HP27 SERIES UNITS

The HP27 is a high efficiency residential split-system heat pump which features a scroll compressor. It operates much like a standard heat pump, but the scroll compressor is unique in the way that it compresses refrigerant. Several models are available in sizes ranging from 2 through 3-1/2 tons. The series uses expansion valves in the outdoor unit and in the indoor unit.

This manual is divided into sections which discuss the major components, refrigerant system and charging procedures, maintenance and operation sequences. All specifications in this manual are subject to change.

SPECIFICATIONS

Model No.			HP27-024	HP27-030	HP27-036	HP27-042
Condenser Coil	Net face area sq. ft. (m^2)	Outer Coil	21.77 (2.02)	21.77 (2.02)	24.06 (2.24)	24.06 (2.24)
		Inner Coil	21.11 (1.96)	21.11 (1.96)	23.33 (2.17)	23.33 (2.17)
	Tube diameter — in. (mm)		5/16 (7.9)	5/16 (7.9)	5/16 (7.9)	5/16 (7.9)
	No. of rows		2	2	2	2
	Fins per inch (m)		22 (866)	22 (866)	22 (866)	22 (866)
Condenser Fan	Diameter in. (mm) — No. of blades		24(610) - 3	24(610) - 3	24(610) - 3	24(610) - 3
	Motor hp (W)		1/10 (75)	1/10 (75)	1/10 (75)	1/10 (75)
	Cfm (L/s)		2800 (1320)	2800 (1320)	2800 (1320)	2800 (1320)
	Rpm		825	825	825	825
	Watts		165	165	170	170
⁘Refrigerant furnished (HCFC-22)			12 lbs. 5 oz. (5.6 kg)	11 lbs. 5 oz. (5.1 kg)	11 lbs. 13 oz. (5.3 kg)	12 lbs. 12 oz. (5.8 kg)
Liquid line conn. o.d. — in. (mm) (sweat)			3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
Vapor line conn. o.d. — in. (mm) (sweat)			3/4 (19)	3/4 (19)	7/8 (22.2)	7/8 (22.2)
Shipping wt. — lbs. (kg) 1 package			268 (122)	271 (123)	328 (149)	328 (149)

⁘Refrigerant charge sufficient for 15 ft. (4.5 m) length of refrigerant lines.

ELECTRICAL DATA

Model No.		HP27-024	HP27-030	HP27-036	HP27-042
Line voltage data		208/230v 60hz-1ph			
Compressor	Rated load amps	10.26	12.18	13.46	18.0
	Power factor	0.96	0.96	0.96	0.97
	Locked rotor amps	56	61	73	104
Outdoor Coil Fan Motor	Full load amps	0.9	0.9	0.9	0.9
	Locked rotor amps	1.6	1.6	1.6	1.6
Rec. max. fuse or circuit breaker size (amps)		20	25	30	40
†Minimum circuit ampacity		13.8	16.2	17.8	23.4

†Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements.
NOTE — Extremes of operating range are plus 10% and minus 5% of line voltage.

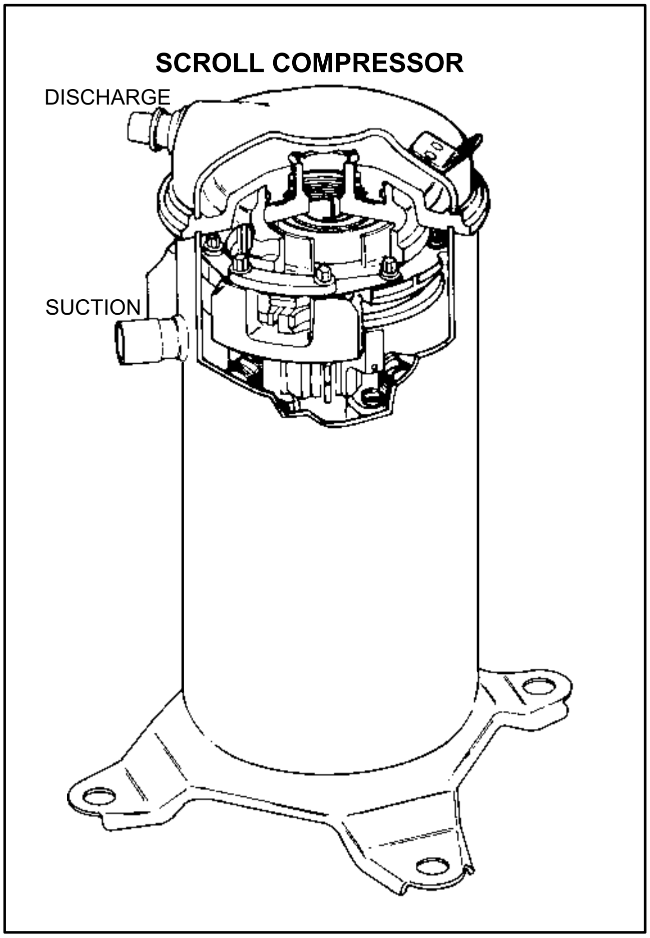


FIGURE 1

I-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.

II-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.

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

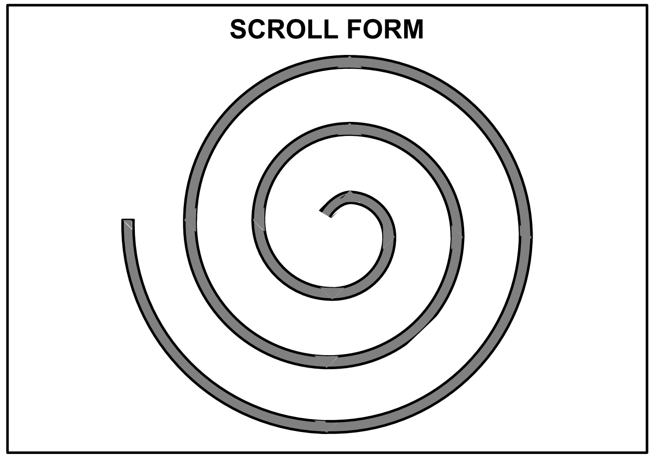


FIGURE 2

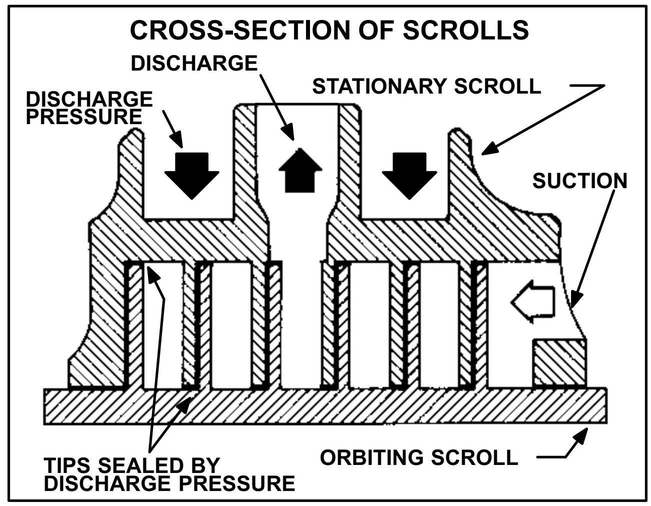


FIGURE 3

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. Continued slugging of liquid will cause damage to the scroll and replacement will be necessary. 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.

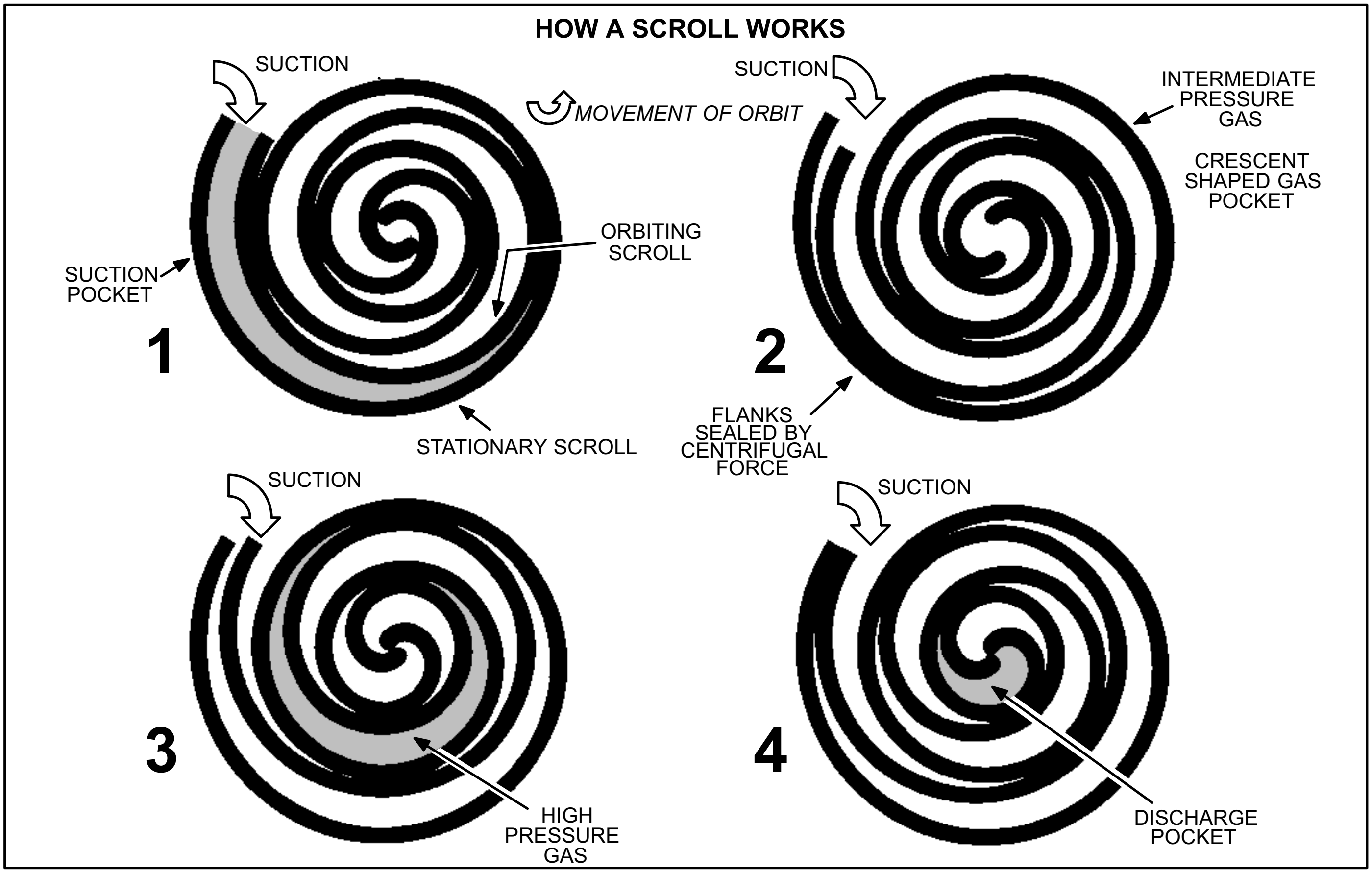


FIGURE 4

III-UNIT COMPONENTS

A-Transformer

The contactor, reversing valve, time delay, and defrost timer are all powered by 24VAC supplied by the indoor unit. All other controls in the outdoor unit are powered by line voltage. Refer to unit wiring diagram. The HP27 **is not equipped** with an internal line voltage to 24V transformer.

B-Terminal Strip

All HP27s are equipped with a low voltage terminal strip located in the unit control box for making thermostat wiring connections (refer to figure 6).

C-Compressor

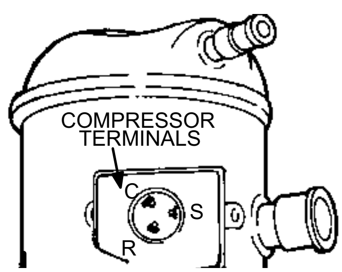
Table 1 shows the specifications of compressors (B1) used in HP27 series units.

TABLE 1

Unit	Vac	Phase	LRA	RLA	Oil fl.oz.
HP27-024	208/230	1	56	10.3	38
HP27-030	208/230	1	61	12.2	42
HP27-036	208/230	1	73	13.5	42
HP27-042	208/230	1	104	18.0	42

*Shipped with conventional white oil (Sontex 200LT). 3GS oil may be used if additional oil is required.

