

INSTALLATION AND MAINTENANCE INSTRUCTIONS 2SHP13 Series Split System Heat Pump

WARNING

The equipment covered in this manual is to be installed by trained and experienced service and installation technicians. Improper installation, modification, service, or use can cause electrical shock, fire, explosion, or other conditions which may cause personal injury, death, or property damage. Use appropriate safety gear including safety glasses and gloves when installing this equipment.

WARNING

Risk of electrical shock. Disconnect all remote power supplies before installing or servicing any portion of the system. Failure to disconnect power supplies can result in property damage, personal injury, or death.

WARNING

Installation and servicing of air conditioning equipment can be hazardous due to internal refrigerant pressure and live electrical components. Only trained and qualified service personnel should install or service this equipment. Installation and service performed by unqualified persons can result in property damage, personal injury, or death.

WARNING

Sharp metal edges can cause injury. When installing the unit, use care to avoid sharp edges.

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Manufactured By
A.A.C.

A Lennox International Inc. Company
421 Monroe Street
Bellevue, OH 44811



Save these instructions for future reference

INSTALLATION

General

Read this entire instruction manual, as well as the instructions supplied in separate equipment, before starting the installation. Observe and follow all warnings, cautions, instructional labels, and tags. Failure to comply with these instructions could result in an unsafe condition and/or premature component failure.

These instructions are intended as a general guide only for use by qualified personnel and do not supersede any national or local codes in any way. The installation must comply with all provincial, state, and local codes as well as the National Electrical Code (U.S.) or Canadian Electrical Code (Canada). Compliance should be determined prior to installation.

When servicing or repairing HVAC components, ensure the fasteners are appropriately tightened. Table 1 shows torque values for fasteners.

Fastener	Torque
Stem Caps	8 ft. lbs.
Service Port Caps	8 ft. lbs.
Sheet Metal Screws	16 in. lbs.
#8 Machine Screws	16 in. lbs.
#10 Machine Screws	28 in. lbs.
Compressor Bolts	90 in. lbs.

Table 1

Inspection of Shipment

Upon receipt of equipment, carefully inspect it for possible shipping damage. If damage is found, it should be noted on the carrier's freight bill. Take special care to examine the unit inside the carton if the carton is damaged. Any concealed damage discovered should be reported to the last carrier immediately, preferably in writing, and should include a request for inspection by the carrier's agent.

If any damages are discovered and reported to the carrier DO NOT INSTALL THE UNIT, as claim may be denied.

Check the unit rating plate to confirm specifications are as ordered.

Location of Unit

Outdoor units operate under a wide range of weather conditions; therefore, multiple factors must be considered when positioning the unit. The unit must be positioned to give adequate clearances for sufficient airflow and servicing. Refer to Figure 1 for installation clearances.

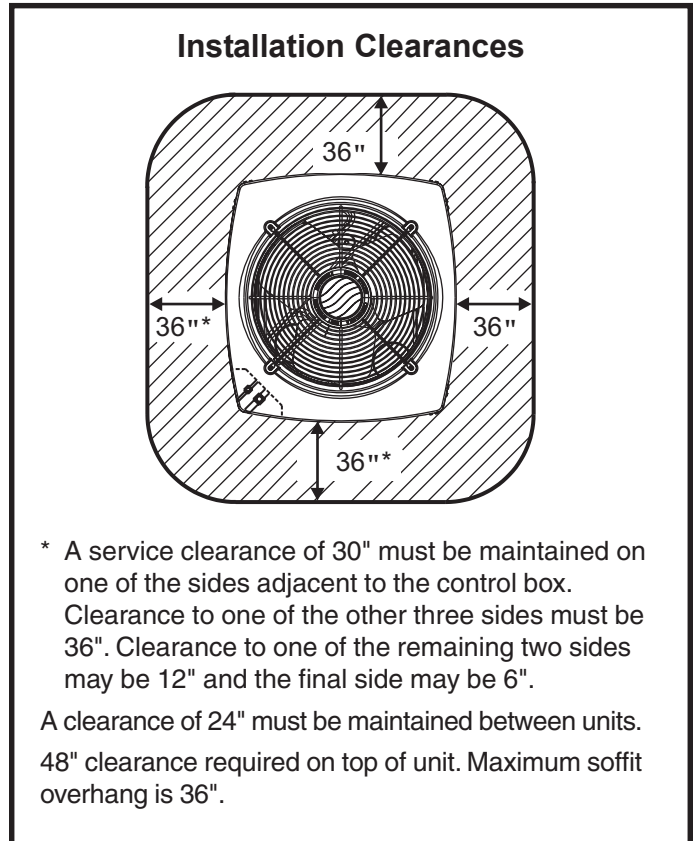


Figure 1

- Place a sound-absorbing material, such as Isomode, under the unit if it will be installed in a location or position that will transmit sound or vibration to the living area or adjacent buildings.
- Install the unit high enough above the ground or roof to allow adequate drainage of defrost water and prevent ice buildup.
- In heavy snow areas, do not locate the unit where drifting snow will occur. The unit base should be elevated above the depth of average snows.

NOTE: Elevation of the unit may be accomplished by constructing a frame using suitable materials. If a support frame is constructed, it must not block drain holes in unit base.

- When installed in areas where low ambient temperatures exist, locate unit so winter prevailing winds do not blow directly into outdoor coil.

- Locate unit away from overhanging roof lines which would allow water or ice to drop on, or in front of, coil or into unit.

Slab Mounting

When installing a unit at grade level, install on slab high enough above grade so that water from higher ground will not collect around the unit (see Figure 2). Slab should have a slope tolerance away from the building of 2° or 2" per 5'. This will prevent ice from building up under the unit during a defrost cycle. Refer to following roof mounting section for barrier construction if unit must face prevailing winter winds.

