarm position
Then:
- The ALARM indication appears on the screen.
- The light of the ALARM button turns on.
- A constant beep sound is activated.

Action

Press the ALARM button. The beep stops and a message appears on the screen (see list below).
Using the arrows ↑ , ↓ , you can look for more messages/problems if exist.

RESET

After the restoration of the problem, press twice the ALARM button. If the problem has been indeed restored, the message **"No alarm pending"** appears. The chiller is now ready to start.

Note :

You can configurate the control system by pressing the MENU button and on the screen you will see all the necessary data's, such as inlet - outlet water temperature or system status (ON / OFF).
In the list below you will find the several messages, the corresponding possible cause and the necessary actions.

High Pressure Switch Comp. Therm Overload Fan Therm. Overload Circuit 1. ⇨	This message suggests three different possible problems. If at least one of the three problems exists, then the system stops the operation of Circuit 1.
(α) High pressure switch has been activated	**Possible cause** - Not enough air flow in the condensers. - Malfunction of fan (fans). **Actions** - Remove any hindrances from the air flow. - Replacement of the defective fans.
(b) Compressor thermal contact has been activated.	**Possible cause** - Damage of a compressor. **Actions** - Call FYROGENIS representative's SERVICE.
(c) Fan thermal contact has been activated.	**Possible cause** - Damage of a fan. **Actions** - Call FYROGENIS representative's SERVICE.
High Pressure Switch Comp. Therm Overload Fan Therm. Overload Circuit 2. ⇨	This message suggests three different possible problems. If at least one of the three problems exists, then the system stops the operation of Circuit 2. (See previous message)

FAWC SH

Low Pressure Switch Circuit 1	Low pressure switch (Circuit No 1) has been activated. **Possible cause** - Leakage of refrigerant. - Low water flow. **Actions** - Clean the water filter. - Air-vent the water circuit. - Call FYROGENIS representative's SERVICE.
Low Pressure Switch Circuit 2	Low pressure switch (circuit No 2) has been activated. (See previous message)
Oil Differential Pressure Switch Circuit 1	Differential oil pressure switch (circuit No 1) has been activated. **Possible cause** - Defective oil pump of the compressor. - Defective oil pressure switch. **Actions** - Replacement of any defective part.
Oil Differential Pressure Switch Circuit 2	Differential oil pressure switch (circuit No 2) has been activated. (See previous message)
Flow Switch Alarm	Flow switch has shut down the operation. **Possible cause** - Insufficient water flow, because of pump failure or hindrances in the water flow. **Actions** - Clean the water filter. - Air - vent the water circuit. - Check the electrical connections of pump contactor and overcurrent relay. - Check the rotation of the pump. If it is not proper, change it by interchanging two phase cables.

Anti-freeze Alarm	⇨	Anti-freeze thermostat has been activated. **Possible cause** - Low water flow. - Low setting of the operation thermostat. **Actions** - Increase the water flow. - Increase the setting of the operation thermostat.
Evaporator Inlet Water High Temper. Threshold Exceeded Alarm	⇨	This message appears when the entering water temperature rises above 30 °C. If this persists for more than 30 min, the Unit will stop. **Possible cause** - Insufficient capacity of the Chiller. **Actions** - Check the study of the plant.
Evaporator Inlet Water Low Temper. Threshold Exceeded Alarm	⇨	This message appears when the water entering temperature in the evaporator falls under 6 °C. If this persists for more than 30 min, the Unit will stop. **Possible cause** - Low cooling loads in the installation. - The unit is feeded from another chiller. - Not proper setting of the operation thermostat. **Actions** - Check the installation. - Check the setting of the operation thermostat.
Evaporator Inlet Water Temperature Probe Broken or not connected	⇨	Defective or disconnected sensor in evaporator water inlet. **Actions** - Restoration of the problem.
Circuit 1 Coil Temperature Probe Broken or not connected	⇨	Defective or disconnected sensor of condenser, Circuit No 1. **Actions** - Restoration of the problem.

Circuit 2 Coil Temperature Probe Broken or not connected	⇨	Defective or disconnected sensor of condenser, Circuit No 2. **Actions** Restoration of the problem.
Unit Running Hours Threshold Exceeded Alarm	⇨	This message suggests that the schedule service of the Unit has to take place.
Running Hours Threshold Exceeded Alarm Compressor 1	⇨	This message suggests that the scheduled service of Compressor No 1 has to take place.
Running Hours Threshold Exceeded Alarm Compressor 2	⇨	This message suggests that the scheduled service of Compressor No 2 has to take place.
Alarm Clock Card not Installed or not Working	⇨	The chiller is programmed to operate according to a timer, but the card of the real time clock is damaged or not properly installed.
Motor-Driven Pump Thermal Overload Alarm	⇨	Activated thermal contact of water pump or not connected between terminals 34-35. If the thermal contact is connected in another way, connect a bridge between 34-35.
Interlock Alarm	⇨	The control system is equipped with a 24 V contact for shut down signal (e.g. fire safety). This message appears when shut down is signaled. The Chiller is delivered with a bridge on this contact.
Alarm Eeprom Broken or Absent Call Assistance	⇨	This messages indicates that the microprocessor is defective. **Actions** - Call FYROGENIS representative's SERVICE.