COMPRESSOR TERMINAL BOX



WARNING

COMPRESSOR MUST BE GROUNDED. DO NOT OPERATE WITHOUT PROTECTIVE COVER OVER TERMINALS. DISCONNECT ALL POWER BEFORE REMOVING PROTECTIVE COVER. DISCHARGE CAPACITORS BEFORE SERVICING UNIT. COMPRESSOR WIRING DIAGRAM IS FURNISHED INSIDE COMPRESSOR TERMINAL BOX COVER. FAILURE TO FOLLOW THESE PRECAUTIONS COULD CAUSE ELECTRICAL SHOCK RESULTING IN INJURY OR DEATH.

FIGURE 5

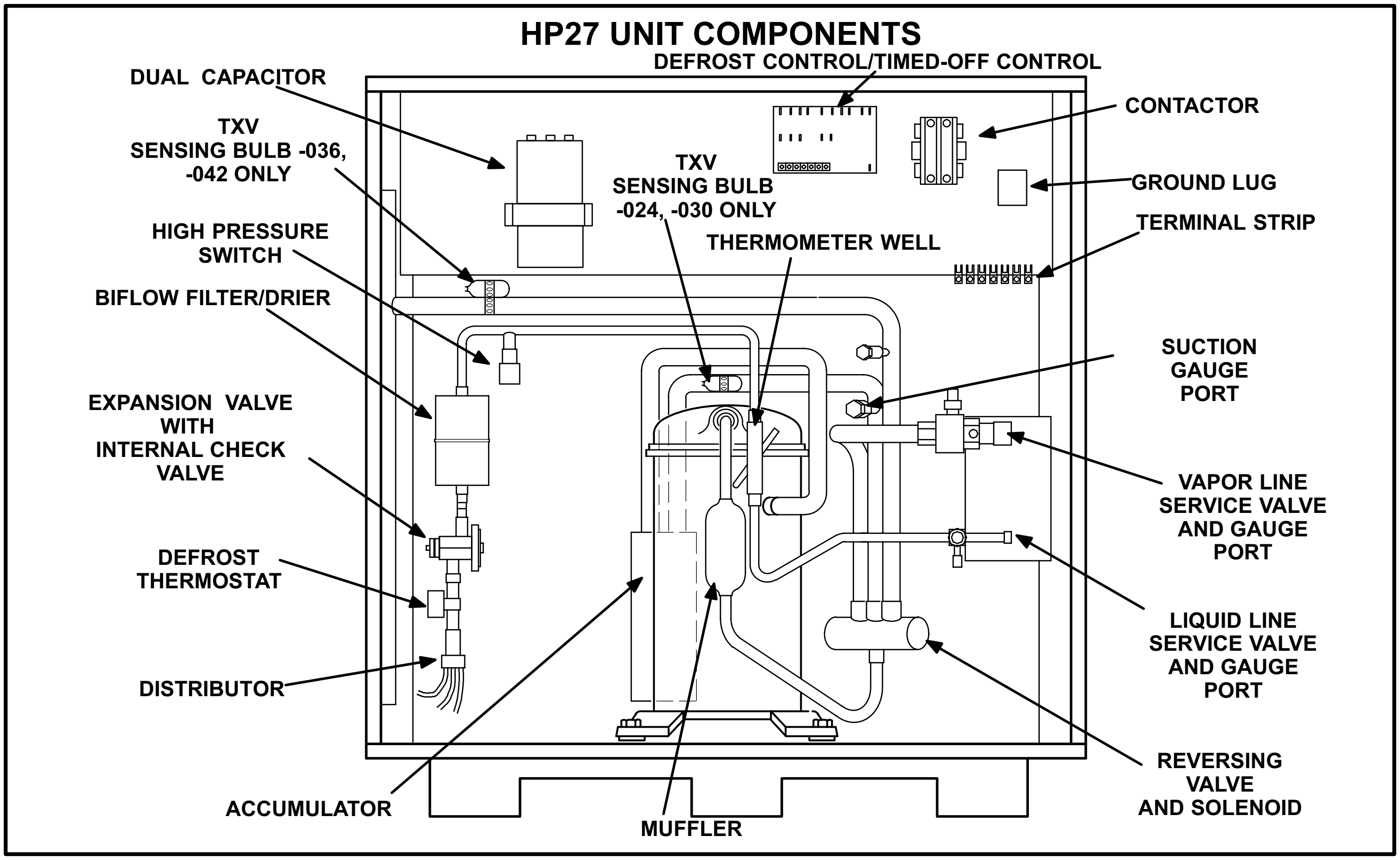


FIGURE 6

D-High Pressure Switch

An automatic reset high pressure switch (S4) located in the liquid line of the compressor shuts off the compressor when liquid line pressure rises above the factory setting. The switch is normally closed and is permanently adjusted to trip (open) at 410 ± 10 psi. The switch closes at 210 ± 10 psi. See figure 6 for switch location.

E-Contactor

The compressor is energized by a contactor (K1) located in the control box. Units will use single-pole or double-pole contactors. See wiring diagrams for specific unit. The contactor is energized by indoor thermostat terminal Y when thermostat demand is present.

⚠ DANGER

Electric Shock Hazard.
May cause injury or death.

Disconnect all remote electrical power supplies berore opening unit panel. Unit may have multiple power supplies.

Some units are equipped with single-pole contactors. When unit is equipped with a single-pole contactor, line voltage is present at all components (even when unit is not in operation).

F-Condenser Fan Motor

See page 1 for specifications for all condenser fan motors (B4) used. See figure 7 if condenser fan motor replacement is necessary. In all units, the condenser fan motor is controlled by the compressor contactor and is de-energized when the defrost relay is energized.

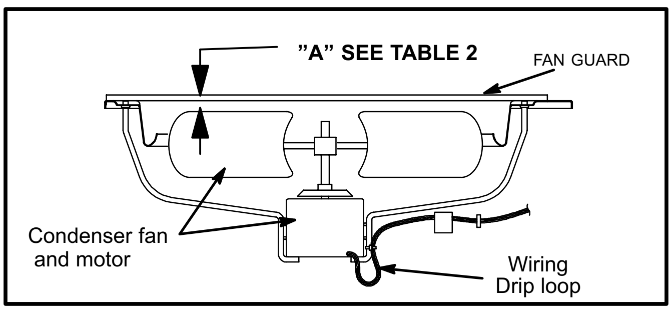


FIGURE 7

TABLE 2

UNIT	"A" DIM.	TOLERANCE
HP27-024, -030	1 1/16"	± 1/8"
HP27-036, -042	1 3/16"	± 1/8"

G-Accumulator

The accumulator is located on the liquid line (see figure 6.) The accumulator retains liquid and releases mostly vapor to the compressor. This ensures that the liquid refrigerant will not enter and damage the compressor.

H-Service Light Thermostat HP27

HP27-1 through -7 units are equipped with a service light thermostat (S54) located on the compressor discharge line. The switch is electrically connected to the service light in the indoor thermostat. The service light, when lit, indicates the compressor is not running. The service light is powered from W1 (2nd stage heat) terminal of the indoor thermostat. The service light thermostat will close when the discharge line falls below 110 ± 5°F, indicating a problem in the system. The service light thermostat opens and the service light goes off when discharge line reaches 130 ± 5°F indicating the compressor is running.

I-Ambient Compensating Thermistor

HP27-1 through -7 units have an ambient compensating thermistor (RT3) mounted on the outdoor fan wiring harness. The thermistor is an NTC thermistor (negative temperature coefficient - increase in temperature equals decrease in resistance) (see figure 8). The device is connected in series with the heat anticipation resistor inside the indoor thermostat. This feature helps to prevent abnormal droop caused by the anticipation resistors. As outdoor temperature increases, the resistance across the thermistor drops. As the resistance across the thermistor drops, the current through the heat anticipation resistor increases. Therefore, heat anticipation increases as outdoor temperature decreases. Resistance at 77°F = 260 ohms ± 5%; at 100°F = 150 ohms; at 32°F = 861 ohms.

OUTDOOR FAN, BRACKET AND AMBIENT COMPENSATING THERMISTOR

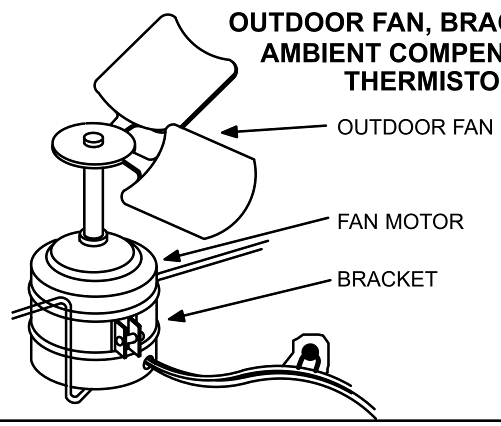


FIGURE 8

J-Dual Capacitor

The compressor and fan in the HP27 series units use permanent split capacitor motors. A single dual capacitor (C12) is used for both the fan motor and the compressor (see unit wiring diagram). The fan side of the capacitor and the compressor side of the capacitor have different mfd ratings. The capacitor is located inside the unit control box (see figure 6). Table 3 shows the ratings of the dual capacitor.

TABLE 3

HP27 DUAL CAPACITOR RATING			
UNITS	FAN MFD	HERM MFD	VAC
HP27-024	4	40	370
HP27-030	4	40	370
HP27-036	4	45	370
HP27-042	4	55	370

K-Reversing Valve and Solenoid

A refrigerant reversing valve (L1) with electromechanical solenoid is used to reverse refrigerant flow during unit operation. The reversing valve is energized during cooling demand and during defrost.

L-Defrost System HP27-1, -2, -3 and -5 units

ELECTROSTATIC DISCHARGE (ESD)
Precautions and Procedures

⚠ CAUTION

Electrostatic discharge can affect electronic components. Take precautions during unit installation and service to protect the unit's electronic controls. Precautions will help to avoid control exposure to electrostatic discharge by putting the unit, the control and the technician at the same electrostatic potential. Neutralize electrostatic charge by touching hand and all tools on an unpainted unit surface before performing any service procedure.

The defrost system includes two components: a defrost thermostat (S6) and a defrost control.

Defrost Thermostat

The defrost thermostat is mounted on the liquid line between the check/expansion valve and the distributor. When defrost thermostat senses 35°F (2°C) or cooler, its contacts close and send a signal to the defrost control board to start the defrost timing. It also terminates defrost when the liquid line warms up to 70°F (21°C).

Defrost Control

The defrost control board has the combined functions of a time/temperature defrost control, defrost relay, time delay, diagnostic LEDs and field connection terminal strip. See figure 9.

The control provides automatic switching from normal heating operation to defrost mode and back. During compressor cycle (room thermostat demand cycle), if the "O" input is not on and the defrost thermostat is closed, the control accumulates compressor run times at 30, 60 or 90 minute field adjustable intervals. If the defrost thermostat remains closed when the accumulated compressor run time ends, the defrost relay is energized and defrost begins.

Defrost Control Timing Pins

Each timing pin selection provides a different accumulated compressor run period during one thermostat run cycle. This time period must occur before a defrost cycle is initiated. The defrost interval can be adjusted to 30, 60 or 90 minutes. See figure 9. The defrost period is a maximum of 14 minutes and cannot be adjusted. If no timing is selected, the control defaults to 90 minutes.

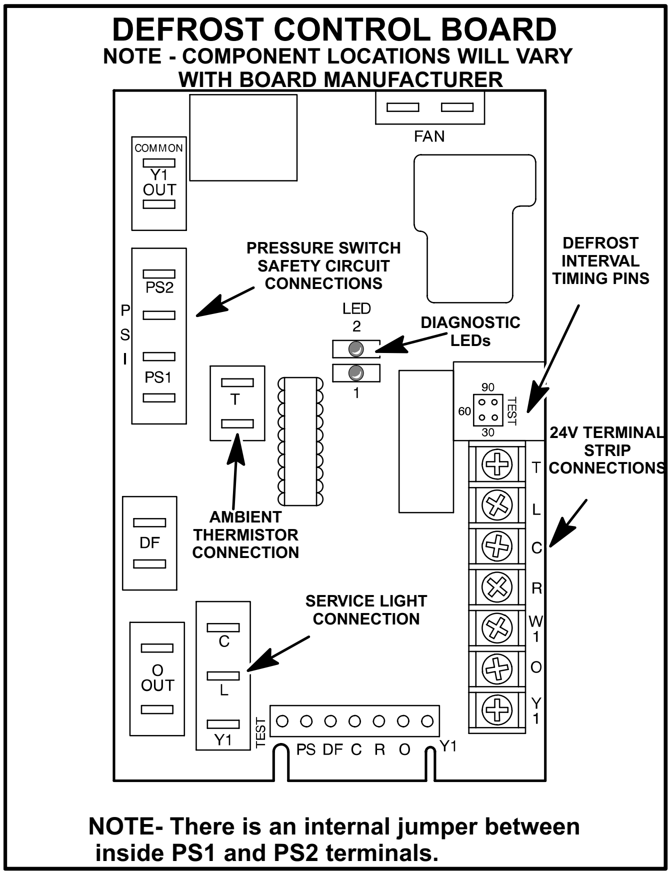


FIGURE 9

A TEST option is provided for troubleshooting. When the jumper is placed across the TEST pins, the timing of all functions is reduced by a factor of 128. For example, a 30 minute interval during TEST is 14 seconds and the 14 minute defrost is reduced to 6.5 seconds.

