Carrier Air Conditioning Company

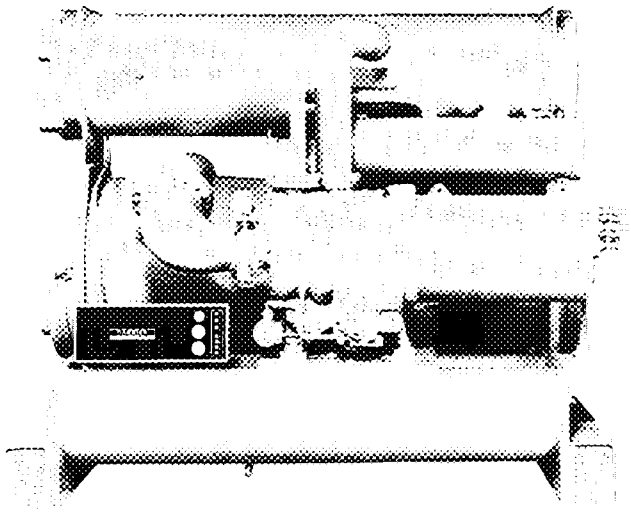
Division of Carrier Corporation

Carrier

Operating and Maintenance Instructions

19FA 1100 thru 1600 Tons

Hermetic Centrifugal Liquid Chillers



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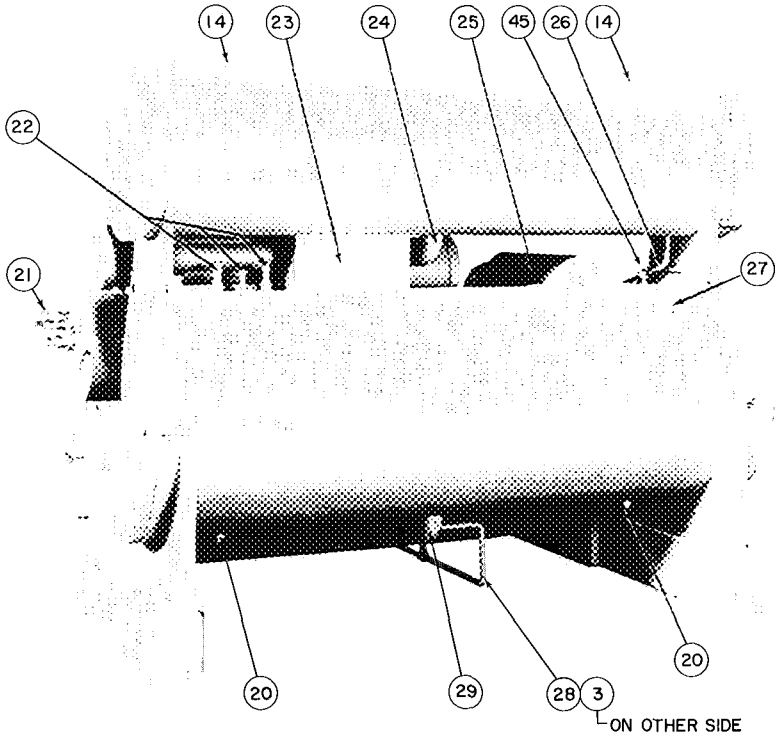
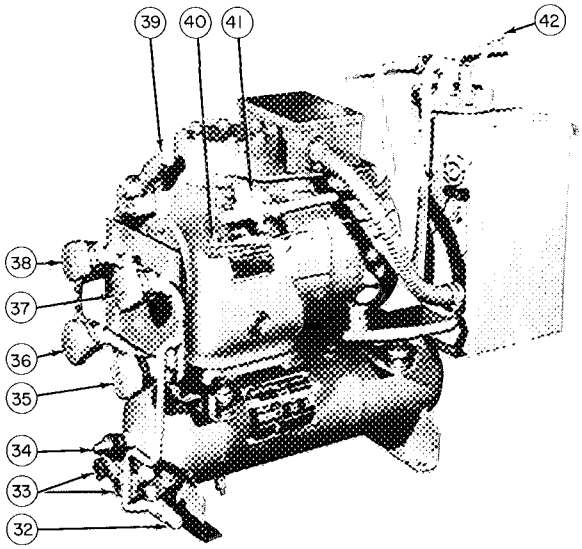
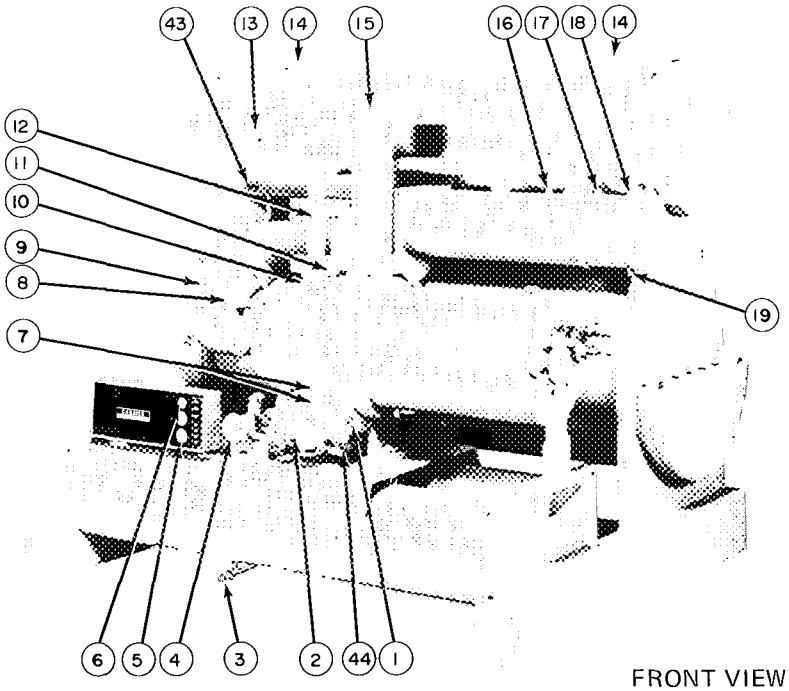


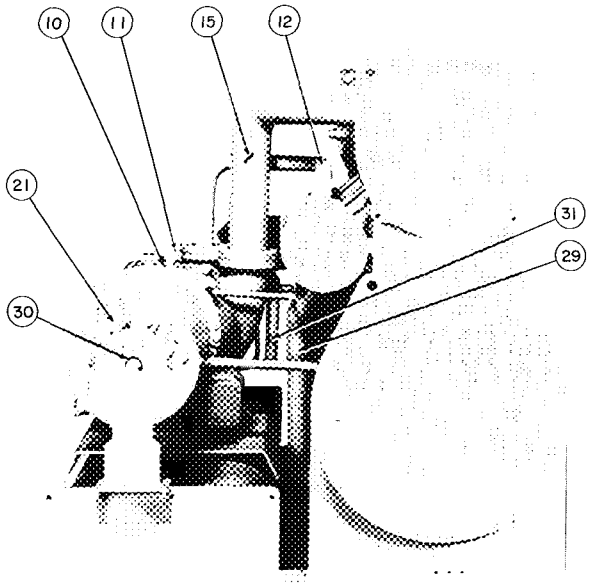
REAR VIEW



PUMPOUT UNIT



FRONT VIEW



END VIEW

LEGEND

1 – Oil Heater and Thermostat
2 – Oil Pump Terminal Box
3 – Refrigerant Charging Valve (Valve 10)
4 – Oil Cooler
5 – Cooler Pressure Gage
6 – Oil Pressure Gage
7 – Oil Level Sight Glass
8 – Guide Vane Actuator
9 – Compressor Suction Elbow
10 – Gear Rotation Sight Glass and Inspection Cover
11 – Thrust Bearing Temperature Gage
12 – Economizer Gas Line to Compressor
13 – Sight Glass or Level Control Connection
14 – Condenser Vent Connection (Valve 11)
15 – Compressor Discharge Pipe
16 – Control Connection
17 – Vent Connection (Flash Gas Chamber)
18 – Vent Connection (Cond Float Valve Chamber)
19 – Economizer High Side Drain
20 – Cooler Drain Connection
21 – Compressor Motor Terminal
22 – Cooler Relief Valves
23 – Vessel Support Plate
24 – Refrigerant Liquid Outlet
25 – Cooler Suction Pipe
26 – Motor Cooling Liquid Supply Line
27 – Pumpout Connection
28 – Refrigerant Transfer Pipe
29 – Cooler Liquid Inlet from Economizer
30 – Motor Rotation Arrow
31 – Oil Filter
32 – Refrigerant Inlet Valve
33 – Condenser Water Connections
34 – Relief Valve
35 – Service Valve 4
36 – Service Valve 5
37 – Service Valve 2
38 – Service Valve 3
39 – Suction Service Valve
40 – Oil Return Line Connection
41 – Discharge Service Valve
42 – Service (Vent) Valve 8
43 – Condenser Thermowell
44 – Oil Charging and Drain Valve
45 – Service Valve 1

Fig. 1 – 19FA Machine Components

OPERATING INSTRUCTIONS

Operator Duties

1. Become familiar with refrigeration machine and related equipment before operating.
2. Start and stop machine as required.
3. Inspect equipment; make routine adjustments, maintain proper levels of oil, water and refrigerant.
4. Maintain log of operating conditions and recognize abnormal readings.
5. Protect system against damage during shutdown.

Before Starting Machine – Check:

1. Power on to circuit breakers, water pumps, cooling tower fans.
2. Cooling tower water level.
3. Oil reservoir level (oil visible at sight glass).
4. Oil reservoir temperature approximately 145 F.
5. Oil cooler plug cock partially open, any other manual valves in oil cooler line fully open.
6. Wing-cap valve near oil filter (Item 31, Fig. 1) fully open.
7. Valves in chilled and condenser water circuits open. *Do not permit water over 100 F to flow thru cooler*
8. Service valve 1 (Fig. 4) open; all other pumpout service valves closed.
9. Adequate air supply to pneumatic controls.

To Start Machine

1. Energize main circuit breaker.
2. Start water pumps and cooling tower fan (if not automatic).
3. Press ON-STOP switch at machine control center.
4. Press machine START switch.
   a. Oil pump starts within 30 seconds. If PROGRAM TIMER light is on, oil pump will start within 15 minutes.
   b. Compressor starts approximately 30 seconds after oil pump; program timer stops (light goes out).

Check Running System – After compressor starts, operator should observe the following conditions of normal operation.

Oil reservoir temperature	140 - 150 F
Bearing oil return temperature	170 F max
Oil level	Visible at lower sight glass
Oil cooler water	Visible at open drain
Condenser leaving water	Over 55 F
Cooler temperature } Condenser temperature	Refer to selected design conditions

NOTE: The compressor may operate at full capacity for a short time during pulldown even though the building cooling load is small. The electrical demand control (Fig. 2) may be adjusted to avoid a high demand charge for the short period of full capacity operation.

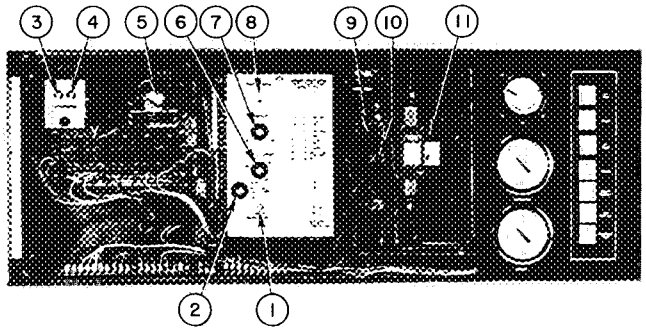
To Stop Machine

1. Press ON-STOP switch (compressor stops).
2. Stop water pumps and cooling tower fan (if not automatic).
3. Oil pump stops in approximately 40 seconds.
4. Machine may be restarted in approximately 15 minutes.

Should machine fail to stop, first close the guide vanes, then pull main circuit breaker Do not attempt to stop machine by opening an isolating knife switch. DO NOT restart machine until malfunction is located and corrected.

On machines with electronic capacity control, close the guide vanes by turning capacity control switch (Fig. 2) to "Dec" (decrease).

On machines with pneumatic control, close the vanes by turning the chilled water thermostat (Fig. 3) to a high setting.



LEGEND

1 – Motor Current Calibration	**8** – Throttle Range Adjustment
2 – Capacity Control Switch	**9** – Condenser High-Pressure Cutout
3 – Bearing High-Temp Cutout	**10** – Econ-Cooler Diff Pressure Switch
4 – Motor High-Temp Cutout	**11** – Low Oil-Pressure Cutout
5 – Program Timer	
6 – Electrical Demand Selector	
7 – Thermostat (Chilled Water)	

Fig. 2 – 19FA Control Center (Electronic Capacity Control)

After Limited Shutdown – No special operations should be necessary. Follow the regular preliminary checks and starting procedures.

Extended Shutdown – Refrigerant 12 or 500 should be transferred into the machine storage tank (see Pumpout Procedures) in order to reduce machine pressure. Maintain a holding charge of 5 to 10 lbs to prevent air leakage into the machine.

If freezing temperatures are likely to occur in the machine area, drain the chilled water, condenser water and oil cooler water circuits to avoid freeze-up. Clear the oil cooler lines with air. Keep water box drains open.

Leave the oil charge in the machine, with the oil heater (Item 1, Fig. 1) energized to maintain a minimum oil temperature of 140 F.

After Extended Shutdown – Be sure that water system drains are closed. It may be advisable to flush water circuits to remove any soft rust which may have formed.

Check cooler gage. If (after adjusting for changes in ambient temperature) any loss in holding charge is indicated, check for refrigerant leakage. Detailed test procedures are given in the 19FA Initial Start-Up Instructions.

Recharge machine by transferring refrigerant charge from the storage tank as described in Pump-out Procedures. *Observe freeze-up precautions.*

Carefully make all regular preliminary and running system checks.

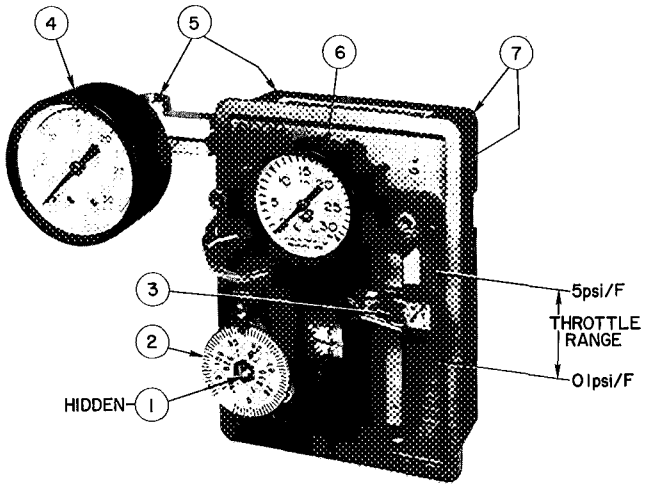
Cold Weather Operation – When entering condenser water temperature drops very low (55 F minimum), cycle the cooling tower fans off to keep the temperature up. Piping may also be arranged to automatically or manually bypass the cooling tower.

Manual Operation – Manual control permits the operator to change the leaving chilled water temperature without altering the automatic temperature control settings. It is useful in checking control operation and safety cutout points, in overcooling the building prior to a heavy load, or in controlling the machine in an emergency.

