

TPA HEAT PUMP SERIES

The TPA090S4S and TPA120S4S 7.5 and 10 (26.4 and 35.2 kW) ton heat pump units are designed for HFC-410A, light commercial applications, with a remotely located blower-coil unit or a furnace with an add-on evaporator coil. TPA model units are equipped with a scroll compressor. The TPA heat pumps match with the TAA blower-coil units. TPA units are all three-phase.

This manual is divided into sections which discuss the major components, refrigerant system, charging procedure, maintenance and operation sequence.

Information in this manual is intended for qualified service technicians only. All specifications are subject to change. Procedures in this manual are presented as recommendations only and do not supersede or replace local or state codes.



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.

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause personal injury, loss of life, or damage to property.

Installation and service must be performed by a licensed professional installer (or equivalent) or a service agency.

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SPECIFICATIONS

General Data		Model No.	TPA090S4S	TPA120S4S
		Nominal Size - Tons	7.5	10
Connections (sweat)	Liquid line - in. (o.d)		5/8	5/8
	Vapor line - in. (o.d)		1-3/8	1-3/8
Refrigerant	R-410A		holding charge	
Outdoor Coil	Net face area - sq. ft. Outer coil		29.3	34.2
	Inner coil		28.4	33.3
	Tube diameter - in. & no. of rows		3/8 - 2	3/8 - 2
	Fins per inch		20	20
Outdoor Coil Fan(s)	Diameter - in. & no. of blades		(2) 24 - 3	(2) 24 - 4
	Motor hp		(2) 1/3	(2) 1/2
	Total air volume - cfm		8300	10,300
	Rpm		1075	1075
	Motor Input - Watts		830	1130
Shipping Data	lbs. - 1 package		435	515

ELECTRICAL DATA

General Data		Line voltage data - 60 hz - 3 phase					
		208/230V	460V	575V	208/230V	460V	575V
¹ Maximum Overcurrent Protection (amps)		45	20	15	70	40	25
² Minimum circuit ampacity		35	17	13	44	24	18
Compressor (1)	Rated load amps	25	12.2	9	30.1	16.7	12.2
	Locked rotor amps	164	100	78	225	114	80
Outdoor Coil Fan Motor (2) (1 phase)	Full load amps (total)	2.4 (4.8)	1.3 (2.6)	1 (2)	3 (6)	1.5 (3)	1.2 (2.4)
	Locked rotor amps (total)	4.7 (9.4)	2.4 (4.8)	1.9 (3.8)	6 (12)	3 (6)	2.9 (5.8)

NOTE - Extremes of operating range are plus and minus 10% 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.

OPTIONS / ACCESSORIES

Item	Catalog No.	090S4S	120S4S
CABINET			
Hail Guards	T2GARDD10L-1- 47W17	x	
	T2GARDD10M-1- 47W18		x
Corrosion Protection	Factory	○	○
CONTROLS			
L Connection® Building Automation System	- - -	x	x
Low Ambient Control (0°F)	T2CWKT01LM1- 44W17	x	x
Network Thermostat Controller	C0CTRL07AE1L 17M10	x	x

NOTE - The catalog numbers that appear here are for ordering field installed accessories only.

○ - Factory Installed with extended lead time.