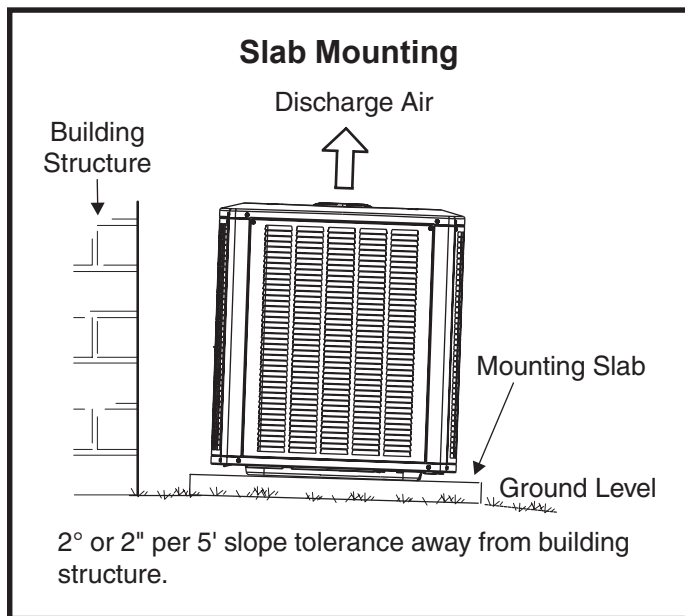


Figure 2

Roof Mounting

Install unit at a minimum of 6" above surface of the roof to avoid ice buildup around the unit. Locate the unit above a load bearing wall or area of the roof that can adequately support the unit. Consult local codes for rooftop applications.

If unit coil cannot be mounted away from prevailing winter winds, a wind barrier should be constructed (see Figure 3). Size the barrier at least the same height and width as the outdoor unit. Mount barrier 24" from the sides of the unit in the direction of the prevailing winds.

Electrical Wiring

All field wiring must be done in accordance with the National Electrical Code (NEC) recommendations, Canadian Electrical Code (CEC) and CSA Standards, or local codes, where applicable.

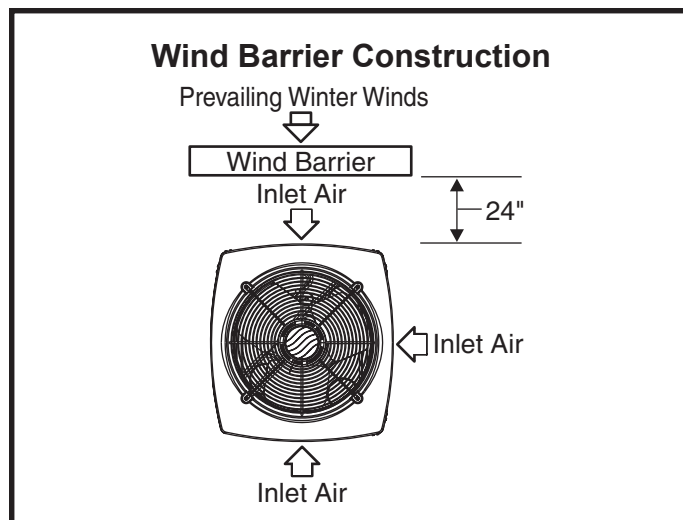


Figure 3

⚠ WARNING

Unit must be grounded in accordance with national and local codes. Failure to ground unit properly can result in personal injury or death.

⚠ WARNING

Line voltage is present at all components when unit is not in operation on units with single pole contactors. Disconnect all remote electric power supplies before opening access panel. Unit may have multiple power supplies. Failure to disconnect all power supplies could result in personal injury or death.

Refer to the furnace or blower coil Installation Instructions for additional wiring application diagrams and refer to unit rating plate for minimum circuit ampacity and maximum overcurrent protection size.

1. Install line voltage power supply to unit from a properly sized disconnect switch. Any excess high voltage field wiring should be trimmed or secured away from the low voltage field wiring.
2. Ground unit at unit disconnect switch or to an earth ground. To facilitate conduit, a hole is in the bottom of the control box. Connect conduit to the control box using a proper conduit fitting. Units are approved for use only with copper conductors. 24V Class II circuit connections are made in the low voltage junction box. A complete unit wiring diagram is located inside the unit control box cover (see also pages 20 and 21 of this instruction).

3. Install room thermostat on an inside wall that is not subject to drafts, direct sunshine, or other heat sources.
4. Install low voltage wiring from outdoor to indoor unit and from thermostat to indoor unit (see Figure 4).
5. Do not bundle any excess 24V control wire inside control box. Run control wire through installed wire tie and tighten wire tie to provide low voltage strain relief and to maintain separation of field-installed low and high voltage circuits.

Refrigerant Piping

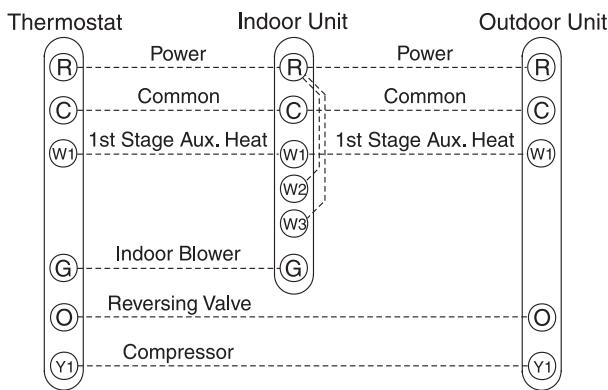
Field refrigerant piping consists of liquid and suction lines from the outdoor unit (sweat connections) to the indoor coil (flare or sweat connections).

Select line set diameters from Table 2 to ensure that oil returns to the compressor. Size vertical suction riser to maintain minimum velocity at minimum capacity. Recommended line length is 50' or less. If more than 50' line set is required, contact Technical Services at (419) 483-4840. Table 2 shows the diameters for line sets up to 100' although vertical lift applications and trapping requirements need to be reviewed with Technical Services for line sets over 50'.

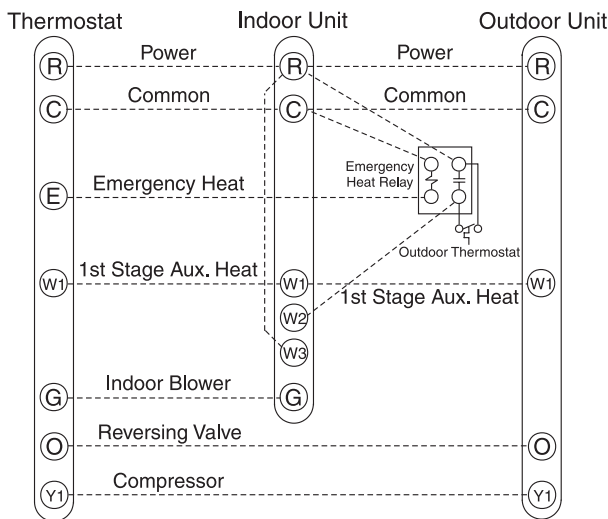
Thermostat Designations

(Some connections may not apply.
Refer to specific thermostat and indoor unit.)