ELECTRONIC CONTROL – Turn capacity control switch to "Dec" to close guide vanes and lower machine capacity.

"Hold" maintains guide vane position

"Inc" opens guide vanes and increases capacity.



LEGEND

1 – Set Point Adjusting Screw
2 – Thermostat Dial
3 – Sensitivity Slider
4 – Supply Air Pressure Gage
5 – Supply Air Connections
6 – Control Air Pressure Gage
7 – Control Air Connections

Fig. 3 – Pneumatic Thermostat

PNEUMATIC CONTROL – Pneumatically controlled machines have no method for independent manual control. However, similar effects can be obtained by manually resetting the air-operated chilled water thermostat (Fig. 3) to a new control point.

Carrier Air Conditioning Company

DATE _____

REFRIGERATION LOG CARRIER 19E/F HERMETIC CENTRIFUGAL REFRIGERATION MACHINE

PLANT _____ MACHINE SERIAL NO _____ MACHINE SIZE _____ REFRIGERANT TYPE _____

	COOLER				CONDENSER				COMPRESSOR					DEHYDRATOR				
	H_2O Press In _____ GPM _____ H_2O Press Out _____				H_2O Press In _____ GPM _____ H_2O Press Out _____					OIL			FLA					
Time	Shut-down Refrigerant Level	Refrigerant Pressure	Water Temperature IN	Water Temperature OUT	Refrigerant Pressure	Refrigerant Temperature	Water Temperature IN	Water Temperature OUT	Bearing Temperature	Level	Temperature (reservoir)	Pressure (differential)	Motor Amps or Vane Position	Refrigerant Level	Condenser Pressure	Operator's Initials		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

REMARKS: Indicate shut downs on safety controls, repairs made, oil or refrigerant added or removed, air exhausted and water drained from dehydrator Include amounts

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Fig. 4 – Refrigeration Log

Refrigeration Log – A properly kept refrigeration log similar to that shown in Fig. 4 is an aid in scheduling maintenance and in diagnosing machine problems. A record of pressures, temperatures and liquid levels should be made regularly and observed for any changes. Copies of this refrigeration log may be obtained thru your local Carrier office. Specify the form number appearing at the lower left corner of the sheet

Pumpout Procedures – The 19FA pumpout system permits transfer of refrigerant between machine and storage tank when reducing machine pressure for extended shutdown or repair.

The system consists of storage tank, pumpout unit with compressor, condenser and controls, and all necessary valves and interconnecting piping.

Before operating the pumpout unit, open both the suction and the discharge valve of the pumpout compressor (Fig. 1) by rotating the valve stem counterclockwise. Open the refrigerant inlet valve (Fig. 1) on the pumpout condenser.

Oil should be visible at the pumpout compressor sight glass during both shutdown and operation. If oil is low, add as follows·

1. With compressor off, close (frontseat) the suction and the discharge valves by turning the valve stems clockwise.
2. Remove the oil return line connection (Item 40, Fig. 1) at the suction manifold and add oil as required. *Use only Carrier compressor oil or Carrier approved equivalent for reciprocating compressors*

WARNING. Always block springs of spring-isolated machines when transferring large quantities of refrigerant.

Pumpout valves, referred to by numbers 1 thru 11, are shown in Fig. 1 and 5. Since valve 1 allows cooler pressure to reach the gage on the control center, it is generally left open. In the valve-condition diagrams which follow, closed valves are indicated by the letter "C."

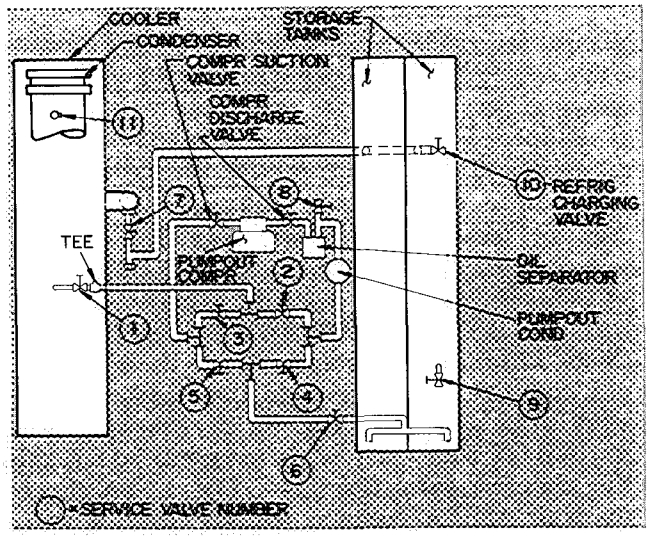


Fig. 5 – Pumpout System Schematic

TRANSFER REFRIGERANT FROM MACHINE TO STORAGE TANK (see Fig. 5).

1. Equalize refrigerant pressure:
   a. Be sure valves 8, 9 and 10 are closed.
   b. Close valves 3, 4 and 5.
   c Open valves 1, 2 and 6.

VALVE	1	2	3	4	5	6	7	8
CONDITION			C	C	C		C	C

   d. Open valve 4 and liquid line valve 7 to allow liquid refrigerant to drain by gravity into storage tank.

VALVE	1	2	3	4	5	6	7	8
CONDITION			C		C			C

2. Transfer remaining liquid.
   a. Be sure that pumpout condenser water is off.
   b. Open valve 5.
   c. Close valve 4.

VALVE	1	2	3	4	5	6	7	8
CONDITION			C	C				C

   d. Run pumpout compressor for 30 minutes, then close valve 7.

VALVE	1	2	3	4	5	6	7	8
CONDITION			C	C			C	C

   e. Turn off pumpout compressor.
3. Remove any entrapped refrigerant:
   a. Run cooler and condenser water pumps.
   b Close valves 2 and 5.
   c. Turn on pumpout condenser water (machine water pumps also running)
   d. Open valves 3 and 4.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C			C		C	C

   e. Run pumpout compressor until machine pressure reaches 45 psig, then shut it off. Warm condenser water will boil off entrapped liquid refrigerant and machine pressure will rise.
   f. When pressure rises above 50 psig, turn on pumpout compressor and reduce machine pressure to 45 psig. Turn off compressor and allow pressure to rise again to 50 psig. Repeat until pressure no longer rises, then pumpout to:
      5 – 10 psig (extended shutdown)
      0 psig (for service)
   g. Turn off pumpout condenser water and machine water pumps.
4. Establish vacuum for service:
   Machine may be opened for service at 0 psig. To conserve refrigerant, it may be desirable to operate pumpout compressor until machine pressure reaches 22 in. Hg, ref 30 in. bar. (4 psia) at step 3-f.

TRANSFER REFRIGERANT FROM STORAGE TANK TO MACHINE (See Fig. 5.)

1. Equalize refrigerant pressure.
   a. Ensure that pumpout vent valve 8 is closed.
   b. Close valves 3, 4 and 5.
   c. Open valves 1, 2 and 6.

VALVE	1	2	3	4	5	6	7	8
CONDITION			C	C	C		C	C

   d. Turn on machine water pumps.
   e. Crack open valve 4, gradually increasing machine pressure to 45 psig. *Feed refrigerant slowly to prevent tube freeze-up.*
   f. Open valve 4 fully and open liquid line valve 7 until refrigerant pressure equalizes.

VALVE	1	2	3	4	5	6	7	8
CONDITION			C		C			C

2. Transfer remaining refrigerant.
   a. Close valve 2.
   b. Open valve 3.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C			C			C

   c. Turn off machine water pumps and be sure pumpout condenser water is off.
   d. Turn on pumpout compressor until liquid is out of storage tank.
   e. Close liquid line valve 7.
   f. Turn off pumpout compressor.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C			C		C	C

   g. Turn off valves 3 and 4.
   h. Open valves 2 and 5.

VALVE	1	2	3	4	5	6	7	8
CONDITION			C	C			C	C

   i. Turn on pumpout condenser water.
   j. Run pumpout compressor until storage tank pressure reaches 5 psig (0 psig if repairing).
   k. Turn off pumpout compressor.
   l. Close valves 2, 5 and 6.
   m. Turn off pumpout condenser water.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C	C	C	C	C

EVACUATE REFRIGERATION MACHINE

1. If machine has been pressurized, vent pressurizing gas (nitrogen or dry air) to atmosphere thru valve 11 on condenser (Fig. 1) until machine pressure reaches approximately 0 psig. Then close valve 11.
2. With pumpout condenser water running, remove flare cap and crack open valve 8. *Vent refrigerant slowly to avoid freeze-up of pumpout condenser water.*

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C	C	C	C	

3. Turn off pumpout condenser water.
4. Open valve 3.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C		C	C	C	C	

5. Operate pumpout compressor until manometer reads 26 in. Hg, ref 30 in. bar (2 psia).
6. Close valve 3.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C	C	C	C	

7. Shut off pumpout compressor.
8. Close vent valve 8 and replace flare cap.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C	C	C	C	C

EVACUATE STORAGE TANK

1. If tank is under pressure, vent pressurizing gas (nitrogen or dry air) to atmosphere thru valve 9 until tank pressure reaches approximately 0 psig.
2. Turn on pumpout condenser water.
3. Remove flare cap and crack open valve 8. *Vent refrigerant slowly to avoid freeze-up of condenser water.*

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C	C	C	C	

4. Turn off pumpout condenser water.
5. Open valves 5 and 6.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C			C	

6. Turn on pumpout compressor and operate until manometer (attached to valve 9 or 10) reads 26 in. Hg, ref 30 in. bar. (2 psia).
7. Close valves 5 and 6.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C	C	C	C	

8. Shut off pumpout compressor.
9. Close vent valve 8 and replace flare cap.

VALVE	1	2	3	4	5	6	7	8
CONDITION		C	C	C	C	C	C	C

WEEKLY MAINTENANCE

Check Lubrication System – While the machine is off, compare the oil level to that marked on the sight glass (Item 7, Fig. 1) at time of initial start-up. If additional oil is required, add it thru the charging valve (Item 44, Fig. 1) on the oil reservoir wall. A pump is required for adding oil against machine pressure.

Use only high-grade oil such as that originally furnished with the machine. An additional supply may be ordered thru the nearest Carrier office. If other oil is used, it must conform to Carrier specifications as follows:

Viscosity at 110 F, SSU	300 ± 25
Viscosity at 210 F, SSU	50 to 55
Viscosity index (min)	95
Pour point (max)	-5 F
Flash point (min)	400 F

Rust inhibiting characteristics: material shall pass ASTM Rust Test D665, latest revision. Procedure A will be used with test period of 24 hours.

Oxidation Resistance: material shall pass ASTM Oxidation Test D943, latest revision, for a minimum of 2000 hours. Acid number at test end shall not exceed 2.0 mg, KOH per gm.

If other oil is used, Carrier assumes no responsibility other than that covered by standard guarantee.

An oil heater and thermostat (Item 1, Fig. 1) maintain the oil reservoir at 140 to 150 F. The heater pilot light should be on whenever the heater is energized. If the light is out and the reservoir is warm, check the terminals to see whether the contacts are closed. Replace the bulb if necessary.

If the pilot light is out and the reservoir is colder than normal, the thermostat may be set too low or the power may be off. Reset the thermostat. Check power source.

Do not operate machine unless the oil temperature is over 135 F.

SCHEDULED MAINTENANCE

Use the time intervals listed in this section as guides in establishing a maintenance schedule suited to your actual machine conditions (machine load, hours of operation, etc).

Inspect Control Center – Maintenance is normally limited to general cleaning, tightening of connections and replacement of relays and modules. Carrier stocks replacement relays and modules. In the event of machine malfunction, directions for checking and adjusting controls may be found in the Troubleshooting section.

Be sure that power is off when making checks and adjustments inside the control center.

Check Safety Controls – To insure machine protection, the safety controls should be checked at least once during the operating season, or at least once every 6 months if the machine is operating continuously.

CHILLED WATER LOW-TEMPERATURE CUTOUT

1. With refrigerant in machine, water pumps operating and all preliminary checks made, start the machine.
2. Open guide vanes slowly (see Manual Operation) while observing thermometer in leaving chilled water line.
3. Check cutout points as follows:
   a. Water chilling duty – Cutout should open and shut down machine at 5 degrees below design leaving water temperature or 37 F whichever is higher.
   b. Brine chilling duty – Cutout should open and shut down machine at 5 degrees below design leaving brine temperature.
4. Chilled water pump continues to run and chilled water (brine) temperature rises. Compressor will restart when temperature is approximately 10 degrees above the cutout point and the program timer has completed the 15-minute delay between machine stop and restart.
5. Adjust the cutout and differential points if required. Check machine operation after each adjustment. Cutout must open ahead of the refrigerant low temperature cutout or machine will not recycle automatically.

REFRIGERANT LOW-TEMPERATURE CUTOUT

1. Place a jumper across the chilled water low-temperature cutout.
2. Start machine.
3. Open guide vanes manually while observing chilled water and refrigerant temperatures.
4. Check cutout points as follows:
   a. Water chilling duty – Switch should open at 33 F or at one degree below design refrigerant temperature, whichever is lower. *Do not permit chilled water temperature to drop below 33 F.*
   b. Brine chilling duty – Switch should open at brine freezing temperature or at 5 degrees below suction temperature, whichever is higher.

OIL LOW-PRESSURE SWITCH – Switch senses pressure difference between oil discharge and oil reservoir.

Pump refrigerant into storage tank until machine side pressure is 0 psig. Disconnect oil supply connection and apply metered air (with reservoir connection side at 0 psig). Switch should close when pressure reaches 17 ± 1 psi and open when pressure is reduced to 13 ± 1 psi.

CONDENSER HIGH-PRESSURE CUTOUT – With machine at 0 psig, disconnect high-pressure cutout and test with metered supply of air. Switch should open at 220 ± 5 psig. Reduce pressure slowly. Switch should allow manual reset at 185 to 192 psig.

PUMPOUT COMPRESSOR HI-PRESSURESTAT – Connect pressurestat to metered supply of air. Switch should open at 161 ± 5 psig. Switch should reset automatically when pressure is reduced to $130 \pm {}^{7}_{0}$ psig.

Inspect Starting Equipment – Before checking starter:

1. Shut off machine.
2. Open disconnect ahead of starter.

Isolating knife switches must not be opened while the machine is running. Serious injury may result.

Inspect the starter contact surfaces for wear or pitting. Do not sandpaper or file silverplated contacts. Refer to starter manufacturer's instructions for contact replacement, lubrication or other maintenance requirements.

Inspect Cooler Tubes – Examine and clean cooler tubes at the end of the first operating season. Tube condition at this time will establish the required frequency for cleaning and will indicate whether water treatement is needed in the chilled water circuit.

Inspect Condenser Tubes – Since this water circuit is usually an open system, the tubes may be subject to contamination by foreign matter, scale etc. Clean the condenser tubes at least once a year, or more often if the water is contaminated.

Higher than normal condenser pressure, together with inability to reach full refrigeration load, usually indicates dirty tubes, or air in the machine. When the refrigeration log indicates a rise above normal condenser pressures, check the pressure against actual refrigerant condensing temperatures as follows:

1. Install a thermometer in the condenser liquid temperature well (Item 43, Fig. 1).
2. If the thermometer reading is more than 2 F below the temperature listed for the existing pressure (Table 1), air is present in the machine.
3. Vent the air in spurts thru the condenser purging valve until condenser pressure is reduced to normal.
4. If the thermometer reading corresponds with the pressure reading (Table 1), the high condenser pressure is due to dirty tubes or to abnormal condensing water conditions such as restricted flow, etc.
5. Check operation of condensing water circuit. If water conditions (flow and temperature) appear normal, the tubes should be cleaned.

