

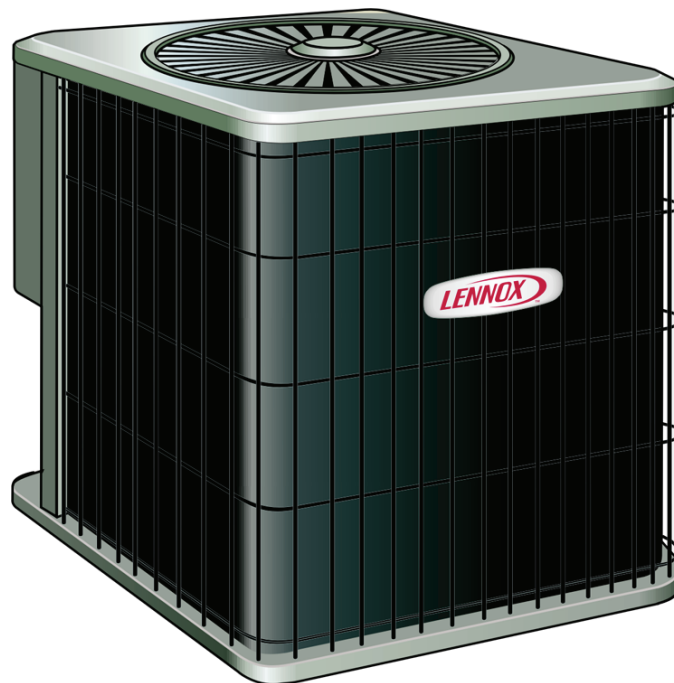
**TSA\*S2 COMMERCIAL SERIES UNITS**

The TSA\*S2 is a commercial split-system condensing unit with SEER ratings up to 14.80. The series is designed for use with expansion valves (TXV) or refrigerant flow control (RFC). All TSA\*S2 units utilize scroll compressors.

TSA\*S2 condensing units are available in 3, 3-1/2, 4 and 5 ton capacities. 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.

Information contained in this manual is intended for use by qualified service technicians only. All specifications are subject to change.

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



**ELECTROSTATIC DISCHARGE (ESD)**  
Precautions and Procedures

**⚠ 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 licensed professional installer (or equivalent) or service agency.**

**⚠ 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.**

**⚠ 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.**

**⚠ IMPORTANT**

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

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**SPECIFICATIONS 036-1, 042-1, 048-1, 048-2, 060-1**

General Data		Model No. Nominal Tonnage (kW)	TSA036S2 3 (10.6)	TSA042S2 3.5 (12.3)	TSA048S2 4 (14.1) *-1 units	TSA060S2 5 (17.6)
<b>Connections (sweat)</b>	Liquid line o.d. - in. (mm)		3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)
	Suction line o.d. - in. (mm)		7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	1-1/8 (28.6)
<sup>1</sup> Refrigerant (R-22) furnished			6 lbs. 15 oz. (3.15 kg)	6 lbs. 15 oz. (3.15 kg)	9 lbs. 8 oz. (4.31 kg) *12 lbs 12 Oz (5.78 kg)	13 lbs. 6 oz. (6.07 kg)
<b>Outdoor Coil</b>	Net face area - sq. ft. (m <sup>2</sup> )	Outer coil	13.22 (1.23)	15.11 (1.40)	18.67 (1.73) * 24.50 (2.28)	24.50 (2.28)
		Inner coil	12.60 (1.17)	14.40 (1.34)	17.96 (1.67) * 23.56 (2.19)	23.56 (2.19)
	Tube diameter - in. (mm)		5/16 (8)	5/16 (8)	5/16 (8)	5/16 (8)
	Fins per inch (m) - No. of rows		22 (866) - 2	22 (866) - 2	22 (866) - 2	22 (866) - 2
<b>Outdoor Fan</b>	Diam. - in. (mm) - No. of blades		18 (457) - 4	18 (457) - 4	22 (559) - 4	22 (559) - 4
		Motor hp (W)	208/230V - 1/5 (149) 460/575V - 1/6 (124)	1/3 (249)	1/4 (186)	
	Cfm (L/s)	2450 (1155)	2930 (1385)	3670 (1735) *3830 (1805)	3830 (1805)	
	Rpm	1100	1100	825	825	
	Watts	200	310	315 *330	330	
<b>Shipping Data - lbs. (kg) 1 package</b>			150 (68)	177 (80)	191 (87) *233 (106)	236 (107)

**ELECTRICAL DATA**

Line voltage data - 60 hz - 3ph		208/230V	460V	575V	208/230V	460V	208/230V	460V	575V	208/230V	460V	460V
<sup>2</sup> Maximum overcurrent protection (amps)		20	15	15	25	15	25	15	15	35	15	15
<sup>3</sup> Minimum circuit ampacity		13.1	7.6	5.6	16.8	8.1	16.8	8.1	6.7	20.8	9.7	9.7
<b>Compressor</b>	Rated load amps	9.6	5.7	4.0	12.1	5.7	12.1	5.7	4.6	15.3	7.0	7.0
	Power factor	.96	.88	.84	.98	.87	.94	.87	.82	.96	.87	.87
	Locked rotor amps	75	35	28	88	44	88	44	37	104	52	52
<b>Outdoor Fan Motor</b>	Full load amps	1.1	.55	.55	1.7	1.0	1.7	1.0	1.0	1.7	1.0	1.0
	Locked rotor amps	1.9	1.1	1.1	4.1	2.2	3.1	2.3	2.3	3.1	2.3	2.3

**OPTIONAL ACCESSORIES - must be ordered extra**

<b>Compressor Low Ambient Cut-Off</b>	<b>45F08</b>	•	•	•	•
<b>Compressor Sound Cover</b>	<b>69J03</b>	•	•	•	•
<b>Compressor Time-Off Control</b>	<b>47J27</b>	•	•	•	•
<b>Freezestat</b>	3/8 in. tubing	<b>93G35</b>	•	•	•
	5/8 in. tubing	<b>50A93</b>	•	•	•
<b>Hail Guards</b>		<b>92M88</b>	•		
		<b>92M89</b>		•	
		<b>12W21</b>			•
		<b>92M94</b>			•
<b>High Pressure Switch Kit</b>	<b>94J46</b>	•	•	•	•
<b>Loss of Charge Kit</b>	<b>84M23</b>	•	•	•	•
<sup>4</sup> <b>Low Ambient Kit (down to 30°F)</b>	<b>24H77</b>	•	•	•	•
<b>Low Ambient Control Option (down to 0°F)</b>		See table page Page 4	See table page Page 4	See table page Page 4	See table page Page 4
<b>Mounting Base</b>	<b>69J06</b>	•	•		
	<b>69J07</b>			•	•
<b>Refrigerant Line Sets</b>	L15-65-30, L15-65-40, L15-65-50	•	•	•	
	Field Fabricate				•
<b>Time Delay Relay Kit</b>	<b>58M81</b>	•	•	•	•
<b>Unit Stand-Off Kit</b>	<b>94J45</b>	•	•	•	•

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

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

<sup>2</sup> HACR type circuit breaker or fuse.

<sup>3</sup> Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements.

<sup>4</sup> Freezestat is recommended with Low Ambient Kit.

**SPECIFICATIONS 036-2, 042-2, 048-3, 060-2**

General Data		Model No.	TSA036S2	TSA042S2	TSA048S2	TSA060S2
		Nominal Tonnage	3	3.5	4	5
Connections (sweat)	Liquid line o.d. - in.		3/8	3/8	3/8	3/8
	Suction line o.d. - in.		7/8	7/8	7/8	1-1/8
<sup>1</sup> Refrigerant (R-22) furnished			5 lbs. 12 oz.	6 lbs. 6 oz.	7 lbs. 8 oz.	10 lbs. 0 oz.
Outdoor Coil	Net face area	Outer coil	15.11	16.33	21.00	18.67
	- sq. ft. (m <sup>2</sup> )	Inner coil	- - -	- - -	- - -	17.96
		Tube diameter - in.	5/16	5/16	5/16	5/16
		Fins per inch - No. of rows	26 - 1	26 - 1	26 - 1	22 (866) - 2
Outdoor Fan	Diam. - in. - No. of blades		18 - 3	22 - 4	22 - 4	22 - 4
	Motor hp		208/230V - 1/5 460/575V - 1/6	1/4	1/4	1/4
	Cfm		2500	3500	3670	3600
	Rpm		1110	825	835	830
	Watts		200	300	295	285
Shipping Data - lbs. 1 package			141	171	191	216

**ELECTRICAL DATA**

Line voltage data - 60 hz - 3ph		208/230V	460V	575V	208/230V	460V	208/230V	460V	575V	208/230V	460V	575V
<sup>2</sup> Maximum overcurrent protection (amps)		20	15	15	25	15	25	15	15	35	15	15
<sup>3</sup> Minimum circuit ampacity		13.1	7.6	5.6	16.8	8.1	16.8	8.1	6.7	20.8	9.7	7.6
Compressor	Rated load amps	9.6	5.7	4.0	12.1	5.7	12.1	5.7	4.6	15.3	7.0	5.3
	Power factor	.96	.88	.84	.98	.87	.94	.87	.82	.96	.87	.90
	Locked rotor amps	75	35	28	88	44	88	44	37	104	52	39
Outdoor Fan Motor	Full load amps	1.1	.55	.55	1.7	1.0	1.7	1.0	1.0	1.7	1.0	1.0
	Locked rotor amps	1.9	1.1	1.1	4.1	2.2	3.1	2.3	2.3	3.1	2.3	2.3

**OPTIONAL ACCESSORIES - must be ordered extra**

Compressor Low Ambient Cut-Off	45F08	•	•	•	•
Compressor Sound Cover	69J03	•	•	•	•
Compressor Time-Off Control	47J27	•	•	•	•
Freezestat	3/8 in. tubing	93G35	•	•	•
	5/8 in. tubing	50A93	•	•	•
Hail Guards	92M89	•			
	92M93		•		
	92M90			•	
	12W21				•
High Pressure Switch Kit	94J46	•	•	•	•
Loss of Charge Kit	84M23	•	•	•	•
<sup>4</sup> Low Ambient Kit (down to 30°F)	24H77	•	•	•	•
Mounting Base	69J06	•			
	69J07		•	•	•
Refrigerant Line Sets	L15-65-30, L15-65-40, L15-65-50	•	•	•	
	Field Fabricate				•
Time Delay Relay Kit	58M81	•	•	•	•
Unit Stand-Off Kit	94J45	•	•	•	•

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

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

<sup>2</sup> HACR type circuit breaker or fuse.

