Carrier s.a.

Carrier

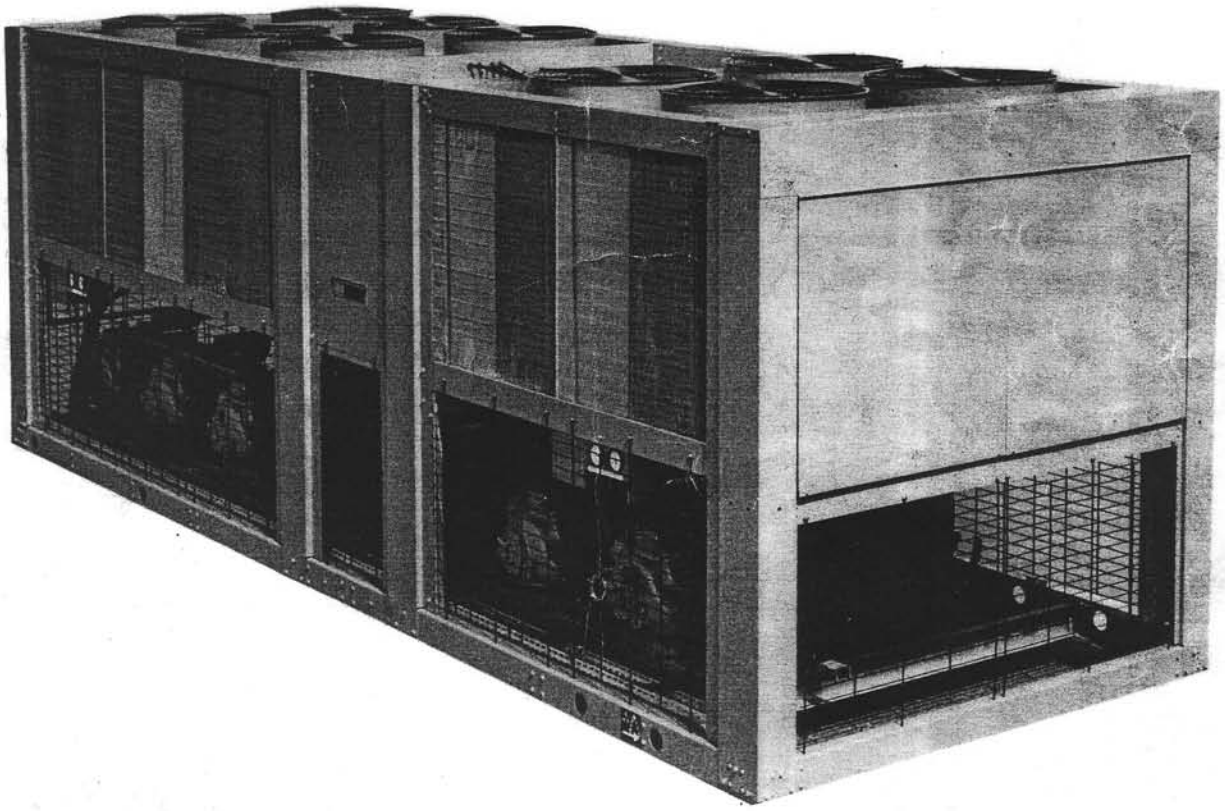
Subsidiary of Carrier Corporation

30GF 085-240

Reciprocating Flotronic liquid chillers

50 Hz

Installation, operation and maintenance instructions



30GF 155 SHOWN

QUALITY ASSURANCE

CERTIFICAT N° 1989/029

AFAQ

ASSOCIATION FRANÇAISE POUR L'ASSURANCE DE LA QUALITÉ

ISO 9001 Lloyd's Quality Assured Firm

NATIONAL ACCREDITATION OF CERTIFICATION BODIES

APPROVALS
BS 5750 Part 1
NFX 50131
ISO 9001

LIST OF CONTENTS

Important : *This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with these instructions may cause radio interference. It has been tested and found to comply with the limits of a Class A computing device as defined by FCC regulations, Subpart J of Part 15, which are designed to provide reasonable protection against such interference when operated in a commercial environment.*

SAFETY CONSIDERATIONS

Installation, start-up and servicing of this equipment can be hazardous due to system pressures, electrical components and equipment location (roofs, elevated structures, etc.).

Only trained, qualified installers and service mechanics should install, start-up and service this equipment.

Untrained personnel can perform basic maintenance functions of cleaning coils. All other operations should be performed by trained service personnel.

When working on the equipment, observe precautions in the literature, tags, stickers and labels attached to the equipment and any other safety precautions that apply.

- Follow all safety codes.
- Wear safety glasses and work gloves.
- Use care in handling, rigging and setting bulky equipment.

ELECTRIC SHOCK HAZARD.

Open all remote disconnects before servicing this equipment.

INTRODUCTION

These instructions cover installation, start-up and service of 30GF 085-240 Flotronic liquid chillers with electronic controls and units with factory-installed options (FIOP).

Chillers are equipped with electronic expansion valves and FIOP units have the conventional thermostatic expansion valves and liquid line solenoid valves. Differences in Quick Test procedures and operation sequence should be carefully noted when following these instructions.

INSTALLATION

Step 1 – Rig and Place the Unit – These units are designed for overhead rigging and **it is important that this method be used.** Holes are provided in the frame base channels, marked for rigging (see rigging label on unit). It is recommended that field-supplied pipes be passed through these holes, extending beyond the frame enough to attach cables or chains on both sides. Use spreader bars or frame to keep cables or chains clear of the unit sides. As a further precaution, sheets of plywood placed along the coils will provide additional protection.

Caution : *Do not use forklift on these units.*

For shipping, the unit is mounted on wood rails which are under the lengthwise members of the frame base. These can be removed before the unit is moved to the installation area. **Lift from above to remove rails.**

If overhead equipment is not available, the unit can be moved on rollers or skidded. When unit is moved on rollers, the shipping rails must be removed. To lift the unit, use jacks at the rigging points. Use a minimum of 3 rollers to distribute the load. If unit is to be skidded, lift as prescribed above and place a pad under the base. **When dragging, apply force to the pad, not the unit.**

The placement area must be level and strong enough to support the operating weight of the unit (see table 1). Unit must have clearances as listed in fig. 1, 2, 3, 4 and 5. When in final position, level the unit with a spirit level and bolt at points shown.

Step 2 – Check Compressor Mounting – In each circuit, the compressors are mounted on a double-rail base. Each rail is mounted on springs, one at each end and one between each 2 compressors. For shipping, the rails are secured to the frame base at each support. **At installation, remove the screw at each mounting spring to be sure that the compressor-rail assembly floats freely on the springs.**

Step 3 – Make Chiller Water and Drain Piping Connections –When facing the cooler side of unit, the inlet (return) chilled water connection is at the right (nearest to the main control box) and the leaving (supply) water connection is at the left. At installation, holes must be cut in the metal screen for field piping and insulation.

To isolate the cooler for servicing, shutoff valves should be installed in the leaving and return chilled water lines as near the cooler as possible. At the highest point in the chilled water circuit, install an air-trap vent.

After field piping has been completed, all piping that is exposed to low ambient temperature should be wrapped with electric heating tape with a rating suitable for the area ambients, and covered with a suitable thickness of closed cell insulation. Bring the power for the heating tape(s) from a separate fused disconnect. Identify the disconnect as the power source for the pipe heater(s), with emphasis that it must never be turned off except when the unit is being serviced.

A drain connection is located at the leaving-water end of the cooler (see fig. 1, 2, 3, 4 and 5).

Water Treatment

If the unit is on year-round operation, add sufficient ethylene glycol to the chilled water to prevent freezing under the operating ambient conditions.

Consult the local water authority on the characteristics of the area water and add a recommended inhibitor to the chilled water.

Preparation for Winter

Do not shut off control power disconnect during off-season shutdown.

At the end of the cooling season, drain the water from the system. Replace the drain plug and put 8 liters (2 gallons) of ethylene glycol in the cooler to prevent freezing of residual water. Remove the plug on top of the leaving chilled water nozzle to add the glycol. At the beginning of the next cooling season, refill the cooler and add the recommended inhibitor.

If the unit is on year-round operation, add sufficient ethylene glycol to the chilled water system to prevent freezing under the operating ambient conditions.

Step 4 – Make Electrical Connections –

Power Supply

Electrical characteristics of available power supply must agree with unit nameplate rating. Supply voltage must be within the limits shown in table 3. Operation of unit on improper supply voltage or with excessive phase imbalance constitutes abuse and is not covered by warranty.

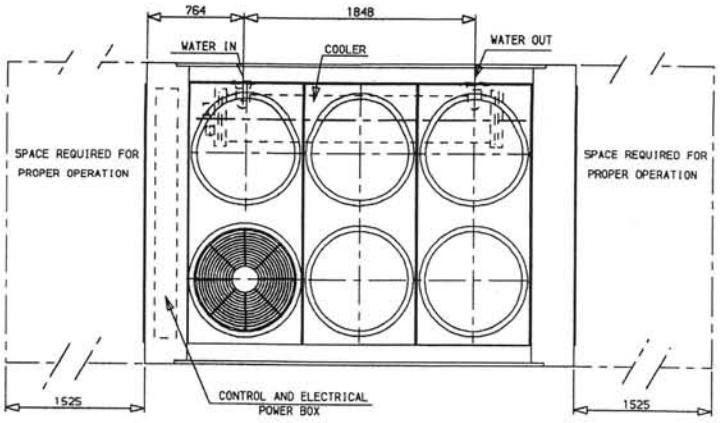
Field Power Connections

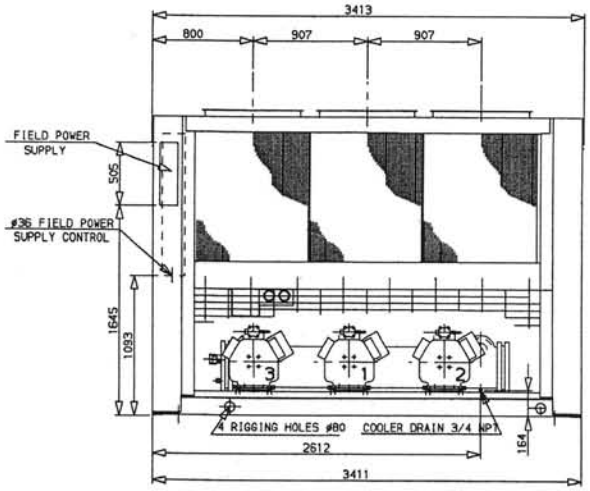
All field power wiring must comply with applicable local and national codes. Install field-supplied branch circuit disconnects of a type that can be locked OFF or OPEN. Disconnects must be located within sight of and readily accessible from the unit in compliance with local codes.

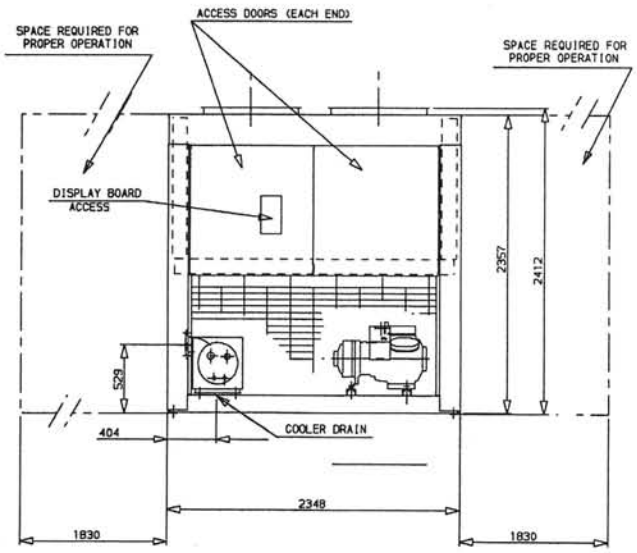
All power enters the unit thru the main control box (left end when unit is viewied facing the compressors). Entrance into the unit is thru adaptation hole located in the corner post (see fig. 1 to 5 for details).

30GF 085 through 155 units have a single point power connection and larger 30GF 180 through 240 units have 2 power supply entrances and connections (as indicated on figures 4 and 5).

DIMENSIONS 30 GF 085-095





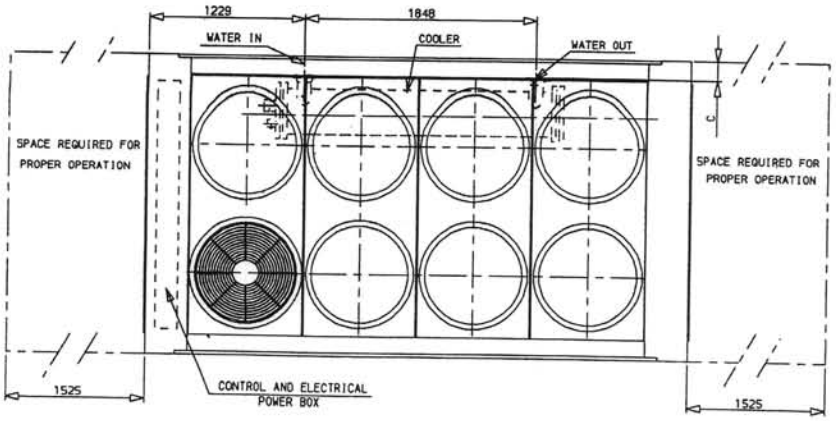


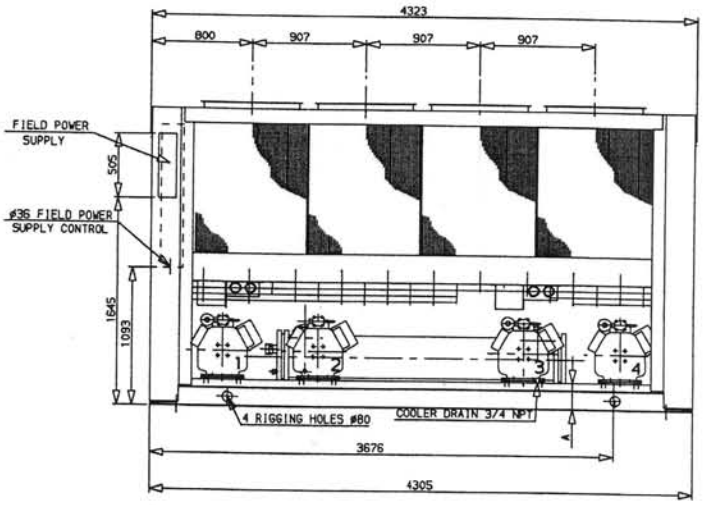
Notes :

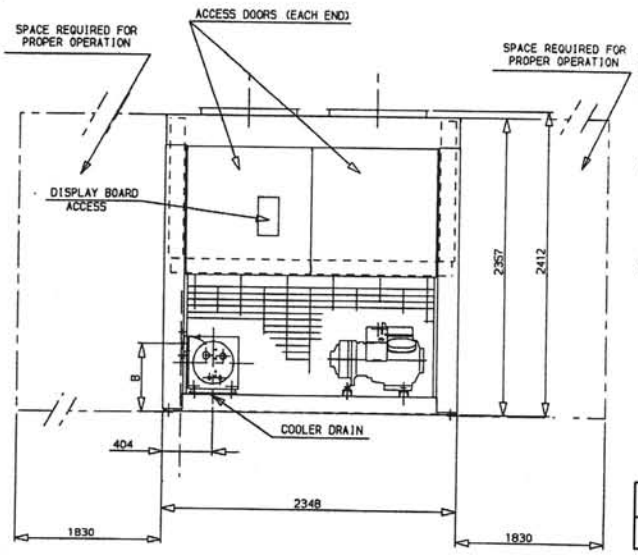
1. The approximate operating weight of the unit is :
   30 GF 085 – 2975 kg
   30 GF 095 – 3030 kg
2. Unit must have clearances as follows :
   Top-Do not restrict in any way
   Ends-1524 MM
   Sides-1829 MM
3. 4" Flat face welding neck flange as per PN 16 DN 150 NFE 29223 220 O.D. x 107.1 I.D. x 20 thick completed with (8)-18 dia. holes on 180 bolt centre.

Note : Use only current drawings, available from your Carrier distributor, when designing an installation.

DIMENSIONS 30GF 105-120







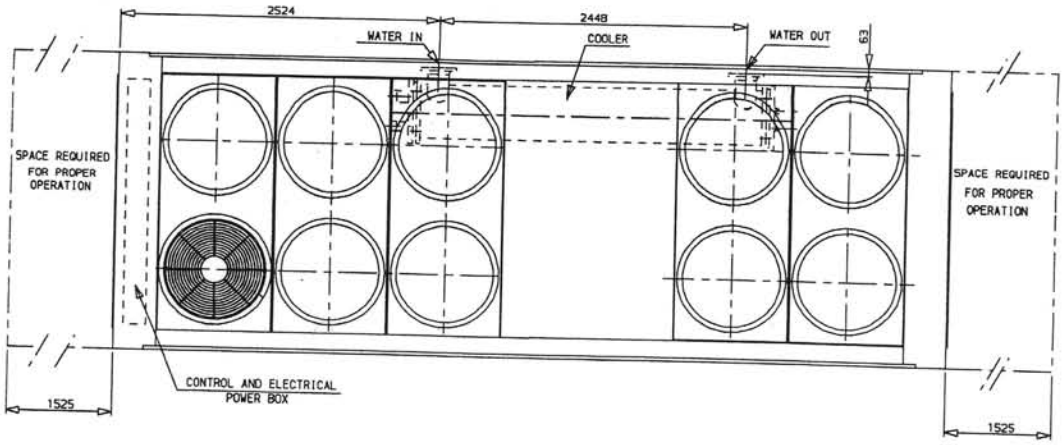
Notes :

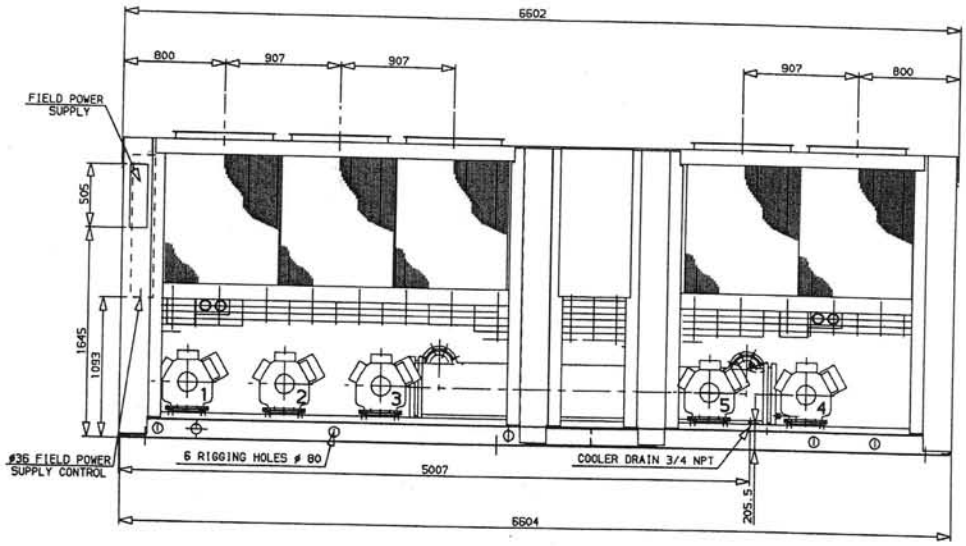
1. The approximate operating weight of the unit is :
   30 GF 105 - 3370 kg
   30 GF 120 - 3780 kg
2. Unit must have clearances as follows :
   Top-Do not restrict in any way
   Ends-1524 MM
   Sides-1829 MM
3. 4"-(GF 105) / 5"-(GF 120) Flat face welding neck flange as per PN 16 DN 100 (GF 105) NFE 29223 / DN 125 (GF 120) NFE 29223
   220 O.D. x 107.1 I.D. x 20 (GF 105) thick completed with
   (8) dia. holes on 180 (GF 105) / 210 (GF 120) bolt centre

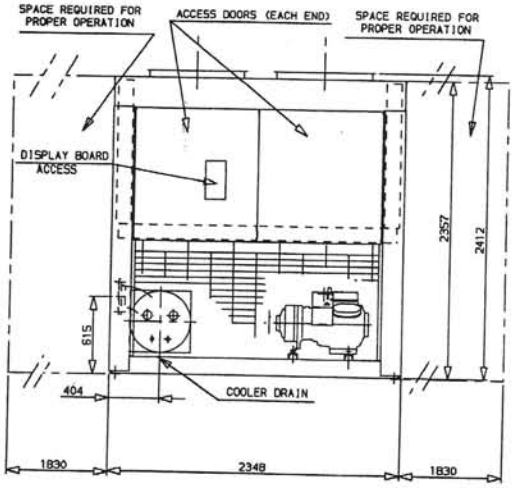
	A	B	C	D
GF 105	1065 MM	164 MM	529 MM	145 MM
GF 120	1125 MM	162 MM	608 MM	88 MM

Note : Use only current drawings, available from your Carrier distributor, when designing an installation.

