Corp. 0412-L3
Revised 07-2006

SPA
3, 4 and 5 ton
(10.5, 14 and 17.6 kW)

SPA COMMERCIAL HEAT PUMP

The SPA is a high efficiency commercial split-system heat pump which features a two-stage scroll compressor and R410A refrigerant. SPA units are available in 3, 4 and 5 ton sizes. The series is designed for use with an expansion valve only (approved for use with R410A) 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 R410A unit are higher than pressures in R22 units. Always use service equipment rated for R410A.

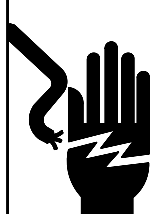
⚠ WARNING

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 my be levied for noncompliance.

⚠ DANGER



Shock Hazard

Remove all power at disconnect before removing access panel.
SPA 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	Nominal Tonnage / Model No.	3 / SPA036H4	4 / SPA048H4	5 / SPA060H4
[1] Cooling Performance	Net Cooling Capacity - Btuh (kW)	36,000 (10.6)	48,000 (14.1)	59,000 (17.3)
	Net Heating Capacity - Btuh (kW)	33,000 (9.7)	44,500 (13.0)	54,000 (15.8)
	Total Cooling Watts	3135	4175	5290
	SEER	17.0	16.0	15.0
	EER	12.40	11.90	11.35
	HSPF Region IV (V)	9.0 (7.6)	8.5 (7.2)	8.35 (7.25)
	[2] Sound Rating Number (dB)	72	75	76
Refrigerant	[3] R-410A furnished	11 lbs. 0 oz. (5.00 kg)	12 lbs. 14 oz. (5.84 kg)	14 lbs. 6 oz. (6.52 kg)
Compressor Type (No.)		Copeland Scroll Ultra Tech™ Two-Stage Compressor (1)	Copeland Scroll Ultra Tech™ Two-Stage Compressor (1)	Copeland Scroll Ultra Tech™ Two-Stage Compressor (1)
Connections (sweat)	Liquid line o.d. - in. (mm)	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)	1-1/8 (28.5)
Outdoor Coil	Net face area sq. ft. (m^2) - Outer Coil	16.04 (1.49)	24.06 (2.24)	24.06 (2.24)
	Inner Coil	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)
	Number of rows	2	2	2
	Fins per inch (m)	22	22	22
Outdoor Fan	Diameter in. (mm) and no. of blades	24 (610) - 3	24 (610) - 4	24 (610) - 4
	Motor hp (W)	1/10 (74.8)	1/4 (187)	1/4 (187)
	Cfm (L/s)	3159 (1485)	3900 (1840)	4200 (1980)
	Rpm	825	820	820
	Watts	170	300	350

1 Certified in accordance with USE certification program which is based on ARI Standard 210/240 with 25 ft. (7.6 m) of connecting refrigerant lines.
2 Sound Rating Number rated in accordance with test conditions included in ARI Standard 270.
3 Refrigerant charge sufficient for 15 ft. (4.6 m) length of refrigerant lines.

Electrical Data

	Model No.	SPA036H4	SPA048H4	SPA060H4
Electrical Data	Line voltage data - 60hz	208/230V-3ph	208/230V-3ph	208/230V-3ph
	[1] Maximum overcurrent protection (amps)	25	30	40
	[2] Minimum circuit ampacity	14.7	18.6	23.7
Compressor	Rated load amps	11.2	13.5	17.6
	Locked rotor amps	58	88	123
	Power factor	0.98	0.99	0.99
Outdoor Coil Fan Motor	Full load amps	0.7	1.7	1.7
	Locked rotor amps	2	3.1	3.1

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

Field Installed Accessories

		Model No.	SPA036H4	SPA048H4	SPA060H4
Compressor Low Ambient Cut-Off			**45F08**	**45F08**	**45F08**
Freezestat		3/8 in. tubing	**93G35**	**93G35**	**93G35**
		1/2 in. tubing	**39H29**	**39H29**	**39H29**
		5/8 in. tubing	**50A93**	**50A93**	**50A93**
Hail Guards			**79M17**	**79M17**	**79M18**
Indoor Blower Speed Relay Kit			**40K58**	**40K58**	**40K58**
[1] **Low Ambient Kits**		to 30°F (-1°C)	**34M72**	**34M72**	**34M72**
	[2] to 0°F (-18°C)	Controller	**43N88**	**43N88**	**43N88**
		Relay	**37H96**	**37H96**	**37H96**
		Condenser Fan Motor - 208/230V	**69H73**	**69H73**	**69H73**
		460V	**69H74**	**69H74**	**69H74**
		Run Capacitor	**53H32**	**53H32**	**53H32**
Mild Weather Kit			**33M07**	**33M07**	**33M07**
Monitor Kit - Service Light			**76F53**	**76F53**	**76F53**
Mounting Base		Catalog No. (Model No.)	**69J07** (MB2-L)	**69J07** (MB2-L)	**69J07** (MB2-L)
		Net Weight	15 lbs. (7 kg)	15 lbs. (7 kg)	15 lbs. (7 kg)
		Dimensions - in. (mm)	32 x 34 x 3 (813 x 864 x 76)	32 x 34 x 3 (813 x 864 x 76)	32 x 34 x 3 (813 x 864 x 76)
Outdoor Thermostat Kit		Thermostat Kit	**56A87**	**56A87**	**56A87**
		Mounting Box - U.S.	**31461**	**31461**	**31461**
		Canada	**33A09**	**33A09**	**33A09**
Refrigerant Line Set		15 ft. (4.6 m) length	L15-65-15	L15-65-15	Field Fabricate
		30 ft. (9 m) length	L15-65-30	L15-65-30	Field Fabricate
		40 ft. (12 m) length	L15-65-40	L15-65-40	Field Fabricate
		50 ft. (15 m) length	L15-65-50	L15-65-50	Field Fabricate
Time Delay Relay Kit			**58M81**	**58M81**	**58M81**

[1] 3/8 in. Freezestat must be ordered separately.
[2] Relay is required for proper operation (order separately). Condenser fan motor and capacitor must be replaced (order separately).

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)

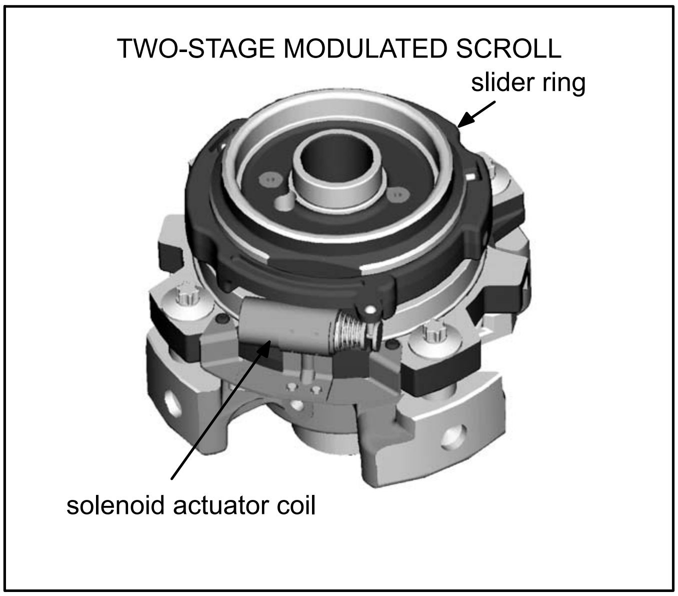


FIGURE 1

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.