Tube cleaning brushes, especially designed to prevent scraping or scratching of tube walls, are available thru your Carrier office. *Do not use wire brushes.* Hard scale may require chemical treatment for its prevention or removal. Consult a water treatment specialist for the proper treatment.

Change Oil and Oil Filters yearly or if machine is opened for repairs.

1. Drain the reservoir by opening the drain valve (Item 44, Fig. 1). Open the valve slowly if machine contains refrigerant.
2. Close the wing-cap valve (Item 1, Fig. 6) to isolate the oil filter(s).
3. Loosen the filter-holding clamp near the filter bottom (Fig. 6).
4. Rotate filter body counterclockwise to remove, as indicated by arrows in Fig. 6. Keep the filter body upright when removing to avoid oil spill.
5. Drain the oil and remove and replace the filter cartridges. Filter cartridges are available thru your nearest Carrier office.
6. Replace new filter(s); tighten clamp; open wing-cap valve.
7. Charge machine with oil.

Table 1 – Refrigerant Temperature vs Pressure (Saturated)

TEMP (F)	REFRIG (psig)		TEMP (F)	REFRIG (psig)	
	R-500	R-12		R-500	R-12
0	13.26	9 15	70	85 81	70 19
2	14 42	10 18	72	89.01	72 86
4	15 73	11 24	74	92.27	75 60
6	17.03	12.34	76	95 59	78.39
8	18 36	13.47	78	99.00	81 25
10	19 75	14 64	80	102 5	84 17
12	21.18	15 84	82	106 1	87 16
14	22 65	17.08	84	109 7	90.22
16	24.16	18.36	86	113 4	93.34
18	25 72	19.68	88	117 3	96 53
20	27 33	21 04	90	121 2	99 79
22	28 99	22.44	92	125 1	103.12
24	30 70	23.88	94	129 2	106.52
26	32 45	25 36	96	133 3	110 00
28	34 26	24 88	98	137 6	113.54
30	36.12	28.45	100	141 9	117 16
32	38 04	30 06	102	146.3	120.9
34	40 01	31.72	104	150 9	124 6
36	42 02	33 42	106	155 4	128 5
38	44.10	35 17	108	160 1	132 4
40	46.24	36 97	110	164 9	136 4
42	48 44	38 82	112	169 8	140.5
44	50 69	40 71	114	174 8	144 7
46	53 01	42.66	116	179.9	148 9
48	55.39	44.65	118	185 0	153 2
50	57 82	46.70	120	190 3	157 6
52	60 32	48 80	122	195 7	162 2
54	62 87	50 95	124	201 2	166 7
56	65 52	53 16	126	206 7	171 4
58	68 21	55 42	128	212 4	176 2
60	70 96	57 74	130	218.2	181.0
62	73.79	60 11	132	224.1	185 9
64	76 69	62 54	134	230 1	191 0
66	79.67	65 03	136	236 3	196 1
68	82 71	67 58	138	242 5	201 3

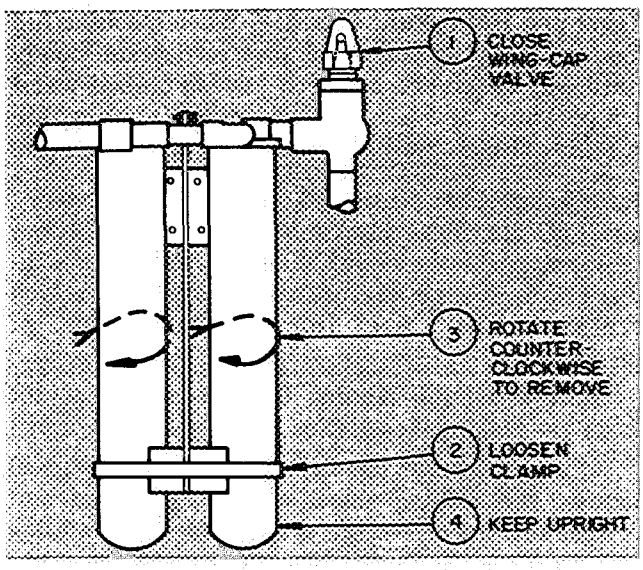


Fig. 6 – Removing the Oil Filters

Check Economizer Damper – With machine side pressure at 0 psig, remove the spring housing from the damper valve (Fig. 7) yearly or when machine is opened for repair. Exercise care in removing cover against the force of the valve spring (approximately 50 lb).

Check the valve, damper and linkage for free travel and clean the assembly thoroughly. Replace the valve packing (Fig. 7) and the housing "O" ring gasket if necessary.

Compressor Bearing Maintenance – The best bearing maintenance consists primarily of maintaining clean oil at proper temperature and pressure in the lubricating system. With machine-side pressure at 0 psig, examine bearings on a scheduled basis for signs of wear. Examination frequency will depend upon condition of lubrication system, hours of machine operation, machine load, etc.

The removal and examination should be done only by a trained service mechanic. Contact your nearest Carrier office for assistance.

Excessive bearing wear can sometimes be detected thru increased vibration or increased bearing temperature. If either of these symptoms appears, contact your nearest Carrier office for assistance by a Carrier service mechanic.

Inspect Refrigerant Float Chambers – With machine pressure at 0 psig, remove access covers from each chamber. Clean chamber and valve assembly thoroughly. Check that orifices, drains, vents and control connections are free from obstructions. Be sure that float valves move freely. Examine cover gaskets and replace if necessary.

Ordering Replacement Parts – Order Carrier Specified Parts from your nearest Carrier office. The following information must accompany order:

1. Machine model and serial number.
2. Name, quantity and part number of part required.
3. Delivery address and mode of shipment.

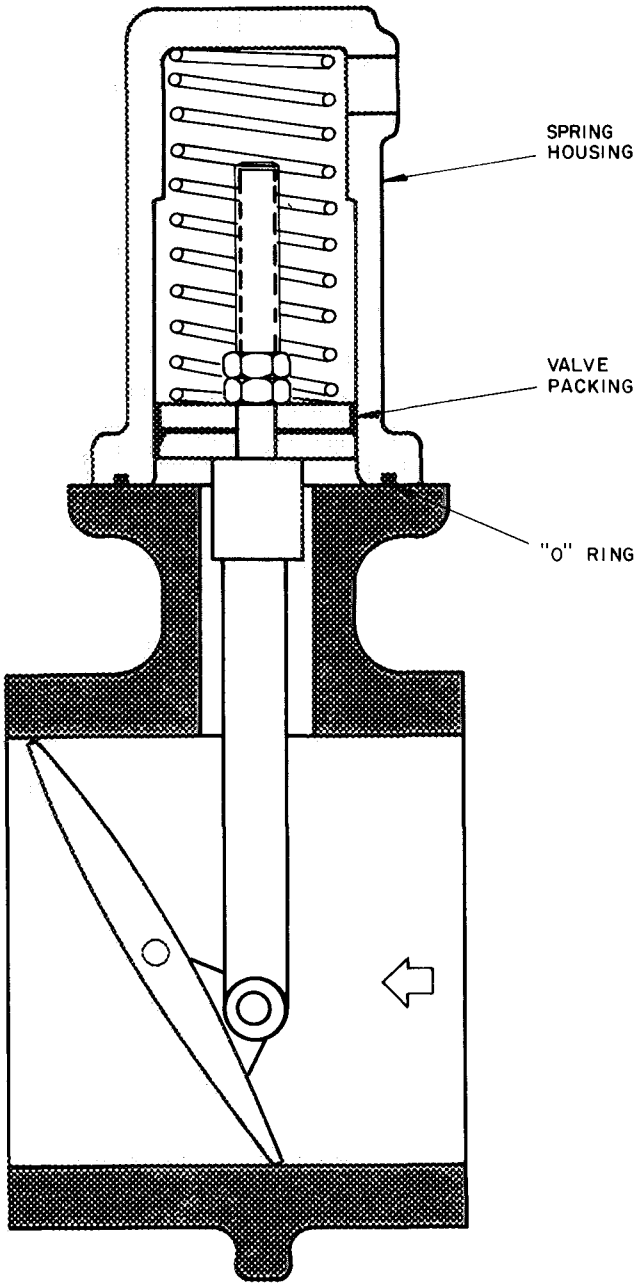


Fig. 7 – Economizer Gas-Line Damper

GENERAL MAINTENANCE

Refrigerant Properties – Refrigerant 500 or 12 is used in 19FA machines, depending upon machine size and application.

At normal room pressure, both refrigerants boil at approximately 25 degrees below 0° F and must therefore be kept in pressurized containers.

Each refrigerant is practically odorless when mixed with air, and is noncombustible and nontoxic (except in open flame). They will, however,

dissolve oil, dry the skin and in heavy concentrations *may displace enough oxygen to cause asphyxiation.* In handling these refrigerants, protect hands and eyes and avoid breathing fumes.

Charging Refrigerant – Large quantities of refrigerant are normally added to the machine thru the charging valve (valve 10) at the bottom of the storage tank (Fig. 1). The refrigerant is then transferred as required to the machine proper. The method of transfer is described in Pumpout Procedures.

Refrigerant may be added directly to the machine cooler thru the tee at valve 1 (Fig. 1). In this case, observe the following caution:

Charging refrigerant as a liquid when vessel pressure is below value listed in Table 2, or with water pumps not operating, may cause tube freeze-up and serious damage.

Table 2 – Pressures Corresponding to 32 F Saturation Temperature

REFRIG	PRESSURE (psig)	CHARGE AS GAS UP TO:
R-500	38.04	45 psig
R-12	30 06	35 psig

Charge refrigerant *as a gas* until system pressure exceeds the Table 2 value. Then charge refrigerant as a liquid until approximately 2/3 of full charge is in the machine. Start the machine and add refrigerant until design temperatures and pressures are reached. Do not overcharge.

Because of the large range of 19FA applications, the exact refrigerant charge must be obtained from the individual job specifications. An approximation of the charge may be obtained by adding proper cooler and condenser-economizer charges in Table 3.

Table 3 – Typical 19FA Refrigerant Charges

COOLER SIZE 17FA*	CHARGE† (lb)		COND-ECON ASSEMBLY 17FA*	CHARGE† (lb)	
	R-500	R-12		R-500	R-12
22	1569	1761	22	1223	1437
24	1743	1954	24	1417	1671
25	1811	2031	25	1410	1663
26	1898	2130	26	1403	1656
27	2186	2448	27	1557	1841
28	2304	2581	28	1550	1833
29	2355	2540	29	1543	1823

*Identify Cooler and Condenser-Economizer size by first 6 digits of vessel assembly number on Machine Identification Plate (located on cooler end flange)

†Complete machine charge is the sum of cooler charge plus condenser-economizer charge

Removing Refrigerant – The 19FA integral storage tank is large enough to hold the full charge of refrigerant. For service work or extended shutdown, refrigerant is transferred to storage tank or to machine as described in Pumpout Procedures.

Trimming Refrigerant Charge – When machine full load is available, add or remove refrigerant slowly until the difference between leaving chilled water temperature and cooler refrigerant temperature reaches design conditions or becomes a minimum.

Refrigerant Leak Testing – Since Refrigerants 12 and 500 are above atmospheric pressure at room temperature, leak testing may be performed with refrigerant in the machine. Be sure the room is well ventilated and free from concentrations of refrigerant.

Before making repairs, transfer all refrigerant from the leaking vessel. (See Pumpout Procedures.)

If all refrigerant has been lost, leak testing will require pressurizing vessel with nitrogen gas and refrigerant tracer, vessel evacuation and standing vacuum test. To ensure removal of all moisture, dehydration may also be necessary.

Pressurizing the Machine – Whenever machine vacuum must be broken for service work, nitrogen is recommended. Dry nitrogen is preferable to air as it ensures that moisture will not be introduced into the machine. *Under no circumstances should oxygen be used for pressurizing.*

To pressurize with nitrogen (or bottled dry air):

1. Connect copper tube from pressure cylinder to charging valve 10 or, if pressurizing machine side only, connect to valve 1 or valve 11. Never apply full cylinder pressure to the pressurizing line. Follow the sequence below.
2. Open charging valve (or valve 1 or 11) fully.
3. Open cylinder regulating valve slowly.
4. Observe pressure gage on storage tank or machine and close cylinder regulating valve when test pressure of 45 psig is reached.
5. Close valve on tank or machine. Remove copper tube if no longer required.

Standing Vacuum Test

1. Attach a manometer to valve 10 or valve 1 as required.
2. Evacuate machine, storage tank or entire chiller with pumpout unit or with vacuum pump.
3. At a manometer reading of 26-in. Hg, ref 30-in. bar. (2 psia), valve off pump to hold vacuum and record the manometer reading.
4. If leakage rate is less than 0.05 in. Hg in 24 hours, machine (and/or storage tank) is sufficiently tight.
5. If leakage rate exceeds 0.05 in. Hg in 24 hours, repeat leak test.

Dehydration – Dehydration is required if moisture has been introduced into the machine.

While dehydration is readily accomplished at normal room temperatures, use of a cold trap (Fig. 8) will substantially reduce the time required.

Dehydration at low room temperatures requires special techniques. Contact your Carrier representative for information.

WARNING: Do not start compressor or oil pump even for a rotation check, nor apply test voltage of any kind while machine is under dehydration vacuum. Motor insulation breakdown and serious damage may result.

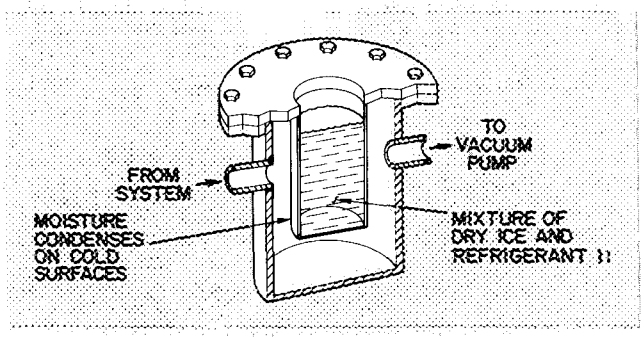


Fig. 8 – Dehydration Cold Trap

1. Attach dehydration pump of at least 3 cfm capacity to valve 10, 1 or 11 as required.
2. Evacuate the vessel(s) with vacuum pump. The pumpout unit may assist down to 22 in. Hg, ref 30 in. bar.
3. Operate vacuum pump until manometer reads 29.80 in. Hg, ref 30 in. bar. (0.20 in. Hg abs).
4. Continue to operate pump for 2 more hours.
5. Close valve at pump connection; stop pump and record manometer reading.
6. After a 2-hour wait, take another manometer reading. If vacuum is holding, dehydration is complete. If vacuum has decreased, repeat steps 3, 4, 5 and 6.

If vacuum fails to hold after several attempts, pressurize the vessel(s) to 45 psig with nitrogen and refrigerant tracer. Locate leak, repair at 0 psig and then repeat dehydration procedure.