DIMENSIONS 30GF 145-155





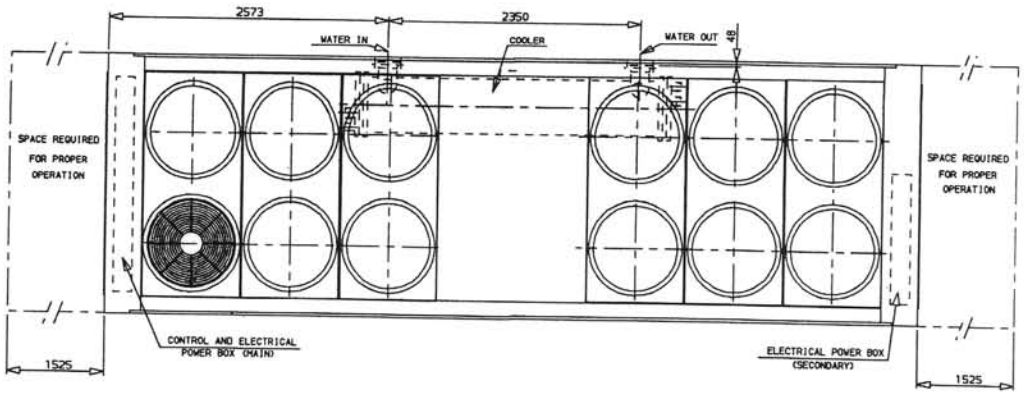


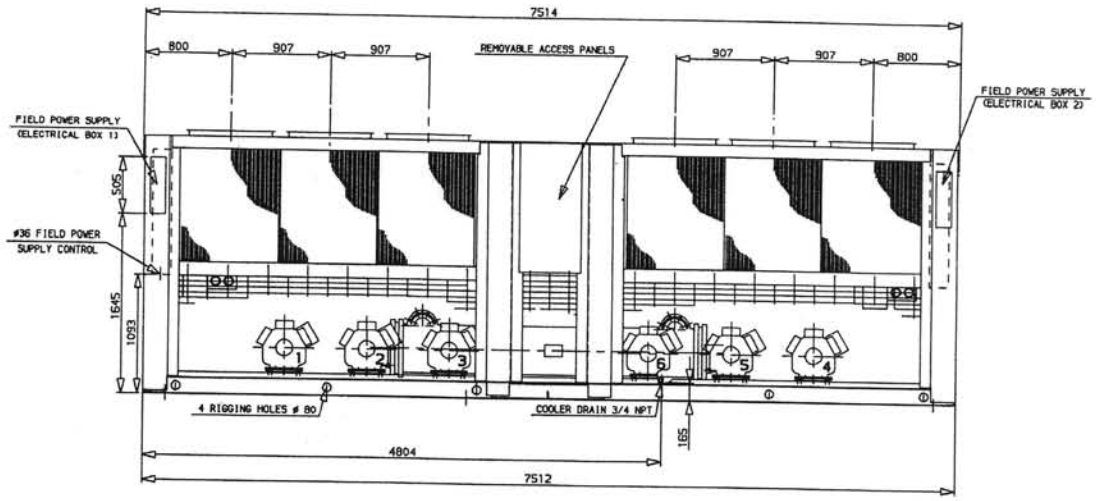
Notes :

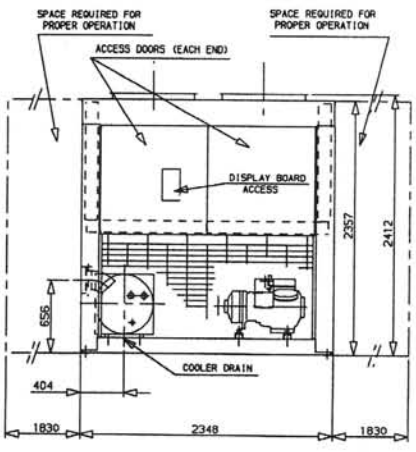
1. The approximate operating weight of the unit is :
   30GF 145 – 4848 kg
   30GF 155 – 4868 kg
2. Unit must have clearances as follows :
   Top-Do not restrict in any way
   Ends - 1525 MM
   Sides - 1829 MM
3. 6" Flat face welding neck flange as per PN 16 DN 150 NFE 29223 285 O.D. x 159 I.D. x 22 thick completed with (8)-22 dia. holes on 240 bolt centre.

Note : Use only current drawings, available from your Carrier distributor, when designing an installation.

DIMENSIONS 30GF 180





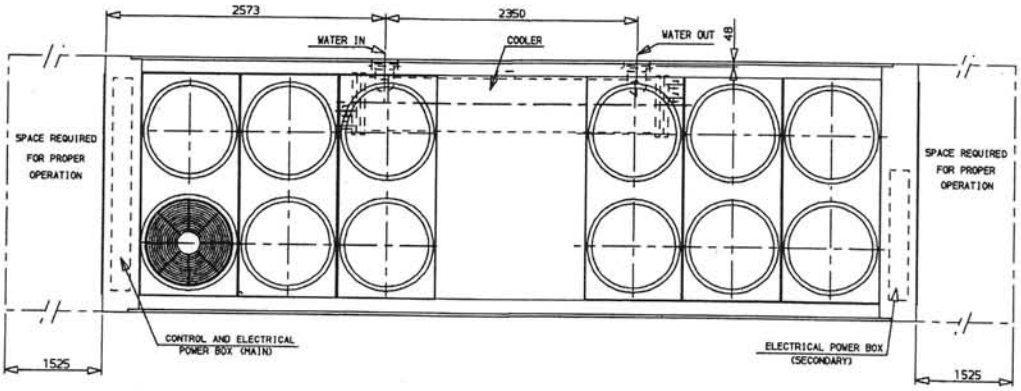


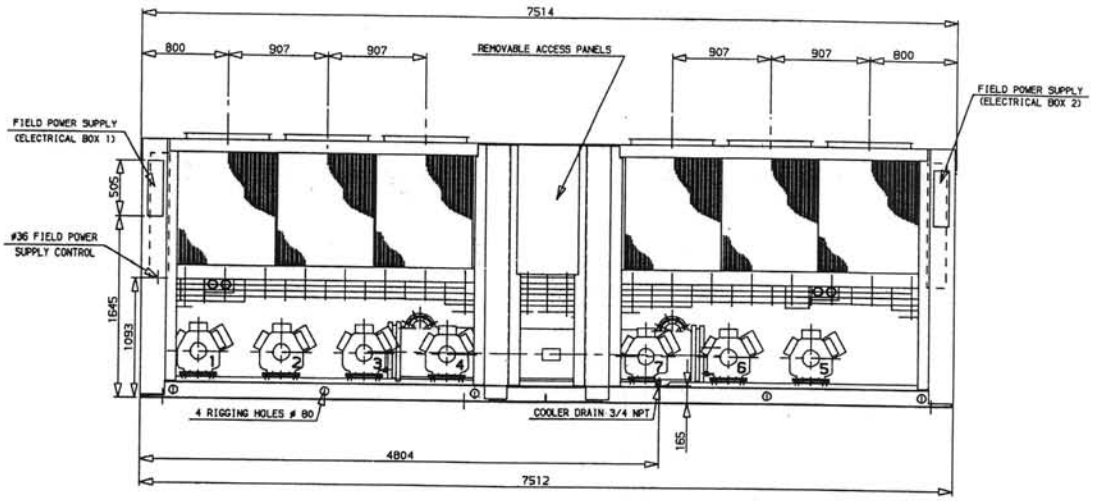
Notes :

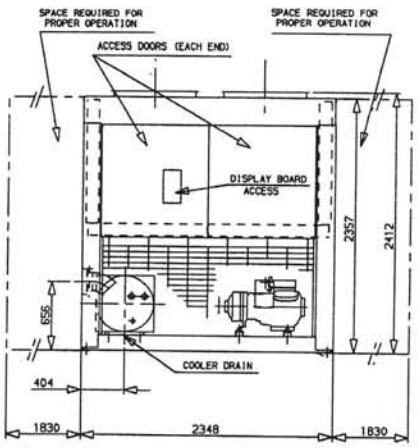
1. The approximate operating weight of the unit is :
   30 GF 180 - 6030 kg
   30 GF 195 - 6278 kg
   30 GF 220 - 6528 kg
2. Unit must have clearances as follows :
   Top-Do not restrict in any way
   Ends-1524 MM
   Sides-1829 MM
3. 6" Flat face welding neck flange as per PN 16 DN 150 NFE 29223 285 O.D. x 159 I.D. x 22 thick completed with (8)-22 dia. holes on 240 bolt centre.

Note : Use only current drawings, available from your Carrier distributor, when designing an installation.

DIMENSIONS 30 GF-195





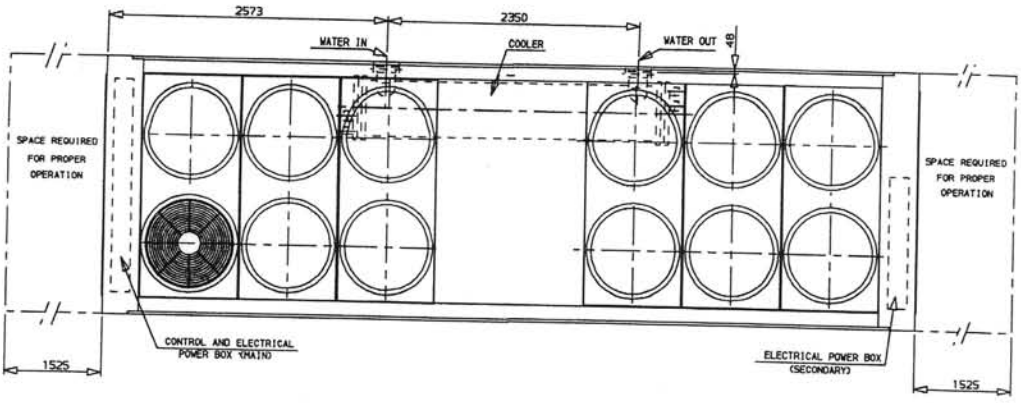


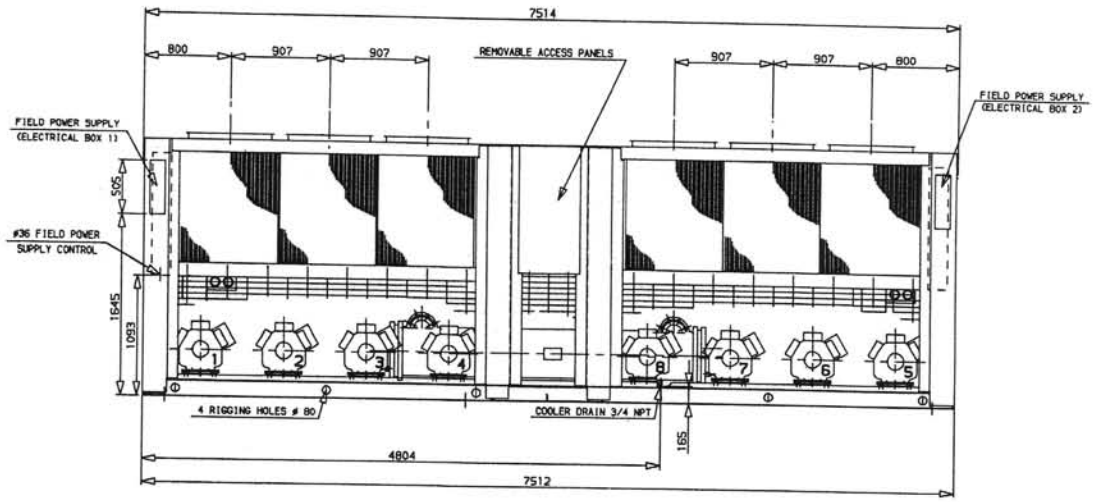
Notes :

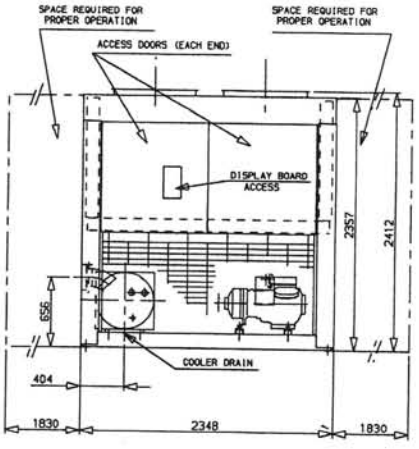
1. The approximate operating weight of the unit is :
   30GF 145 – 4848 kg
   30GF 155 – 4868 kg
2. Unit must have clearances as follows :
   Top-Do not restrict in any way
   Ends - 1525 MM
   Sides - 1829 MM
3. 6" Flat face welding neck flange as per PN 16 DN 150 NFE 29223 285 O.D. x 159 I.D. x 22 thick completed with (8)-22 dia. holes on 240 bolt centre.

Note : Use only current drawings, available from your Carrier distributor, when designing an installation.

DIMENSIONS 30 GF-220





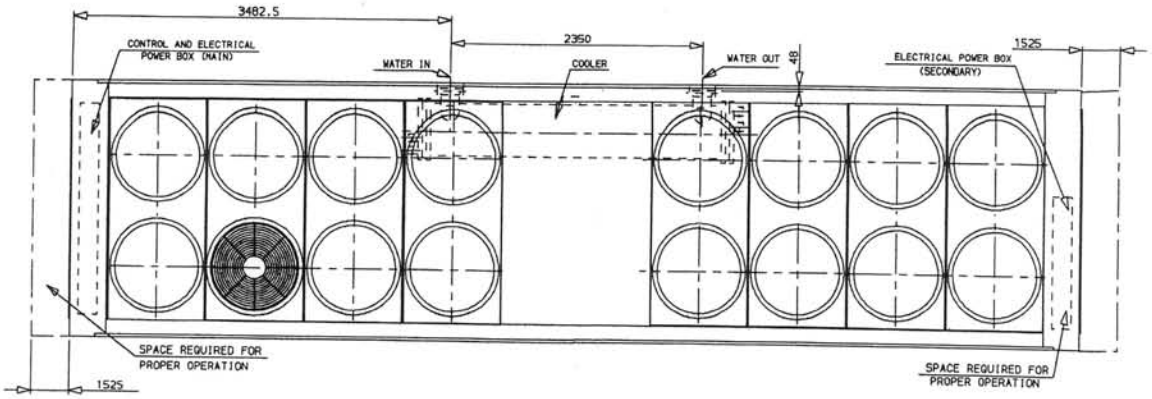


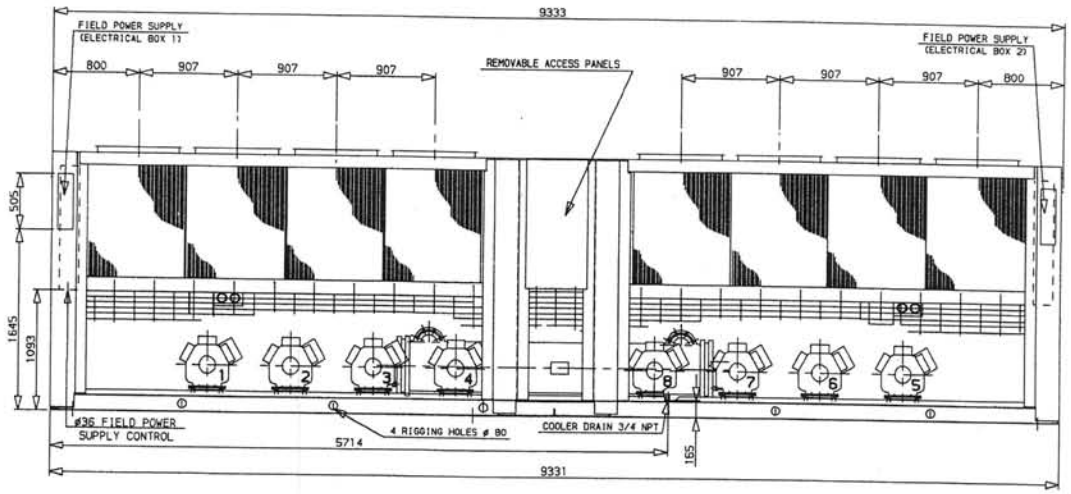
Notes :

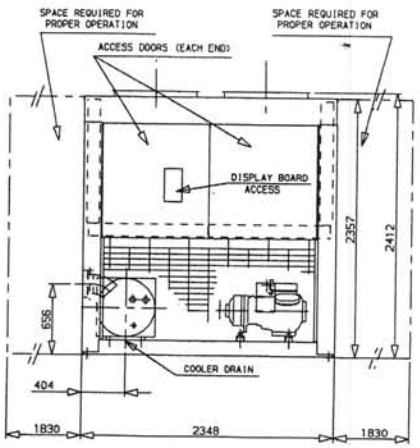
1. The approximate operating weight of the unit is :
   30GF 145 – 4848 kg
   30GF 155 – 4868 kg
2. Unit must have clearances as follows :
   Top-Do not restrict in any way
   Ends - 1525 MM
   Sides - 1829 MM
3. 6" Flat face welding neck flange as per PN 16 DN 150 NFE 29223 285 O.D. x 159 I.D. x 22 thick completed with (8)-22 dia. holes on 240 bolt centre.

Note : Use only current drawings, available from your Carrier distributor, when designing an installation.

DIMENSIONS 30 GF 240







Notes :

1. The approximate operating weight of the unit is :
   30 GF 240 - 7830 kg
2. Unit must have clearances as follows :
   Top-Do not restrict in any way
   Ends-1524 MM
   Sides-1829 MM
3. 6" Flat face welding neck flange as per PN 16 DN 150 NFE 29223
   285 O.D. x 159 I.D. x 22 thick completed with (8)-22 dia. holes
   on 240 bolt centre.

Note : Use only current drawings, available from your Carrier distributor, when designing an installation.