The TEST mode may be started at anytime. If the jumper is in the TEST position at power-up or for longer than five minutes, the control will ignore the TEST selection and will default to a 90 minute interval. In order to test defrost cycle, defrost thermostat must be closed or jumpered. Once defrost is initiated, remove jumper immediately. Failure to remove jumper will reduce defrost cycle to seconds.

Time-Delay

A 5-minute timed-off delay protects the compressor from short-cycling when there is an interruption in power to the unit or when a pressure switch resets.

Pressure Switch Safety Circuits

The defrost control incorporates a safety circuit that allows the application of an additional pressure switch. The unit's high pressure switch (S4) is factory-wired into this circuit. See figure 9. PS1 and PS2 terminals are wired in series with a jumper internal to the control board. This feature is available on all units.

During one demand cycle, the defrost control will lock out the unit on the third instance that the unit goes off on any auto-reset pressure switch wired to this circuit. In addition, the diagnostic LEDs will indicate a locked out pressure switch after the third occurrence of an open pressure switch. See table 4. The unit will remain locked out until 24 volt power is broken to terminal "R" on the defrost board and then remade.

The PS2 safety circuit terminals are connected to the compressor thermostat. An optional loss of charge switch may be field-installed by connecting it in series with the other switches. See unit wiring diagram.

Diagnostic LEDs

The defrost board uses two LEDs for diagnostics. The LEDs flash a specific sequence according to the condition.

TABLE 4

DEFROST CONTROL BOARD DIAGNOSTIC LED		
MODE	**LED 1**	**LED 2**
Normal Operation/ Power to board	Flash together with LED 2	Flash together with LED 1
Time Delay To Protect Compressor	Alternating Flashes with LED 2	Alternating Flashes with LED 1
Pressure Switch Open	Off	On
Pressure Switch Lockout	On	Off
Board Malfunction	On	On

Ambient Thermistor & Service Light Connection

The defrost control board provides terminal connections for the ambient thermistor and a service light. The thermistor compensates for changes in ambient temperature which might cause thermostat droop. The service light thermostat provides a signal which activates the room thermostat service light during periods of inefficient operation.

M-Defrost System HP27-4 and -6 ONLY

HP27-4 and -6 units are equipped with a demand defrost system. The self-calibrating defrost control board includes defrost relays, sensors (two) which monitor coil and outdoor ambient temperatures, a timed-off control, protection circuits (two), a 3-strike lockout feature, a test mode jumper and a terminal strip. The demand defrost control board initiates a defrost cycle based on temperature differential and compressor run time. This type of system allows greater frost accumulation on the outdoor coil and initiates fewer defrost cycles than the time/temperature defrost system. The defrost board is shown in figure 10.

Temperature Sensors

The demand defrost control board includes two permanently attached sensors which monitor coil and outdoor ambient temperatures. The coil temperature sensor is equipped with a spring clip to allow proper positioning on the outdoor coil. These sensors must not be detached from the control board and must be replaced as part of the control board. Do not attempt to cut or splice the temperature sensor wires. See figure 11 for ambient and coil temperature sensor location.

Timed-Off Control

The control board includes a 5-minute timed-off delay which protects the compressor from short cycling. The 5-minute delay is initiated at the end of a compressor cycle, any time a system protection switch is reset, or if the Y1 circuit is interrupted for more than two continuous line cycles.

If a system protection switch opens while the “Y1 OUT” circuit is energized, the timed-off control will initiate a 5-minute delay when the pressure switch closes.

The timed-off control run times can be bypassed by shorting the “TEST” pins.

Protection Circuits

The control board includes two protection circuits.

The unit high pressure switch is factory-wired to the HI - PS terminals. The circuit through “Y1” (input and “Y1 OUT”) is completed through the high pressure switch. When the high pressure switch opens, the control board de-energizes the compressor and the 3-strike lockout counter registers one strike. **If, for any reason, the high pressure switch is removed, a jumper must be applied across the HI - PS terminals to complete the circuit.**

The second protection circuit is not used in this application **A jumper must be applied across the LO - PS terminals to ensure proper control board operation.**

Inputs (24V Terminal Strip Connections)	
Y1	Thermostat input, controls unit operation
O	Thermostat input, reversing valve
R	24VAC power
C	24VAC common
W1	24VAC input/output from indoor thermostat to indoor unit
L	Service light thermostat
T	Ambient sensor (connection for Room Thermostat with ambient compensation)

(1/4” Quick Connect Terminal Factory Connections)	
HI-PS	Pressure switch / system fault sensor
LO-PS	Pressure switch / system fault sensor
Y1 Out	Compressor contactor
O Out	Reversing valve
FAN	Condenser fan
W/L/C	Service light thermostat
T/T	Ambient sensor

Defrost Control Board

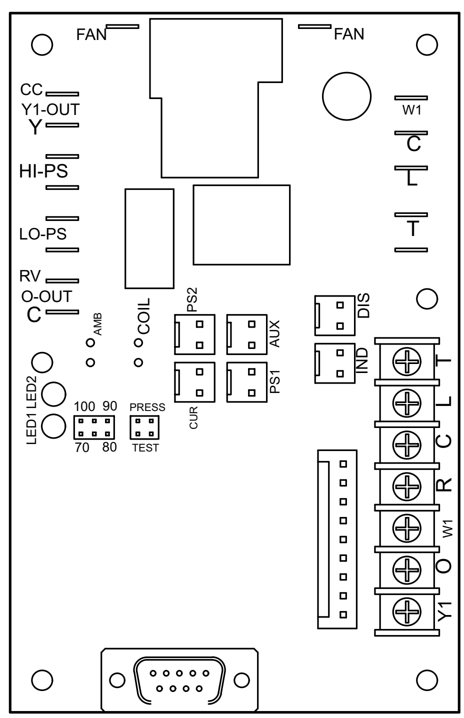


FIGURE 10

3-Strike Lockout

The demand defrost system control board includes a 3-strike lockout feature. This internal feature registers protection circuit interruptions while “Y1” (input) is energized. If any protection circuit switch opens three times during a single “Y1” (input) cycle, the control initiates lockout. If the circuit is interrupted once or twice during a single “Y1” (input) cycle, the control resets the strike register to zero at the end of the cycle.

The 3-strike register can be reset by interrupting 24V power to the control board or by shorting the “TEST” pins.

TEST Mode

The control board includes a test mode to facilitate service. During the test mode, the 14-minute defrost period is shortened. Initiate the test mode by placing the defrost temperature selection jumper across the “TEST” pins.

Normal test mode operation is described below and in figure 12:

- 24V power must be applied to the demand defrost control board BEFORE the jumper is installed on the “TEST” pins.
- If test pins are shorted before 24V power is applied to the board, the test mode will be ignored until the short is removed and reapplied. Each test pin short will result in one test event. For each test, the shunt (jumper) must be removed for at least 1 second then reapplied.
- If the Y signal is interrupted, the unit will exit the test mode.
- LO - PS input is ignored during test mode operation.
- Test mode operation is limited to 5 minutes. The control will revert to normal operation and ignore the test mode after this period of time.

Defrost Temperature Selection Jumper

The control board can be set to terminate defrost at one of four temperature settings: 70°F, 80°F, 90°F, or 100°F. If the jumper is removed, the control board will terminate defrost at the default setting of 100°F.

Communication Port

The demand defrost system control board is equipped with a communication port. This port has been included for future use and is not functional at this time.

⚠ IMPORTANT

Do not connect an electronic device to the communication port. Incompatibility between the control board and the device could result in damage to both.

Defrost Operation (Table 5)

The demand defrost control board has three modes of operation: normal, calibration and defrost.

Normal Operation

During normal operation, the control board continuously monitors the system operation mode (heating / cooling), the outdoor ambient temperature, the outdoor coil temperature and compressor run time to determine the need for a defrost cycle.

Calibration Mode

The demand defrost control board is considered uncalibrated when one of the following conditions applies: immediately after power has been applied to the control board, immediately after operation in the cooling mode, or any time the outdoor coil temperature exceeds the termination temperature during the heating mode. During the calibration mode, the demand defrost control board measures the outdoor coil and outdoor ambient temperatures to establish an average (calibrated) temperature differential between the two.

Defrost Mode

The following operation sequence applies when the demand defrost control initiates a defrost cycle:

1 - The control board energizes the reversing valve and de-energizes the condenser fan motor.

2 - The control energizes the “W1” (auxiliary heat) circuit. The unit will operate in this mode until the outdoor coil temperature rises above the selected termination temperature, the 14-minute defrost interval has been completed, or the room temperature rises to satisfy the heating demand.
NOTE - If the termination temperature selection jumper has been left off, the defrost termination temperature is set at the 100°F default.

3 - If the defrost cycle is terminated by the room thermostat because the heating demand has been satisfied, the call for a defrost cycle will be carried over to the next heating demand cycle. If the outdoor coil temperature is still below the selected termination temperature when the heating demand is re-initiated, the defrost cycle will be continued until it is terminated by one of the three methods outlined in step 2.

4 - If the defrost cycle is terminated by the 14-minute defrost interval and the outdoor coil has not remained above 35°F (2°C) for 4 minutes, the control will initiate a 34-minute time/temperature defrost mode.

Ambient Thermistor & Service Light Connection

The defrost control board provides terminal connections for the ambient thermistor and a service light. The thermistor compensates for changes in ambient temperature which might cause thermostat droop. The service light thermostat provides a signal which activates the room thermostat service light during periods of inefficient operation.

Diagnostic LEDs (Table 5)

The defrost board includes two LEDs used for diagnostics. The LED flashes indicate a specific diagnostic code as detailed in the table below.

TABLE 5

LED 1	LED 2	Condition	Possible Cause(s)	Solution
OFF	OFF	Power problem	1 No power (24V) to board terminals R & C. 2 Board failure.	1 Check control transformer power (24V). 2 If power is available and LED(s) are unlit, replace board and all sensors.
ON	ON	Coil sensor problem	1 Coil temperature outside of sensor range. 2 Faulty sensor wiring connections at board or poor sensor contact on coil. 3 Sensor failure.	1 Sensor function will resume when coil temperature is between -20°F and 110°F. 2 Check sensor wiring connections at board and sensor contact on coil. 3 Replace board and all sensors.
OFF	ON	Ambient sensor problem	1 Ambient temperature outside of sensor range. 2 Faulty sensor wiring connections at board or sensor. 3 Sensor failure.	1 Sensor function will resume when coil temperature is between -20°F and 110°F. 2 Check sensor wiring connections at board and sensor. 3 Replace board and all sensors.
FLASH	FLASH	Normal operation	Unit operating normally or in standby mode.	None required.
ON	OFF	3-Strike pressure lockout (Short test pins or reset 24V power to board to override lockout)	1 Restricted air flow over indoor or outdoor coil. 2 Improper refrigerant charge. 3 Improper metering device operation. 4 Poor contact between coil sensor and coil.	1 Remove any blockages or restrictions. Check outdoor fan motor for proper operation. 2 Check approach, superheat & subcooling temperatures. 3 Check system pressures. Repair leaks. Replace metering device. 4 Make sure that sensor is properly positioned on coil and that firm contact is established. Refer to service manual for proper placement.
ON	FLASH	Low pressure switch circuit open during Y1 demand		
FLASH	ON	High pressure switch circuit open during Y1 demand		
ALTERNATING FLASH	ALTERNATING FLASH	5-minute delay (Jumper test pins to override delay)	Thermostat demand for cooling or heat pump operation. Unit operating in 5-minute anti-short-cycle mode.	None required.

OPERATION

The demand defrost control board initiates a defrost cycle based on either frost detection or time.

Frost Detection - If the compressor runs longer than 34 minutes and the actual difference between the clear coil and frosted coil temperatures exceeds the maximum difference allowed by the control, a defrost cycle will be initiated.

IMPORTANT - The demand defrost control board will allow a greater accumulation of frost and will initiate fewer defrost cycles than a time/temperature defrost system.