Checking Guide Vane Linkage – The 19FA guide vane actuator and linkage assembly is carefully preset and tested at the factory.

When machine is off, the guide vanes are closed and the actuator mechanism is stopped in the position shown in Fig. 9 (electronic) or Fig. 10 (pneumatic).

19FA4 ELECTRONIC ACTUATOR (Fig. 9)

If the motor crank arm is in the proper position at machine shutdown but the vane crank arm is not, the vanes are not fully closed. Loosen the vane arm linkage connector, close the vanes firmly by hand and retighten the connector.

If the motor crank arm is not in the proper position do not attempt adjustment or repair. Contact your nearest Carrier office for assistance.

19FA5 ELECTRONIC ACTUATOR (Fig. 9)

If slack develops in the drive chain, backlash can be eliminated as follows:

1. With machine shut down (guide vanes closed), remove chain guard, loosen actuator hold-down bolts and remove chain.
2. Loosen vane sprocket set screw and rotate sprocket wheel until set screw clears existing spotting hole.
3. With set screw still loose, replace chain and move vane actuator to the left until all chain slack is taken up.
4. Tighten actuator hold-down bolts and retighten set screw in new position.
5. Realign chain guard as required to clear chain.

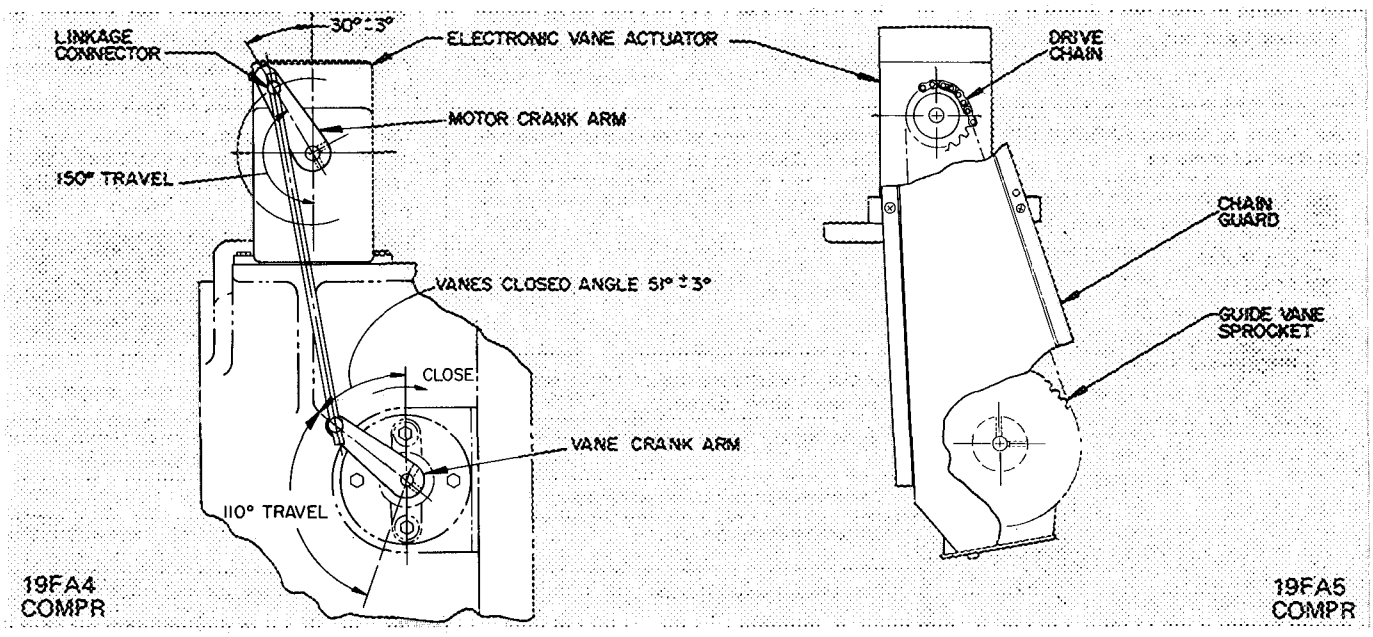


Fig. 9 – Compressor Guide Vane Linkage (Electronic)

PNEUMATIC ACTUATOR (Fig. 10)

If the actuator piston is fully retracted at machine shutdown but the vane crank arm is not at the angle shown in Fig. 10, the vanes are not fully closed. Loosen the 5/16-in. hex nuts and rotate the threaded push rod as required to move the vane crank arm to the closed position.

If the actuator piston is not fully retracted and there is sufficient supply air pressure, do not attempt adjustment or repair. Contact your nearest Carrier office for assistance.

Sensor Test Procedure – The dual modules for motor and for discharge-or-bearing sensors are located in the machine control center (Fig. 14).

With control power off, remove the wires from sensor module terminals "Sensor 1," "Sensor 2" and "C." With an ohmmeter, check the resistance between the wire from "Sensor 1" and the wire from "C." Repeat check with the wires from "Sensor 2" and "C." Resistance should be between 70 ohms (at 50 F) and 80 ohms (at 100 F).

WARNING: Use an ohmmeter only. Application of more than 6 volts to sensor will cause damage.

If resistance readings indicate an open sensor, it must be replaced. Contact your Carrier representative.

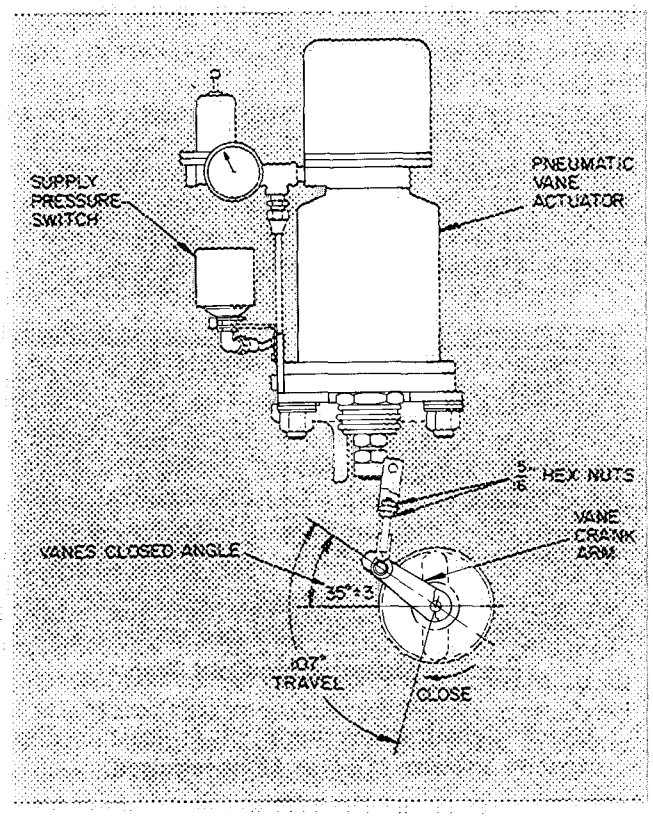


Fig. 10 – Compressor Guide Vane Linkage (Pneumatic)

TROUBLESHOOTING GUIDE

Since the control center panel lights are indicative of machine conditions, the operator should be familiar with both normal and abnormal light sequences.

Normal machine recycle, start and stop sequences are described and illustrated in the Controls section.

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
COMPRESSOR WILL NOT START. **All panel lights out.**	No control power	Check for building power failure. Check main circuit breaker.
	Blown fuse	Check 15-amp fuse in control circuit; examine circuit for ground or short.
Panel lights as shown; SAFETY CIRCUIT light does not come on. ■ ON-STOP □ START □ OIL PUMP ■ POWER □ SAFETY CIRCUIT □ LOAD RECYCLE □ PROGRAM TIMER	Bearing or motor winding circuit breaker (CB1 or CB2) tripped	Check CB1. If open, reset. Check relay KB by replacing it with relay KM Check CB2. If open, reset. Check relay KM by replacing it with relay KB **If compressor trips out, check immediately for high bearing or motor temperatures. If present, DO NOT RESTART without proper corrective action.**
	Cooler low-temperature or condenser high-pressure switch tripped	Reset switch manually.
	Blown fuse	Check 3-amp fuse in control circuit; examine circuit for ground or short.
	Compressor motor overloads tripped	Reset overloads in starter
	Oil temperature too low.	Check oil heater and oil low-temperature switch
	Time-delay relay K4 open.	Remove control power and check continuity between (17) and (14); if open, check K4 relay.

TROUBLESHOOTING (cont)

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
Panel lights as shown; LOAD RECYCLE light does not come on. ■ ON-STOP ■ START □ OIL PUMP ■ POWER ■ SAFETY CIRCUIT □ LOAD RECYCLE □ PROGRAM TIMER	Chilled water temperature too low	Check water temperature
	Chilled water low-temperature switch incorrectly set	Check setting of switch
[*] **PROGRAM TIMER light goes on momentarily, then out.** ■ ON-STOP ■ START □ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE [*] PROGRAM TIMER	1CR normally closed contact open	Check for 120 volts between (15) and (L2)
[●] **OIL PUMP light goes on 10 to 30 seconds after pushing START button; goes out after about one minute.** **START light stays on.** ■ ON-STOP ■ START [●] OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE ■ PROGRAM TIMER	Oil pump not operating (check by pressing OIL PUMP button)	Push ON-STOP button (light out) and then: Check for open oil pump disconnect Check for faulty pump wiring Check for faulty oil pump
	Oil pump operates but oil pressure low	Check oil level. Check for dirty oil filters; replace Check oil pressure regulating valve
	Oil low-pressure switch open (oil pressure normal)	Check setting of oil low-pressure switch Check that both sets of contacts close when oil pressure is normal.
	Guide-vane-close switch open	Check continuity between (V1) and (V2); if none, check guide vane adjustment linkage per Fig 9 or 10. If actuator is not in fully closed position, check relay K2 by replacing it with K3
[●] **OIL PUMP light goes on 10 to 30 seconds after pushing START button; goes out after about one minute.** **START light goes out.** ■ ON-STOP □ START [●] OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE ■ PROGRAM TIMER	Water pumps not running	Start pumps. Check pump starter(s) and relay(s)
	Water flow switches open (pumps running)	Check contacts of flow switches Check for air in water line; vent air.
	Oil pump starter auxiliary contacts M3 open (oil pressure normal)	Check contacts
	Oil low-pressure switch open (oil pressure normal)	Check setting of oil low-pressure switch. Check that both sets of contacts close when oil pressure is normal.
COMPRESSOR TRIPS OFF **(Note: See Machine Recycle, page 24.)** **All panel lights out.** □ ON-STOP □ START □ OIL PUMP □ POWER □ SAFETY CIRCUIT □ LOAD RECYCLE □ PROGRAM TIMER	Power failure	Check for building power failure Check main circuit breaker and/or fuses
	Blown fuse	Check 15-amp fuse in control circuit; examine circuit for ground or short.

TROUBLESHOOTING (cont)

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
● **OIL PUMP light goes out approximately 40 seconds after compressor stops. START light goes out, but SAFETY CIRCUIT light stays on.** ■ ON-STOP □ START ◉ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE ■ PROGRAM TIMER	Low oil pressure	Check oil level in reservoir. Check for dirty oil filters
	Oil pump not operating (button depressed)	Check for open oil pump disconnect. Check for faulty pump wiring. Check for faulty oil pump.
	Water-flow switch(es) open	Pump(s) off; check starting equipment Insufficient water flow; check water valves Check for air in water lines; vent air Defective flow switch; check contacts of switch.
	Momentary power interruption	Push START button Compressor will restart within 15 minutes.
Panel lights as shown; START light and SAFETY CIRCUIT light go out. ■ ON-STOP □ START □ OIL PUMP ■ POWER □ SAFETY CIRCUIT □ LOAD RECYCLE ■ PROGRAM TIMER	Circuit breaker CB1 tripped, high bearing or discharge temperature, or impeller displacement switch tripped	Check bearing thermometer. If over 180°F, or if no one was present when machine stopped, DO NOT ATTEMPT TO RESTART MACHINE! Contact your Carrier representative. Check for high discharge temperature; if present check for closed guide vanes. Check condensing water flow and temperature. Check for high oil reservoir temperature. Check oil cooler water flow. With control power off, check 1/8 amp fuses in sensor junction box on compressor Check for open circuit in sensors per Sensor Test Procedure, page 12 With control power on, check bearing and discharge protection circuit transformer: 24 volts a-c across yellow leads /S/ and /S/, 12 volts a-c across blue and yellow leads /CT/ and /S/ If no voltage across /CT/ and /S/, check continuity across leads of impeller displacement switch (line 15, Fig 18) Contact Carrier Service if switch is open Check relay KB by replacing it with relay KM If all else fails, replace discharge and bearing protection control module
	Circuit breaker CB2 tripped, high motor winding temperature	Check motor cooling system; clean orifices; clean refrigerant strainer With control power off, check 1/8 amp fuses in sensor junction box on motor end bell Check for open circuit in sensors per Sensor Test Procedure, page 12. With control power on, check motor protection circuit transformer: 24 volts a-c across yellow leads /S/ and /S/, 12 volts a-c across red and yellow leads /CT/ and /S/. Check relay KM by replacing it with relay KB If all else fails, replace motor high temperature protection control module.
	Cooler low-temperature switch tripped	Manually reset switch and: Check that capacity control switch is in "Auto" position Check for refrigerant loss Determine and correct cause and add refrigerant. Low chilled water recycle switch should trip out machine before cooler low temperature switch If chilled water temperature is low, check settings of both switches.

