

**HPXA16 SERIES UNITS**

The HPXA16 is a high efficiency residential split-system heat pump unit, which features a two-stage scroll compressor and R-410A refrigerant. HPXA16 units are available in 2, 3, 4 and 5 ton sizes. The series is designed for use with an expansion valve only (approved for use with R-410A) in the indoor unit. This manual is divided into sections which discuss the major components, refrigerant system, charging procedure, maintenance and operation sequence. Information contained in this manual is intended for use by qualified service technicians only. All specifications are subject to change.




**⚠ IMPORTANT**  
Operating pressures of this R-410A unit are higher than pressures in R22 units. Always use service equipment rated for R-410A.

**⚠ WARNING**  
Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Installation and service must be performed by a qualified installer or service agency.

**⚠ IMPORTANT**  
The Clean Air Act of 1990 bans the intentional venting of (CFC's and HFC's) as of July 1, 1992. Approved methods of recovery, recycling or reclaiming must be followed. Fines and/or incarceration may be levied for noncompliance.

**⚠ DANGER**  
**Shock Hazard**  
Remove all power at disconnect before removing access panel. HPXA16 units use single-pole contactors. Potential exists for electrical shock resulting in injury or death. Line voltage exists at all components (even when unit is not in operation).



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## SPECIFICATIONS

| General Data                        |                                      | Model No.                          | HPXA16-024              | HPXA16-036              | HPXA16-048               | HPXA16-060              |
|-------------------------------------|--------------------------------------|------------------------------------|-------------------------|-------------------------|--------------------------|-------------------------|
|                                     |                                      | Nominal Tonnage (kW)               | 2 (7.0)                 | 3 (10.6)                | 4 (14.1)                 | 5 (17.6)                |
| Connections (sweat)                 | Liquid line o.d. - in. (mm)          |                                    | 3/8 (9.5)               | 3/8 (9.5)               | 3/8 (9.5)                | 3/8 (9.5)               |
|                                     | Vapor line o.d. - in. (mm)           |                                    | 7/8 (22.2)              | 7/8 (22.2)              | 7/8 (22.2)               | 1-1/8 (28.5)            |
| Refrigerant                         |                                      | <sup>1</sup> R-410A furnished      | 10 lbs. 4 oz. (4.65 kg) | 11 lbs. 0 oz. (5.00 kg) | 12 lbs. 14 oz. (5.84 kg) | 14 lbs. 6 oz. (6.52 kg) |
| Outdoor Coil                        | Net face area                        |                                    | 16.04 (1.49)            | 16.04 (1.49)            | 24.06 (2.24)             | 24.06 (2.24)            |
|                                     | Outer Coil sq. ft. (m <sup>2</sup> ) |                                    | 15.56 (1.45)            | 15.56 (1.45)            | 23.33 (2.17)             | 23.33 (2.17)            |
|                                     | Inner Coil                           |                                    | 15.56 (1.45)            | 15.56 (1.45)            | 23.33 (2.17)             | 23.33 (2.17)            |
|                                     | Tube diameter - in. (mm)             |                                    | 5/16 (0.52)             | 5/16 (0.52)             | 5/16 (0.52)              | 5/16 (0.52)             |
|                                     |                                      | Number of rows - Fins per inch (m) | 2 - 22                  | 2 - 22                  | 2 - 22                   | 2 - 22                  |
| Outdoor Fan                         | Diameter in. (mm) - Number of blades |                                    | 24 (610) - 3            | 24 (610) - 3            | 24 (610) - 4             | 24 (610) - 4            |
|                                     | Motor hp (W)                         |                                    | 1/10 (74.8)             | 1/10 (74.8)             | 1/4 (187)                | 1/4 (187)               |
|                                     | Cfm (L/s)                            |                                    | 3159 (1485)             | 3159 (1485)             | 3900 (1840)              | 4200 (1980)             |
|                                     | Rpm                                  |                                    | 825                     | 825                     | 820                      | 820                     |
|                                     | Watts                                |                                    | 170                     | 170                     | 300                      | 350                     |
| Shipping Data - lbs. (kg) 1 package |                                      |                                    | 261 (118)               | 262 (119)               | 318 (144)                | 340 (154)               |

## ELECTRICAL DATA

|  |                   |              |              |              |              |      |
|--|-------------------|--------------|--------------|--------------|--------------|------|
| Line voltage data - 60hz                           |                   | 208/230V-1ph | 208/230V-1ph | 208/230V-1ph | 208/230V-1ph |      |
| <sup>3</sup> Maximum overcurrent protection (amps) |                   | 20           | 35           | 45           | 60           |      |
| <sup>2</sup> Minimum circuit ampacity              |                   | 13.7         | 22.1         | 28.2         | 33.8         |      |
| Compressor   | Rated load amps   |              | 10.3         | 16.7         | 21.2         | 25.7 |
|  | Locked rotor amps |              | 52           | 82           | 96           | 118  |
|  | Power factor      |              | 0.99         | 0.98         | 0.99         | 0.99 |
| Outdoor Coil Fan Motor                             | Full load amps    |              | 0.8          | 0.8          | 1.7          | 1.7  |
|  | Locked rotor amps |              | 2            | 2            | 3.1          | 3.1  |

## OPTIONAL ACCESSORIES - must be ordered extra

|  |                   |                 |   |   |   |
|--|-------------------|-----------------|---|---|---|
| Compressor Hard Start Kit              | 10J42             | Factory         | • |   |   |
|  | 81J69             |                 |   | • | • |
| Compressor Low Ambient Cut-Off         | 45F08             |                 | • | • | • |
| Freezestat                             | 3/8 in. tubing    | 93G35           | • | • | • |
|  | 1/2 in. tubing    | 39H29           | • | • | • |
|  | 5/8 in. tubing    | 50A93           | • | • | • |
| Indoor Blower Relay                    | 40K58             |                 | • | • | • |
| Low Ambient Kit                        | 54M89             |                 | • | • | • |
| Mild Weather Kit                       | 33M07             |                 | • | • | • |
| Monitor Kit - Service Light            | 76F53             |                 | • | • | • |
| Mounting Base                          | 69J07             |                 | • | • | • |
| Outdoor Thermostat Kit                 | Thermostat        | 56A87           | • | • | • |
|  | Mounting Box - US | 31461           | • | • | • |
|  | Canada            | 33A09           | • | • | • |
| Refrigerant Line Sets                  | L15-65-15         | L15-65-40       | • | • |   |
|  | L15-65-30         | L15-65-50       |   |   |   |
|  |                   | Field Fabricate |   |   | • |
| SignatureStat™ Home Comfort Controller | 81M28             |                 | • | • | • |
| Time Delay Relay                       | 58M81             |                 | • | • | • |

NOTE — Extremes of operating range are plus 10% and minus 5% of line voltage.

<sup>1</sup> Refrigerant charge sufficient for 15 ft. (4.6 m) length of refrigerant lines.

<sup>2</sup> Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements.

<sup>3</sup> HACR type breaker or fuse.

## I-APPLICATION

All major components (indoor blower and coil) 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-Unit Components

### 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.

## A-Two-Stage Scroll Compressor (B1)

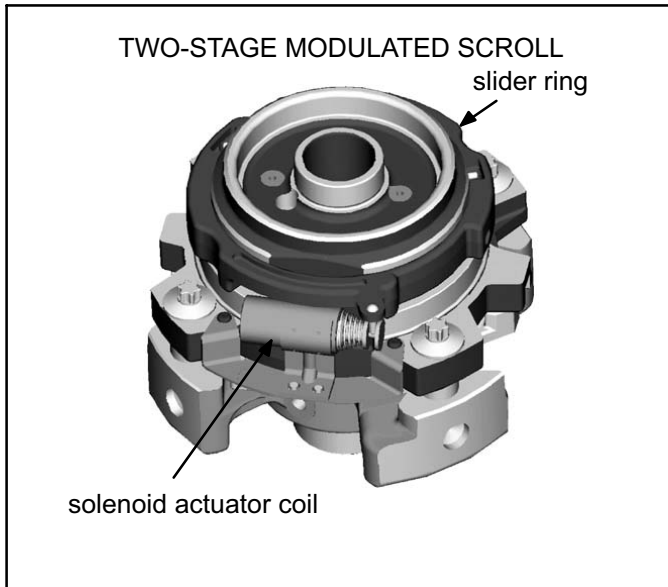


FIGURE 1

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 just below. 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.

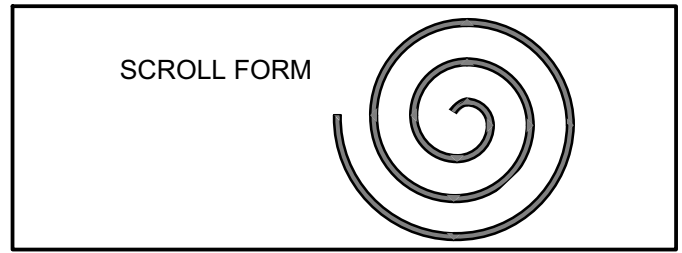


FIGURE 2

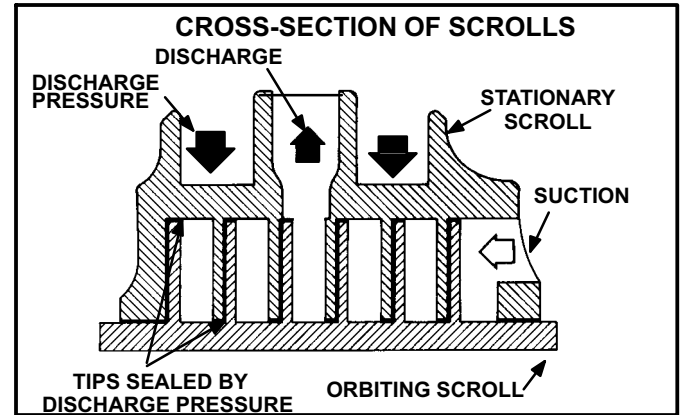


FIGURE 3

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.

Due to its efficiency, the scroll compressor is capable of drawing a much deeper vacuum than reciprocating compressors. Deep vacuum operation can cause internal fuse arcing resulting in damaged internal parts and will result in compressor failure. This type of damage can be detected and will result in denial of warranty claims. The scroll compressor can be used to pump down refrigerant as long as the pressure is not reduced below 7 psig.

*NOTE - During operation, the head of a scroll compressor may be hot since it is in constant contact with discharge gas.*

The scroll compressors in all HPXA16 model units are designed for use with R-410A refrigerant and operation at high pressures. Compressors are shipped from the factory with 3MA (32MMMA) P.O.E. oil. If oil must be added for service, Copeland has approved Mobile EAL™ Arctic 22CC

and ICI EMKARATE™ RL32CF for use with these compressors. Lennox recommends adding 1 oz. of oil per additional 10 ft. for applications with line sets over 50 ft. See electrical section in this manual for compressor specifications.

### TWO-STAGE OPERATION

The two-stage scroll compressor operates like any standard scroll compressor with the exception the two-stage compressor modulates between first stage (low capacity approximately 67%) and second stage (high capacity). Modulation occurs when gas is bypassed through bypass ports (figure 5 bypass ports open) in the first suction pocket. This bypassing of gas allows the compressor to operate on first stage (low capacity) if thermostat demand allows.

Indoor thermostat setting will determine first or second stage operation. The compressor will operate on first-stage until demand is satisfied or the indoor temperature reaches the thermostat set point calling for second-stage.

Second-stage (high capacity) is achieved by blocking the bypass ports (figure 5 bypass ports closed) with a slider ring. The slider ring begins in the open position and is controlled by a 24VDC internal solenoid. On a Y2 call the internal solenoid closes the slider ring, blocking the bypass ports and bringing the compressor to high capacity. Two-stage modulation can occur during a single thermostat demand as the motor runs continuously while the compressor modulates from first-stage to second-stage.