Time - If 6 hours of heating mode compressor run time has elapsed since the last defrost cycle while the coil temperature remains below 35°F (2°C), the demand defrost control will initiate a defrost cycle.

Actuation - When the reversing valve is de-energized, the Y1 circuit is energized, and the coil temperature is below 35°F (2°C), the board logs the compressor run time. If the board is not calibrated, a defrost cycle will be initiated after 34 minutes of heating mode compressor run time. The control will attempt to self-calibrate after this (and all other) defrost cycle(s). Calibration success depends on stable system temperatures during the 20-minute calibration period. If the board fails to calibrate, another defrost cycle will be initiated after 90 minutes of heating mode compressor run time. Once the defrost board is calibrated, it will use demand defrost logic to initiate a defrost cycle. A demand defrost system initiates defrost when the difference between the clear coil and frosted coil temperatures exceeds the maximum difference allowed by the control OR after 6 hours of heating mode compressor run time has been logged since the last defrost cycle.

Termination - The defrost cycle ends when the coil temperature exceeds the termination temperature or after 14 minutes of defrost operation. If the defrost is terminated by the 14-minute timer, another defrost cycle will be initiated after 34 minutes of run time.

Test Mode - When Y1 is energized and 24V power is being applied to the board, a test cycle can be initiated by placing the termination temperature jumper across the “Test” pins for 2 to 5 seconds. If the jumper remains across the “Test” pins longer than 5 seconds, the control will ignore the test pins and revert to normal operation. The jumper will initiate one cycle per test.

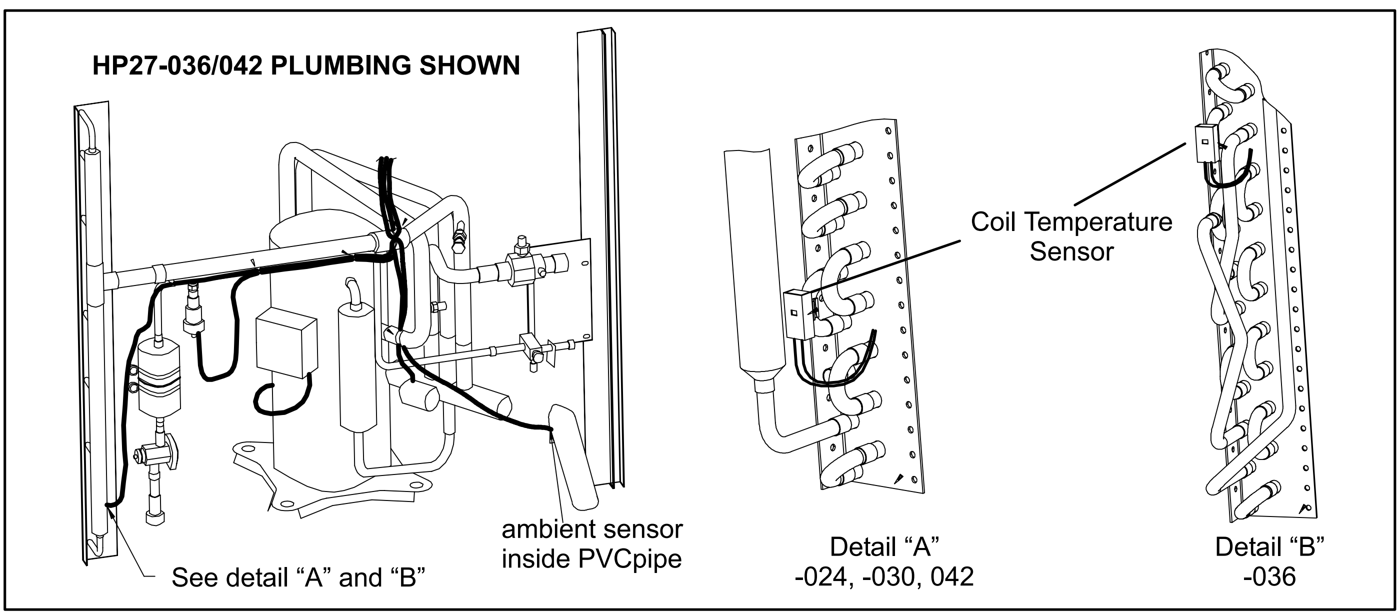


FIGURE 11

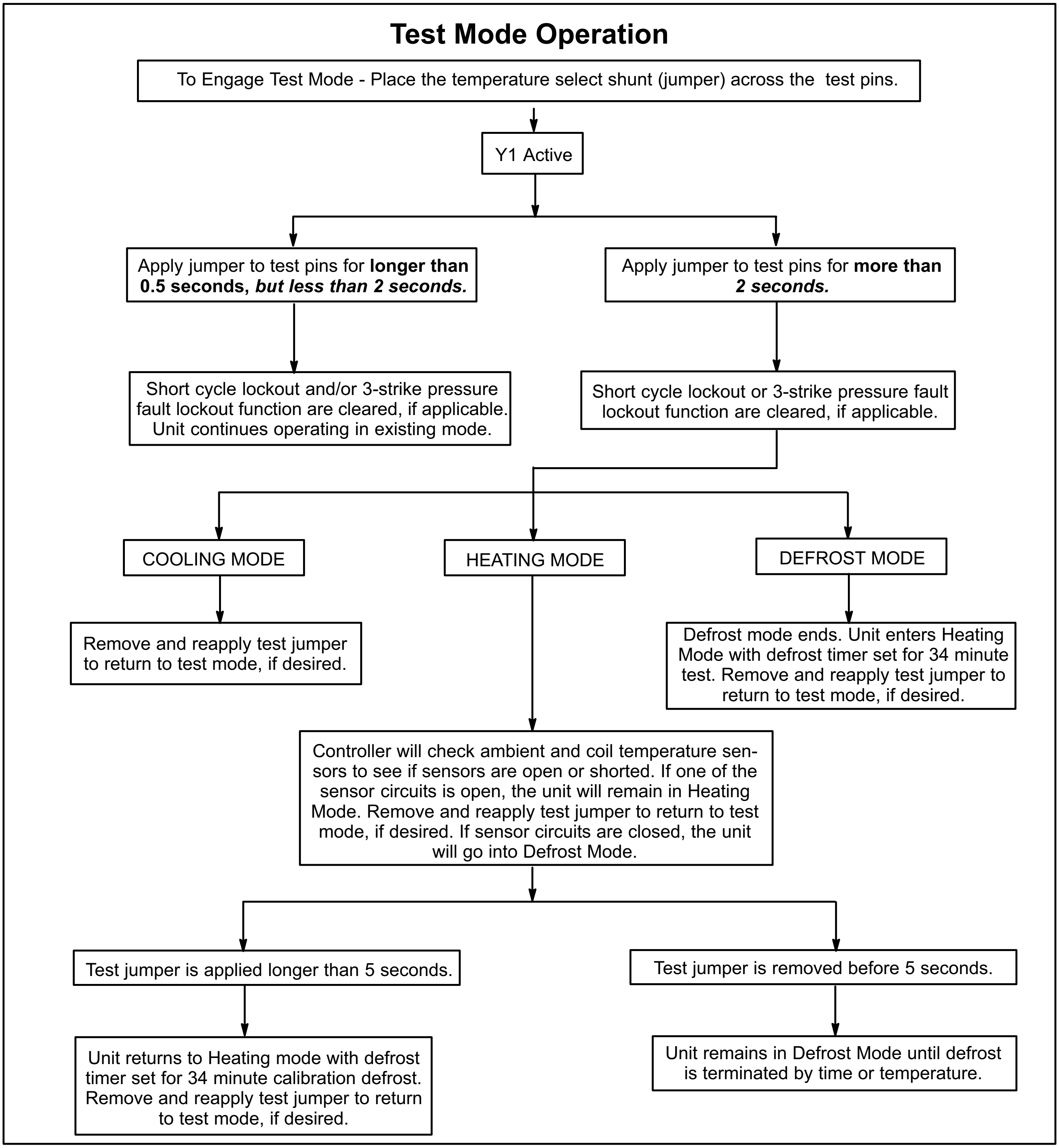

Test Mode Operation
To Engage Test Mode - Place the temperature select shunt (jumper) across the test pins.
Y1 Active
Apply jumper to test pins for longer than 0.5 seconds, but less than 2 seconds.
Apply jumper to test pins for more than 2 seconds.
Short cycle lockout and/or 3-strike pressure fault lockout function are cleared, if applicable. Unit continues operating in existing mode.
Short cycle lockout or 3-strike pressure fault lockout function are cleared, if applicable.
COOLING MODE
HEATING MODE
DEFROST MODE
Remove and reapply test jumper to return to test mode, if desired.
Defrost mode ends. Unit enters Heating Mode with defrost timer set for 34 minute test. Remove and reapply test jumper to return to test mode, if desired.
Controller will check ambient and coil temperature sensors to see if sensors are open or shorted. If one of the sensor circuits is open, the unit will remain in Heating Mode. Remove and reapply test jumper to return to test mode, if desired. If sensor circuits are closed, the unit will go into Defrost Mode.
Test jumper is applied longer than 5 seconds.
Test jumper is removed before 5 seconds.
Unit returns to Heating mode with defrost timer set for 34 minute calibration defrost. Remove and reapply test jumper to return to test mode, if desired.
Unit remains in Defrost Mode until defrost is terminated by time or temperature.

FIGURE 12

N-Defrost System HP27-7 and later

The defrost system includes two components:

- a defrost thermostat
- a defrost control

Defrost Thermostat

The defrost thermostat is located on the liquid line between the check/expansion valve and the distributor. When the defrost thermostat senses 42°F (5.5°C) or cooler, its contacts close and send a signal to the defrost control board to start the defrost timing. It also terminates defrost when the liquid line warms up to 70°F (21°C).

Defrost Control

The defrost control board includes the combined functions of a time/temperature defrost control, defrost relay, time delay, diagnostic LEDs, and a terminal strip for field wiring connections. See figure 9.

The control provides automatic switching from normal heating operation to defrost mode and back. During compressor cycle (call for defrost), the control accumulates compressor run times at 30, 60, or 90 minute field adjustable intervals. If the defrost thermostat is closed when the selected compressor run time interval ends, the defrost relay is energized and defrost begins.

Defrost Control Timing Pins

Each timing pin selection provides a different accumulated compressor run time period during one thermostat run cycle. This time period must occur before a defrost cycle is initiated. The defrost interval can be adjusted to 30 (T1), 60 (T2), or 90 (T3) minutes. See figure 9. The defrost timing jumper is factory-installed to provide a 60-minute defrost interval. If the timing selector jumper is not in place, the control defaults to a 90-minute defrost interval.The maximum defrost period is 14 minutes and cannot be adjusted.

A TEST option is provided for troubleshooting. **The TEST mode may be started any time the unit is in the heating mode and the defrost thermostat is closed or jumpered.** If the jumper is in the TEST position at power-up, the control will ignore the test pins. When the jumper is placed across the TEST pins for two seconds, the control will enter the defrost mode. If the jumper is removed before an additional 5-second period has elapsed (7 seconds total), the unit will remain in defrost mode until the defrost thermostat opens or 14 minutes have passed. If the jumper is not removed until after the additional 5-second period has elapsed, the defrost will terminate and the test option will not function again until the jumper is removed and re-applied.

Time Delay

The timed-off delay is five minutes long. The delay helps protect the compressor from short-cycling in case the power to the unit is interrupted or a pressure switch opens. The delay is bypassed by placing the timer select jumper across the TEST pins for 0.5 seconds.

Pressure Switch Circuits

The defrost control includes two pressure switch circuits. The high pressure switch (S4) is factory-connected to the board's HI PS terminals. The board also includes LO PS terminals to accommodate the addition of a field-provided low pressure or loss of charge pressure switch. See figure 9. This feature is available on all units.

During a single demand cycle, the defrost control will lock out the unit after the third time that the circuit is interrupted by any pressure switch that is wired to the control board. In addition, the diagnostic LEDs will indicate a locked out pressure switch after the third occurrence of an open pressure switch. See table 4. The unit will remain locked out until power is broken then remade to the control or until the jumper is applied to the TEST pins for 0.5 seconds.

NOTE - The defrost control board ignores input from the low pressure switch terminals during the TEST mode, during the defrost cycle, during the 90-second start-up period, and for the first 90 seconds each time the reversing valve switches heat/cool modes. ***If the TEST pins are jumpered and the 5-minute delay is being bypassed, the LO PS terminal signal is not ignored during the 90-second start-up period.***

Ambient Thermistor & Service Light Connection

The defrost control board provides terminal connections for the ambient thermistor and a service light. The thermistor compensates for changes in ambient temperature which might cause thermostat droop. The service light thermostat provides a signal which activates the room thermostat service light during periods of inefficient operation.