x - Field Installed

TPA090 PARTS ARRANGEMENT

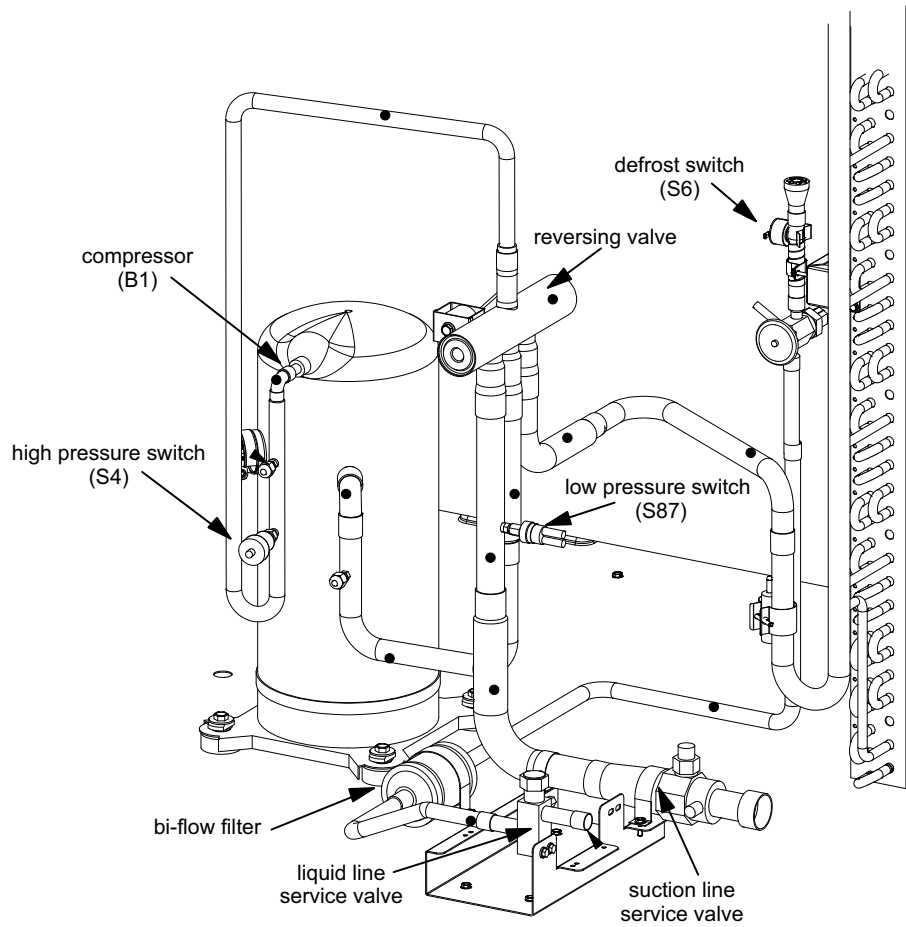


FIGURE 1

TPA120 PARTS ARRANGEMENT

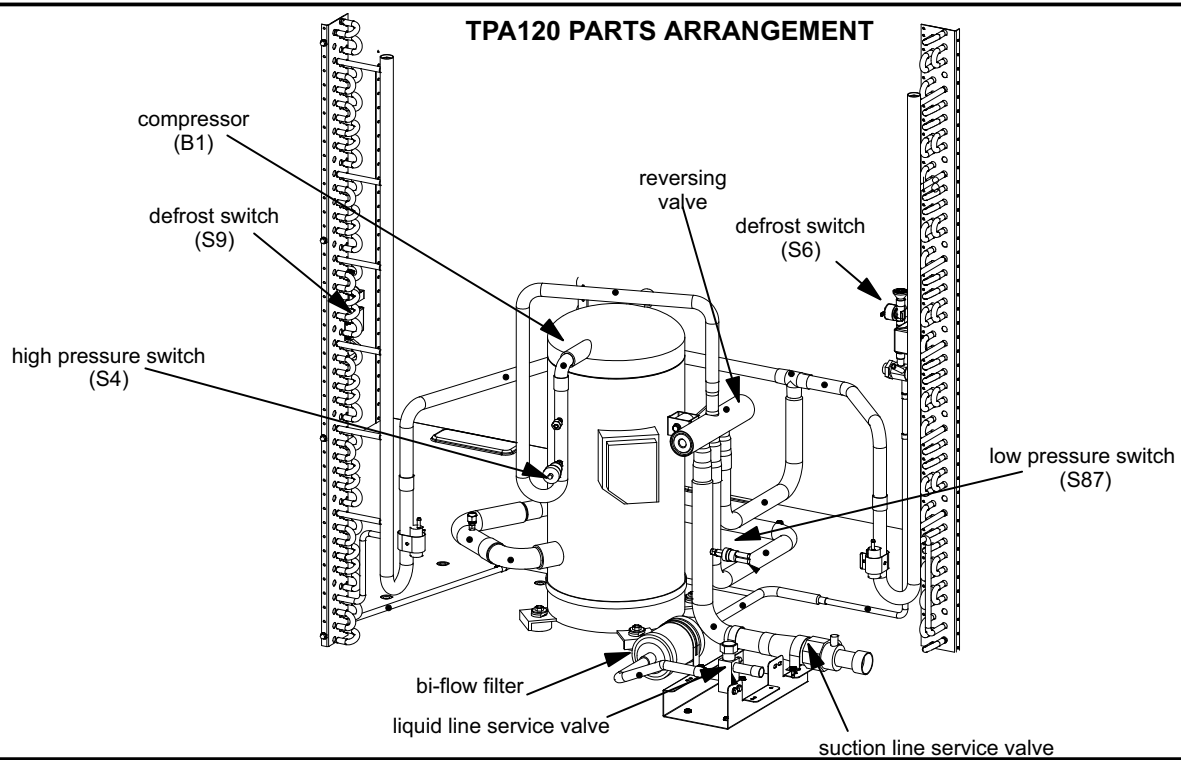


FIGURE 2

I-UNIT COMPONENTS

The TPA090/120 components are shown in figures 1 and 2.

A-CONTROL BOX COMPONENTS

The TPA090/120 control box components are shown in figure 3.

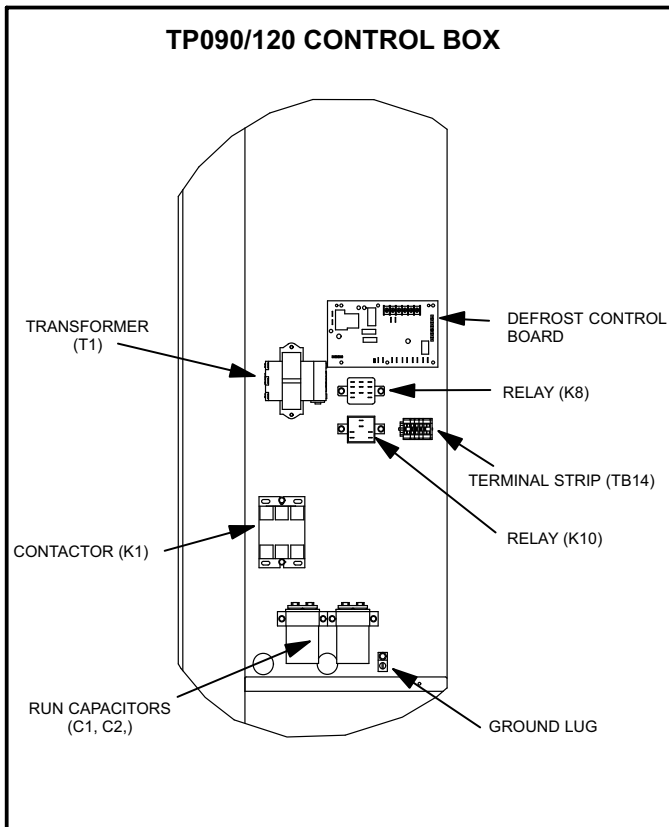


FIGURE 3

1 - Transformer T1

All TPA models use a single line voltage to 24VAC transformer mounted in the control box. Transformer T1 supplies power to control circuits in the TPA unit. The transformer is rated at 70VA and is protected by a 3.5 amp circuit breaker (CB8). CB8 is internal to the transformer. The 208/230 (Y) voltage transformers use two primary voltage taps as shown in figure 4, while 460 (G) and 575

(J) voltage transformers use a single primary voltage tap.

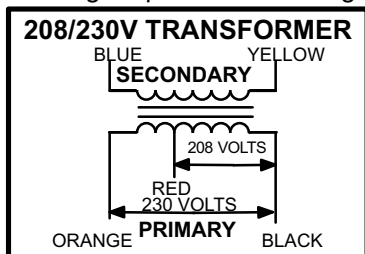


FIGURE 4

NOTE-208 volt units are field wired with the red wire connected to control transformer. 230 volt units are factory wired with the orange wire connected to control transformer primary.

2 - Outdoor Fan Capacitors C1 and C2

All TPA units use single-phase condenser fan motors. Motors are equipped with a fan run capacitor to maximize motor efficiency. Outdoor fan capacitors C1 and C2 assist in the start up of condenser fan motors B4 and B5. Capacitor ratings are on outdoor fan motor nameplates.

3 - Compressor Contactor K1 (all units)

All compressor contactors are three-pole-double break contactors with a 24V coil. K1 energizes compressor B1 in both TPA090 and TPA120 units. The contactor is energized from indoor thermostat terminal Y when thermostat demand is present.

4 - Transfer Relay K8

Transfer relay K8 ensures that the indoor blower will operate during all modes of operation. K8 also completes the circuit to Y1 on the defrost control board CMC1. When there is a demand for cooling, K8-1 closes completing the Y1 circuit to defrost control board CMC1 terminal Y1. K8-2 normally closed contacts ensure an unbroken circuit between indoor thermostat "G" and indoor blower contactor through terminals "G" and "G1" on terminal strip TB14. When there is a heat demand, normally closed K8-1 opens breaking the Y1 circuit to the defrost control CMC1. Power is sent to the "RESET" coil on K6. K6-1 opens de-energizing the reversing valve. K8-2 closes sending voltage from "G1" to the indoor blower control.

5 - Terminal Strip TB14 (all units)

TB14 terminal strip distributes 24V power from the thermostat to control box components.

6 - Low Ambient Bypass Relay K58

K58 is a normally closed DPDT relay with a 24V coil, used in both TPA090 and TPA120 units. K58 is wired in parallel with the reversing valve L1. When L1 is energized in the cooling cycle, K58 is also energized, opening K58-1. This shuts off power to the outdoor fans but does not by-pass S11 which allow fans to cycle during cooling demand. During heating demand, K58 remains closed by-passing S11 so fans can operate.

7 - CMC1 Defrost System

The defrost system includes a defrost thermostat and a defrost control.