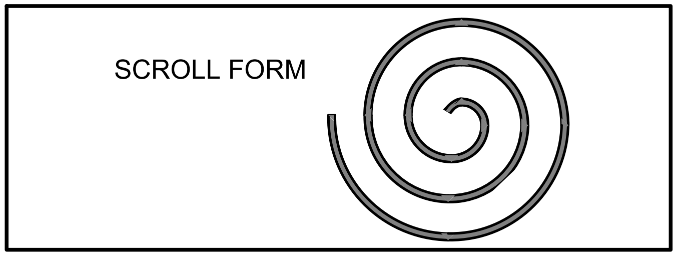


FIGURE 2

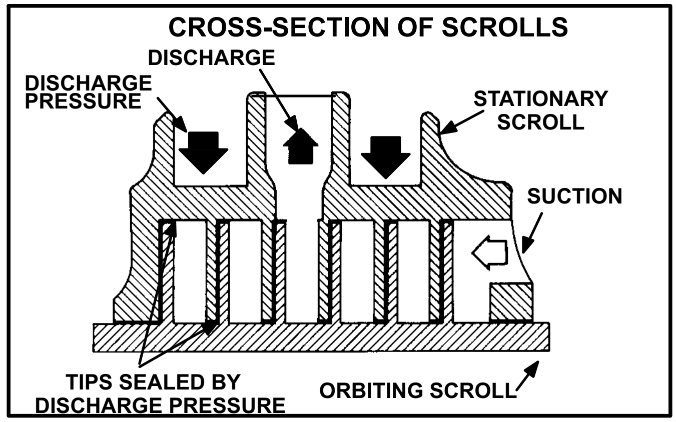


FIGURE 3

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 (figure1). 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 fusite 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 SPA model units are designed for use with R410A 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.

Three-Phase Compressor Rotation

Three-phase scroll compressors must be phased sequentially to ensure correct compressor rotation and operation. At compressor start-up, a rise in discharge and drop in vapor pressures indicate proper compressor phasing and operation. If discharge and vapors pressures do not perform normally, follow the steps below to correctly phase in the unit.

1 - Disconnect power to the unit.

2 - Reverse any two field power leads to the unit.

3 - Reapply power to the unit.

Discharge and vapor pressures should operate at their normal start-up ranges.

NOTE - Compressor noise level will be significantly higher when phasing is incorrect and the unit will not provide cooling when compressor is operating backwards. Continued backward operation will cause the compressor to cycle on internal protector.