High Pressure Threshold Exceeded Alarm Circuit 1	If an analogue high pressure switch is used for outdoor fans control, this message suggests that the high pressure of circuit No 1 has exceeded the threshold set. **Action** - Remove any hindrances from the air flow. - Replacement of the defective fans.
High Pressure Threshold Exceeded Alarm Circuit 2	If an analogue high pressure switch is used, for outdoor fans control, this message suggests that the high pressure of circuit No 2 has exceeded the threshold set. **Action** - Remove any hindrances from the air flow. - Replacement of the defective fans.
Circuit 1 Pressure Probe Broken Alarm	The analogue high pressure switch of circuit No 1 is defective. **Action** - Replacement of the high pressure switch.
Circuit 2 Pressure Probe Broken Alarm	The analogue high pressure switch of circuit No 2 is defective. **Action** - Replacement of the high pressure switch.
Evap. Outlet Water Temperature Probe Broken or not Com. Alarm	Defective or disconnected temperature water sensor in outlet of indoor heat exchanger. **Action** - Connection of the sensor or replacement.
No Alarm Pending	There is no activated alarms. The Chiller can operate.

3. INSTALLATION MANUAL

FYROGENIS chillers are designed for maximum convenience during installation so relevant cost and space required are minimized if the instructions given in the present section are followed.

All units are delivered fully assembled, cabled, filled with refrigerant and factory tested.
The steps to be followed on site, prior to operation, are :

- **Mounting the unit on the final place.**
- **Electrical connecting to the mains**
- **Piping to the respective thermal loads network (Air Handling Units / Fan Coils or other consumption).**

In the following pages these steps will be clarified in details.

3.1 RECEIVING INSPECTION

Every possible effort is made to assure a safe transportation by means of appropriate design and assembly of the unit in the factory.
Nevertheless an "Acceptance of transportation" inspection should be made, upon arrival and before unloading, in order to testify eventual damage during transportation.

In case of damages :
- Make the relevant remarks on the transporter's delivery document and FYROGENIS document.
- Inform FYROGENIS by writing a "Damage report".
- Proceed to a carefully check-up of the unit and make a written notice to the transporter within 3 days from arrival day.

NOTES
1. If this action is not taken, eventual repair cost will be burden by the client and not by the transporter.
2. In any case upon arrival of the unit, refrigerant pressure indications on the High and Low pressure manometer should be checked. Zero pressure means refrigerant leakage and the reason for this should be investigated.

3.2 LIFTING - TRANSPORTATION OF THE UNIT

A fork-lift or crane could be required for lifting. In the later case, please, observe lifting instructions shown on the *Figure 3*. Weights are giving for transporter's convenience in the following Table.

Centres of gravity are given on next page of the present manual.

Table 3

Weights (kg) of FYROGENIS FAWC SH Chillers.

SIZE	WEIGHT (kg)		
	R 22	R 407C	R 134a
2070	1750	1800	1750
2080	1900	1950	1900
2100	2200	2250	2200
2120	2300	2350	2300
2150	2750	2800	-
3150	3100	3200	3100
3180	3250	3350	3250
4200	4250	4350	4250
4240	4550	4650	4550
4300	5550	5650	-

3.3 PLACE OF INSTALLATION

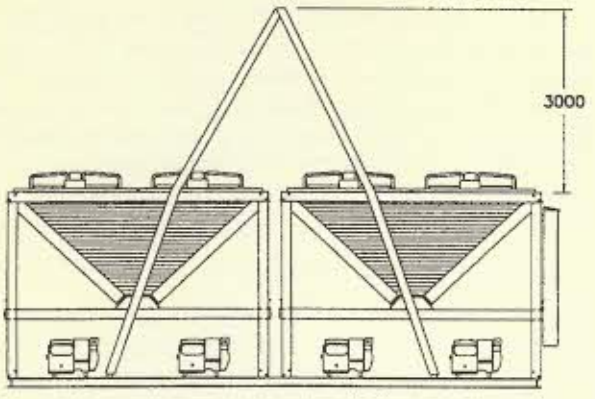
The unit could be located in a free space, either on a flat roof or on the ground, provided that a free space according to *Figure 4A* of minimum distances around the unit will be left.