<sup>3</sup> Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements.

<sup>4</sup> Freezestat is recommended with Low Ambient Kit.

## LOW AMBIENT CONTROL Option (Down to 0°F)

Order one each: Speed Control Kit, Weatherproof Kit, Outdoor Fan Motor and Capacitor

	Model No.	TSA036S2	TSA042S2	TSA048S2	TSA060S2
Speed Control Kit	X5867	•	•	•	•
Weatherproof Kit	56N41	•	•	•	•
Outdoor Fan Motor	1/2 HP - 230V	•	•	•	•
	460V	•	•	•	•
Capacitor	with mounting bracket	•	•	•	•

## I - UNIT COMPONENTS

### **⚠ DANGER**



**Electric Shock Hazard.**  
May cause injury or death.

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

### 1-Compressor Contactor K1

The compressor is energized by a contactor located in the control box. See figure 1. Three-pole contactors are used in TSA\*S2 series units. K1 is energized by the indoor thermostat terminal Y1 (24V) when thermostat demand is present.

### 2-Condenser Fan Motor B4 & Capacitor C7

### **⚠ DANGER**

**Make sure all power is disconnected before beginning electrical service procedures.**

All units use single-phase PSC fan motors which require a run capacitor C7 located in the control box. Ratings for C7 will be on fan motor nameplate. In all units, the condenser fan is controlled by the compressor contactor.

ELECTRICAL DATA tables in this manual show specifications for condenser fans used in TSA\*S2s.

Access to the condenser fan motor on all units is gained by removing the seven screws securing the fan assembly. See figure 2. The condenser fan motor is removed from the fan guard by removing the four nuts found on the top panel. Drip loops should be used in wiring when servicing motor. See figure 3 if condenser fan motor replacement is necessary.

### 3-High Pressure Switch S4 (option)

The manual-reset high pressure switch is located in the liquid line. When liquid line pressure exceeds the factory setting of  $410 \pm 10$  psi, the switch opens and shuts off the compressor.

### 4-Loss of Charge Switch S24 (option)

The loss of charge switch is N.C. auto re-set and located on the suction line of the compressor. The switch opens when suction line pressure drops to  $25 \pm 5$  psig and shuts off the compressor. The switch closes on a pressure rise at  $55 \pm 5$  psig. The settings are factory set and cannot be adjusted.

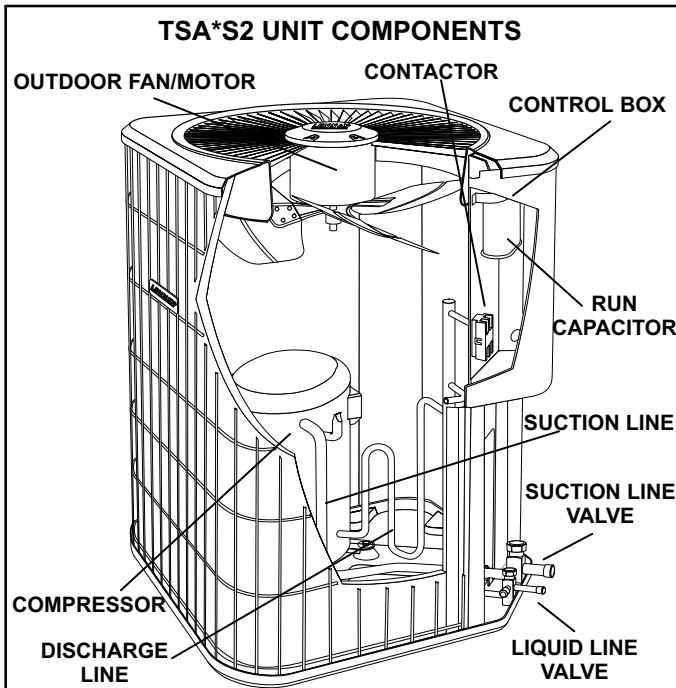


FIGURE 1

### Control Box

TSA\*S2 units are not equipped with a 24V transformer. All 24 VAC controls are powered by the indoor unit. Refer to wiring diagram.

Electrical openings are provided under the control box cover. Field thermostat wiring is made to color-coded pigtail connections.

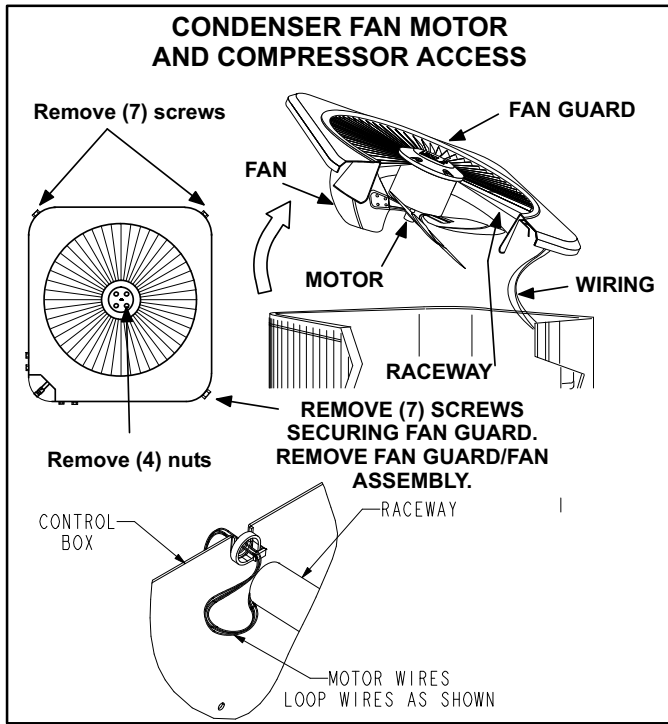


FIGURE 2

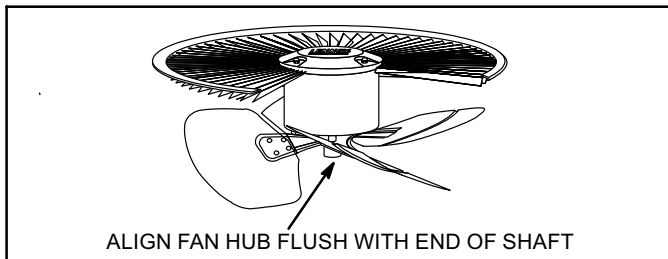


FIGURE 3

### 5-Start Kit (option)

The start kit consists of potential relay K31 and capacitor C7. K31 controls the operation of the starting circuit. K31 is normally closed when contactor K1 is de-energized. When K1 is energized, the compressor immediately begins start up. K31 remains closed during compressor start up and capacitor C7 remains in the circuit. When the compressor reaches approximately 75% of its speed, K31 is energized. When K31 is energized the contacts open and the capacitor is taken out of the circuit.

### 6-Crankcase Heater HR1 & Thermostat S40 (option)

Crankcase heater HR1 prevents liquid from accumulating in the compressor. HR1 is controlled by crankcase heater thermostat S40, located on the liquid line. When liquid line temperature drops below 50° F, S40 closes energizing HR1. S40 opens when liquid line temperature reaches 70°.

