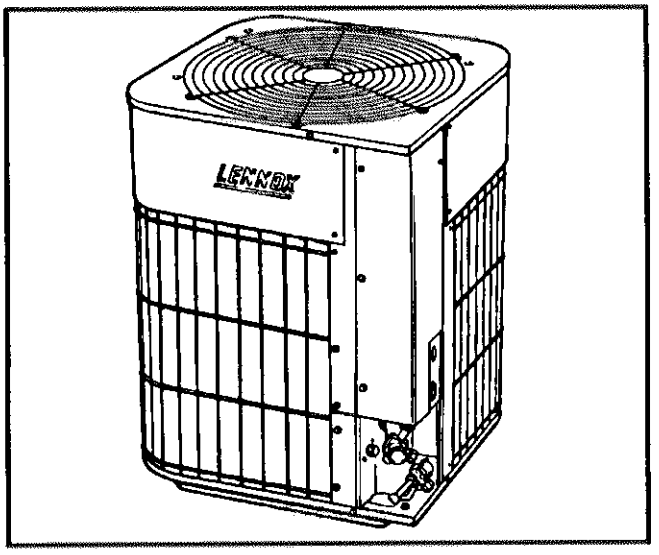
HP20 SERIES UNITS

The HP20 is a residential split-system heat pump which features a scroll compressor. It operates much like a standard heat pump, but the HP20's scroll compressor is unique in the way that it compresses refrigerant. The unit is a draw-through design and is available in 2.5, 3 and 3.5 ton sizes.

The first part of this manual describes what a scroll compressor is and how it works. The next sections list the components used in HP20's and describe how the unit operates. The final section of this manual includes wiring diagrams and a step by step sequence of operation.



SPECIFICATIONS

Model No.		HP20-311	HP20-411	HP20-461
Outdoor Coil	Net face area (sq. ft.)	7.39	9.24	11.39
	Tube diameter (in.) & No. of Rows	3/8 - 2	3/8 - 2	3/8 - 2
	Fins per inch	20	20	18
Outdoor Fan	Diameter (in.) & No. of blades	18 / 4	18 / 4	22 / 4
	Motor hp	1/6	1/6	1/3
	Cfm	2400	2600	3800
	Rpm	1040	1060	1060
	Watts	250	260	400
Refrigerant-22 (charge furnished)		6 lbs. 1 oz.	6 lbs. 15 oz.	8 lbs. 5 oz.
Liquid line connection o.d. (in.) (sweat)		3/8	3/8	3/8
Vapor line connection o.d. (in.) (sweat)		3/4	3/4	7/8
Shipping Weight (lbs.)		148	170	217

ELECTRICAL DATA

Model No.		HP20-311	HP20-411	HP20-461
Line voltage data - 60 hz. / 1 ph.		208/230V	208/230V	208/230V
Compressor	Rated load amps	13.5	18.0	20.0
	Power factor	.96	.96	.97
	Locked rotor amps	76.0	90.5	107.0
Outdoor Fan Motor	Full load amps	1.2	1.2	2.0
	Locked rotor amps	2.2	2.2	4.5
Recommended maximum fuse size or Circuit breaker size (amps)		30	40	45
*Minimum circuit ampacity		18.1	23.7	27.0

*Refer to National Electric Code manual to determine wire, fuse and disconnect size requirements.
NOTE - Extremes of operating range are plus 10% and minus 5% of line voltage.

I-INTRODUCTION

The HP20 incorporates a scroll compressor manufactured by Copeland. The unit operates as a standard heat pump with conventional refrigerant flow for heating and reverse refrigerant flow for cooling.

II-APPLICATION

All major components (indoor blower/coils) must be matched according to Lennox recommendations for the compressor to be covered under warranty. Refer to the Engineering Handbook for approved system matchups. A misapplied system will cause erratic operation and can result in early compressor failure.

Table 1 lists the line sets available for the HP20. All HP20's use sweat connections at the unit.

TABLE 1

Unit Model No.	Line Set Model No.	Length of Lines (ft.)	Liquid Line (o.d. in.)	Vapor Line (o.d. in.)
HP20-311 HP20-411	L10-41-20	20	3/8	3/4
	L10-41-30	30		
	L10-41-40	40		
	L10-41-50	50		
HP20-461	L10-65-30	30	3/8	7/8
	L10-65-40	40		
	L10-65-50	50		

NOTE – Refrigerant lines must not exceed 50 ft. in any installation. If longer length is required, contact your Lennox Division Service Department.

III-SCROLL COMPRESSOR

The scroll compressor design is simple, efficient and requires few moving parts. A cutaway diagram of the scroll compressor is shown in figure 1. The scrolls are located in the top of the compressor can and the motor is located in the bottom of the compressor can. The oil level is immediately below the motor.

The scroll is a simple compression concept centered around the unique spiral shape of the scroll and its inherent properties. Figure 2 shows the basic scroll form. Two identical scrolls are mated together forming concentric spiral shapes (figure 3). One scroll remains stationary, while the other is allowed to 'orbit' (figure 4). Note that the orbiting scroll does not rotate or turn but merely 'orbits' the stationary scroll.