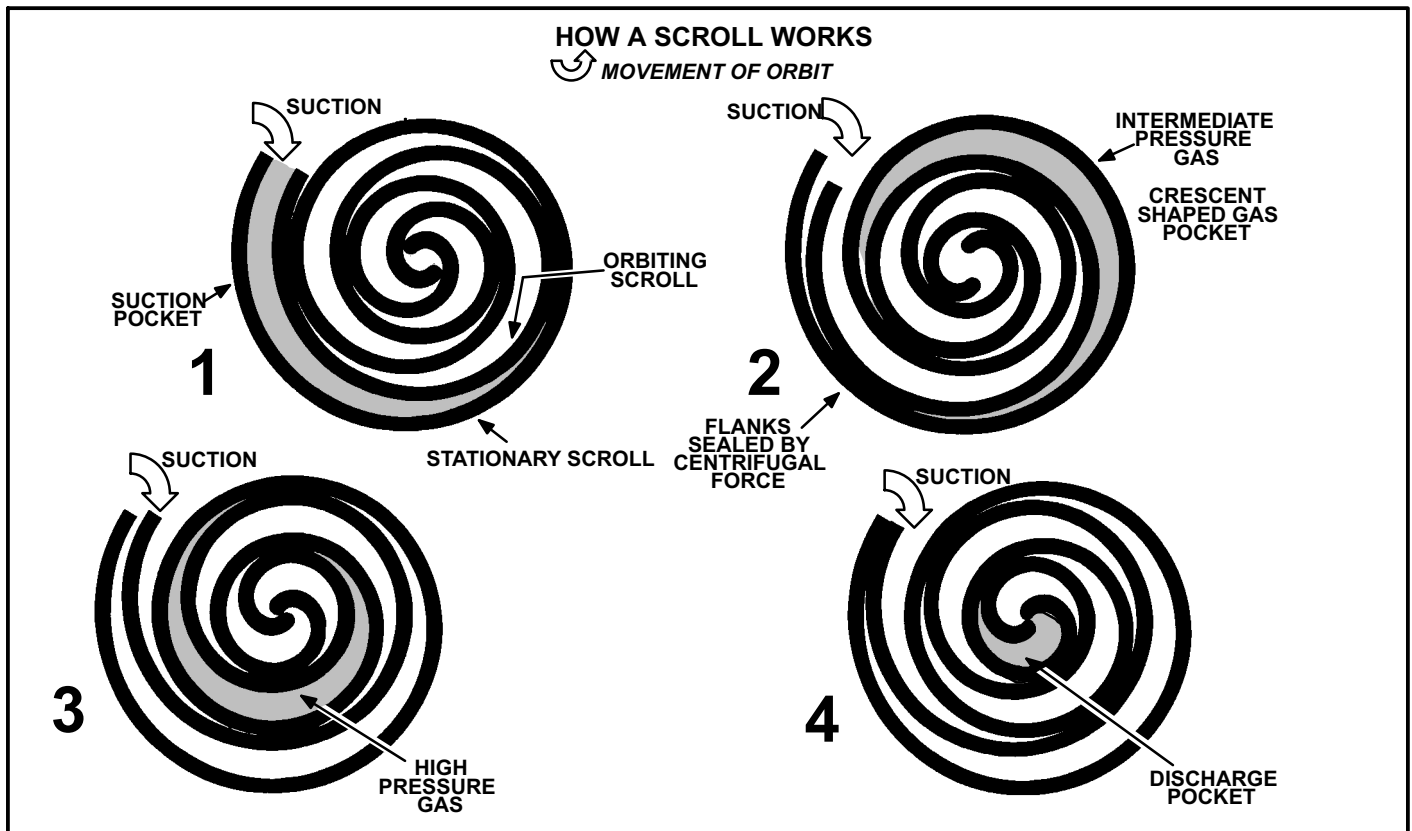


FIGURE 4

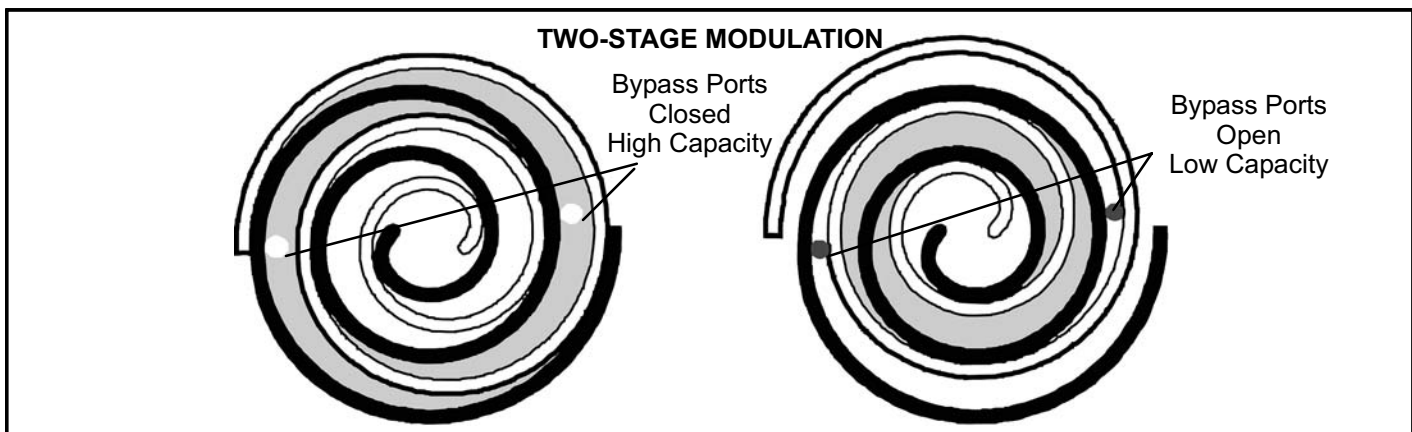


FIGURE 5

## INTERNAL SOLENOID (L34)

The internal unloader solenoid controls the two-stage operation of the compressor by shifting a slide ring mechanism to close two by-pass ports in the first compression pocket of the scrolls in the compressor. The internal solenoid is activated by a **24 volt direct current solenoid coil**. The coil power requires 20VAC. The internal wires from the solenoid in the compressor are routed to a 2 pin fusite connection on the side of the compressor shell. The external electrical connection is made to the compressor with a molded plug assembly. This plug contains a full wave rectifier that converts 24 volt AC into 24 volt DC power to power the unloader solenoid. Refer to unit diagram for internal circuitry view of plug.

If it is suspect the unloader is not operating properly, check the following

### **IMPORTANT**

**This performance check is ONLY valid on systems that have clean indoor and outdoor coils, proper air-flow over coils, and correct system refrigerant charge. All components in the system must be functioning proper to correctly perform compressor modulation operational check. (Accurate measurements are critical to this test as indoor system loading and outdoor ambient can affect variations between low and high capacity readings).**

#### **STEP 1 Confirm low to high capacity compressor operation**

##### **Tools required**

Refrigeration gauge set

Digital volt/amp meter

Electronic temperature thermometer

On-off toggle switch

## **Procedure**

1. Turn main power "OFF" to outdoor unit.
2. Adjust room thermostat set point above (heating operation on heat pump) or below (cooling operation) the room temperature 5°F.
3. Remove control access panel. Install refrigeration gauges on unit. Attach the amp meter to the common (black wire) wire of the compressor harness. Attach thermometer to discharge line as close as possible to the compressor.
4. Turn toggle switch "OFF" and install switch in series with Y2 wire from room thermostat.
5. Cycle main power "ON."
6. Allow pressures and temperatures to stabilize before taking any measured reading (may take up to 10 minutes).

*NOTE - Block outdoor coil to maintain a minimum of 375 psig during testing).*

7. Record all of the readings for the Y1 demand on table 1.
8. Close switch to energize Y2 demand.
9. Allow pressures and temperatures to stabilize before taking any measured reading (this may take up to 10 minutes).
10. Record all of the readings of Y2 demand on table 1.

*NOTE - On new installations or installations that have shut down for an extended period of time, if the compressor does not cycle from low stage to high stage on the first attempt, it may be necessary to recycle the compressor back down to low stage and back up to high stage a few times in order to get the bypass seals to properly seat*

Compare Y1 readings with Y2 readings in table 1. Some readings should be higher, lower or the same. If the readings follow what table 1 specifies, the compressor is operating and shifting to high capacity as designed. If the readings do not follow what table 1 specifies, continue to step 2 to determine if problem is with external solenoid plug power.

TABLE 1

| Unit Readings              | Compressor Operation |                                       |                |
|----------------------------|----------------------|---------------------------------------|----------------|
|                            | Y1 - 1st-Stage       | Expected Results                      | Y2 - 2nd-Stage |
| <b>Compressor</b>          |                      |                                       |                |
| Voltage                    |                      | Same                                  |                |
| Amperage                   |                      | Higher                                |                |
| <b>Condenser Fan motor</b> |                      |                                       |                |
| Amperage                   |                      | Same or Higher                        |                |
| <b>Temperature</b>         |                      |                                       |                |
| Ambient                    |                      | Same                                  |                |
| Outdoor Coil Discharge Air |                      | Higher in Cooling<br>Lower in Heating |                |
| Compressor Discharge Line  |                      | Higher                                |                |
| Indoor Return Air          |                      | Same                                  |                |
| Indoor Coil Discharge Air  |                      | Lower in Cooling<br>Higher in Heating |                |
| <b>Pressures</b>           |                      |                                       |                |
| Suction (Vapor)            |                      | Lower                                 |                |
| Liquid                     |                      | Higher                                |                |

**STEP 2 Confirm DC voltage output on compressor solenoid plug**

1. Shut power off to outdoor unit.
2. Supply 24 volts AC control voltage to the wire ends of the full wave rectifier plug. Listen for a “click” as the solenoid is energized. See figure 6.

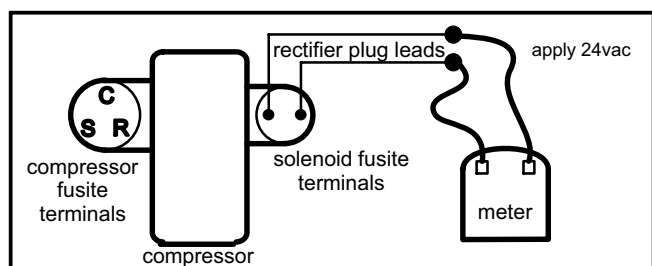


FIGURE 6

3. Unplug the full wave rectifier plug from the fusite connection on the compressor.
4. Turn the low voltage power back onto the unit. Supply 24VAC to the wires of the full wave rectifier plug. Set volt meter to DC volts and measure the DC voltage at the female connector end of the full wave rectifier plug. The DC voltage reading should be 1.5 to 3 volts lower than the input voltage to the plug wire leads. (EX: Input voltage is 24VAC output voltage is 22VDC). See figure 7.

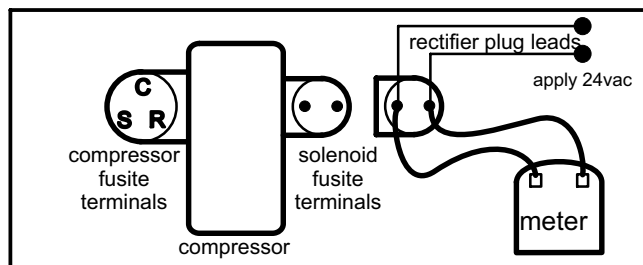


FIGURE 7

If the above checks verify that the solenoid plug is providing power to cycle into high capacity operation, continue to step 3 to determine if problem is with solenoid coil in compressor

**STEP 3 Confirm internal unloader solenoid has proper resistance**

1. Shut all power off to unit (main and low voltage)
2. Unplug the molded plug from the compressor solenoid 2-pin fusite.
3. Using a volt meter set on the 200 ohm scale

**Replace the Compressor under these conditions:**

**Bad Solenoid**

- a. Measure the resistance at the 2-pin fusite. The resistance should be 32 to 60 ohms depending on compressor temperature. If no resistance replace compressor.
- b. Measure the resistance from each fusite pin to ground. There should **not be** continuity to ground. If solenoid coil is grounded, replace compressor.

**Good Solenoid**

- a. Seals not shifting, replace compressor
- b. Slider ring not shifting, replace compressor.

## B-Dual Capacitor (C12)

The compressor and fan in HPXA16 units use permanent split capacitor motors. A single “dual” capacitor is used for both the fan motor and the compressor (see unit wiring diagram). The two sides (fan and compressor) of the capacitor have different mfd ratings and may change with each compressor. The capacitor is located inside the unit control box.