### 7-Compressor

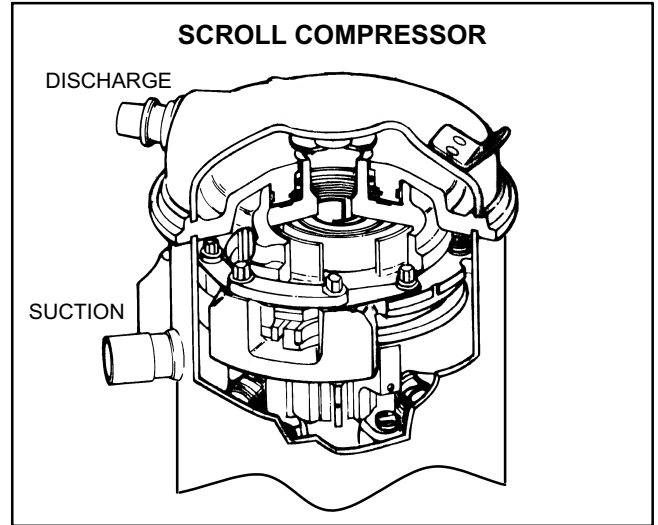
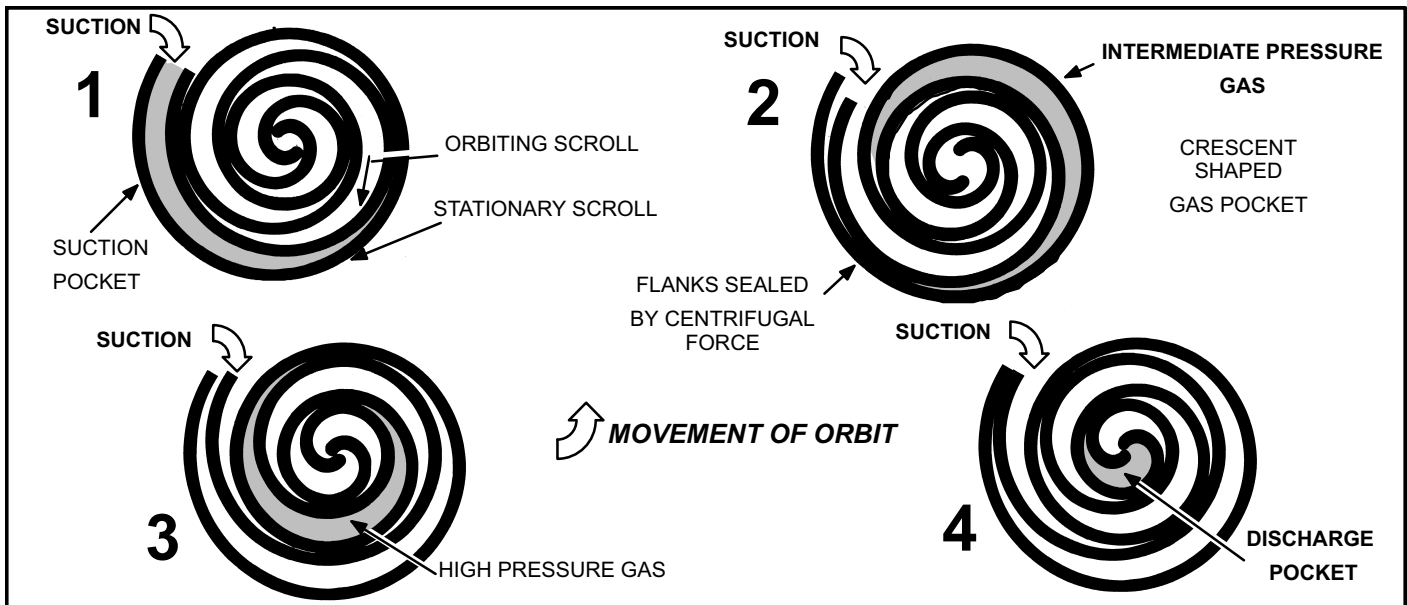


FIGURE 4

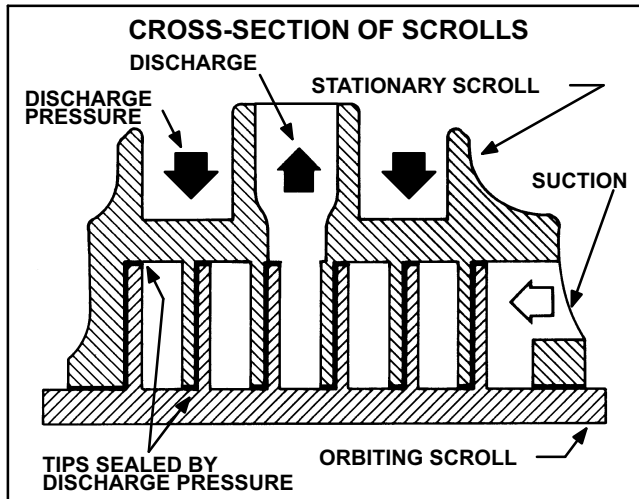
All TSA\*S2 units utilize a scroll compressor. The scroll compressor design is simple, efficient and requires few moving parts. A cutaway diagram of the scroll compressor is shown in figure 4. The scrolls are located in the top of the compressor can and the motor is located just below. The oil level 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. Two identical scrolls are mated together forming concentric spiral shapes (figure 6). One scroll remains stationary, while the other is allowed to "orbit" (figure 5). 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.*



**FIGURE 5**



**FIGURE 6**

The counterclockwise orbiting scroll draws gas into the outer crescent shaped gas pocket created by the two scrolls (figure 5 - 1). The centrifugal action of the orbiting scroll seals off the flanks of the scrolls (figure 5 - 2). As the orbiting motion continues, the gas is forced toward the center of the scroll and the gas pocket becomes compressed (figure 5 - 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 6). The discharge pressure forcing down on the top

scroll helps seal off the upper and lower edges (tips) of the scrolls (figure 6). During a single orbit, several pockets of gas are compressed simultaneously providing smooth continuous compression.

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

See compressor nameplate or ELECTRICAL DATA for compressor specifications.

## II - REFRIGERANT SYSTEM

### A - Plumbing

Field refrigerant piping consists of liquid and suction lines from the condensing unit (sweat connections) to the indoor evaporator coil (flare or sweat connections). Use Lennox L15 (sweat) series line sets as shown in table 1.

TABLE 1

Refrigerant Line Sets					
Model	Valve Field Size Connections		Recommended Line Set		
	Liquid Line	Suction Line	Liquid Line	Suction Line	L15 Line Sets
-036 -042 -048	3/8 in. (10 mm)	7/8 in. (22 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

**NOTE** - Units are designed for line sets of up to fifty feet (15 m). For applications longer than fifty feet, consult the Lennox Refrigerant Piping Guide (Corp. 9351-L9). Select line set diameters from table 1 to ensure that oil returns to the compressor.

### B - Service Valves

The liquid line and suction line service valves (figures 8 and 7) and gauge ports are used for leak testing, evacuating, charging and checking charge. Valves cannot be serviced. If a valve has failed, you must replace it.

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.

#### 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 the stem cap with an adjustable wrench.
- 2 - Use a service wrench with a hex-head extension to back the stem out counterclockwise as far as it will go.  
*NOTE - Use a 3/16" hex head extension for liquid line sizes or a 5/16" extension for vapor line sizes.*
- 3 - Replace the stem cap. Tighten finger tight, then tighten an additional 1/6 turn.

#### To Close Service Valve:

- 1 - Remove the stem cap with an adjustable wrench.
- 2 - Use a service wrench with a hex-head extension to turn the stem clockwise to seat the valve. Tighten the stem firmly.

*NOTE - Use a 3/16" hex head extension for liquid line sizes or a 5/16" extension for vapor line sizes.*

- 3 - Replace the stem cap. Tighten finger tight, then tighten an additional 1/6 turn.

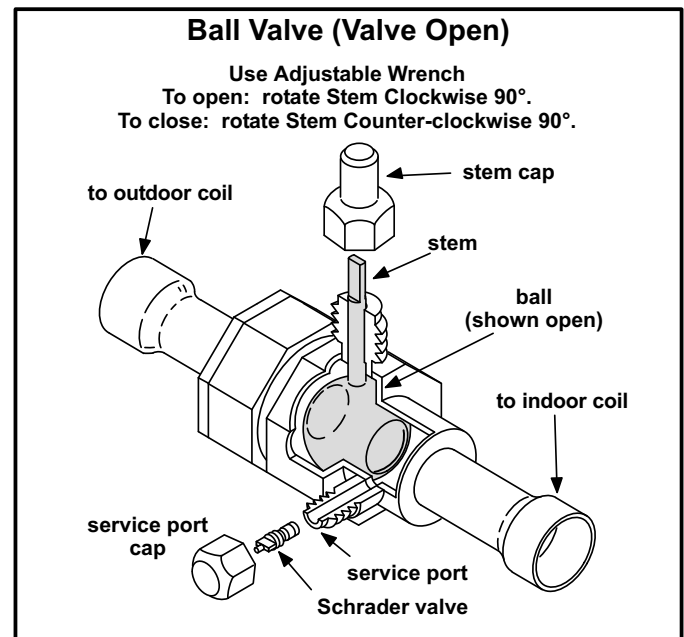


FIGURE 7

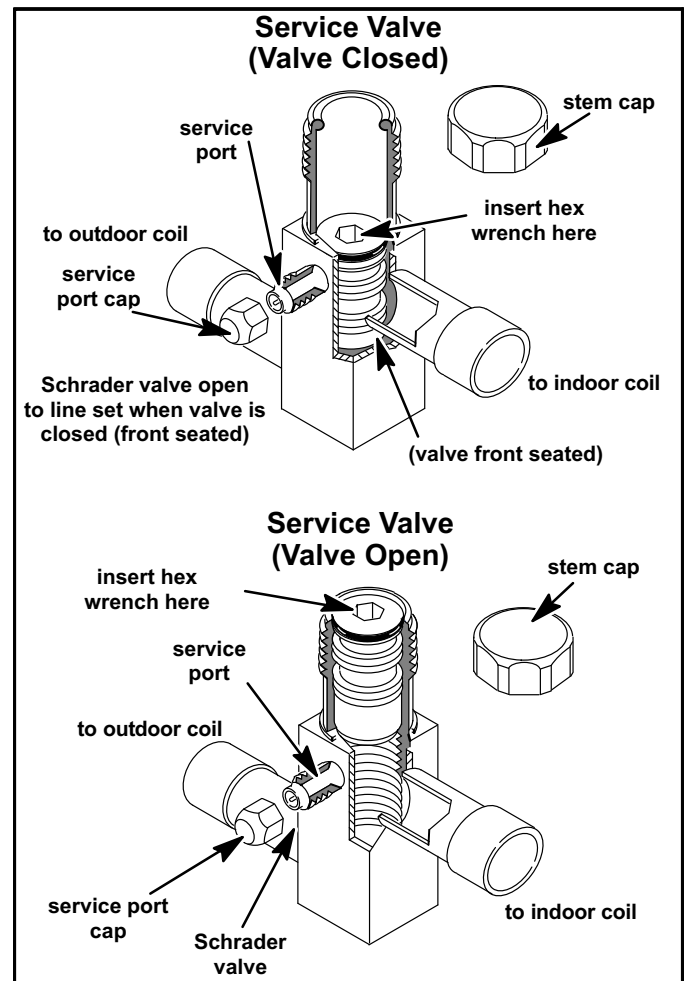


FIGURE 8

## Ball Valve (5 ton only)

Ball valves function the same way as the other valves, the difference is in the construction. A ball valve is illustrated in figure 7.