TROUBLESHOOTING (cont)

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
Panel lights as shown; START light and SAFETY CIRCUIT lights go out. (cont)	Condenser high-pressure switch tripped.	Manually reset switch and: Check condensing water flow Check condenser water temperature; if high, examine cooling tower operation Check for air and water leaks, fouled tubes (see Maintenance section)
	Motor overload relays tripped	Manually reset relays in starter and: Check that guide vanes stop opening when motor current exceeds 100% of full load amps Adjust electrical demand control, if required, per 19FA Initial Start-Up Instructions Check overload relay setting per starter manufacturer's instructions
	Blown fuse	Check 3-amp fuse in control circuit; examine circuit for ground or short
Pneumatic Control Only	Inadequate air supply to vane actuator	Check air supply If over 20 psig, check switch contacts (Fig 10) Switch should close at 20 ± 2 psig
COMPRESSOR RUNS BUT GUIDE VANES WILL NOT OPEN.	Compressor not in "Run" condition	At least one minute after compressor starts, check for 120 volts across 18 and L2
	K2 or K3 relay open	Check continuity between 73 and 74
	Capacity control switch improperly set	Turn switch to "Auto" position
	Motor current calibration incorrect	Check per Initial Start-Up Instructions
Electronic Control Only	Chilled water probe defective	Check probe resistance per Fig 11 Replace
	Incorrect voltage in capacity control module	Check for +24 volts on *d-c scale*, between 30 and 28 (ground); −24 volts, d-c between 81 and 28 (ground) Replace module if voltage varies from above
	Control air supply inadequate	Check air supply Adjust regulator
Pneumatic Control Only	Chilled water pneumatic thermostat defective	Check per manufacturer's instructions Repair or replace
CHILLED WATER TEMPERATURE TOO HIGH (machine running).	Thermostat set too high	Return thermostat to proper setting as marked on dial at initial start-up
	Excessive cooling load (machine at capacity)	Check for infiltration of outside air into conditioned spaces
	Condenser temperature too high	Check condensing water flow Check condensing water temperature; examining cooling tower operation Check for air and water leaks, fouled tubes
	Refrigerant level low	Check for leak; repair Add refrigerant
	Liquid bypass in water box	Examine division plates and gaskets for leaks
	Excess throttling range (should be near minimum for proper control)	Reduce throttling range by turning adjusting screw clockwise in small increments
	Guide vanes fail to open fully	Ensure that capacity control switch is in "Auto" position If vanes will not open with switch at "Inc", check for excessive cooling load (see above) Check relays K2 and K3 Check guide vane linkage Check cycling timer If all else fails, replace capacity control module
Electronic Control Only		
	Excess throttling range (should be near minimum for proper control)	Reduce throttling range by moving sensitivity slider of pneumatic thermostat away from point DA.
Pneumatic Control Only	Guide vanes fail to open fully	Check for excessive cooling load (see above) Check relays K2 and K3

TROUBLESHOOTING (cont)

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
CHILLED WATER TEMPERATURE TOO LOW (machine running).	Thermostat set too low.	Return thermostat to setting marked on dial at initial start-up
	Low chilled water switch improperly set.	Water chilling duty – Switch should open at 5 F below design chilled water temperature, or at 37 F, whichever is higher. Brine chilling duty – Switch should open at 5 F below design leaving brine temperature
Electronic Control Only	Excess throttling range (should be near minimum for proper control).	Reduce throttling range by turning adjusting screw clockwise in small increments
Electronic Control Only	Guide vanes fail to close.	Ensure that capacity control switch is in "Auto." position. Check chilled water probe resistance per Fig 11. Check guide vane actuator linkage (See Fig 9) If all else fails, and vanes close in "Dec" but not in "Auto.", replace capacity control module.
Pneumatic Control Only	Excess throttling range (should be near minimum for proper control).	Reduce throttling range by moving sensitivity slider on pneumatic thermostat away from point DA.
Pneumatic Control Only	Guide vanes fail to close.	Check air signal to pilot positioner. Check guide vane actuator linkage (See Fig 10.)
CHILLED WATER TEMPERATURE FLUCTUATES: VANES HUNT Electronic Control Only	Throttling range too narrow	Add throttling range by turning adjusting screw counterclockwise in small increments
Electronic Control Only	Defective capacity control module	Replace module.
Pneumatic Control Only	Throttling range too narrow	Add throttling range by moving sensitivity slider on pneumatic thermostat towards point DA. Set point may need readjustment; refer to calibration procedure in Initial Start-Up Instructions
OIL RESERVOIR TEMPERATURE TOO LOW.	Oil cooler water flow too high	Throttle water to reduce flow.
	Thermostat improperly set or defective	Check voltage across thermostat while adjusting it; if contacts do not close, replace thermostat.
	Oil heater defective.	If light indicates power but unit does not heat, check unit for open or short Replace unit if required
OIL RESERVOIR TEMPERATURE TOO HIGH.	Thermostat improperly set.	Adjust thermostat.
	Oil cooler water flow too low	Open plug cock.
	Oil cooler solenoid valve operating improperly.	Check electrical operation of solenoid. Inspect valve; if screen is fouled, install a 20-mesh screen ahead of valve.
	Oil cooler tubes fouled.	Clean or replace tubes if required.

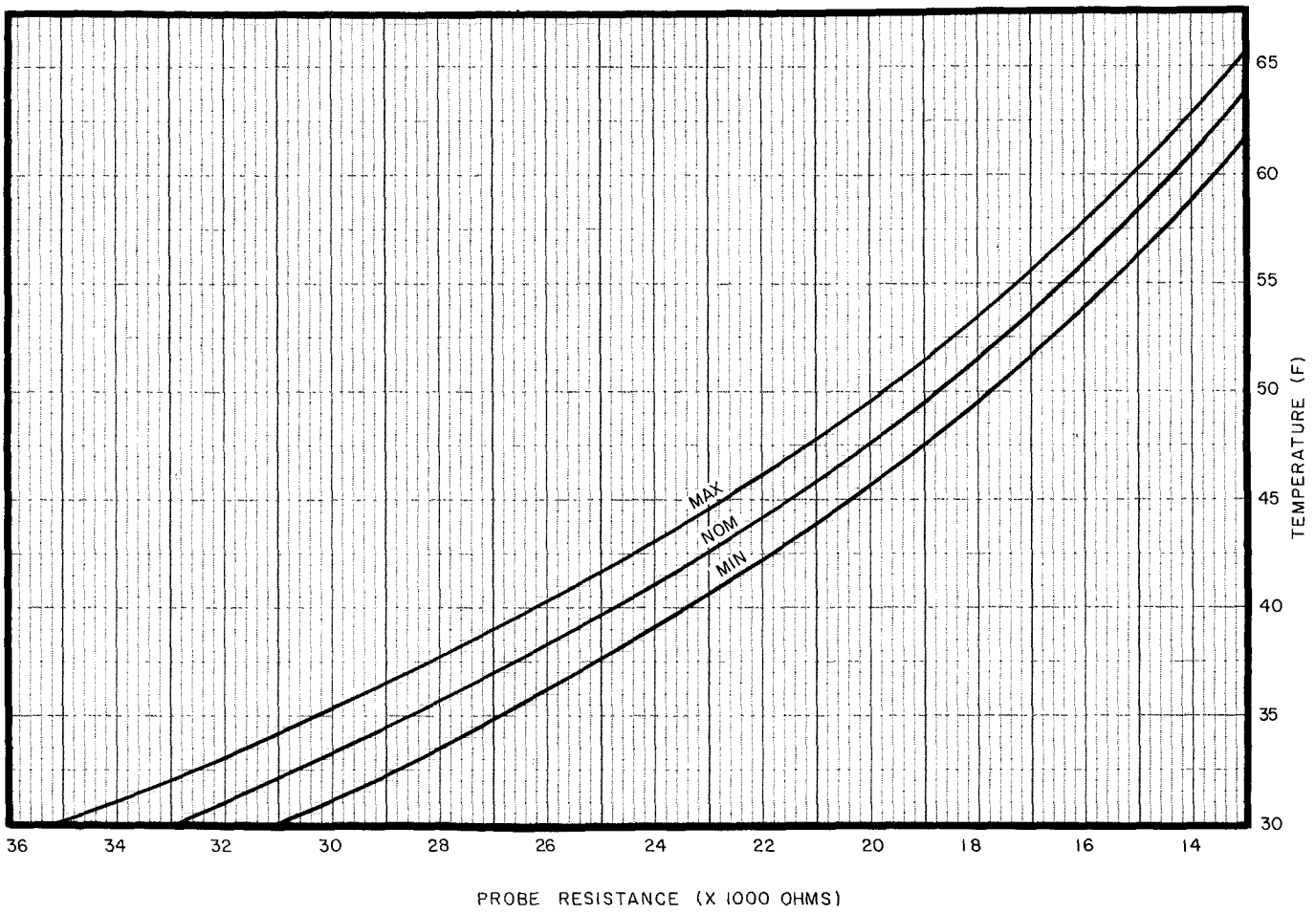


Fig. 11 – Chilled Water Probe Resistance vs Temperature

GENERAL DATA

Machine Nameplate is located on the cooler support foot at the suction end of the machine. Always give machine model, serial number and name of owner in corresponding with Carrier.

Compressor Nameplate is mounted on the compressor support foot on the suction end of the compressor adjacent to the oil pump.

System Components include cooler, condenser, economizer, motor-compressor and machine control center. A storage tank for the full refrigerant charge forms the support for compressor and control center. Most machines are also supplied with a machine-mounted pumpout unit.

COOLER – A heat exchanger vessel in which flashing refrigerant picks up heat from, and therefore chills, the water (or brine) flowing thru its tubes.

CONDENSER – A heat exchanger vessel in which heat is removed from compressed refrigerant and is carried out of the system.

ECONOMIZER – A vessel at intermediate pressure between cooler and condenser which returns "flash gas" to the compressor for greater cycle efficiency.

MOTOR-COMPRESSOR maintains the necessary pressure differences in the system and moves the heat-carrying refrigerant from cooler to condenser.

CONTROL CENTER controls machine start and stop, regulates machine capacity as required, contains machine safety devices, indicates cooler, condenser and oil pump pressures and records machine operating hours.

STORAGE TANK supports machine components and provides a ready storage for the refrigerant charge during machine service periods and at extended shutdown.

PUMPOUT UNIT is used for refrigerant transfer, machine evacuation and machine pressurizing.

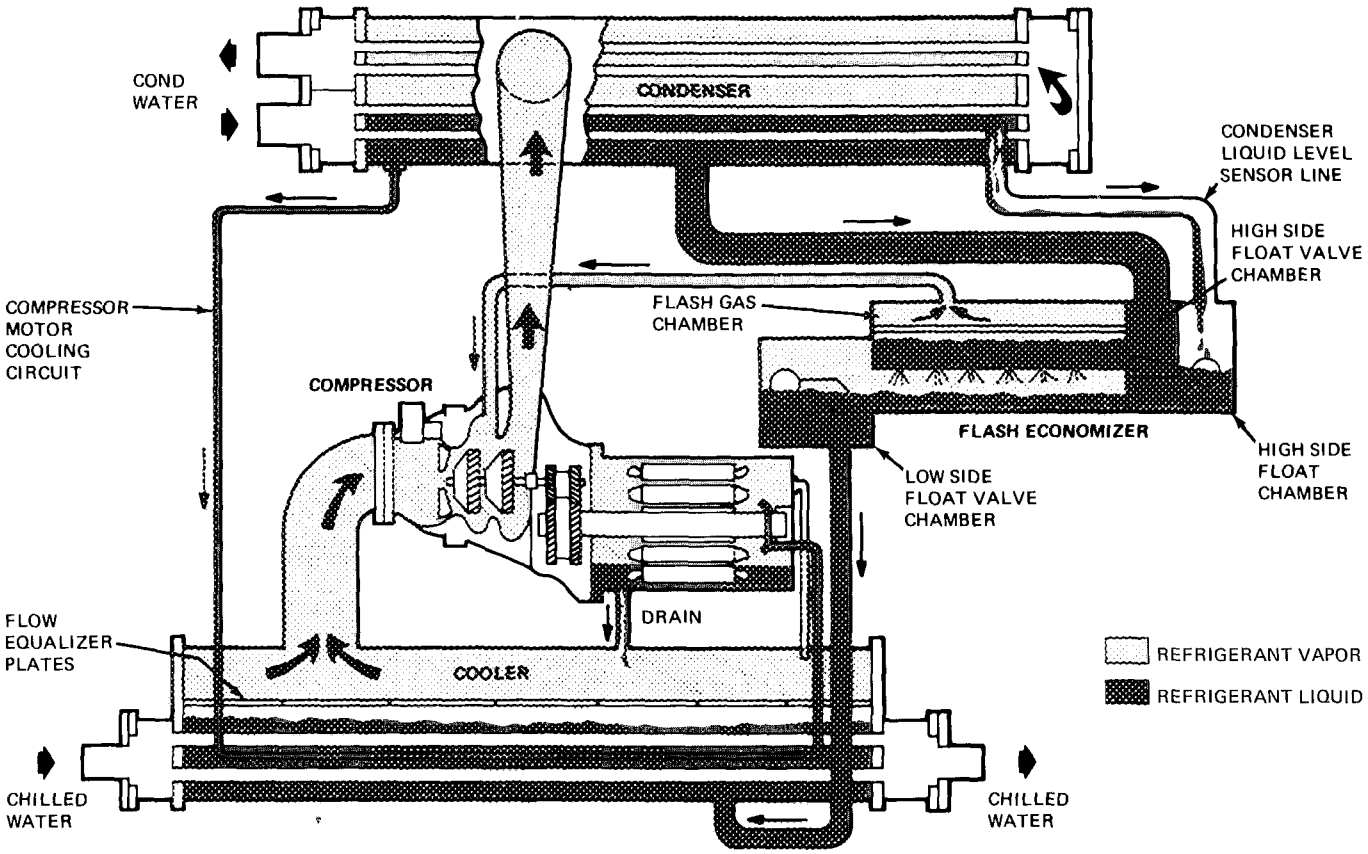


Fig. 12 – 19FA Refrigeration Cycle

19FA REFRIGERATION CYCLE

With the exception of the thermal economizer, which is used on water chilling duty only, the basic refrigeration cycle described below is applicable to either water or brine chilling.

The machine compressor continuously draws large quantities of refrigerant vapor from the cooler, at a rate set by the amount of guide vane opening. This compressor suction reduces the pressure within the cooler and causes the remaining refrigerant to boil vigorously at low temperature (typically 30 to 35 F).

The energy required for boiling is obtained as heat from the water (or brine) flowing thru the cooler tubes. With heat removed, the chilled water (brine) can then be used for air conditioning or for process liquid cooling.

After removing heat from the water, the refrigerant vapor passes thru the compressor first stage, is compressed and moves into the compressor second stage. Here it is mixed with flash-economizer gas and is further compressed.

Compression raises the refrigerant temperature above that of the water flowing thru the condenser tubes. When the warm (typically 100 to 105 F) refrigerant is discharged into the condenser, the relatively cool condensing water removes some of the heat and the vapor condenses into a liquid. In water chilling machines, further removal of heat occurs in the thermal economizer at the bottom of the condenser. Here the liquefied refrigerant is subcooled by contact with the coolest (entering water) condenser tubes.

The liquid refrigerant drains into the flash economizer where a valve system maintains pressure intermediate between the condenser and the cooler pressure. At this lower pressure, part of the liquid refrigerant flashes to gas, thus cooling the remaining liquid. The "flash gas" is returned directly to the compressor second stage. Here it is mixed with gas already compressed by the first stage impeller. Since the economizer gas has to pass thru only half the compression cycle to reach condenser pressure, there is a savings in power, hence the term "economizer."

The cooled liquid refrigerant in the economizer is metered thru the low-side float chamber to the cooler. Because cooler pressure is lower than the economizer pressure, some of the liquid flashes and cools the remainder to cooler temperature. The cycle is now complete.

19FA MOTOR COOLING CYCLE

Refrigerant liquid from a sump at the bottom of the condenser (Fig. 12) is subcooled by passage thru a line immersed in the refrigerant within the cooler. The liquid then enters the compressor motor end where it sprays on and cools the compressor rotor and stator. It then collects in the base of the motor casing and drains back into the cooler. Refrigerant gas is vented from the compressor motor casing and returns to the upper

portion of the cooler thru a check valve. Differential pressure between condenser and cooler maintains the refrigerant flow.

19FA LUBRICATION CYCLE

General – The compressor oil pump and oil reservoir are located in the compressor base. Oil is pumped thru an oil cooler and a filter to remove heat and any foreign particles. Part of the oil flow is directed to the compressor motor-end bearings and seal. The remaining flow lubricates the compressor transmission, thrust and journal bearings and seal. Oil is then returned to the reservoir to complete the cycle (Fig. 13).

Lubrication Details – Oil is charged into reservoir (1) thru a hand valve (2) which also functions as an oil drain. If there is refrigerant in machine, a pump is required for charging. Sight glasses (5) on reservoir wall permit observation of oil level.