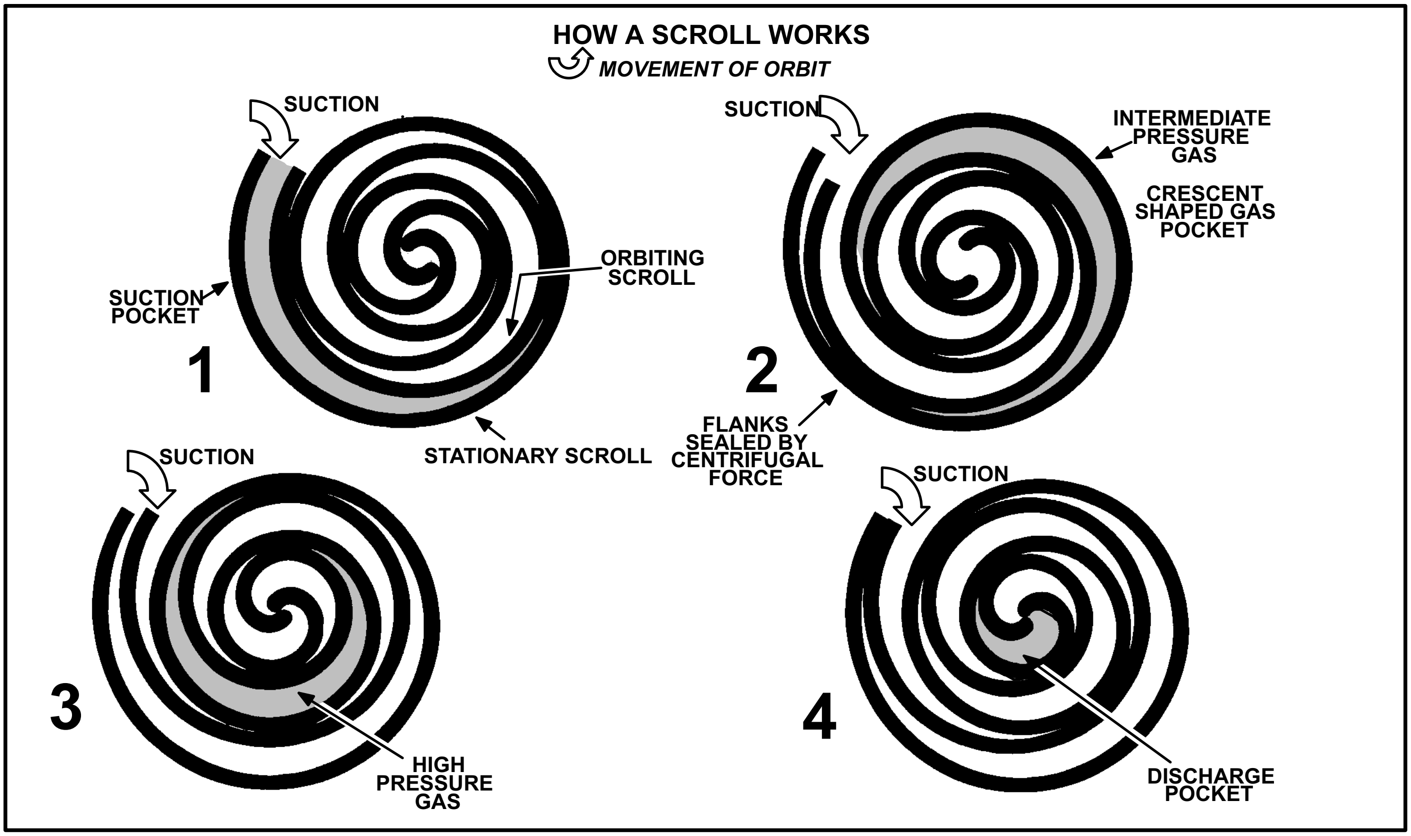


FIGURE 4

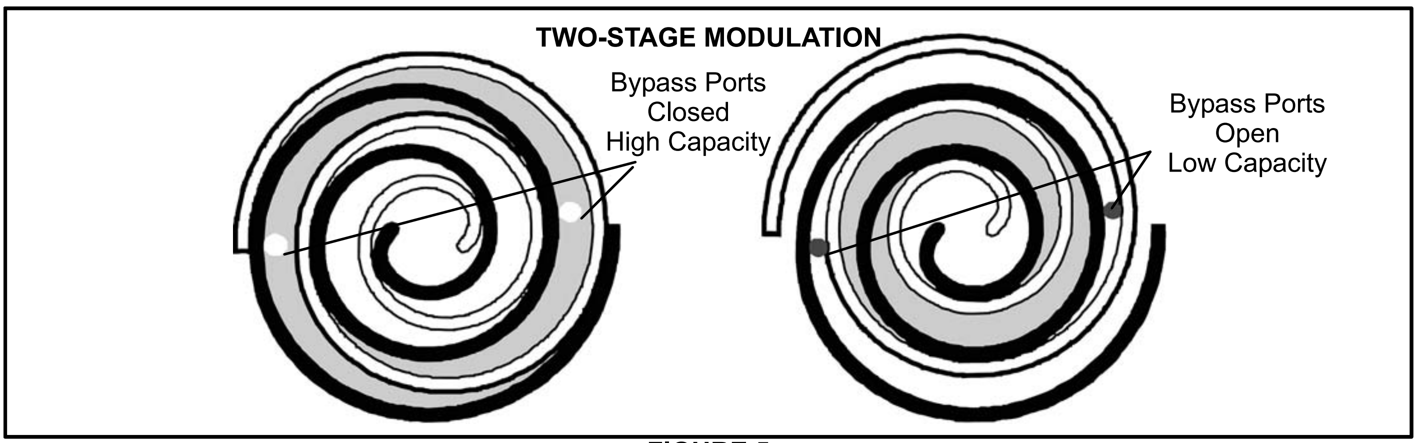


FIGURE 5

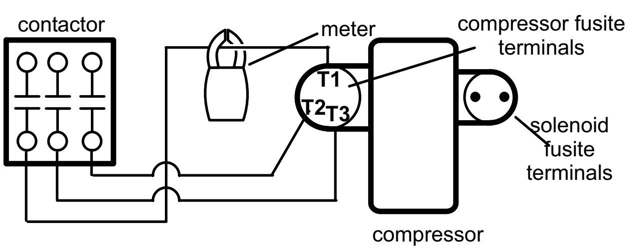
INTERNAL SOLENOID (L34)

The internal unloader solenoid controls the two-stage operation of the compressor by shifting a slide ring mechanism to open 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

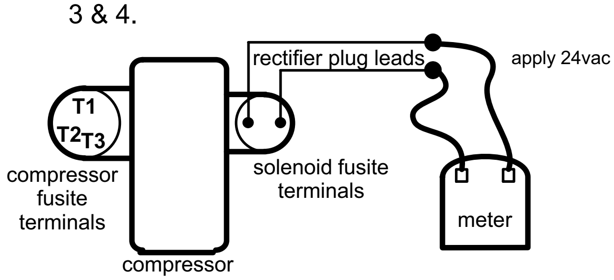
STEP 1

Connect an amp meter onto the common main power leg of the compressor (black wire). With compressor operating, cycle 24VAC on and off to full wave rectifier plug at 10 second intervals (cycle from Y1 to Y2 demands). The amperage should go up or down at least 25%. If amperage varies as voltage is applied to the rectifier plug, the unloader solenoid is operating correctly and no further checks are required. If amperage does not change, proceed to step 2.



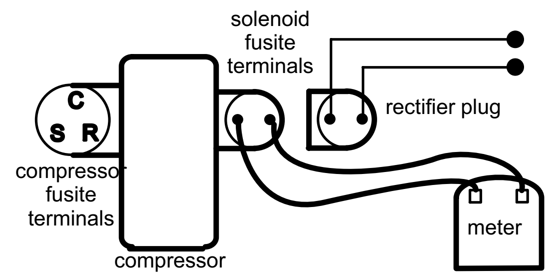
STEP 2

Shut compressor off. Apply 24VAC directly to the full wave rectifier plug wire leads and listen for a “click” as the solenoid returns to its original position. If “click can’t be heard, go to step 3 & 4.



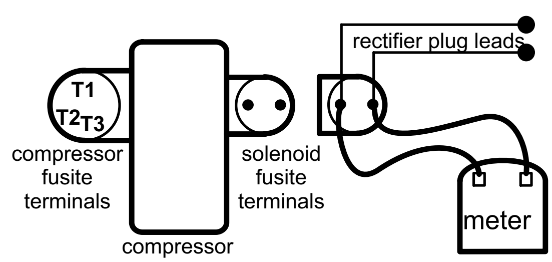
STEP 3

Shut all power off to unit (main and low voltage). Unplug the molded plug from unloader solenoid fusite. Using a volt meter set on 200 ohm scale (a) measure the resistance at the 2 fusite pins that go to the internal unloader solenoid in the compressor. The resistance should be 32 to 60 ohms depending on the compressor temperature. (b) Measure the resistance from each fusite pin to ground. There should not be continuity to ground. If coil is grounded replace compressor.



STEP 4

With all power off to the unit, unplug the full wave rectifier plug from the fusite connection on the compressor. 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).



B-Contactor (K1)

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

C-Low Pressure Switch (S87)

The SPA 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. This switch is ignored during the first 90 seconds of compressor start up, during defrost operation, 90 seconds after defrost operation, during test mode and when the outdoor temperature drops below 15°F.

The switch closes when it is exposed to 55 psig and opens at 25 psig. It is not adjustable.

D-High Pressure Switch (S4)

⚠ IMPORTANT

Pressure switch settings for R410A refrigerant will be significantly higher than units with R22.

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 640 ± 10 psi and close at 448 ± 10 psi. See figure 11 for switch location.

E-Low Ambient Thermostat (S23) (Second-Stage)

Second-stage low ambient thermostat S23 (figure 6) is a SPST thermostat located in the compressor compartment. The control uses a cap-tube sensor to monitor the temperature inside the compressor compartment. The cap-tube sensor is coiled adjacent to the control.