## C-Condenser Fan Motor (B4)

HPXA16 units use single-phase PSC fan motors which require a run capacitor. The “FAN” side of the dual capacitor is used for this purpose. In all units, the outdoor fan is controlled by the compressor contactor. See ELECTRICAL DATA and SPECIFICATIONS section for more information. See figure 8 if condenser fan motor replacement is necessary. Rain shield location is critical on the condenser fan assembly. Two shields are used in unison to prevent moisture from entering the motor bearings. Installing the shields too close to the bearing hub will create noise and may affect operation. Installing too far away will allow moisture to enter the bearing, resulting in motor failure. See figure 9.

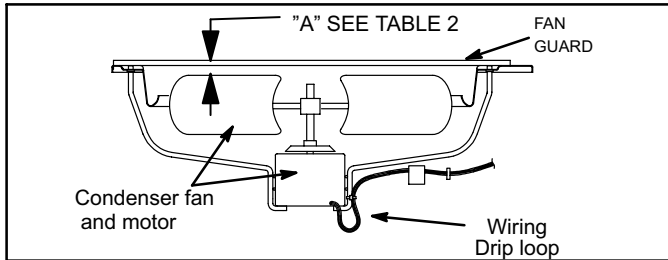


FIGURE 8

TABLE 2

| HPXA16 UNIT | ”A” DIM. ± 1/8” |
|-------------|-----------------|
| -024, -036  | 1 1/16”         |
| -048        | 1 3/16”         |
| -060        |                 |

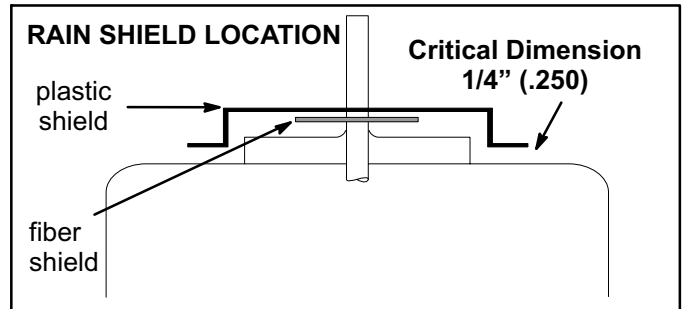


FIGURE 9

## D-Transformer (T46)

Transformer T46 is located in the control box and is energized any time the compressor is operating.

## E-Contactor (K1)

The compressor is energized by a contactor located in the control box. All HPXA16 units are single phase and use single-pole contactors.

## F-Low Pressure Switch (S87)

The HPXA16 is equipped with an auto-reset low pressure switch which is located on the suction line. The switch shuts off the compressor when the suction pressure falls below the factory setting. The switch closes when it is exposed to 55 psig and opens at 25 psig. It is not adjustable.

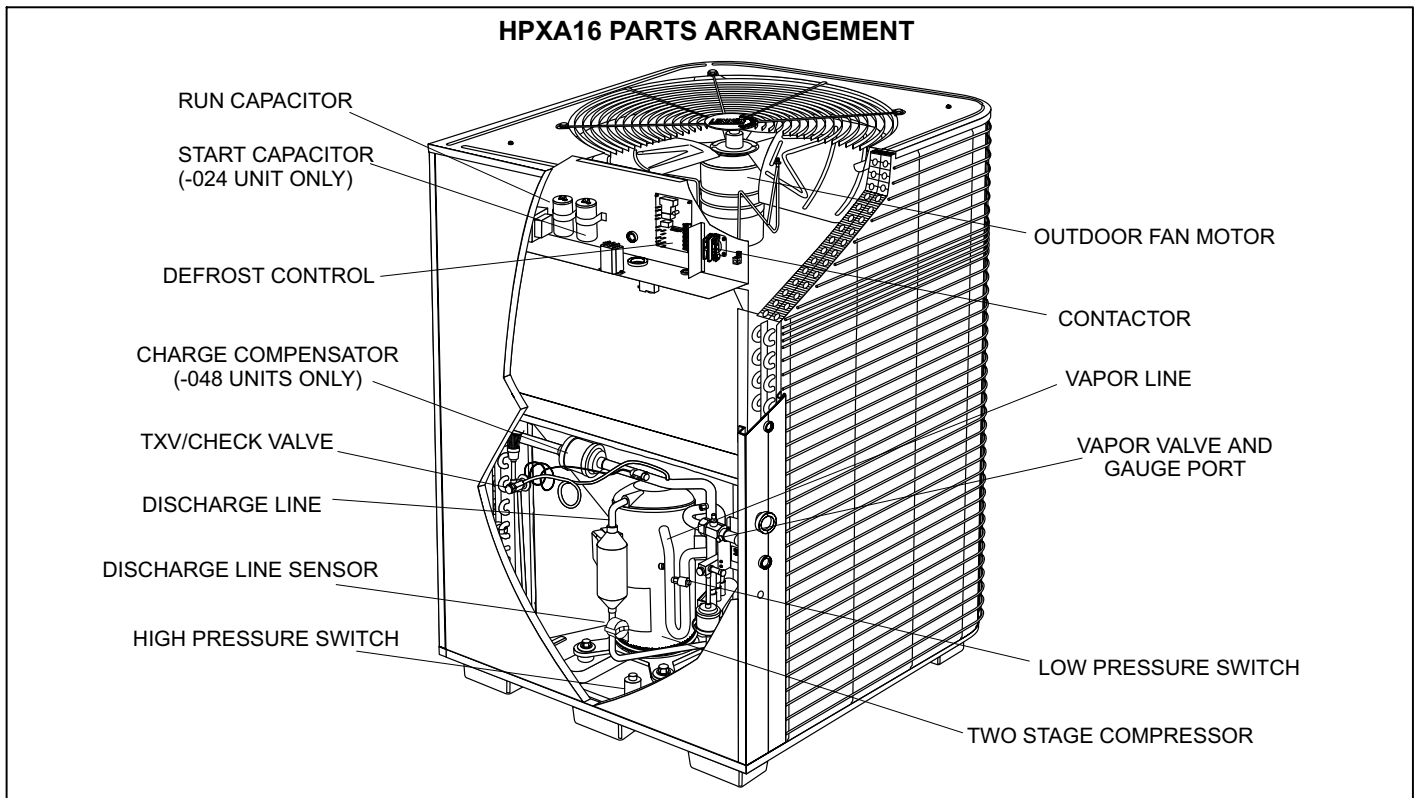


FIGURE 10

## G- Crankcase heater Thermostat (S40)

Thermostat S40 controls the crankcase heater in all units. S40 is located on the liquid line. When liquid line temperature drops below 50° F the thermostat S40 closes energizing HR1. The thermostat will open, de-energizing HR1 once liquid line temperature reaches 70° F .

## H-Filter Drier

A filter drier designed for all HPXA16 model units is factory installed in the liquid line. The filter drier is designed to remove moisture and foreign matter, which can lead to compressor failure.

### Moisture and / or Acid Check

Because POE oils absorb moisture, the dryness of the system must be verified any time the refrigerant system is exposed to open air. A compressor oil sample must be taken to determine if excessive moisture has been introduced to the oil. Table 3 lists kits available from Lennox to check POE oils.

If oil sample taken from a system that has been exposed to open air does not test in the dry color range, the filter drier MUST be replaced.

**⚠ IMPORTANT**

**Replacement filter drier MUST be approved for R-410A refrigerant and POE application.**

### Foreign Matter Check

It is recommended that a liquid line filter drier be replaced when the pressure drop across the filter drier is greater than 4 psig.

## I-Accumulator (HPXA16-060 only)

ALL 5 ton HPXA16 units are equipped with an accumulator. The purpose of the accumulator is to trap and evaporate all liquid refrigerant returning to the compressor.

## J-Charge Compensator

HPXA16-048 series units are equipped with a charge compensator located in the vapor line between the reversing valve and outdoor coil manifold. The compensator is used to collect and store excess refrigerant in the heating mode. Figure 11 shows operation of the charge compensator.

In heating mode, the vapor line passing through the charge compensator tank is cooler than the liquid line. Excess refrigerant (condensed liquid) from the indoor coil is trapped by the compensator. The vapor line is cooler than the liquid line so liquid migrates from the liquid line to the compensator tank where it is stored. In cooling mode, the vapor line passing through the charge compensator tank is hotter than the liquid line. Stored liquid is boiled and forced back into circulation.

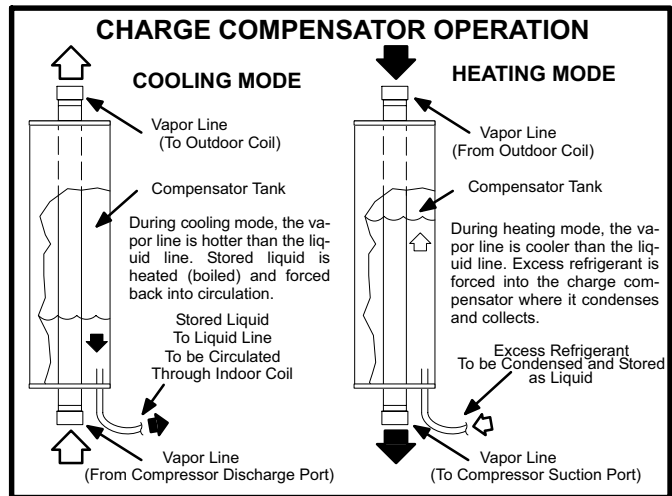


FIGURE 11

## K-Crankcase Heater (HR1)

Compressors in all units are equipped with a 70 watt belly-band type crankcase heater. HR1 prevents liquid from accumulating in the compressor. HR1 is controlled by the crankcaseheater thermostat.

## L-Defrost System

The demand defrost controller measures differential temperatures to detect when the system is performing poorly because of ice build-up on the outdoor coil. The controller “self-calibrates” when the defrost system starts and after each system defrost cycle. The defrost control board components are shown in figure 12.

TABLE 3

| KIT                          | CONTENTS                              | TUBE SHELF LIFE  |
|------------------------------|---------------------------------------|--|
| 10N46 - Refrigerant Analysis | Checkmate-RT700                       |  |
| 10N45 - Acid Test Tubes      | Checkmate-RT750A (three pack)         | 2 - 3 years @ room temperature. 3+ years refrigerated  |
| 10N44 - Moisture Test Tubes  | Checkmate - RT751 Tubes (three pack)  | 6 - 12 months @ room temperature. 2 years refrigerated |
| 74N40 - Easy Oil Test Tubes  | Checkmate - RT752C Tubes (three pack) | 2 - 3 years @ room temperature. 3+ years refrigerated  |
| 74N39 - Acid Test Kit        | Sporlan One Shot - TA-1               |  |



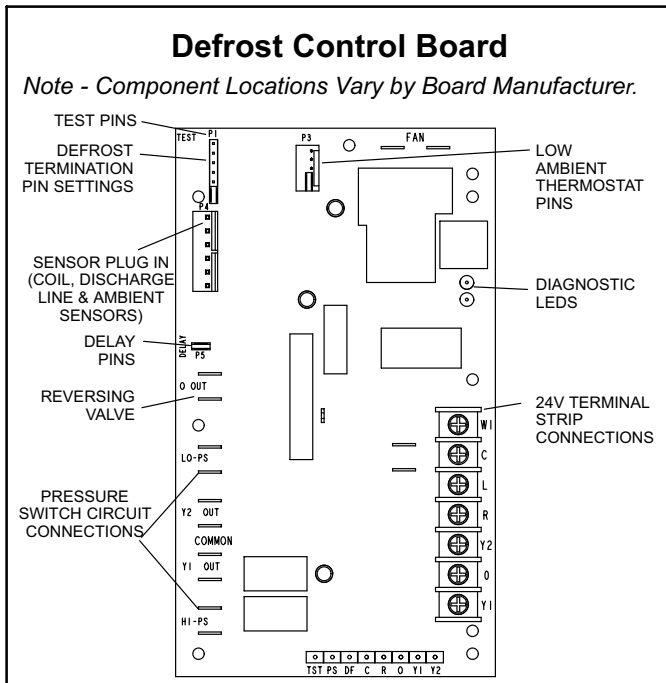


FIGURE 12

The control monitors ambient temperature, outdoor coil temperature, and total run time to determine when a defrost cycle is required. The coil temperature probe is designed with a spring clip to allow mounting to the outside coil tubing. The location of the coil sensor is important for proper defrost operation.