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.

### III - CHARGING

#### A - Pumping Down System

Remove existing HCFC-22 refrigerant using one of the following methods:

## ⚠ CAUTION

Deep vacuum operation (operating compressor below 0 psig) can cause internal fuse arcing resulting in a damaged or failed compressor. This type of damage will result in denial of warranty claim.

The system may be pumped down when leak checking the line set and indoor coil or making repairs to the line set or indoor coil. Attach gauge manifold then follow below:

- 1- Close liquid line valve.
- 2- Start outdoor unit.
- 3- Monitor suction gauge. Stop unit when 0 psig is reached.
- 4- Close vapor line valve.

#### B - Recovering Refrigerant

Remove existing HCFC-22 refrigerant using one of the following methods:

##### METHOD 1:

If the existing outdoor unit is not equipped with shut-off valves, or if the unit is not operational, then:

- 1-. Disconnect all power to the existing outdoor unit.
- 2-. Connect to the existing unit a gauge set, clean recovery cylinder and a recovery machine. Use the instructions provided with the recover machine on how to setup the connections.

- 3-. Remove all HCFC-22 refrigerant from the existing system. Check gauges after shutdown to confirm that the entire system is completely void of refrigerant.

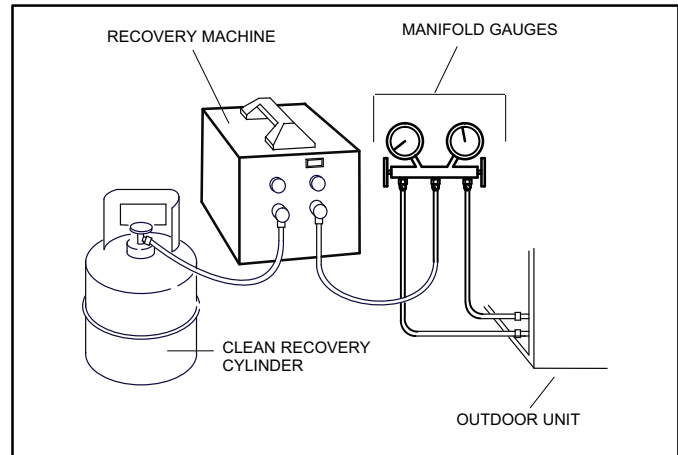


FIGURE 9 (Method 1)

*NOTE - Use recovery machine instructions for specific set-up requirements.*

##### METHOD 2:

If the existing outdoor unit is equipped with manual shut-off valves and you plan to use new HCFC-22 refrigerant to flush the system then:

- 1-. Start the existing HCFC-22 system in the cooling mode and close the liquid line valve.
- 2-. Pump all of the existing HCFC-22 refrigerant back into the outdoor unit.

*NOTE - It may be necessary to bypass the low pressure switches to ensure complete refrigerant evacuation.*

- 3-. When the low side system pressures reach 0 psig, close the suction line valve.
- 4-. Check gauges after shutdown to confirm that the valves are not allowing refrigerant to flow back into the low side of the system.



## C - Leak Testing

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

### 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 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 or Halide

- 1 - Connect a cylinder of HCFC-22 to the center port of the manifold gauge set.
- 2 - With both manifold valves closed, open the valve on the HCFC-22 cylinder (vapor only).
- 3 - Open the high pressure side of the manifold to allow the HCFC-22 into the line set and indoor unit. Weigh in a trace amount of HCFC-22. [A trace amount is a maximum of 2 ounces (57 g) or 3 pounds (31 kPa) pressure.] Close the valve on the HCFC-22 cylinder and the valve on the high pressure side of the manifold gauge set. Disconnect the HCFC-22 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 HCFC-22 mixture. Correct any leaks and recheck.

## D - Evacuating the System

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.

*NOTE - This evacuation process is adequate for a new installation with clean and dry lines. If excessive moisture is present, the evacuation process may be required more than once.*

### 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 10,000 microns.

- 1 - Connect manifold gauge set to the service valve ports :
  - 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 the 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.

## E - Charging for 036-1, 042-1, 048-1, 048-2 & 060-1

Units are factory-charged with the amount of HCFC-22 refrigerant indicated on the unit rating plate. This charge is based on a matching indoor coil and outdoor coil with 15 feet (4.6 m) line set. For varying lengths of line set, refer to table 2 for refrigerant charge adjustment.

TABLE 2

Refrigerant Charge per Line Set Lengths	
Liquid Line Set Diameter	Oz. per 5 ft. (g per 1.5 m) adjust from 15 ft. (4.6 m) line set*
3/8 in. (9.5 mm)	3 ounce per 5 ft. (85 g per 1.5 m)
<small>NOTE - *If line length is greater than 15 ft. (4.6 m), add this amount. If line length is less than 15 ft. (4.6 m), subtract this amount.</small>	

The outdoor unit should be charged during warm weather. However, applications arise in which charging must occur in the colder months. The method of charging is determined by the unit's **refrigerant metering device** and the **outdoor ambient temperature**.

Measure the liquid line temperature and the outdoor ambient temperature as outlined below:

- 1-. Connect the manifold gauge set to the service valves:
  - low pressure gauge to *vapor* valve service port
  - high pressure gauge to *liquid* valve service port
- 2-. Close manifold gauge set valves. Connect the center manifold hose to an upright cylinder of HCFC-22.
- 3-. Set the room thermostat to call for heat. This will create the necessary load for properly charging the system in the cooling cycle.
- 4-. Use a digital thermometer to record the outdoor ambient temperature.
- 5-. When the heating demand has been satisfied, switch the thermostat to cooling mode with a set point of 68°F (20°C). When pressures have stabilized, use a digital thermometer to record the liquid line temperature.
- 6-. The outdoor temperature will determine which charging method to use. Proceed with the appropriate charging procedure.

### Charge Using Weigh-in Method (Fixed Orifice/TXV Systems) - Outdoor Temp. <65°F (18°C)

If the system is void of refrigerant, or if the outdoor ambient temperature is cool, use the weigh-in method to charge 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 charge according to the total amount shown on the unit nameplate.

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

**⚠ CAUTION**

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

- 7 - Shut off the nitrogen cylinder and remove the manifold gauge hose from the cylinder. Open the manifold gauge valves to release the nitrogen from the line set and indoor unit.
- 8 - Reconnect the manifold gauge to the vacuum pump, turn the pump on, and continue to evacuate the line set and indoor unit until the absolute pressure does not rise above 500 microns (29.9 inches of mercury) within a 20-minute period after shutting off the vacuum pump and closing the manifold gauge valves.
- 9 - When the absolute pressure requirement above has been met, disconnect the manifold hose from the vacuum pump and connect it to an upright cylinder of R-22 refrigerant. Open the manifold gauge valves to break the vacuum from 1 to 2 psig positive pressure in the line set and indoor unit. Close manifold gauge valves and shut off the R-22 cylinder and remove the manifold gauge set.

### Charge Using Subcooling Method (Fixed Orifice Systems) - Outdoor Temp. $\geq 65^{\circ}\text{F}$ ( $18^{\circ}\text{C}$ )

If you charge a fixed orifice system when the outdoor ambient is  $65^{\circ}\text{F}$  ( $18^{\circ}\text{C}$ ) or above, use the subcooling method to charge the unit.

- 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 HCFC-22 to determine the saturation temperature for the liquid line pressure reading.
- 4-. Subtract the liquid line temperature from the saturation temperature (according to the chart) to determine subcooling.
 
$$\text{---}^{\circ} \text{ Saturation Temperature } ^{\circ}\text{F} (^{\circ}\text{C})$$

$$\text{---}^{\circ} \text{ Liquid Line Temperature } ^{\circ}\text{F} (^{\circ}\text{C})$$

$$= \text{---}^{\circ} \text{ Subcooling Value } ^{\circ}\text{F} (^{\circ}\text{C})$$
- 5-. Compare the subcooling value with those in table 3. If subcooling is greater than shown, recover some refrigerant. If subcooling is less than shown, add some refrigerant.