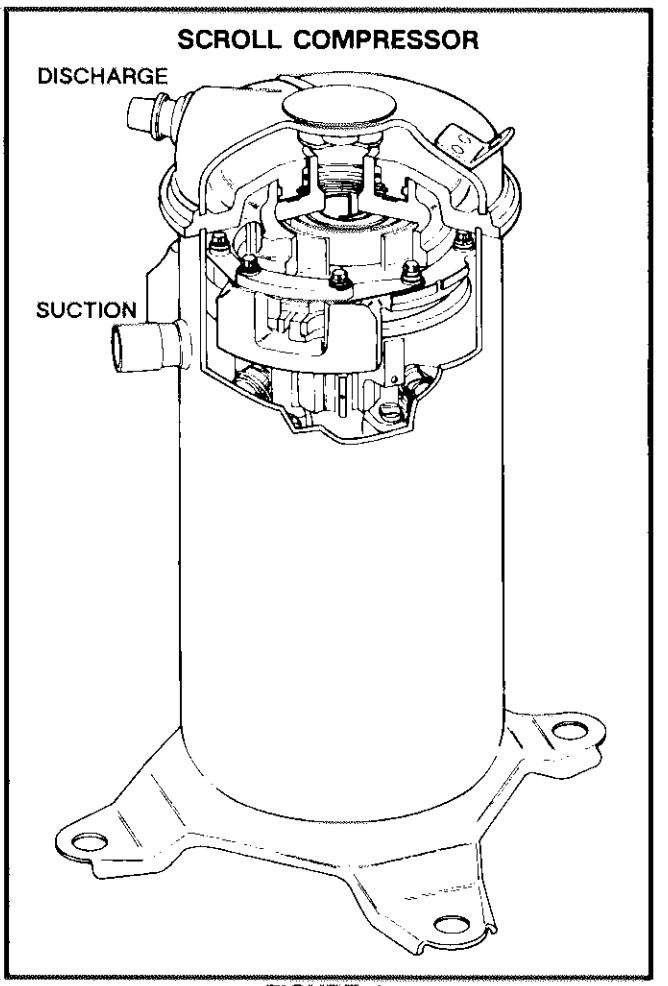


FIGURE 1

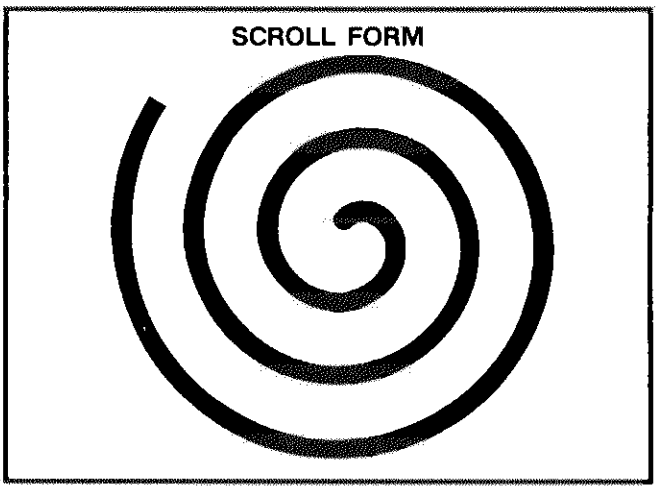


FIGURE 2

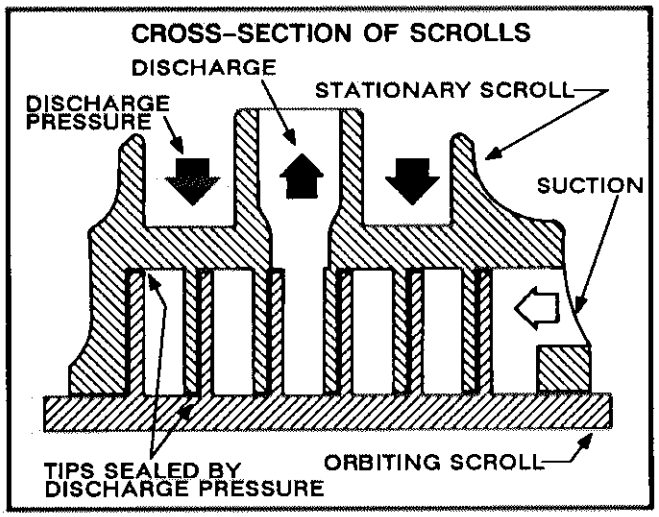


FIGURE 3

The counterclockwise orbiting scroll draws gas into the outer crescent shaped gas pocket created by the two scrolls (figure 4 – 1). The centrifugal action of the orbiting scroll seals off the flanks of the scrolls (figure 4 – 2). As the orbiting motion continues, the gas is forced toward the center of the scroll and the gas pocket becomes compressed (figure 4 – 3). When the compressed gas reaches the center, it is discharged vertically into a chamber and discharge port in the top of the compressor (figure 1). The discharge pressure forcing down on the top scroll helps seal off the upper and lower edges (tips) of the scrolls (figure 3). During a single orbit, several pockets of gas are compressed simultaneously providing smooth continuous compression.

The scroll compressor is tolerant to the effects of liquid return. If liquid enters the scrolls, the orbiting scroll is allowed to separate from the stationary scroll. The liquid is worked toward the center of the scroll and is discharged. If the compressor is replaced, conventional Lennox cleanup practices must be used.

NOTE – The head of a scroll compressor may be hot since it is in constant contact with discharge gas.

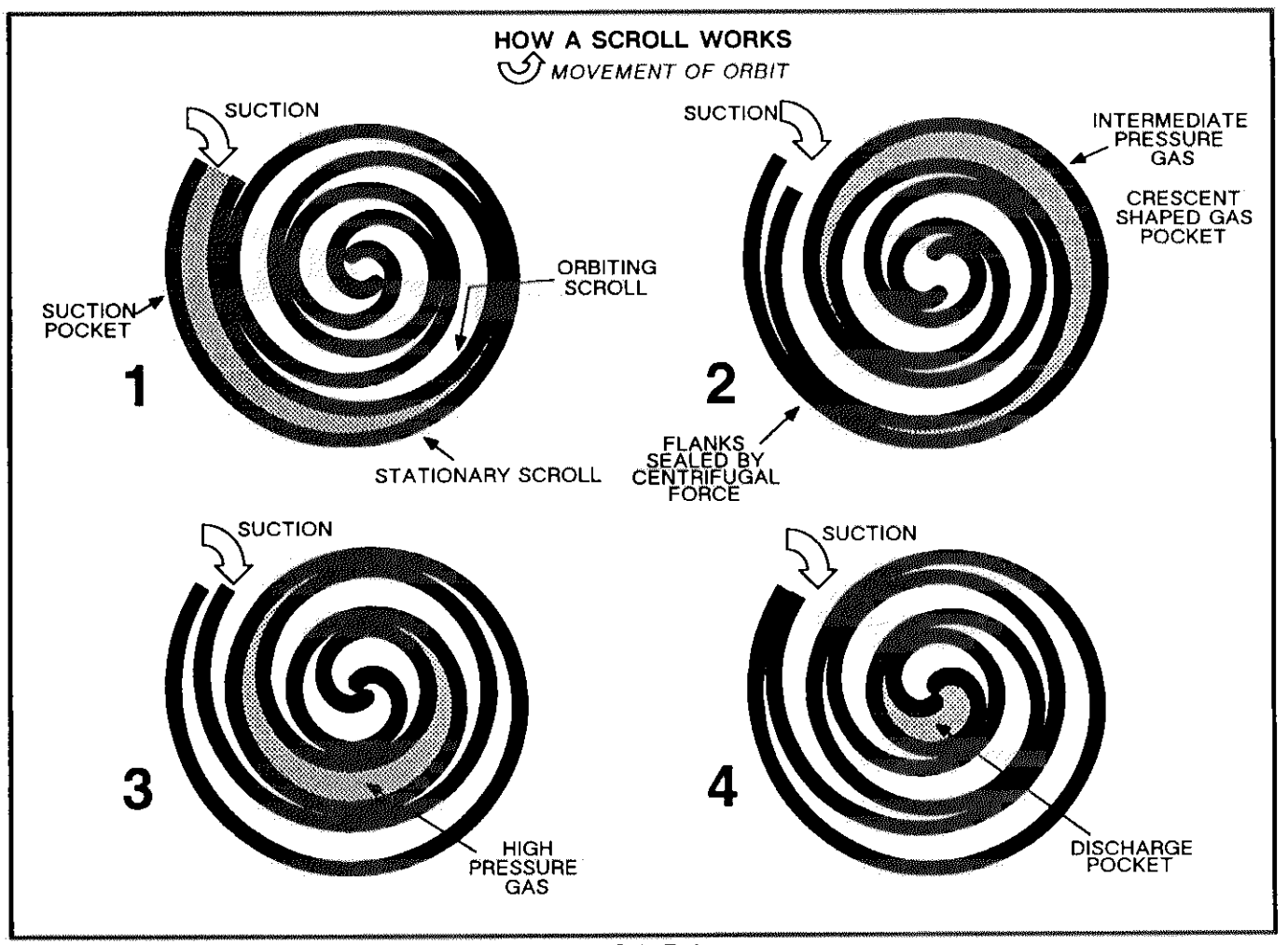


FIGURE 4

IV-UNIT COMPONENTS

A-Transformer

The contactor, timed off control, discharge temperature thermostat and reversing valve in the HP20 are powered by 24VAC power supplied by the indoor unit. All other controls in the unit are powered by outdoor unit line voltage. Refer to Unit Wiring Diagram. The HP20 is not equipped with an internal line voltage to 24V transformer.

B-Compressor Contactor

The compressor is energized by a SPST contactor located in the control box (figure 5). The contactor is energized by thermostat terminal M through the timed off control.

CAUTION - HP20 SERIES UNITS USE SINGLE POLE CONTACTORS. WHEN THE CONTACTOR IS DE-ENERGIZED, ONE SIDE IS 'HOT' THROUGHOUT THE UNIT. TO AVOID ELECTRICAL SHOCK, DISCONNECT ALL POWER TO UNIT BEFORE SERVICING.

C-Timed Off Control / Brownout Protector

Each HP20 is equipped with a timed off control located in the control box (figure 5). The timed off control serves two purposes. The first is to prevent the compressor from short cycling and the second is to provide brownout protection. The timed off control is electrically connected between thermostat terminal M and the compressor contactor.

On initial thermostat demand, the compressor contactor is immediately energized. When thermostat demand is satisfied, the timed off control opens the circuit to the compressor contactor coil and the compressor is prevented from being energized for 3 minutes. At the end of 3 minutes, the circuit to the contactor is closed and the compressor can once again be energized.

The brownout feature protects the unit from low voltage situations. If, during unit operation, the voltage through the timed off control drops below 20VAC, the timed off control opens the circuit to the contactor coil until voltage is restored.