DEFROST THERMOSTAT

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

DEFROST CONTROL

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

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

DEFROST CONTROL TIMING PINS

Each timing pin selection provides a different accumulated compressor run time period during one thermostat run cycle. This time period must occur before a defrost cycle is initiated. The defrost interval can be adjusted to 30 (T1), 60 (T2), or 90 (T3) minutes. (See figure 5 on page 5). The defrost timing jumper is factory-installed to provide a 60-minute defrost interval. If the timing selector jumper is not in place, the control defaults to a 90-minute defrost interval. The maximum defrost period is 14 minutes and cannot be adjusted.

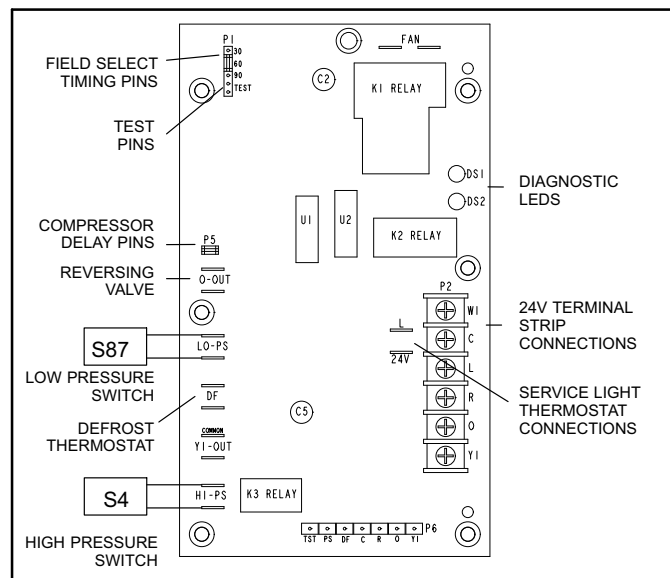


FIGURE 5

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

COMPRESSOR DELAY

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 the compressor delay jumper is removed, the compressor will be cycled off for 30 seconds going in and out of the defrost mode.

NOTE - The 30-second compressor feature is ignored when jumpering the TEST pins.

TIME DELAY

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

NOTE - The board must have a thermostat demand for the bypass function.

PRESSURE SWITCH CIRCUITS

The defrost control includes two pressure switch circuits. The factory-installed high pressure switch (S4) wires are connected to the board's HI PS terminals (figure 5). The board also includes LO PS terminals to accommodate a field-provided low (or loss-of-charge) pressure switch.

During a single thermostat cycle, the defrost control will lock out the unit after the fifth time that the circuit is interrupted by any pressure switch that is wired to the control board. In addition, the diagnostic LEDs will indicate a pressure switch lockout after the fifth occurrence of an open pressure switch (see table 1). The unit will remain locked out until power is broken then remade to the control or until the jumper is applied to the TEST pins for 0.5 seconds.

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

SERVICE LIGHT CONNECTION

The defrost control board includes terminal connections for a service light thermostat which provides a signal that activates the room thermostat service light during periods of inefficient operation.

! IMPORTANT

NOTE - After testing has been completed, properly reposition test jumper across desired timing pins.

DIAGNOSTIC LEDs

The defrost board uses two LEDs for diagnostics. The LEDs flash a specific sequence according to the diagnosis. See table 1.

TABLE 1

DS2 Green	DS1 Red	Condition
OFF	OFF	Power problem
Simultaneous Slow Flash		Normal operation
Alternating Slow Flash		5-min. anti-short cycle delay
Simultaneous Fast Flash		Ambient Sensor Problem
Alternating Fast Flash		Coil Sensor Problem
ON	ON	Circuit Board Failure
Fault and Lockout Codes		
OFF	Slow Flash	Low Pressure Fault
OFF	ON	Low Pressure Lockout
Slow Flash	OFF	High Pressure Fault
ON	OFF	High Pressure Lockout
Slow Flash	ON	Discharge Line Temp. Fault
Fast Flash	ON	Disch. Line Temp. Lockout
OFF	Fast Flash	Discharge Sensor Fault
Fast Flash	OFF	Discharge Sensor Lockout

Shaded entries apply to demand boards only.

B-COOLING COMPONENTS

! WARNING

Refrigerant can be harmful if it is inhaled. Refrigerant must be used and recovered responsibly.

Failure to follow this warning may result in personal injury or death.

1 - Compressor

ALL TPA model units use scroll compressors. Compressor B1 operates during all cooling demand and is energized by contactor K1 upon receiving demand. See ELECTRICAL section or compressor nameplate for compressor specifications.

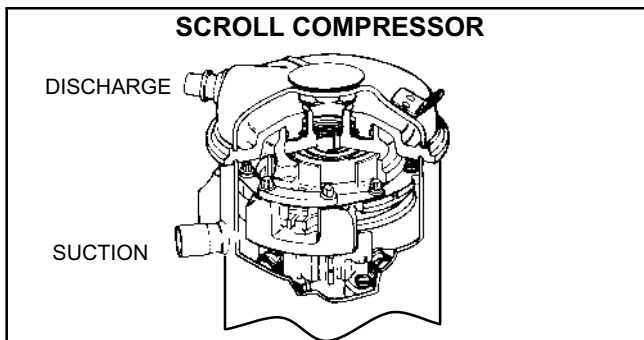


FIGURE 6

The scroll compressor design is simple, efficient and requires few moving parts. A cutaway diagram of the scroll compressor is shown in figure 6. 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 7 shows the basic scroll form. Two identical scrolls are mated together forming concentric spiral shapes (figure 8). One scroll remains stationary, while the other is allowed to "orbit" (figure 9). Note that the orbiting scroll does not rotate or turn but merely orbits the stationary scroll.

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

! IMPORTANT

Three-phase scroll compressor noise will be significantly higher if phasing is incorrect. Compressor will operate backwards so unit will not provide cooling. If phasing is incorrect, disconnect power to unit and reverse any two power leads (L1 and L3) preferred) to unit.