Without Auxiliary Heat



With Auxiliary Heat



Do not connect C (common) connection between indoor unit and thermostat except when required by the indoor thermostat. Refer to thermostat installation instructions. C (common) connection between indoor unit and outdoor unit required for proper operation.

Refrigerant Line Set Diameters (in.)

Liquid Line					
BTUH	Line Set Length and Size				
	12 ft.	25 ft.	50 ft.	75 ft.	100 ft.
18,000	3/8	3/8	3/8	3/8	3/8
24,000	3/8	3/8	3/8	3/8	3/8
30,000	3/8	3/8	3/8	3/8	1/2
36,000	3/8	3/8	3/8	3/8	1/2
42,000	3/8	3/8	3/8	1/2	1/2
48,000	3/8	3/8	3/8	1/2	1/2
60,000	3/8	3/8	3/8	1/2	1/2

Suction Line					
BTUH	Line Set Length and Size				
	12 ft.	25 ft.	50 ft.	75 ft.	100 ft.
18,000	3/4	3/4	3/4	3/4	3/4
24,000	3/4	3/4	3/4	3/4	7/8
30,000	3/4	3/4	3/4	7/8	7/8
36,000	7/8	7/8	7/8	7/8	1-1/8
42,000	7/8	7/8	7/8	1-1/8	1-1/8
48,000	7/8	7/8	7/8	1-1/8	1-1/8
60,000	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8

For installations exceeding 50', contact
Technical Services at (419) 483-4840.

Table 2

Figure 4

Installing Refrigerant Line

During the installation of an air conditioning system, it is important to properly isolate the refrigerant line to prevent unnecessary vibration. Line set contact with the structure (wall, ceiling, or floor) may cause objectionable noise when vibration is translated into sound. As a result, more energy or vibration can be expected. Close attention to line set isolation must be observed.

Following are some points to consider when placing and installing a high-efficiency outdoor unit:

Placement

Be aware that some localities are adopting sound ordinances based on how noisy the unit is at the neighbor's home, not at the original installation. Install the unit as far as possible from the property line. When possible, do not install the unit directly outside a bedroom window. Glass has a very high level of sound transmission. Figure 5 shows how to place the outdoor unit and line set to reduce line set vibration.

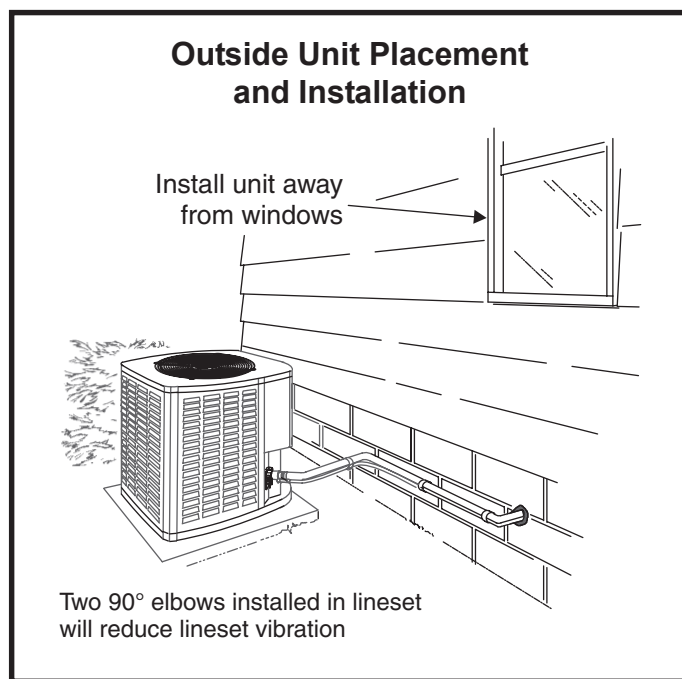


Figure 5

Line Set Isolation

Illustrations on the pages 6 and 7 demonstrate procedures which ensure proper refrigerant line set isolation. Figure 6 shows how to install line sets on horizontal runs. Figure 7 shows how to make a transition from horizontal to vertical. Figure 8 shows how to install line sets on vertical runs.

Brazing Connection Procedure

1. Cut ends of refrigerant lines square (free from nicks or dents). Debur the ends. The pipe must remain round; do not pinch end of line.
2. Before making line set connections, use dry nitrogen to purge the refrigerant piping. This will help to prevent oxidation and the introduction of moisture into the system.
3. Use silver alloy brazing rods (5% or 6% silver alloy for copper-to-copper brazing or 45% silver alloy for copper-to-brass or copper-to-steel brazing) which are rated for use with HCFC-22 refrigerant.
4. Remove the Schrader core assemblies before brazing to protect them from damage due to extreme heat. Replace the cores when brazing is complete.
5. Wrap a wet cloth around the valve body and copper tube stub to protect them from heat damage during brazing. Wrap another wet cloth underneath the valve body to protect the base paint.
6. Braze the line set to the service valve. Quench the joints with water or a wet cloth to prevent heat damage to the valve core and opening port. **The tube end must stay bottomed in the fitting during final assembly to ensure proper seating, sealing, and rigidity.**
7. Install the factory-supplied fixed orifice (or thermal expansion valve which is sold separately and which is approved for use with HCFC-22 refrigerant) in the liquid line at the indoor coil.

Refrigerant Metering Device

2SHP13 units are designed for use with either fixed orifice or TXV systems. Refer to the appropriate following section for information on installing the chosen refrigerant metering device.

Fixed Orifice Systems

2SHP13 units are shipped with a fixed orifice refrigerant metering device. Replace the existing indoor unit fixed orifice with the orifice supplied with this unit. Place the supplied fixed orifice sticker on the indoor cabinet after installation. See Table 3 on page 7 for the proper fixed orifice size for each unit. In nonstandard applications, the provided fixed orifice may not be appropriately sized.

Install the fixed orifice as shown in Figure 9 on page 7. Do not twist cap tubes when loosening the seal nut from the orifice housing. Use wrench to back up the distributor.

Refrigerant Line Sets: Installing Horizontal Runs

To hang line set from joist or rafter, use either metal strapping material or anchored heavy nylon wire ties.