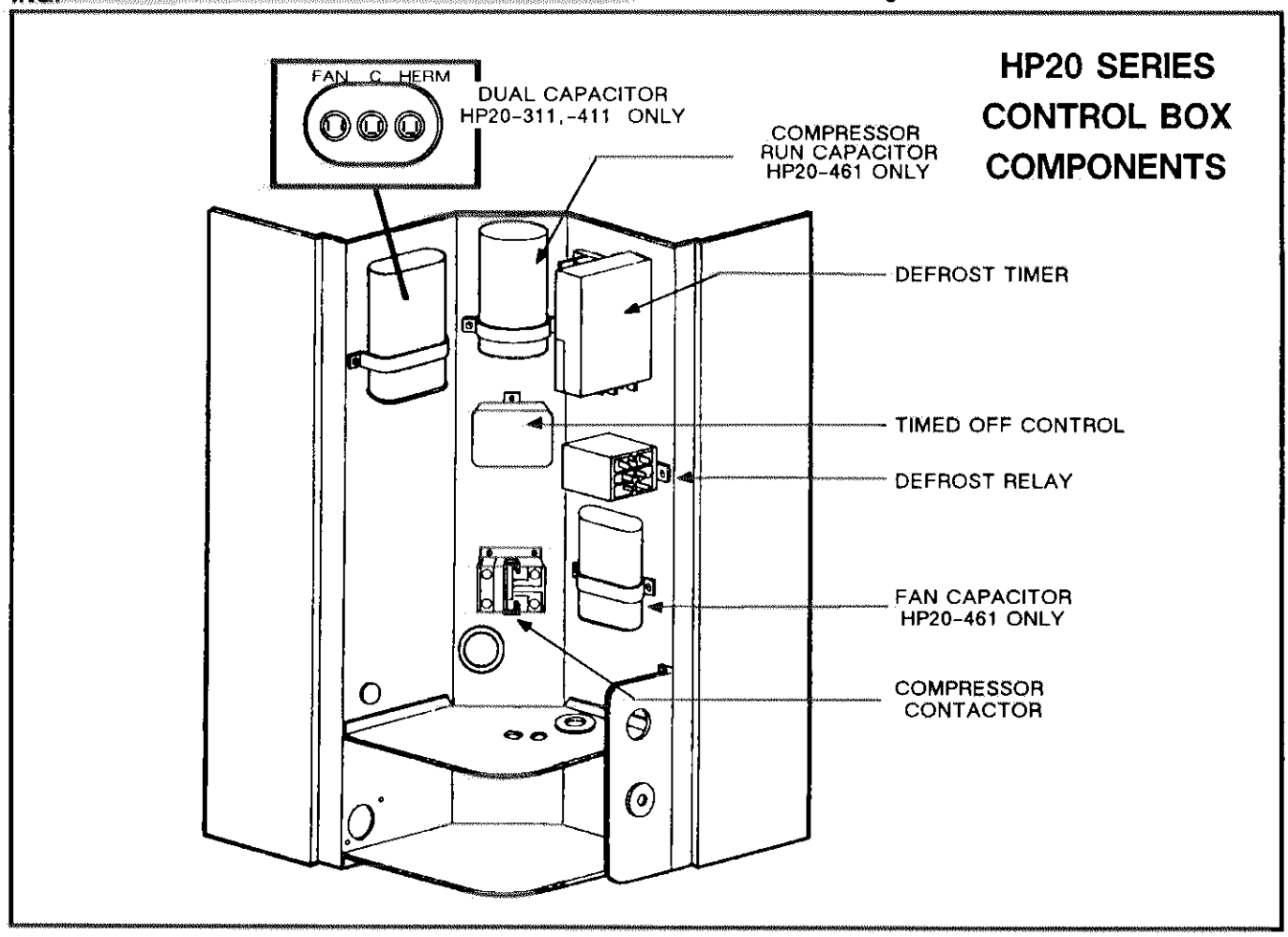


FIGURE 5

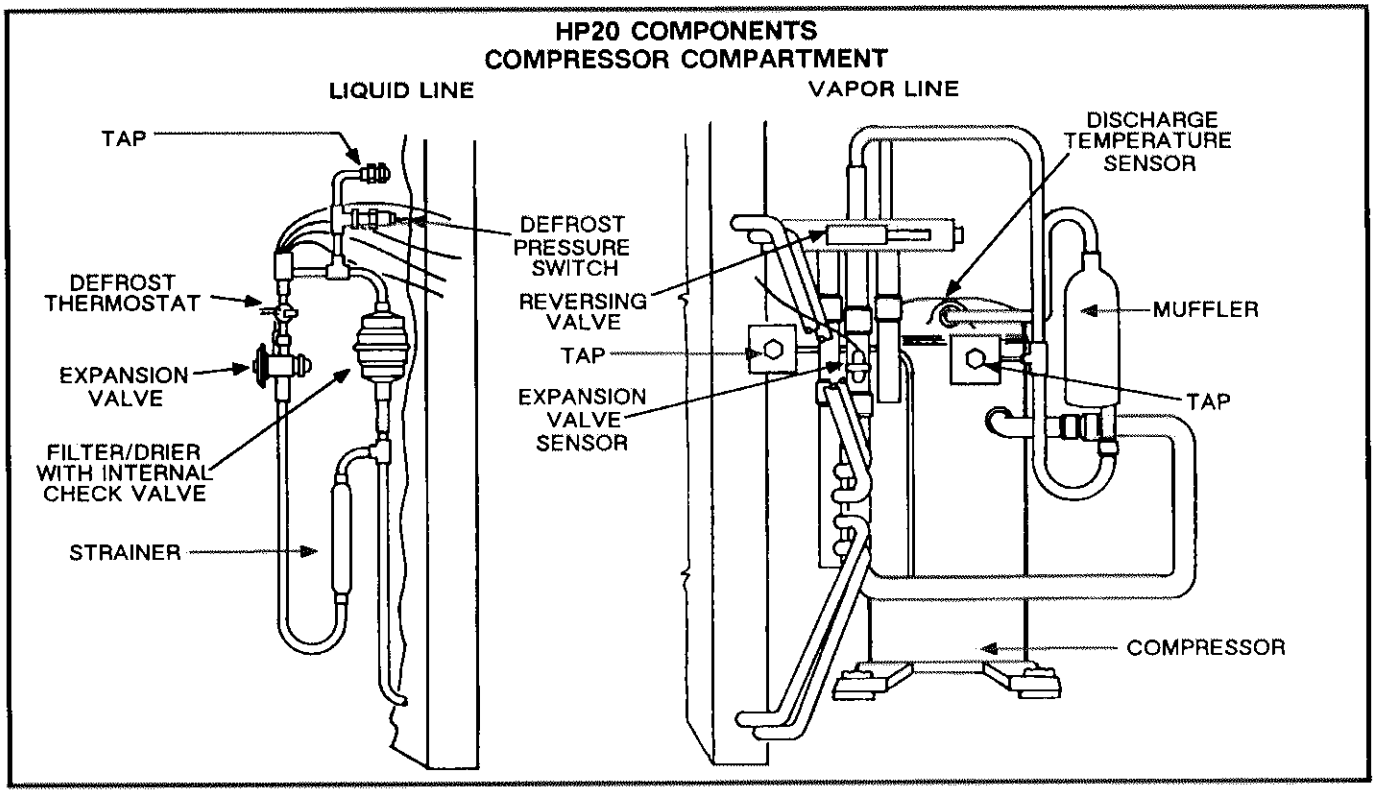


FIGURE 6

D-Compressor

See Section III for description of scroll compressor.

E-Fan and Motor

Fan and motor specifications are listed in the tables on page 1.

F-Discharge Temperature Sensor

Each scroll compressor is equipped with discharge temperature sensor located on the outside top of the compressor. The sensor is a SPST thermostat which opens when the discharge temperature exceeds 280°F ± 8°F on a temperature rise. When the switch opens, the circuit to the compressor contactor and the timed off control is de-energized and the unit shuts off. The switch automatically resets when the compressor temperature drops below 130°F ± 14°F.

The sensor can be accessed by prying up on the snap plug on top of the compressor (see figure 7). Make sure to securely reseal the sensor after replacement. The sensor terminals are located inside the compressor terminal box. Figure 8 shows the arrangement of compressor line voltage terminals and discharge sensor terminals.

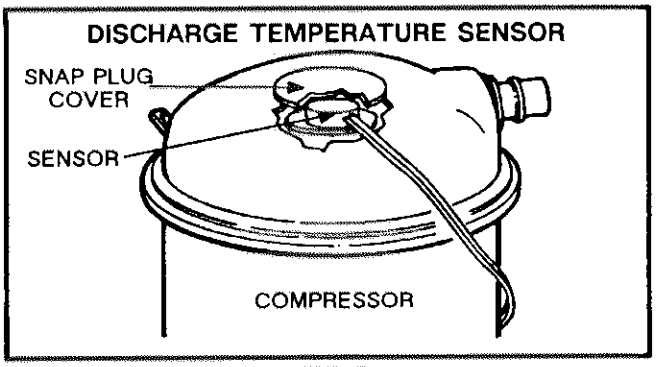


FIGURE 7

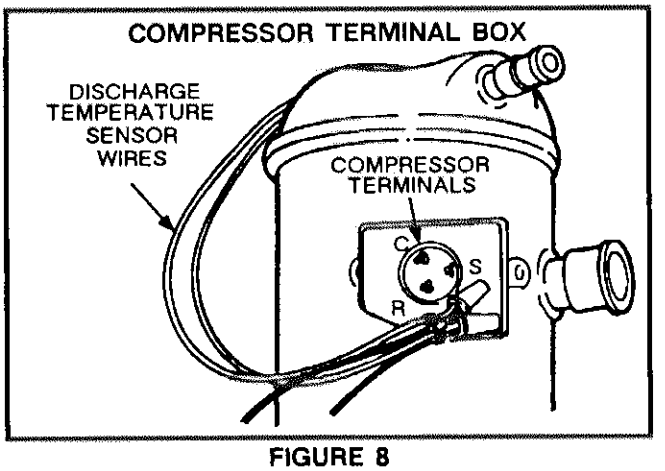


FIGURE 8

G-Dual Capacitor (HP20-311,-411 only)

The compressor and fan in HP20-311,-411 series units use permanent split capacitor (PSC) motors. A single 'dual' capacitor is used for both the fan motor and the compressor (see unit wiring diagram). This capacitor is located inside the control box (see figure 5). Table 2 shows the rating of the dual capacitor.