SCROLL FORM

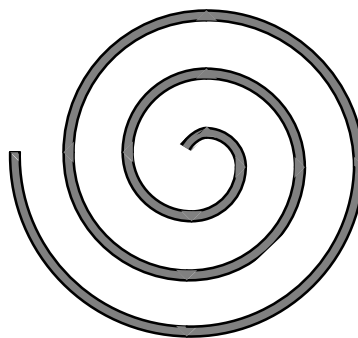


FIGURE 7

CROSS-SECTION OF SCROLLS

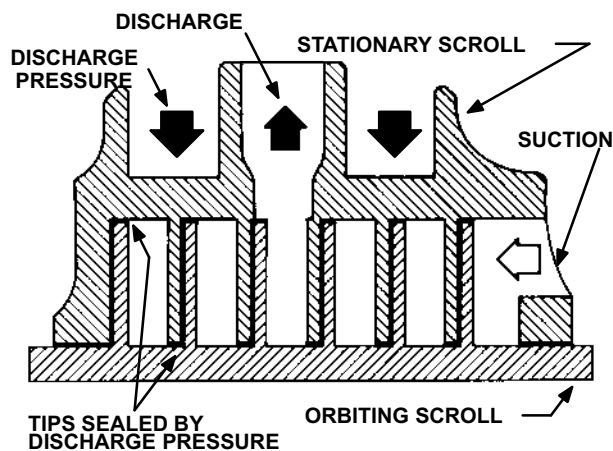


FIGURE 8

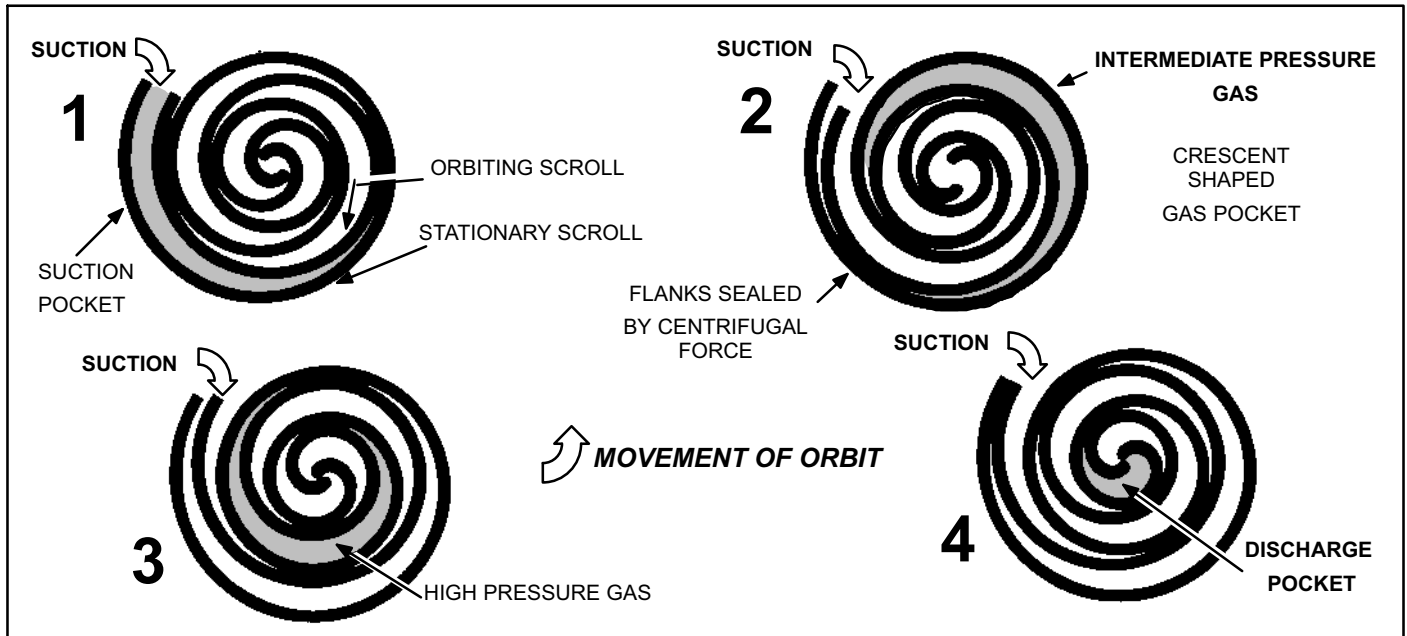


FIGURE 9

The counterclockwise orbiting scroll draws gas into the outer crescent shaped gas pocket created by the two scrolls (figure 9- 1). The centrifugal action of the orbiting scroll seals off the flanks of the scrolls (figure9-2). As the orbiting motion continues, the gas is forced toward the center of the scroll and the gas pocket becomes compressed (figure 9- 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 8). The discharge pressure forcing down on the top scroll helps seal off the upper and lower edges (tips) of the scrolls (figure 8). 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 sepa-

rate from the stationary scroll. The liquid is worked toward the center of the scroll and is discharged. If the compressor is replaced, conventional Lennox cleanup practices must be used. 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. Never use a scroll compressor for evacuating or "pumping-down" the system. This type of damage can be detected and will result in denial of warranty claims.

The scroll compressor is quieter than a reciprocating compressor, however, the two compressors have much different sound characteristics. The sounds made by a scroll compressor do not affect system reliability, performance, or indicate damage.

2 - Crankcase Heaters HR1 (all units)

All TPA units use a belly-band crankcase heater. Heater HR1 is wrapped around compressor B1. HR1 assures proper compressor lubrication at all times.

3 - High Pressure Switch S4

The high pressure switch is a auto-reset SPST N.C. switch which opens on a pressure rise. The switch is located on the compressor discharge line and is wired to the defrost control board CMC1. When discharge pressure rises to 450 ± 10 psig (3103 ± 69 kPa) the switch opens and the compressor is de-energized through the CMC1. The switch will close when discharge pressure drops to 300 ± 20 psig (2068 ± 138 kPa).

4 - Low Pressure Switch S87

The low pressure switch is a auto-reset SPST N.C. switch which opens on a pressure drop. The switch is located on the compressor suction line and is wired to the defrost control board CMC1. When suction line pressure drops to 40 psi the switch opens and the compressor is de-energized through the CMC1. The switch will close when pressure rises to 90 psi.

5 - Filter Drier (all units)

All TP model units have a filter drier that is located in the liquid line of each refrigerant circuit at the exit of each condenser coil. The drier removes contaminants and moisture from the system.

6 - Low Ambient Switch S11 (field installed option)

The low ambient switch is an auto-reset SPST N.O. pressure switch, which allows for mechanical cooling operation at low outdoor temperatures. The switch is located in the liquid line. In all TPA units, S11 is wired in series with fan relay K10. When liquid pressure rises to 450 ± 10 psig (3103 ± 69 kPa), the switch closes and the condenser fan is energized. When the discharge pressure drops to 240 ± 10 psig (1655 ± 69 kPa), the switch opens and the condenser fan is de-energized. This intermittent fan operation results in higher evaporating temperature, allowing the system to operate without icing the evaporator coil and losing capacity.

7 - Reversing Valve L1 (all units)

A reversing valve with an electromechanical solenoid is used to reverse refrigerant flow during unit operation. L1 is energized during cooling demand and defrost. See figures 1 and 2.

8 - Condenser Fans B4 & B5

See page 2 for the specifications on the condenser fans used in the TPA units. All condenser fans have single-phase motors. The TPA090/120 units are equipped with two condenser fans. The fan assembly may be removed for servicing by removing the motor mounts nuts.

II- REFRIGERANT SYSTEM

A-Plumbing

Field refrigerant piping consists of liquid and vapor lines from the outdoor unit (sweat connections) to the indoor evaporator coil (sweat connections). Refer to table 2 for field-fabricated refrigerant line sizes. Refer to Lennox Refrigerant Piping manual Corp. #9351-L9 for proper size, type and application of field-fabricated lines. Separate discharge and suction service ports are provided at the compressor for connection of gauge manifold during charging procedure.

**TABLE 2
REFRIGERANT LINE SIZES**

TPA	LIQUID LINE	VAPOR LINE
090	5/8 in (16 mm)	1-3/8 in (35mm)
120	5/8 in (16 mm)	1-3/8 in (35mm)

B-Service Valves

When servicing or repairing HVAC components, ensure caps and fasteners are appropriately tightened. Table 3 lists torque values for typical service and repair items.

**TABLE 3
Torque Requirements**

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

USING MANIFOLD GAUGE SETS

When checking the system charge, use a manifold gauge set that features low-loss anti-blow back fittings. See figure 10 for a typical manifold gauge connection setup.