**TABLE 3**

Subcooling Values For Fixed Orifice Systems					
Outdoor Temp. $^{\circ}\text{F} (^{\circ}\text{C})$	TSA*S2 Model				
	036	042	048-1 units	048	060
	Liquid Subcooling [ $\pm 1^{\circ}\text{F}$ ( $.6^{\circ}\text{C}$ )]				
65 (18)	14 (8)	15 (8.3)	9 (5)	11 (6)	13 (7)
70 (21)	13 (7)	14 (8)	9 (5)	10 (5.6)	12 (6.7)
75 (24)	13 (7)	13 (7)	9 (5)	9 (5)	12 (6.7)
80 (27)	12 (6.7)	12 (6.7)	9 (5)	8 (4.5)	12 (6.7)
85 (29)	11 (6)	11 (6)	9 (5)	7 (4)	11 (6)
90 (32)	10 (5.6)	10 (5.6)	9 (5)	5 (2.8)	10 (5.6)
95 (35)	9 (5)	9 (5)	9 (5)	5 (2.8)	10 (5.6)
100 (38)	9 (5)	8 (4.5)	9 (5)	3 (1.7)	9 (5)
105 (41)	8 (4.5)	7 (4)	9 (5)	3 (1.7)	9 (5)
110 (43)	6 (3.3)	7 (4)	9 (5)	2 (1.1)	9 (5)
115 (45)	6 (3.3)	5 (3)	8 (4.5)	2 (1.1)	8 (4.5)

### Charge Using Approach Method (TXV Systems) - Outdoor Temperature $\geq 65^{\circ}\text{F}$ ( $18^{\circ}\text{C}$ )

When charging an expansion valve system when the outdoor ambient temperature is  $65^{\circ}\text{F}$  ( $18^{\circ}\text{C}$ ) or above, it is best to charge the unit using the approach method. Subtract the outdoor ambient temperature from the liquid line temperature to determine the approach temperature.

The resulting difference (approach temperature) should agree with the values given in table 4. If not, add refrigerant to lower the approach temperature or recover refrigerant from the system to increase the approach temperature.

**TABLE 4**

TSA*S2 Approach Values				
	$\text{---}^{\circ}$	Liquid Line Temperature $^{\circ}\text{F} (^{\circ}\text{C})$		
	$\text{---}^{\circ}$	Outdoor Temperature $^{\circ}\text{F} (^{\circ}\text{C})$		
	$=$	Approach Temperature $^{\circ}\text{F} (^{\circ}\text{C})$		
TSA*S2 Model	036	042	048	060
Temp. $^{\circ}\text{F} (^{\circ}\text{C})$	9 (5)	6 (3.3)	6 (5 (2.8))	8 (4.4)
Approach Value is the Liquid Line Temperature minus Outdoor Ambient Temperature [ $^{\circ}\text{F} (^{\circ}\text{C}) \pm 1^{\circ}\text{F} (0.5^{\circ}\text{C})$ ] NOTE - For best results, use the same digital thermometer to check both outdoor ambient and liquid temperatures.				

## IMPORTANT

Use table 5 to help perform maintenance checks. Table 5 is not a procedure for charging the system. Minor variations in these pressures may be due to differences in installations. Significant deviations could mean that the system is not properly charged or that a problem exists with some component in the system.

**TABLE 5**

<b>Normal Operating Pressures</b>				
<b>TSA*S2 Model</b>	<b>036</b>	<b>042</b>	<b>048-2 (-1 units)</b>	<b>060</b>
Values below are typical pressures; indoor unit match up, indoor air quality equipment, and indoor load will cause the pressures to vary.				
<b>*Temp. °F (°C)</b>	<b>Liquid Line / Vapor Line</b>			
<b>Expansion Valve (TXV)</b>				
<b>65 (18)</b>	145 / 74	143 / 78	140 / 77 (145 / 80)	151 / 76
<b>70 (21)</b>	157 / 75	153 / 79	152 / 77 (157 / 81)	164 / 77
<b>75 (24)</b>	170 / 76	167 / 80	165 / 77 (170 / 81)	177 / 78
<b>80 (27)</b>	186 / 76	182 / 80	179 / 78 (184 / 82)	192 / 78
<b>85 (29)</b>	201 / 77	198 / 81	192 / 79 (198 / 82)	207 / 79
<b>90 (32)</b>	217 / 77	215 / 81	209 / 80	223 / 80
<b>95 (35)</b>	234 / 78	231 / 82	227 / 81 (230 / 84)	240 / 80
<b>100 (38)</b>	251 / 79	249 / 83	243 / 81 (247 / 84)	259 / 81
<b>105 (41)</b>	268 / 79	268 / 84	261 / 82 (265 / 85)	277 / 81
<b>110 (43)</b>	288 / 80	287 / 84	279 / 83 (283 / 85)	297 / 82
<b>115 (45)</b>	309 / 81	308 / 85	296 / 83 (303 / 86)	318 / 83
<b>Fixed Orifice (RFC)</b>				
<b>65 (18)</b>	150 / 67	147 / 70	143 / 73 (145 / 70)	150 / 67
<b>70 (21)</b>	162 / 70	158 / 72	154 / 75 (156 / 72)	163 / 70
<b>75 (24)</b>	176 / 72	171 / 75	167 / 78 (170 / 75)	177 / 72
<b>80 (27)</b>	190 / 74	184 / 77	180 / 79 (183 / 78)	191 / 75
<b>85 (29)</b>	205 / 76	198 / 78	193 / 81 (198 / 80)	207 / 77
<b>90 (32)</b>	220 / 78	213 / 80	207 / 82 (213 / 82)	221 / 79
<b>95 (35)</b>	237 / 79	228 / 81	221 / 84 (230 / 84)	239 / 80
<b>100 (38)</b>	255 / 80	245 / 82	237 / 85 (246 / 85)	256 / 81
<b>105 (41)</b>	273 / 81	262 / 84	253 / 86 (264 / 86)	274 / 83
<b>110 (43)</b>	291 / 83	281 / 84	269 / 87 (282 / 87)	295 / 84
<b>115 (45)</b>	314 / 84	300 / 85	289 / 88 (301 / 88)	315 / 85
*Temperature of the air entering the outside coil.				

## F - Charging for

**036-2, 042-2, 048-3 & 060-2**

### SETTING UP TO CHECK CHARGE

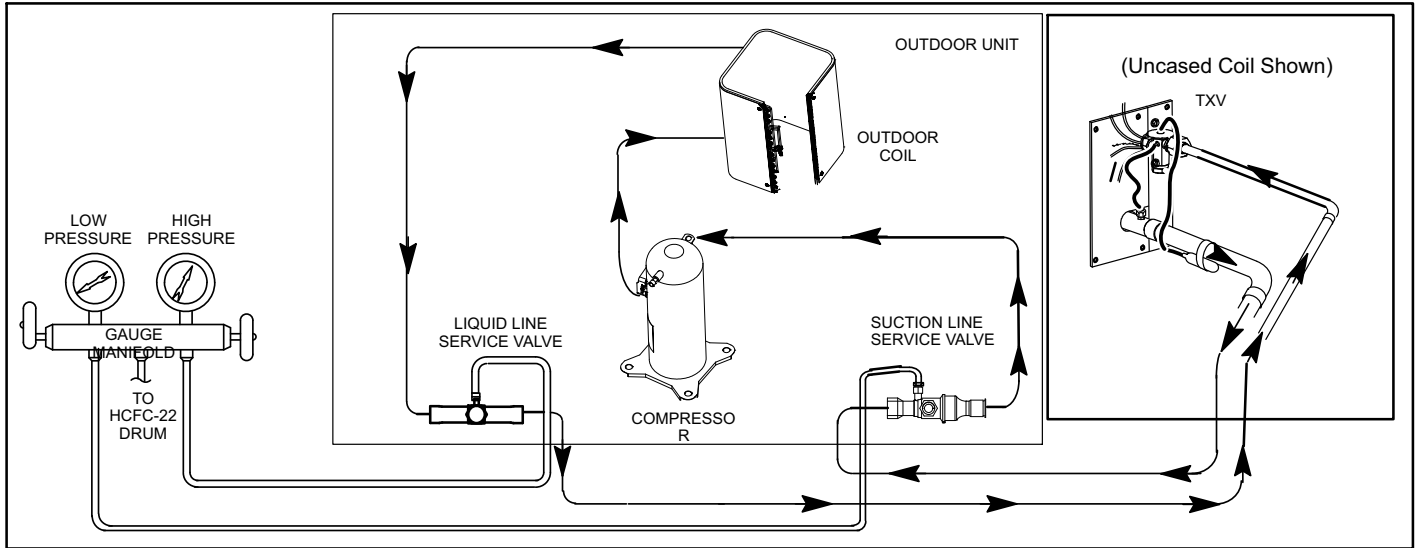
- 1-. Close manifold gauge set valves. Connect the center manifold hose to an upright cylinder of HCFC-22.
- 2-. Connect the manifold gauge set to the unit's service ports as illustrated in figure 10.
  - low pressure gauge to **suction service port**
  - high pressure gauge to **liquid service port**