TABLE 2

HP20 DUAL CAPACITOR RATING			
Terminal	Connected To	MFD	VAC
FAN	Fan - Purple Wire	5	440
HERM	Compressor - Terminal S	35	440
C	Line Voltage L2	---	---

H-Run Capacitor (HP20-461 only)

The compressor in HP20-461 series units is equipped with a permanent split capacitor(PSC) motor. The capacitor, which is located inside the control box, is electrically connected between compressor terminal S and line voltage L2 (see unit wiring diagram and figure 5). The capacitor is rated 35MFD at 440VAC.

I-Fan Capacitor (HP20-461 only)

The fan in HP20-461 series units is also equipped with a permanent split capacitor (PSC) motor. The capacitor is electrically connected to the fan motor only but is located inside the control box (see unit wiring diagram and figure 5).The capacitor is rated 7MFD at 370VAC.

J-Defrost Relay

The defrost relay controls defrost. The relay is a 1PDT & 2PST relay powered by line voltage in the outdoor unit. When the defrost relay is energized during the heating mode the reversing valve and indoor auxiliary heat are energized. Simultaneously, the outdoor fan is de-energized. The relay, when energized, latches in for the duration of the defrost period, but when de-energized, prevents the relay from being energized during a cooling demand. Refer to unit wiring diagram and operation sequence in the back of this manual.

K-Defrost (Initiation) Thermostat

The defrost thermostat is located on the liquid line between the expansion valve and distributor (figure 6). The thermostat is a SPST switch connected to line voltage in the outdoor unit. It monitors the temperature of the outdoor coil. During a heating demand, the thermostat closes to allow defrost to begin when the outdoor coil drops below 35°F ± 4°F. During defrost, the defrost thermostat resets when the outdoor coil rises above 60°F ± 5°F. The reset temperature also prevents defrost from being initiated during a cooling demand.

L-Defrost Pressure Switch

The defrost pressure switch is located on the liquid line between the distributor and drier/check valve (figure 6). The pressure switch is a SPST auto-reset switch connected to line volatge in the outdoor unit. It monitors the pressure of the liquid line. During a heating demand, the switch closes at 260 psig ± 7 psig on a pressure drop to allow defrost to begin. During defrost, the switch opens when the liquid line rises to 325 psig ± 7 psig to terminate defrost.

M-Defrost Timer

The defrost timer (figure 9) controls the interval between defrosts and the duration of defrost. Figure 10 shows the timing action of the defrost timer terminals. The defrost timer is a motor driven cam switch timer. The motor uses 240VAC powered from outdoor unit line voltage. The motor drives cams to operate 2SPST switches.

1- **To change from 90 minute to 45 minute defrost interval**

   The defrost timer can be field adjusted from a 90 minute to 45 minute defrost interval if warranted by climatic conditions. Figure 9 shows how to change the defrost interval.

2- **To manually advance timer through defrost cycle**

   The defrost timer may be manually advanced through the defrost cycle when troubleshooting the unit. Figure 9 also shows how to manually advance the defrost timer.

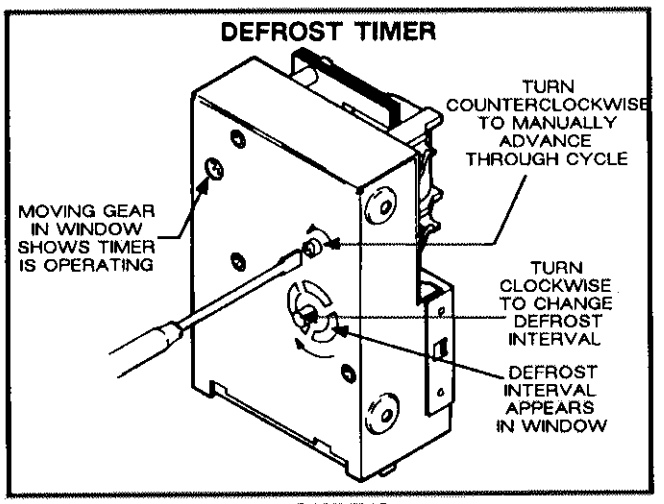
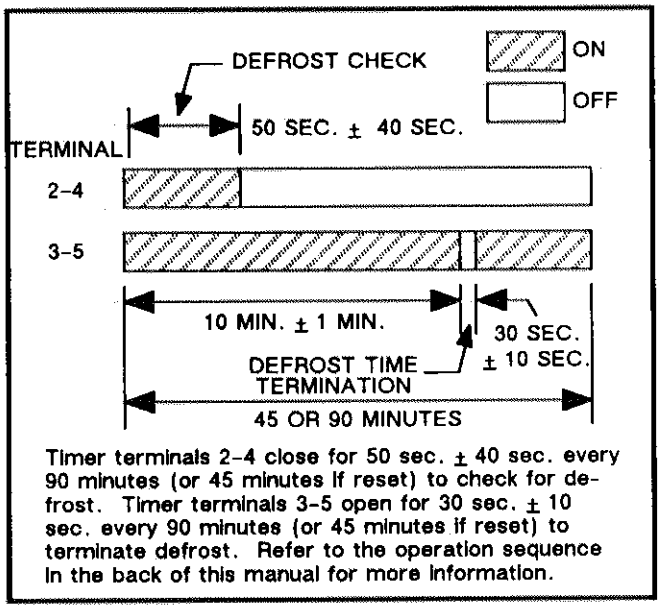


FIGURE 9



Timer terminals 2-4 close for 50 sec. ± 40 sec. every 90 minutes (or 45 minutes if reset) to check for defrost. Timer terminals 3-5 open for 30 sec. ± 10 sec. every 90 minutes (or 45 minutes if reset) to terminate defrost. Refer to the operation sequence in the back of this manual for more information.

FIGURE 10

N-Reversing Valve and Solenoid

A refrigerant reversing valve with electromechanical solenoid is used to reverse refrigerant flow during unit operation. The reversing valve is energized during cooling demand and during defrost. Refer to figures 12 and 13 in section V for more information.

V-REFRIGERANT SYSTEM

Vapor and liquid line connections are located outside the cabinet and are made with sweat connections. Brass service valves provide access to refrigerant system. Vapor line valve (figure 11), liquid line service valve and guage ports are accessible outside the cabinet below the control box. HP20's use one-shot vapor line valves which cannot be closed after being opened. The liquid line valve can be closed. The thermometer well is field installed in the liquid line outside the unit. It is sweated in between the liquid line valve and the line set. Refer to the HP20 installation instructions for information on thermometer well placement and installation. Figure 12 shows the HP20 cooling cycle and figure 13 shows the HP20 heating cycle.