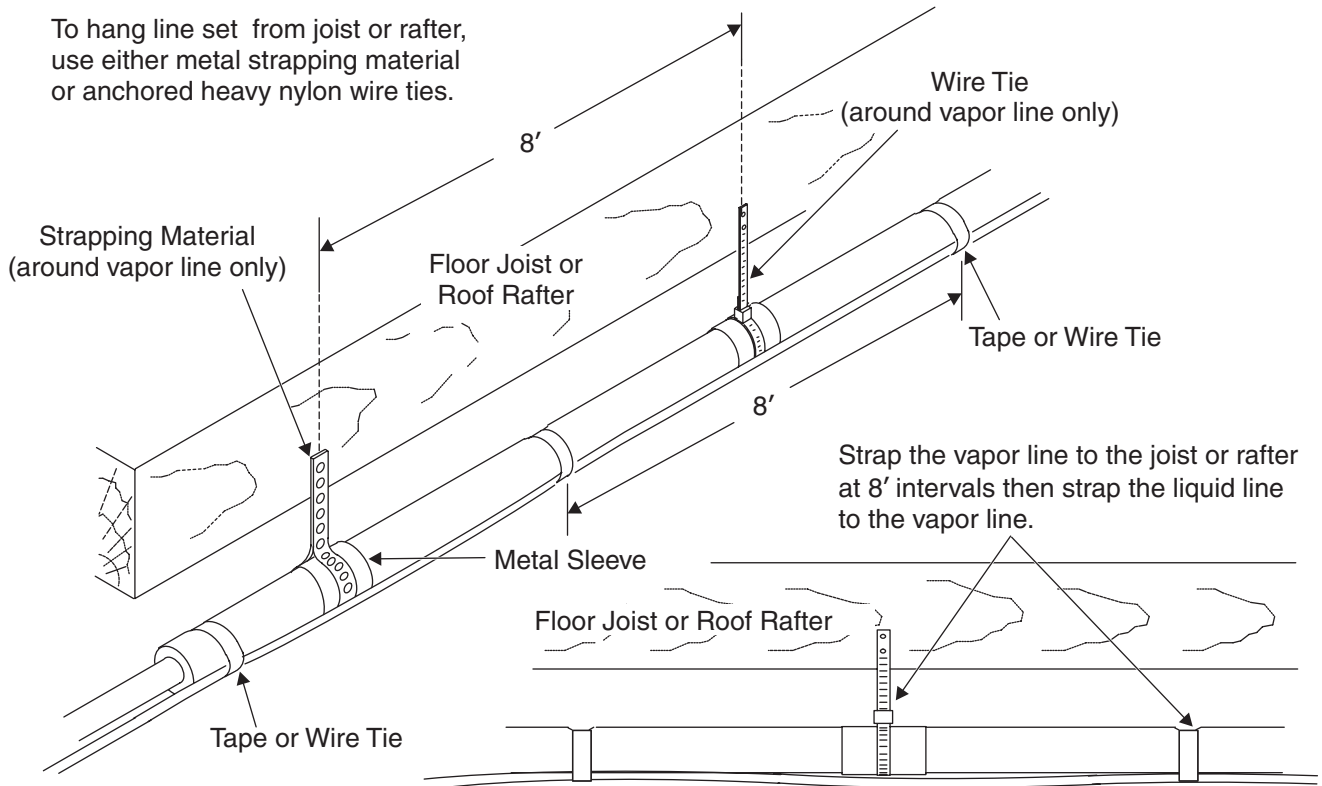


Figure 6

Refrigerant Line Sets: Transition from Vertical to Horizontal

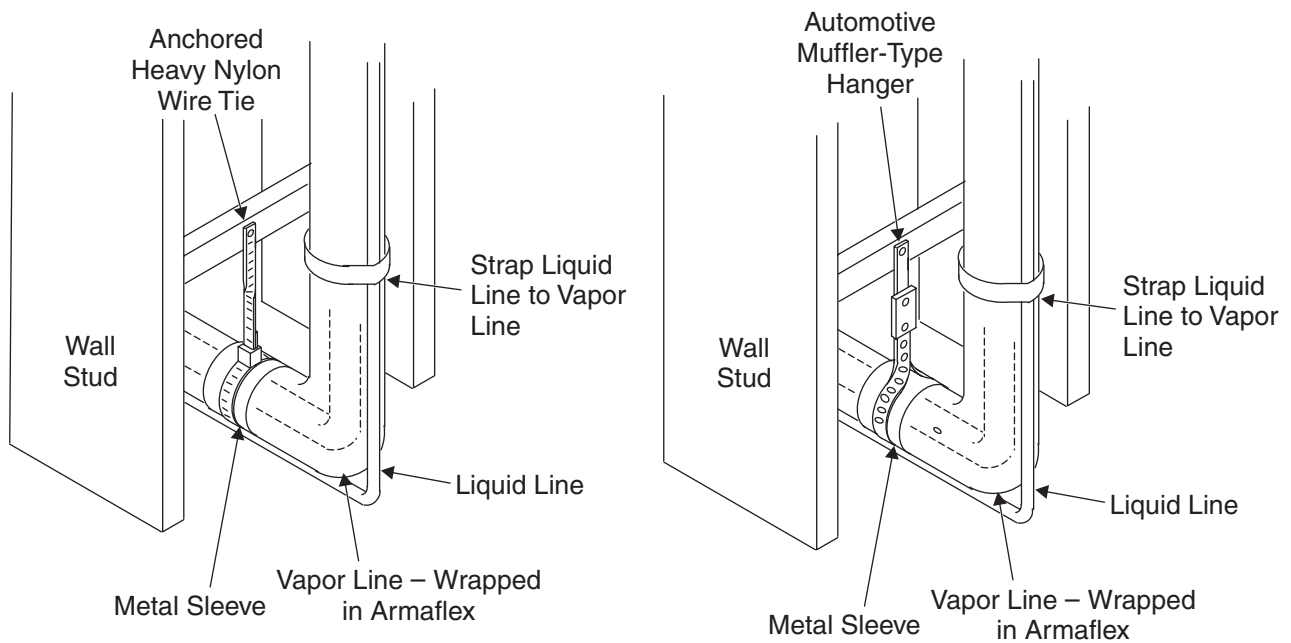


Figure 7

Refrigerant Line Sets: Installing Vertical Runs (new construction shown)

NOTE: Similar installation practices should be used if line set is to be installed on exterior of outside wall.