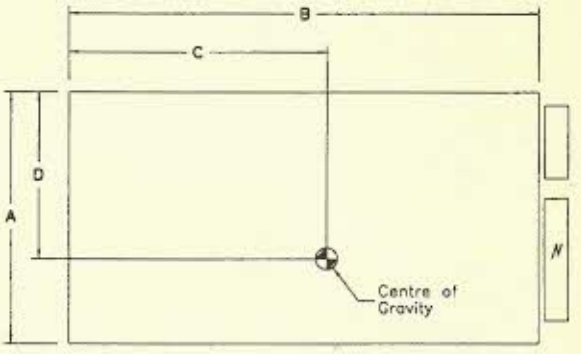
Further specifications for the ground are :
1. To be levelled (Maximum vertical deviation end to end of the unit base : 5 mm).
2. To be able to withstand the weight of the unit.
3. Drainage to be provided.

3.4 MOUNTING OF THE UNIT

No additional anchoring of the unit is required.
If very strict vibration allowance is observed, local expert can advise respective spring type vibration isolators based on the weight and center of gravity of the unit.

LIFTING ISTRUCTIONS





FAWC SH		2070	2080	2100	2120	2150	3150	3180	4200	4240	4300
A	(mm)	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100
B	(mm)	2875	2875	2875	2875	4363	4363	4363	5850	5850	8826
C	(mm)	1800	1800	1800	1800	2600	2600	2600	3300	3300	4800
D	(mm)	1250	1250	1250	1250	1250	1250	1250	1350	1350	1350
H	(mm)	2158	2158	2158	2158	2158	2158	2158	2198	2198	2198

Figure 3
Lifting Instructions

MINIMUM REQUIRED SPACE AROUND THE UNIT OUTDOORS

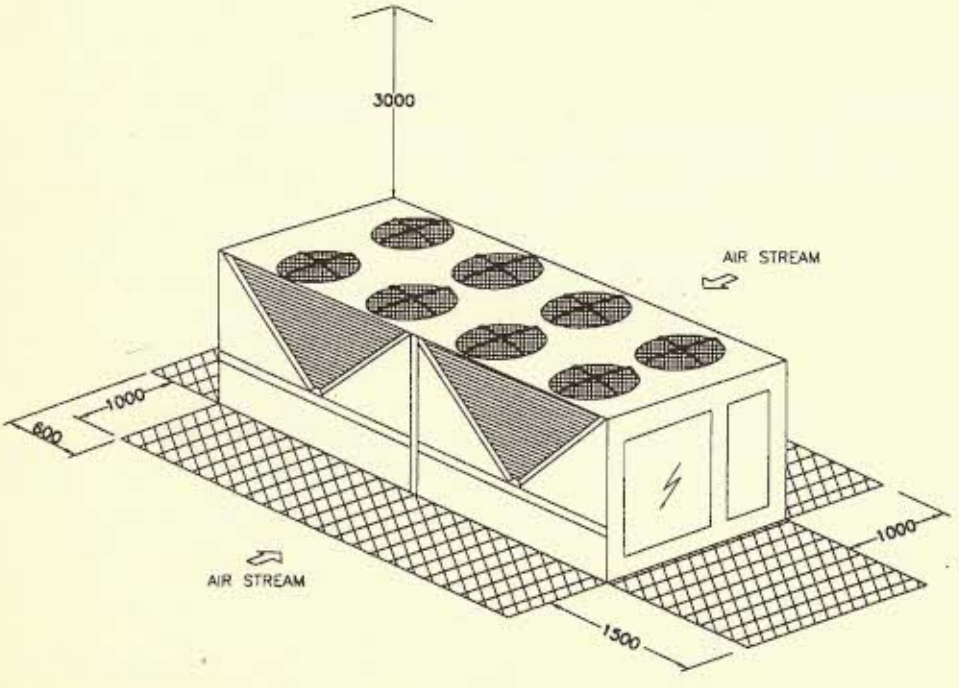


Figure 4A
Minimum required space around the unit
(for outdoor installation).

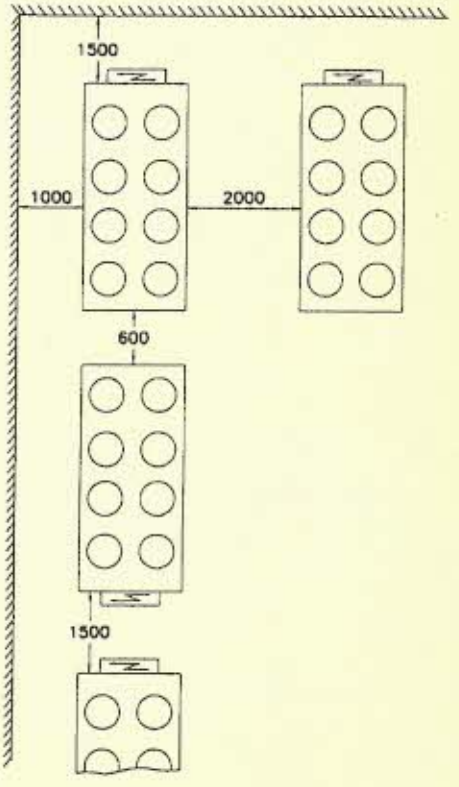


Figure 4B
Minimum required distance between
units (for outdoor installation)

3.5 HYDRAULIC CONNECTIONS

Necessary equipment provided by the installer are shown on the respective *Figure 5* of the present manual. This Figure should be followed without any deviation! Water inlet/outlet are clearly marked on the unit.