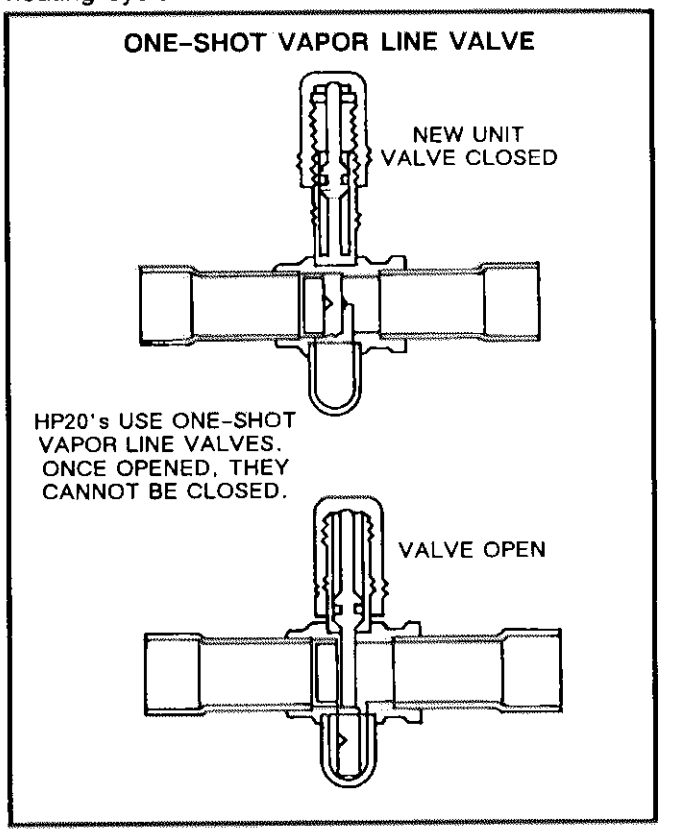


FIGURE 11

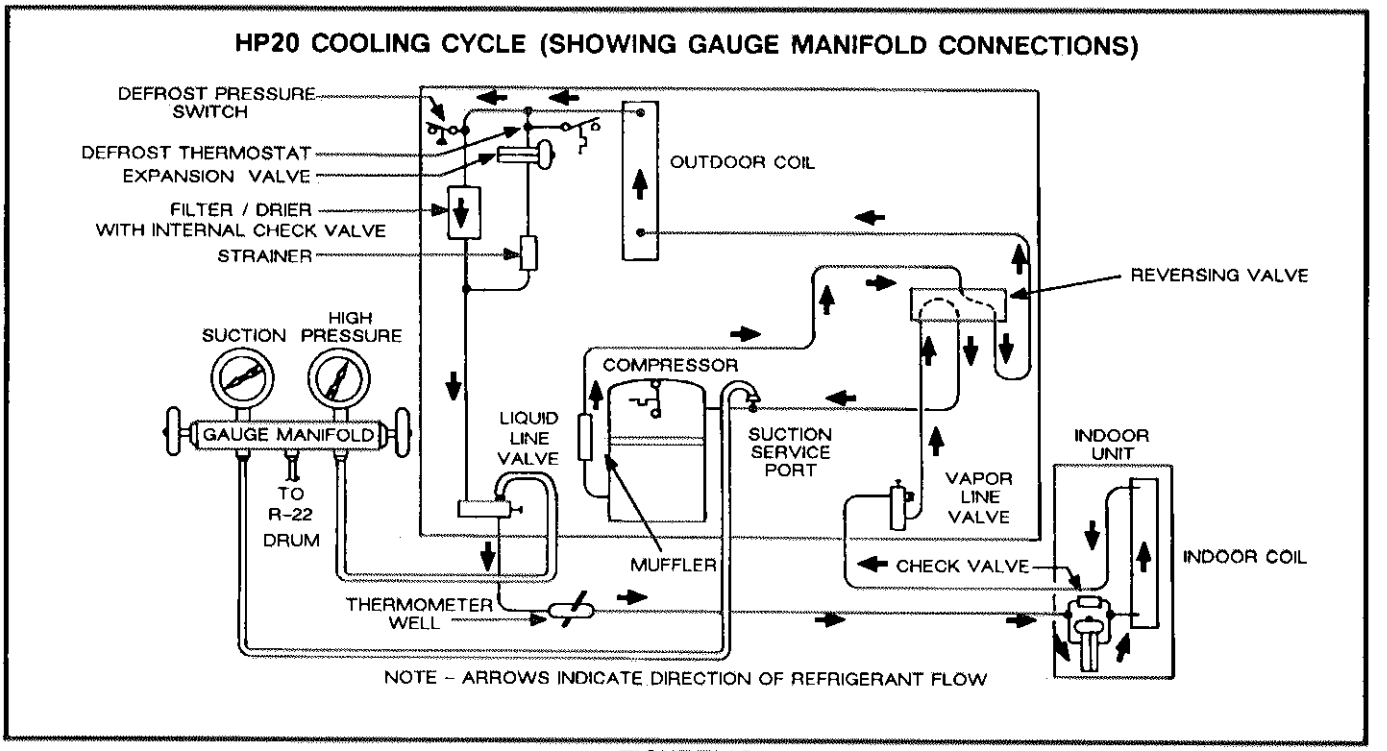


FIGURE 12

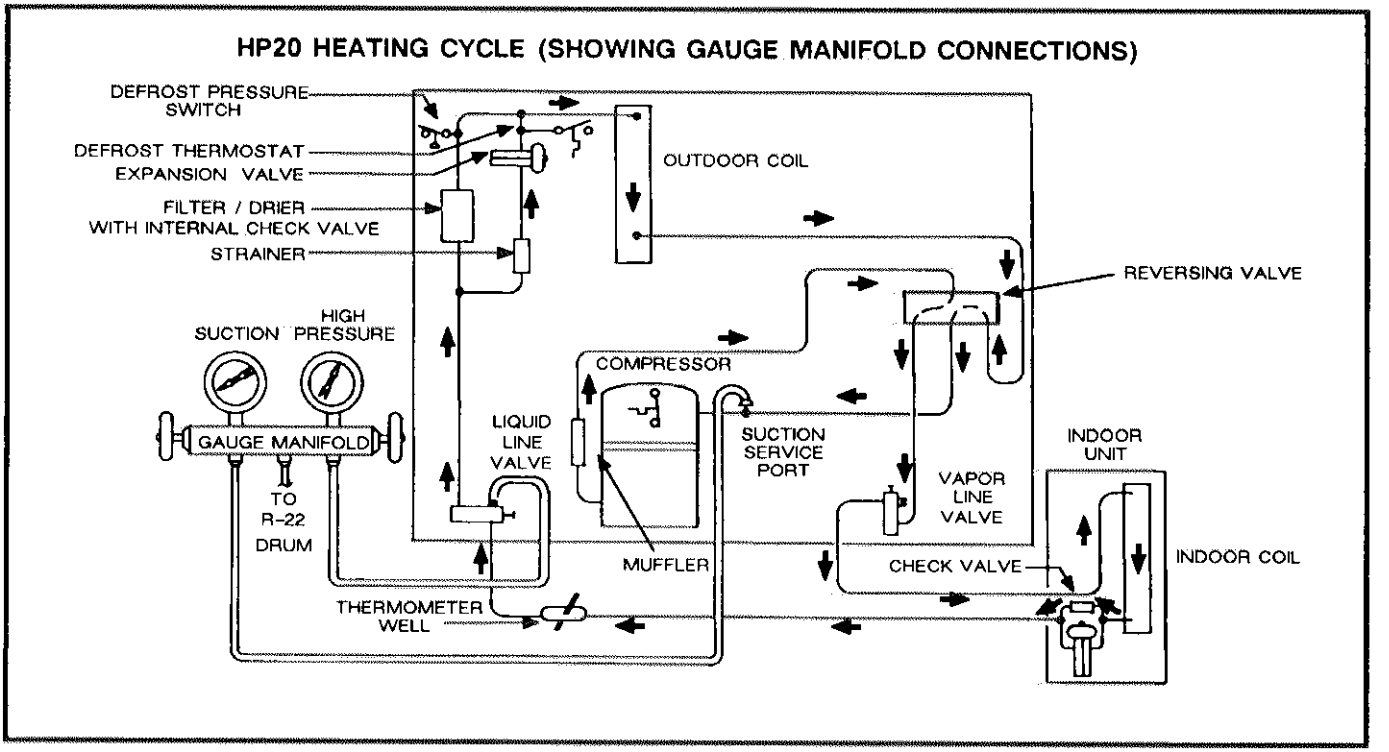


FIGURE 13

VI-CHARGING PROCEDURE

A-Refrigerant Charge

The following charging procedure is intended as a general guide. It is intended for use on expansion valve systems only. For best results, indoor temperature should be between 70°F and 80°F. Be sure to monitor system pressures while charging. Charging should be done in cooling mode.

1- Check to make sure that thermometer well is filled with oil before checking liquid line temperature.

2- Connect gauge manifold as shown in figure 12. Connect an upright R-22 drum to center port of gauge manifold.

3- Set room thermostat to 74°F (23°C) in "Emergency Heat" or "Heat" position and allow unit to run until heating demand is satisfied. This will create the necessary load for proper system charging in the cooling cycle. Change thermostat setting to 68°F (20°C) in "Cool" position. Allow unit to run until system pressures stabilize.

Approach Method

(Ambient Temperature of 60°F [16°C] or Above)

4- If outdoor temperature is 60°F (16°C) or above, the approach method of checking charge is used. The approach temperature is equal to the liquid line temperature minus the ambient temperature. Place the thermometer in the thermometer well and read the liquid line temperature. The difference between the liquid line and the ambient temperature should match the value given in table 3.

NOTE-For best results, use same thermometer to measure both ambient and liquid line temperatures.