*NOTE - The demand defrost board accurately measures the performance of the system as frost accumulates on the outdoor coil. This typically will translate into longer running time between defrost cycles as more frost accumulates on the outdoor coil before the board initiates defrost cycles.*

**Diagnostic LEDs**

The defrost board uses two LEDs for diagnostics - DS1 (Red) and DS2 (Green). The LEDs flash a specific sequence according to the diagnostic condition. See table 5.

**Low Pressure Switch (LO-PS)**

The unit's automatic reset low pressure switch (S87) is factory-wired into the defrost board on the LO-PS terminals. When the low pressure switch trips, the defrost board will cycle off the compressor, and the strike counter in the board will count one strike. The low pressure switch is ignored under the following conditions:

- during the defrost cycle and 90 seconds after the termination of defrost
- when the average ambient sensor temperature is below 15° F (-9°C)
- for 90 seconds following the start up of the compressor
- during "test" mode

**High Pressure Switch (HI-PS)**

The unit's automatic reset high pressure switch (S4) is factory-wired into the defrost board on the HI-PS terminals. When the high pressure switch trips, the defrost board will cycle off the compressor, and the strike counter in the board will count one strike.

**5-Strike Lockout Feature**

- The internal control logic of the board counts the pressure switch trips only while the Y1 (Input) line is active. If a pressure switch opens and closes four times during a Y1 (Input), the control logic will reset the pressure switch trip counter to zero at the end of the Y1 (Input). If the pressure switch opens for a fifth time during the current Y1 (Input), the control will enter a lockout condition.
- The 5-strike pressure switch lockout condition can be reset by cycling OFF the 24-volt power to the control board or by shorting the TEST pins between 1 to 2 seconds. All timer functions (run times) will also be reset.
- If a pressure switch opens while the Y1 Out line is engaged, a 5-minute short cycle will occur after the switch closes.

**Sensors**

Sensors connect to the defrost board through a field-replaceable harness assembly that plugs into the board. Through the sensors, the board detects outdoor ambient, coil, and discharge temperature fault conditions. As the detected temperature changes, the resistance across the sensor changes. Sensor resistance values can be checked by ohming across pins shown shown in table 4.

*NOTE - When checking the ohms across a sensor, be aware that a sensor showing a resistance value (as opposed to either a shorted or open circuit) that is not within the range shown in table 4, may be performing as designed. However, if a shorted or open circuit is detected, then the sensor may be faulty and the sensor harness will need to be replaced.*

TABLE 4

| Sensor Temperature / Resistance Range |                           |                                |            |
|---------------------------------------|---------------------------|--------------------------------|------------|
| Sensor                                | Temperature Range °F (°C) | Resistance values range (ohms) | Lead Color |
| Outdoor                               | -35 (-37) to 120 (48)     | 280,000 to 3750                | Black      |
| Coil                                  | -35 (-37) to 120 (48)     | 280,000 to 3750                | Brown      |
| Discharge (if applicable)             | 24 (-4) to 350 (176)      | 41,000 to 103                  | Yellow     |

Note: Sensor resistance increases as sensed temperature decreases.

**Ambient Sensor**—The ambient sensor considers outdoor temperatures below -35°F (-37°C) or above 120°F (48°C) as a fault. If the ambient sensor is detected as being open, shorted or out of the temperature range of the sensor, the board will not perform demand defrost operation. The board will revert to time/temperature defrost operation and will display the appropriate fault code. Heating and cooling operation will be allowed in this fault condition. The ambient temperature sensor is located in the PVC tube next to the filter drier. See figure 15.

**Coil Sensor**—The coil temperature sensor considers outdoor temperatures below -35°F (-37°C) or above 120°F (48°C) as a fault. If the coil temperature sensor is detected as being open, shorted or out of the temperature range of the sensor, the board will not perform demand or time/temperature defrost operation and will display the appropriate fault code. Heating and cooling operation will be allowed in this fault condition. See figure 13 for location.

Under certain ambient conditions, the internal cabinet temperature of the HPXA16-036 will affect the temperature that is sensed by the coil sensor. This can set up a condition where the defrost board would not initiate a defrost. To overcome this issue, the coil sensor **should be** moved to the other side of the cabinet to a coil hairpin as shown in figure 14.

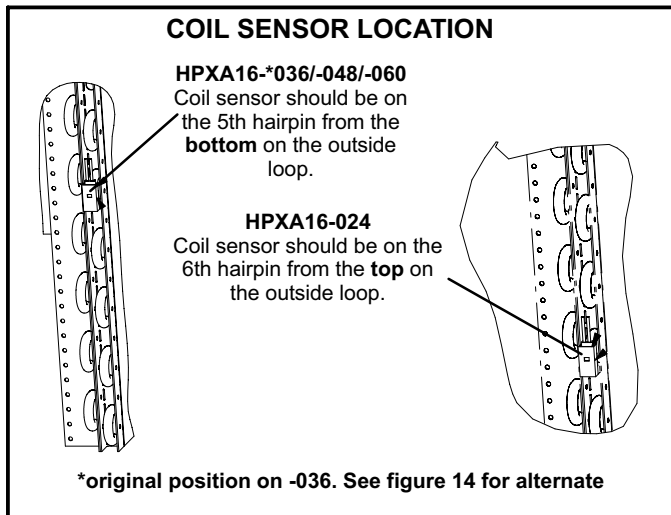


FIGURE 13

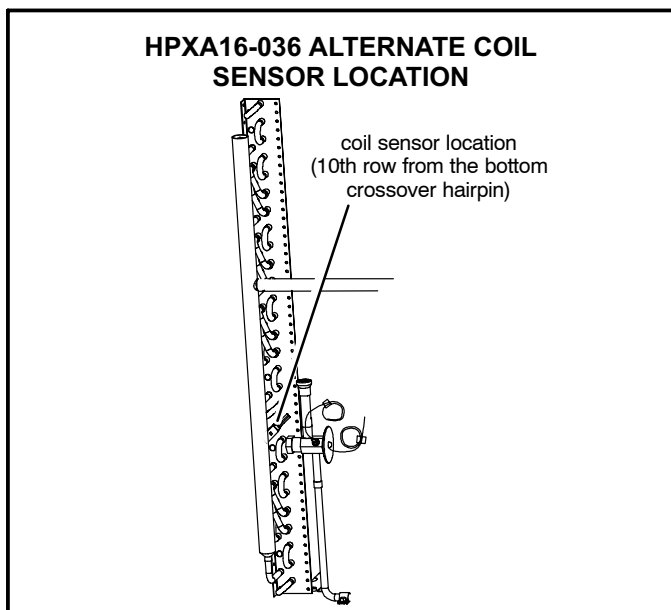


FIGURE 14

**Discharge Line Sensor**—If the discharge line temperature exceeds a temperature of 300°F (148°C) during compressor operation, the board will de-energize the compressor contactor output (and the defrost output, if active). The compressor will remain off until the discharge temperature has dropped below 225°F (107°C) and the 5-minute anti-short cycle delay has been satisfied. See figure 15 for location. This sensor has two fault and lockout codes:

1. If the board recognizes five high discharge line temperature faults during a single (Y1) compressor demand, it reverts to a lockout mode and displays the appropriate code. This code detects shorted sensor or high discharge temperatures. (Code on board is “Discharge Line Temperature Fault and Lockout”).

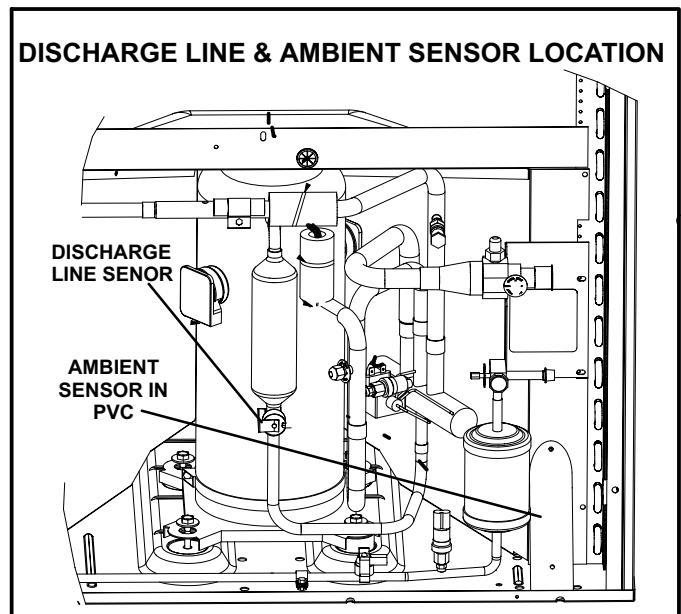


FIGURE 15

2. If the board recognizes five temperature sensor range faults during a single (Y1) compressor demand, it reverts to a lockout mode and displays the appropriate code. The board detects open sensor or out-of-temperature sensor range. This fault is detected by allowing the unit to run for 90 seconds before checking sensor resistance. If the sensor resistance is not within range after 90 seconds, the board will count one fault. After 5 faults, the board will lockout. (Code on board is “Discharge Sensor Fault and Lockout”).

The discharge line sensor, which covers a range of 150°F (65°C) to 350°F (176°C), is designed to mount on a ½” refrigerant discharge line.

*NOTE - Within a single room thermostat demand, if 5-strikes occur, the board will lockout the unit. Defrost board 24 volt power “R” must be cycled “OFF” or the “TEST” pins on board must be shorted between 1 to 2 seconds to reset the board.*

**Second-Stage Operation**—If the board receives a call for second-stage compressor operation “Y2” in heating or cooling mode and the first-stage compressor output is active, the second-stage compressor solenoid output will be energized.

If first-stage compressor output is active in heating mode and the outdoor ambient temperature is below the selected compressor lock-in temperature, the second-stage compressor solenoid output will be energized without the “Y2” input. If the jumper is not connected to one of the temperature selection pins on P3 (40, 45, 50, 55°F), the default lock-in temperature of 40°F (4.5°C) will be used.

The board de-energizes the second-stage compressor solenoid output immediately when the “Y2” signal is removed or the outdoor ambient temperature is 5°F above the selected compressor lock-in temperature, or the first-stage compressor output is de-energized for any reason.

**Defrost Temperature Termination Shunt (Jumper) Pins**—The defrost board selections are: 50, 70, 90, and 100°F (10, 21, 32 and 38°C). The shunt termination pin is factory set at 50°F (10°C). If the temperature shunt is not installed, the default termination temperature is 90°F (32°C).

### Delay Mode

The defrost board has a field-selectable function to reduce occasional sounds that may occur while the unit is cycling in and out of the defrost mode. When a jumper is installed on the DELAY pins, the compressor will be cycled off for 30 seconds going in and out of the defrost mode. Units are shipped with jumper installed on DELAY pins.

*NOTE - The 30 second off cycle is NOT functional when jumpering the TEST pins.*

### Operational Description

The defrost control board has three basic operational modes: normal, defrost, and calibration.

- **Normal Mode**—The demand defrost board monitors the O line, to determine the system operating mode (heat/cool), outdoor ambient temperature, coil temperature (outdoor coil) and compressor run time to determine when a defrost cycle is required.
- **Calibration Mode**—The board is considered uncalibrated when power is applied to the board, after cool mode operation, or if the coil temperature exceeds the termination temperature when it is in heat mode.  
Calibration of the board occurs after a defrost cycle to ensure that there is no ice on the coil. During calibration, the temperature of both the coil and the ambient sensor are measured to establish the temperature differential which is required to allow a defrost cycle.
- **Defrost Mode**—The following paragraphs provide a detailed description of the defrost system operation.

### Detailed Defrost System 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 initiates a demand defrost cycle 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.