PHYSICAL DATA

Model 30GF			085	095	105	120	145	155	180	195	220	240
Nominal Capacity*		kW	272.6	313.7	360.1	409.7	482.8	522.6	604.9	685.1	750.8	796.2
Operating Weight		kg	2975	3030	3370	3780	4850	4870	6030	6280	6530	7830
Refrigerant Charge**												
Ckt1. Total/O.C.G. ***		kg	50.0/4.5	53.0/4.5	50.0/4.5	59.0/9	77.1/6.8	77.1/6.8	104.3/15.9	104.3/15.9	104.3/15.9	108.0/16.4
Ckt2. Total/O.C.G.		kg	32.0/9.1	32.0/9.1	50.0/4.5	59.0/9	54.4/6.8	54.4/6.8	104.3/15.9	104.3/15.9	104.3/15.9	108.0/16.4
Compressor****			06E Reciprocating, Semi-hermetic, 24.2 r/s ; 1450 rpm									
N°... Model	Ckt.1		1...6275	1...6299	1...F275	2...F299	1...F275	3...F299	1...F275	1...F275	1...F275	4...F299
			1...F299	1...F299	1...F299	–	2...F299	–	2...F299	3...F299	3...F299	–
	Ckt.2		1...F275	1...F299	1...F275	2...F299	1...F275	2...F299	1...F275	1...F275	1...F275	4...F299
			–	–	1...F299	–	1...F299	–	2...F299	2...F299	3...F299	–
Capacity Control Steps			See Capacity Control Steps Chart									
% Total Capacity	Ckt.1		70	66.3	50	50	59	60	50	57	50	50
	Ckt.2		30	33.7	50	50	41	40	50	43	50	50
Minimum Step Capacity		%	20.0	22.2	21.5	25	16.7	20	14	12	10	12.5
Oil Charge			4 Cyl. Compressors 6.6 L. 6 Cyl. Compressors 9 L.									
Condenser Fans - Type			Directly Driven, Propeller, 15.5 r/s ; 930 rpm									
Number			6	6	8	8	10	10	12	12	12	16
Diameter		mm	762	762	762	762	762	762	762	762	762	762
Total Air Flow		L/s	28314	28314	37752	37752	47190	47190	56628	56628	56628	75504
Condenser Coils - Type			1/2 in OD Copper Tube, 551 Fins/m ; 14 Fins/in - 3 or 4 Rows per Circuit.									
Face Area	Ckt.1	m^2	7.49	7.49	7.49	7.49	11.24	11.24	11.24	11.24	11.24	14.96
	Ckt.2	m^2	3.74	3.74	7.49	7.49	7.52	7.52	11.24	11.24	11.24	14.96
Cooler - N°...type			One...Direct Expansion, Shell and tube									
Model 10HA			090	090	090	105	160	160	200	200	200	200
N° of refrigerant Ckts.			2	2	2	2	2	2	2	2	2	2
Net Water Volume		L	92	92	92	154	199	199	242	242	242	242
Max. design working pressure												
Refrigerant Side			1800 kPa (261 psig)									
Water Side (Shell)			1000 kPa (145 psig)									
Water connections			NFE 29223 Flat Face Flange									
Inlet, Outlet		in	4	4	4	5	6	6	6	6	6	6
			(	PN16DN100	)	(PN16DN125)	(			PN16DN150		)
Drain (NPT)		in	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4

Notes :

* Nominal capacity is according to ARI 590 - 86 for a condenser dry bulb air entering temperature of 35° and a leaving chilled water temperature of 6.7°C and 6.0°C rise.

** All units use refrigerant R-22.

*** O.C.G. – Over clear glass. Amount of refrigerant added when sight glass shows clear liquid (charging when unit is running).

**** Unloaders : "6" – one
"F" – none

Table 1

PRESSURE LIMITS (kPa)

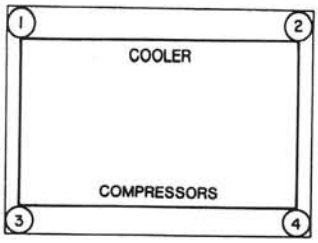
	Refrigerant side (R-22)			Water side (evaporator)	
	Maximum Operating Pressure HP	LP	Test Pressure	Max. Operating Pressure	Test Pressure
SERVICE DES MINES	2950	1600	3200	1000	–
TÜV, German code	2980	1800	2340	1000	1300
TÜV, Austrian code	2980	1800	3000	1000	1500
ISPESL, Italian code	2950	1680	2170	1000	–
SA, Swedish code	2950	1680	2100	1000	1300
TTL, Finnish code	2950	1600	2100	1000	1300
ASME, USA code	3000	1600	2500	1000	–
SAA, Australian code	2950	1600	2400	1000	1500

HP – High pressure (condenser)
LP – Low pressure (evaporator)

Table 2

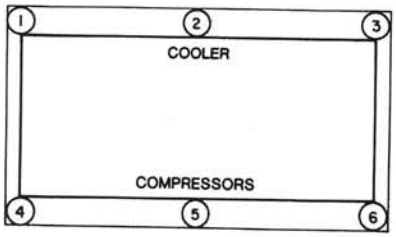
MOUNTING WEIGHTS (APPROXIMATE) KG

30GF 085-240

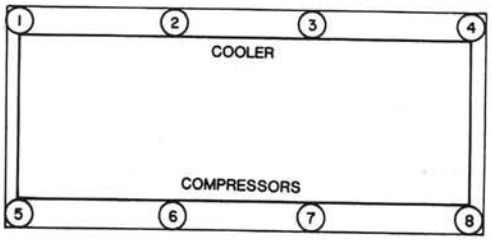


UNIT BASE FRAME*

30GF 085, 095, 105, 120 Support points



30GF 145, 155 Support points



30GF 180, 195, 220, 240 Support points

SUPPORT POINTS	30GF UNIT WITH ALUMINIUM/COPPER CONDENSER COILS									
	085	095	105	120	145	155	180	195	220	240
1	794	808	803	927	627	632	539	585	585	744
2	755	768	803	927	1190	1190	955	973	973	1137
3	733	747	881	964	612	617	955	955	973	1137
4	693	707	881	964	744	749	539	539	585	744
5	–	–	–	–	1055	1055	579	723	723	866
6	–	–	–	–	620	625	941	983	983	1147
7	–	–	–	–	–	–	941	941	983	1147
8	–	–	–	–	–	–	579	579	723	886
TOTAL OPERATING WEIGHT	2975	3030	3368	3782	4848	4868	6028	6278	6528	7828

SUPPORT POINTS	30GF UNIT WITH ALL COPPER FINS AND TUBES CONDENSER COILS									
	085	095	105	120	145	155	180	195	220	240
1	950	964	983	1157	805	810	719	765	765	974
2	914	927	983	1157	1368	1368	1135	1153	1153	1367
3	889	903	1061	1194	790	795	1135	1135	1153	1367
4	852	866	1061	1194	922	927	719	719	765	974
5	–	–	–	–	1233	1233	759	903	903	1116
6	–	–	–	–	798	803	1121	1163	1163	1377
7	–	–	–	–	–	–	1121	1121	1163	1377
8	–	–	–	–	–	–	759	759	903	1116
TOTAL OPERATING WEIGHT	3605	3660	4088	4702	5916	5936	7468	7718	7968	9668

Note :
* see Fig. dimensions (pages 3 through 7) for distances between mounting holes.

Main Power Supply

Conductors for 400 or 230 volt - 3 phase - 50 Hertz units can be copper, copper-clad aluminium or aluminium.

All field power enters unit through the left corner post opening (30GF 085-155) and left and right corner post openings (30GF 180-240) when unit is viewed facing the compressors (see fig. 1-5 for details).

Each power opening is completed with cover plate which must be field cut to match the outside diameters of power cables.

Control Power

A separate single phase power source (230 volts - 1 ph - 50 Hz) must be provided for the control circuit through the factory installed control circuit breaker (CCB), refer to unit wiring diagram for connection details. The control circuit supplies power to the compressor crankcase heaters, cooler heaters and processor board heaters.

The control power entrance into the unit is through a hole of 28,5 mm located below the main electrical box (see fig. 1 to 5).

A switch marked on-off on the control panel (SW on control circuit diagram) allows the control circuit to be manually disconnected without affecting the power to the crankcase heaters, cooler heaters and processor board heaters.

Control circuit power draw includes crankcase heaters at 200 watts each and cooler heaters. 30GF 085 to 120 units have two cooler heaters of 220 watt each and 30GF 145 to 240 have two cooler heaters of 280 watt each.

There are also two electronic board heaters of 40 watts each.

Caution : *Crankcase heaters, cooler heaters and board heaters are wired into the control circuit ahead of control circuit switch (SW) so they are always operational as long as the control circuit breaker (CCB) is on, even if any safety device is open or the control circuit ON-OFF switch is off. Compressor heaters must be on for 24 hours prior to start-up of any compressor.*

Unbalanced 3-Phase Supply Voltage

Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the % voltage imbalance.

% voltage imbalance =

$$100 \times \frac{\text{max. voltage deviation from avg voltage}}{\text{average voltage}}$$

Example : Supply voltage is 400-3-50

AB = 406 volts
BC = 399 volts
AC = 394 volts

$$\text{Average voltage} = \frac{406 + 399 + 394}{3} = \frac{1199}{3}$$

$$= 399{,}7 \quad 400\ \text{V}$$

Determine deviation average voltage :

(AB) = 406 – 400 = 6
(BC) = 400 – 399 = 1
(AC) = 400 – 394 = 6

Maximum deviation is 6 volts.

Determine % voltage imbalance :

$$\% \text{ voltage imbalance is } 100 \times \frac{6}{400} = 1{,}5\%$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable of 2%.

Important : *If the supply voltage phase imbalance is more than 2%, contact your local electric utility company immediately. Allowing the unit to operate with a voltage imbalance in excess of 2% may void the warranty.*

Step 5 – Install Accessories –

Electrical

Several electrical accessories are available to provide the following optional features (for details, refer to the Wiring Diagrams and the Controls and Troubleshooting booklet).

- Demand limit control module.
- Leaving chilled water temperature reset accessory board.
- Sensor kit assembly for outdoor or space temperature reset or chilled water temperature.
- Capacity control accessory electric suction cutoff unloader (not applicable to 30GF 195-240).
- Motormaster head pressure control (requires unit modification for low ambient operation below – 18°C).
- Compressor part winding start.
- Control transformer.
- Remote ON-OFF control

Mechanical protection

- Condenser coil protection grille.

Low ambient operation

- Wind Baffles
  If operating temperatures below 0°C and wind velocity greater than 2.3 m/s are expected , install wind baffles. For details, refer to Operating Limitations section in these instructions.

PRE-START-UP

Do not attempt to start chiller, even momentarily, until the following checks have been completed :

SYSTEM CHECK

1. Check all auxiliary components such as chilled water circulating pump, air handling equipment, or other equipment to which the chiller supplies liquid. Consult the manufacturer's instructions. Auxiliary contacts for chilled water pump starter must be properly interlocked in the control circuit (see Field Wiring Diagrams). Do not use the cooler pump for on-off chiller control without the pump interlock circuitry.
2. Backseat (open) compressor discharge shutoff valves. Close valves one turn to allow pressure to reach test gages.
3. Open liquid line valves.
4. Fill chilled liquid circuit with clean water (with recommended inhibitor added) or other noncorrosive fluid to be cooled. Bleed all air out of high points of system (see Chilled Water Piping). If outdoor temperatures below 0°C are anticipated, sufficient ethylene glycol should be added to the chilled liquid circuit to prevent freezing under those ambient conditions.
5. Check tightness of all electrical connections.
6. Compressor oil should be visible in sight glass. Acceptable oil level is from bottom of sight glass to 3/8 of compressor sight glass (see fig. 8).
7. Electrical power source must agree with unit nameplate rating.
8. Crankcase heaters must be firmly locked into compressors, and must be on for 24 hours prior to start-up.
9. Fan motors are 3 phase. Check rotation during Quick Test. Rotation is clockwise as viewed from top of unit. Reverse 2 power wires to correct rotation - if necessary.
10. Check compressor suspension. The mounting rails must be floating freely on the springs.
11. Perform Quick Test.

QUICK TEST
(Table 4)

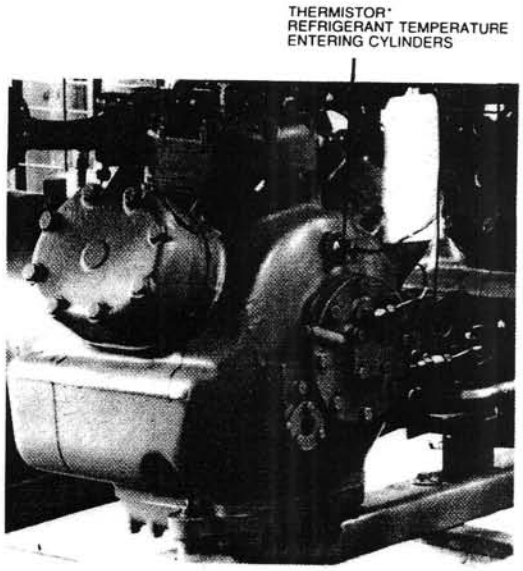
Both main power and control circuit power must be on.

The Quick Test program utilizes the 2-digit LED display (fig. 9) on the set point board to show status of all input and output signals to the microprocessor control. Display action and Quick Test procedure are described as follows :

The Quick Test is a 42-step program that provides a means of checking all input and output signals of the microprocessor control prior to unit start-up. This check ensures that all control options, thermistors and control switches are in proper working order.

To initiate the Quick Test program, first turn the unit control switch (SW) to the ON position. When a **20** appears in the display, immediately press the display button *once*. An **88** will appear in the display and the alarm light will be energized ; this indicates that the microprocessor in the control system is ready to run the Quick Test program.

Important : *Do not allow the unit control circuit to remain energized with **20** showing in the display for more than 2 minutes. If the display button is not pressed within this time, the control will attempt to start the unit.*



*Lead compressor only.

Fig. 8 – Compressor Connections (Lead Compressor Shown)

ELECTRICAL DATA

Model 30GF	Unit							Compressors					Fan motors						Control Circuit
	Volts			Type of start	WSA	ICF	Circuit	N°	Size	FLA each	LRA each	MTA each CB	N°	kW	Ph	FLA each	N° FCB	MTA (FCB)	kW*
	Nameplate V-Ph-Hz	Supplied Min.	Max.																
085	230-3-50	198	264	XL	389	820	–	2 1	275 299	94 133	438 597	126 184	6	10.6	3	5.7	3	22.4	1.12
	400-3-50	342	457	XL	224	473	–	2 1	275 299	54 77	253 345	69 101	6	10.6	3	3.3	2	22.4	1.12
095	230-3-50	198	264	XL	467	897	–	3	299	133	597	184	6	10.6	3	5.7	3	22.4	1.12
	400-3-50	342	457	XL	270	519	–	3	299	77	345	101	6	10.6	3	3.3	2	22.4	1.12
105	230-3-50	198	264	XL	533	963	–	2 2	275 299	94 133	438 597	126 184	8	14.1	3	5.7	4	22.4	1.32
	400-3-50	342	457	XL	308	557	–	2 2	275 299	54 77	253 345	69 101	8	14.1	3	3.3	1 2	14.0 22.4	1.32
120	230-3-50	198	264	XL	611	1042	–	4	299	133	597	184	8	14.1	3	5.7	4	22.4	1.32
	400-3-50	342	457	XL	354	603	–	4	299	77	345	101	8	14.1	3	3.3	1 2	14.0 22.4	1.32
145	230-3-50	198	264	XL	677	1108	–	2 3	275 299	94 133	438 597	126 184	10	17.7	3	5.7	5	22.4	1.64
	400-3-50	342	457	XL	392	641	–	2 3	275 299	54 77	253 345	69 101	10	17.7	3	3.3	2 2	14.0 22.4	1.64
155	230-3-50	198	264	XL	755	1186	–	5	299	133	597	184	10	17.7	3	5.7	5	22.4	1.64
	400-3-50	342	457	XL	438	686	–	5	299	77	345	101	10	17.7	3	3.3	2 2	14.0 22.4	1.64 1.64
180	400-3-50	342	457	XL XL	247 247	496 496	1 2	2 4	275 299	54 77	253 345	69 101	12	21.2	3	3.3	4	22.4	1.84
195	400-3-50	342	457	XL XL	324 247	573 496	1 2	2 5	275 299	54 77	253 345	69 101	12	21.2	3	3.3	4	22.4	2.04
220	400-3-50	342	457	XL XL	324 324	573 573	1 2	2 6	275 299	54 77	253 345	69 101	12	21.2	3	3.3	4	22.4	2.24
240	400-3-50	342	457	XL XL	347 347	602 602	1 2	8	299	77	345	101	16	28.3	3	3.3	4 2	22.4 14.0	2.24

Table 3

CB – Compressor circuit breaker.
FCB – Fan circuit breaker.
FLA – Full load amps.
ICF – Maximum instantaneous current flow during starting (the point in the starting sequence where the sum of the LRA for the starting compressor plus the total FLA for all running motors is maximum).
kW – Condenser fan motor power input.
LRA – Locked rotor amps.
MTA – Must trip amps (compressor circuit breaker or fan circuit breaker).
WSA – Wire sizing amps ; one terminal block per unit (30GF 085-155) and two for 30GF 180-240. To size wires, it is customary to take 125% of the FLA of the largest motor plus 100% of this for the other motors in the unit or circuit for 30GF 180-240.
Ph – Phase.
XL – Across-the-line.

General electrical notes :

1. 30GF 085 through 155 units have a single-point power connection and larger 30GF 180 through 240 units have 2 power supply entrances and connections. Main power must be supplied from a field-supplied fused disconnect.
2. The 230-1-50 control circuit power must be supplied from a separate source, through a field-supplied fused disconnect, unless control circuit power transformer is used.
3. Crankcase and cooler heaters are wired into the control circuit so they are always operable as long as the control circuit breaker is on, even if any safety device is open or the unit ON-OFF circuit breaker is off.

For each step of the 42-step program, the display button must be pressed *twice.* On the first press, the step number is displayed ; the second press initiates the required action and the code as shown in table 4 is displayed.

Note : The step number is a numeral followed by a decimal point (a 2-digit number has a decimal point after *each* numeral). The Action Code Number is one or 2 digits with no decimal point(s).

Important : *Once the Quick Test is initiated, the display button must be pressed at least once every 10 minutes for the control to remain in the Quick Test mode. If the button is not pressed within this time, the control will attempt to start the unit.*

To recheck any step in the Quick Test, the control must be recycled by turning the unit control switch off for a few seconds, then on again. Restart the Quick Test program as described above and proceed through the Quick Test steps. Press the display button *twice* for each step until the step to be rechecked is reached.

The Quick Test program is divided into 3 sections as described below and shown in table 4. For more detailed information ; refer to the Controls and Troubleshooting booklet.

A. Quick Test Steps 1-15 – Unit Configuration – The microprocessor in the unit control system is programmed by 2 switch assemblies located on the processor board (fig. 9). The Configuration header is factory set and cannot be changed in the field. The dip switch assembly contains 8 microswitches that must be set in accordance with various options and accessories selected by the customer. As shipped from the factory, all dip switches except those controlling the pull-down option (switch nº 3) and those controlling compressor unloaders where applicable (switch nº 6 on 30GF 085-095) are in the OFF position. All dip switches should be checked and set to the proper position for options selected during the Quick Test.

Dip switch functions and display codes are shown in fig. 9 and in table 6. Refer to the Controls and Troubleshooting booklet for details.

B. Quick Test Steps 16.-30. – Thermistors and Set Point Potentiometers – In these steps, the microprocessor checks the resistance values of all sensors and set point potentiometers to ensure that they are functional, connected properly and set within the proper range for the unit configuration.

Nominal resistance values for all sensors range from 100.049 to 285 ohms in accordance with table 14. Normal display code for good sensors and potentiometer is **1.** Display code **0** indicates a faulty potentiometer, thermistor or wiring. A **0** display also indicates the option is not being used.

Tables 4 and 7 show set point potentiometer function, location, and Quick Test display codes.