The motor-driven oil pump (6) discharges oil to an oil cooler (7) at a rate and pressure controlled by an oil regulator (8). The differential pressure (supply versus return) is registered on a gage at the machine control center.

Water flow thru the oil cooler is manually adjusted by a plug cock (9) to maintain the oil at an operating temperature, at the reservoir, of approximately 145 F. During machine shutdown, the oil temperature is also maintained at 140 to 150 F by an immersion heater (10) so that absorption of refrigerant by the oil is minimized.

After it leaves the oil cooler, the oil is filtered (11) and a portion flows to the motor-end bearing (12) and seal. The remainder lubricates the compressor transmission (14) and the thrust and journal bearings (15). Thrust bearing temperature is indicated on a gage (16) mounted on the bearing inspection cover. Oil from each circuit returns by gravity to the reservoir.

A demister (17) and (18), by centrifugal action, draws refrigerant gas from the transmission area to the motor shell. The resulting pressure difference prevents oil in the transmission cavity from leaking into the motor shell.

Several safety devices monitor the lubrication system:

In the event of power failure, a small oil reservoir (19) supplies sufficient oil reserve to ensure continued lubrication until all compressor parts have come to a complete stop.

Solid state sensors (20) monitor motor-winding and bearing temperatures and shut off machine if temperature rises above a selected point.

Low-oil cutout (Fig. 14) shuts down machine or prevents start if oil pressure is not adequate.

A program timer in the machine control center ensures proper lubrication at start-up and at coastdown by energizing the oil pump for approximately 30 seconds before the compressor starts, and keeping the pump running for almost one minute after the compressor motor is de-energized.

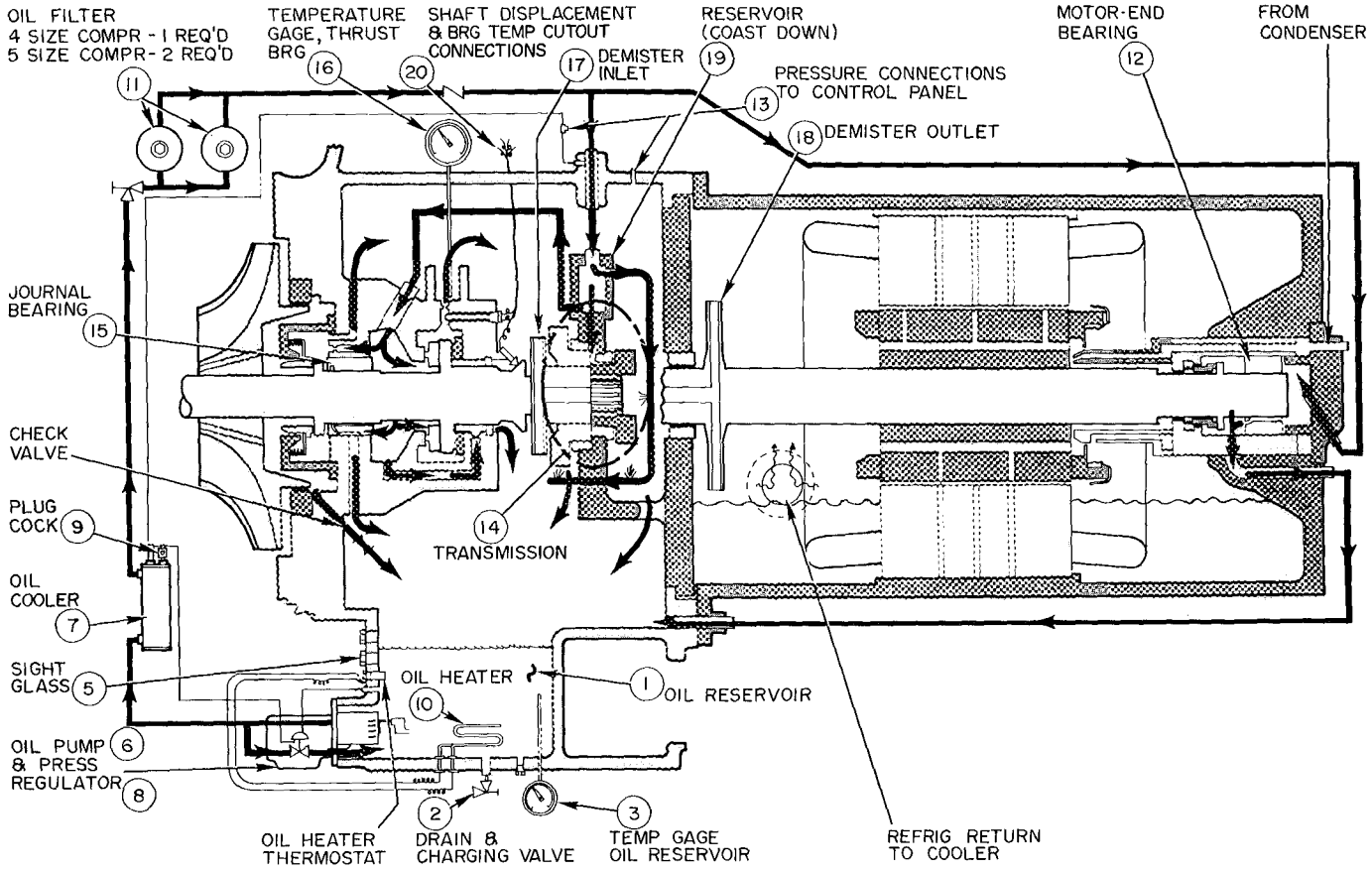


Fig. 13 – 19FA Lubrication Cycle

CONTROLS

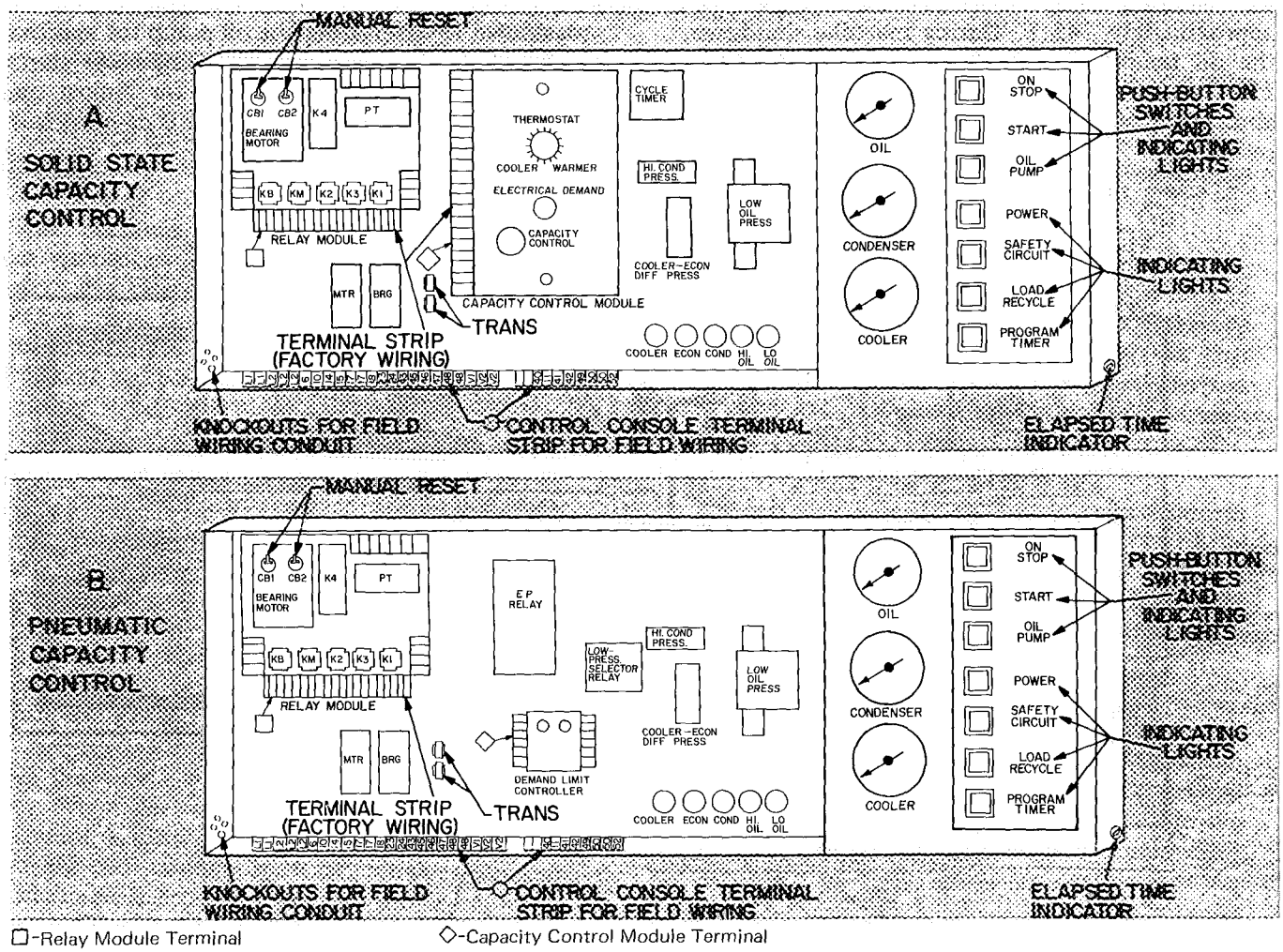
General – Basic 19FA controls and wiring are described in this section. Actual machine controls may differ in some respects, depending upon job specifications.

Operating Controls – The cooling capacity of all 19FA machines is automatically adjusted to match the cooling demand by changing the position of the compressor inlet guide vanes (Fig. 9 and 10). A temperature sensing device in the leaving chilled water (or brine) circuit of the machine cooler produces signals which are transmitted to an automatic guide vane actuator. A drop in leaving chilled water temperature causes the guide vanes to move towards the closed position. This reduces the rate of refrigerant evaporation into the compressor and decreases machine capacity. A rise in chilled water temperature opens the vanes. More refrigerant is moved thru the compressor and capacity increases. For precise control of guide vane response, signals from sensing device to vane actuator are modulated at machine control center.

SOLID STATE CAPACITY CONTROL – In addition to amplifying and modulating signals from the chilled water sensor, a solid state module in the control center provides means for preventing the compressor from exceeding full load amps and for limiting motor current down to 40% of full load amps as a means of reducing electrical demand rates. A throttle range adjustment screw eliminates guide vane hunting, and a manual capacity control knob allows the operator to open, close or hold guide vane position when desired.

PNEUMATIC CAPACITY CONTROL – An electrical demand control (Fig. 14) prevents motor current from exceeding full load amperage, and allows limiting of power demand down to 40% FLA. The electrical signals of the demand control are converted to air signals by an electro-pneumatic relay. To be certain that the signals from the electrical demand control override any capacity "increase" signals from the pneumatic thermostat when motor current limits are approached, a selector relay compares and selects the proper signal from thermostat and demand control.

Safety Controls – Standard 19FA safety controls shut down the machine to protect it against damage from motor winding high temperature, discharge gas and bearing high temperatures, refrigerant low temperature, condenser high pressure, low oil pressure and inadequate cooler and condenser water flow. In addition, oil pump failure,



□-Relay Module Terminal ◇-Capacity Control Module Terminal

Fig. 14 – Control Center Variations

compressor motor overload or impeller displacement will shut down the machine. Machines using pneumatic capacity control will also shut down on low air supply to the vane actuator.

If chilled water temperature should drop approximately 5 F below the normal set point, the chilled water low-temperature cutout and recycle switch will stop the compressor. Machine restart is automatic when the water temperature rises to approximately 5 F above the set point and a programmed safety time interval has gone by.

Oil Heater and Thermostat – Typical field wiring for the oil heater is illustrated in Fig. 15. To ensure that the heater remains energized during machine shutdown, power wiring is from a separate source.

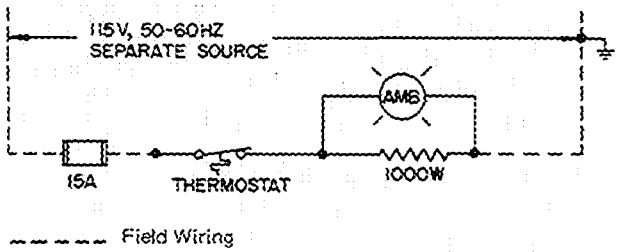


Fig. 15 – Oil Heater Wiring Schematic

Pumpout Controls – Include ON-OFF switch, 3-amp fuse, compressor contactor, compressor overloads and internal thermostat, refrigerant high-pressure cutout. The fused disconnect for the pumpout unit is customer supplied.

Standard pumpout compressor voltages are: 208, 230 and 460. Control voltage is 115 v, single phase.

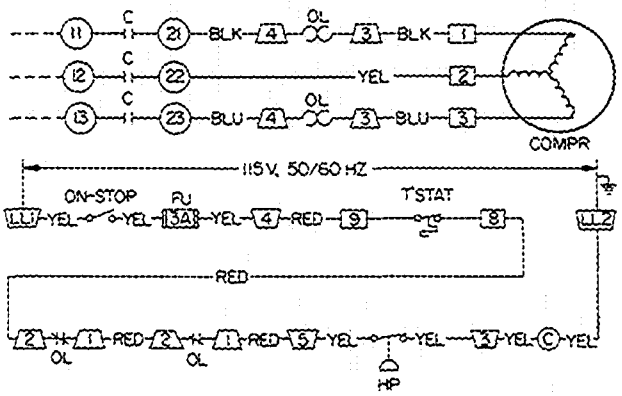


Fig. 16 – Pumpout Unit Wiring Schematic

Machine Control Wiring – Figure 18 schematically illustrates typical machine control wiring. Numerals at the right of the diagram indicate the line on which relay contacts may be found. Underlining indicates that the contact is normally closed.

The sequence for the program timer used on 19FA units is pictorially shown in Fig. 17. Switch numbers and positions correspond with those marked on machine wiring schematic, Fig. 18.

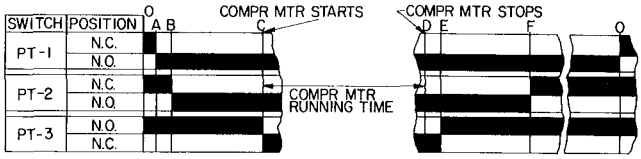
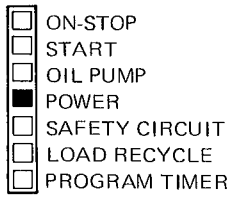


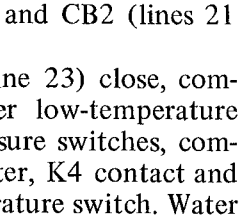
Fig. 17 – Program Timer Sequence

Typical Machine Start Sequence (See Fig. 18.)