TABLE 3

Model	Liq. Temp Minus Amb. Temp. (°F)
HP20-311	12.0 to 14.0
HP20-411	10.0 to 12.0
HP20-461	7.0 to 9.0

An approach temperature greater than the value given in table 3 indicates an undercharge. Add refrigerant slowly and continue to watch liquid line temperature until approach temperature approximates the value given in table 3.

An approach temperature less than the value shown in table 3 indicates an overcharge. Use an approved refrigerant reclaiming method to remove refrigerant from the system.

When unit is properly charged, liquid line pressures should approximate those given in table 4.

TABLE 4
NORMAL OPERATING PRESSURES

MODE	OUTDOOR COIL ENTERING AIR TEMPERATURE	HP20-311		HP20-411		HP20-461	
		LIQUID ± 10 PSIG	SUCTION ± 5 PSIG	LIQUID ± 10 PSIG	SUCTION ± 5 PSIG	LIQUID ± 10 PSIG	SUCTION ± 5 PSIG
COOLING	65°F	160	75	170	72	165	75
	85°F	220	78	230	74	225	77
	95°F	250	80	260	75	255	78
	105°F	280	82	290	76	285	79
HEATING	30°F	180	37	185	36	185	37
	40°F	190	47	195	44	195	47
	50°F	205	56	210	52	210	55
	60°F	215	66	220	60	220	64

Subcooling Method
(Ambient Temperatures Below 60°F [16°C])

5- If outdoor temperature is less than 60°F (16°C), the subcooling method of charging is used. The subcooling temperature is equal to the condensing temperature minus the liquid line temperature.

It may be necessary to restrict air flow in order to reach liquid pressures in the 200-250 psig range which are required for checking charge. Block equal sections of air intake panels as shown in figure 14, moving obstructions sideways until liquid pressures in the 200-250 psig range are reached.

Insert thermometer in well and check liquid line temperature. Read liquid line pressure from gauge and convert to condensing temperature using standard R-22 temperature/pressure conversion chart. The subcooling temperature should approximate the value given in table 5.

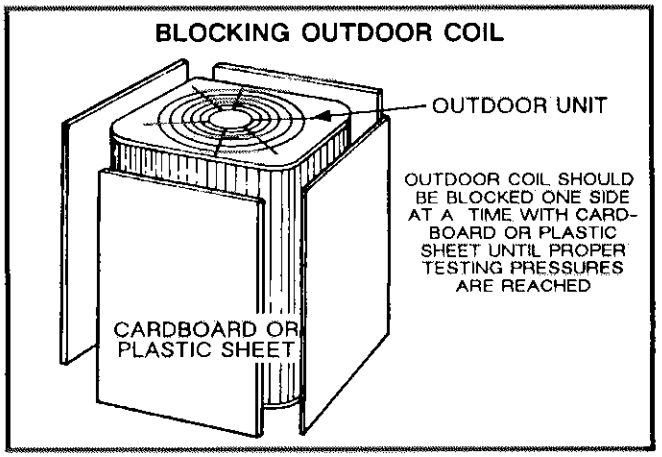


FIGURE 14

A subcooling temperature less than the value given in table 5 indicates an undercharge. Add refrigerant slowly and continue to watch liquid line temperature until subcooling temperature approximates the value given in table 5.

TABLE 5

Model	Subcooling °F
HP20-311	9.0° ± 3.0°
HP20-411	13.0° ± 3.0°
HP20-461	10.0° ± 3.0°

A subcooling temperature greater than the value given in table 5 indicates an overcharge. Use an approved refrigerant reclaiming method to remove refrigerant from system.

B-Weighing In Refrigerant/Factory Charge

If the system is completely void of refrigerant, the recommended and most accurate method of charging is to weigh the refrigerant into the unit according to the total amount shown on the unit nameplate and in table 6. To compensate for length of line set, add additional refrigerant per table 7

TABLE 6

Unit	Refrigerant Charge R-22
HP20-311	6 lbs. 1 oz.
HP20-411	6 lbs. 15 oz.
HP20-461	8 lbs. 5 oz.

TABLE 7

Line Set Dia.		Ozs. per ft. (ml per mm) adjust from 25 ft. (7620 mm) line set*
Vapor	Liquid	
5/8 in. (16mm)	5/16 in. (8mm)	1/2 ounce (15ml)
5/8 in. (16mm)	3/8 in. (10mm)	1 ounce (30ml)
3/4 in. (19mm)	3/8 in. (10mm)	1 ounce (30ml)
7/8 in. (22mm)	3/8 in. (10mm)	1 ounce (30ml)
1-1/8 in. (29mm)	1/2 in. (13mm)	1-3/4 ounce (52ml)

**If line length is greater than 25 feet (7620 mm), add this amount. If line length is less than 25 feet (7620 mm), subtract this amount.*

C-Oil Charge

Table 8 shows the factory oil charge in HP20 series units. All scroll compressors use white oil.

TABLE 8

Unit	Oil Charge
HP20-311	28 fluid ounces
HP20-411	34 fluid ounces
HP20-461	38 fluid ounces

VII-COMPRESSOR COMPARTMENT ACCESS

Access to the compressor compartment is gained by removing the fan and orifice panel. The unit compressor, plumbing, reversing valve, defrost switches and discharge temperature switch may all be accessed in the compressor compartment. Figure 15 shows how to gain access to the compressor compartment.

To Remove Fan Orifice (Figure 15)

1- Turn off power at disconnect.

2- Discharge fan capacitor (or fan side of dual capacitor).

3- Disconnect fan wires. Feed wires through hole in control box into compressor compartment.

4- Loosen the fan guard securing screws and remove fan guard.

5- Remove orifice securing screws. Leave fan and motor attached to orifice.

6- Remove support arm screws.

7- Lift off fan orifice.

To Reinstall Fan Orifice (Figure 15)

1- Route wires back through hole into control box.

2- Position fan and orifice on unit.

3- Line up support arms with holes in orifice. Insert screws but do not tighten.

4- Insert screws attaching orifice to unit and tighten securely.

5- Tighten support arm screws securely.

6- Replace fan guard and tighten screws securely.

7- Reconnect wires as shown in unit diagram (back of this manual and inside control box cover).

8- Reconnect power to unit.

CAUTION - MAKE SURE ALL FAN WIRES ARE CONNECTED CORRECTLY AND ARE SECURELY FASTENED BEFORE PLACING UNIT BACK IN SERVICE.

DANGER - MAKE SURE THAT ALL SCREWS AND FAN GUARD ARE IN PLACE AND ARE SECURELY FASTENED BEFORE PLACING UNIT BACK IN SERVICE.