C. Output Relays, Steps 31.-42 – These Quick Test steps allow the microprocessor to check the output signals from the relay boards in the unit control system. In addition, the operation of all condenser fans and compressors is checked at each step.

Normal display code for steps **3.1.** through **3.4.** is **1.** In steps **3.5.** through **4.2.**, each compressor is started and allowed to run for approximately 10 seconds. At start-up, **0** will appear, followed by a **1** in a few seconds. At the end of the 10-second test, code **0** returns to the display, indicating that the test step has been successfully completed. The code **1** indicated that the compressor protection circuit (CPCS) was tested.

Fan and compressor operating sequence for Quick Test steps **3.1.** through **4.2.** are shown in table 4 and table 5.

If Quick Test steps do not operate as described, a defect exists in one or more of the following : relay being tested ; the electronic control ; unit wiring. Refer to the Wiring, Controls and Troubleshooting publication for additional information.

START-UP AND OPERATION

DIGITAL DISPLAY ACTION

The electronic control system uses a 2-digit LED display located on the display set point board (see fig. 9) to show operational information and diagnostic codes.

When the control ON-OFF switch is turned on, the display shows **20** for 2 minutes to indicate the control is in the initialization mode. The Flotron expansion valve will be closed as part of the initialization sequence.

After the 2-minute period, the display turns off and the unit is allowed to start. If the button is pressed after the **20** has been removed from the display, operational status codes or diagnostic information will be shown as long as the button is held in. The code numbers on the display will have the following significance :

CODE NUMBER	OPERATIONAL STATUS
0-12	Capacity stage
20-26	Operational information
51-87	Overload information

Refer to the unit label diagram or the Wiring, Controls and Troubleshooting book.

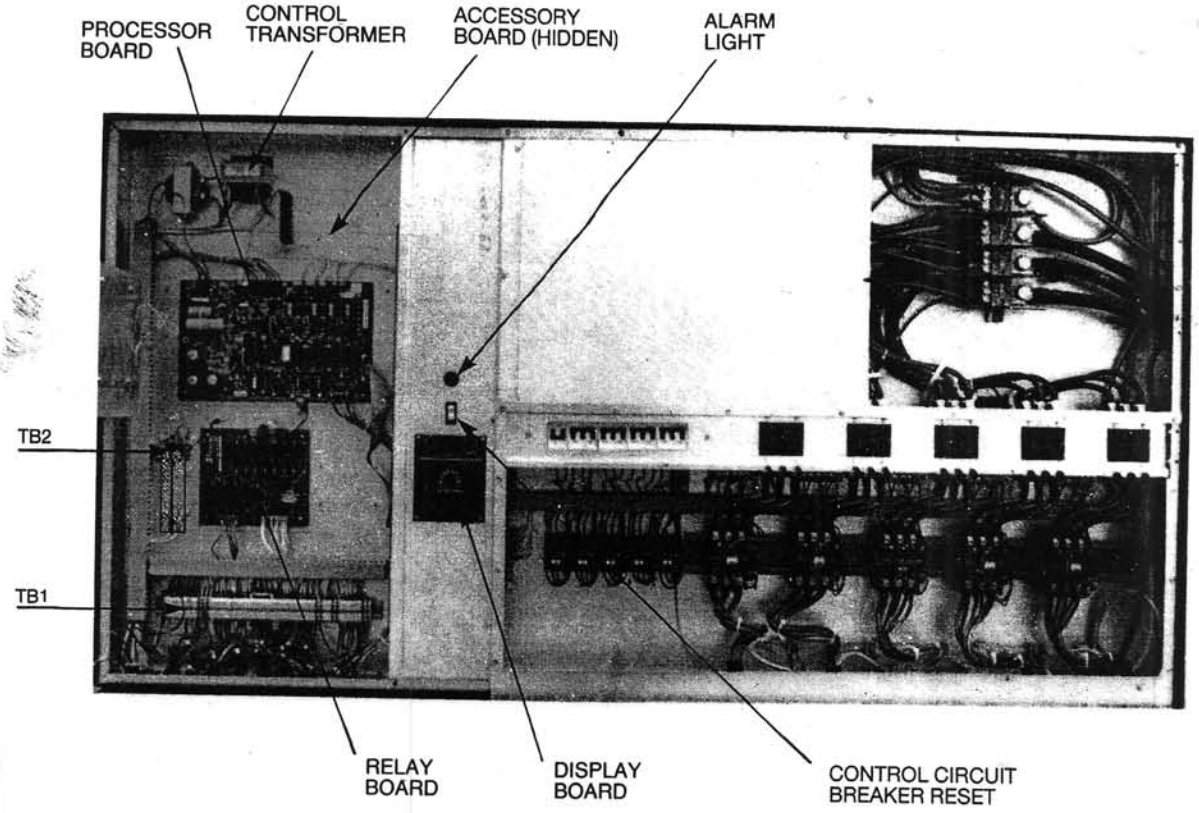
Under normal operation, only the stage number will be displayed. If an operational status code or an overload code is displayed, the display will rotate every 2 seconds and will display up to 3 numbers. Overload information will take priority over all other codes and the alarm light will be energized. The codes will be stored by the microprocessor as long as the board is energized.

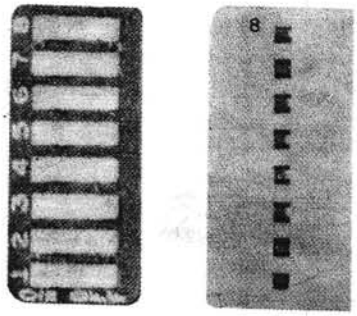
Important : *The memory is cleared when power is removed.*

ACTUAL START-UP

Actual start-up should be done only under supervision of a qualified refrigeration mechanic.

1. Be sure all service valves are open.
2. Set leaving water temperature. No cooling range adjustment is necessary.
3. If accessory board or demand limit accessory are used, set potentiometers. Refer to the Wiring, Controls and Troubleshooting book for details.
4. Turn ON-OFF switch to ON and wait 2 minutes for **20** to be removed from display.
5. Allow unit to operate and confirm that everything is functioning properly. Check to see that the leaving water temperature agrees with the dial setting on the set point board. If the temperature does not agree with the setting, the variation can be compensated by shifting the control point slightly. If temperature reset is used, the actual water temperature may not agree with the leaving water set point.





DIP SWITCH ASSEMBLY

CONFIGURATION HEADER

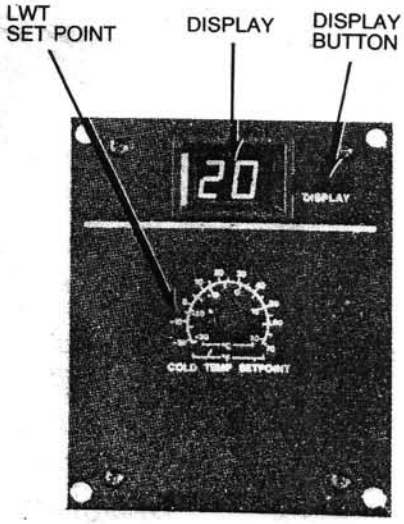


Fig. 9 – Typical Control Box

SECTION A — CONFIGURATION AND SWITCH CHECK

QUICK TEST STEP NO.	NORMAL DISPLAY	STEP DESCRIPTION	CONTROL SWITCH
1	00	Type Unit — Air-Cooled Chiller	Configuration Header
2	2 to 8	Number of Compressors	Configuration Header
3	0 1	Number of Unloaders	Dip Switches 6 and 7
	or 2	0 — Switches 6 and 7 Off	
		1 — Switch 6 On; Switch 7 Off	
		2 — Switch 6 Off; Switch 7 On	
4	0 or 1	0 — Standard Chiller (Switch Off)	Dip Switch 8
		1 – Brine Chiller* (Switch Off)	
5	0 or 1	0 — TXV	Configuration Header
		1 — EXV	
6	50 or 60	50 — 50-Hertz Power	Configuration Header
		60 — 60-Hertz Power	
7	0 or 1	0 — External Reset (Switch Off)	Dip Switch 1
		1 — Return Water Reset (Switch On)	
8	0 or 1	0 — No Reset (Switch Off)	Dip Switch 2
		1 — Reset Used (Switch On)	
9	0 or 1	0 — Pulldown Not Used (Switch Off)	Dip Switch 3
		1 — Pulldown Used (Switch On)	
10	0 or 1	0 — Demand Limit Not Used (Switch Off)	Dip Switch 5
		1 — Demand Limit Used (Switch On)	
11	0 or 1	0 – With Remote On/Off (Switch Open)	S9 Jumper**
		1 – Without Remote On/Off (Switch Closed)	
12	1	1 — Loss-of-Charge Switch Closed	Circuit 1 Loss-of-Charge Switch
		0 — Loss-of-Charge Switch Open	
13	1	1 — Loss-of-Charge Switch Closed	Circuit 2 Loss-of-Charge Switch
		0 — Loss-of-Charge Switch Open	
14	0	1 — Low Oil Pressure Switch Closed	Circuit 1 Low Oil Pressure Switch
		0 — Low Oil Pressure Switch Open	
15	0	1 — Low Oil Pressure Switch Closed	Circuit 2 Low Oil Pressure Switch
		0 — Low Oil Pressure Switch Open	

* Do not change select switch to brine on units that do not have modifications for brine. Special modifications are required. Contact Carrier for details.

** Units with EPROM HT 204 247-1-13 or higher.

Table 4 –Quick Test 88

SECTION B — THERMISTOR AND POTENTIOMETER CHECKOUT

QUICK TEST STEP NO.	NORMAL DISPLAY	STEP DESCRIPTION	THERMISTOR OR POTENTIOMETER
1.6.	1	1 — Thermistor OK 0 — Thermistor Faulty	Cooler Leaving Water Thermistor
1.7.	1	1 — Thermistor OK 0 — Thermistor Faulty	Cooler Entering Water Thermistor
1.8.	1	1 — Thermistor OK 0 — Thermistor Faulty	Condenser Thermistor Circuit 1
1.9.	1	1 — Thermistor OK 0 — Thermistor Faulty	Condenser Thermistor Circuit 2
2.0.	1	1 — Thermistor OK 0 — Thermistor Faulty	Cooler Thermistor Circuit 1
2.1.	1	1 — Thermistor OK 0 — Thermistor Faulty	Cooler Thermistor, Circuit 2
2.2.	1	1 — Thermistor OK 0 — Thermistor Faulty	Compressor Thermistor, Circuit 1
2.3.	1	1 — Thermistor OK 0 — Thermistor Faulty	Compressor Thermistor, Circuit 2
2.4.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	Accessory Reset Thermistor
2.5.	1	1 — Potentiometer OK 0 — Potentiometer Faulty	Leaving Water Setpoint Potentiometer
2.6.	0	No Significance	—
2.7.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Reset Limit Potentiometer
2.8.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Demand Limit Potentiometer
2.9.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Reset Ratio Potentiometer
3.0.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Reset Setpoint Potentiometer

Table 4 - Quick Test 58 (cont)

SECTION C — OUTPUT RELAY CHECK

QUICK TEST STEP NO	NORMAL DISPLAY	STEP DESCRIPTION	RELAY NO.
3.1.	1	Energize First Stage of Condenser Fans (See Table 10)	K11
3.2.	1	Energize Second Stage of Condenser Fans (See Table 10)	K12
3.3.	1	Energize Liquid Line Solenoid, Circuit 1 *	K9
3.4.	1	Energize Liquid Line Solenoid, Circuit 2 * (* If used)	K10
3.5. through 4.2.	0 then 1 then 0	These steps energize compressors according to chart below for 10 seconds. Display shows status of compressor board feedback contacts : 0 — Compressor Board Off 1 — Compressor Board On	K1 through K8

STEP	RELAY	UNIT 30GF					
		085-095	105-120	145-155	180	195	220-240
		Compressor Number					
3.5. †	K1	1	1	1	1	1	1
3.6.	K2	2	2	2	2	2	2
3.7.	K3	–	–	3	3	3	3
3.8.	K4	U1‡	U1‡	U1‡	U1‡	4	4
3.9. †	K5	3	3	4	4	5	5
4.0.	K6	–	4	5	5	6	6
4.1.	K7	–	–	–	6	7	7
4.2.	K8	U2‡	U2‡	U2‡	U2‡	–	8

U Unloader
† Steps 35 and 39 also turn on a condenser fan (see table 5)
‡ 30GF 085-095 have one unloader as standard ; the second unloader is accessory. On other units, both unloaders are accessories.

Note : – Unloaders cannot be used on 30GF 195-220-240.
– When unloader is energized, U will be displayed.

Table 4 - Quick Test 88 (cont)

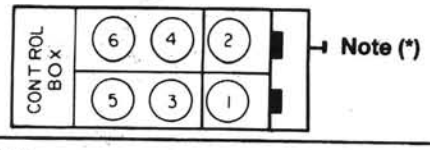
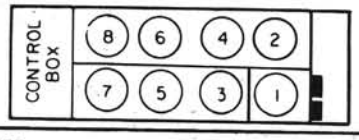
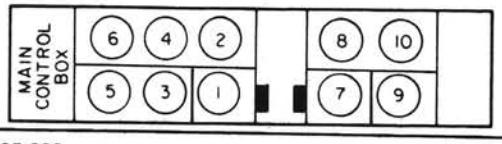
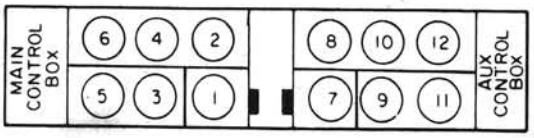
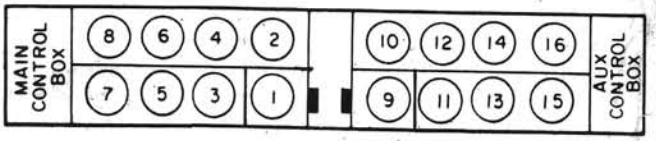
FAN ARRANGEMENT	FAN NO.	CONTROLLED BY	
		During Quick Test	Normal Control
30GF 085-095 	1 **	3.5	Compressor No. 1
	2 **	3.9	Compressor No. 3
	3, 5	3.1	First Stage of Microprocessor
	4, 6	3.2	Second Stage of Microprocessor
30GF 105-120 	1 **	3.5 & 3.9	Compressor No 1 or 3
	3, 5, 7	3.1	First Stage of Microprocessor
	2, 4, 6, 8	3.2	Second Stage of Microprocessor
30GF 145-155 	1 **	3.5	Compressor No. 1
	7 **	3.9	Compressor No. 4
	3, 5, 9	3.1	First Stage of Microprocessor
	2, 4, 6, 8, 10	3.2	Second Stage of Microprocessor
30GF 180-195-220 	1 **	3.5	Compressor No. 1
	7 **	3.9	Compressor No. 4 (30GF 180)
			Compressor No. 5 (30GF 195-220)
	3, 5, 9, 11	3.1	First Stage of Microprocessor
	2, 4, 6, 8, 10, 12	3.2	Second Stage of Microprocessor
30GF 240 	1 **	3.5	Compressor No. 1
	9 **	3.9	Compressor No. 5
	3, 5, 7, 11 13, 15	3.1	First Stage of Microprocessor
	2, 4, 6, 8 10, 12, 14, 16	3.2	Second Stage of Microprocessor

Table 5 – Condenser Fan Sequence

Notes :
* Motormaster location
** Lead fan location

Dip Switch N°	Selected Function
1	Type of Reset
2	Reset
3	Pull Down Limit
4	Not Used
5	Demand Limit
6	1 Unloader
7	2 Unloaders
8	Brine

Table 6 – Dip Switch Functions

Potentiometer	Location
Leaving Water Set Point	Set point Board (Standard)
Reset Limit Set Point	Accessory Board (Option)
Load Sheld Input	Field-Supply Option
Reset Ratio Set Point	Accessory Board (Option)
Warm-Up Set Point	Accessory Board (Option)

Table 7 – Potentiometer Locations

OPERATING LIMITATIONS

Temperatures

	°C
Maximum Ambient Temperature	**52**
Minimum Ambient Temperature	**0**
Maximum Cooler EWT	**29**
Maximum Cooler LWT	**16**
Minimum Cooler LWT	**4**

EWT – Entering Water Temperature
LWT – Leaving Water Temperature

Table 8 – Temperature limits

Leaving water temperature limitations

Standard equipment leaving water temperatures can range from 4° C to 16° C. The units should be set for leaving water temperatures no higher than 16° C even though there is a maximum set point of 21° C on the Flotronic set point controller.

For operation with leaving water temperature above approximately 16° C, the electronic expansion valves (EXV) will limit the suction pressure to 90 psig (620 kPa) to avoid overloading the compressor.

Special order medium temperature brine units must be provided for those jobs having leaving water temperatures in the range of −9° C to 4° C. It is permissible to use a standard flotronic microprocessor controlled unit having leaving water temperatures in the range of 1° C to 4° C if a protective brine solution (20% E.G. or greater) is used and the microprocessor brine chiller dip switch number 8 is properly set.

Entering water temperature limitations

When starting up a system after prolonged shutdown where the fluid in the system may approach the ambient temperature, pull down will be no problem because of the limiting MOP feature of the expansion valve. With flotronic chillers, it is advisable to use the controlled pull down feature when starting up systems having high temperature water. For sustained operation, it is recommended that an entering water temperature no higher than 2ᵉ° C be used.

Low-ambient operation

All 30GF Flotronic chillers (either with Carrier electronic expansion valve or with factory-option thermal expansion valve) will operate at ambient temperatures down to 0°C without modification.

Whenever these chillers are operated at ambient conditions below 0°C, it is necessary that they be modified as described below :

a. Ethylene glycol or another suitable brine must be added to the cooler water loop to protect it to temperatures 8°C below the lowest expected outdoor temperature.

b. To minimize compressor cycling, provide sufficient volume in the chilled water loop, even if it means adding a properly baffled storage tank to the system. At least 6.5 liters per kW of refrigeration is recommended to moderate system load. (It may be needed up to 10.8 liters per kW of refrigeration for unit operating under low load conditions).

c. Minimum applied system load must not be below the minimum step of unit loading.
Add accessory unloaders to both lead compressors in those cases where permissible and not standard (not applicable to medium temperature brine chillers).

d. Standard 30GF units with Electronic Expansion Valves do not require the addition of 32LT Motormaster unless outdoor temperatures are expected to drop below −18°C.
Motormaster is available as factory installed option (number 28). It may also be field mounted, as described further.

Winter Start – All 30GF Flotronic chillers have winter start features included in their microprocessor control logic. No additional provisions are necessary.

MINIMUM OUTDOOR TEMPERATURE	30GF 085-240 FLOTRONIC CHILLER	
	With Electronic Expansion Valve (EXV)	With Thermal Expansion Valve (Option)
Down to 0°C	No changes	No changes
0 down to −17.8°C	1	All : 1, 2, 3
−17.8 down to −28.8°C	All : 1, 2, 3	All : 1, 2, 3

Note : Unit operation below −28.8°C not recommended.
Required changes :
Step 1 – Add accessory wind baffles.
Step 2 – Modify lead fans (see fig. 11, Tables 5 and 10).
Change 2 lead fan motors (per table 10).
Add 2 capacitors (per table 10).
Change 2 lead fan blades (fig. 11).
Step 3 – Add Motormaster control(s).

Table 9 – Changes Required for Low- Ambient Operation

Step 1 – Wind baffles are available as an accessory and they must be field installed for 30GF 085-240 units to operate at ambient temperatures below 0°C (See fig. 10 for details of installation).