3.5.1. Piping

According to *Figure 4*, free space for maintenance should be left after completion of the piping arrangement.

3.5.2 Water pump (WP)

- A 3 phase pump is always advisable for thermal protection of the pump's motor.
- It is also advisable for the pump to discharge to unit's heat exchanger, so that the latter is always filled with water.

3.5.3. Flow switch (FS)

The water flow switch is always mounted on an horizontal water pipe with constant diameter at a distance at least 5 d to 10 d (where d is the corresponding water pipe diameter) from the next or after the last pipe bend or vane, but distanced not more than 5 m from the chiller's outlet, in order to assure the best possible laminar flow around it.
Free space around the FS is necessary for maintenance or replacement.

Adjustment of the FS.
The flow switch should be activated if the designed flow rate is reduced by 40%. Under this limit the FS should stop the compressor, otherwise the reduced water volume will be cooled down to a very low temperature and may be freezed, causing a fracture to the water-refrigerant heat exchanger. This would cause entry of the water into the refrigerant circuit and, consequently, would destroy the compressors.

3.5.4. Water accumulator

This is necessary to avoid frequent start / stop of the compressors if the water volume of the installation is less than required (see following relevant table 3).

3.5.5. Immersion Thermometers

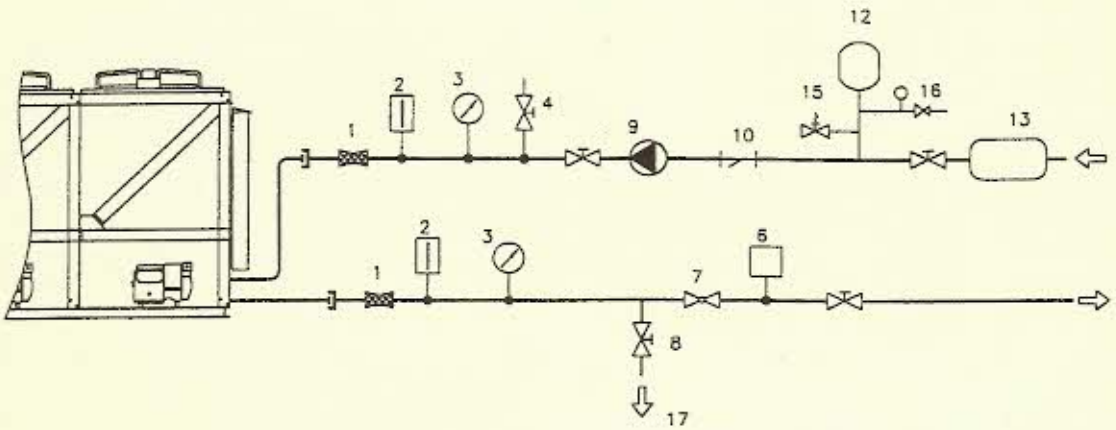
For cooling required scale : 0 °C - 30 °C.
Length of the sensor's probe inside the pipe should be equal to d/2, where d corresponding pipe diameter.

3.5.6. Water pressure manometers

Working scale 0 - 5 bar.

3.5.7. Other components

As shown on the relevant figure 5.



* 1. Anti-vibrators
2. Flexible connectors
3. Thermometer
4. Pressure gauge
5. Air vent
6. Flow switch
7. Flow control valve
8. Shut-off valve
9. Water pump
10. Strainer
12. Expansion tank
13. Water accumulator
15. Pressure safety valve
16. Pressure reducing device connected to water supply
17. Drain

Note

*(1.) They are necessary only when the installer uses extra anti-vibration mountings for the unit.

Figure 5

Water circuit diagram
(All indicated equipment to be installed by the contractor)

Table 2 : Water Pressure Drop through FAWC SH Units

MODEL	FAWC-SH		2070	2080	2100	2120	2150	3150	3180	4200	4240	4300
WATER FLOW RATE	MINIMUM	(m^3/h)	20	22,2	27,1	32	35,5	41	49	54,3	65,2	71
	NOMINAL	(m^3/h)	31	35,6	43,4	51	56,7	65,4	78,1	86,8	104,2	113
	MAXIMUM	(m^3/h)	38	43	65	68	70	100	100	105	140	148
Water pressure drop *		(bar)	0,3	0,41	0,45	0,51	0,53	0,70	0,79	0,83	0,47	0,50

*** For the Nominal Flow Rate**

Table 3 : Minimum required water volume

MODEL FAWC-SH	2070	2080	2100	2120	2150	3150	3180	4200	4240	4300
Water Volume (lit)	1300	1400	1500	1600	1700	1900	2050	2600	2700	3000