## INDOOR AIRFLOW CHECK

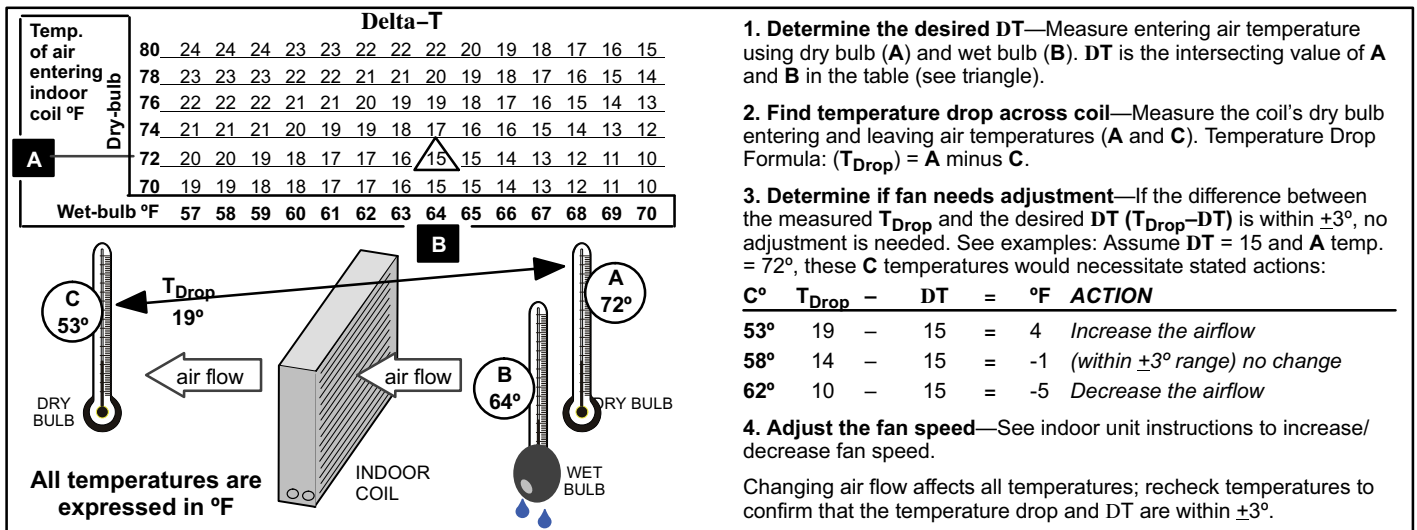
Check airflow using the Delta-T (DT) process using the illustration in figure 11.

### DETERMINING CHARGE METHOD

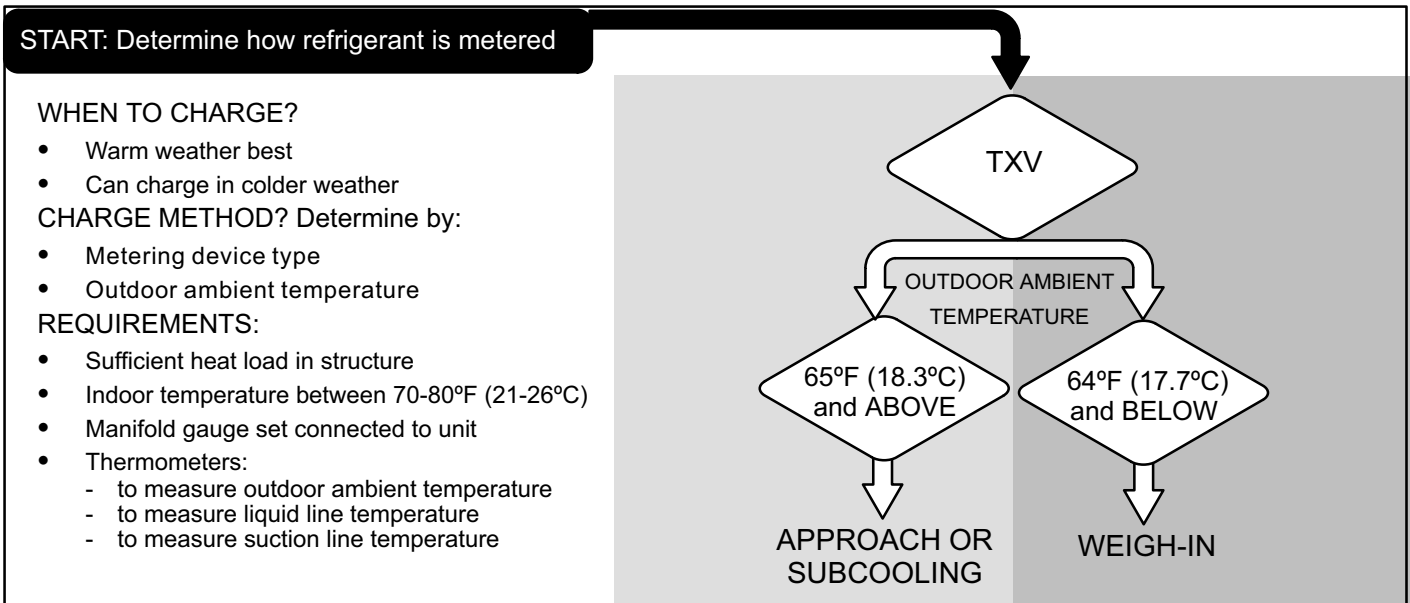
Use the illustration in figure 12 to determine the correct charging method.



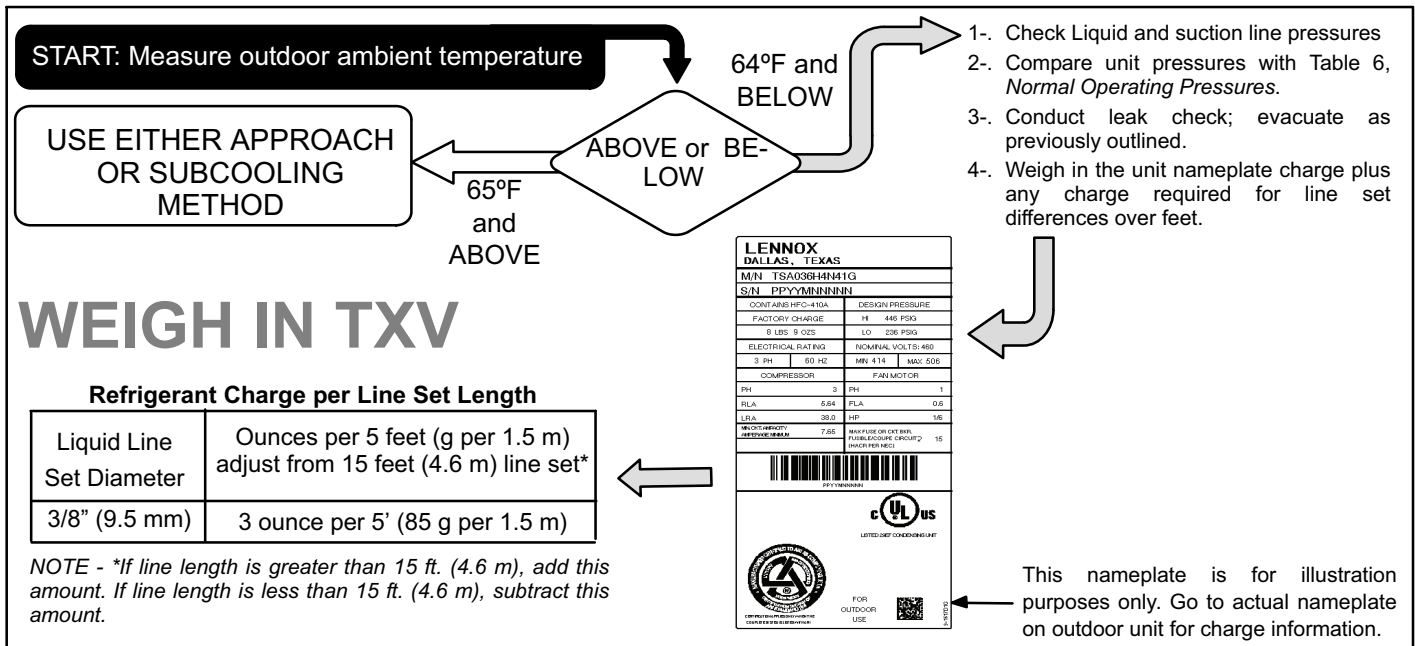
**FIGURE 10 Typical Manifold Gauge Connection Setup**