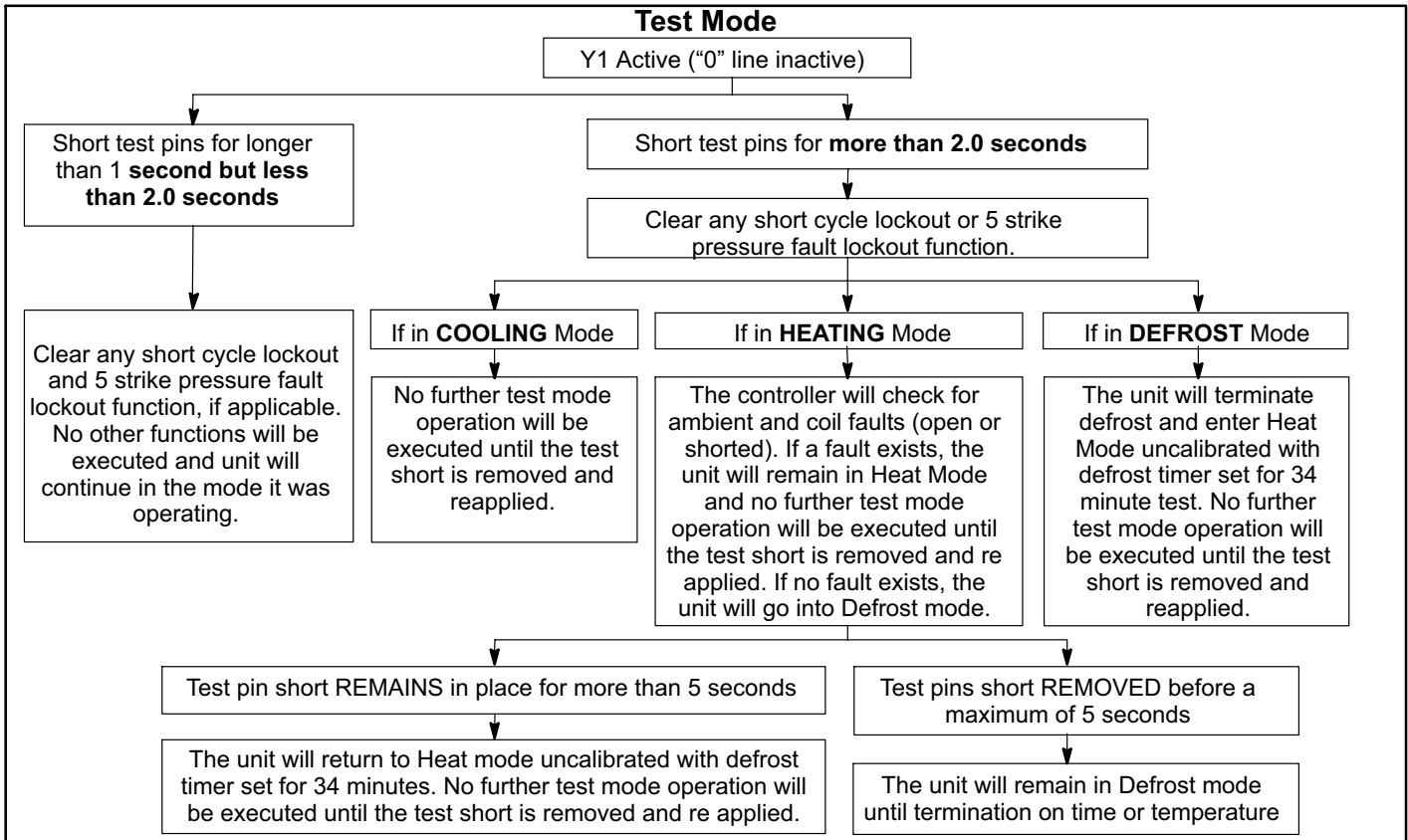
Enter the “TEST” mode by placing a shunt (jumper) across the “TEST” pins on the board **after** power-up. (The “TEST” pins are ignored and the test function is locked out if the shunt is applied on the “TEST” pins before power-up). Board timings are reduced, the low-pressure switch and loss of charge detection fault is ignored and the board will clear any active lockout condition.

**Each test pin shorting will result in one test event.** For each “TEST” the shunt (jumper) must be removed for at least 1 second and reapplied. Refer to flow chart (figure 16) for “TEST” operation.

*Note: The Y1 input must be active (ON) and the “O” room thermostat terminal into board must be inactive.*

### Defrost Board Diagnostics

See table 5 to determine defrost board operational conditions and to diagnose cause and solution to problems.



**FIGURE 16**

**TABLE 5**

| <b>Defrost Control Board Diagnostic LEDs (5-Strike)</b> |                |  |   |  |
|---|----------------|--|---|--|
| <b>DS2 Green</b>  | <b>DS1 Red</b> | <b>Condition</b>                               | <b>Possible Cause(s)</b>  | <b>Solution</b>  |
| OFF   | OFF            | Power problem                                  | No power (24V) to board terminals R & C or board failure.   | <sup>1</sup> Check control transformer power (24V).<br><sup>2</sup> If power is available to board and LED(s) do not light, replace board.   |
| Simultaneous SLOW Flash                                 |                | Normal operation                               | Unit operating normally or in standby mode.   | None required.   |
| Alternating SLOW Flash                                  |                | 5-minute anti-short cycle delay                | Initial power up, safety trip, end of room thermostat demand.   | None required (Jumper TEST pins to override)   |
| OFF   | SLOW Flash     | Low Pressure Fault                             | <sup>1</sup> Restricted air flow over indoor or outdoor coil.   | <sup>1</sup> Remove any blockages or restrictions from coils and/or fans. Check indoor and outdoor fan motor for proper current draws.<br><sup>2</sup> Check system charge using approach & sub-cooling temperatures.<br><sup>3</sup> Check system operating pressures and compare to unit charging charts.<br><sup>4</sup> Make sure all pressure switches and sensors have secure connections to system to prevent refrigerant leaks or errors in pressure and temperature measurements. |
| OFF   | ON             | Low Pressure Lockout (5 strikes)               | <sup>2</sup> Improper refrigerant charge in system.   |  |
| SLOW Flash  | OFF            | High Pressure fault                            | <sup>3</sup> Improper metering device installed or incorrect operation of metering device.  |  |
| ON  | OFF            | High Pressure Lockout (5 strikes)              | <sup>4</sup> Incorrect or improper sensor location or connection to system.   |  |
| SLOW Flash  | ON             | Discharge Line Temperature Fault               | This code detects shorted sensor or high discharge temperatures. If the discharge line temperature exceeds a temperature of 300°F (148°C) during compressor operation, the board will de-energize the compressor contactor output (and the defrost output if active). The compressor will remain off until the discharge temperature has dropped below 225°F (107°C). |  |
| FAST Flash  | ON             | Discharge Line Temperature Lockout (5 strikes) |   |  |
| Simultaneous FAST Flash                                 |                | Ambient Sensor Problem                         | Sensor being detected open or shorted. Board will revert to time/temperature defrost operation. (System will still heat or cool).   |  |
| Alternating FAST Flash                                  |                | Coil Sensor Problem                            | Sensor being detected open or shorted. Board will not perform demand or time/temperature defrost operation. (System will still heat or cool).   |  |
| ON  | ON             | Circuit Board Failure                          | Indicates that board has internal component failure. Cycle 24 volt power to board. If code does not clear, replace board.   |  |
| OFF   | Fast Flash     | Discharge Sensor Fault                         | The board detects open sensor or out of temperature sensor range. This fault is detected by allowing the unit to run for 90 seconds before checking sensor resistance. If the sensor resistance is not within range after 90 seconds, the board will count one fault. After 5 faults, the board will lockout.   |  |
| Fast Flash  | OFF            | Discharge Sensor Lockout (5 strikes)           |   |  |

### M-Start Capacitor (C7) -024 model only

All 2 ton HPXA16 units are equipped with a start capacitor (C7). The capacitor is located in the control box and wired in parallel with the compressor side of the dual capacitor. C7 is de-energized by potential relay K31 when the compressor nears full speed.

### N-Potential Relay (K31) -024 model only

All 2 ton HPXA16 units are equipped with potential relay K31, which controls the operation of the starting circuit. The relay is located inside the control box and is normally closed when contactor K1 is de-energized. When K1 is energized the compressor begins start up. K31 remains closed during start up and capacitor C7 remains in the circuit. When the compressor reaches 75% of its speed, K31 is energized, de-energizing capacitor C7.

### O-High Pressure Switch (S4)

An auto-reset, single-pole/single-throw high pressure switch is located in the liquid line. This switch 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  $590 \pm 10$  psi and close at  $418 \pm 10$  psi. See figure 10 for switch location.

### P-Reversing Valve (L1)

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

## III-REFRIGERANT SYSTEM

Field refrigerant piping consists of liquid and vapor lines from the outdoor unit (sweat connections). Use Lennox L15 series line sets as shown in table 6.

Separate liquid and suction service ports are provided at the service valves for connection of gauge manifold during charging procedure. Figure 17 shows HPXA16 refrigerant flow and gauge manifold connections.

TABLE 6

| Model     | Valve Field Size Connections |                    | Recommended Line Set |                    |   |
|-----------|------------------------------|--------------------|----------------------|--------------------|---|
|           | Liquid Line                  | Vapor Line         | Liquid Line          | Vapor Line         | L15 Line Sets                             |
| -024,-036 | 3/8 in.<br>10 mm             | 7/8 in.<br>22 mm   | 3/8 in.<br>10 mm     | 7/8 in.<br>19 mm   | L15-65<br>15 ft. - 50 ft.<br>4.6 m - 15 m |
| -048      | 3/8 in.<br>10 mm             | 1-1/8 in.<br>29 mm | 3/8 in.<br>10 mm     | 7/8 in.<br>22 mm   | L15-65<br>15 ft. - 50 ft.<br>4.6 m - 15 m |
| -060      | 3/8 in.<br>10 mm             | 1-1/8 in.<br>29 mm | 3/8 in.<br>10 mm     | 1-1/8 in.<br>29 mm | Field Fabricated                          |

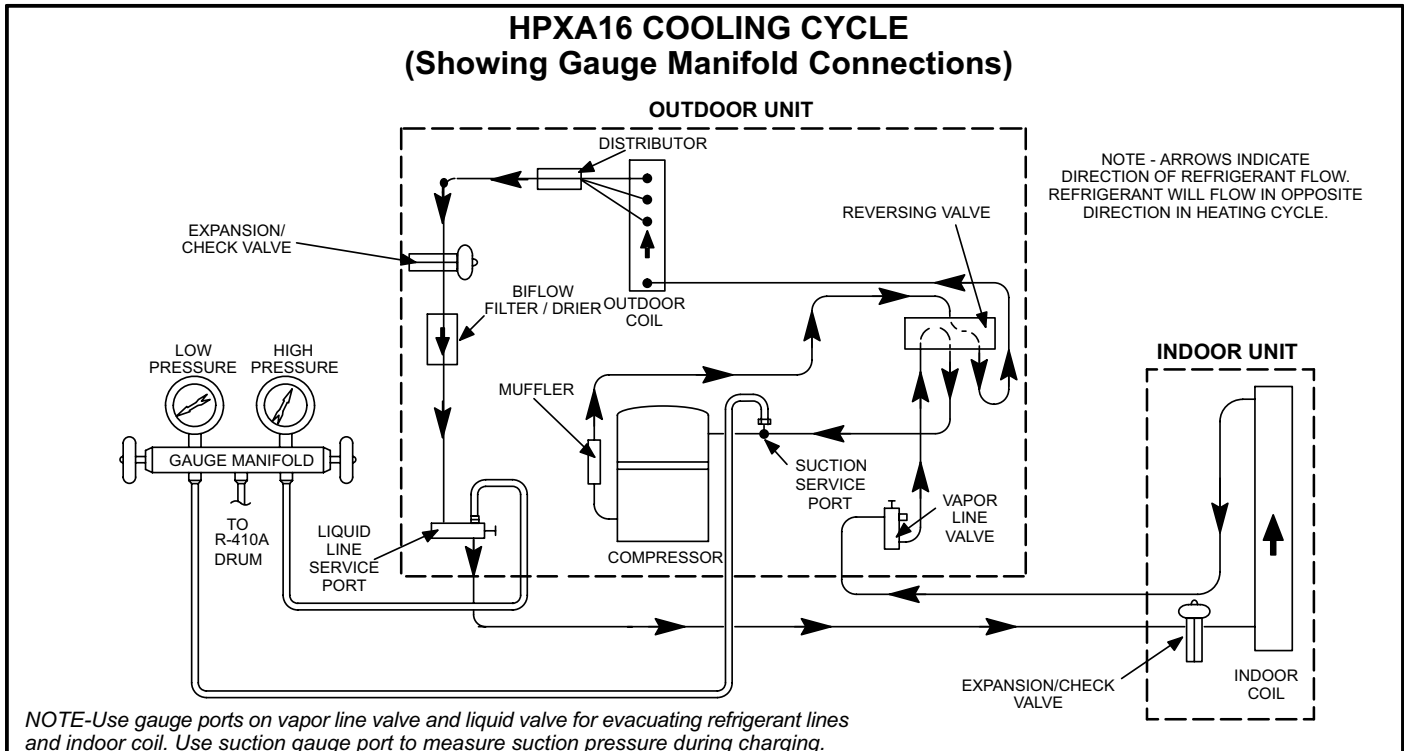


FIGURE 17

## A-Service Valves

### ⚠ IMPORTANT

Only use Allen wrenches of sufficient hardness (50Rc - Rockwell Harness Scale min). Fully insert the wrench into the valve stem recess. Service valve stems are factory torqued (from 9 ft lbs for small valves, to 25 ft lbs for large valves) to prevent refrigerant loss during shipping and handling. Using an Allen wrench rated at less than 50Rc risks rounding or breaking off the wrench, or stripping the valve stem recess.