Table 4 : Electrical Data for Water Chillers FAWC SH

MODEL	FAWC - SH	2070	2080	2100	2120	2150	3150	3180	4200	4240	4300
POWER SUPPLY		400 V / 3 Ph / 50 Hz + N + GROUND									
COMPRESSORS POWER SUPPLY		400 V / 3 Ph / 50 Hz									
STARTING METHOD		IN 4 STEPS					IN 6 STEPS		IN 8 STEPS		
STARTING CURRENT	(A)	140	170	230	230	320	230	230	230	230	320
NOMINAL RUNNING CURRENT	(A)	113	140	170	200	210	255	300	340	400	420
FAN MOTORS POWER SUPPLY		400 V / 3 Ph / 50 Hz									
NOMINAL RUNNING CURRENT	(A)	4 x 3,2	4 x 3,2	4 x 3,2	6 x 3,2	4 x 3,2	6 x 3,2	6 x 3,2	8 x 3,2	8 x 3,2	8 x 3,2
FUSE	(A)	2 x 16	2 x 16	2 x 16	2 x 16	2 x 16	2 x 16	2 x 16	2 x 16	2 x 16	2 x 16
CONTROL CIRCUIT FUSE	(A)	10	10	10	10	10	10	10	10	10	10

3.6. ELECTRICAL WIRING

- The 3-phase electrical switch board of the unit is weatherproof (IP 54) and should be cabled to the mains through an external isolator switch (provided by the contractor).
  Electrical data Table 4 (page 17) gives starting and operating current for all sizes and types.
- Water pump, flow switch and remote control wiring according to the electrical connections diagram (*Figure 6*): Respective cable size : min . 0,75 mm^2.
- Sizing of phase lines should correspond to normal operating current, referred to the name plate of the unit, but taking into account the local regulations.
- Neutral line should be minimum 2,5 mm^2.
- Fuses sizing should be done according to local regulations.
- It is advisable to use copper cables, because other material (i.e. Aluminium) could cause galvanic corrosion of the terminal.
- All cable connections made at site should be securely fastened after cleaning carefully cables contact surfaces.

By taking these precautions, sparks, that could destroy cables and terminals, can be avoided.

AIRCOOLED WATER CHILLERS FAWC SH

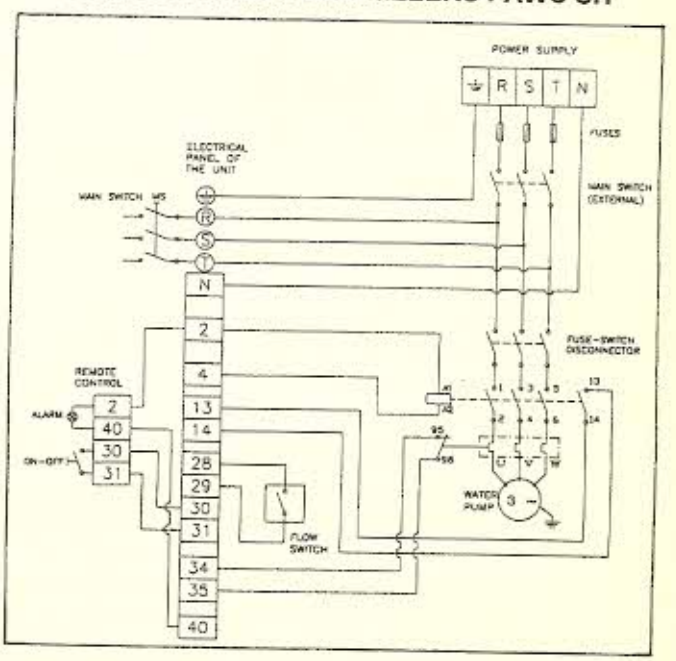


Figure 6 : Electrical Diagram (with Remote Control)

3.7. GENERAL CHECK-UP BEFORE THE START-UP

WARNING
This work should be done in cooperation with an authorised electrician.

The following check-outs should be done:

- Water circuit (should be filled-out and air-vented)
- Rotational direction of Pump's motor check. (The pump should discharge to the unit. If not, interchange 2 phases after switching off the electric supply to the pump).
- Pump operation for at least 3 hours with the chiller off.
- "Pressure drop through the unit" measurement while it is off. Compare with opposite Diagram's corresponding value.
- Filter's cleaning after this initial 3 hrs operation of the pump (with the unit OFF).
- Flow switch on-off check. When water pump operates the contact of the flow switch must be closed.
- Concluding electrical wiring, the following checks should be carried out:
  - Electrical connections to be securely fastened.
  - Remote control to be in OFF position.
  - Voltage supply though the external isolator switch.
  - Compressor's crankcase electrical heater to be ON at least 12 hrs prior to start-up, so all refrigerant is evaporated from the crankcase before start-up, and therefore compressor's oiling is as expected. The indicating lamp CRANKCASE HEATER must light.
  - Phase asymmetry / under voltage relay to be OFF. Otherwise :
    - Measure the 3 phases voltages. If there is asymmetry, contact utilities company.
    - Check electrical connections and fasten any loose contact.
    - If the problem remains after all these actions, replace the relay.
  - Refrigerant's pressure indication on the units manometers should not be zero. Otherwise contact FYROGENIS distributor.