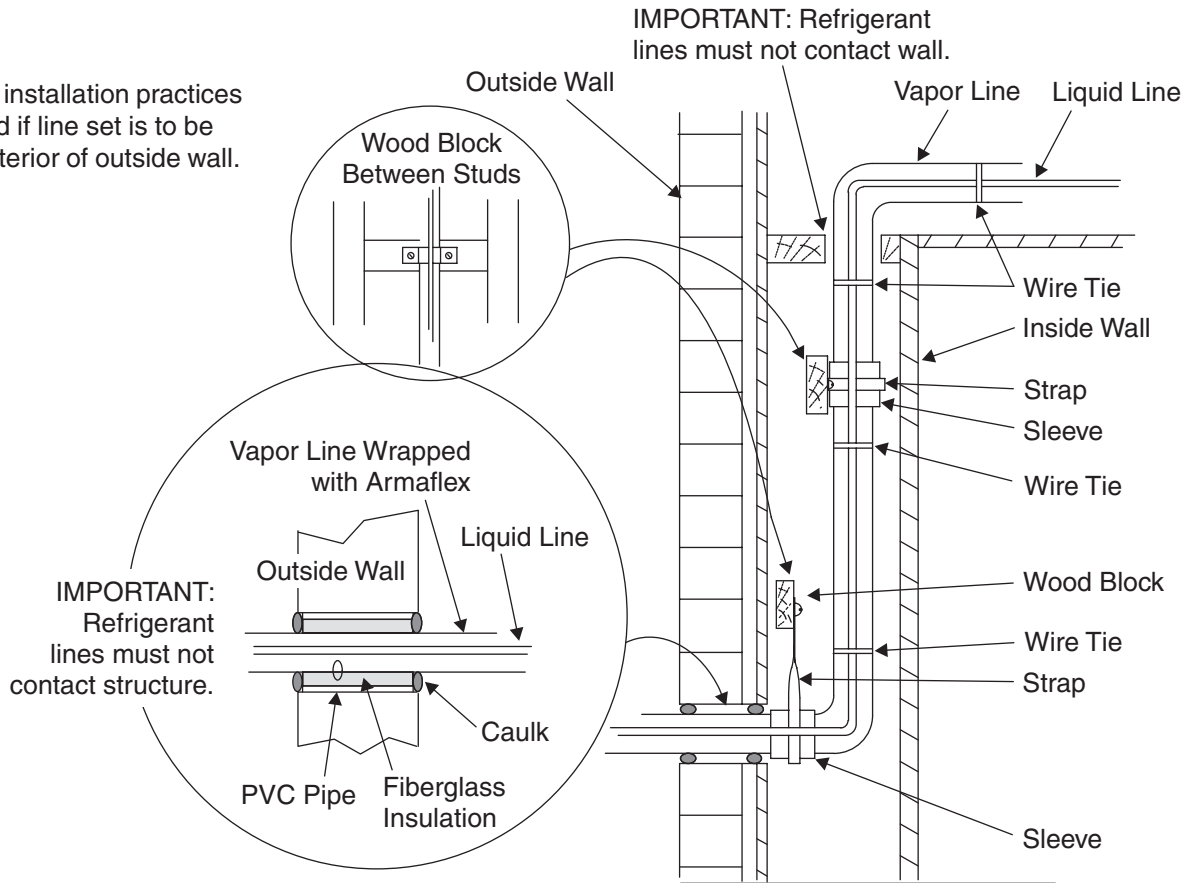


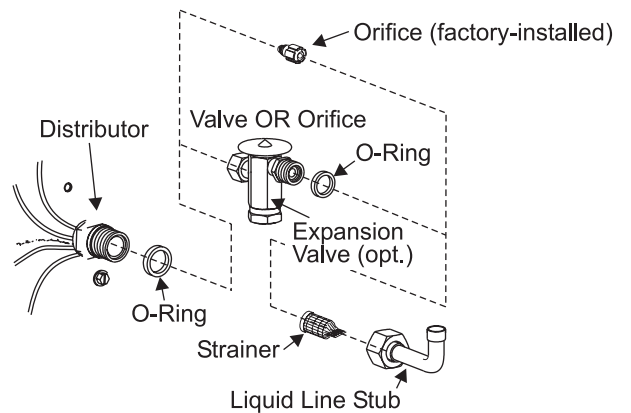
Figure 8

Fixed Orifice Data

Model	Part Number	Drill Size
2SHP13-18	100484-08	.057
2SHP13-24	100484-11	.061
2SHP13-30	100484-21	.072
2SHP13-36	100484-23	.074
2SHP13-42	100484-33	.086
2SHP13-48	100484-35	.088
2SHP13-60	100484-37	.090

Table 3

Metering Device Installation



If installing an expansion valve on an indoor coil that previously used a fixed orifice, remove orifice before installing valve.

Figure 9

Expansion Valve Systems

Expansion valves equipped with Chatleff-type fittings are available from the manufacturer. See Table 4 for proper TXV for each unit.

TXV Data	
Model	Part Number
2SHP13-18, -24, -30, -36	H2TXV01
2SHP13-42, -48	H2TXV02
2SHP13-60	H2TXV03

Table 4

To install an expansion valve (see Figure 9 on page 7):

1. Separate the distributor assembly and remove the piston orifice and used teflon seal. Insert nozzle end of the expansion valve along with a new teflon seal into the distributor and tighten to 20 – 30 ft. lbs. Use backup wrench on all wrench flats. **Overtightening will crush the teflon seal and may cause a leak.**
2. Attach liquid line portion of distributor assembly along with new teflon seal to the inlet of the expansion valve. Tighten to 20 – 30 ft. lbs. Use backup wrench on all wrench flats. **Overtightening will crush the teflon seal and may cause a leak.**
3. Connect the external equalizer line to the equalizer port on the suction line and tighten to 8 ft. lbs.
4. Strap the superheat sensing bulb to the suction header.

If installing an expansion valve on an indoor coil that previously used a fixed orifice, be sure to remove the existing fixed orifice. Failure to remove a fixed orifice when installing an expansion valve to the indoor coil will result in improper operation and damage to the system.

Manifold Gauge Set

When checking the unit charge, use a manifold gauge set that is equipped with “low loss” hoses. Do not use a manifold gauge set with anything other than a “low loss” hose.

Liquid and Suction Line Service Valves

The liquid line and suction line service valves (see Figure 10) and service ports are used for leak testing, evacuating, charging, and checking charge.