Diagnostic LEDs

The defrost board uses two LEDs for diagnostics. The LEDs flash a specific sequence according to the diagnosis.

TABLE 6

DEFROST CONTROL BOARD DIAGNOSTIC LED

MODE	LED 1	LED 2
Normal operation / power to board	Synchronized Flash with LED 2	Synchronized Flash with LED 1
Board failure or no power	Off	Off
Board failure	On	On
High pressure switch open	Flash	On
Low pressure switch open	On	Flash
Pressure switch lockout	On	Off
Anti-short-cycle / 5-minute delay	Alternating Flash with LED 2	Alternating Flash with LED 1

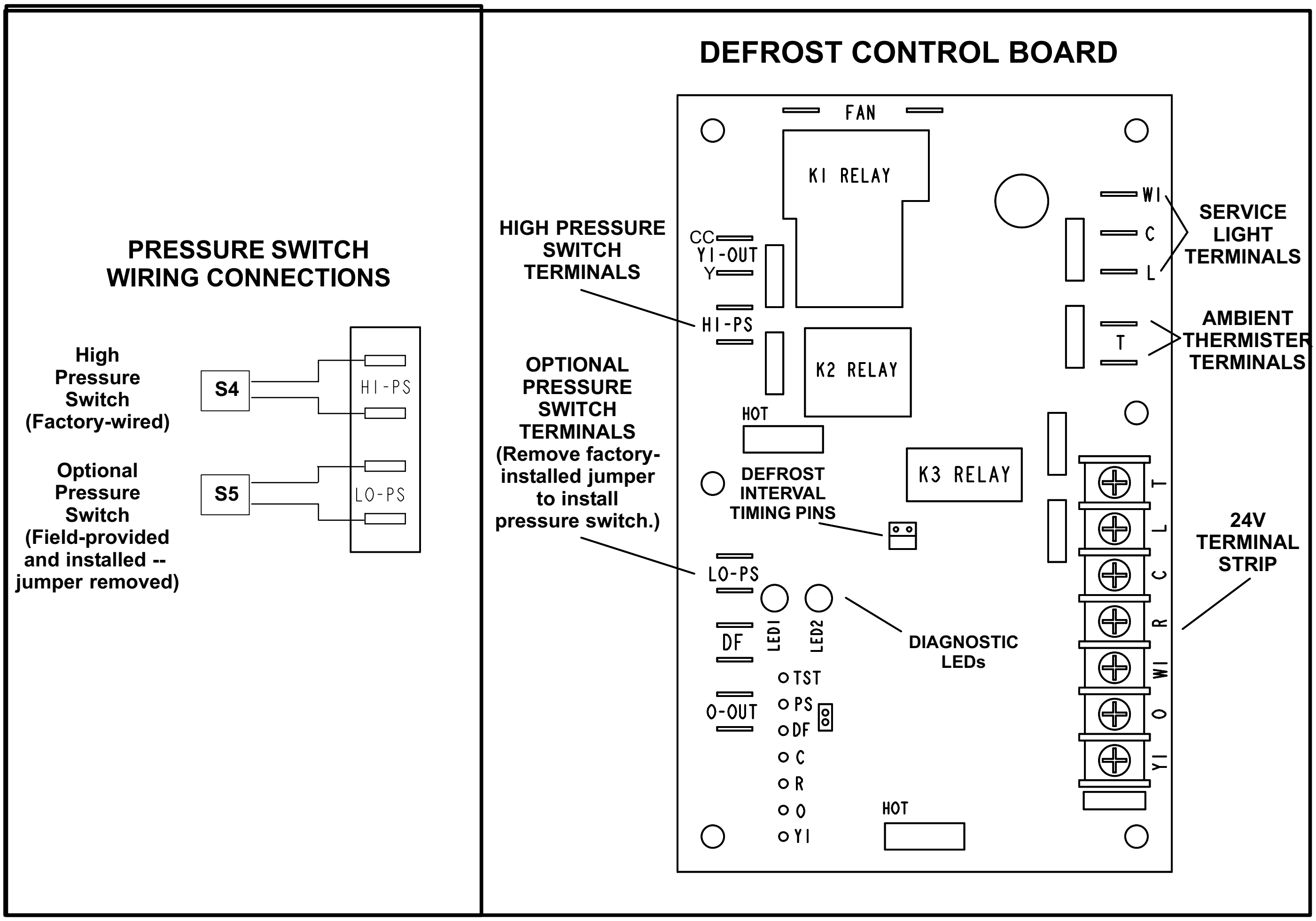


FIGURE 13

IV-REFRIGERANT SYSTEM

A-Plumbing

An expansion/check valve is used in parallel in the liquid line. The check valve is closed when the unit is in heating mode to force refrigerant through the expansion valve. The check valve is open when the unit is in cooling mode.

Field refrigerant piping consists of liquid and vapor lines from the outdoor unit (sweat connections). Use Lennox L10 (flare) or L15 (sweat) series line sets as shown in table 7 or field fabricated refrigerant lines. Refer to the piping section of the Lennox Unit Information Service Manual for proper size, type and application of field-fabricated lines.

If refrigerant tubes are routed through a wall, seal and isolate the opening so vibration is not transmitted to the building.

NOTE - Line length should be no greater than 50 feet (15.2 m). Select line set diameters from table 1 to ensure oil return to compressor.

TABLE 7
REFRIGERANT LINE SET KITS

HP27 UNIT	LIQUID LINE	VAPOR LINE	L10 LINE SETS	L15 LINE SETS
-024 -030	3/8 in. (9.5 mm)	3/4 in. (19.1 mm)	L10-41 20 ft. - 50 ft. (6.1 m-15.2 m)	L15-41 15 ft. - 50 ft. (4.5 m-15.2 m)
-036 -042	3/8 in. (9.5 mm)	7/8 in. (22.2 mm)	L10-65 30 ft. - 50 ft. (9.1 m - 15.2 m)	L15-65 15 ft. - 50 ft. (4.5 m-15.2 m)

Separate discharge and suction service ports are provided at the compressor for connection of gauge manifold during charging procedure. Figure 14 and 15 show HP27 gauge manifold connections.

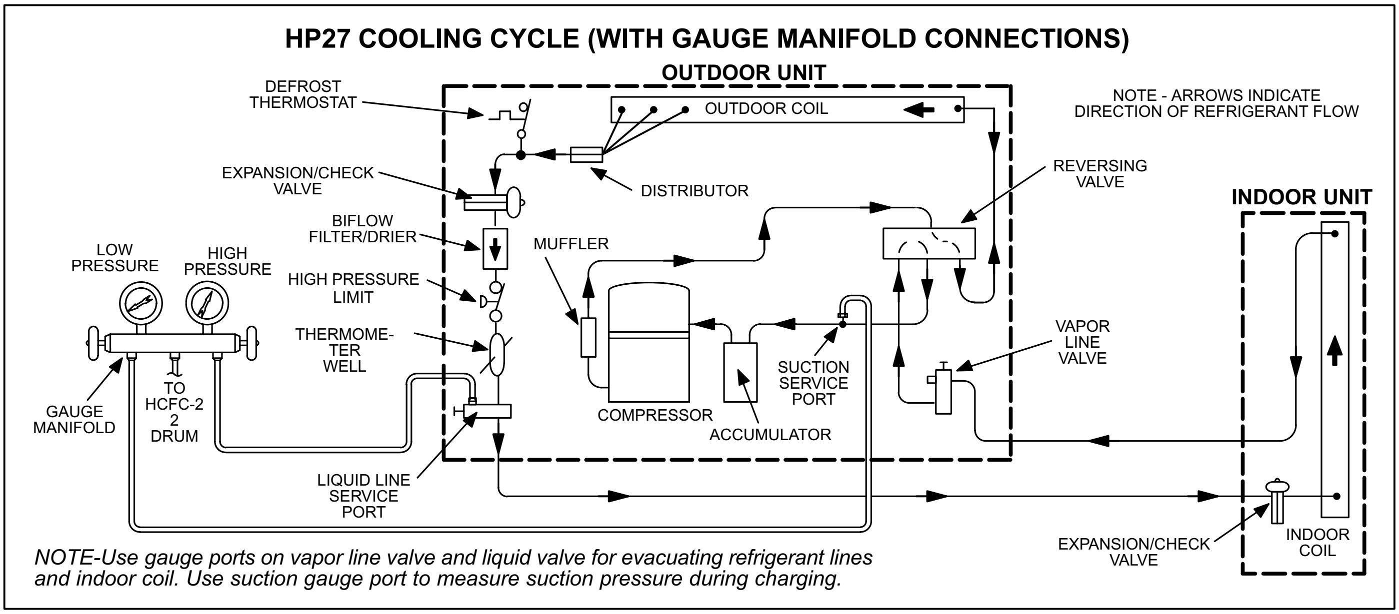


FIGURE 14

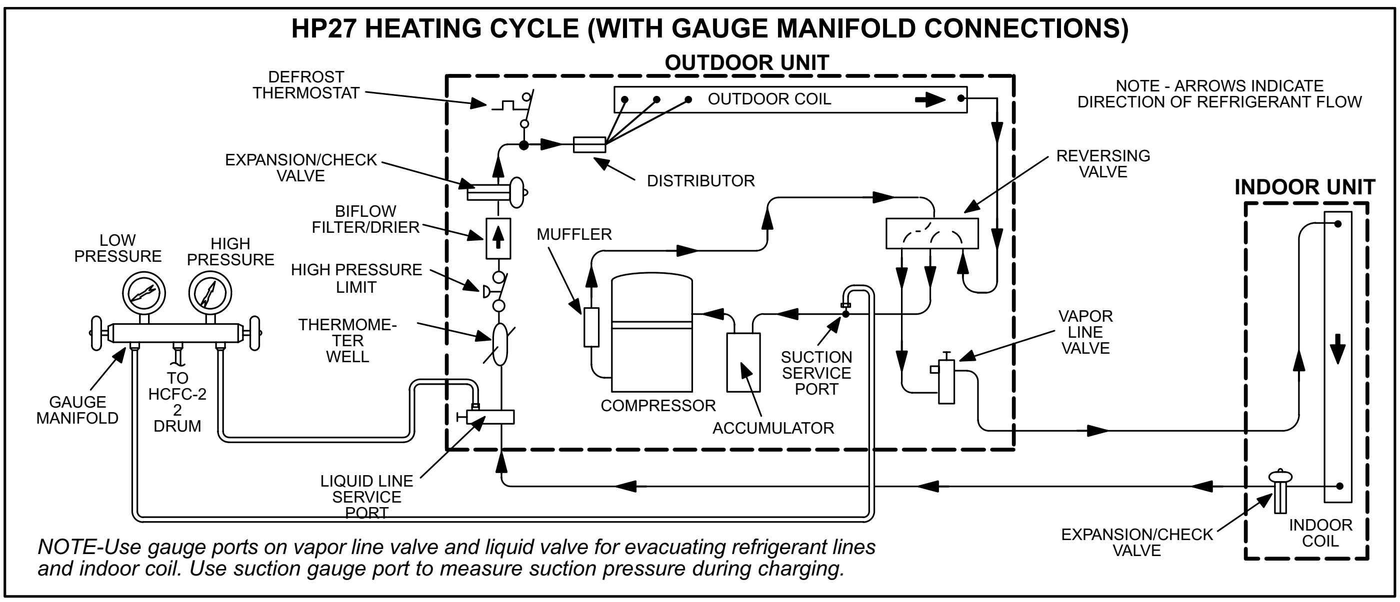


FIGURE 15

B-Liquid and Vapor Line Service Valves

The liquid line and vapor line service valves and gauge ports are accessible from outside of the unit. Full service liquid and vapor line valves are used. The service ports are used for leak testing, evacuating, charging and checking charge.

A full-service liquid and vapor line valve made by one of several manufacturers may be used. All liquid and vapor line service valves function the same way, differences are in construction. Valves manufactured by Parker are forged assemblies. Valves manufactured by Primore are brazed together. Valves are not rebuildable. If a valve has failed it must be replaced. The liquid line service valve is illustrated in figure16. The vapor line service valve is illustrated in figure17.

The valves are equipped with a service port. A schrader valve is factory installed. A service port cap is supplied to protect the schrader valve from contamination and serve as the primary leak seal. Service port cap must be in place and turned 1/8 to 1/4 turn to assure proper seal.

NOTE- Always keep valve stem clean.