Manifold gauge sets used with HFC-410A refrigerant systems must be capable of handling the higher system operating pressures. The gauges should be rated for use with pressures of 0 - 800 on the high side and a low side of 30" vacuum to 250 psi with dampened speed to 500 psi. Gauge hoses must be rated for use at up to 800 psi of pressure with a 4000 psi burst rating.

OPERATING SERVICE VALVES

The liquid and suction line service valves are typically used for removing refrigerant, flushing, leak testing, evacuating, checking charge and charging.

! IMPORTANT

Only use Allen wrenches of sufficient hardness (50Rc - Rockwell Harness Scale minimum). 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.

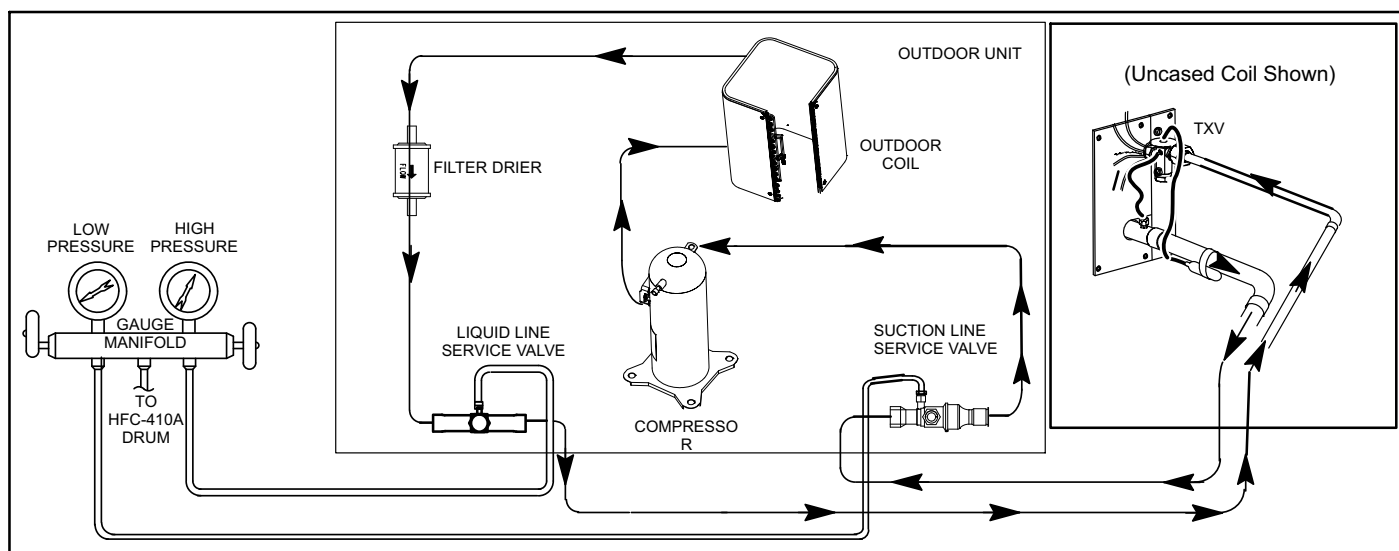


FIGURE 10

Each valve is equipped with a service port which has a factory-installed valve stem.

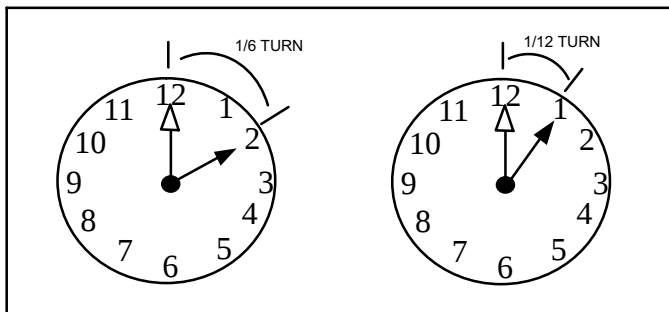


FIGURE 11

⚠ IMPORTANT

To prevent stripping of the various caps used, the appropriately sized wrench should be used and fitted snugly over the cap before tightening.

To Access Angle-Type Service Port:

A service port cap protects the service port core from contamination and serves as the primary leak seal.

1. Remove service port cap with an appropriately sized wrench.
2. Connect gauge to the service port.
3. When testing is completed, replace service port cap and tighten as follows:
 - *With Torque Wrench:* Finger tighten and then tighten per table 3.
 - *Without Torque Wrench:* Finger tighten and use an appropriately sized wrench to turn an additional 1/6 turn clockwise as illustrated in figure 11.

To Open Liquid Line Service Valve:

- 1 - Remove stem cap with an adjustable wrench.
- 2 - Using service wrench and 5/16" hex head extension if needed (part #49A71) back the stem out counterclockwise until the valve stem just touches the retaining ring.
- 3 - Replace stem cap. Tighten finger tight, then tighten an additional 1/6 turn. Do not over torque.

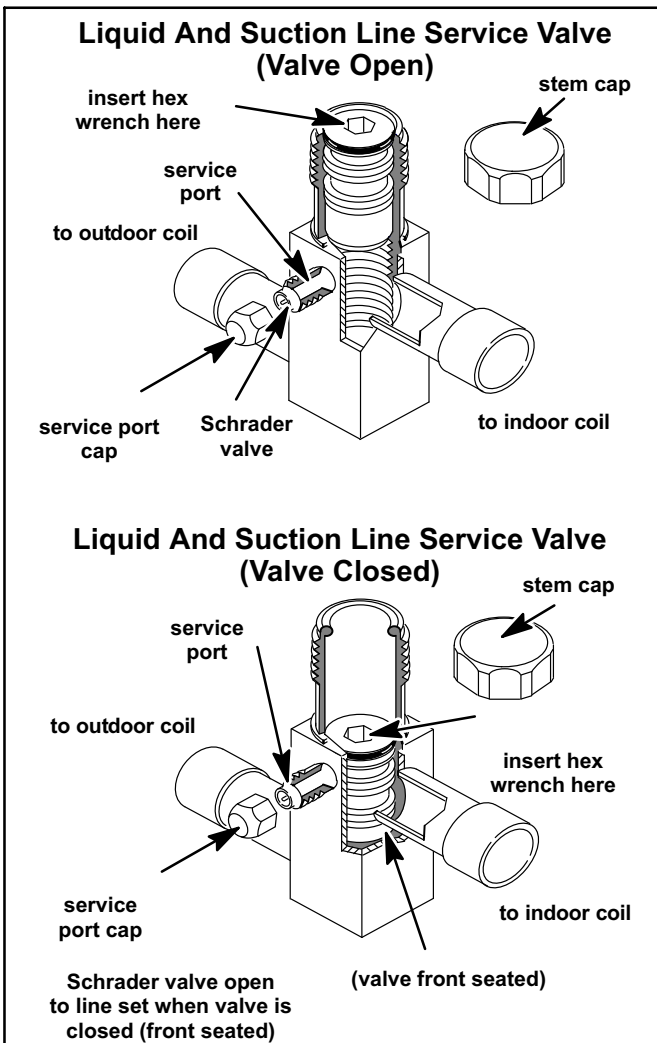


FIGURE 12

To Close Liquid Line Service Valve:

- 1 - Remove stem cap with an adjustable wrench.
- 2 - Using service wrench and 5/16" hex head extension if needed (part #49A71), turn stem clockwise to seat the valve. Tighten firmly.
- 3 - Replace stem cap. Tighten finger tight, then tighten an additional 1/6 turn. Do not over torque.
- 3 - Replace stem cap. Tighten finger tight, then tighten an additional 1/6 turn. Do not over torque.