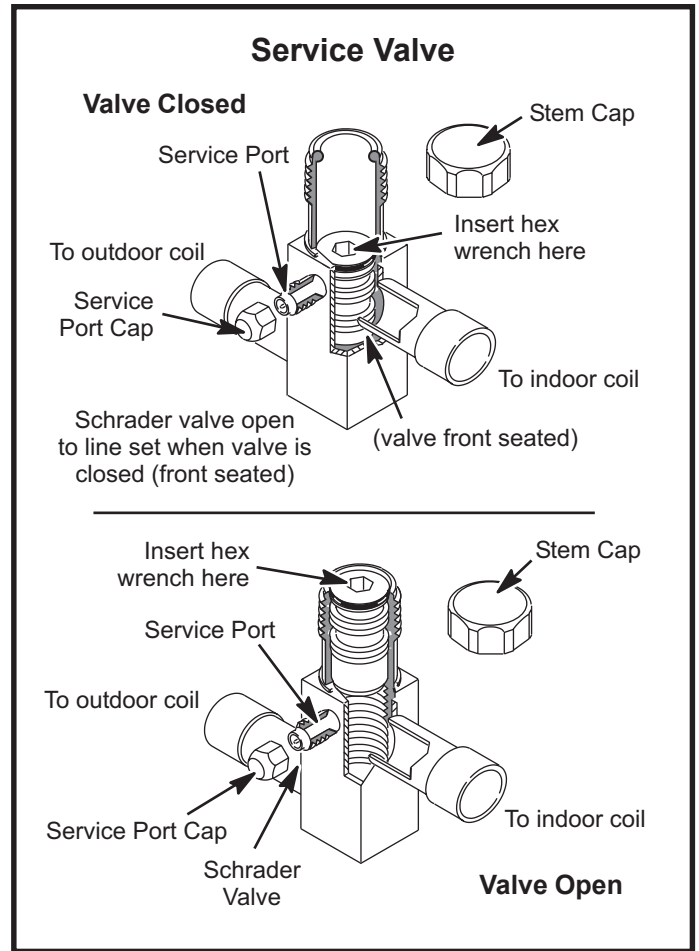


Figure 10

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 the Schrader Port:

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

To Open Liquid or Suction Line Service Valve:

1. Remove 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. Use a 3/16" hex head extension for liquid line service valves and a 5/16" extension for suction line service valves.
3. Replace the stem cap. Tighten finger tight, then tighten an additional 1/6 turn.

To Close Liquid or Suction Line 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 firmly.
3. Replace the stem cap. Tighten finger tight, then tighten an additional 1/6 turn.

Suction Line (Ball Type) Service Valve

Suction line (ball type) service valves function the same way as the other valves; the difference is in the construction (see Figure 11).

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 serves as the primary seal.

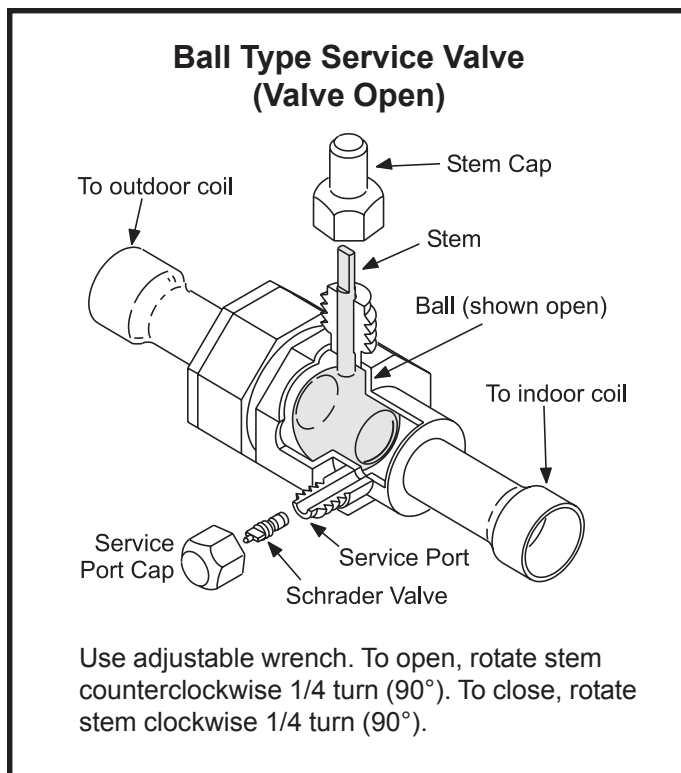


Figure 11

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 always be used and recovered responsibly. Incorrect or irresponsible use of refrigerant can result in personal injury or death.

WARNING

Never use oxygen to pressurize refrigeration or air conditioning systems. Oxygen will explode on contact with oil and could cause personal injury or death.

Using an Electronic Leak Detector

1. Connect the high pressure hose of the manifold gauge set to the suction valve service port. (Normally the high pressure hose is connected to the liquid line port; however, connecting it to the suction ports helps to protect the manifold gauge set from damage caused by high pressure.)
2. With both manifold valves closed, connect the cylinder of HCFC-22 refrigerant. Open the valve on the HCFC-22 cylinder (vapor only).
3. Open the high pressure side of the manifold to allow 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 oz. of refrigerant or 3 lbs. 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. **When using high pressure gas such as nitrogen for this purpose, be sure to use a regulator that can control the pressure down to 1 or 2 psig.**
5. Adjust nitrogen pressure to 150 psig. Open the valve on the high side of the manifold gauge set to pressurize the line set and the indoor coil.

Evacuation

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.

⚠ WARNING

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

Use a thermocouple or thermistor electronic vacuum gauge that is calibrated in microns. Use an instrument that reads down to 50 microns.

1. Connect the manifold gauge set to the service valve ports as follows:
 - Low pressure gauge to suction 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 a minimum of 500 microns or lower. 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. A rapid rise in pressure indicates a relatively large leak. If this occurs, the leak testing procedure must be repeated.
6. When 500 microns or lower is maintained, close the manifold gauge valves, turn off the vacuum pump, and disconnect the manifold gauge center port hose from the vacuum pump. Attach the manifold gauge center port hose to a nitrogen cylinder with pressure regulator set to 150 psig 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.
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 500 microns is maintained

within a 20-minute period after shutting off the vacuum pump and closing the manifold gauge valves.

9. When the requirements above have been met, disconnect the manifold hose from the vacuum pump. Open the service valves to break the vacuum in the line set and indoor unit.

START-UP

CAUTION

If unit is equipped with a crankcase heater, it should be energized 24 hours before unit start-up to prevent compressor damage as a result of slugging.