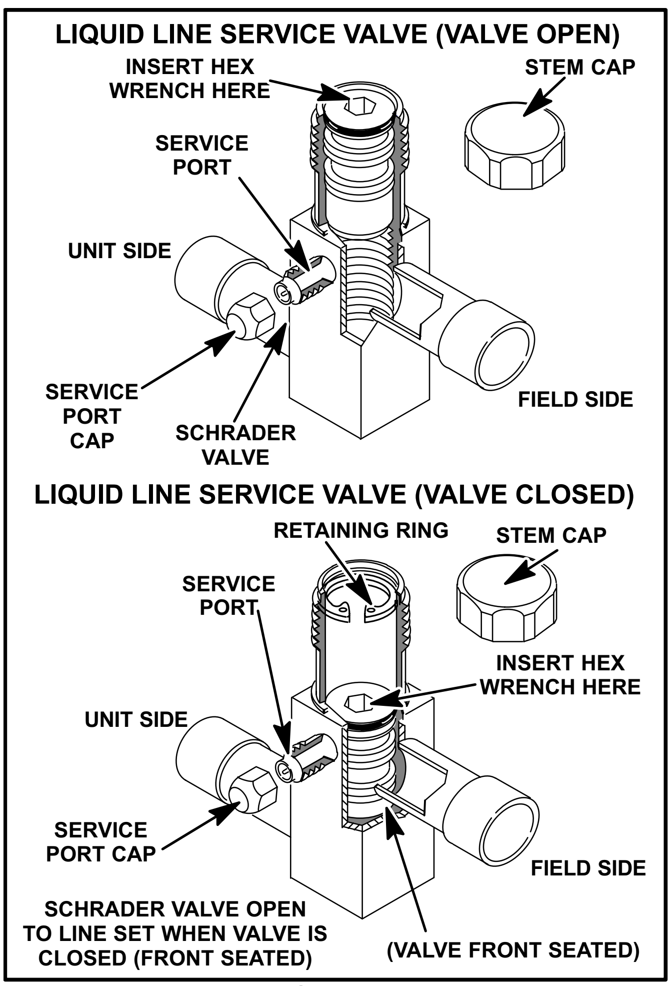


FIGURE 16

To Access Schrader Port:

1 - Remove access panel.
2 - Remove service port cap with an adjustable wrench.
3 - Connect gauge to the service port.
4 - When testing is completed, replace service port cap. Tighten finger tight, then an additional 1/6 turn.

To Open Liquid or Vapor Line Service Valve:

1 - Remove stem cap with an adjustable wrench.
2 - For liquid line valve use service wrench and 3/16 hex head extension. Back the stem out counterclockwise until the valve stem just touches the retaining ring. For vapor line valve use adjustable wrench and back the stem out counterclockwise 1/4 turn.
3 - Replace stem cap tighten firmly. Tighten finger tight, then tighten an additional 1/6 turn.

⚠ DANGER

Do not attempt to backseat this valve. Attempts to backseat this valve will cause snap ring to explode from valve body under pressure of refrigerant. Personal injury and unit damage will result.

To Close Liquid or Vapor Line Service Valve:

1 - Remove stem cap with an adjustable wrench.
2 - For liquid line valve use service wrench and 3/16 hex head extension. Turn stem clockwise to seat valve. Tighten firmly. For vapor line valve use adjustable wrench and turn stem clockwise 1/4 turn to seat valve. Tighten firmly.
3 - Replace stem cap. Tighten finger tight, then tighten an additional 1/6 turn.

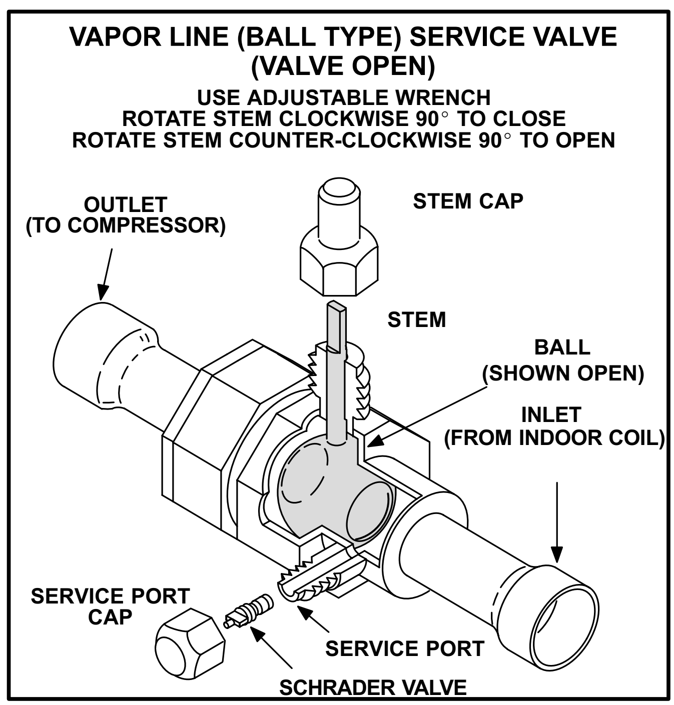


FIGURE 17

V-CHARGING

Unit charge is based on a matching indoor coil and outdoor coil with a 15 foot (4.5m) line set. For varying lengths of line set, refer to table 8.

⚠ IMPORTANT

If line length is greater than 15 feet (4.5m), add the amount of refrigerant listed in table 8 . If line length is less than 15 feet (4.5), subtract this amount.

TABLE 8

Liquid Line Set Diameter	Ounce per 5 foot (ml per mm) adjust from 15 ft. (4.5m)*
3/8 in. (9.5 mm)	3 ounce per 5 feet (88.05g per 1.5m)

***If line set is greater than 15 ft. (4.5m) add this amount. If line set is less than 15 ft. (4.5m) subtract this amount**

A-Leak Testing

1 - Attach gauge manifold and connect a drum of dry nitrogen to center port of gauge manifold.

2 - Add a small amount of refrigerant to the lines and coil. Open high pressure gauge valve and pressurize line set and indoor coil to 150 psig (1034 kPa).

⚠ WARNING

Danger of Explosion.
Can cause injury, death and equipment damage.
When using dry nitrogen, use a pressure-reducing regulator, set at 150 pig (1034 kPa) or less to prevent excessive pressure.

3 - Check lines and connections for leaks.

NOTE-If electronic leak detector is used, add a trace of refrigerant to nitrogen for detection by leak detector.

4 - Release nitrogen pressure from the system, correct any leaks and recheck.

B-Evacuating the System

Evacuating the system of non-condensables is critical for proper operation of the unit. Non-condensables are defined as any gas that will not condense under temperatures and pressures present during operation of an air conditioning system. Non-condensables such as water vapor, combine with refrigerant to produce substances that corrode copper piping and compressor parts.

⚠ CAUTION

Danger of Equipment Damage. Avoid deep vacuum operation. Do not use compressors to evacuate a system. Extremely low vacuums can cause internal arcing and compressor failure. Damage caused by deep vacuum operation will void warranty.

1- Attach gauge manifold. Connect vacuum pump (with vacuum gauge) to center port of gauge manifold. With both manifold service valves open, start pump and evacuate indoor coil and refrigerant lines.

⚠ IMPORTANT

A temperature vacuum gauge, mercury vacuum (U-tube), or thermocouple gauge should be used. The usual Bourdon tube gauges are not accurate enough in the vacuum range.

2- Evacuate the system to 29 inches (737mm) vacuum. During the early stages of evacuation, it is desirable to stop the vacuum pump at least once to determine if there is a rapid loss of vacuum. A rapid loss of vacuum would indicate a leak in the system and a repeat of the leak testing section would be necessary.

3- After evacuating system to 29 inches (737mm), close gauge manifold valves to center port, stop vacuum pump and disconnect from gauge manifold. Attach an upright nitrogen drum to center port of gauge manifold and open drum valve slightly to purge line at manifold. Break vacuum in system with nitrogen pressure by opening manifold high pressure valve. Close manifold high pressure valve to center port.

4- Close nitrogen drum valve and disconnect from gauge manifold center port. Release nitrogen pressure from system.

5- Connect vacuum pump to gauge manifold center port. Evacuate system through manifold service valves until vacuum in system does not rise above .5mm of mercury absolute pressure or 500 microns within a 20-minute period after stopping vacuum pump.

6- After evacuation is complete, close manifold center port, and connect refrigerant drum. Pressurize system slightly with refrigerant to break vacuum.

C-Charging

Charging must be done in the cooling mode. If 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. Length of refrigerant lines should be considered. See table 8 for varying line lengths.

If weighing facilities are not available or if unit is just low on charge, the following procedure applies.

Separate discharge and vapor line service ports are provided outside the unit for connection of gauge manifold during charging procedure as well as a suction line service port.

1 - Expansion Valve Systems

The following procedures are intended as a general guide for use with expansion valve systems only. For best results, indoor temperature should be between 70°F and 80°F (21°C and 26.5°C). If outdoor temperature is 60°F (16 °C) or above the approach method of charging is used. If outdoor temperature is less than 60 °F (16 °C) the subcooling method of charging is used. Slight variations in charging temperature and pressure should be expected. Large variations may indicate a need for further servicing.

⚠ IMPORTANT

The following procedures require accurate readings of ambient (outdoor) temperature, liquid temperature and liquid pressure for proper charging. Use a thermometer with accuracy of ±2 °F and a pressure gauge with accuracy of ±5 PSIG.

APPROACH METHOD (TXV SYSTEMS)
(Ambient Temperature Above 60°F [16°C])

1 - Connect gauge manifold. Connect an upright HCFC-22 drum to center port of gauge manifold.
2 - Record outdoor air (ambient) temperature.
3 - Operate indoor and outdoor units in cooling mode. Allow outdoor unit to run until system pressure stabilize.
4 - Make sure thermometer well is filled with mineral oil before checking liquid line temperature.
5 - Place thermometer in well and read liquid line temperature. Liquid line temperature should be a few degrees warmer than the outdoor air temperature. Table 9 shows how many degrees warmer the liquid line should be.

Add refrigerant to make the liquid line cooler.

Remove refrigerant to make the liquid line warmer.

TABLE 9

Model	Liquid Temp. Minus Ambient Temp. °F (°C)
HP27-024	8 ± 1 (4.4 ± .5)
HP27-030	5 ± 1 (2.8 ± .5)
HP27-036	5 ± 1 (2.8 ± .5)
HP27-042	8 ± 1 (4.4 ± .5)

SUBCOOLING METHOD (TXV SYSTEMS)
(Ambient Temperature Below 60°F [16°C])

NOTE- 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 18, moving obstructions sideways until liquid pressures in the 200-250 psig range are reached.

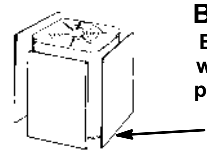


FIGURE 18

1 - Connect gauge manifold. Connect an upright HCFC-22 drum to center port of gauge manifold.
2 - Operate indoor and outdoor units in cooling mode. Allow units to run until system pressures stabilize.
3 - Make sure thermometer well is filled with mineral oil before checking liquid line temperature.
4 - Read liquid line pressure and convert to condensing temperature using temperature/ pressure conversion chart.

    Condensing temperature (from gauges) should be a few degrees warmer than the liquid line.
5 - Place thermometer in well and read liquid line temperature. Table 10 shows how much warmer the condensing temperature should be.

TABLE 10

Model	Subcooling °F (°C)
HP27-024	8 ± 2 (4.4 ± 1)
HP27-030	7 ± 2 (3.9 ± 1)
HP27-036	8 ± 2 (4.4 ± 1)
HP27-042	7 ± 2 (3.9 ± 1)

Add refrigerant to make the liquid line cooler.

Recover refrigerant to make the liquid line warmer.

6 - When unit is properly charged liquid line pressures should approximate those given in table 11.

⚠ IMPORTANT

Use table 11 as a general guide for performing maintenance checks. Table 11 is not a procedure for charging the system. Minor variations in pressures may be expected due to differences in installations. Significant deviations may mean the system is not properly charged or that a problem exists with some component in the system. Used prudently, table 11 could serve as a useful service guide.

D-Oil Charge

Refer to table 1 on page 3.