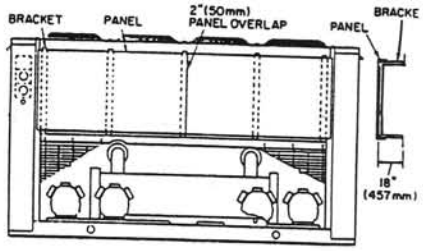


Fig. 10 – 30GF 105-120 with Wind Baffle Accessory

Step 2 – Modify Lead Fans change lead fan motors, add capacitors, change lead fan blades and fan motor support as shown in fig. 11.

The lead fan motors are those shown numbered (1 and 2, 7 or 9 in table 5).

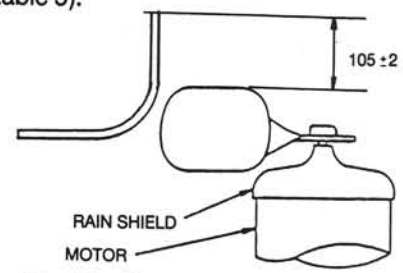


Fig. 11 – Motormaster Fan Adjustement

Each fan motor is supported by a formed-wire mount bolted to the fan deck and covered with a wire guard. Figure 11 shows proper position of fan blade in orifice.

Unit	Unit Volt.	Nbr required	REPLACEMENT PARTS			
			Motor	Capacitor	Fan blade	Motor support
30GF 085-240	230-3-50 400-3-50	2	HC 52 TE 231	GA 12 AA 003 EE	LA 01 LA 030	30GA 403 743

Table 10 – Lead Fan Modifications

Note : 30GF 105-120 requires 2 Motormaster controls, but only one set of for fan replacement parts (for fan n°1, FM1). (See unit wiring diagrams for details).

Step 3 – Install Motormaster Control(s). Motormaster control part n° 32LT 900 300 mounts on partition nearest to fan to be controlled. Refer to Installation Instruction furnished with this accessory for details mounting instructions.

***Caution :** Use extreme care when drilling and screwing in fasteners to avoid damaging components and wiring.*

Table 5 shows locations of motormaster control and lead fan(s). Fig. 21 shows locations of motormaster sensor.

Maximum outside air temperature limitations

30 GF units are designed for operation up to 52° C outside air temperatures ; however, if the unit is to be used in an area with high solar radiation, the mounted position should be such that the control box is not exposed to direct radiation.

Minimum cooler water flow rates and minimum loop volume

UNIT 30 GF	MINIMUM FLOW (1) L/s	PRESSURE DROP kPa	MINIMUM VOLUME (2) Liters
085	6	6,4	878
095	6	6,4	1010
105	6	6,4	1162
120	8.5	6.2	1321
145	9.8	6.5	1559
155	9.8	6.5	1684
180	12.1	6.6	1953
195	12.1	6.6	2210
220	12.1	6.6	2422
240	12.1	6.6	2570

Notes :

1. Minimum flow based on (0.46 m/s) velocity in cooler without special cooler baffling.
2. Minimum Loop Volumes :
   Liters = N x ARI Cap. (kW)

APPLICATION	N
Normal Air conditionning	3.25
Process Type Cooling	6.5
Low Ambient Unit Operation	6.5 - 10.8

Table 11

OPERATION SEQUENCE

During the unit off cycle, the crankcase heaters are energized. If the ambient temperature is below 2° C, cooler heaters and a microprocessor board heater are also energized.

When control ON-OFF switch is turned to ON, control first goes through a 2-minute initialization period, during which the display will continuously show **20**. Ninety (90) seconds after **20** leaves display, control begins to bring on compressors. Rate at which compressors are started depends on leaving chilled water temperature set point and rate of change of the leaving water temperature.

On standard units (one unloader), refrigerant circuit n° 1 is always first to start. With addition of an accessory unloader, an automatic lead-lag feature in control system determines by random selection either circuit 1 or 2 to start first.

At first call for cooling, microprocessor starts first compressor, de-energizes crankcase heater and starts one condenser fan.

Units with electronic expansion valve (EXV) – Electronic expansion valve (EXV) remains closed for 10 seconds to purge cooler and suction line of any liquid refrigerant that may have migrated to these areas during off period. After 10 seconds, expansion valve starts to open. As more cooling is required, control brings on additional stages of capacity. Loading sequence for compressors is shown in table 12. Automatic lead-lag control is provided on some units.

— On to 30 GF 240 units, each leader compressor starts up on two cylinders for the time being necessary to the evaporator pumpdown. This is to avoid slugging after a long period of a unit stoppage.

— At the end of this process, the compressor may run again at full throttle.

The pressurestat set point is = 2 bar.

Units with standard thermostatic expansion valve (TXV) – Liquid line solenoid valve is not energized for first 10 seconds of compressor operation. This is called pre-pumpout cycle.

Microprocessor determines how rapidly capacity stages are added or subtracted, based on deviation from leaving chilled water temperature set point and rate of change of leaving water temperature. If water temperature is very warm and pull-down option is being used, microprocessor limits rate of temperature drop of leaving water to 0.56° C per minute to avoid high peak kW charges. If the capacity is being limited by pulldown, the control display shows a **24** when the display button is pressed.

Units with EXV – When the capacity is satisfied and a refrigerant circuit is to be shut down, the microprocessor closes the EXV. The compressor continues to run for 10 seconds to purge the cooler and suction line of liquid refrigerant, then stops.

Units with TXV – When a circuit is shut down, liquid line solenoid is de-energized 10 seconds prior to compressor stopping. This is called pumpout cycle. The rest of operation sequence is same as Flotronic units.

If load shed option is being used, control limits maximum capacity to load shed input value. Refer to Controls and Troubleshooting publication for details. If capacity is limited by a load shed signal, display shows a **22** when display button is pressed.

All units – If temperature reset is being used, microprocessor adjusts leaving water temperature to obtain greater part-load efficiency. Refer to Controls and Troubleshooting book for details. If leaving water temperature is being reset, the display shows a **21** when the display button is pressed.

Units with EXV – Microprocessor also controls electronic expansion valve (EXV) to maintain a superheat of 11°C-14°C entering compressor cylinders. This is equivalent to 2° C to 3° C superheat leaving cooler.

Microprocessor control also cycles condenser fans on and off to maintain an adequate pressure differential across the expansion valves. Fans are controlled by the position of EXV and saturated condensing temperature thermistors. When expansion valve is fully open and superheat is greater than 4°C, fan stages are removed ; when the valve is approximately half open, fan stages are added. This allows unit to run at very low condensing temperatures at part load. Thus the chiller has very high part-load EER's. Fan sequence is shown in table 5.

Units with TXV – Thermostat expansion valves, one for each refrigerant circuit are factory set to maintain 5°C-6°C superheat of vapor leaving cooler to control flow of liquid refrigerant into cooler. Superheat can be reset but should be done only if necessary.

Logic to cycle microprocessor-controlled fans is based on satured condensing temperature only. This temperature is sensed by thermistors T3 and T4 (fig. 19).

The microprocessor will turn on an additional stage of fans when either of coil thermistors (T3 or T4) is greater than 45°C and will turn off a fan stage when T3 and T4 are both below 23°C. Between each change in fan stage, control will wait one minute to allow head pressure to stabilize unless either T3 or T4 is greater than 52°C, in which case all microprocessor-controlled fans will come on immediately.

Condenser fan sequence is shown in table 5.

CAPACITY CONTROL STEPS

UNIT 30GF	CONTROL STEPS	% DISPLACEMENT (Approx.)	LOADING SEQUENCE A				LOADING SEQUENCE B			
			Operating				Operating			
			No. of Compr.	No of Cyl.	Compressor No.		No. of Compr.	No. of Cyl.	Compressor No.	
					Circuit 1	Circuit 2			Circuit 1	Circuit 2
085-095† Standard	1	22	1	4	1*	–	–	–	–	–
	2	33	1	6	1	–	–	–	–	–
	3	56	2	10	1*	3	–	–	–	–
	4	67	2	12	1	3	–	–	–	–
	5	89	3	16	1*, 2	3	–	–	–	–
	6	100	3	18	1, 2	3	–	–	–	–
085-095 Accessory Unloader Added to Compr. No. 3	1	22	1	4	1*	–	1	4	*	3*
	2	44	2	8	1*	3*	2	8	1*	3*
	3	56	2	10	1*	3	2	10	1	3*
	4	67	2	12	1	3	2	12	1	3
	5	89	3	16	1*, 2	3	3	16	1*, 2	3
	6	100	3	18	1, 2	3	3	18	1, 2	3
105-120 Standard	1	25	1	6	1	–	1	6	–	3
	2	50	2	12	1	3	2	12	1	3
	3	75	3	18	1, 2	3	3	18	1	3, 4
	4	100	4	24	1, 2	3, 4	4	24	1, 2	3, 4
105-120† Accessory Unloader Added to Compr. No. 1	1	17	1	4	1*	–	–	–	–	–
	2	25	1	6	1	–	–	–	–	–
	3	42	2	10	1*	3	–	–	–	–
	4	50	2	12	1	3	–	–	–	–
	5	67	3	16	1*, 2	3	–	–	–	–
	6	75	3	18	1, 2	3	–	–	–	–
	7	92	4	22	1*, 2	3, 4	–	–	–	–
	8	100	4	24	1, 2	3, 4	–	–	–	–
105-120 Accessory Unloaders Added to Compr. No. 1 & 3	1	17	1	4	1*	–	1	4	–	3*
	2	33	2	8	1*	3*	2	8	1*	3*
	3	42	2	10	1*	3	2	10	1	3*
	4	50	2	12	1	3	2	12	1	3
	5	67	3	16	1*, 2	3	3	16	1	3*, 4
	6	75	3	18	1, 2	3	3	18	1	3, 4
	7	92	4	22	1*, 2	3, 4	4	22	1, 2	3*, 4
	8	100	4	24	1, 2	3, 4	4	24	1, 2	3, 4
145-155 Standard	1	20	1	6	1	–	1	6	–	4
	2	40	2	12	1	4	2	12	1	4
	3	60	3	18	1, 2	4	3	18	1	4, 5
	4	80	4	24	1, 2	4, 5	4	24	1, 2	4, 5
	5	100	5	30	1, 2, 3	4, 5	5	30	1, 2, 3	4, 5
145-155† Accessory Unloader Added to Compr. No. 1	1	13	1	4	1*	–	–	–	–	–
	2	20	1	6	1	–	–	–	–	–
	3	33	2	10	1*	4	–	–	–	–
	4	40	2	12	1	4	–	–	–	–
	5	53	3	16	1*, 2	4	–	–	–	–
	6	60	3	18	1, 2	4	–	–	–	–
	7	73	4	22	1*, 2	4, 5	–	–	–	–
	8	80	4	24	1, 2	4, 5	–	–	–	–
	9	93	5	28	1*, 2, 3	4, 5	–	–	–	–
	10	100	5	30	1, 2, 3	4, 5	–	–	–	–
145-155 Accessory Unloaders Added to Compr. No. 1 & 4	1	13	1	4	1*	–	1	4	–	4*
	2	27	2	8	1*	4*	2	8	1*	4*
	3	33	2	10	1*	4	2	10	1	4*
	4	40	2	12	1	4	2	12	1	4
	5	53	3	16	1*, 2	4	3	16	1	4*, 5
	6	60	3	18	1, 2	4	3	18	1	4, 5
	7	73	4	22	1*, 2	4, 5	4	22	1, 2	4*, 5
	8	80	4	24	1, 2	4, 5	4	24	1, 2	4, 5
	9	93	5	28	1*, 2, 3	4, 5	5	28	1, 2, 3	4*, 5
	10	100	5	30	1, 2, 3	4, 5	5	30	1, 2, 3	4, 5
180 Standard	1	17	1	6	1	–	1	6	–	4
	2	33	2	12	1	4	2	12	1	4
	3	50	3	18	1, 2	4	3	18	1	4, 5
	4	67	4	24	1, 2	4, 5	4	24	1, 2	4, 5
	5	83	5	30	1, 2, 3	4, 5	5	30	1, 2	4, 5, 6
	6	100	6	36	1, 2, 3	4, 5, 6	6	36	1, 2, 3	4, 5, 6

Table 12 – Capacity Control Steps

CAPACITY CONTROL STEPS (CONT.)

UNIT 30GF	CONTROL STEPS	% DISPLACEMENT (Approx.)	LOADING SEQUENCE A				LOADING SEQUENCE B			
			Operating				Operating			
			No. of Compr.	No of Cyl.	Compressor No.		No. of Compr.	No. of Cyl.	Compressor No.	
					Circuit 1	Circuit 2			Circuit 1	Circuit 2
180† Accessory Unloader Added to Compr. No. 1	1	11	1	4	1*	–	–	–	–	–
	2	17	1	6	1	–	–	–	–	–
	3	28	2	10	1*	4	–	–	–	–
	4	33	2	12	1	4	–	–	–	–
	5	44	3	16	1*, 2	4	–	–	–	–
	6	50	3	18	1, 2	4	–	–	–	–
	7	61	4	22	1*, 2	4, 5	–	–	–	–
	8	67	4	24	1, 2	4, 5	–	–	–	–
	9	78	5	28	1*, 2, 3	4, 5	–	–	–	–
	10	83	5	30	1, 2, 3	4, 5	–	–	–	–
	11	94	6	34	1*, 2, 3	4, 5, 6	–	–	–	–
	12	100	6	36	1, 2, 3	4, 5, 6	–	–	–	–
180 Accessory Unloaders Added to Compr. No. 1 & 4	1	11	1	4	1*	–	1	4	–	4*
	2	22	2	8	1*	4*	2	8	1*	4*
	3	28	2	10	1*	4	2	10	1	4*
	4	33	2	12	1	4	2	12	1	4
	5	44	3	16	1*, 2	4	3	16	1	4*, 5
	6	50	3	18	1, 2	4	3	18	1	4, 5
	7	61	4	22	1*, 2	4, 5	4	22	1, 2	4*, 5
	8	67	4	24	1, 2	4, 5	4	24	1, 2	4, 5
	9	78	5	28	1*, 2, 3	4, 5	5	28	1, 2	4*, 5, 6
	10	83	5	30	1, 2, 3	4, 5	5	30	1, 2	4, 5, 6
	11	94	6	34	1*, 2, 3	4, 5, 6	6	34	1, 2, 3	4*, 5, 6
	12	100	6	36	1, 2, 3	4, 5, 6	6	36	1, 2, 3	4, 5, 6
195‡ Standard	1	14	1	6	1	–	1	6	–	5
	2	29	2	12	1	5	2	12	1	5
	3	43	3	18	1, 2	5	3	18	1	5, 6
	4	57	4	24	1, 2	5, 6	4	24	1, 2	5, 6
	5	71	5	30	1, 2, 3	5, 6	5	30	1, 2	5, 6, 7
	6	86	6	36	1, 2, 3	5, 6, 7	6	36	1, 2, 3	5, 6, 7
	7	100	7	42	1, 2, 3, 4	5, 6, 7	7	42	1, 2, 3, 4	5, 6, 7
220-240‡ Standard	1	13	1	6	1	–	1	6	–	5
	2	25	2	12	1	5	2	12	1	5
	3	38	3	18	1, 2	5	3	18	1	5, 6
	4	50	4	24	1, 2	5, 6	4	24	1, 2	5, 6
	5	63	5	30	1, 2, 3	5, 6	5	30	1, 2	5, 6, 7
	6	75	6	36	1, 2, 3	5, 6, 7	6	36	1, 2, 3	5, 6, 7
	7	88	7	42	1, 2, 3, 4	5, 6, 7	7	42	1, 2, 3	5, 6, 7, 8
	8	100	8	48	1, 2, 3, 4	5, 6, 7, 8	8	48	1, 2, 3, 4	5, 6, 7, 8

* Compressor unloaded.
† There is only one loading sequence because there is only one unloader.
‡ Accessory unloaders cannot be added to 30GF 195-220-240.

Notes :

1. The microprocessor has a random number generator that selects loading sequence A or B, which in turn determines the compressor circuit that is energized first. This evens out operating hours on each circuit over an extended period of time.
2. If unit operation is anticipated with system load below minimum unloaded capacity of chiller :
   a. Consider using 2 smaller units in place of larger unit.
   b. Increase *water loop volume* to ensure adequate run time (see Application Data).

Table 12 – Capacity Control Steps (cont)

SERVICE

Electric shock hazard

Turn off all power to unit before servicing. The ON-OFF switch on the control panel does not shut off control power ; use the control circuit breaker (CCB).

Diagnostics and Troubleshooting – Refer to the Controls and Troubleshooting book.

REFRIGERANT CIRCUIT

Leak Testing

All 30GF units are shipped with complete operating charge of refrigerant R-22 (see table 1) and should be under sufficient pressure to conduct a leak test. If there is no system pressure, admit refrigerant until a pressure is observed and then proceed to test for leaks. After leaks are repaired, the system must be dehydrated.

Dehydratation

Refer to the Carrier Standard Service Techniques Manual, Chapter 1, Refrigerants, Sections 6 and 7 for details. **Do not use the compressor to evacuate the system.**

Refrigerant Charge (Refer to tables 1 and 2)

Immediately ahead of the filter drier in each circuit is a factory-installed liquid line service valve. On each valve is a 1/4-in. flare connection for charging liquid refrigerant.

Charging with Unit Off and Evacuated – Close liquid line service valve before charging. Weigh in the charge shown on the unit nameplate (also in tables 1). Open liquid line service valve ; start unit and allow it to run several minutes fully loaded.

Check for a clear sight glass. Be sure the clear condition is liquid and not vapor.

Charging with Unit Running – If charge is to be added while unit is operating, it will be necessary to have all condenser fans and compressors on. It may be necessary to block the condenser coils at low ambient temperatures to raise the condensing pressure to approximately 280 psig (1931 kPa) in order to turn all the condenser fans on. Do not totally block a coil to do this. Randomly block all coils in uniform pattern. Charge each circuit until the sight glass shows clear liquid, then weigh in the amount over a clear sight glass as listed.

Important : *When adjusting refrigerant charge, circulate water through the cooler continuously to prevent freezing. Do not overcharge and never charge liquid into the low-pressure side of the system.*

ELECTRONIC COMPONENTS

Control Components

The unit uses an advanced electronic control system that normally will not require service. For details on the controls refer to the Controls and Troubleshooting book.

Unit Control Boxes

Viewed facing the compressors, the main control box on the units 30GF 180-240 is at the left end and the auxiliary box is at the right end. On units 30GF 085-155, the control box at the left end is the only box.

The external panels over the control boxes are removable and can be locked for security. Inner panels are hinged and there is sliding door over DISPLAY BOARD. Only simply screwdriver is needed for opening.

The main control box contains the electronic controls, and power components. The auxiliary box, when used, contains only the power components for circuit 2.

COMPRESSORS

If the lead compressor on either refrigerant circuit on a Flotronic chiller becomes inoperative for any reason, the circuit is locked off and **cannot** be operated due to features built into the electronic control system. **Do not attempt to bypass this compressor to force other compressors in the circuit to run.**

If a replacement compressor is not immediately available and the equipment must be operated, it is recommended that one of the other compressors in that circuit be transferred to the lead compressor position.

Caution : *Be sure to deactivate all power to the position left vacant by the compressor transfer.*

When the screens are removed from the front of the unit, the oil pump end of each compressor is readily accessible as shown in fig. 8. Access to the motor end of the compressors is readily gained when the screens are removed from the ends of the unit. Every compressor can be removed from the front of the unit.

Important : *All compressor mounting hardware and support brackets removed during servicing must be reinstalled prior to start-up.*

Oil Charge (Refer to table 1)

All units are factory charged with oil. The units do not have oil level equalizing lines between the compressors ; therefore, the oil levels in the compressors on the same refrigerant circuit will be different. Acceptable oil level for each compressor is from the bottom of the external sight glass to 3/8 of the compressor sight glass (see fig. 8).