Access the liquid line and vapor line service valves (figures 18 and 19) and gauge ports are used for leak testing, evacuating, charging and checking charge. See table 7 for torque requirements.

Each valve is equipped with a service port which has a factory-installed Schrader valve. A service port cap protects the Schrader valve from contamination and serves as the primary leak seal.

TABLE 7

| Part                | Recommended Torque |       |
|---------------------|--------------------|-------|
| Service valve cap   | 8 ft.- lb.         | 11 NM |
| Sheet metal screws  | 16 in.- lb.        | 2 NM  |
| Machine screws #10  | 28 in.- lb.        | 3 NM  |
| Compressor bolts    | 90 in.- lb.        | 10 NM |
| Gauge port seal cap | 8 ft.- lb.         | 11 NM |

### ⚠ IMPORTANT

Service valves are closed to the outdoor unit and open to line set connections. Do not open the valves until refrigerant lines have been leak tested and evacuated. All precautions should be exercised to keep the system free from dirt, moisture and air.

#### To Access Schrader Port:

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

#### To Open Service Valve:

- 1 - Remove stem cap with an adjustable wrench.
- 2 - Using service wrench and hex head extension, back the stem out counterclockwise as far as it will go.  
*NOTE - Use a 3/16" hex head extension for liquid line size.*
- 3 - Replace stem cap and tighten it firmly. Tighten finger tight, then tighten an additional 1/6 turn.

#### To Close Service Valve:

- 1 - Remove stem cap with an adjustable wrench.
- 2 - Using service wrench and hex head extension, turn stem clockwise to seat valve. Tighten it firmly.  
*NOTE - Use a 3/16" hex head extension for liquid line size.*
- 3 - Replace stem cap. Tighten finger tight, then tighten an additional 1/6 turn.

#### Vapor Line (Ball Type) Valve

Vapor line service valves function the same way as the other valves, the difference is in the construction. These valves are not rebuildable. If a valve has failed, you must replace it. A ball valve valve is illustrated in figure 19.

The ball valve is equipped with a service port with a factory-installed Schrader valve. A service port cap protects the Schrader valve from contamination and assures a leak-free seal.

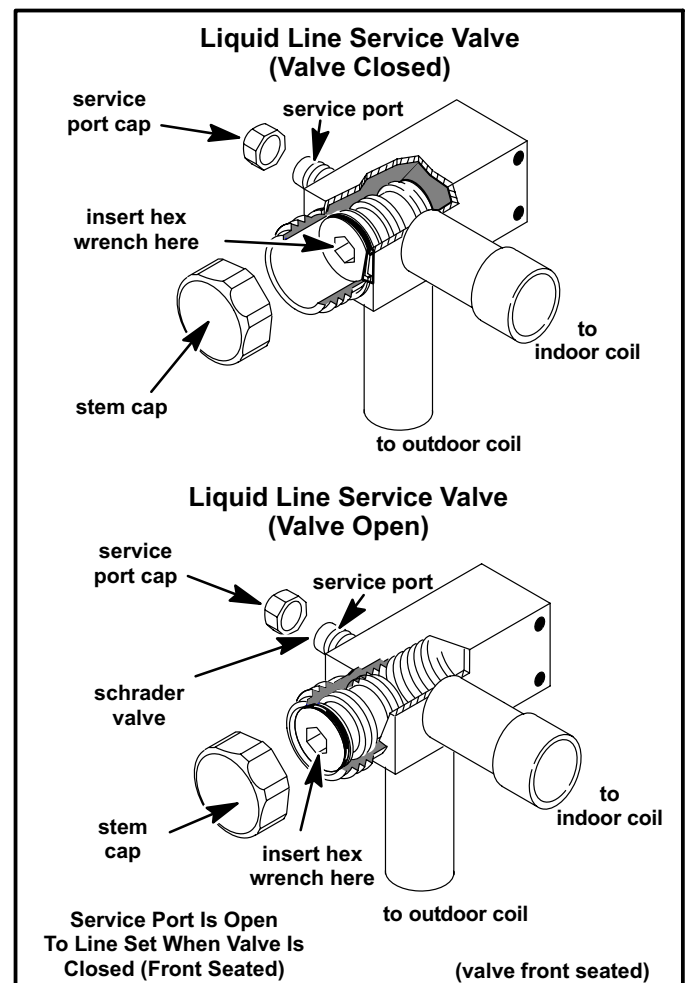
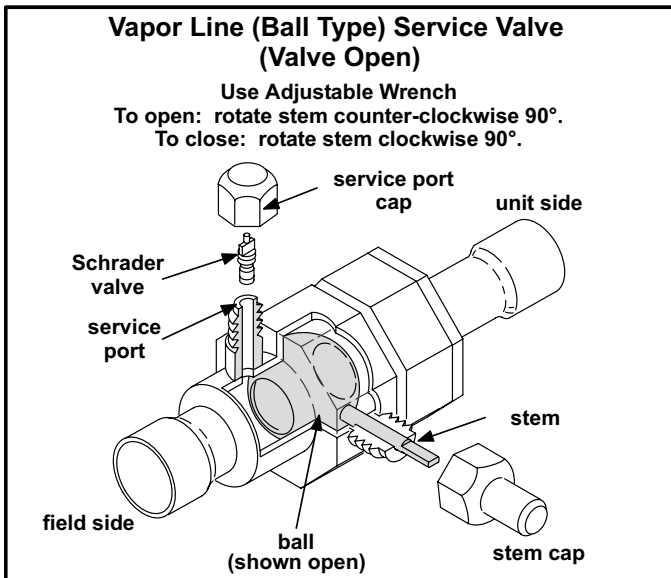


FIGURE 18



**FIGURE 19**

## IV-CHARGING

Units are factory charged with the amount of R-410A refrigerant indicated on the unit rating plate. This charge is based on a matching indoor coil and outdoor coil with 15 ft. (4.6m) line set. For varying lengths of line set, refer to table 8 for refrigerant charge adjustment.

**TABLE 8**

| Liquid Line Set Diameter | Ozs. per 5 ft. (grams per 1.5m) adjust from 15 ft. (4.6m) line set* |
|--------------------------|---|
| 3/8 in. (10mm)           | 3 ounces per 5 feet (85g per 1.5m)                                  |

\*If line length is greater than 15 ft. (4.6m), add this amount. If line length is less than 15 ft. (4.6), subtract this amount.

### A-Leak Testing

After the line set has been connected to the indoor and outdoor units, the line set connections and indoor unit must be checked for leaks.

## ⚠ WARNING

**Refrigerant can be harmful if inhaled. Refrigerant must be used and recovered responsibly. Failure to follow this warning can lead to injury or death.**

## ⚠ WARNING

**Danger of explosion!**

**When using a high pressure gas such as dry nitrogen to pressurize a refrigerant or air conditioning system, use a regulator that can control the pressure down to 1 or 2 psig (6.9 to 13.8 kPa).**

## ⚠ WARNING



**Fire, Explosion and Personal Safety Hazard.**

**Failure to follow this warning could result in damage, personal injury or death.**

**Never use oxygen to pressurize or purge refrigeration lines. Oxygen, when exposed to a spark or open flame, can cause damage by fire and / or an explosion, that can result in personal injury or death.**

### Using an Electronic Leak Detector

- 1 - Connect a cylinder of R-410A to the center port of the manifold gauge set.
- 2 - With both manifold valves closed, open the valve on the R-410A cylinder (vapor only).
- 3 - Open the high pressure side of the manifold to allow the R-410A into the line set and indoor unit. Weigh in a trace amount of R-410A . [A trace amount is a maximum of 2 ounces (57 g) or 3 pounds (31 kPa) pressure.] Close the valve on the R-410A cylinder and the valve on the high pressure side of the manifold gauge set. Disconnect the R-410A cylinder.
- 4 - Connect a cylinder of nitrogen with a pressure regulating valve to the center port of the manifold gauge set.
- 5 - Connect the manifold gauge set high pressure hose to the vapor valve service port. (Normally, the high pressure hose is connected to the liquid line port; however, connecting it to the vapor port better protects the manifold gauge set from high pressure damage.)
- 6 - Adjust the nitrogen pressure to 150 psig (1034 kPa). Open the valve on the high side of the manifold gauge set which will pressurize line set and indoor unit.
- 7 - After a few minutes, open a refrigerant port to ensure the refrigerant you added is adequate to be detected. (Amounts of refrigerant will vary with line lengths.) Check all joints for leaks. Purge nitrogen and R-410A mixture. Correct any leaks and recheck.

## ⚠ IMPORTANT

**Leak detector must be capable of sensing HFC refrigerant.**

### B-Evacuating

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



## ⚠ IMPORTANT

**Use a thermocouple or thermistor electronic vacuum gauge that is calibrated in microns. Use an instrument that reads from 50 microns to at least 23,000 microns.**

- 1 - Connect the manifold gauge set to the service valve ports as follows:
  - low pressure gauge to *vapor* line service valve
  - high pressure gauge to *liquid* line service valve
- 2 - Connect micron gauge.
- 3 - Connect the vacuum pump (with vacuum gauge) to the center port of the manifold gauge set.
- 4 - Open both manifold valves and start vacuum pump.
- 5 - Evacuate the line set and indoor unit to an **absolute pressure** of 23,000 microns (29.01 inches of mercury). During the early stages of evacuation, it is desirable to close the manifold gauge valve at least once to determine if there is a rapid rise in **absolute pressure**. A rapid rise in pressure indicates a relatively large leak. If this occurs, repeat the leak testing procedure.

*NOTE - The term absolute pressure means the total actual pressure within a given volume or system, above the absolute zero of pressure. Absolute pressure in a vacuum is equal to atmospheric pressure minus vacuum pressure.*
- 6 - When the absolute pressure reaches 23,000 microns (29.01 inches of mercury), close the manifold gauge valves, turn off the vacuum pump and disconnect the manifold gauge center port hose from vacuum pump. Attach the manifold center port hose to a nitrogen cylinder with pressure regulator set to 150 psig (1034 kPa) and purge the hose. Open the manifold gauge valves to break the vacuum in the line set and indoor unit. Close the manifold gauge valves.

## ⚠ WARNING

**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.**

- 7 - Shut off the nitrogen cylinder and remove the manifold gauge hose from the cylinder. Open the manifold gauge valves to release the nitrogen from the line set and indoor unit.
- 8 - Reconnect the manifold gauge to the vacuum pump, turn the pump on, and continue to evacuate the line set and indoor unit until the absolute pressure does not rise above 500 microns (29.9 inches of mercury) within a 20-minute period after shutting off the vacuum pump and closing the manifold gauge valves.

- 9 - When the absolute pressure requirement above has been met, disconnect the manifold hose from the vacuum pump and connect it to an upright cylinder of R-410A refrigerant. Open the manifold gauge valves to break the vacuum from 1 to 2 psig positive pressure in the line set and indoor unit. Close manifold gauge valves and shut off the R-410A cylinder and remove the manifold gauge set.