1. Rotate fan to check for frozen bearings or binding.
2. Inspect all factory and field-installed wiring for loose connections.
3. After evacuation is complete, open liquid line and suction line service valves to release refrigerant charge (contained in outdoor unit) into system.
4. Replace the stem caps and secure finger tight, then tighten an additional 1/6 of a turn.
5. Check voltage supply at the disconnect switch. The voltage must be within the range listed on the unit nameplate. If not, do not start equipment until the power company has been consulted and the voltage condition corrected.
6. Set thermostat for cooling demand, turn on power to indoor blower, and close the outdoor unit disconnect switch to start the unit.
7. Recheck unit voltage with unit running. Power must be within range shown on unit nameplate.

Refrigerant Charging

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' line set. For varying lengths of line set, refer to Table 5 for refrigerant charge adjustment.

Refrigerant Charge Adjustment

Liquid Line Set Diameter	Oz. per 5 ft. adjust from 15 ft. line set*
3/8 in.	3 oz. per 5 ft.

* If line length is **greater than 15 ft.**, add this amount.
If line length is **less than 15 ft.**, remove this amount.

Table 5

If the system is void of refrigerant, clean the system using the procedure described below.

1. Use dry nitrogen to pressurize the system and check for leaks. Repair leaks, if possible.
2. Evacuate the system to remove as much of the moisture as possible.
3. Use dry nitrogen to break the vacuum.
4. Evacuate the system again.
5. Weigh the appropriate amount of HCFC-22 refrigerant (listed on unit nameplate) into the system.
6. Monitor the system to determine the amount of moisture remaining in the oil. Use a test kit to verify that the moisture content is within the kit's dry color range. It may be necessary to replace the filter drier several times to achieve the required dryness level. **If system dryness is not verified, the compressor will fail in the future.**

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 valve ports as follows (see Figure 12 on page 12):
 - Low pressure gauge to suction line service valve
 - High pressure gauge to liquid line service valve
2. Close manifold gauge set valves. Connect the center manifold hose to an upright cylinder of HCFC-22.
3. If room temperature is below 70°F, 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. When pressures have stabilized, use a digital thermometer to record the liquid and suction line temperatures.
6. The outdoor temperature will determine which charging method to use. Proceed with the appropriate charging method.

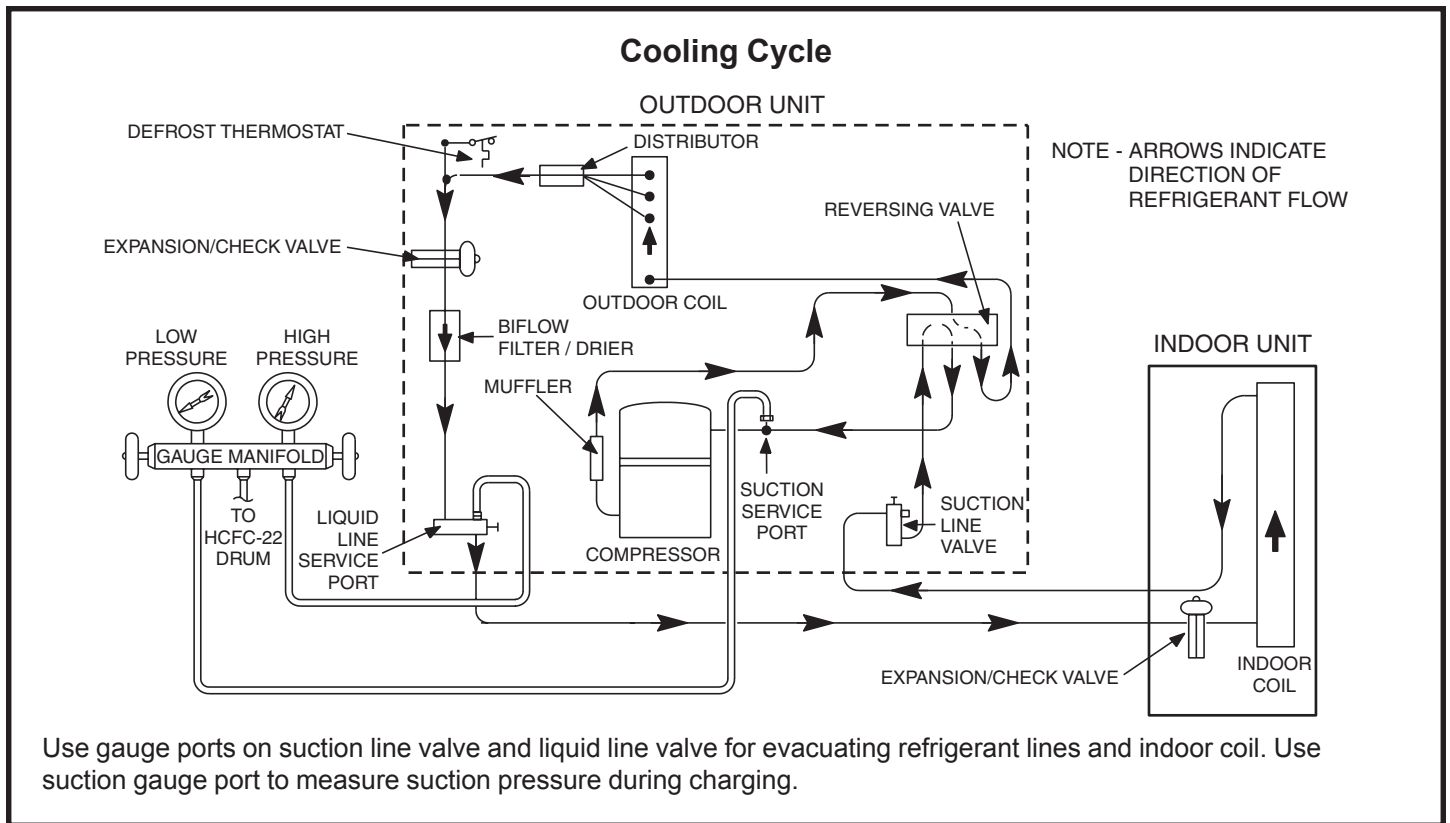


Figure 12

Charge Using Weigh-In Method (Fixed Orifice/TXV Systems)

If the system is void of refrigerant, or if the outdoor ambient temperature is cool, first locate and repair any leaks then use the weigh-in method to charge the unit.

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 unit is being charged during warm weather, follow one of the other procedures outlined below.

Charge Using Subcooling Method (Fixed Orifice/TXV Systems) – Outdoor Temperatures 65°F or Above

If charging a fixed orifice or TXV system when the outdoor ambient temperature is 65°F or above, the subcooling method can be used 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. For best results, use the same digital thermometer to

check both the outdoor ambient and the liquid line temperatures.