Service (Ball) Valve

Some TPA units are equipped with a full service ball valve, as shown in figure 13. One service port that contains a valve core is present in this valve. A cap is also provided to seal off the service port. The valve is not rebuildable so it must always be replaced if failure has occurred.

Opening the Suction Line Service Valve

- 1 - Remove the stem cap with an adjustable wrench.
- 2 - Using a service wrench, turn the stem counterclockwise for 1/4 of a turn.
- 3 - Replace the stem cap and tighten it firmly.

Closing the Suction Line Service Valve

- 1 - Remove the stem cap with an adjustable wrench.
- 2 - Using a service wrench, turn the stem clockwise for 1/4 of a turn.
- 3 - Replace the stem cap and tighten firmly.

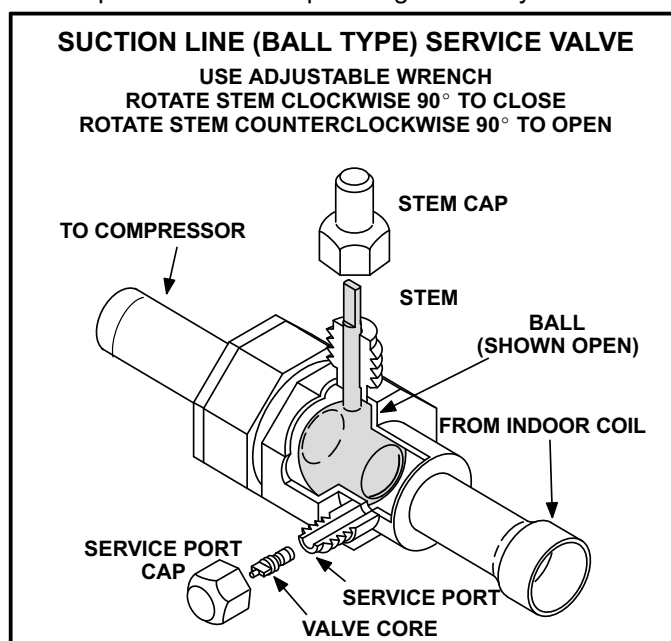


FIGURE 13

III-START UP

Use the following procedure prior to starting up the unit for the first time.

1. Rotate fan to check for binding.
2. Inspect all factory- and field-installed wiring for loose connections.
3. Open the liquid line and suction line service valves to release the refrigerant charge (contained in outdoor unit) into the system.
4. Replace the stem caps and secure finger tight, then tighten an additional one-sixth (1/6) of a turn as illustrated in figure 11.
5. Check voltage supply at the disconnect switch. The voltage must be within the range listed on the unit's nameplate. If not, do not start the equipment until you have consulted the power company and the voltage condition has been corrected.

⚠ IMPORTANT

If unit is equipped with a crankcase heater and the outdoor ambient air is 50°F (10°C) or below, it should be energized 24 hours before unit start-up to prevent compressor damage as a result of slugging.

6. Set the thermostat for a cooling demand. Turn on power to the indoor blower and close the outdoor unit disconnect switch to start the unit.
7. Recheck voltage while the unit is running. Power must be within range shown on the nameplate.
8. Check system for sufficient refrigerate using the procedures outlined Section IV- subsection C-.

IV- CHARGING

⚠ CAUTION

Any nitrogen cylinder connected to system must have a 150 psig maximum setting regulator. Never introduce pressures greater than 150 psig to any refrigerant system.

A-Leak Testing

⚠ IMPORTANT

Leak detector must be capable of sensing HFC refrigerant.

⚠ WARNING

Refrigerant can be harmful if it is inhaled. Refrigerant must be used and recovered responsibly.

Failure to follow this warning may result in personal 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 could result in personal injury or death.

1. Connect an HFC-410A manifold gauge set as illustrated in figure 14.
2. Open the valve on the HFC-410A cylinder (suction only).
3. Open the high pressure side of the manifold to allow HFC-410A into the line set and indoor unit. Weigh in a trace amount of HFC-410A. *[A trace amount is a maximum of two ounces (57 g) refrigerant or three pounds (31 kPa) pressure].*
4. Close the valve on the HFC-410A cylinder and the valve on the high pressure side of the manifold gauge set.
5. Disconnect the HFC-410A cylinder.
6. Connect a cylinder of dry nitrogen with a pressure regulating valve to the center port of the manifold gauge set.
7. Adjust dry nitrogen pressure to 150 psig (1034 kPa). Open the valve on the high side of the manifold gauge set in order to pressurize the line set and the indoor unit.
8. After a few minutes, open one of the service valve ports and verify that the refrigerant added to the system earlier is measurable with a leak detector.

NOTE - Amounts of refrigerant will vary with line lengths.

9. Check all joints for leaks.
10. Purge dry nitrogen and HFC-410A mixture.
11. Correct any leaks and recheck.
12. After leak testing disconnect gauges from service ports.