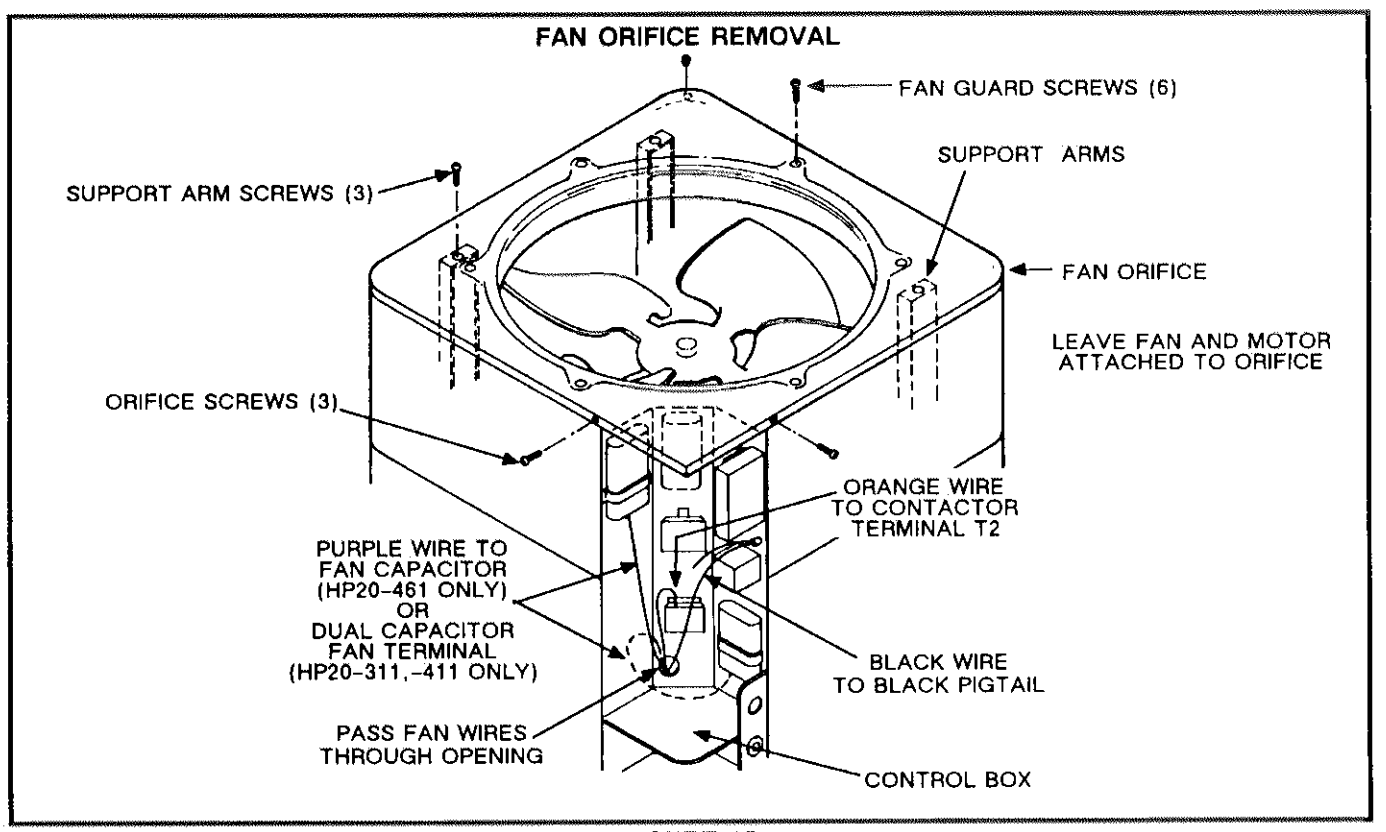


FIGURE 15

VIII-MAINTENANCE

At the beginning of each heating or cooling season, the system should be cleaned as follows:

A-Heat Pump Unit

1- Clean and inspect outdoor coil (may be flushed with a water hose).

2- Outdoor fan motor is prelubricated and sealed. Always relubricate motor according to the instructions on the motor manufacturer's nameplate.

3- Visually inspect all connecting lines, joints and coils for evidence of oil leaks.

4- Check all wiring for loose connections.

5- Check for correct voltage at unit (unit operating).

6- Check amp draw on heat pump fan motor.
Unit nameplate_____Actual_____.

7- Inspect drain holes in coil compartment base and clean if necessary.

NOTE-If insufficient heating or cooling occurs, the unit should be gauged and refrigerant charge should be checked.

B-Indoor Coil

1- Clean coil if necessary.

2- Check connecting lines, joints and coil for evidence of oil leaks.

3- Check condensate line and clean if necessary.

C-Indoor Unit

1- Clean or change filters.

2- Lubricate blower motor according to motor manufacturer's instructions. If no instructions are provided, use the following as a guide:

a- *Motors without Oiling Ports* -- Prelubricated and sealed. No further lubrication required.

b- *Direct Drive Motors with Oiling Ports* -- Prelubricated for an extended period of operation. For extended bearing life, relubricate with a few drops of SAE No.10 non-detergent oil once every two years. It may be necessary to remove blower assembly for access to oiling ports.

3- Adjust blower speed for cooling. The pressure drop over the coil should be checked to determine the correct blower CFM. Refer to the Lennox Cooling Service Handbook for pressure drop tables and procedures.

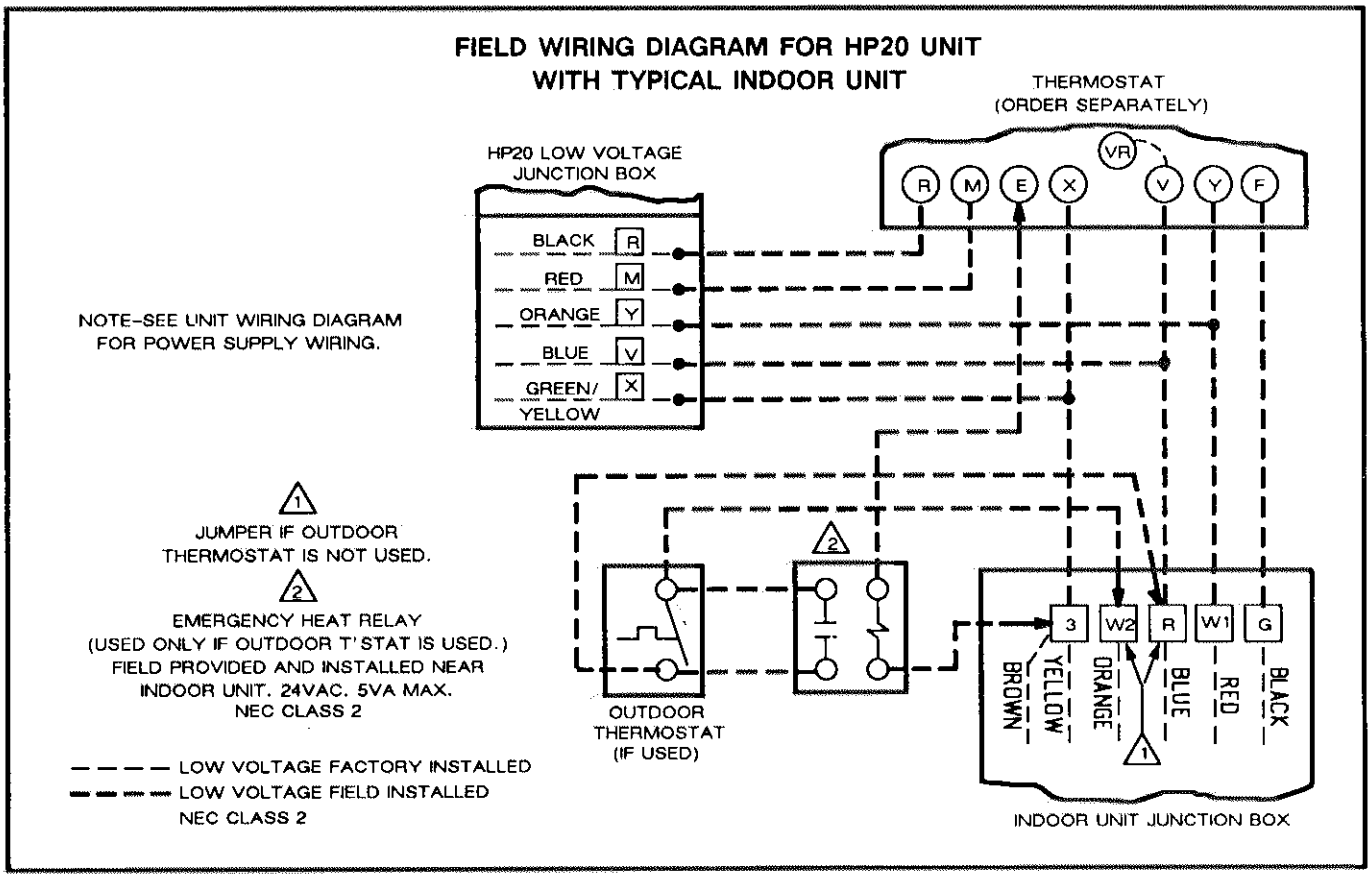
4- Check all wiring for loose connections.