Low Ambient Thermostat S23

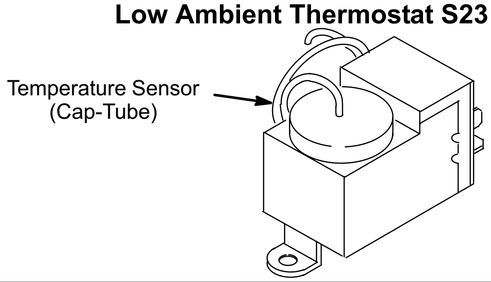


FIGURE 6

S23 continually monitors the temperature inside the compressor compartment. When compressor compartment temperature drops below the control setpoint, the control closes. When the control closes, the contacts shunt across Y1 and Y2 inside the unit. When Y1 heating demand is present and S23 is closed, the compressor will run in high capacity. The compressor will operate in high capacity mode anytime there is a Y1 heating call from indoor thermostat, until the units control box warms and S23 opens.

S23 has field adjustable setpoints. Temperature differential (difference between cut-in and cut-out) is fixed and cannot be adjusted. Table 1 shows S23 control setpoints. The control is factory set to close at 40±2°F on a temperature drop and reset at 50±2°F on a temperature rise.

TABLE 1
Control Setpoints

Low Ambient Thermostat Adjustable Range	Factory Setting	Min.	Max.
Cut-In (Close on Temperature Drop)	40±2°F	37±2°F	55±2°F
Cut-Out (Open on Temperature Rise)	50±2°F	47±2°F	65±2°F

Regional climatic conditions may require the control to be adjusted to a different setting. The adjustment screw is located on the control. A hole cut into the bottom shelf of the control box provides access to the control from the compressor compartment. See figure 7.

Adjusting Low Ambient Thermostat

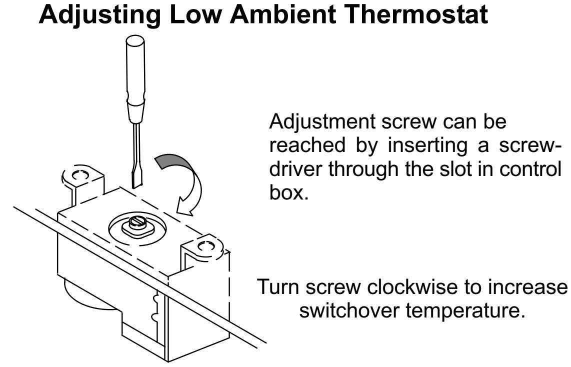


FIGURE 7

Figure 8 shows the adjustment range of the control. Turn adjustment screw clockwise to raise the switchover temperature and counterclockwise to lower the switchover temperature.

Low Ambient Thermostat

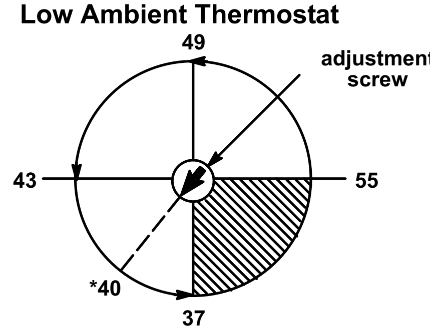


FIGURE 8

NOTE: This control is located in the compressor compartment. The ambient temperature sensed may be 10 ºF to 15ºF higher than the outdoor ambient. The temperature sensed may vary because of long compressor run times, continuous crankcase heater operation, or direct sunlight.

If this condition exists it can prevent the S23 from closing and restrict the unit to low capacity heating when there is a requirement for high capacity heat.

Ambient Compensation Adjustments

In order to overcome this potential situation, there are two possible adjustments:

- The factory setting of the S23 can be reset to a higher temperature. This will allow the controller to compensate for the ambient temperature differences. (Control setting 65ºF, compartment 65ºF - outdoor ambient 55ºF).
- Secondly, the capillary tube on the control can be routed with the low voltage thermostat wires. Because the capillary tube senses at its coldest point, temperature variation will be reduced between the control and the outdoor ambient temperature. (Keep capillary tube away from direct sunlight).

Single-Stage Heating Application

- In single-stage heat applications, the low ambient thermostat can be set to the highest setting. The system will operate in second-stage heating when the temperature drops below 55 $\pm$ 2°F, and it will go back to first-stage when the temperature rises above 65 $\pm$ 2°F. The low-stage heating capacity is approximates 70% of the high-stage heating capacity.

F-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.

G-Transformer (T46)

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

H-Solenoid Relay (K195)

Relay K195 is N.O. SPDT relay located in the control box. On a Y2 call K195-1 closes allowing AC voltage from (T46) to the two pin full wave rectifier plug (D4).

I-Rectifier Plug (D4)

D4 is a molded assembly that plugs into the compressor. On a Y2 call D4 converts 24 volts AC to 24 volts DC. The DC voltage energizes solenoid L34, allowing the compressor to operate at full capacity.

J-Discharge Line Thermostat (S5)

S5 is an automatic reset SPST N.C. switch which opens on temperature rise. S5 is located on the discharge line and wired in series with S4 high pressure switch on the defrost control board. When discharge line temperature rises to 275° $\pm$ 8°F the switch opens and shuts down the compressor. The switch resets when discharge line temperature drops to 225° $\pm$ 11°F.

K-Outdoor Fan Motor (B4) & Capacitor (C1)

SPA units use single-phase PSC fan motors which require a run capacitor (C1). The capacitor assists in the start up of the outdoor fan. Rating s for (C1) will be on outdoor fan motor nameplate. In all units, the outdoor fan is controlled by the defrost board and compressor contactor. See ELECTRICAL DATA and SPECIFICATIONS section for more information. See figure 9 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 to 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 10.