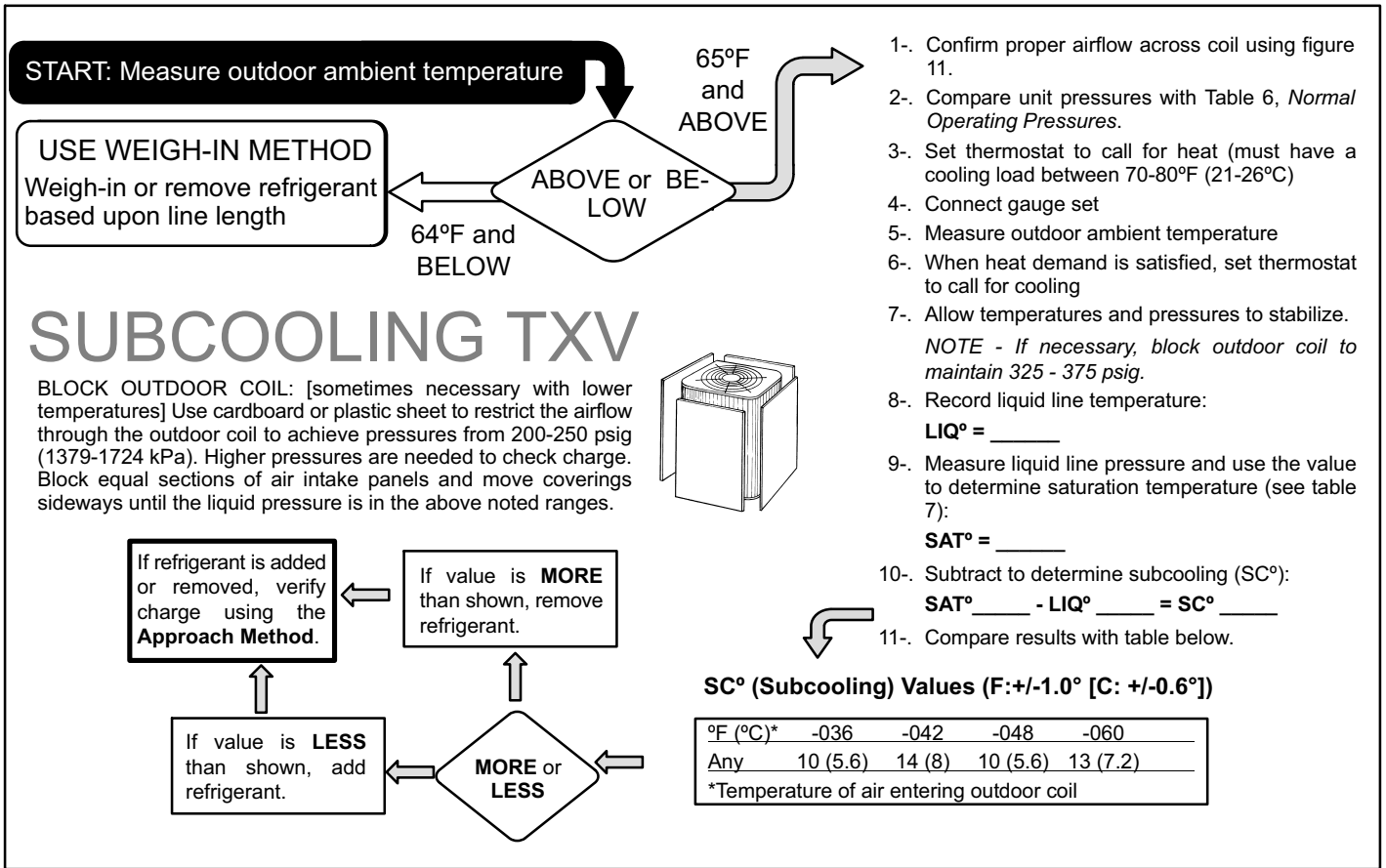
**FIGURE 11 Checking Indoor Airflow over Evaporator Coil using Delta-T Chart**



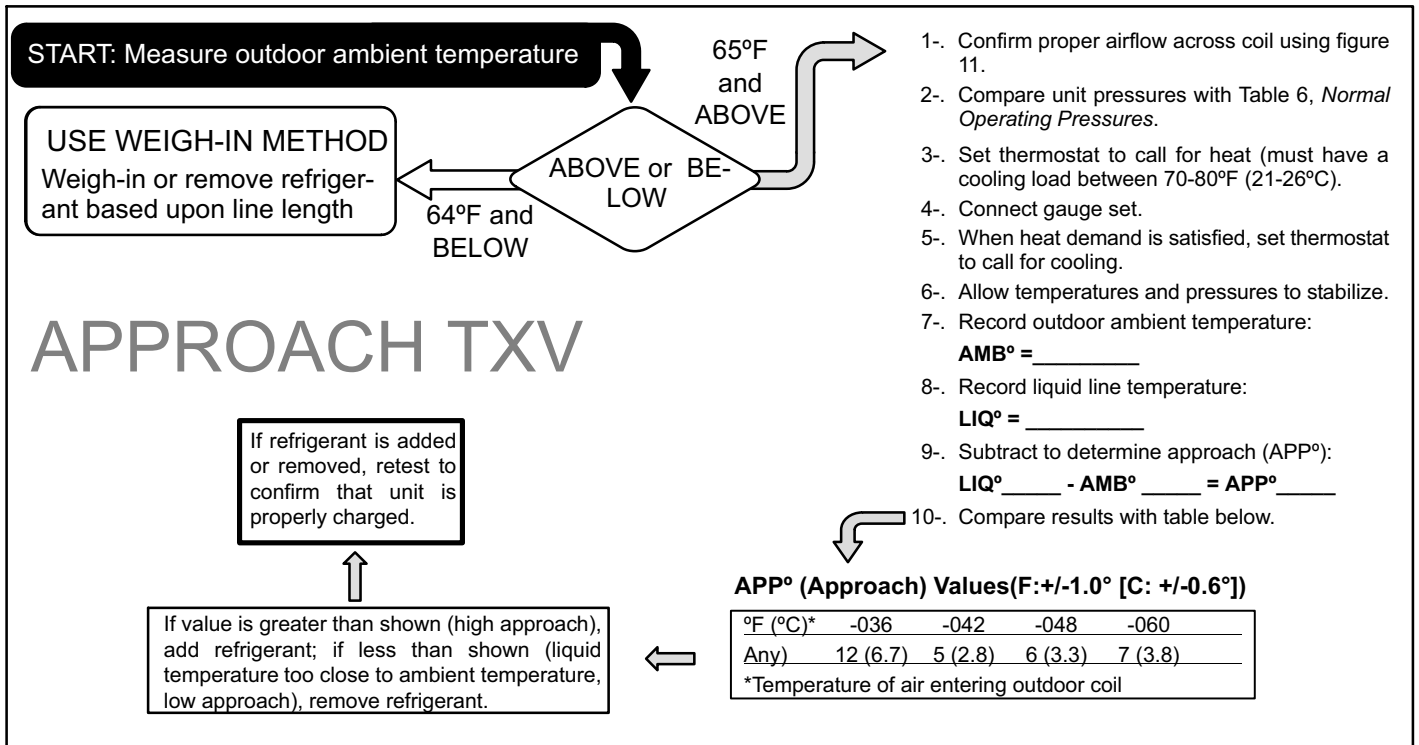
**FIGURE 12 Determining Charge Method**



**FIGURE 13 HCFC-22 Weigh In**



**FIGURE 14 HCFC-22 Subcooling TXV Charge**



**FIGURE 15 HCFC-22 Approach TXV Charge**

**TABLE 6**  
**HCFC-22 Normal Operating Pressures (Liquid +10 and Suction +5 psig)**

**⚠ IMPORTANT**

**Use this table to perform maintenance checks; it is not a procedure for charging the system. Minor variations in these pressures may be due to differences in installations. Significant deviations could mean that the system is not properly charged or that a problem exists with some component in the system.**

TSA*S2	-036	-042	-048	-060
°F (°C)*	Liquid / Suction	Liquid / Suction	Liquid / Suction	Liquid / Suction
<b>Expansion Valve (TXV)</b>				
65 (18)	155 / 79	147 / 78	144 / 77	152 / 73
70 (21)	169 / 80	158 / 78	152 / 77	164 / 75
75 (24)	183 / 81	172 / 79	163 / 78	177 / 77
80 (27)	199 / 81	189 / 79	179 / 78	192 / 78
85 (29)	215 / 82	205 / 80	195 / 79	208 / 79
90 (32)	233 / 82	222 / 81	212 / 80	225 / 80
95 (35)	252 / 83	241 / 81	229 / 80	243 / 80
100 (38)	271 / 83	259 / 82	245 / 81	261 / 81
105 (41)	291 / 84	279 / 82	265 / 81	280 / 82
110 (43)	311 / 85	299 / 83	287 / 82	299 / 83
115 (45)	331 / 86	320 / 84	309 / 83	320 / 83

**TABLE 7.**  
**HCFC-22 Temperature (°F) - Pressure (Psig)**

°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig
32	57.5	50	84.1	68	117.3	86	158.2	104	207.7	122	267.1	140	337.4
33	58.8	51	85.7	69	119.4	87	160.7	105	210.8	123	270.7	141	341.6
34	60.2	52	87.4	70	121.4	88	163.2	106	213.8	124	274.3	142	345.9
35	61.5	53	89.1	71	123.5	89	165.8	107	216.9	125	278.0	143	350.3
36	62.9	54	90.8	72	125.7	90	168.4	108	220.0	126	281.7	144	354.6
37	64.3	55	92.6	73	127.8	91	171.0	109	223.2	127	285.4	145	359.0
38	65.7	56	94.4	74	130.0	92	173.7	110	226.4	128	289.2	146	363.5
39	67.1	57	96.1	75	132.2	93	176.4	111	229.6	129	293.0	147	368.0
40	68.6	58	98.0	76	134.5	94	179.1	112	232.8	130	296.9	148	372.5
41	70.0	59	99.8	77	136.7	95	181.8	113	236.1	131	300.8	149	377.1
42	71.5	60	101.6	78	139.0	96	184.6	114	239.4	132	304.7	150	381.7
43	73.0	61	103.5	79	141.3	97	187.4	115	242.8	133	308.7		
44	74.5	62	105.4	80	143.6	98	190.2	116	246.1	134	312.6		
45	76.1	63	107.3	81	146.0	99	193.0	117	249.5	135	316.7		
46	77.6	64	109.3	82	148.4	100	195.9	118	253.0	136	320.7		
47	79.2	65	111.2	83	150.8	101	198.8	119	256.5	137	324.8		
48	80.8	66	113.2	84	153.2	102	201.8	120	260.0	138	329.0		
49	82.4	67	115.3	85	155.7	103	204.7	121	263.5	139	333.2		