3.8. FIRST START-UP

This could take place after 12 hrs of crankcase heating time. Manual contact with this part of the compressor would confirm or not that the crankcase outer surface is hot or not. If no, postpone 1st start-up for 12 hrs while heating the crankcase. If yes, proceed with the start-up, provided that the cooling load is at least 50% of the nominal, as follows:

- Turn the ON-OFF switch on the remote control to ON position.
- As soon as preset time delay elapses, the 1st compressor should start running smoothly (followed by the others) together with the first basic group of the fans. The remaining fans high group will start when refrigerant's high pressure exceeds intermediate preset limit (17 bar). *Figure 7.*

WARNING
Immediately after, the start-up FLOW SWITCH control should follow by shutting off a gate valve of the water circuit. The FS should turn OFF the unit immediately, before even the gate valve is completely closed.
To restart, open again this gate valve and make RESET (clear) on the microprocessor control (see page 5). The unit should start running after the time delay elapses again.

Twenty minutes (20 min) after the start-up, proceed as follows:

- Check high and low refrigerant pressures. These should be within the ranges given in the relevant Table 1.
- Check inlet/outlet water pressure. This will confirm that water cooling is on.
- Check / adjustment of operation thermostat (controls the inlet water temperature).
  Factory adjustment : 11,5 °C for a single circuit unit.
  10,5 °C for 2-circuit units.
- Check / adjustment of water flow : Water inlet/outlet temperature difference should be 4°C - 6°C. If greater, increase w.f.
  For inlet water temperature, readout see Microprocessor's User's Manual.
- Check water pressure drop : The Δp within the heat exchange can be calculated Δp(mWG) = Pin - Pout (mWG) using water manometer in/out installed by the contractor. This Δp should be within the range given in the corresponding diagram of this manual.

If problems arise during these checks, please consult Troubleshooting Section of this manual.

FANS QUANTITY	SIZES	FANS GROUPS
4	FAWC SH 2070, 2080, 2100, 2120	● ● / ○ ○
6	FAWC SH 2150	● ● ● / ○ ● ○
6	FAWC SH 3150, 3180	○ ○ ○ / ● ● ●
8	FAWC SH 4200, 4240	○ ○ ○ ○ / ● ● ● ●
12	FAWC SH 4300	○ ● ○ ○ ● ○ / ● ● ● ● ● ●

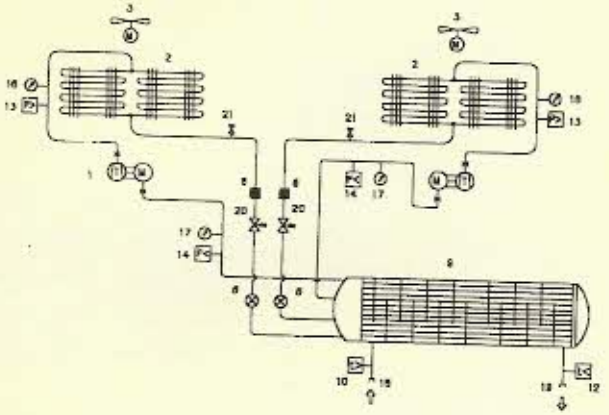
● Basic Fans Group (H.P. < 17 bar) ○ High Pressure Fans Group (H.P. > 17 bar)