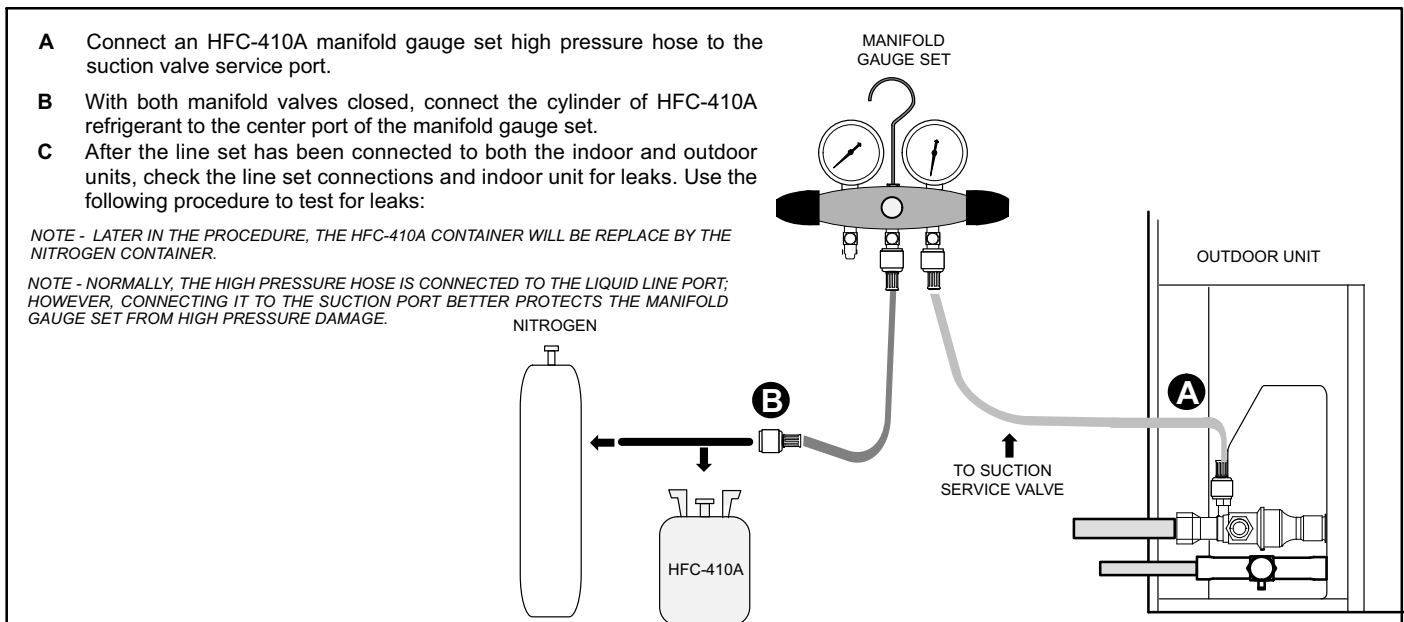


FIGURE 14

B-Evacuating the System

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.

IMPORTANT

Use a thermocouple or thermistor electronic vacuum gauge that is calibrated in microns. Use an instrument capable of accurately measuring down to 50 microns.

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

NOTE - Remove cores from service valves if not already done.

1. Connect an HFC-410A manifold gauge set as illustrated in figure 15.
2. Open both manifold valves and start the vacuum pump.
3. Evacuate the line set and indoor unit to an **absolute pressure** of 23,000 microns (29 inches of mercury).

*NOTE - 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 pressure this 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.*

4. When the absolute pressure reaches 23,000 microns (29 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 dry 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.
5. Shut off the dry nitrogen cylinder and remove the manifold gauge hose from the cylinder. Open the manifold gauge valves to release dry nitrogen from the line set and indoor unit.
6. Reconnect the manifold gauge to vacuum pump, turn pump on, and continue to evacuate line set and indoor unit until the absolute pressure does not rise above 500 microns within a 20-minute period after shutting off vacuum pump and closing the manifold gauge valves.
7. 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 HFC-410A refrigerant. Open the manifold gauge valve pressure line set to break vacuum with 2 to 5 psi.
8. Perform the following:
 - A Close manifold gauge valves
 - B Shut off HFC-410A cylinder
 - C Reinstall service valve cores by removing manifold hose from service valve. Quickly install cores with core tool while maintaining a positive system pressure.
 - D Replace the stem caps and secure finger tight, then tighten an additional one-sixth (1/6) of a turn as illustrated in figure 11.

NOTE - Remove cores from service valves if not already done.

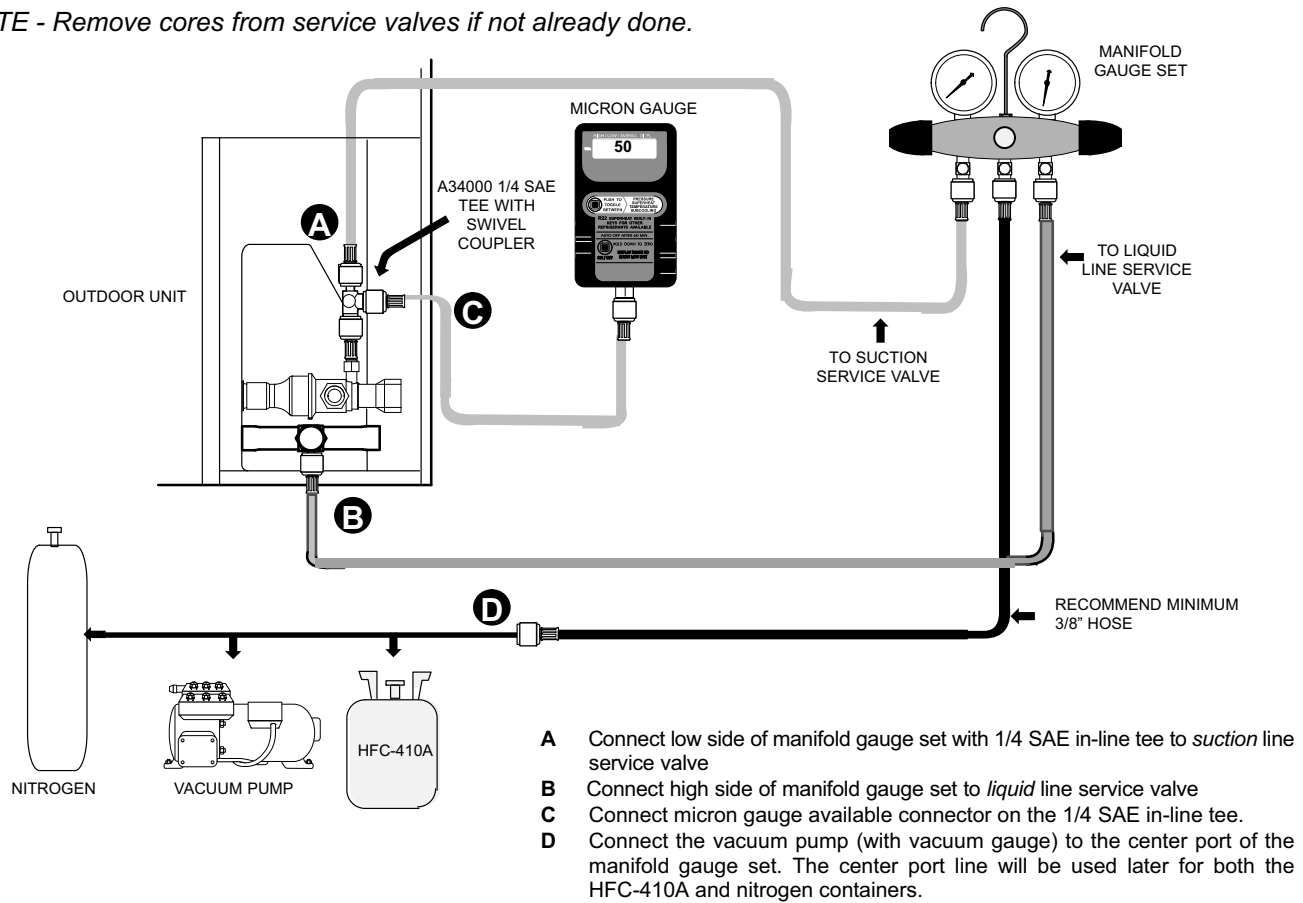


FIGURE 15

C-Charging

This unit has a factory holding charge of one pound of HFC-410A refrigerant for each stage. Additional refrigerant will be needed.

NOTE - Refrigerant line sets longer than 200 feet (60 meters) are not recommended. For assistance contact Lennox Application Department.