When additional oil or a complete charge is required, use only Carrier-approved compressor oil.

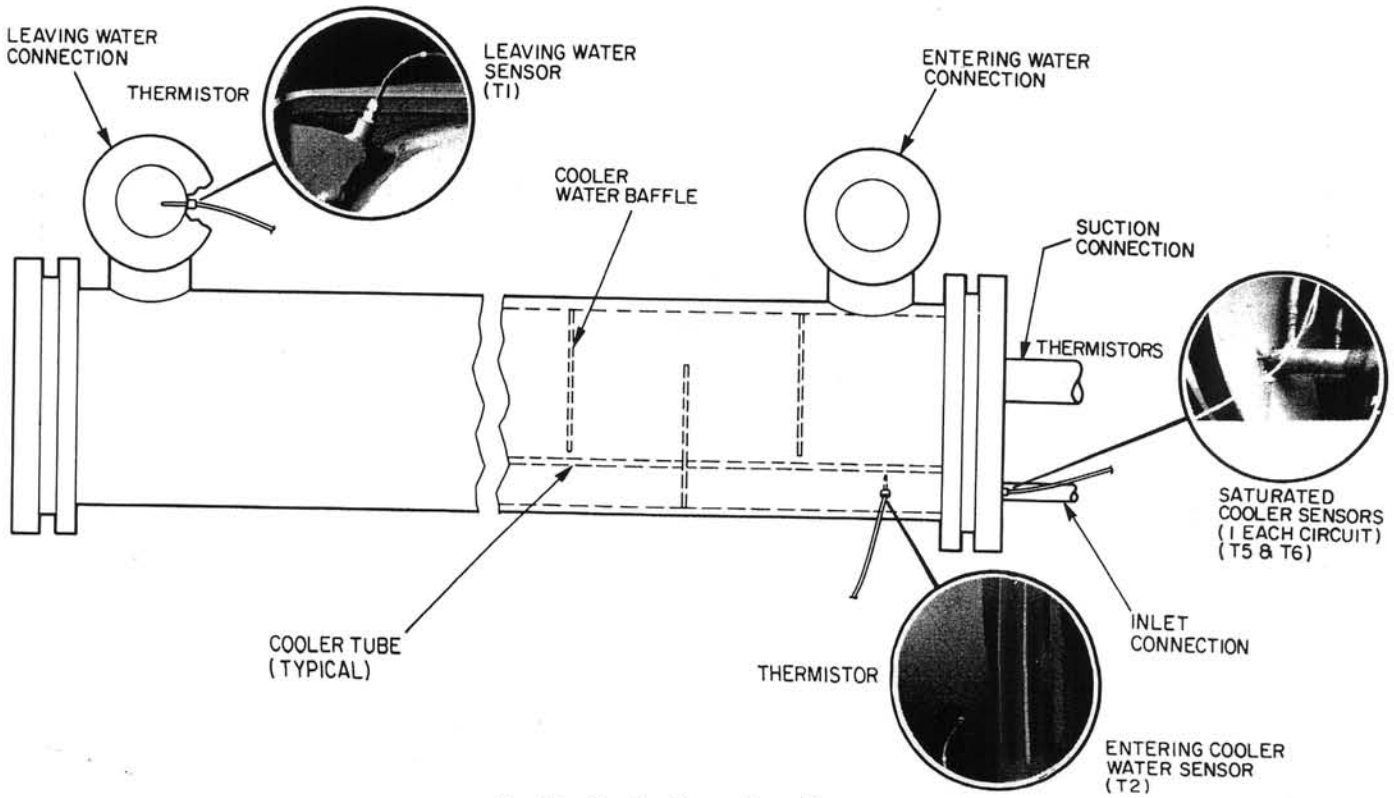


Fig. 12 – Cooler Sensor Locations

Approved oils are :

Chevron Chemical Co.	Zerol 150 (Synthetic)
Sun Oil Co.	Suniso 3GS
Texaco, Inc.	Capella WF-32
Mobil Oil	Gargoyle Artic 155

Do not reuse drained oil and do not use any oil that has been exposed to atmosphere.

COOLER

– When the screens on the back of the unit are removed, the cooler and the refrigerant feed components are readily accessible.

Cooler Removal

Cooler can be removed from the rear of the unit.
Proceed as follows :

1. Close shutoff valves in chilled water lines, if installed, and remove chilled water piping.
2. Drain water from cooler.
3. Disconnect conduits to cooler heater cables and remove all thermistors from cooler. (See fig. 12).
4. Remove insulation at refrigerant connection end.
5. Remove suction lines by cutting lines with tubing cutter at convenient point.
6. Remove liquid lines by breaking the silversoldered joints at the cooler nozzle.
7. On 30GF 145 through 240 units, remove the left upright and the related inner half post at the center of the cooler side of the unit (viewed facing the cooler).
   On 30GF 085 through 120 units, remove vertical support post under center of coil.
8. Unbolt the cooler and slide to the left (away from the refrigerant piping). Rotate to clear there maining structural members and remove through rear of unit.

Servicing the Cooler

When the cooler heads and partition plates are removed, the tube sheets are exposed showing the ends of the tubes. On units 30GF 105 through 240, 8 tubes in the bundle are secured inside the cooler at the baffles and **cannot be removed ;** on units 30GF 085 through 095, there are 6 fixed tubes. These are identified on the tube sheets by a drill mark horizontally adjacent to each of the tubes (see fig. 13). **If leakage occurs in any of these tubes, plug the tube(s) as described under Tube Plugging.**

Tube Plugging (see table 13)

A leaky tube(s) can be plugged until retubing can be done. The number of plugged tubes determines how soon the cooler **must** be retubed. If several tubes require plugging, check with your local representative to find out how the number and location will affect unit capacity.
Figure 14 shows an Elliot tube plug and cross-sectional view of a plug in place.

Caution : *Use extreme care when installing plugs to prevent damaging the tube sheet sections between the holes.*

Unit 30GF	085-240
Components for plugging	Part Number
For Tubes Brass Pin Brass Ring For Holes without Tubes Brass Pin Brass Ring	 ---T-853--103500S-* ---T-853--002559S-* ---T-853--1031- -S-* ---T-853--002631S-*
Loctite	**N° 75****
Locquic	**"N"****

* Order direct from your Carrier distributor
** Can be obtained locally

Table 13 - Plugs and Tubes

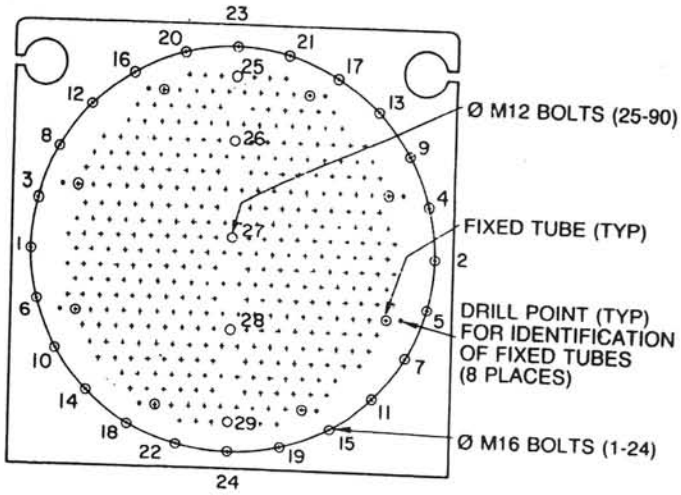


Fig. 13 – Typical Tube Sheet of 10HA 200 Cooler

Clean parts with Locquic "N" and apply a few drops of Loctite N° 75 to obtain a tight seal without using too much force to set the pin.
Usually plugs can be removed by heating the projecting end of the pin to approximately 540° C and chilling quickly with water. Apply the heating flame to the side of the pin to prevent over-heating the tube sheet.

Retubing (see table 13)

When retubing is to be done, obtain the service of qualified personnel, experienced in boiler maintenance and repair. Most standard procedures can be followed, except that for the tubes in the 10HA coolers, a 5% crush is recommended in setting torque control – 15.87 mm (0.625 in.) diameter tubes are used in these coolers –.
Example :

a. Tube sheet hole diameter	16.00 mm (0.630 in.)
b. Tube OD	15.87 mm (0.625 in.)
c. Clearance (a minus b)	0.13 mm (0.005 in.)
d. Tube ID before rolling (Use Elliot tube gage)	13.94 mm (0.549 in.)
e. 5% of twice the wall thickness (5% of b minus d)	0.10 mm (0.004 in.)
f. Tube ID after rolling (c + d + e)	14.17 mm (0.558 in.)

Note : The tubes next to the gasket webs must be flush with the tube sheet (both ends).

Cooler Head Bolt Tightening

Gasket Preparation – **When reassembling, use new gaskets.** Compressed asbestos / neoprene gaskets, Material Specification ZA00-24, are to be **momentarily** dipped in compressor break-in oil prior to assembly. Gaskets are **not** to be soaked in oil as gasket deterioration results. Dipped gaskets are to be used within 30 minutes to prevent deterioration.

Bolt Torques – The following torques are to be applied during the bolt tightening sequence described below :

Ø M16 diameter flange bolts	203-230-N-m (150-170 lb-ft)
Ø M12 diameter center bolts	95-122-N-m (70-90 lb-ft)

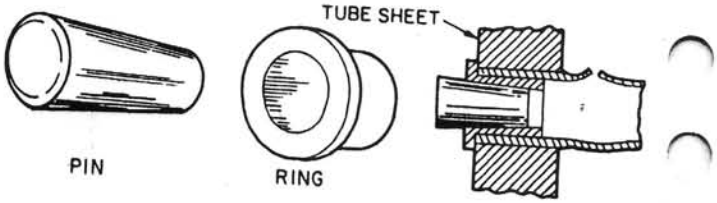


Fig. 14 – Elliot Tube Plug

Bolt Tightening Sequence (fig. 13) – The following is a recommended bolt tightening sequence :

Step 1 – Assemble all Ø M16. flange bolts and Ø M12 center bolts.

Step 2 – Following the sequence shown in fig. 13, tighten the bolts and nuts to approximately 50% of the specified torque.

Step 3 – Starting at the top (12 o'clock) tighten the flange bolts to the specified torque (see Bolt Torques) consecutively in a clockwise direction.

Step 4 – Tighten the center bolts to the specified torque in the sequence shown.

Step 5 – No less than one hour later, retighten the center nuts.

Step 6 – After refrigerant is restored to cooler, check center studs and exposed gasket edges for refrigerant leaks with soap solution or Halide device.

Step 7 – Replace cooler insulation.

CONDENSER COILS

Coil Cleaning

Clean coils with a vacuum cleaner, fresh water, compressed air or a bristle brush (not wire). Units installed in corrosive environments should have coil cleaning as part of a planned maintenance schedule. In this type of application, all accumulations of dirt should be washed off the coil.

Condenser Coil Removal (see fig. 15)

Note : *Weight of each coil (vertical or flat) is approximately 325 lb (150 kg).*

Before coil(s) can be removed, either or both control box(es) must be removed.

Control Box Removal – Both outer and inner hinged access panels must be removed. The outer panels are removed by opening all the way and lifting them off the hinges.

Caution : *Do not remove inner panels until all power to the unit is shut off.*

To remove the inner panels, remove the hinges from the panels, not the control box. (The inner panels cannot be lifted off the hinges as were the outer panels). With the hinged access panels off, proceed as follows :

Main Control Box Removal

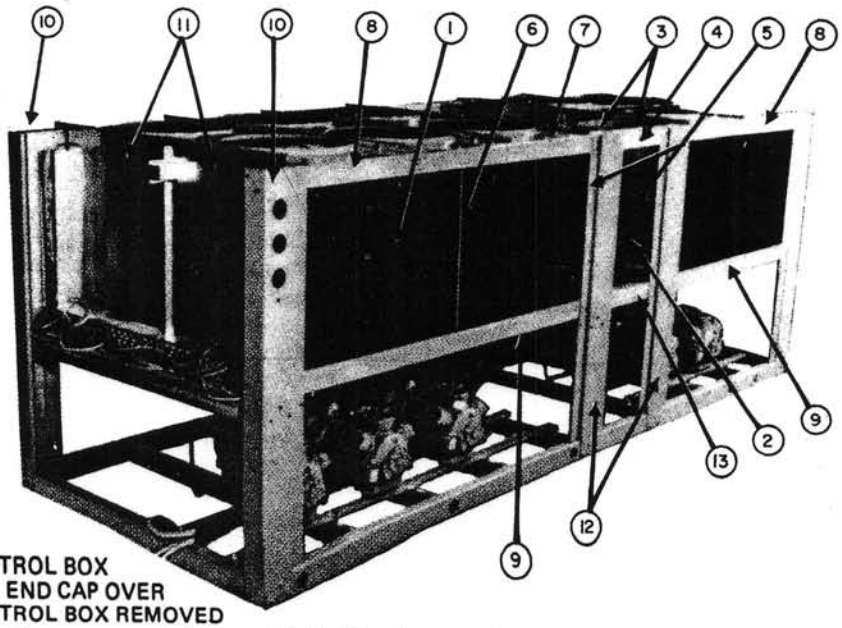
1. Disconnect main power wires, control power wires and all field interlocks.
2. Disconnect the wires connected to the microprocessor cover and remove cover.
3. Disconnect electronic expansion valve (EXV) cables from J7 and thermistor wires from J1. Then remove wires from the wire duct.
4. Reinstall microprocessor cover.
5. Remove strain relief from shield in corner of control box. Remove screws from corner shield, the remove wires from shield.
6. Pull EXV and thermistor wires through hole in bottom of shelf.
7. Remove cooler heater thermostat and bracket from shelf and secure to control box.
8. Valve off all compressors in the unit and blow charge from compressors.
9. Disconnect capillary tubes from back of gage panel and label them for identification.
10. Disconnect raceway wires from main power terminal blocks and disconnect the plugs which connect the 2 control boxes together (30GF 180-240 only).
11. Disconnect all fan motor ground wires from control box.
12. Disconnect all compressor and fan wires from their respective contactors and tag to identify.
13. Disconnect all Molex plugs which are connected to compressor conduits and tag to identify.
14. Remove compressor conduit nut and pull conduits below the shelf.
15. Remove control box mounting screws from sides and bottom of box.
16. Carefully lift control box out of unit. The maximum weight of control box is approximately 220 lb (100 kg).

Auxiliary Control Box Removal (30GF 180-240)

After the access panels are removed, follow steps 10 through 16 of main box removal.

Vertical Coil Removal

1. Remove appropriate control box. For detailed procedure, see Control Box Removal.
2. Disconnect and remove condenser temperature thermistor if attached to return bend of coil.
3. On 30GF 085 through 120 units, remove corner post opposite control box.
   On units 30GF 145-240, remove center-section access panel nearest coil to be removed.



CONTROL BOX AND END CAP OVER CONTROL BOX REMOVED

Callouts are components associated with coil removal.

CALLOUTS FOR FIG. 15

Components are numbered in sequence as they appear in the coil removal procedure.

1 - Vertical coil (Typ)
2 - Center section
3 - Center-section fan decks
4 - Upper center splice cap
5 - End baffle (inner) ; one baffle hidden
6 - Middle baffle location
7 - Fan deck (Typ)
8 - Vertical-coil cap
9 - Flat-coil cap
10 - Corner post
11 - End baffles (outer)
12 - Center uprights
13 - Lower center splice cap

Fig. 15 – Unit Partially Disassembled.

4. On 30GF 085 through 120 units, remove end cap and fan deck.
   On units 30GF 145-240, remove the near center-section fan deck and the upper center-splice cap.
5. Remove the end baffle.
6. Lay a sheet of plywood across the flat coil tube sheets and crawl through to the center of the coil being removed. Remove the screws holding the middle baffle to the tube sheet bracket (bracket remains on the tube sheet).
7. Unbolt fan decks from the vertical-coil cap.
8. Remove the appropriate control box. For detailed procedure, see Control Box Removal.
9. Remove the end cap over the control box.
10. Remove the corner post.
11. Remove the screws holding the end baffle to the vertical-coil tube sheet.
12. Unbraze the refrigerant line connections at the header.
13. Remove the coil carefully, to avoid fin damage (slide toward the control box end to avoid piping).

Flat Coil Removal

1. Remove appropriate control box. For detailed procedure, see Control Box Removal.
2. Remove appropriate vertical coil as described under Vertical Coil.
3. Remove appropriate end baffle.
4. Remove lower center-splice cap.

CONDENSER FANS

Each fan is supported by a formed-wire mount bolted to the fan deck and covered with a wire guard. The exposed end of the fan motor shaft is protected from the weather by Permagum sealant. If a fan motor must be removed for service or replacement, be sure the sealant is reinstalled and be sure the fan guard is in place before starting the unit. Figure 16 shows the proper position of the mounted fan. Fan motors have permanently lubricated bearings.

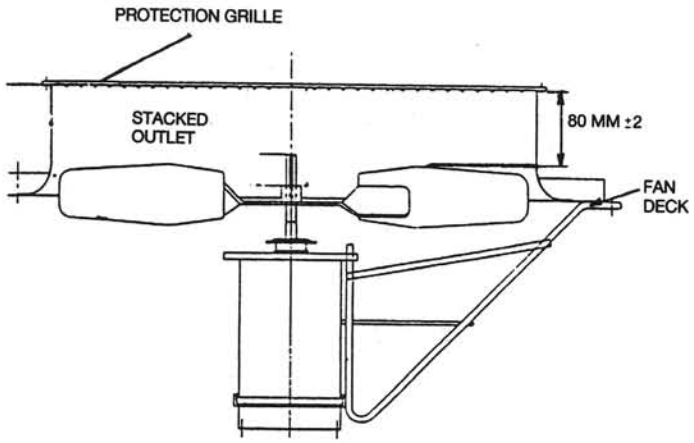


Fig. 16 – Condenser Fan Adjustment

Important : *Check for proper fan rotation (clockwise viewed from above). If necessary to reverse, switch leads.*

REFRIGERANT FEED COMPONENTS

Each circuit has all the necessary refrigerant controls.

Electronic Expansion Valve

The chiller is equipped with the new Carrier-designed electronic expansion valve (EXV). A cut-away drawing of the valve is shown in fig. 17.

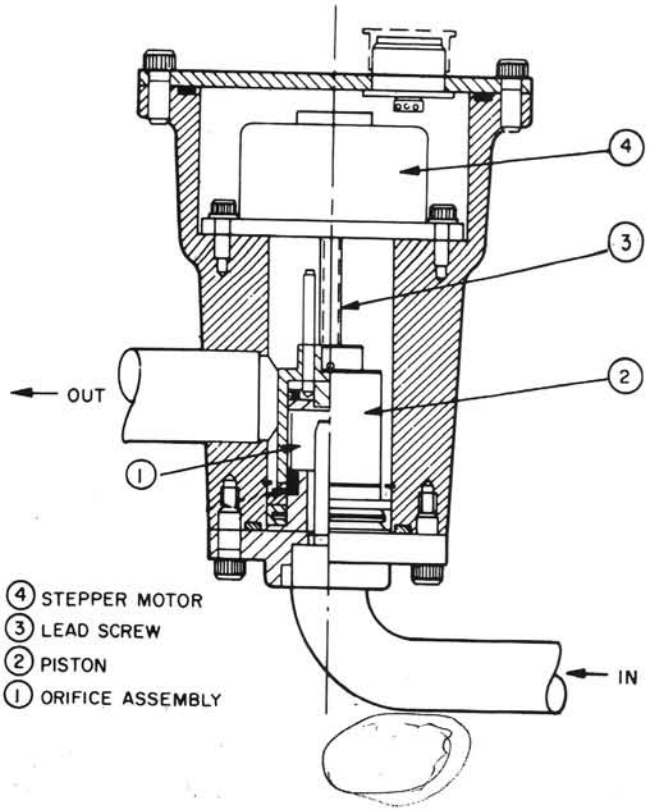


Fig. 17 – Electronic Expansion Valve

The high-pressure liquid refrigerant enters the valve through the bottom. A series of calibrated slots have been machined in the side of the orifice assembly (item 1). As the refrigerant passes through the orifice, the pressure drops and the refrigerant changes to a 2-phase condition (liquid and vapor). To control the refrigerant flow for different operating conditions, the piston (item 2) moves up and down over the orifice and modulates the orifice size. The piston is moved by a linear stepper motor (item 4). The stepper motor moves in increments and is controlled directly by the processor board. As the stepper motor rotates, the motion is transferred into linear movement by the lead screw (item 3). Through the stepper motor and lead screw, 760 distinct steps of motion are obtained. The large number of steps and the long stroke results in very accurate control of the refrigerant flow.