1. Supply power to machine. POWER light goes on.

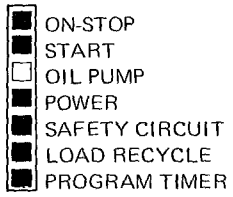


2. Press water pump start button (line 2).
   a. Pilot relay (PR) energizes water pumps and cooling tower fan. PR contact holds relay in.
   b. Water flow switches (line 26) close.
3. Press ON-STOP button.
   a. Relays KM (line 9) and KB (line 17) are energized thru motor temperature module and bearing temperature and impeller displacement module.
   b. KB and KM contacts (lines 21 and 22) open, breaking circuit to CB1 and CB2 (lines 21 and 22).
   c. KB and KM contacts (line 23) close, completing circuit to cooler low-temperature and condenser high-pressure switches, compressor overloads in starter, K4 contact and low chilled water temperature switch. Water flow switches (line 26) and oil low-pressure switch are temporarily bypassed.
   d. ON-STOP, SAFETY CIRCUIT and LOAD RECYCLE lights go on.



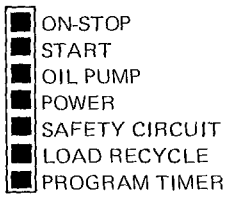
4. Press machine START button.
   a. K1 is energized and is held in by its holding contact. Second K1 contact (line 31) closes circuit to program timer motor (PT).

b. START and PROGRAM TIMER lights go on.



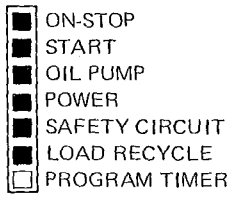
5. PT-1 (line 35) moves to N.O. position; timer motor is kept energized thru 1CR normally closed contact.

6. PT-2 moves to N.O. position (line 5).
   a. Power reaches oil pump starter relay M3, and reaches refrigerant feed control thru the econ-cooler differential pressure switch (DPS).
   b. OIL PUMP light goes on.



   c. Oil pressure builds up and contacts (lines 26 and 31) close.
   d. K4 time-delay relay is energized. In 10 seconds, K4 contact (line 25) opens; safety circuit is completed thru water flow switches, oil-pressure switch and M3 contact. Second K4 contact (line 31) closes circuit to PT-3.

7. PT-3 moves to N.C. position. Compressor motor start relay 1CR and relay K2 are energized thru VANE CLOSED switch. Compressor starts.
   a. 1CR contact (line 31) closes to hold in 1CR relay.
   b. 1CR contact (line 35) opens; program timer stops and PROGRAM TIMER light goes out.

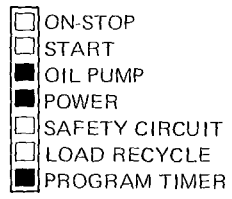


   c. K2 contact (line 40) opens and removes "close" signal from guide vane actuator.
   d. Cycling timer (M) alternately makes and breaks circuit to K2 and K3 contacts (line 42).

8. Compressor reaches "Run" condition.
   a. Relay K3, oil cooler solenoid valve (OCW) and capacity control module are energized.
   b. K3 contacts close to interlock oil pump, water pumps and cooling tower fan (lines 3 and 4).
   c. K2 and K3 contacts (line 42) are now closed to allow an "open" signal to reach guide vane actuator.

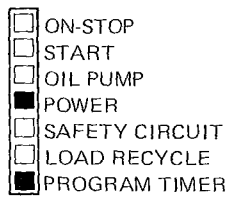
Typical Machine Stop Sequence – Refer to Fig. 18.

1. Push ON-STOP switch.
   a. All machine control relays are de-energized.
   b. As 1CR relay drops out, compressor stops. 1CR contact (line 35) closes and program timer starts.
   c. As K3 relay drops out, its contacts (lines 3 and 4) open, and remove interlocking circuits to water pumps, cooling towers and oil pump starter.
   d. Third K3 contact (line 42), and both K2 contacts return to de-energized condition and compressor guide vanes close.
   e. ON-STOP, START, SAFETY CIRCUIT and LOAD RECYCLE lights go off; PROGRAM TIMER light goes on.

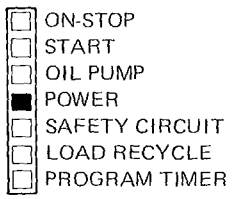


2. In a few seconds, PT-3 moves to its N.O. position, preventing compressor start relay 1CR from being energized for approximately 15 minutes.

3. PT-2 moves to N.C. position about 40 seconds after ON-STOP switch was pushed. Oil pump stops. OIL PUMP light goes off.



4. In approximately 14 minutes, PT-1 moves to its N.C. position. Program timer stops and light goes off. Machine may be restarted.



LEGEND (for Fig. 18)

1CR	– Compr Motor Starter Holding Coil	–( )–	Field Wiring
CB1, CB2	– Circuit Breakers	– – – –	Starter Wiring
DPS	– Economizer-Cooler Diff Press Switch	———	Factory Wiring
ETI	– Elapsed Time Indicator		
FS1, FS2	– Flow Switches or Auxiliary Contacts (Cooler and Cond)	//////	Pneumatic Piping, not by Carrier
J	– Jumper	⬡	Field-Wiring Term.
K	– Relays		
LCW	– Low Chilled Water Temp Switch	△	Starter Term.
M	– Cycling Timer Motor	□	Relay Module Term
M3	– Oil Pump Starter and Contact	▱	Temp Sensor Module Term
OCW	– Oil Cooler Water Solenoid Valve		
OL	– Motor Overloads	◇	Capacity Control Module Term (Electronic)
O-LPS	– Oil Low-Press Switch		
PR	– Pilot Relay		
PT	– Program Timer	◇	Load Limiting Controller Term (Pneumatic)
R-HPS	– Refrig High-Press. Switch (Condenser)		
R-LTS	– Refrig Low-Temp Switch (Cooler)	○	Guide Vane Actuator Term
TDR	– Time-Delay Relay		

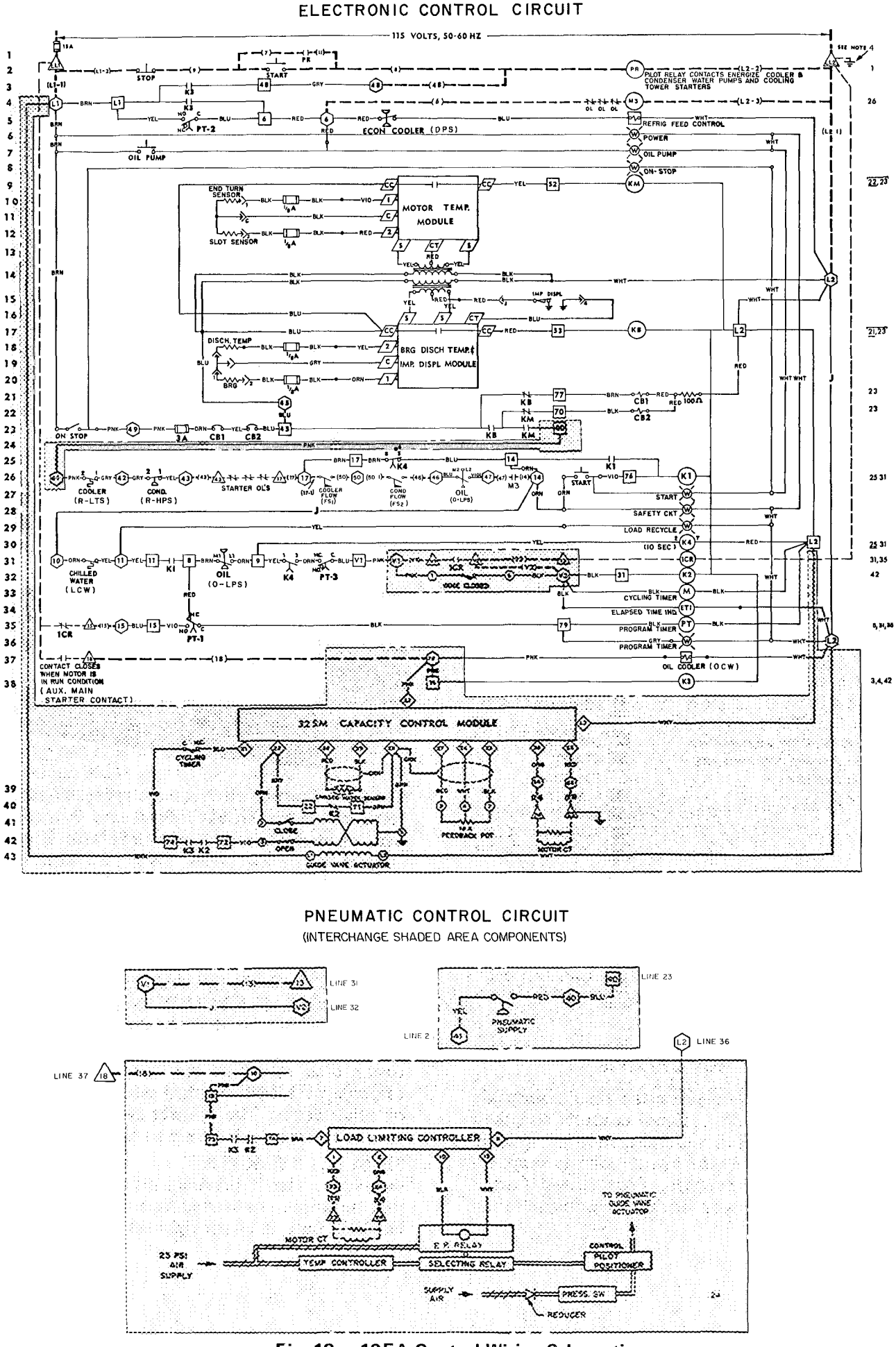


Fig. 18 – 19FA Control Wiring Schematic

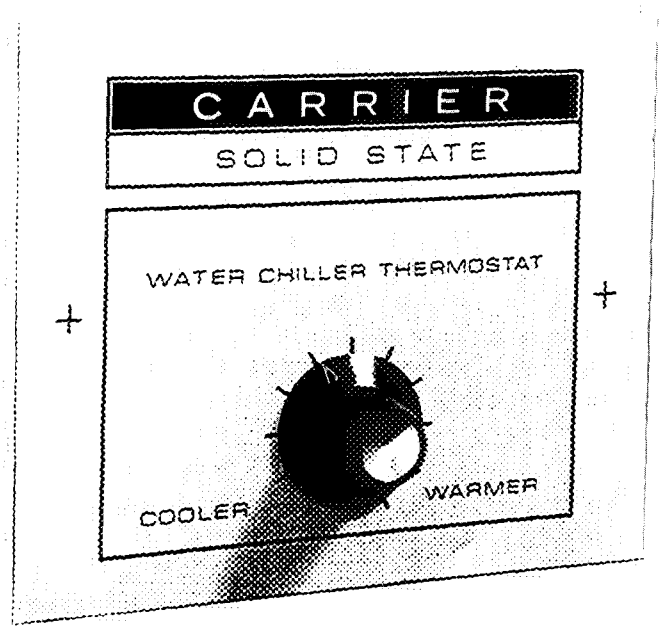
Machine Recycle – During normal cooling, the building load may drop low enough to make continuous operation of the refrigeration machine unnecessary. When the chilled water temperature reaches its low cutout point, the machine will shut off automatically. It will remain off for a minimum of 15 minutes and until the rise in chilled water temperature closes the switch contacts. The machine will then restart automatically.

Typical Machine Recycle

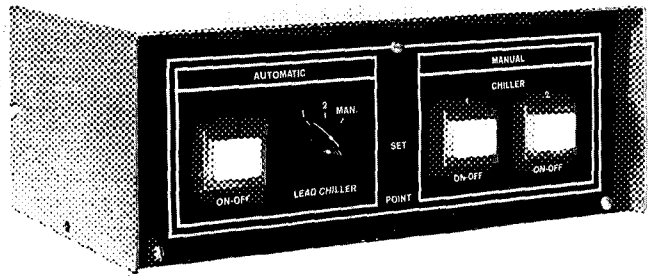
1	Machine operating normally	■ ON-STOP ■ START ■ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE □ PROGRAM TIMER
2.	Low chilled water temperature cutout opens , Relay 1CR is de-energized Compressor stops Program timer starts	■ ON-STOP ■ START ■ OIL PUMP ■ POWER ■ SAFETY CIRCUIT □ LOAD RECYCLE ■ PROGRAM TIMER
3	Oil pump stops approx 40 seconds after compressor	■ ON-STOP ■ START □ OIL PUMP ■ POWER ■ SAFETY CIRCUIT □ LOAD RECYCLE ■ PROGRAM TIMER
4	Chilled water temperature rises and low chilled water temperature cutout closes	■ ON-STOP ■ START □ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE ■ PROGRAM TIMER
5	Program timer completes its cycle; machine restarts automatically (15 minutes from stop to start)	■ ON-STOP ■ START ■ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE □ PROGRAM TIMER

CONTROL OPTIONS

General – This section presents a brief description of the most common optional controls and their operation. Installation and calibration of optional controls is covered in the instructions accompanying each accessory package. Your nearest Carrier office can provide you with this information if required.



Remote Thermostat – This set point control permits selection and alteration of the leaving chilled water temperature from a central station or other location of the customer's choice.



Lead-Lag Control provides centralized control of 2 refrigeration machines. Control may be applied to parallel machines, series machines with a common control point or series machines with a split control point.

PREPARATION – On initial start only, push the ON-STOP and START buttons (lights go on) at each control center. Machine start and stop can now be made at the lead-lag control.

AUTOMATIC OPERATION – When the lead-lag ON-OFF button at the left side of the control is pushed and lighted, the chillers, water pumps and tower fans will start and stop automatically in response to a field-supplied outside-air thermostat or other device. The transfer switch permits selection of either machine for part load recycle.

MANUAL OPERATION – With the transfer switch in "Man." position, either or both chillers may be stopped or started manually by pushing the ON-OFF buttons at the right side of the control.

Machine Recycle – During normal cooling, the building load may drop low enough to make continuous operation of the refrigeration machine unnecessary. When the chilled water temperature reaches its low cutout point, the machine will shut off automatically. It will remain off for a minimum of 15 minutes and until the rise in chilled water temperature closes the switch contacts. The machine will then restart automatically.