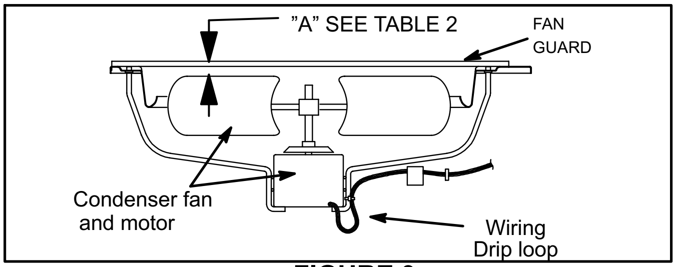


FIGURE 9

TABLE 2

SPA UNIT	"A" DIM. $\pm$ 1/8"
-036	1 1/16"
-048	1 3/16"
-060	

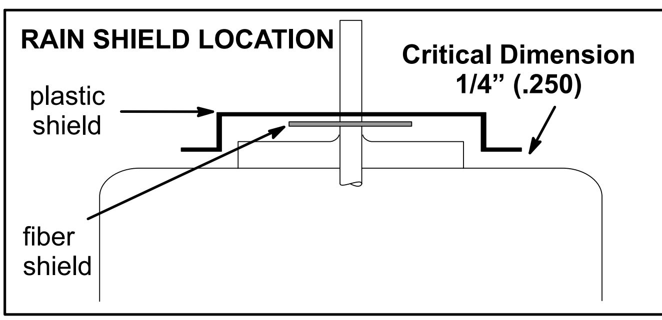


FIGURE 10

SPA PARTS ARRANGEMENT

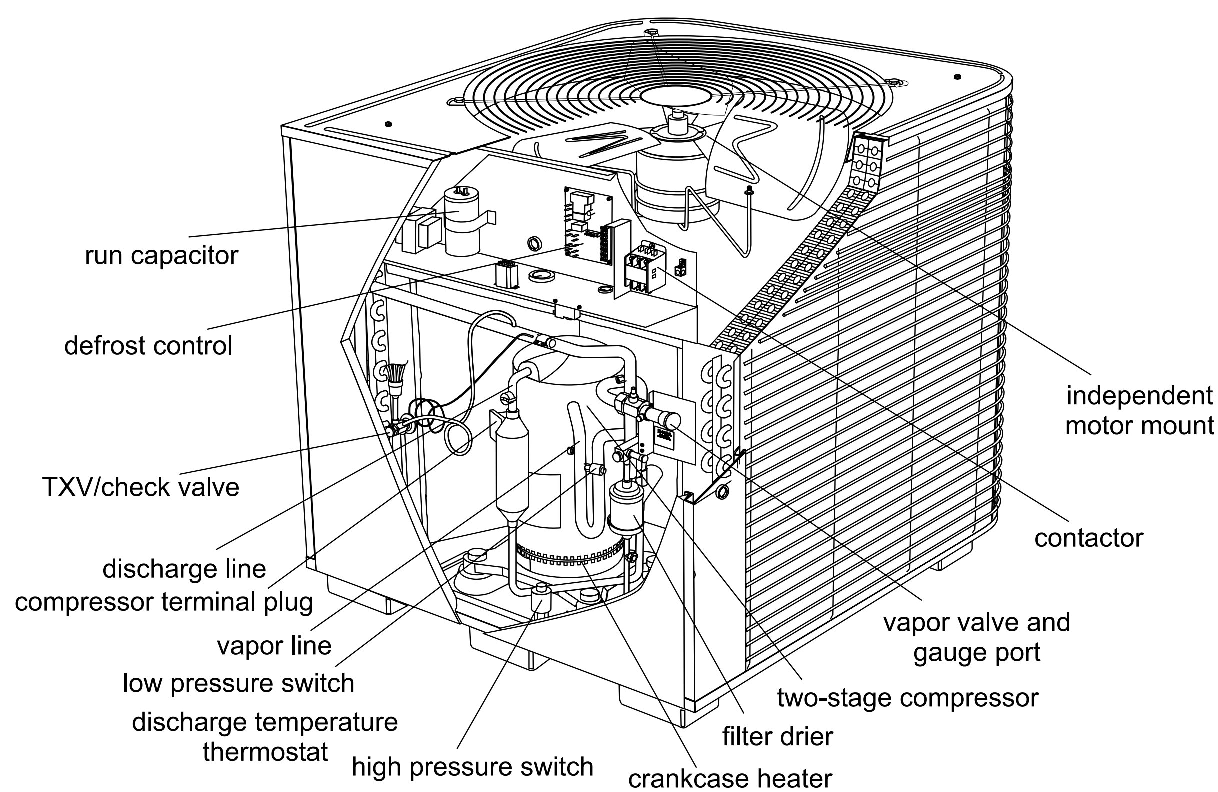


FIGURE 11

L-Filter Drier

A filter drier designed for all SPA 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 **c**ompressor 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 R410A 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.

CHARGE COMPENSATOR OPERATION

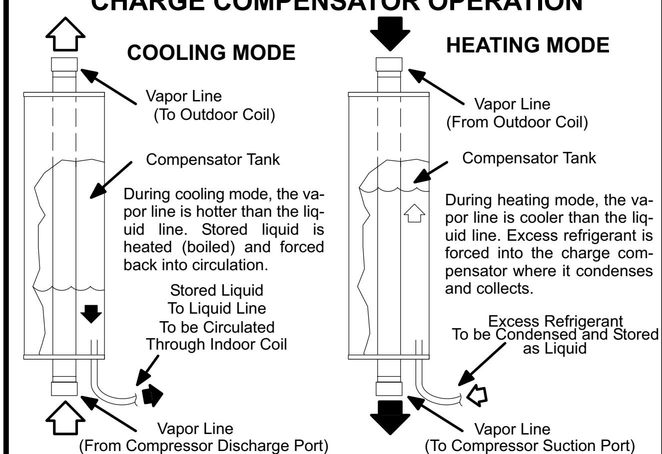


FIGURE 12

M-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.

N- 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 .

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	

O-Accumulator (SPA-060 only)

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

P-Charge Compensator

SPA-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 12 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 the liquid line for circulation.

Q-Defrost System

The demand defrost controller uses basic differential temperature means to detect when the system performs poorly because of ice build-up on the outdoor coil. The controller also uses "self-calibrating" principles to calibrate itself when the system starts and after every time the system defrosts. The control board has the following components: defrost relays, anti-short cycle timed-off control, pressure switch/safety control, 5-trip lockout circuit, test mode pins, ambient and coil temperature sensors, field selectable termination temperature pins, and a field low voltage connection terminal strip. See figure 13.

The control monitors ambient temperature, outdoor coil temperature and total run time to determine when a defrost cycle is required. Two temperature probes are permanently attached to the control. 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. See figure 14 for coil sensor location. The ambient temperature sensor is located in the PVC tube next to the filter drier.

NOTE - The logic of 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.