Control of the valve is by the microprocessor. Two thermistor temperature sensors are used to determine superheat. One thermistor is located in the cooler and the other is located in the passage between the compressor motor and the cylinders. The difference between the 2 temperatures controls the superheat. On a normal TXV system, the superheat leaving the evaporator is normally 5.6° C and the motor then adds approximately 11° C, resulting in approximately 16.7° C superheat entering the cylinders. The EXV controls the superheat entering the cylinders to approximately 11° C. Thus the superheat leaving the cooler is approximately 0° C to 3° C.
A significant improvement in cooler performance results. Because the EXV's are controlled by the processor board, it is possible to track the valve position. By this means, head pressure is controlled and the unit is protected against loss of charge and a faulty valve. During initial start-up, the EXV is fully closed.
After the initialization period, the valve position is tracked by the processor by constantly observing the amount of valve movement.
The EXV is also used to limit the cooler suction temperature to 13° C. This makes it possible for the chiller to start at high cooler water temperatures without overloading the compressor. This is commonly referred to as MOP (maximum operating pressure).

If it appears that electronic expansion valve is not properly controlling operating suction pressure or superheat, there are a number of checks that can be made using Quick Test and initialization features built into the microprocessor control.

Follow steps below to diagnose and correct EXV problems.

Step 1 – Check Processor EXV Outputs – Check EXV output signals at appropriate terminals on J7 terminal strip, as follows :

Turn power OFF. Connect positive test lead of meter to terminal 8 on connector J7 (see fig. 18). Set meter for approximately 20 vdc. Turn power ON, but do not enter Quick Test mode. For first 50 seconds valve motor windings will be alternately energized to close valve in circuit 1. During this time, connect negative test lead to terminals 9, 10, 11 and 12 in succession. Voltage should rise and fall at each pin. If it remains constant at a voltage or at 0 volts, remove connector and recheck. If problem is still there, replace processor board. If it is no longer there, expansion valve should be checked.

Turn power OFF and connect positive lead to terminal 1 on connector J7. Turn power ON. After 50 seconds, motor windings in circuit 2 valve will begin to be energized. During this time, connect negative test lead to terminals 2, 3, 4 and 5. Voltage should rise and fall at each pin. If it remains constant at a voltage or at 0 volts, remove connector and recheck. If problem is still there, replace processor board. If it is no longer there, expansion valve should be checked.

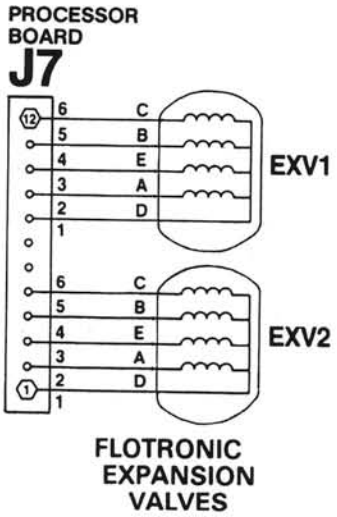


Fig. 18 – Printed-Circuit Board Connector

Step 2 – Check EXV Wiring – Check wiring to electronic expansion valves from J7 terminal strip on processor board (see fig. 18).

1. Check color coding and wire connections. Make sure they are connected to correct terminals at J7 and EXV plug connections.
2. Check for continuity and tight connection at all pin terminals.
3. Check plug at J7 and at EXV's. Be sure EXV connections are not crossed.

Step 3 – Check Resistance of EXV Motor Windings – Remove plug at J7 terminal strip and check resistance between common lead (red wire, terminal D) and remaining leads A, B, C, and E (see fig. 18). Resistance should be 25 ohms ±2 ohms.

Step 4 – Check Thermistors that Control EXV – Check thermistors that control processor output voltage pulses to EXV's. Circuit No. 1 thermistors are T5 and T7, circuit No. 2 thermistors are T6 and T8. Refer to fig. 19 for location.

1. Use Quick Test steps 2.0. through 2.3. to determine if thermistors are shorted or open.
2. Check thermistor calibration at known temperature by measuring actual resistance and comparing value measured with values listed in table 14.
3. Make sure that thermistor leads are connected to proper pin terminals at J1 terminal strip on processor board and that thermistor probes are located in proper position in refrigerant circuit (fig. 19).

When above checks have been completed, actual operation of EXV can be checked by using procedures outlined in Step 5. During Quick Test steps 3.5. and 3.9. each EXV is opened approximately 250 steps by processor. This Quick Test feature, along with initialization mode **20** can be used to verify proper valve operation.

Step 5 – Check Operation of the EXV – Use following procedure to check actual operation of electronic expansion valves.

1. Close liquid line service valve for circuit to be checked and run through appropriate Quick Test step 3.5. or 3.9. to pump down low side of system. Repeat Quick Test step 3 times to insure that all refrigerant has been pumped from low side and that EXV has been driven fully open (760 steps).

Note : Do not use control ON/OFF circuit breaker to recycle control during this step, and be sure to allow compressors to run full 10 seconds at each step.

2. Turn OFF control circuit breaker and compressor circuit breaker(s). Close compressor service valves and vent any remaining refrigerant from low side of system.
3. Remove screws holding top cover of EXV. Carefully remove top cover, using caution to avoid damage to the O-ring seal and motor leads. If EXV plug was disconnected during this process, reconnect it after the cover is removed.
4. Note position of lead screw (see fig. 17). If valve has responded properly to processor signals in Step 5.1. above, valve should be fully open and lead screw should protrude approximately 1/4 in. (6 mm) to 3/4 in. (19 mm) above top of motor.
5. Recycle control by turning control circuit breaker to ON position. This puts control in initialization mode **20**. During first 100 seconds of initialization mode, each valve is driven to fully closed position (760 steps) by processor. With cover lifted off EXV valve body, observe operation of valve motor and lead screw. The motor should turn in the counterclockwise (CCW) direction and lead screw should move down into motor hub until valve is fully closed. Lead screw movement should be smooth and uniform from full open to fully closed position.

This process of opening and closing EXV can be repeated by repeating Quick Test steps 3.5. or 3.9. and recycling control as described in preceding steps. If valve does not operate as described when properly connected to processor and receiving correct signals, it should be replaced.

If operating problems persist after reassembly, they may be due to out-of-calibration thermistor(s), or intermittent connections between processor board terminals and EXV plug. Recheck all wiring connections and voltage signals.

Other possible causes of improper refrigerant flow control could be restrictions in liquid line. Check for plugged filter drier(s), stuck liquid line solenoid valve(s) or restricted metering slots in the EXV. Formation of ice or frost on lower body of electronic expansion valve is one symptom of restricted metering slots. Clean or replace valve if necessary.

Note : Frosting of valve is normal during Quick Test steps 3.5. and 3.9. and at initial start up. Frost should dissipate after 5 to 10 minutes operation of a system that is operating properly. If valve is to be replaced, wrap valve with a wet cloth to prevent excessive heat from damaging internal components. Superheat control built into valve is *not* adjustable.

Thermostatic expansion valve (TXV) – The FIOP chiller is equipped with conventional thermostatic expansion valve, one per circuit. This control system necessitates use of a liquid line solenoid valve. TXV is factory set to maintain 4.4°C to 5.6°C superheat of vapor leaving cooler by controlling flow of refrigerant into cooler. *Superheat can be reset but should be done only if absolutely necessary.*

When TXV is used, thermistors T5, T6, T7, T8 are eliminated (see fig. 19).

TXV also incorporates an MOP feature to limit cooler suction to 12.8°C, making it possible for compressor to start at higher cooler water temperatures without overloading.

Moisture-Liquid Indicator

Clear flow of liquid refrigerant indicates sufficient charge in the system. Bubbles indicate undercharged system or presence of noncondensables. Moisture in the system measured in parts per million (ppm) changes color of indicator. See chart below :

Moisture Content - Parts Per Million (ppm)			
Temperature	Indicator Color		
	Blue	Light Violet	Pink
24°C	Below 30	30-120	Above 120
38°C	Below 45	45-180	Above 180
52°C	Below 60	60-240	Above 240

Change filter drier cores at first sign of moisture in the system.

Important : *Unit must be in operation at least 12 hours before moisture indicator can give an accurate reading. With unit running, indicating element must be in contact with liquid refrigerant to give true reading.*

Filter Drier

Whenever the moisture-liquid indicator shows presence of moisture, replace filter-drier core. Refer to Standard Service Techniques Manual, Chapter 1, Refrigerants, for details on servicing filter driers.

Liquid Line Solenoid Valve

On some units, a liquid line solenoid valve may be used to prevent liquid refrigerant migration to the low side of the system. On other units, the EXV will function as both the expansion valve and the solenoid valve.

Liquid Line Service Valve

This valve is located immediately ahead of the filter drier, provided with a 1/4-in. flare connection for field charging. In combination with the compressor discharge service valve, each circuit can be pumped down into the high side.

THERMISTORS

The electronic control uses 9 thermistors to sense temperatures. These sensors are for :

1. Cooler leaving water temperature (T1).
2. Cooler entering water temperature (T2).
3. Saturated condensing temperature, circuit 1 (T3).
4. Saturated condensing temperature, circuit 2 (T4).
5. Cooler saturation temperature, circuit 1 (T5).
6. Cooler saturation temperature, circuit 2 (T6).
7. Compressor return gas temperature, circuit 1 (T7).
8. Compressor return gas temperature, circuit 2 (T8).
9. Accessory reset-space or outside air sensor (T10).

The general locations are shown in fig. 19.

All thermistors are identical in the temperature vs resistances performance. The resistance at various temperatures are listed in table 14.

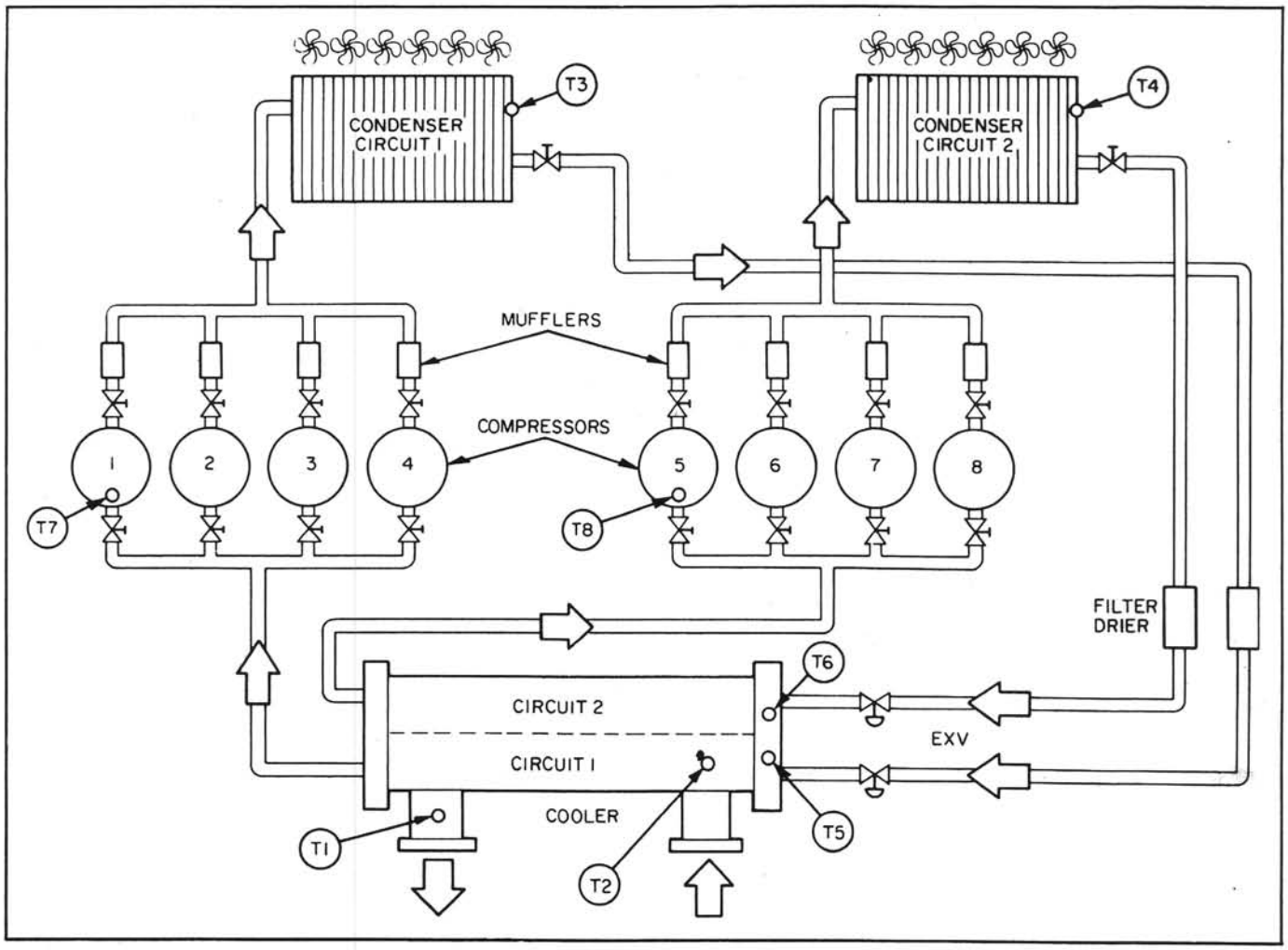


Fig. 19 – Thermistor Locations

Thermistor/temperature sensor check – A high quality digital volt-ohmmeter is required to perform this check.

1. Connect the digital voltmeter across the appropriate thermistor terminals at the J1 terminal strip on the processor board (see fig. 19 and 20). Using the voltage reading obtained, read the sensor temperature from table 14. To check thermistor accuracy, measure temperature at probe location with an accurate thermocouple-type temperature measuring instrument. Insulate thermocouple to avoid ambient temperatures from influencing reading. Temperature measured by thermocouple and temperature determined from thermistor voltage reading should be close, ± 3°C if care was taken in applying thermocouple and taking readings.
2. If a more accurate check is required, machine must be shut down, thermistor removed and checked at a known temperature (freezing point or boiling point of water) using either voltage drop measured across thermistor at the J1 terminals with unit in Quick Test mode **88** or by determining the resistance with chiller shut down and thermistor disconnected from J1.

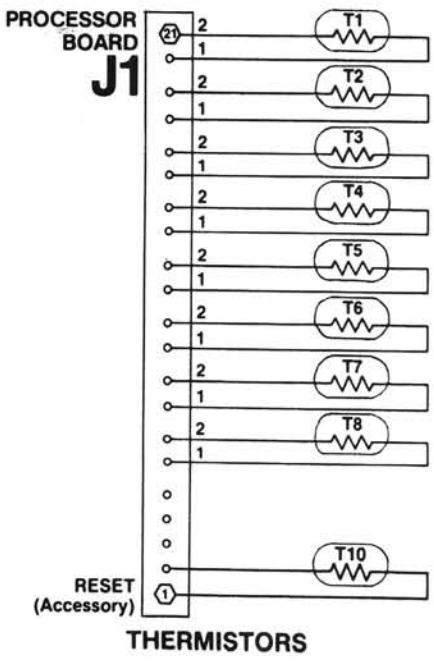
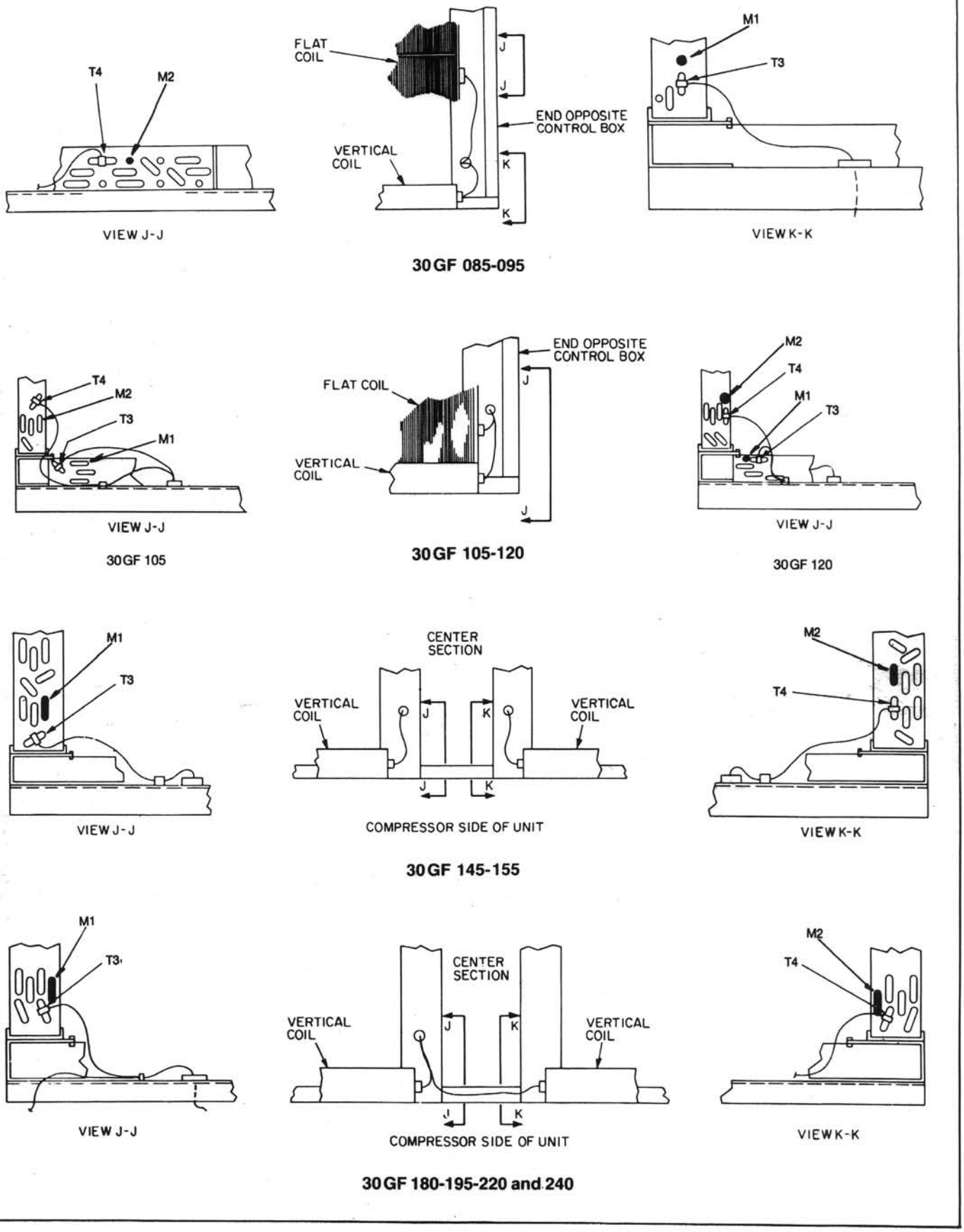