Typical Machine Recycle

1	Machine operating normally	■ ON-STOP ■ START ■ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE □ PROGRAM TIMER
2.	Low chilled water temperature cutout opens , Relay 1CR is de-energized Compressor stops Program timer starts	■ ON-STOP ■ START ■ OIL PUMP ■ POWER ■ SAFETY CIRCUIT □ LOAD RECYCLE ■ PROGRAM TIMER
3	Oil pump stops approx 40 seconds after compressor	■ ON-STOP ■ START □ OIL PUMP ■ POWER ■ SAFETY CIRCUIT □ LOAD RECYCLE ■ PROGRAM TIMER
4	Chilled water temperature rises and low chilled water temperature cutout closes	■ ON-STOP ■ START □ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE ■ PROGRAM TIMER
5	Program timer completes its cycle; machine restarts automatically (15 minutes from stop to start)	■ ON-STOP ■ START ■ OIL PUMP ■ POWER ■ SAFETY CIRCUIT ■ LOAD RECYCLE □ PROGRAM TIMER

CONTROL OPTIONS

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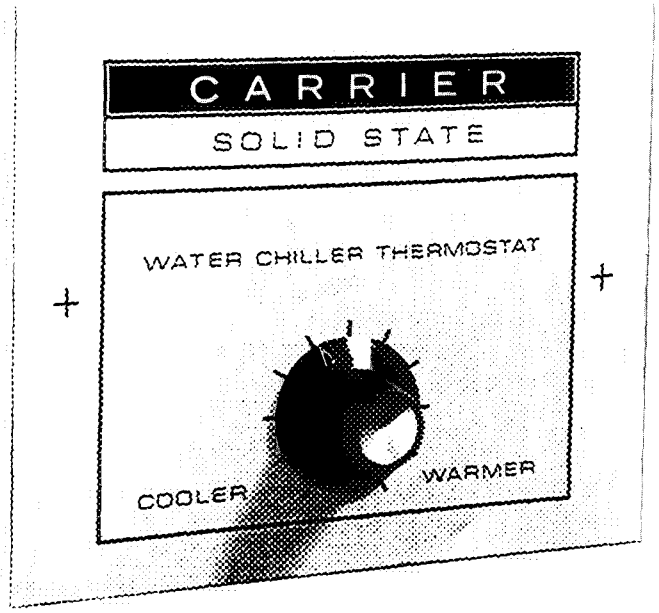
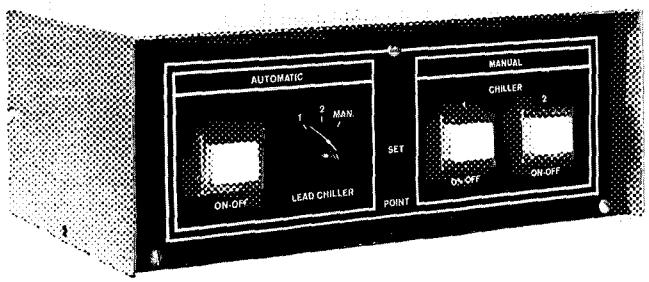


Remote Thermostat – This set point control permits selection and alteration of the leaving chilled water temperature from a central station or other location of the customer's choice.



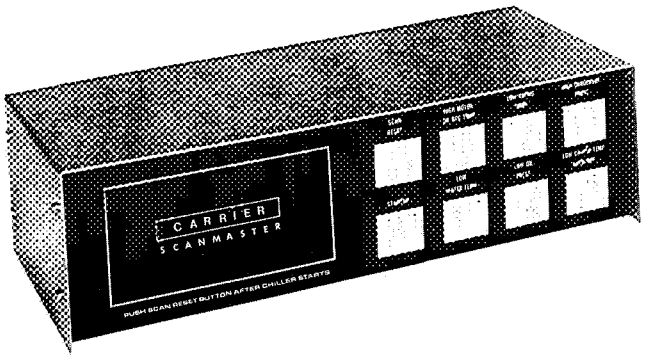
Lead-Lag Control provides centralized control of 2 refrigeration machines. Control may be applied to parallel machines, series machines with a common control point or series machines with a split control point.

PREPARATION – On initial start only, push the ON-STOP and START buttons (lights go on) at each control center. Machine start and stop can now be made at the lead-lag control.

AUTOMATIC OPERATION – When the lead-lag ON-OFF button at the left side of the control is pushed and lighted, the chillers, water pumps and tower fans will start and stop automatically in response to a field-supplied outside-air thermostat or other device. The transfer switch permits selection of either machine for part load recycle.

MANUAL OPERATION – With the transfer switch in "Man." position, either or both chillers may be stopped or started manually by pushing the ON-OFF buttons at the right side of the control.

Auxiliary Safety Indicator Panel – The safety indicator panel provides "first out" indication for each of the 7 machine safety controls listed below, plus the sounding or lighting of an optional remote alarm.



First-out indication is given for:

1. High motor or bearing temperature
2. Low refrigerant temperature
3. High condenser pressure
4. Motor overload
5. Insufficient water flow (cooler and cond)
6. Low oil pressure
7. Low chilled water temperature

SETTING THE INDICATOR PANEL – After the refrigeration machine has been started, press the panel SCAN-RESET button. The panel is now in the ready condition. All lights will remain off until the machine shuts down on a safety cutout. The indicator lamp for that particular safety will light and, except for LOAD RECYCLE/AUTO.OFF lamp, will remain lit until panel is reset. The LOAD RECYCLE/AUTO.OFF lamp will go out when chilled water temperature rises and the switch remakes.

RESETTING THE INDICATOR PANEL

1. Correct the condition which caused the safety tripout (except low chilled water temp).
2. Reset the safety control if manual reset.
3. Restart the refrigeration machine.
4. Press the indicator panel SCAN RESET button.

PRESS-TO-TEST FEATURE – To check the condition of any indicator lamp, merely press the lamp button. The lamp will light. A burned out lamp does not affect the operation of the alarm circuit. This lamp test does not in any way indicate whether the actual safety control is tripped or not.

If an alarm has been added to the panel, it will sound and/or light when the LOW OIL PRESSURE button is pressed.

OTHER SAFETY INDICATIONS – On all 19FA machines, the HIGH MOTOR OR BEARING TEMP lamp will light in the unlikely event that the compressor impellers are displaced beyond the normal limits. If motor and bearing temperatures appear normal (under 180 F) but machine will not restart, check motor and bearing sensors, relays KB and KM and the impeller displacement switch contacts as described in Troubleshooting section.

Machines with pneumatic capacity control have a pneumatic supply switch which will cause the HIGH MOTOR OR BEARING TEMP lamp to light if the air supply to the guide vane actuator is low.

Autostart Control – Automatic machine and auxiliary start and stop in response to an outside-air thermostat, time clock or other customer-supplied device is available as a modification to the refrigeration machine starter. Figure 19 shows a typical autostart circuit. For application of this circuit to 19FA machine control system, refer to your Job Wiring Data.

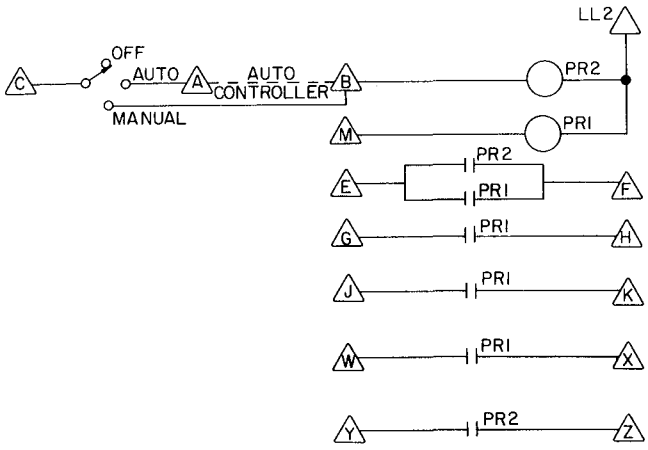
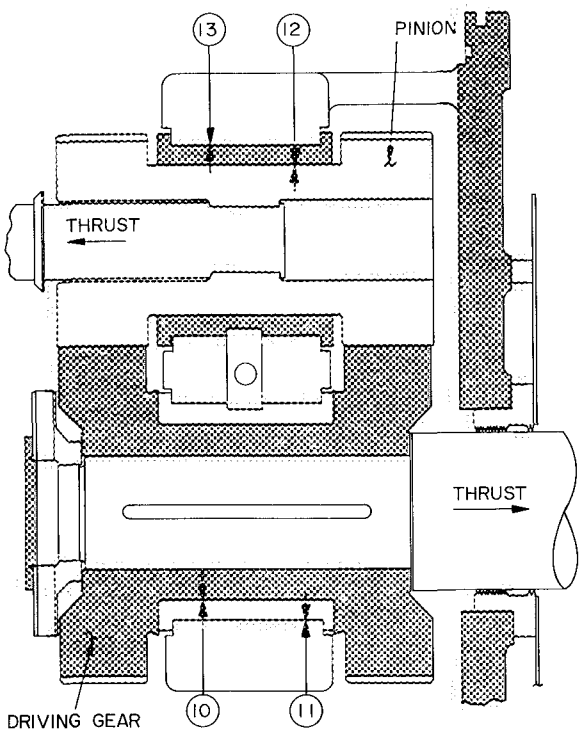


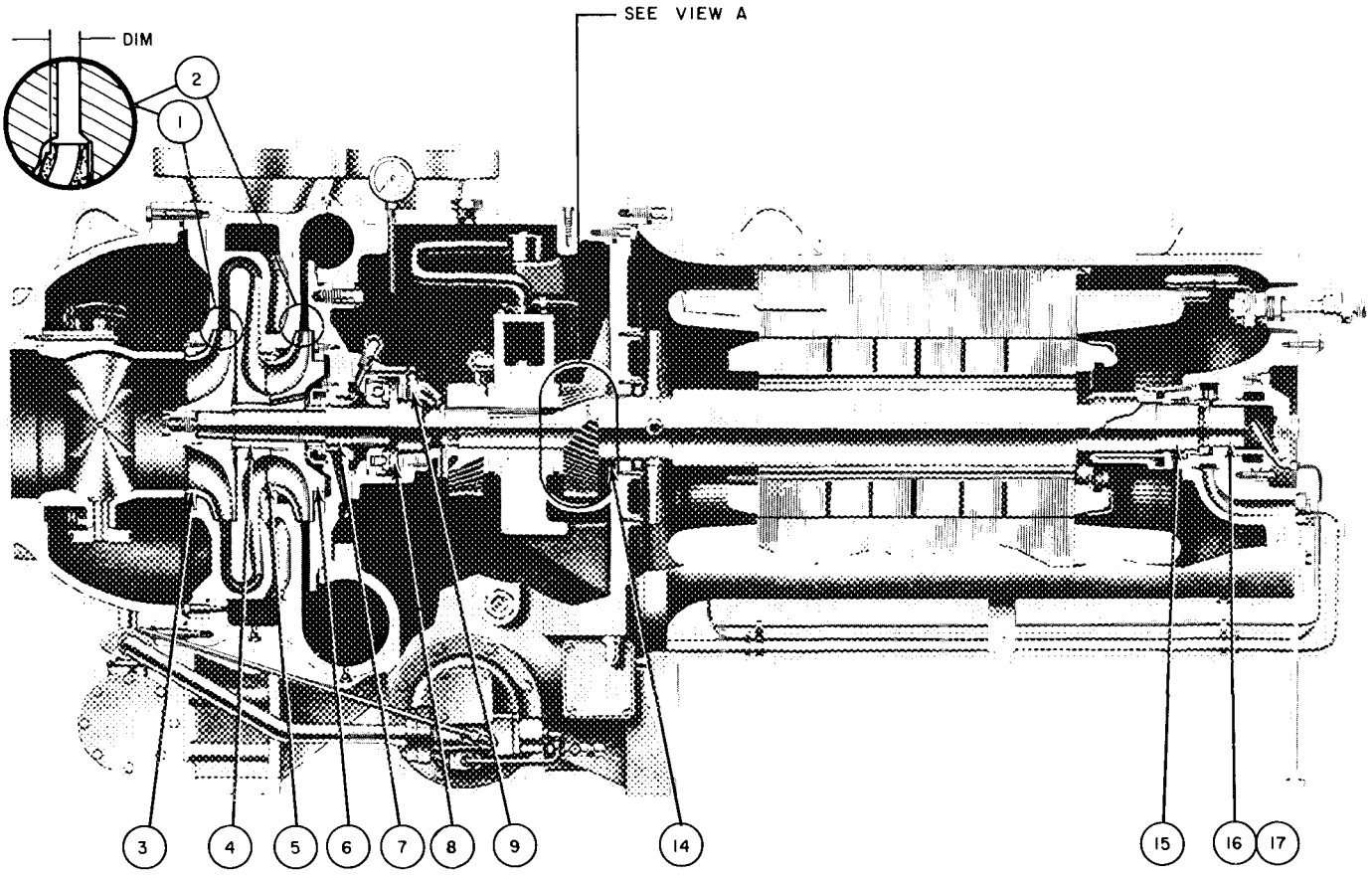
Fig. 19 – Autostart Connection Diagram (Typical)

COMPRESSOR FITS AND CLEARANCES

Purpose – Service and repair of Carrier centrifugal compressors should be performed only by fully trained and qualified personnel. The information in this section is included as a reference for such personnel only.



VIEW A



Refer to Table 4 for dimensions.

Fig. 20 – Compressor Fits and Clearances

Table 4 — Compressor Fits and Clearances

ITEM	DESCRIPTION	MEASUREMENT	DIMENSION 19FA4	DIMENSION 19FA5
1	1st stage impeller to diaphragm	Axial	See tabulation	
2	2nd stage impeller to discharge wall	Axial	See tabulation	
3	1st stage labyrinth	Diametral	.016 020	.016 .020
4	Interstage labyrinth	Diametral	.012 016	012 016
5	2nd stage labyrinth	Diametral	008 012	008 012
6	Balancing piston labyrinth	Diametral	008 012	008 012
7	Impeller shaft journal bearing	Diametral	.0020 0035	.0030 .0045
8	Thrust-end float	Axial	010 015	010 015
9	Counterthrust bearing seal ring	Diametral	002 .004	002 004
10	Gear bearing to gear	Diametral	0040 0055	0050 .0065
11	Gear bearing to bearing housing	Diametral	0005 0025	.0005 0025
12	Pinion bearing to pinion	Diametral	0020 0035	0040 0055
13	Pinion bearing to bearing housing	Diametral	001 .003	0005 0025
14	Transmission labyrinth	Diametral	.006 010	.006 010
15	Motor-end labyrinth	Diametral	005 .008	005 008
16	Motor-end bearing to shaft	Diametral	0040 0054	.0040 0054
17	Motor-end bearing to bearing housing	Diametral	0005 0020	0005 0020

Tabulation — Impeller Clearances

COMPR SIZE	ROTOR ASSY CODE*	SHROUD	IMPELLER DIAMETER	DIMENSION (Item 1)†	DIMENSION (Item 2)†
19FA4	0F	A2	9 10	631	498
	0G		9.40	.596	473
	0H		9 70	561	448
	0J		10.00	531	423
	0K		10 40	.511	418
	1F	A3	9 10	701	548
	1G		9 40	671	.508
	1H		9 70	641	488
	1J		10 00	611	468
	1K		10 40	596	.458
	2F and 2L	A4	9 10	.811	628
	2G and 2M		9 40	781	578
	2H and 2N		9 70	741	558
	2J and 2P		10.00	711	528
	2K and 2Q		10 40	686	518
	3L	A5	9 10	921	708
	3M		9.40	881	688
	3N		9 70	841	638
	3P		10.00	801	598
	3Q		10.40	776	578
	4L	A6	9 10	1 041	798
	4M		9.40	991	758
	4N		9 70	951	718
	4P		10.00	901	668
	4Q		10 40	886	648
19FA5	5A	A3	12 00	837	638
	5B		12 38	.797	609
	5C		12 75	757	579
	5D		13 25	717	541
	5E		13 75	690	541
	6A	A4	12 00	977	760
	6B		12 38	937	726
	6C		12 75	897	688
	6D		13 25	837	639
	6E		13 75	810	632
	7F and 7L	A5	12 00	1 177	895
	7G and 7M		12 38	1 137	852
	7H and 7N		12 75	1 077	809
	7J and 7P		13 25	1 017	750
	7K and 7Q		13 75	970	731
	8L	A6	12 00	1 297	972
	8M		12 38	1 237	.928
	8N		12 75	1 177	880
	8P		13 25	1 097	817
	8Q		13 75	1 050	.796

*See 19FA Ordering Code

†Measured with shaft in thrust position (towards suction end); tol = ± 005

For replacement items use Carrier Specified Parts.

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

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