To check the charge, use the following procedure:

1. Attach gauge manifolds and operate unit in **cooling mode** until system stabilizes (approximately five minutes). Make sure outdoor air dampers are closed.
2. Use a thermometer to accurately measure the outdoor ambient temperature.
3. Apply the outdoor temperature to table 4 to determine normal operating pressures.
4. Compare the normal operating pressures to the pressures obtained from the gauges. 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. **Correct any system problems before proceeding.**

5. If discharge pressure is high, remove refrigerant from the system. If discharge pressure is low, add refrigerant to the system.

- Add or remove charge in increments.
- Allow the system to stabilize each time refrigerant is added or removed.

CHARGE VERIFICATION - APPROACH METHOD

Use the following approach method along with the normal operating pressures to confirm readings.

1. Using the same thermometer, compare liquid temperature to outdoor ambient temperature.

Approach Temperature = Liquid temperature minus ambient temperature

2. Approach temperature should be $6^{\circ}\text{F} \pm 1$ ($3.3^{\circ}\text{C} \pm 0.5$) for each stage. An approach temperature greater than this value indicates an undercharge. An approach temperature less than this value indicates an overcharge.

TABLE 4
HFC-410A Normal Operating Pressures (Liquid ± 10 and Suction ± 5 psig) (Single-Stage Units)

Temp*	-090S4S		-120S4S	
	Liquid	Suction	Liquid	Suction
65° F (18° C)	231	128	243	130
75° F (24° C)	265	130	281	133
85° F (29° C)	310	131	325	136
95° F (35° C)	358	134	372	139
105° F (41° C)	410	137	427	140
115° F (46° C)	467	140	478	142
125° F (52° C)	551	146	548	142

*Temperature of air entering outdoor Coil

TABLE 5
HFC-410A Temperature (°F) - Pressure (Psig)

°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig
32	100.8	48	137.1	63	178.5	79	231.6	94	290.8	110	365.0	125	445.9	141	545.6
33	102.9	49	139.6	64	181.6	80	235.3	95	295.1	111	370.0	126	451.8	142	552.3
34	105.0	50	142.2	65	184.3	81	239.0	96	299.4	112	375.1	127	457.6	143	559.1
35	107.1	51	144.8	66	187.7	82	242.7	97	303.8	113	380.2	128	463.5	144	565.9
36	109.2	52	147.4	67	190.9	83	246.5	98	308.2	114	385.4	129	469.5	145	572.8
37	111.4	53	150.1	68	194.1	84	250.3	99	312.7	115	390.7	130	475.6	146	579.8
38	113.6	54	152.8	69	197.3	85	254.1	100	317.2	116	396.0	131	481.6	147	586.8
39	115.8	55	155.5	70	200.6	86	258.0	101	321.8	117	401.3	132	487.8	148	593.8
40	118.0	56	158.2	71	203.9	87	262.0	102	326.4	118	406.7	133	494.0	149	601.0
41	120.3	57	161.0	72	207.2	88	266.0	103	331.0	119	412.2	134	500.2	150	608.1
42	122.6	58	163.9	73	210.6	89	270.0	104	335.7	120	417.7	135	506.5	151	615.4
43	125.0	59	166.7	74	214.0	90	274.1	105	340.5	121	423.2	136	512.9	152	622.7
44	127.3	60	169.6	75	217.4	91	278.2	106	345.3	122	428.8	137	519.3	153	630.1
45	129.7	61	172.6	76	220.9	92	282.3	107	350.1	123	434.5	138	525.8	154	637.5
46	132.2	62	175.4	77	224.4	93	286.5	108	355.0	124	440.2	139	532.4	155	645.0
47	134.6			78	228.0			109	360.0			140	539.0		

V-MAINTENANCE

At the beginning of each cooling season, the system should be checked as follows:

⚠ 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.

Outdoor Unit

- 1 - Clean and inspect the condenser coil. You can flush the coil with a water hose.
- 2 - The outdoor fan motor is prelubricated and sealed. No further lubrication is necessary.
- 3 - Visually inspect connecting lines and coils for evidence of oil leaks.
- 4 - Check wiring for loose connections.
- 5 - Check for correct voltage at the unit while the unit is operating and while it is off.
- 6 - Check amp-draw of the outdoor fan motor.
Unit nameplate _____ Actual _____ .
Check amp-draw of the compressor.
Unit nameplate _____ Actual _____ .

NOTE - If the owner complains of insufficient cooling, gauge the unit and check the refrigerant charge. Refer to section on refrigerant charging in this instruction.

Indoor Coil

- 1 - If necessary, clean the coil.
- 2 - Check connecting lines and coils for evidence of oil leaks.
- 3 - If necessary, check the condensate line and clean it.

Indoor Unit

- 1 - Clean or change filters.
- 2 - Adjust the blower speed for cooling. Refer to the unit information service manual for pressure drop tables and procedure.
- 3 - On belt drive blowers, check the belt for wear and proper tension.
- 4 - Check all wiring for loose connections.
- 5 - Check for correct voltage at the unit (blower operating).
- 6 - Check amp-draw on blower motor.
Unit nameplate _____ Actual _____ .

24V POWER

24V COMMON

24V

380V, 420V UNITS

480V, 575V UNITS

TO L1 AND T18

TO N

TO L1 AND T18

TO N

240V

208V

T1

CB8

P36 J36

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SEQUENCE OF OPERATION TPA090/120

COOLING

- 1 - Cooling demand energizes through terminal Y1 at the indoor thermostat.
- 2 - Voltage passes through N.C. K8-1 to CMCI defrost control.
- 3 - L1 reversing valve is energized.
- 4 - K58 low ambient relay is energized. N.C. K58-1 contacts open.
- 5 - Voltage passes through S11 low pressure switch (switch will close provided liquid line pressure rises to 275 ± 10 psig.), energizing outdoor fan relay K10. N.O. K10-1 contacts close, energizing outdoor fans B4 and B5. N.C. K10-2 contacts open, de-energizing HR1 crankcase heater.
- 6 - Compressor contactor K1 is energized. N.O. K1-1 contacts close, energizing compressor B1.

HEATING

- 1 - Heating demand energizes through terminal W1 at the indoor thermostat.
- 2 - K8 transfer relay is energized. N.C. K8-1 contacts open and N.O. K8-2 contacts close, sending voltage to CMCI defrost control.
- 3 - L1 reversing valve is de-energized.
- 4 - K58 low ambient relay is de-energized. N.C. K58-1 contacts close, by-passing S11 low ambient switch.
- 5 - K10 outdoor fan relay is energized. N.O. K10-1 contacts close, energizing outdoor fans B4 and B5. N.C. K10-2 contacts open, de-energizing HR1 crankcase heater.
- 6 - Compressor contactor K1 is energized. N.O. K1-1 contacts close, energizing compressor B1.

DEFROST MODE

During heating operation, when outdoor coil drops below 42° F, the defrost thermostat closes. If defrost thermostat remains closed at the end of 30, 60, or 90 minutes, defrost control energizes and defrost begins.

When defrost control energizes, reversing valve L1 and indoor heat relay are energized. Outdoor fan is de-energized.

Defrost continues until 14 ± 1 minutes have elapsed or until defrost pressure switch opens. When defrost pressure switch opens to terminate defrost, the defrost timer loses power and resets. Defrost timing is stopped until the next call for defrost (when defrost thermostat closes).