### C-Charging

This system is charged with R-410A refrigerant which operates at much higher pressures than R22. The check/expansion valve provided with the unit is approved for use with R-410A. Do not replace it with a valve designed for use with R22. This unit is NOT approved for use with coils which include metering orifices or capillary tubes.

#### Processing Procedure

The unit is factory-charged with the amount of R-410A refrigerant indicated on the unit rating plate. This charge is based on a matching indoor coil and outdoor coil with a 15 foot (4.6m) line set. For varying lengths of line set, refer to table 8 for refrigerant charge adjustment. .

## ⚠ IMPORTANT

**Mineral oils are not compatible with R-410A. If oil must be added, it must be a polyol ester oil.**

It is desirable to charge the system in the cooling cycle if weather conditions permit. However, if the unit must be charged in the heating season, one of the following procedures must be followed to ensure proper system charge.

#### Weighing in the Charge TXV Systems – Outdoor Temp. < 65°F (18°C)

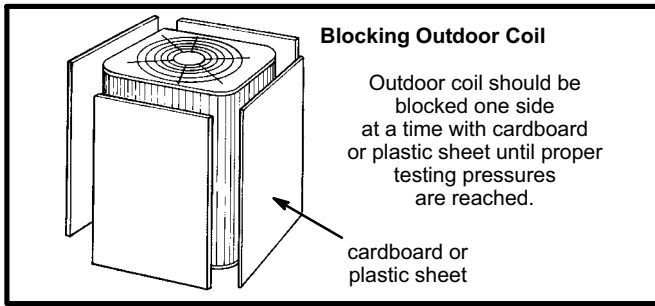
If the system is void of refrigerant, or if the outdoor ambient temperature is cool, the refrigerant charge should be weighed into the unit. Do this after any leaks have been repaired.

- 1 - Recover the refrigerant from the unit.
- 2 - Conduct a leak check, then evacuate as previously outlined.
- 3 - Weigh in the unit nameplate charge.

If weighing facilities are not available or if you are charging the unit during warm weather, follow one of the other procedures outlined below.

#### Subcooling Method Outdoor Temp. < 65°F (18°C)

When the outdoor ambient temperature is below 65°F (18°C), use the subcooling method to charge the unit. It may be necessary to restrict the air flow through the outdoor coil to achieve pressures in the 325-375 psig (2240-2585 kPa) range. These higher pressures are necessary for checking the charge. Block equal sections of air intake panels and move obstructions sideways until the liquid pressure is in the 325-375 psig (2240-2585 kPa) range. Figure 20 shows a four sided unit for example..



**FIGURE 20**

- 1 - With the manifold gauge hose still on the liquid service port and the unit operating stably, use a digital thermometer to record the liquid line temperature.
- 2 - At the same time, record the liquid line pressure reading.
- 3 - Use a temperature/pressure chart for R-410A to determine the saturation temperature for the liquid line pressure reading. See table 13.
- 4 - Subtract the liquid line temperature from the saturation temperature (according to the chart) to determine subcooling. **(Saturation temperature - Liquid line temperature = Subcooling)**
- 5 - Compare the subcooling value with those in table 9. If subcooling is greater than shown, recover some refrigerant. If subcooling is less than shown, add some refrigerant. Be aware of the R-410A refrigerant cylinder. It will be light maroon-colored. Refrigerant should be added through the vapor line valve in the liquid state. **Some R-410A cylinders are equipped with a dip tube that allows you to draw liquid refrigerant from the bottom of the cylinder without turning the cylinder upside-down. The cylinder will be marked if it is equipped with a dip tube.**

**TABLE 9**  
**2nd stage High Capacity**

| Model Number | Subcooling Values<br>Conversion Temp. - Liquid Line Temp. °F (°C) |
|--------------|---|
| HPXA16-024   | 11.0 ± 1 (6 ± .5)   |
| HPXA16-036   | 8.5 ± 1 (4.7 ± .5)  |
| HPXA16-048   | 7.5 ± 1 (4.1 ± .5)  |
| HPXA16-060   | 7.0 ± 1 (3.9 ± .5)  |

## Charging Using Normal Operating Pressures and the Approach Method

### Outdoor Temp. ≥ 65°F (18°C)

The following procedure is intended as a general guide and is for use on expansion valve systems only. For best results, indoor temperature should be 70°F (21°C) to 80°F (26°C). Monitor system pressures while charging.

- 1 - Record outdoor ambient temperature using a digital thermometer.
- 2 - Attach high pressure gauge set and operate unit for several minutes to allow system pressures to stabilize.
- 3 - Compare stabilized pressures with those provided in tables 11 and 12, "Normal Operating Pressures." Minor variations in these pressures may be expected due to differences in installations. Significant differences could mean that the system is not properly charged or that a problem exists with some component in the system. Pressures higher than those listed indicate that the system is overcharged. Pressures lower than those listed indicate that the system is undercharged. Verify adjusted charge using the approach method.

#### Approach Method

- 4 - Use the same digital thermometer used to check outdoor ambient temperature to check liquid line temperature. Verify the unit charge using the approach method.
- 5 - The difference between the ambient and liquid temperatures should match values given in table 10. If the values don't agree with the those in table 10, add refrigerant to lower the approach temperature or recover refrigerant from the system to increase the approach temperature.

**TABLE 10**  
**2nd Stage High Capacity**

| Model Number | Approach Temperature<br>Liquid Line Temp. - Outdoor Ambient °F (°C) |
|--------------|---|
| HPXA16-024   | 4.0 ± 1 (2.2 ± .5)  |
| HPXA16-036   | 7.0 ± 1 (3.9 ± .5)  |
| HPXA16-048   | 8.0 ± 1 (4.4 ± .5)  |
| HPXA16-060   | 10.0 ± 1 (5.6 ± .5)   |

## ⚠ IMPORTANT

Use table 11 and table 12 as a general guide when performing maintenance checks. This is not a procedure for charging the unit (Refer to Charging/Checking Charge section). Minor variations in these pressures may be expected due to differences in installations. Significant differences could mean that the system is not properly charged or that a problem exists with some component in the system.

**TABLE 11**  
**NORMAL OPERATING PRESSURES**  
**COOLING OPERATION**  
(Liquid ±10 and Vapor ±5 psig)

| <b>First Stage (Low Capacity)</b>                      |                   |              |                   |              |                   |              |                   |              |
|--|-------------------|--------------|-------------------|--------------|-------------------|--------------|-------------------|--------------|
| <b>Outdoor Coil<br/>Entering Air<br/>Temp. °F (°C)</b> | <b>HPXA16-024</b> |              | <b>HPXA16-036</b> |              | <b>HPXA16-048</b> |              | <b>HPXA16-060</b> |              |
|  | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> |
| 65 (18.3)  | 217               | 143          | 227               | 142          | 222               | 140          | 225               | 140          |
| 75 (23.9)  | 250               | 145          | 262               | 145          | 258               | 143          | 259               | 142          |
| 85 (29.4)  | 291               | 147          | 305               | 146          | 298               | 145          | 293               | 146          |
| 95 (35.0)  | 336               | 149          | 352               | 148          | 343               | 147          | 356               | 147          |
| 105 (40.6)   | 386               | 151          | 403               | 152          | 402               | 147          | 408               | 147          |
| 115 (49.0)   | 440               | 153          | 458               | 155          | 452               | 152          | 455               | 151          |
| <b>Second Stage (High Capacity)</b>                    |                   |              |                   |              |                   |              |                   |              |
| <b>Outdoor Coil<br/>Entering Air<br/>Temp. °F (°C)</b> | <b>HPXA16-024</b> |              | <b>HPXA16-036</b> |              | <b>HPXA16-048</b> |              | <b>HPXA16-060</b> |              |
|  | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> |
| 65 (18.3)  | 222               | 143          | 244               | 136          | 232               | 134          | 249               | 126          |
| 75 (23.9)  | 256               | 145          | 282               | 139          | 266               | 136          | 289               | 134          |
| 85 (29.4)  | 302               | 145          | 325               | 142          | 309               | 139          | 330               | 140          |
| 95 (35.0)  | 349               | 147          | 377               | 144          | 359               | 142          | 378               | 143          |
| 105 (40.6)   | 403               | 149          | 428               | 146          | 410               | 144          | 433               | 146          |
| 115 (49.0)   | 464               | 152          | 488               | 148          | 468               | 147          | 492               | 149          |

**TABLE 12**  
**NORMAL OPERATING PRESSURES**  
**HEATING OPERATION**  
(Liquid ±10 and Vapor ±5 psig)

| <b>First Stage (Low Capacity)</b>                      |                   |              |                   |              |                   |              |                   |              |
|--|-------------------|--------------|-------------------|--------------|-------------------|--------------|-------------------|--------------|
| <b>Outdoor Coil<br/>Entering Air<br/>Temp. °F (°C)</b> | <b>HPXA16-024</b> |              | <b>HPXA16-036</b> |              | <b>HPXA16-048</b> |              | <b>HPXA16-060</b> |              |
|  | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> |
| 40 (4.4)   | 321               | 99           | 296               | 95           | 315               | 97           | 319               | 93           |
| 50 (10)  | 340               | 120          | 310               | 112          | 330               | 114          | 335               | 111          |
| <b>Second Stage (High Capacity)</b>                    |                   |              |                   |              |                   |              |                   |              |
| <b>Outdoor Coil<br/>Entering Air<br/>Temp. °F (°C)</b> | <b>HPXA16-024</b> |              | <b>HPXA16-036</b> |              | <b>HPXA16-048</b> |              | <b>HPXA16-060</b> |              |
|  | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> | <b>Liquid</b>     | <b>Vapor</b> |
| 20 (-7.0)  | 273               | 68           | 277               | 60           | 294               | 60           | 300               | 57           |
| 30 (-1.0)  | 296               | 80           | 296               | 74           | 303               | 75           | 312               | 70           |
| 40 (4.4)   | 321               | 95           | 321               | 88           | 314               | 90           | 323               | 83           |
| 50 (10)  | 341               | 115          | 341               | 104          | 325               | 106          | 339               | 97           |

**Table 13  
R-410A Temperature/Pressure Chart**

| Temperature °F | Pressure Psig | Temperature °F | Pressure Psig | Temperature °F | Pressure Psig | Temperature °F | Pressure Psig |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 32             | 100.8         | 63             | 178.5         | 94             | 290.8         | 125            | 445.9         |
| 33             | 102.9         | 64             | 181.6         | 95             | 295.1         | 126            | 451.8         |
| 34             | 105.0         | 65             | 184.3         | 96             | 299.4         | 127            | 457.6         |
| 35             | 107.1         | 66             | 187.7         | 97             | 303.8         | 128            | 463.5         |
| 36             | 109.2         | 67             | 190.9         | 98             | 308.2         | 129            | 469.5         |
| 37             | 111.4         | 68             | 194.1         | 99             | 312.7         | 130            | 475.6         |
| 38             | 113.6         | 69             | 197.3         | 100            | 317.2         | 131            | 481.6         |
| 39             | 115.8         | 70             | 200.6         | 101            | 321.8         | 132            | 487.8         |
| 40             | 118.0         | 71             | 203.9         | 102            | 326.4         | 133            | 494.0         |
| 41             | 120.3         | 72             | 207.2         | 103            | 331.0         | 134            | 500.2         |
| 42             | 122.6         | 73             | 210.6         | 104            | 335.7         | 135            | 506.5         |
| 43             | 125.0         | 74             | 214.0         | 105            | 340.5         | 136            | 512.9         |
| 44             | 127.3         | 75             | 217.4         | 106            | 345.3         | 137            | 519.3         |
| 45             | 129.7         | 76             | 220.9         | 107            | 350.1         | 138            | 525.8         |
| 46             | 132.2         | 77             | 224.4         | 108            | 355.0         | 139            | 532.4         |
| 47             | 134.6         | 78             | 228.0         | 109            | 360.0         | 140            | 539.0         |
| 48             | 137.1         | 79             | 231.6         | 110            | 365.0         | 141            | 545.6         |
| 49             | 139.6         | 80             | 235.3         | 111            | 370.0         | 142            | 552.3         |
| 50             | 142.2         | 81             | 239.0         | 112            | 375.1         | 143            | 559.1         |
| 51             | 144.8         | 82             | 242.7         | 113            | 380.2         | 144            | 565.9         |
| 52             | 147.4         | 83             | 246.5         | 114            | 385.4         | 145            | 572.8         |
| 53             | 150.1         | 84             | 250.3         | 115            | 390.7         | 146            | 579.8         |
| 54             | 152.8         | 85             | 254.1         | 116            | 396.0         | 147            | 586.8         |
| 55             | 155.5         | 86             | 258.0         | 117            | 401.3         | 148            | 593.8         |
| 56             | 158.2         | 87             | 262.0         | 118            | 406.7         | 149            | 601.0         |
| 57             | 161.0         | 88             | 266.0         | 119            | 412.2         | 150            | 608.1         |
| 58             | 163.9         | 89             | 270.0         | 120            | 417.7         | 151            | 615.4         |
| 59             | 166.7         | 90             | 274.1         | 121            | 423.2         | 152            | 622.7         |
| 60             | 169.6         | 91             | 278.2         | 122            | 428.8         | 153            | 630.1         |
| 61             | 172.6         | 92             | 282.3         | 123            | 434.5         | 154            | 637.5         |
| 62             | 195.5         | 93             | 286.5         | 124            | 440.2         | 155            | 645.0         |

## V-SERVICE AND RECOVERY

### **⚠ WARNING**

Polyol ester (POE) oils used with R-410A refrigerant absorb moisture very quickly. It is very important that the refrigerant system be kept closed as much as possible. **DO NOT** remove line set caps or service valve stub caps until you are ready to make connections.