TABLE 11

NORMAL OPERATING PRESSURES									
MODE/ TYPE OF EXPANSION	OUTDOOR COIL AIR ENTERING TEMPERATURE °F	HP27-024		HP27-030		HP27-036		HP27-042	
		LIQ. ±10 PSIG	SUC. ±5 PSIG	LIQ. ±10 PSIG	SUC. ±5 PSIG	LIQ. ±10 PSIG	SUC. ±5 PSIG	LIQ. ±10 PSIG	SUC. ±5 PSIG
Cooling TXV Only	65	134	82	136	80	137	80	134	75
	75	159	83	161	81	163	81	167	76
	85	186	84	188	82	190	82	199	77
	95	216	83	217	83	221	83	232	78
	105	248	86	251	85	257	85	257	80
Heating	20	179	36	173	36	177	33	184	29
	30	188	49	192	49	195	40	194	39
	40	203	58	205	58	208	46	205	48
	50	228	65	218	65	217	58	216	58

VI-MAINTENANCE

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

A-Outdoor Unit

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

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

IMPORTANT

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

B-Indoor Coil

1 - Clean coil if necessary.

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

3 - Check condensate line and clean if necessary.

C-Indoor Unit

1 - Clean or change filters.

2 - Adjust blower cooling speed. Static pressure drop over coil should be checked to determine correct blower CFM. Refer to Lennox Engineering Handbook.

3 - Belt Drive Blowers - Check condition and tension.

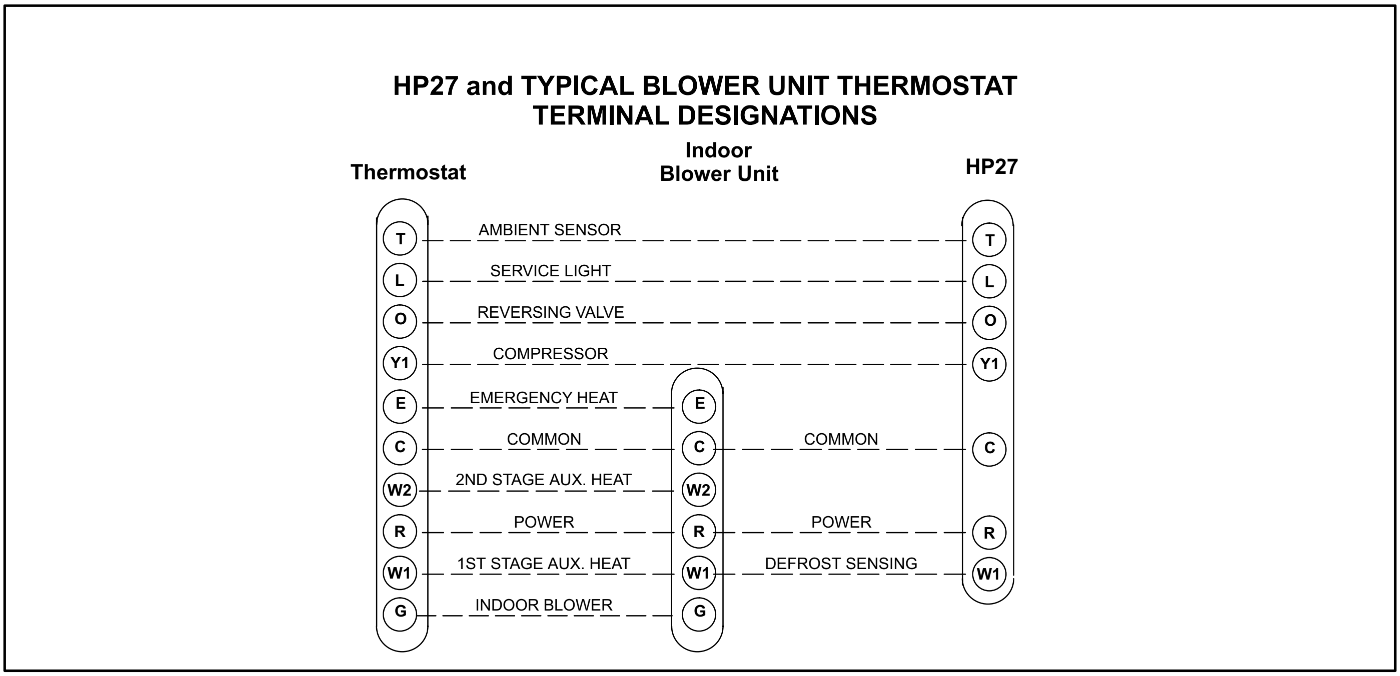
4 - Check all wiring for loose connections.

5 - Check for correct voltage at unit.

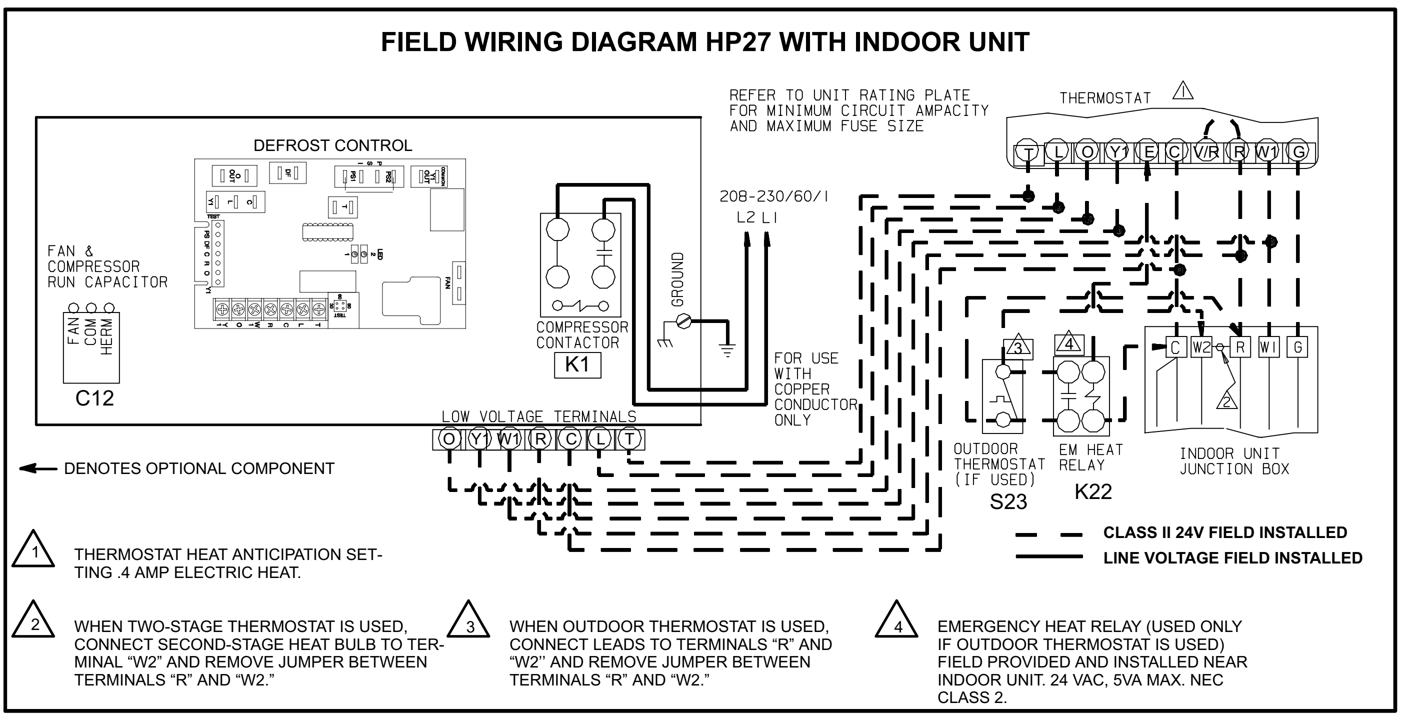
6 - Check amp-draw on blower motor.
Unit nameplate_________Actual_________.