Figure 7: *Fans operation in groups*

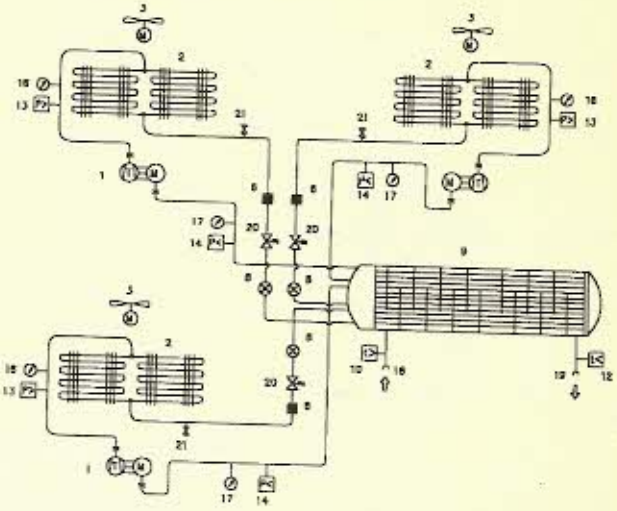
APPENDIX

REFRIGERANT DIAGRAMS

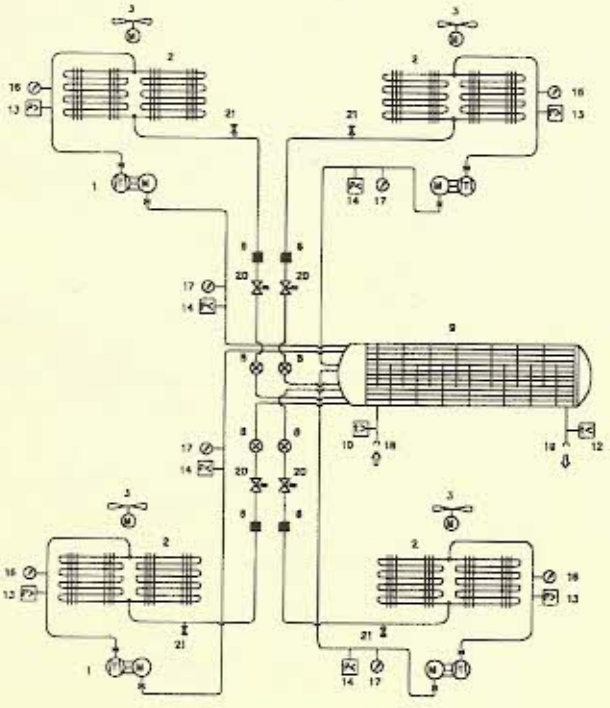
FAWC SH 2070 - 2080 - 2100 - 2120 - 2150