### **⚠ IMPORTANT**

**Use recovery machine rated for R410 refrigerant.**

If the HPXA16 system must be opened for any kind of service, such as compressor or filter drier replacement, you must take extra precautions to prevent moisture from entering the system. The following steps will help to minimize the amount of moisture that enters the system during recovery of R-410A.

- 1 - Use a regulator-equipped nitrogen cylinder to break the system vacuum. Do not exceed 5 psi. The dry nitrogen will fill the system, and will help purge any moisture.
- 2 - Remove the faulty component and quickly seal the system (using tape or some other means) to prevent additional moisture from entering the system.
- 3 - Do not remove the tape until you are ready to install new component. Quickly install the replacement component.
- 4 - Evacuate the system to remove any moisture and other non-condensables.

*The HPXA16 system MUST be checked for moisture any time the sealed system is opened.*

Any moisture not absorbed by the polyol ester oil can be removed by triple evacuation. Moisture that has been absorbed by the compressor oil can be removed by replacing the filter drier.

### **⚠ IMPORTANT**

**Evacuation of system only will not remove moisture from oil. Filter drier must be replaced to eliminate moisture from POE oil.**

## VI-MAINTENANCE

### **⚠ WARNING**



**Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit OFF at disconnect switch(es). Unit may have multiple power supplies.**

Maintenance and service must be performed by a qualified installer or service agency. At the beginning of each cooling or heating season, the system should be checked as follows:

#### **Outdoor Unit**

- 1 - Clean and inspect outdoor coil (may be flushed with a water hose). Ensure power is off before cleaning.
- 2 - Outdoor unit fan motor is prelubricated and sealed. No further lubrication is needed.
- 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 outdoor fan motor and compressor (high and low capacity).
- 7 - Inspect drain holes in coil compartment base and clean if necessary.

*NOTE - If owner complains of insufficient cooling, the unit should be gauged and refrigerant charge checked. Refer to section on refrigerant charging in this instruction.*

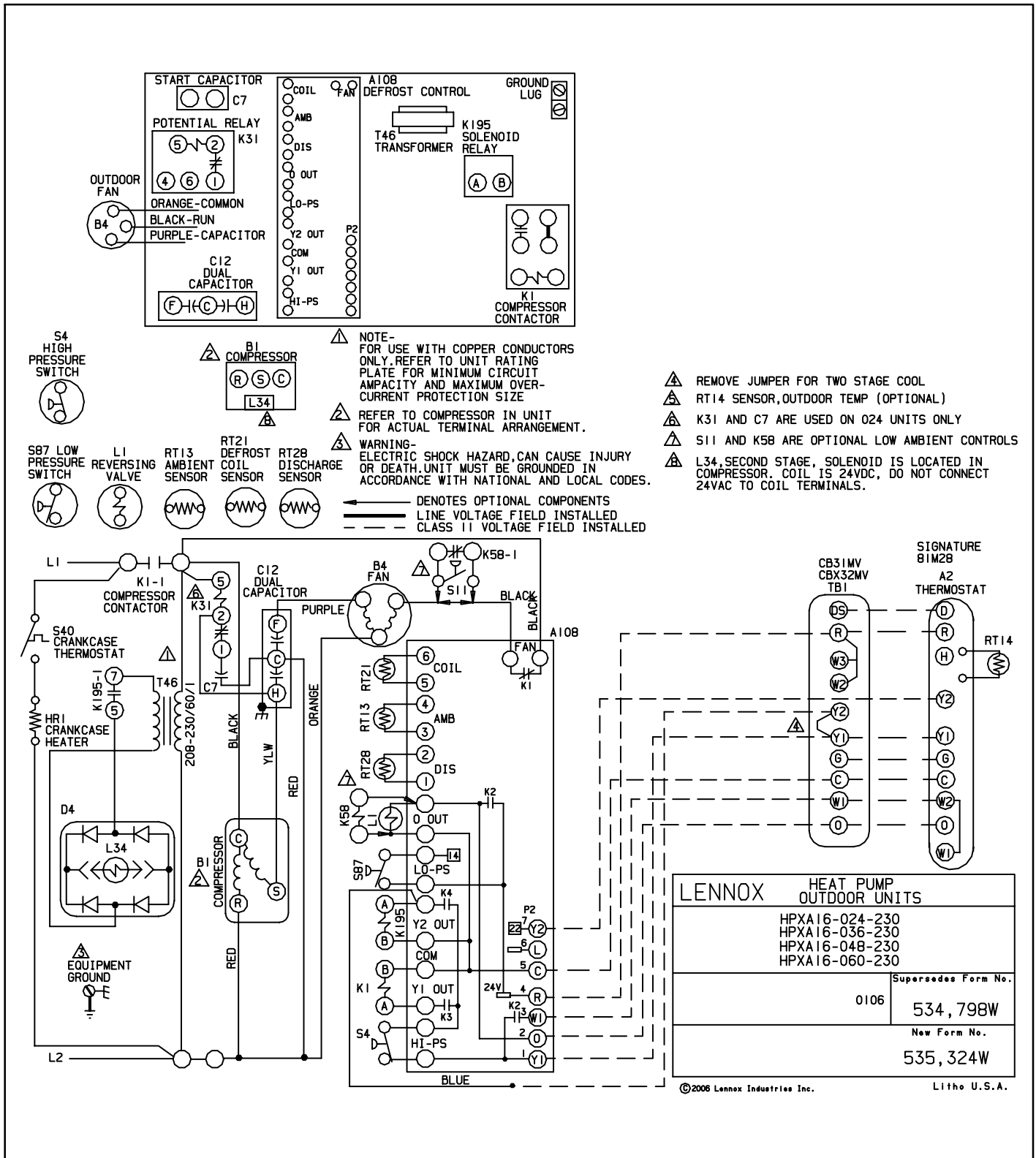
#### **Indoor Coil**

- 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.

#### **Indoor Unit**

- 1 - Clean or change filters.
- 2 - Lennox blower motors are prelubricated and permanently sealed. No more lubrication is needed.
- 3 - Adjust blower speed for cooling. Measure the pressure drop over the coil to determine the correct blower CFM. Refer to the unit information service manual for pressure drop tables and procedure.
- 4 - *Belt Drive Blowers* - Check belt for wear and proper tension.
- 5 - Check all wiring for loose connections.
- 6 - Check for correct voltage at unit.
- 7 - Check amp-draw on blower motor.

# VII-DIAGRAM / OPERATING SEQUENCE



## Sequence of Operation HPXA16-024/060

### First Stage Cool (low capacity)

Transformer from indoor unit supplies 24VAC power to the thermostat and outdoor unit controls.

- 1- Internal wiring energizes terminal O by cooling mode selection, energizing the reversing valve. Cooling demand initiates at Y1 in the thermostat.
- 2- 24VAC passes through high pressure switch S4 and discharge thermostat switch S5 energizing compressor contactor K1.  
*HPXA16-024* - Compressor begins start up. Relay K31 remains closed during start up and capacitor C7 remains in the circuit. As compressor speeds up K31 is energized, de-energizing capacitor C7.
- 3- K1-1 N.O. closes energizing compressor B1 and outdoor fan motor B4. Transformer T46 is also energized.
- 4- Solenoid L34 is NOT energized. The slider ring remains open limiting compressor to low capacity.

### Second Stage Cool (high capacity)

- 5- Second stage thermostat demand energizes solenoid relay K195. K195-1 closes sending voltage to rectifier plug D4. D4 converts the AC voltage to DC voltage and energizes L34 unloader solenoid. L34 then closes the slider ring, allowing the compressor to operate at high capacity.

## Heating

### A – Low Capacity

- 1- Room thermostat in heating mode. Room thermostat outputs Y1 signal to the defrost board in the heat pump and to the indoor air handler.
- 2- The defrost board checks for open low or high-pressure switches and proper coil, ambient and discharge sensor readings. If checks show no issues, the defrost board sends 24 volts through Y1 OUT signal to the K1 compressor contactor coil.
- 3- K1-1 closes, energizing the compressor and outdoor fan motor through the normally closed fan relay contacts on the defrost board.
- 4- The compressor will run on low capacity along with the single speed outdoor fan motor.

### B – High Capacity (Ambient temperature above defrost board Y2 lock-in temperature)

- 1- Room thermostat in heating mode. Room thermostat outputs Y1 and Y2 (if applicable to that room thermostat) signal to the defrost board in the heat pump and to the indoor unit.
- 2- The defrost board checks for open low or high-pressure switches and proper coil, ambient and discharge sensor readings. If checks show no issues, the defrost board sends 24 volts through Y1 OUT signal to the K1 compressor contactor coil.

- 3- The defrost board sends 24 volts through Y2 OUT to the L34 compressor solenoid plug. The 2- wire compressor solenoid plug converts the 24volt AC outputs to a 24volt DC signal input to the L34 internal high capacity solenoid valve in the compressor.
- 4- K1-1 closes, energizing the compressor and outdoor fan motor through the normally closed fan relay contacts on the defrost board. The compressor runs high capacity.

### B – High Capacity (Ambient temperature below defrost board Y2 lock-in temperature)

- 1- Room thermostat in heating mode. Room thermostat outputs Y1 signal to the defrost board in the heat pump and to the indoor unit.
- 2- The defrost board checks for open low or high-pressure switches and proper coil, ambient and discharge sensor readings. If checks show no issues, the defrost board sends 24 volts through Y1 OUT signal to the K1 compressor contactor coil.
- 3- The defrost board Y2 locks in sends 24 volts through Y2 OUT to the L34 compressor solenoid plug. The plug converts the 24volt AC outputs to a 24volt DC signal input to the L34 internal high capacity solenoid valve in the compressor.
- 4- K1-1 closes, energizing the compressor and outdoor fan motor through the normally closed fan relay contacts on the defrost board. The compressor runs on high capacity.

## Defrost Mode

When a defrost cycle is initiated, the control energizes the reversing valve solenoid and turns off the condenser fan. The control will also put 24VAC on the “W1” (auxiliary heat) line. The unit will stay in this mode until either the coil sensor temperature is above the selected termination temperature, the defrost time of 14 minutes has been completed, or the room thermostat demand cycle has been satisfied. (If the temperature select shunt is not installed, the default termination temperature will be 90°F.) If the room thermostat demand cycle terminates the cycle, the defrost cycle will be held until the next room thermostat demand cycle. If the coil sensor temperature is still below the selected termination temperature, the control will continue the defrost cycle until the cycle is terminated in one of the methods mentioned above. If a defrost is terminated by time and the coil temperature did not remain above 35°F (2°C) for 4 minutes the control will go to the 34-minute Time/Temperature mode.