Fig. 20 – Thermistor Connections to J1, Processor Board

Table 14 – Thermistor Resistance and Voltage Drop Characteristics (°C)

TEMP. (°C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP. (°C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP. (°C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP. (°C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP. (°C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)
-32.0	100049.0	4.690	**- 4.0**	20075.9	3.756	**24.0**	5203.2	2.201	**52.0**	1694.0	1.003	**80.0**	602.4	0.431
-31.5	97006.4	4.680	**- 3.5**	19560.8	3.732	**24.5**	5088.1	2.174	**52.5**	1663.5	0.988	**80.5**	592.4	0.425
-31.0	94060.8	4.671	**- 3.0**	19060.6	3.707	**25.0**	4976.0	2.147	**53.0**	1633.5	0.974	**81.0**	582.8	0.418
-30.5	91209.3	4.661	**- 2.5**	18574.8	3.682	**25.5**	4866.8	2.120	**53.5**	1604.1	0.959	**81.5**	573.4	0.412
-30.0	88449.0	4.651	**- 2.0**	18102.9	3.656	**26.0**	4760.2	2.094	**54.0**	1575.2	0.945	**82.0**	564.4	0.406
-29.5	85777.0	4.641	**- 1.5**	17644.5	3.631	**26.5**	4656.4	2.067	**54.5**	1546.9	0.931	**82.5**	555.7	0.400
-29.0	83190.7	4.630	**- 1.0**	17199.1	3.605	**27.0**	4555.2	2.041	**55.0**	1519.0	0.917	**83.0**	547.2	0.394
-28.5	80687.1	4.620	**- 0.5**	16766.3	3.579	**27.5**	4456.6	2.015	**55.5**	1491.6	0.903	**83.5**	539.1	0.388
-28.0	78263.9	4.609	**0.0**	16345.7	3.553	**28.0**	4360.4	1.989	**56.0**	1464.7	0.890	**84.0**	531.2	0.383
-27.5	75918.3	4.597	**0.5**	15936.9	3.526	**28.5**	4266.7	1.963	**56.5**	1438.3	0.876	**84.5**	523.6	0.377
-27.0	73648.0	4.586	**1.0**	15539.5	3.500	**29.0**	4175.4	1.938	**57.0**	1412.3	0.863	**85.0**	516.2	0.371
-26.5	71450.6	4.574	**1.5**	15153.1	3.473	**29.5**	4086.3	1.912	**57.5**	1386.8	0.850	**85.5**	509.2	0.366
-26.0	69323.7	4.562	**2.0**	14777.5	3.446	**30.0**	3999.6	1.887	**58.0**	1361.6	0.837	**86.0**	502.3	0.361
-25.5	67265.0	4.550	**2.5**	14412.2	3.419	**30.5**	3915.0	1.862	**58.5**	1336.9	0.825	**86.5**	495.7	0.355
-25.0	65272.4	4.537	**3.0**	14056.9	3.392	**31.0**	3832.5	1.837	**59.0**	1312.6	0.812	**87.0**	489.4	0.350
-24.5	63343.7	4.525	**3.5**	13711.4	3.364	**31.5**	3752.1	1.813	**59.5**	1288.7	0.800	**87.5**	483.2	0.345
-24.0	61476.9	4.512	**4.0**	13375.3	3.337	**32.0**	3673.7	1.789	**60.0**	1265.2	0.788	**88.0**	477.4	0.340
-23.5	59670.0	4.499	**4.5**	13048.3	3.309	**32.5**	3597.3	1.764	**60.5**	1242.1	0.776	**88.5**	471.6	0.335
-23.0	57920.9	4.485	**5.0**	12730.1	3.281	**33.0**	3522.9	1.741	**61.0**	1219.3	0.765	**89.0**	466.1	0.331
-22.5	56227.9	4.471	**5.5**	12420.5	3.253	**33.5**	3450.2	1.717	**61.5**	1196.9	0.753	**89.5**	460.8	0.326
-22.0	54589.1	4.457	**6.0**	12119.2	3.225	**34.0**	3379.4	1.693	**62.0**	1174.8	0.742	**90.0**	455.6	0.321
-21.5	53002.7	4.443	**6.5**	11826.0	3.197	**34.5**	3310.4	1.670	**62.5**	1153.2	0.731	**90.5**	450.6	0.317
-21.0	51467.0	4.428	**7.0**	11540.5	3.169	**35.0**	3243.1	1.647	**63.0**	1131.8	0.720	**91.0**	445.7	0.312
-20.5	49980.4	4.413	**7.5**	11262.7	3.140	**35.5**	3177.5	1.624	**63.5**	1110.9	0.709	**91.5**	440.9	0.308
-20.0	48541.1	4.398	**8.0**	10992.1	3.112	**36.0**	3113.4	1.602	**64.0**	1090.2	0.698	**92.0**	436.3	0.303
-19.5	47147.7	4.383	**8.5**	10728.8	3.083	**36.5**	3051.0	1.579	**64.5**	1069.9	0.688	**92.5**	431.8	0.299
-19.0	45798.6	4.367	**9.0**	10472.3	3.054	**37.0**	2990.1	1.557	**65.0**	1050.0	0.678	**93.0**	427.4	0.295
-18.5	44492.4	4.351	**9.5**	10222.6	3.026	**37.5**	2930.7	1.536	**65.5**	1030.3	0.667	**93.5**	423.0	0.291
-18.0	43227.6	4.334	**10.0**	9979.3	2.997	**38.0**	2872.8	1.514	**66.0**	1011.0	0.657	**94.0**	418.8	0.287
-17.5	42002.9	4.318	**10.5**	9742.5	2.968	**38.5**	2816.2	1.492	**66.5**	992.1	0.648	**94.5**	414.5	0.283
-17.0	40816.9	4.301	**11.0**	9511.7	2.939	**39.0**	2761.1	1.471	**67.0**	973.4	0.638	**95.0**	410.3	0.279
-16.5	39668.3	4.283	**11.5**	9287.0	2.911	**39.5**	2707.2	1.450	**67.5**	955.1	0.628	**95.5**	406.0	0.275
-16.0	38555.9	4.266	**12.0**	9068.0	2.882	**40.0**	2654.7	1.430	**68.0**	937.1	0.619	**96.0**	401.8	0.271
-15.5	37478.4	4.248	**12.5**	8854.7	2.853	**40.5**	2603.4	1.409	**68.5**	919.4	0.609	**96.5**	397.6	0.267
-15.0	36434.7	4.230	**13.0**	8646.9	2.824	**41.0**	2553.3	1.389	**69.0**	902.1	0.600	**97.0**	393.3	0.264
-14.5	35423.7	4.211	**13.5**	8444.5	2.795	**41.5**	2504.4	1.369	**69.5**	885.1	0.591	**97.5**	389.0	0.260
-14.0	34444.2	4.193	**14.0**	8247.2	2.766	**42.0**	2456.6	1.349	**70.0**	868.4	0.582	**98.0**	384.7	0.257
-13.5	33495.2	4.174	**14.5**	8055.0	2.737	**42.5**	2410.0	1.330	**70.5**	852.0	0.574	**98.5**	380.3	0.253
-13.0	32575.6	4.154	**15.0**	7867.7	2.708	**43.0**	2364.4	1.311	**71.0**	836.0	0.565	**99.0**	375.8	0.250
-12.5	31684.6	4.135	**15.5**	7685.1	2.680	**43.5**	2319.9	1.292	**71.5**	820.2	0.557	**99.5**	371.1	0.246
-12.0	30821.0	4.115	**16.0**	7507.2	2.651	**44.0**	2276.3	1.273	**72.0**	804.8	0.548	**100.0**	366.5	0.243
-11.5	29984.0	4.094	**16.5**	7333.9	2.622	**44.5**	2233.8	1.254	**72.5**	789.8	0.540	**100.5**	361.6	0.240
-11.0	29172.7	4.074	**17.0**	7164.9	2.593	**45.0**	2192.2	1.236	**73.0**	775.0	0.532	**101.0**	356.7	0.236
-10.5	28386.3	4.053	**17.5**	7000.3	2.565	**45.5**	2151.5	1.218	**73.5**	760.6	0.524	**101.5**	351.5	0.233
-10.0	27623.8	4.032	**18.0**	6839.8	2.536	**46.0**	2111.7	1.200	**74.0**	746.5	0.516	**102.0**	346.3	0.230
- 9.5	26884.4	4.010	**18.5**	6683.4	2.508	**46.5**	2072.8	1.182	**74.5**	732.6	0.508	**102.5**	341.1	0.227
- 9.0	26167.5	3.989	**19.0**	6530.9	2.479	**47.0**	2034.7	1.165	**75.0**	719.2	0.501	**103.0**	335.3	0.224
- 8.5	25472.2	3.967	**19.5**	6382.3	2.451	**47.5**	1997.4	1.148	**75.5**	706.1	0.493	**103.5**	329.7	0.221
- 8.0	24797.8	3.944	**20.0**	6237.5	2.423	**48.0**	1960.9	1.131	**76.0**	693.3	0.486	**104.0**	323.8	0.218
- 7.5	24143.6	3.922	**20.5**	6096.3	2.395	**48.5**	1925.1	1.114	**76.5**	680.8	0.479	**104.5**	317.9	0.215
- 7.0	23509.0	3.899	**21.0**	5958.7	2.367	**49.0**	1890.1	1.098	**77.0**	668.6	0.472	**105.0**	311.6	0.212
- 6.5	22893.2	3.876	**21.5**	5824.6	2.339	**49.5**	1855.7	1.081	**77.5**	656.8	0.465	**105.5**	305.3	0.209
- 6.0	22295.6	3.852	**22.0**	5693.9	2.311	**50.0**	1822.1	1.065	**78.0**	645.2	0.458	**106.0**	298.6	0.206
- 5.5	21715.7	3.829	**22.5**	5566.4	2.283	**50.5**	1789.1	1.049	**78.5**	634.0	0.451	**106.5**	292.1	0.204
- 5.0	21152.8	3.805	**23.0**	5442.2	2.256	**51.0**	1756.8	1.034	**79.0**	623.2	0.444	**107.0**	285.2	0.201
- 4.5	20606.4	3.781	**23.5**	5321.2	2.228	**51.5**	1725.1	1.019	**79.5**	612.6	0.437			
- 4.0	20075.9	3.756	**24.0**	5203.2	2.201	**52.0**	1694.0	1.003	**80.0**	602.4	0.431			



Legend :
T3, T4 – Condenser sensors
M1 – Motormaster sensor of circuit 1.
M2 – Motormaster sensor of circuit 2.

Fig. 21 – Condenser Sensor and Motormaster sensor Locations

COOLER SENSORS

Cooler Leaving Water Sensor.
This thermistor is located in the leaving water nozzle. The probe is immersed directly in the water. Connection is made through a 1/4-in. coupling (fig. 22). Actual location is shown in fig. 12.

Cooler Entering Water Sensor
This thermistor is located in the cooler shell in the first baffle space, in close proximity to the tube bundle. The 1/4-in. coupling is used (fig. 22). Actual location is shown in fig. 12.

Saturated Condensing Temperature Sensors
These thermistors are each clamped to the outside of a return bend on the condenser coil. Exact locations for all units are shown in fig. 21.

Cooler Saturation Temperature Sensors
These thermistors are located next to the refrigerant inlet in the cooler head. The 1/4-in. coupling is used (fig. 22). Typical location is shown in fig. 12.

Compressor Return Gas Temperature Sensors.
These thermistors are located in the lead compressor in each circuit in a suction passage between the motor and the cylinders, above the oil pump. The 1/4-in. coupling is used (fig. 22). Location is shown in fig. 8.

Reset Sensor
This is an accessory thermistor, mounted remotely from the unit. Refer to the Wiring, Controls and Troubleshooting book for further information.

Sensor Replacement (Compressor and Cooler)
Caution : *The sensors are installed directly in the refrigerant or water circuit. Relieve all refrigerant pressure or drain water before removing.*
Proceed as follows (refer to fig. 22) :

1. Remove and discard original sensor and coupling. ***Important :*** *Do not disassemble new coupling, install as received.*
2. Apply pipe sealant to 1/4-in. NPT threads on replacement coupling and install in place of original. **Do not use packing nut to tighten coupling ; this would damage the ferrules** (see fig. 22).
3. Insert new sensor in coupling body to its full depth. Hand tighten packing nut to position ferrules, then finish tightening 1-1/4 turns with a suitable tool. The ferrules are now attached to the sensor, which can be withdrawn from the coupling for unit servicing.

SAFETY DEVICES

The chillers contain many safety devices and protection logic built into the electronic control. The following is a brief summary of the major safeties. For complete details refer to the Controls and Troubleshooting book.

Compressor Protection

Circuit Breaker – One manual reset calibrated trip magnetic circuit breaker for each compressor protects against overcurrent. Do not bypass or increase size of a breaker to correct problems. Determine the cause for the trouble and correct before resetting the breaker. Circuit breaker must trip amps (MTA) are listed in table 3.

Compressor Protection Board (CPCS) – The compressor protection board, shown in fig. 9, is used to control and protect the compressors and crankcase heaters. The board provides the following features :

- Compressor contactor control
- Crankcase heater control
- Ground current protection
- Status communication to processor board
- High-pressure protection
- Discharge gas temperature protection
- Compressor contactor thermal protection

One large relay is located on the CPCS board that controls the crankcase heater and compressor contactor ; also, the relay provides a set of contacts that the microprocessor monitors to determine the operating status of the compressor. If the processor board determines that the compressor is not operating properly through the feedback contacts, the control locks the compressor off.

The board contains logic that can detect if the current-to-ground of any winding exceeds 2.5 amps ; if so, the compressor shuts down.

A high-pressure switch is mounted on each compressor ; the switch setting is shown in table 15. The switch is wired in series with the CPCS board. If the switch opens, the CPCS relay opens and the processor detects it through feedback contacts ; the compressor locks off.

A discharge gas thermostat (DGT) mounted in the center head of the compressor detects excessive discharge gas temperatures.

The DGT is set to trip at 146 ± 3° C and to reset at minimum 113° C. The switch is wired in series with the CPCS board and when it opens, the compressor stops.

Switch		Cut-Out	Cut-In
High pressure	kPa	2937 ± 48	2206 ± 138
	psig	426 ± 7	320 ± 20
Loss of charge	kPa	34 ± 20	138 ± 34
	psig	5 ± 3	20 ± 5

Note : Both these pressure switches are automatically reset.

Table 15 – Pressure Switch Setting

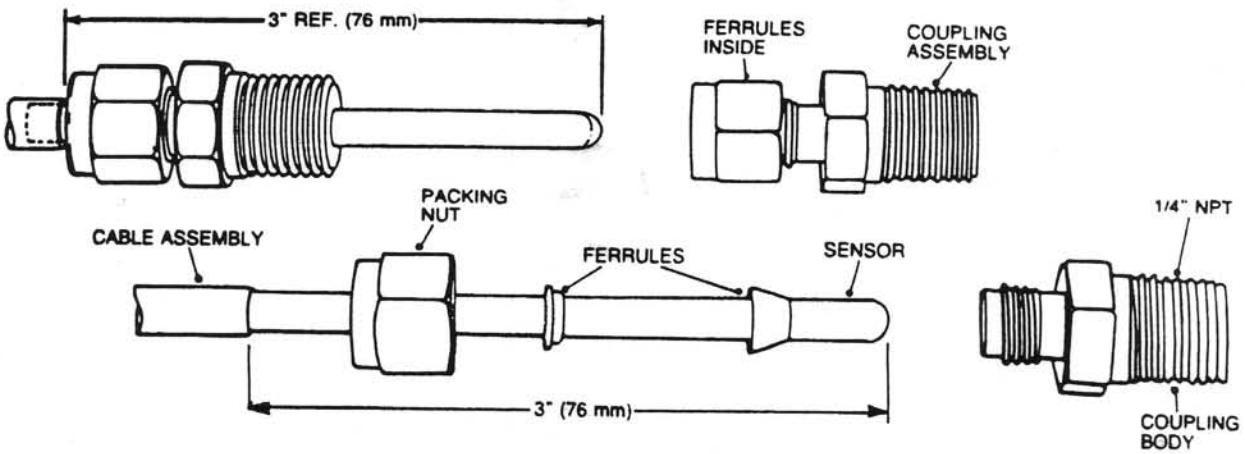


Fig. 22 – Thermistor (Compressor and Cooler)

Low Oil Pressure Protection

The lead compressor in each circuit is equipped with a switch to detect low oil pressure. The switch is connected directly to the processor board. The switch is set to open at approximately 6 psig (41 kPa) and to close at 14 psig (96 kPa) maximum of pressure differential. If the switch opens when the compressor is running, the processor board stops all compressors in the circuit. During start-up, the switch is bypassed for 60 seconds.

Crankcase Heaters

Each compressor has a 200-watt crankcase heater to prevent absorption of liquid refrigerant by oil in the crankcase when the compressor is not running. The heater power source is the auxiliary control power, independent of the main unit power. This assures compressor protection even when the main unit power disconnect switch is off.

Important : *Never open any switch or disconnect that de-energizes the crankcase heaters unless the unit is being serviced or is to be shut down for a prolonged period. After a prolonged shutdown or a service job, energize the crankcase heaters for 24 hours before starting the unit.*

Cooler Protection

Freeze Protection – The cooler is wrapped with heater cables, which are wired through an ambient temperature switch set at 2° C. The entire cooler is covered with 1 layer of 3/4-in. (19 mm) closed-cell insulation, applied over the heater cables. The heaters plus the insulation protects the cooler against low ambient temperature to – 18° C.

Important : *If the unit is installed in an area where ambient temperatures fall below 0° C, it is recommended that ethylene glycol or other suitable solution be used in the chilled-liquid circuit.*

Low Water Temperature – The microprocessor is programmed to shut the chiller down if leaving water temperature drops below 1.7° C. When the water temperature rises 3.3° C above the leaving water set point, the safety resets and chiller restarts.

No-Flow Protection – The microprocessor contains internal logic that protects the cooler against loss of cooler flow. The entering and leaving water temperature sensors in the cooler detect a no-flow condition. The leaving sensor is located in the leaving water nozzle and the entering sensor is located in the first cooler baffle space in close proximity to the cooler tubes, as shown in fig. 12. When there is no cooler flow and the compressors start, the leaving water temperature does not change. However, the entering water temperature drops rapidly as refrigerant enters the cooler through the EXV. The entering sensor detects this temperature drop and when the entering temperature is 2.8° C below the leaving temperature, the unit stops and is locked off.

Loss-of-Charge – A pressure switch connected to the high side of each refrigerant circuit protects against total loss-of-charge. The switch settings are listed in table 15. If the switch is open, the unit cannot restart ; if it opens during operation, the unit locks out and cannot restart until the switch is closed.

A low charge is detected by monitoring the electronic expansion valve (EXV) position and the superheat entering the compressor. If the EXV is wide open, the superheat is greater than 28° C and the saturated cooler suction is less than 13° C. The circuit is stopped and locked off.

RELIEF DEVICES

Fusible plugs are located in each circuit to protect against damage from excessive pressures.

High-Side Protection

One device is located between the condenser and the filter drier ; a second is on the filter drier. These are both designed to relieve on a temperature rise to approximately 99° C.

Low-Side Protection

A device is located on the suction line, designed to relieve on a temperature rise to approximately 77° C.

OTHER SAFETIES

There are several other safeties that are provided by the microprocessor control. For details on these, refer to Controls and Troubleshooting booklet.

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