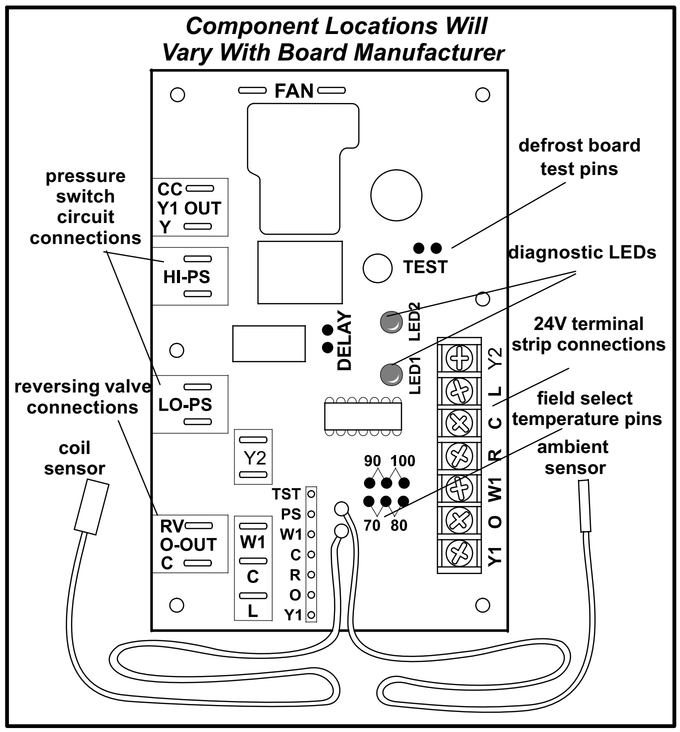


FIGURE 13

COIL SENSOR LOCATION

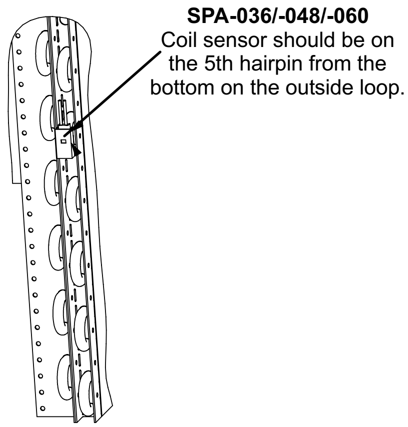


FIGURE 14

The temperature probes cannot be removed from the control. The control and the attached probes MUST be replaced as a unit. Do not attempt to cut or splice probe wires.

Diagnostic LEDs

The defrost board uses two LEDs for diagnostics. The LEDs flash a specific sequence according to the diagnostic condition. See table 4.

HI-PS/LO-PS Terminals

High pressure switch (S4) is factory wired into the defrost board HI-PS terminals. When (S4) trips, the defrost board will cycle off the compressor and the strike counter in the board will count one strike.

Low pressure switch (S87) is factory wired into the defrost board LO-PS terminals. When (S87) trips, the defrost board will cycle off the compressor and the strike counter in the board will count one strike.

(S87) is ignored during certain conditions:

- During the defrost cycle and 90 seconds after the termination of defrost
- When the average ambient sensor temperature is below 15 F (-9)
- For 90 seconds following the start up of the compressor
- During ”Test” mode

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. All timer functions (run times) will also be reset.
- If a pressure switch or discharge line thermostat switch opens while the Y1 Out line is engaged, a 5-minute short cycle will occur after the switch closes.

“DELAY” Option

The defrost board has a field selectable function to reduce occasional noise that may occur while the unit is cycling in and out of defrost mode. When a jumper is installed on the “DELAY” pins, the compressor will cycle off for 30 seconds going in and out of defrost mode.

NOTE - 30 second off cycle is not functional when jumpering “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.

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 100°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 into the 34-minute Time/Temperature mode.

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.

TABLE 4
Defrost Control Board Diagnostic (5 strike)

<table>
<tr><th>LED 1</th><th>LED 2</th><th>Condition</th><th>Possible Cause(s)</th><th>Solution</th></tr>
<tr><td>OFF</td><td>OFF</td><td>Power problem</td><td>1 No power (24V) to board terminals R & C.
2 Board failure.</td><td>1 Check control transformer power (24V).
2 If power is available and LED(s) are unlit, replace board and all sensors.</td></tr>
<tr><td>ON</td><td>ON</td><td>Coil sensor problem</td><td>1 Coil temperature outside of sensor range.
2 Faulty sensor wiring connections at board or poor sensor contact on coil.
3 Sensor failure.</td><td>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.</td></tr>
<tr><td>OFF</td><td>ON</td><td>Ambient sensor problem</td><td>1 Ambient temperature outside of sensor range.
2 Faulty sensor wiring connections at board or sensor.
3 Sensor failure.</td><td>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.</td></tr>
<tr><td>FLASH</td><td>FLASH</td><td>Normal operation</td><td>Unit operating normally or in standby mode.</td><td>None required.</td></tr>
<tr><td>ON</td><td>OFF</td><td>5-Strike pressure lockout (Short test pins or reset 24V power to board to override lockout)</td><td rowspan="3">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.</td><td rowspan="3">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.</td></tr>
<tr><td>ON</td><td>FLASH</td><td>Low pressure switch circuit open during Y1 demand</td></tr>
<tr><td>FLASH</td><td>ON</td><td>High pressure switch or discharge thermostat switch circuit open during Y1 demand</td></tr>
<tr><td>ALTERNATING FLASH</td><td>ALTERNATING FLASH</td><td>5-minute delay (Jumper test pins to override delay)</td><td>Thermostat demand for cooling or heat pump operation. Unit operating in 5-minute anti-short-cycle mode.</td><td>None required.</td></tr>
</table>

Demand Defrost 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.

III-REFRIGERANT SYSTEM

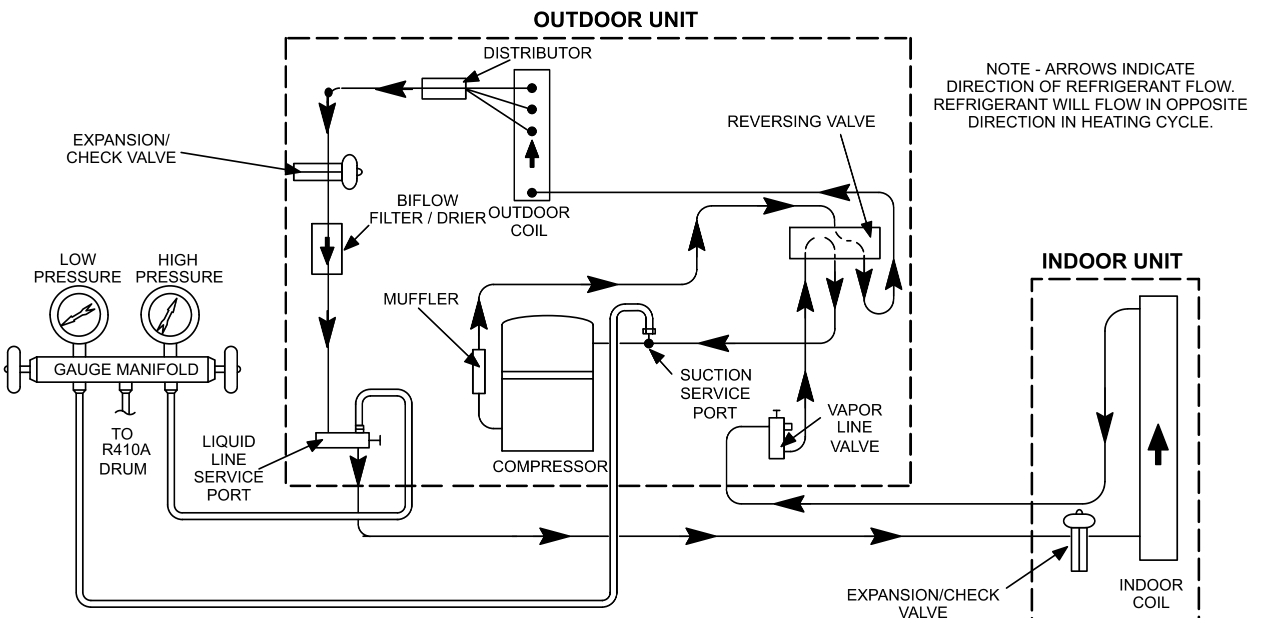
Field refrigerant piping consists of liquid and vapor lines from the outdoor unit (sweat connections). Use Lennox L15 series line sets as shown in table 5.