## IV - MAINTENANCE

### **⚠ WARNING**

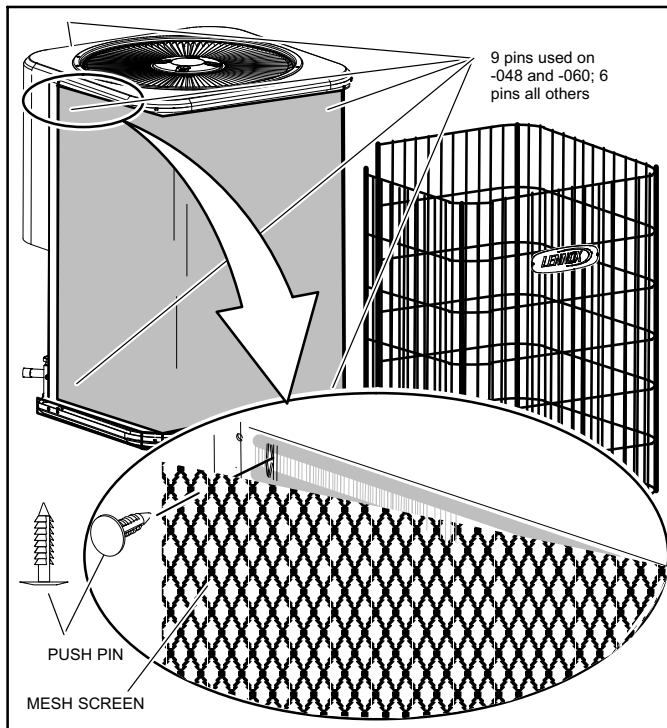


**Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit OFF at disconnect switch(es). Unit may have multiple power supplies.**

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

- 1 - Clean and inspect outdoor coil. The coil may be flushed with a water hose. Make sure power is off before cleaning.

The outdoor coil is protected by an inner mesh screen and a wire cage (see figure 16).



**FIGURE 16**

If debris has collected between the mesh screen and the coil and cannot be dislodged by spraying unpressurized water from inside coil surface to the outside, the mesh may be removed by first removing the top of the unit which will allow for removal of the wire cage.

Then, using pliers to grip the head of the push pins, pull straight out to extract the push pins along one side of the coil. If necessary, remove the push pins along the back of the unit; it is usually unnecessary to fully remove the inner mesh screen.

Drape the mesh screen back and wash the coil. When all the debris has been removed from the coil, reinstall the mesh screen by positioning it in its original position and reinserting the push pin. No tool is required to push the pin back into the same slot in the fins.

If the push pin is loose and tends not to stay in place, brush the fins with a fin brush (22 fins/in). Line up the push pin a couple fins to the right or left of the original hole and re-insert the pin.

- 2 - Condenser fan motor is prelubricated and sealed. No further lubrication is needed.
- 3 - Visually inspect connecting lines and coils for evidence of oil leaks.
- 4 - Check wiring for loose connections.
- 5 - Check for correct voltage at unit (unit operating).
- 6 - Check amp-draw condenser fan motor.  
Unit nameplate \_\_\_\_\_ Actual \_\_\_\_\_.

*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**

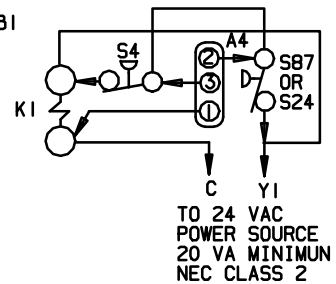
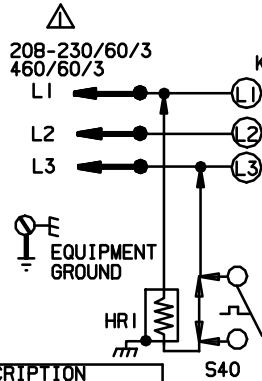
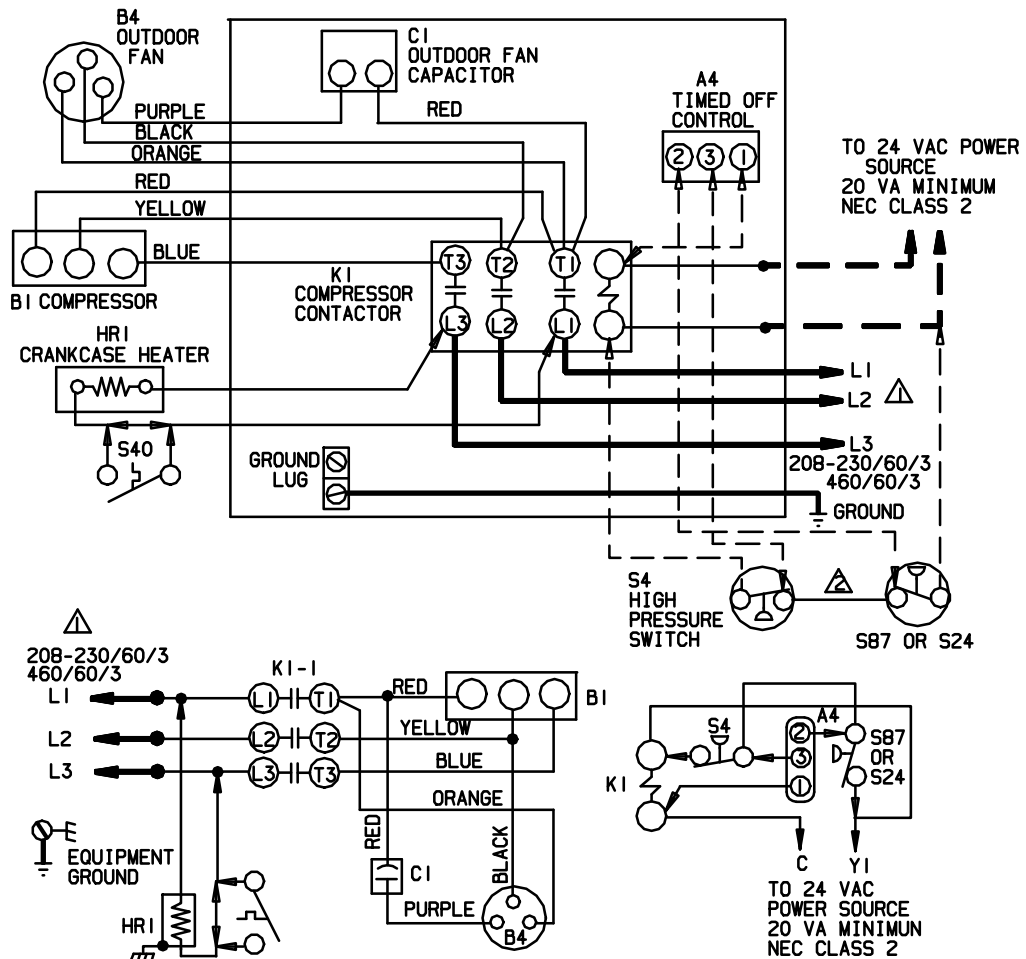
- 1 - Clean coil, if necessary.
- 2 - Check connecting lines and coils for evidence of oil leaks.
- 3 - Check the condensate line and clean it if necessary.

### **Indoor Unit**

- 1 - Clean or change filters.
- 2 - 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.
- 3 - *Belt Drive Blowers* - Check belt for wear and proper tension.
- 4 - Check all wiring for loose connections
- 5 - Check for correct voltage at unit (blower operating).
- 6 - Check amp-draw on blower motor  
Unit nameplate \_\_\_\_\_ Actual \_\_\_\_\_.

# V - WIRING DIAGRAMS AND SEQUENCE OF OPERATION

## TSA\*S2036, 042, 048, 060



KEY	DESCRIPTION
A4	CONTROL-TIMED OFF
B1	COMPRESSOR
B4	MOTOR-OUTDOOR FAN
C1	CAPACITOR-OUTDOOR FAN
HR1	HEATER-COMPRESSOR
K1-1	CONTACTOR-COMPRESSOR
S4	SWITCH-HIGH PRESSURE
S24	SWITCH-LOSS OF CHARGE
S40	THERMOSTAT-CRANKCASE

⚠ FOR USE WITH COPPER CONDUCTORS ONLY. REFER TO UNIT RATING PLATE FOR MINIMUM CIRCUIT AMPACITY AND MAXIMUM OVER-CURRENT PROTECTION SIZE

⚡ JUMPER IS USED WHEN TOC IS NOT USED

**WARNING-**  
ELECTRIC SHOCK HAZARD, CAN CAUSE INJURY OR DEATH. UNIT MUST BE GROUND IN ACCORDANCE WITH NATIONAL AND LOCAL CODES.

— LINE VOLTAGE FIELD INSTALLED  
- - - CLASS 11 VOLTAGE FIELD INSTALLED

NOTE- The thermostat used may be electromechanical or electronic.

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

### COOLING:

- 1- Cooling demand initiates at Y1 in the thermostat.
- 2- 24VAC from indoor unit (Y1) energizes contactor K1.
- 3- K1-1 N.O. closes, energizing compressor (B1) and outdoor fan motor (B4).

### END OF COOLING DEMAND:

- 4- Cooling demand is satisfied. Terminal Y1 is de-energized.
- 5- Compressor contactor K1 is de-energized.
- 6- K1-1 opens and compressor (B1) and outdoor fan motor (B4) are de-energized and stop immediately.

1005	Supersedes Form No.
	New Form No. 535,274W

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