FAWC SH 3150 - 3180



FAWC SH 4200 - 4240 - 4300

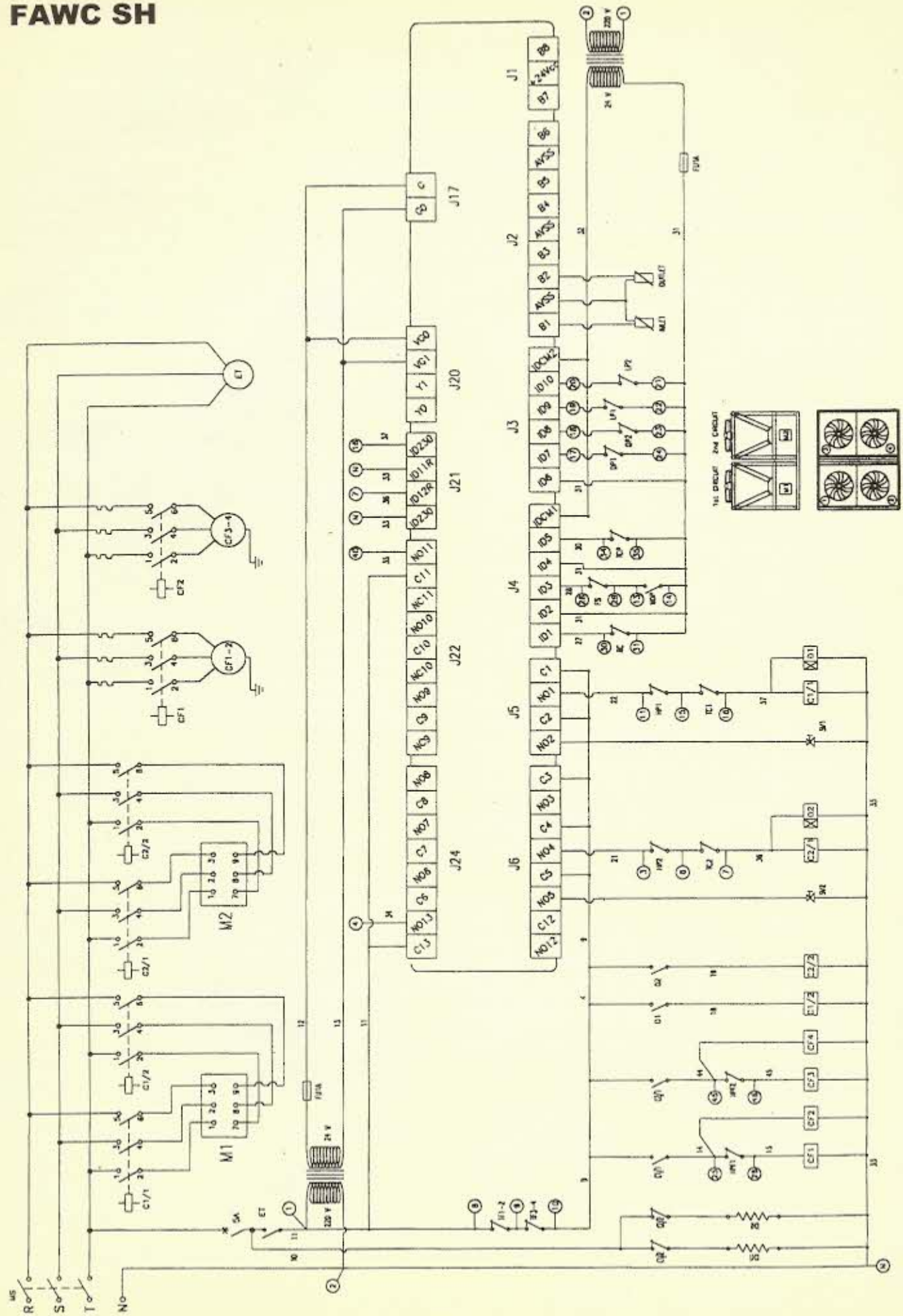


Legends

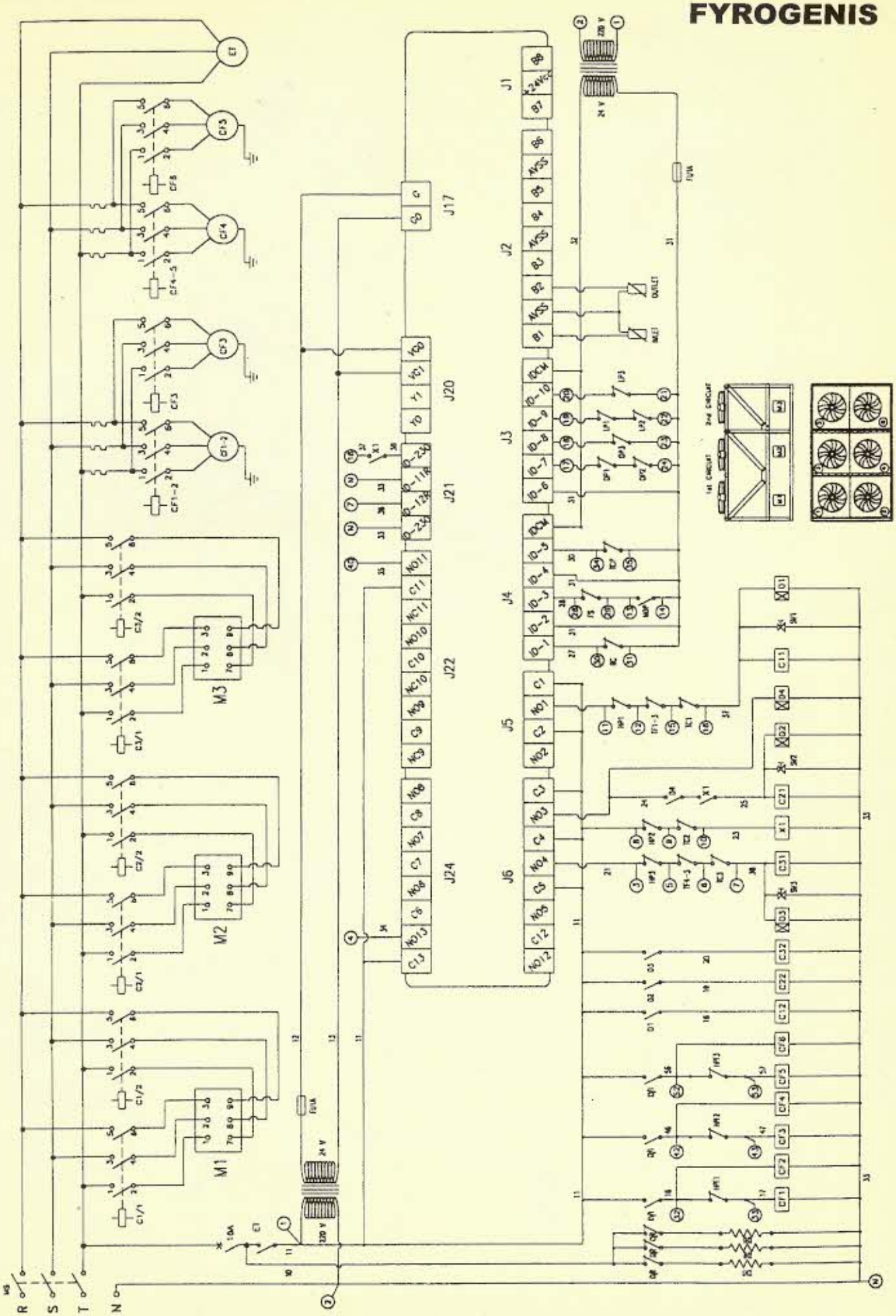
1. Compressor
2. Condenser
3. Fan
6. Filter-Drier
8. Expansion valve
9. Evaporator
10. Cooling operation thermostat
12. Freeze-up protection
13. High pressure switch
14. Low pressure switch
16. High pressure gauge
17. Low pressure gauge
18. Water inlet
19. Water outlet
20. Solenoid valve
21. Overpressure safety valve
22. Oil pressure switch

FAWC SH

ELECTRICAL CIRCUIT FAWC 2070 - 2150 SH



ELECTRICAL CIRCUIT FAWC 3150 - 3180 SH



ELECTRICAL CIRCUIT FAWC 4200 - 4300 SH