VII-WIRING DIAGRAM/OPERATING SEQUENCE

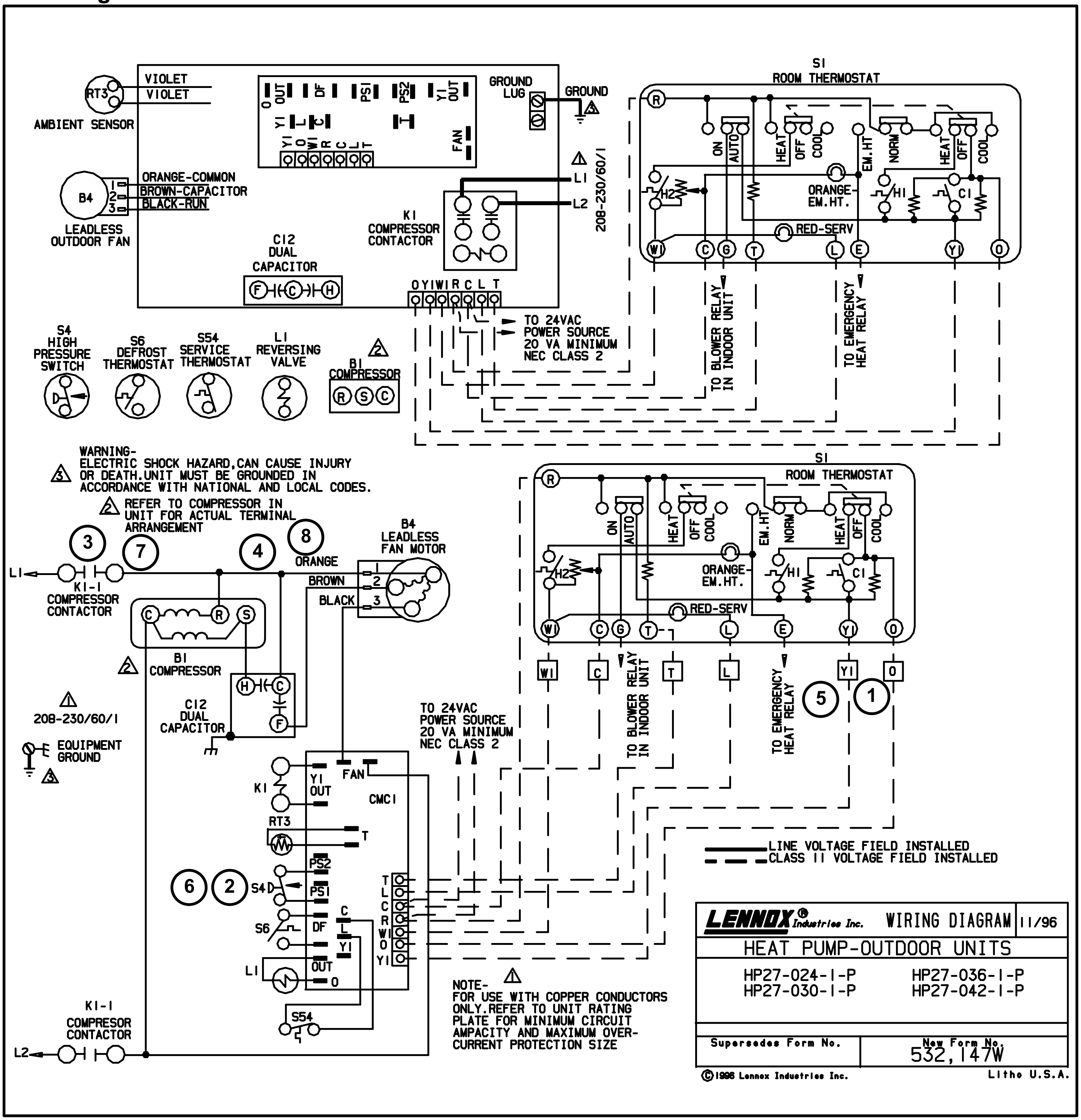
A-Field Wiring, Thermostat Connections



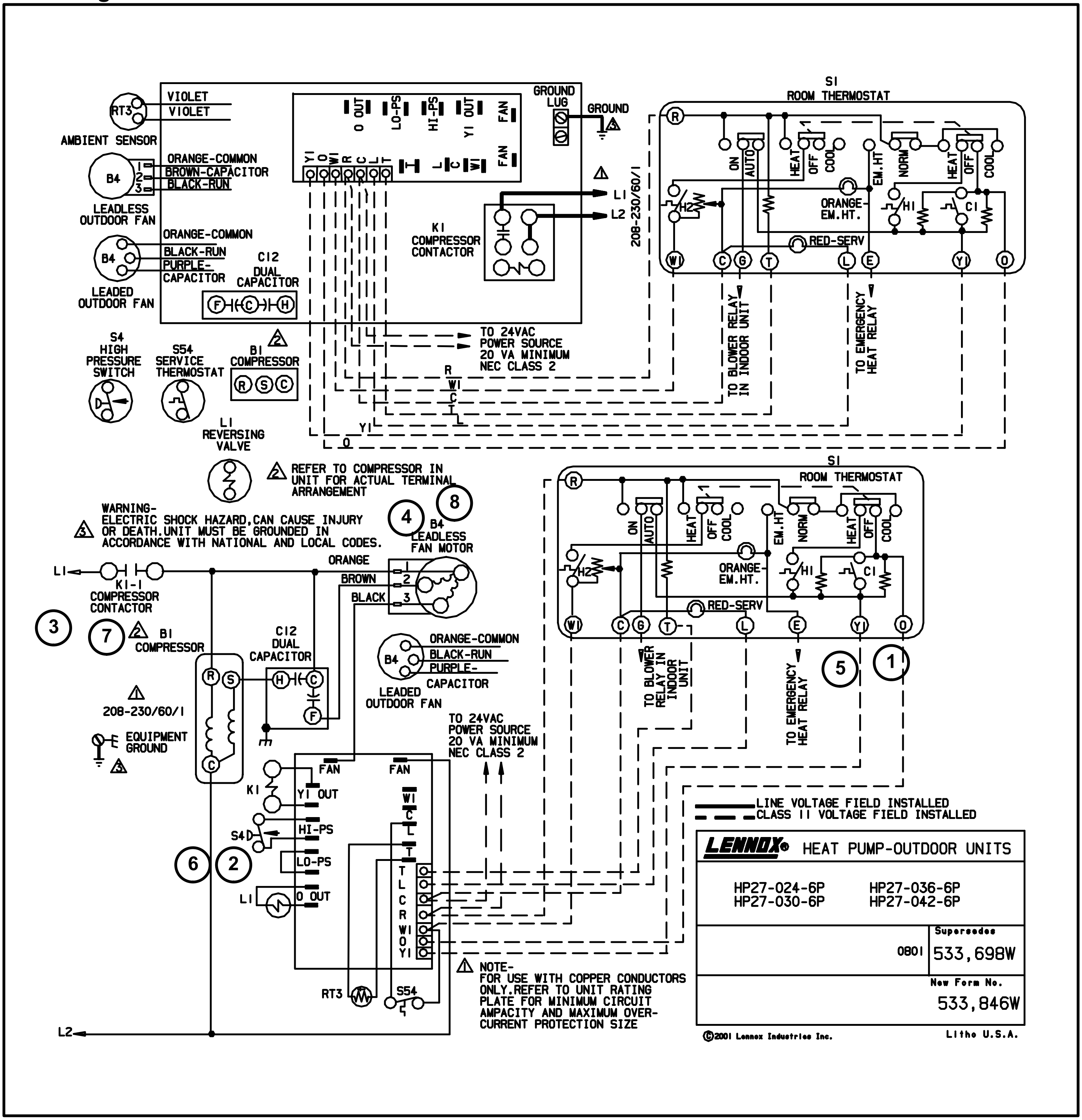
B-Field Wiring, Thermostat Connections



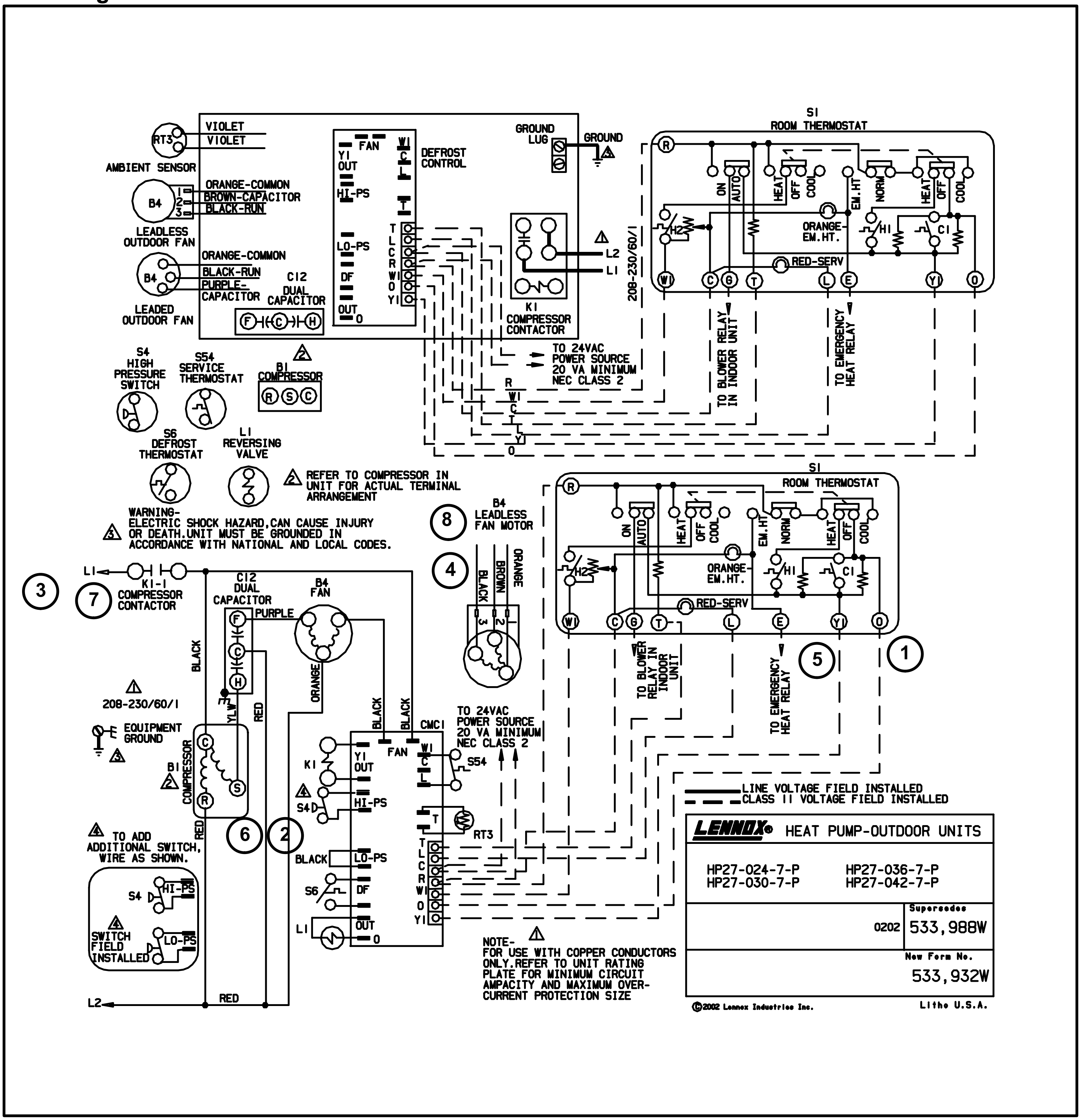
C-Diagram HP27-1-208/230 Volt



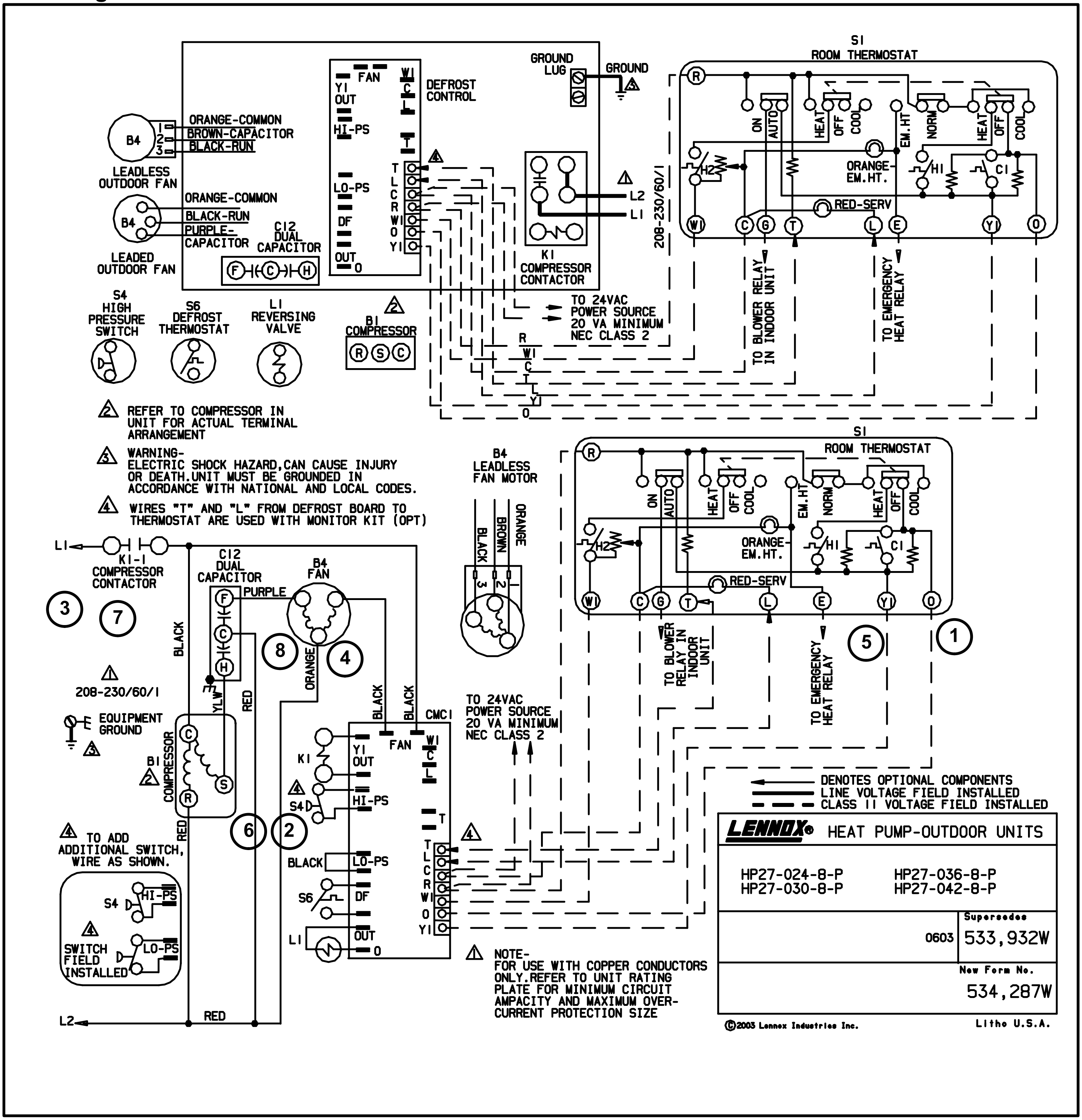
D-Diagram HP27-6-208/230 Volt



E-Diagram HP27-7-208/230 Volt



F-Diagram HP27-7-208/230 Volt



Operating Sequence HP27

NOTE- Transformer in indoor unit supplies power (24VAC) to the thermostat and outdoor unit controls.

COOLING

1 - Internal wiring energizes terminal O by cooling mode selection, energizing the reversing valve. Cooling demand initiates at Y1 in the thermostat.

2 - 24VAC energizes N.C. high pressure limit S4 which energizes compressor contactor K1.

3 - K1-1 N.O. contacts close energizing compressor B1 and outdoor fan motor B4.

4 - Compressor B1 and outdoor fan motor B4 begin immediate operation.

HEATING

5 - Internal thermostat wiring de-energizes terminal O by heating mode selection, de-energizing the reversing valve. Heating demand initiates at Y1.

6 - 24VAC energizes N.C. high pressure limit S4 and compressor contactor K1.

7 - K1-1 N.O. contacts close energizing compressor and outdoor fan motor.

8 - Compressor B1 and outdoor fan motor B4 begin immediate operation.

DEFROST MODE

9- During heating operation when outdoor coil temperature drops below 35°F (2°C) or 42°(5.5°C) *see defrost system description for specific unit dash number* defrost switch (thermostat) S6 closes.

10- Defrost control CMC1 begins timing. If defrost ther-mostat (S6) remains closed at the end of the 30,60 or 90 minute period, defrost relay energizes and defrost begins.

11 - During defrost CMC1 energizes the reversing valve and W1 on the terminal strip (operating indoor unit on the first stage heat mode), while de-energizing outdoor fan motor B4.

12 - Defrost continues 14 $\pm$ 1 minutes or until thermostat switch (S6) opens. When defrost thermostat opens, defrost control timer loses power and resets.

13 - When CMC1 resets, the reversing valve and W1 on the terminal strip are de-energized, while the outdoor fan motor B4 is energized.

14- After each thermostat demand, time delaylocks out the circuit to compressor contactor coil and defrost control for 5 minutes $\pm$ 2 minutes. At the end of the timed period, the time delay allows the compressor contactor and defrost control to be energized upon demand as in step 1.