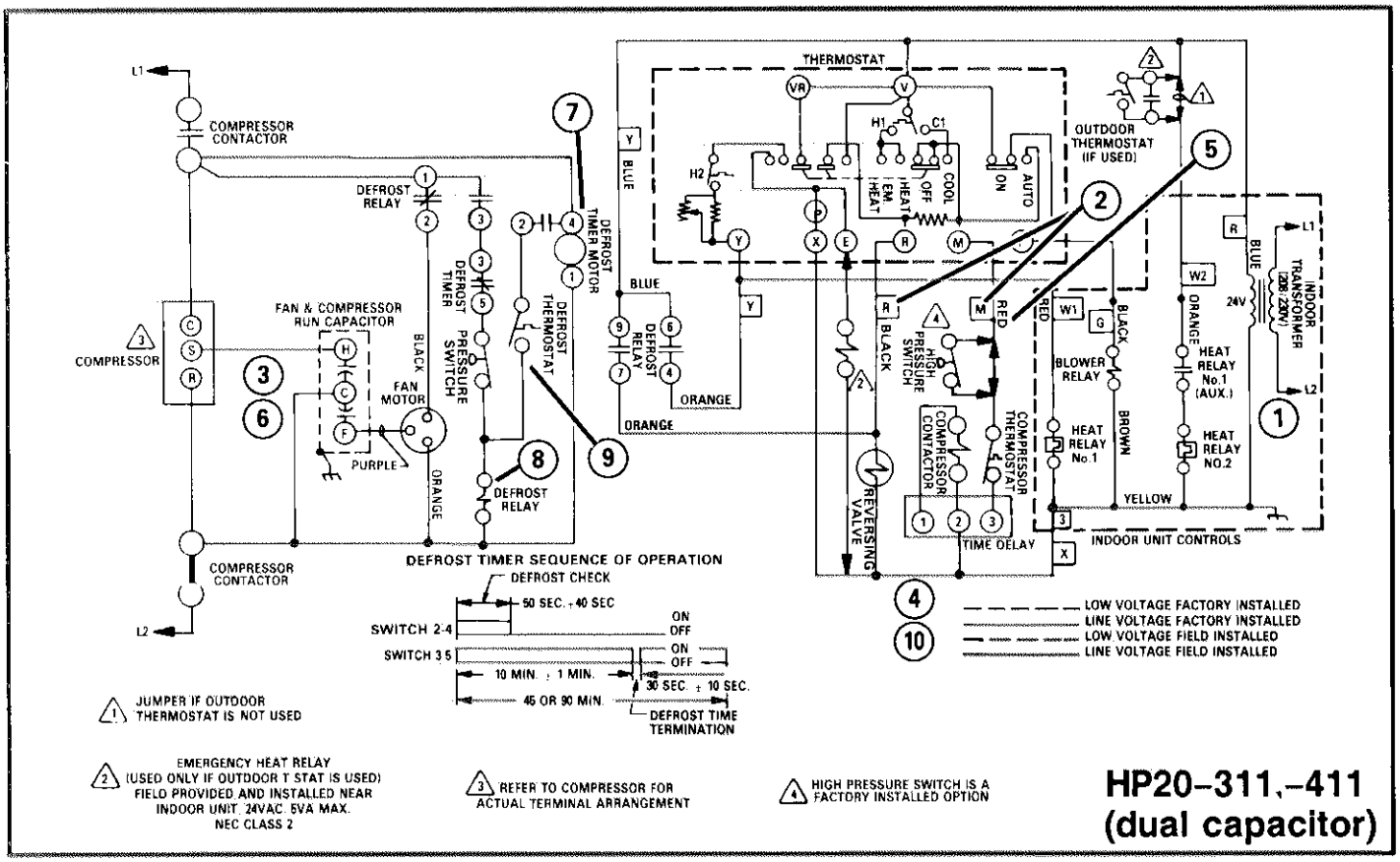
5- Check for correct voltage at unit.

6- Check amp draw on blower motor.
Motor nameplate_____Actual_____.

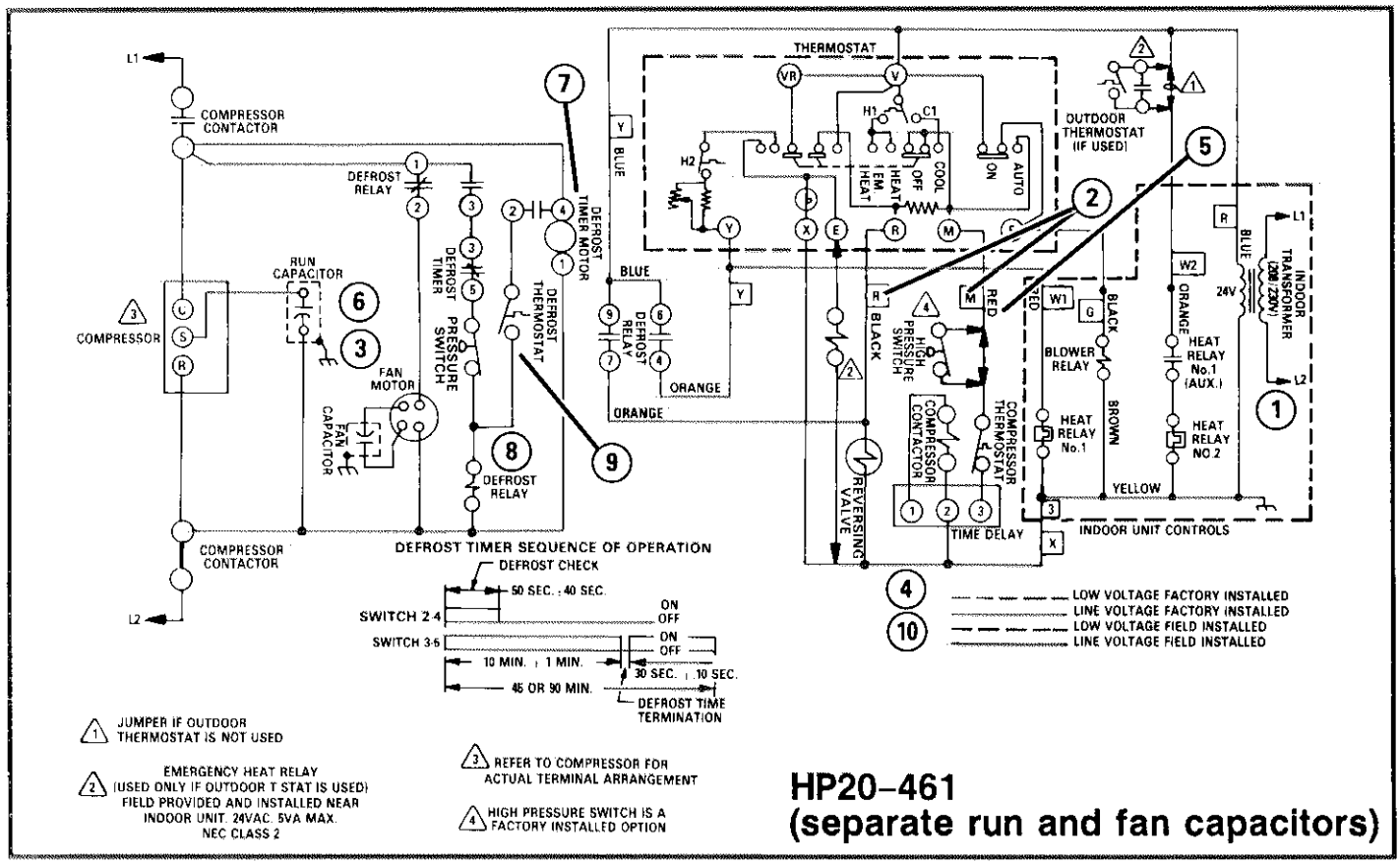
IX-UNIT DIAGRAMS AND SEQUENCE OF OPERATION

A-Field Wiring





HP20-311,-411 (dual capacitor)



HP20-461 (separate run and fan capacitors)

B-Operation Sequence

1- Transformer in indoor unit supplies 24VAC power to the thermostat and outdoor unit's controls.

2- Initial cooling demand energizes thermostat terminals M and R. Voltage from terminal M passes through compressor thermostat and energizes timed off control. The timed off control immediately energizes compressor contactor. Voltage from terminal R energizes the reversing valve.

3- The compressor and fan startup as follows:

Units with Dual Capacitor (facing page above):

When the compressor contactor closes, the compressor and fan motor are energized (providing the compressor has been off 3 minutes). No start components are used. The following table shows how the compressor and fan are energized.

HP20-311,-411		Is energized by
Compressor Terminal	C	L1
	R	L2
	S	L2 through 'HERM' Terminal of Dual Capacitor
Fan Motor Wire	Black	L1 through defrost relay term. 1-2
	Purple	L2 through 'FAN' Terminal of Dual Capacitor
	Orange	L2

Units with separate Run and Fan Capacitors (facing page below):

When the compressor contactor closes, the compressor and fan motor are energized (providing the compressor has been off 3 minutes). No start components are used. Compressor terminal C is energized by L1, terminal R is energized by L2 and terminal S is energized by the run capacitor.

4- When cooling demand is satisfied the timed off control prevents the compressor from short cycling for 3 minutes.

5- Initial heating demand energizes thermostat terminal M only. Voltage from terminal M passes through the compressor thermostat and energizes the timed off control. The timed off control immediately energizes the compressor contactor.

6- When compressor contactor closes, step 3 repeats.

7- Every 90 minutes of heating demand (or 45 minutes if reset) the defrost timer closes terminals 2-4 to check for defrost. If defrost thermostat is closed when this happens, defrost relay will energize. When defrost timer contacts 2-4 open, the defrost relay remains 'latched in' by defrost timer contacts 3-5.

8- When defrost relay energizes, the reversing valve and indoor electric heat are also energized.

9- When defrost pressure switch opens during defrost or when 10 minutes has elapsed, the defrost relay is de-energized and defrost stops. The unit continues heat pump operation.

10- When heating demand is satisfied step 4 repeats.