Separate liquid and suction service ports are provided at the service valves for connection of gauge manifold during charging procedure. Figure 15 shows SPA refrigerant flow and gauge manifold connections.

TABLE 5

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

SPA COOLING CYCLE
(Showing Gauge Manifold Connections)



NOTE-Use gauge ports on vapor line valve and liquid valve for evacuating refrigerant lines and indoor coil. Use suction gauge port to measure suction pressure during charging.

FIGURE 15

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 16 and 17) and gauge ports are used for leak testing, evacuating, charging and checking charge. See table 6 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 6

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 17.

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.

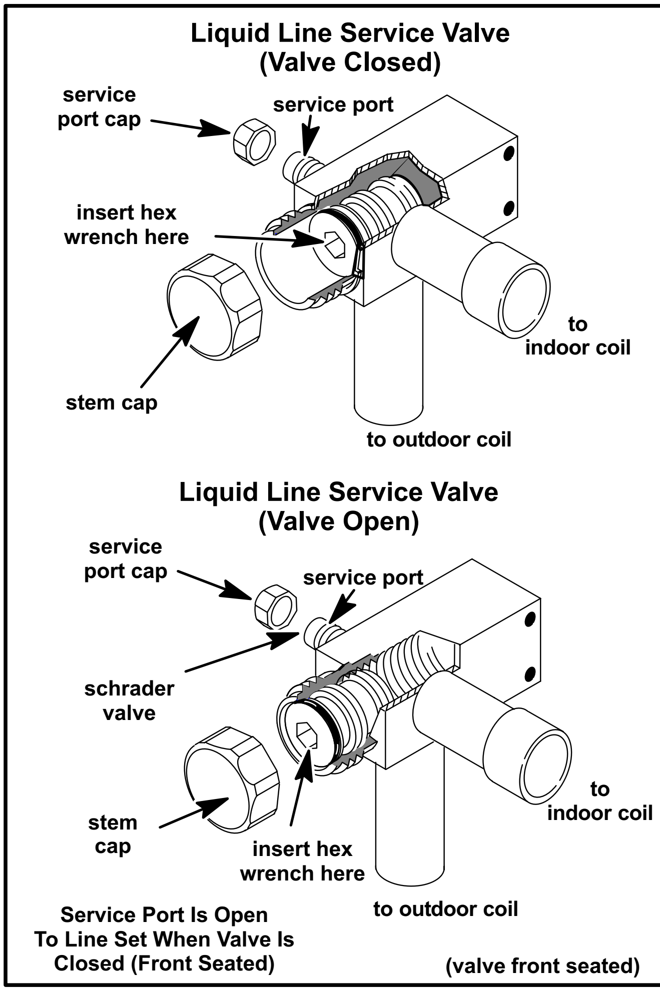


FIGURE 16

Vapor Line (Ball Type) Service Valve (Valve Open)

Use Adjustable Wrench
To open: rotate stem counter-clockwise 90°.
To close: rotate stem clockwise 90°.

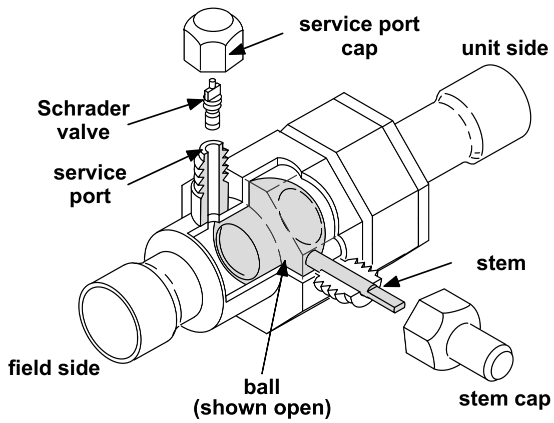


FIGURE 17

IV-CHARGING

Units are factory charged with the amount of R410A 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 7 for refrigerant charge adjustment.

TABLE 7

Liquid Line Set Diameter	Oz. per 5 ft. (grams per 1.5 m) adjust from 15 ft. (4.5 m) line set*
3/8 in. (10 mm)	3 ounces per 5 feet (85g per 1.5 m)

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

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.

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).

Using an Electronic Leak Detector

1 - Connect a cylinder of R410A to the center port of the manifold gauge set.
2 - With both manifold valves closed, open the valve on the R410A cylinder (vapor only).
3 - Open the high pressure side of the manifold to allow the R410A into the line set and indoor unit. Weigh in a trace amount of R410A . [A trace amount is a maximum of 2 ounces (57 g) or 3 pounds (31 kPa) pressure.] Close the valve on the R410A cylinder and the valve on the high pressure side of the manifold gauge set. Disconnect the R410A 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 R410A 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 R410A 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 R410A cylinder and remove the manifold gauge set.

C-Charging

This system is charged with R410A refrigerant which operates at much higher pressures than R22. The check/expansion valve provided with the unit is approved for use with R410A. 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 R410A 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 7 for refrigerant charge adjustment. .

IMPORTANT

Mineral oils are not compatible with R410A. 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 18 shows a four sided unit for example..

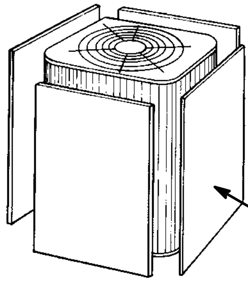


FIGURE 18

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 R410A to determine the saturation temperature for the liquid line pressure reading. See table 12.

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 8. If subcooling is greater than shown, recover some refrigerant. If subcooling is less than shown, add some refrigerant. Be aware of the R410A refrigerant cylinder. It will be light maroon-colored. Refrigerant should be added through the vapor line valve in the liquid state. **Some R410A 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 8

Model Number	Second Stage (High Capacity) Subcooling Values Conversion Temp. - Liquid Line Temp. °F (°C)
SPA-036	8.5 ± 1 (4.7 ± .5)
SPA-048	7.5 ± 1 (4.1 ± .5)
SPA-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 10 and 11, “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 9. If the values don’t agree with the those in table 9, add refrigerant to lower the approach temperature or recover refrigerant from the system to increase the approach temperature.

TABLE 9

Model Number	Second Stage (High Capacity) Approach Temperature Liquid Line Temp. - Outdoor Ambient °F (°C)
SPA-036	7.0 ± 1 (3.9 ± .5)
SPA-048	8.0 ± 1 (4.4 ± .5)
SPA-060	10.0 ± 1 (5.6 ± .5)

⚠ IMPORTANT

Use table 10 and table 11 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 10
NORMAL OPERATING PRESSURES
COOLING OPERATION
(Liquid ±10 and Vapor ±5 psig)

First Stage (Low Capacity)						
Outdoor Coil Entering Air Temp. °F (°C)	SPA036HA		SPA048HA		SPA060HA	
	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
65 (18.3)	227	142	222	140	225	140
75 (23.9)	262	145	258	143	259	142
85 (29.4)	305	146	298	145	293	146
95 (35.0)	352	148	343	147	356	147
105 (40.6)	403	152	402	147	408	147
115 (49.0)	458	155	452	152	455	151
Second Stage (High Capacity)						
Outdoor Coil Entering Air Temp. °F (°C)	SPA036HA		SPA048HA		SPA060HA	
	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
65 (18.3)	244	136	232	134	249	126
75 (23.9)	282	139	266	136	289	134
85 (29.4)	325	142	309	139	330	140
95 (35.0)	377	144	359	142	378	143
105 (40.6)	428	146	410	144	433	146
115 (49.0)	488	148	468	147	492	149

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

First Stage (Low Capacity)						
Outdoor Coil Entering Air Temp. °F (°C)	SPA036HA		SPA048HA		SPA060HA	
	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
40 (4.4)	296	95	315	97	319	93
50 (10)	310	112	330	114	335	111
Second Stage (High Capacity)						
Outdoor Coil Entering Air Temp. °F (°C)	SPA036HA		SPA048HA		SPA060HA	
Outdoor Coil Entering Air Temp. °F (°C)	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
20 (-7.0)	277	60	294	60	300	57
30 (-1.0)	296	74	303	75	312	70
40 (4.4)	321	88	314	90	323	83
50 (10)	341	104	325	106	339	97

Table 12
R410A 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 R410A 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 SPA 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 R410A.

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 SPA 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.

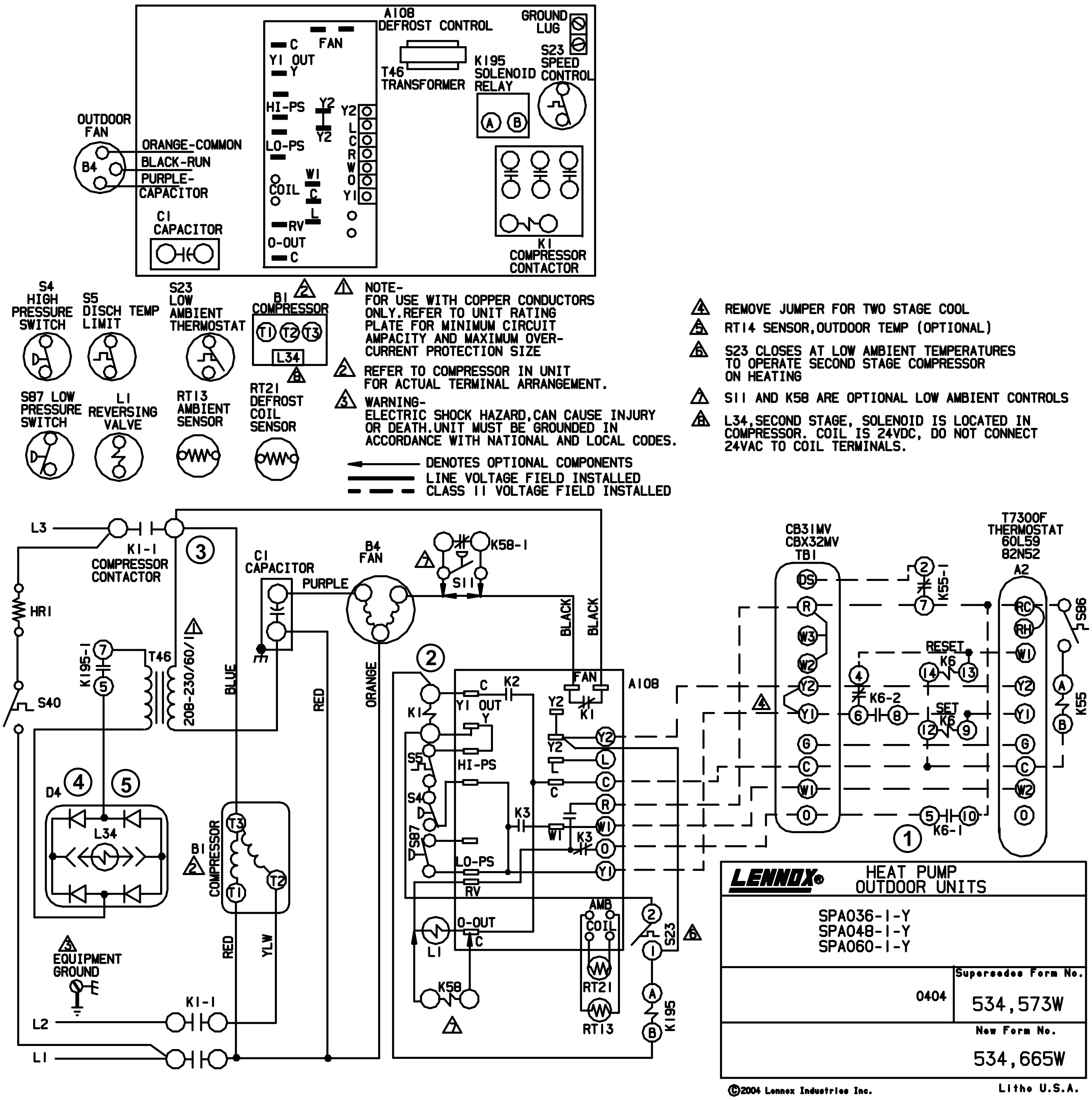
5 - Check all wiring for loose connections.

6 - Check for correct voltage at unit.

7 - Check amp-draw on blower motor.

VII-DIAGRAM / OPERATING SEQUENCE

SPA-036, -048 & -060



Sequence of Operation SPA-036/060

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.

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- Ambient temperature ABOVE S23 low ambient thermostat setting. S23 remains open.

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

2- 24VAC passes through high pressure switch S4 and discharge thermostat switch S5 energizing compressor contactor K1.

3- K1-1 N.O. closes, energizing compressor, outdoor fan motor and transformer T46.

4- Solenoid L34 is NOT energized. The slider ring remains open limiting compressor to low capacity.

B- Ambient temperature BELOW S23 low ambient thermostat setting. S23 closes shunting Y1 and Y2.

1- Internal wiring de-energizes terminal O by heating mode selection, de-energizing the reversing valve. Thermostat calls for heating demand.

2- 24VAC passes through high pressure switch S4 and discharge thermostat switch S5 energizing compressor contactor K1.

3- K1-1 N.O. closes, energizing compressor, outdoor fan motor and transformer T46.

4- Heat 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 full 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 100°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.