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.

$$\begin{aligned} & \text{_____}^\circ \text{ Saturation Temperature } ^\circ\text{F} \\ - & \text{_____}^\circ \text{ Liquid Line Temperature } ^\circ\text{F} \\ = & \text{_____}^\circ \text{ Subcooling Value } ^\circ\text{F} \end{aligned}$$

5. Compare the subcooling value with those shown in Table 6. If subcooling is greater than shown, recover some refrigerant. If subcooling is less than shown, add some refrigerant.

Charge Using Superheat Method (Fixed Orifice Systems) – Outdoor Temperatures 65°F or Above

1. With the manifold gauge hose on the suction service port and the unit operating stably, use a digital thermometer to record the suction line temperature.
2. At the same time, record the suction line pressure reading.

Subcooling Values for Fixed Orifice or TXV Systems

Outdoor Temp. °F	Liquid Subcooling (±1°F)						
	-18	-24	-30	-36	-42	-48	-60
65	13	15	14	13	13	15	14
75	10	13	12	10	10	13	12
85	8	11	11	8	8	11	11
95	7	9	10	7	7	9	10
105	6	8	9	6	6	8	9
115	3	5	6	3	3	5	6

Table 6

- Use a temperature/pressure chart for HCFC-22 to determine the saturation temperature for the suction line pressure reading.
- Subtract the saturation temperature (according to the chart) from the suction line temperature to determine the superheat.

$$\begin{aligned} & \text{_____}^\circ \quad \text{Suction Line Temperature } ^\circ\text{F} \\ - & \text{_____}^\circ \quad \text{Saturation Temperature } ^\circ\text{F} \\ = & \text{_____}^\circ \quad \text{Superheat Value } ^\circ\text{F} \end{aligned}$$

- Compare the superheat value with those shown in Table 7. If superheat is greater than shown, add some refrigerant. If superheat is less than shown, recover some refrigerant.

Charge Using Approach Method (TXV Systems) – Outdoor Temperatures 65°F or Above

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

- Record outdoor ambient temperature using a digital thermometer.
- Attach high pressure gauge set and operate unit for several minutes to allow system pressures to stabilize.
- Compare stabilized pressures with those provided in Table 8 on page 14. 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.**

Superheat Values for Fixed Orifice Systems (80°DB/67°WB Return Air)

Outdoor Ambient Temp. °F	Superheat °F
60	38
65	35
70	30
75	26
80	22
85	18
90	12
95	8
100	5
105	0

Table 7

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.

- Use the same digital thermometer used to check outdoor ambient temperature in Step 1 to check liquid line temperature. Verify the unit charge using the approach method.
- Subtract the outdoor ambient temperature from the liquid line temperature to determine the approach temperature.

$$\begin{aligned} & \text{_____}^\circ \quad \text{Liquid Line Temperature } ^\circ\text{F} \\ - & \text{_____}^\circ \quad \text{Outdoor Ambient Temperature } ^\circ\text{F} \\ = & \text{_____}^\circ \quad \text{Approach Temperature } ^\circ\text{F} \end{aligned}$$

- Compare the approach value with those shown in Table 9 on page 14. If the values do not agree with those provided in Table 9, add refrigerant to lower the approach temperature or recover refrigerant from the system to increase the approach temperature.

Check Charge Using Normal Operating Pressures

Use Table 8 on page 14 to perform maintenance checks. Table 8 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

Normal Operating Pressures

Cooling														
Outdoor Coil Entering Air Temp. °F	-18		-24		-30		-36		-42		-48		-60	
	L	S	L	S	L	S	L	S	L	S	L	S	L	S
65	141	81	148	80	146	78	154	78	139	67	147	78	146	67
75	163	82	176	82	171	79	180	88	163	74	173	79	170	74
85	191	84	206	83	201	80	210	99	191	81	203	80	199	81
95	222	85	240	84	233	81	246	109	220	84	236	81	230	84
105	256	87	277	86	271	81	277	119	256	85	273	83	266	85
115	296	89	322	87	313	83	318	130	294	87	315	84	306	87

Heating														
Outdoor Coil Entering Air Temp. °F	-18		-24		-30		-36		-42		-48		-60	
	L	S	L	S	L	S	L	S	L	S	L	S	L	S
50	192	64	185	60	198	58	196	58	204	59	212	59	214	60
40	180	53	176	50	188	47	185	47	195	49	195	40	202	50
30	172	43	165	49	175	35	176	37	184	39	189	39	191	40
20	164	34	162	31	163	26	170	30	178	32	179	31	181	33

L – Liquid S – Suction

Values provided above are typical pressures. Indoor unit matchup, indoor air quality, and indoor load will cause pressures to vary.

Table 8

system is not properly charged or that a problem exists with some component in the system.

Approach Values for TXV Systems

Model	-18	-24	-30	-36	-42	-48	-60
Temp. °F	7	8	9	11	7	8	7

Approach value is the liquid line temperature minus the outdoor ambient temperature ($\pm 1^\circ\text{F}$).

NOTE: For best results, use the same digital thermometer to check both outdoor ambient and liquid temperatures.

Table 9

OPERATION

Outdoor unit and indoor blower cycle on demand from the room thermostat. When the thermostat blower switch is moved to the ON position, the indoor blower operates continuously.

Filter Drier

The unit is equipped with a bi-flow filter, If replacement is necessary, replace with one of similar design.

Crankcase Heater

If unit is equipped with a crankcase heater, it should be energized 24 hours before unit start-up to prevent compressor damage as a result of slugging.

Emergency Heat Function (Room Thermostat)

An emergency heat function is designed into some room thermostats. This feature is applicable when isolation of outdoor unit is required or when auxiliary electric heat is stage by outdoor thermostats. When the room thermostat is placed in the emergency heat position, the outdoor unit control circuit is isolated from power and the field-supplied relays bypass the outdoor thermostats. An amber indicating light simultaneously comes on to remind the homeowner that the unit is operating in the emergency heat mode.

Emergency heat is usually used during an outdoor shut-down, but it should also be used following a power outage if power has been off for over an hour and the outdoor temperature is below 50°F. System should be left in the emergency heat mode at least 6 hours to allow the crankcase heater sufficient time to prevent compressor slugging.

Defrost System

The defrost system includes two components: the defrost thermostat and the 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 or cooler, the thermostat 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.

Defrost Control

The defrost control board includes the combined functions of time/temperature defrost control, defrost relay, diagnostic LEDs and terminal strip for field wiring connections (see Figure 13).

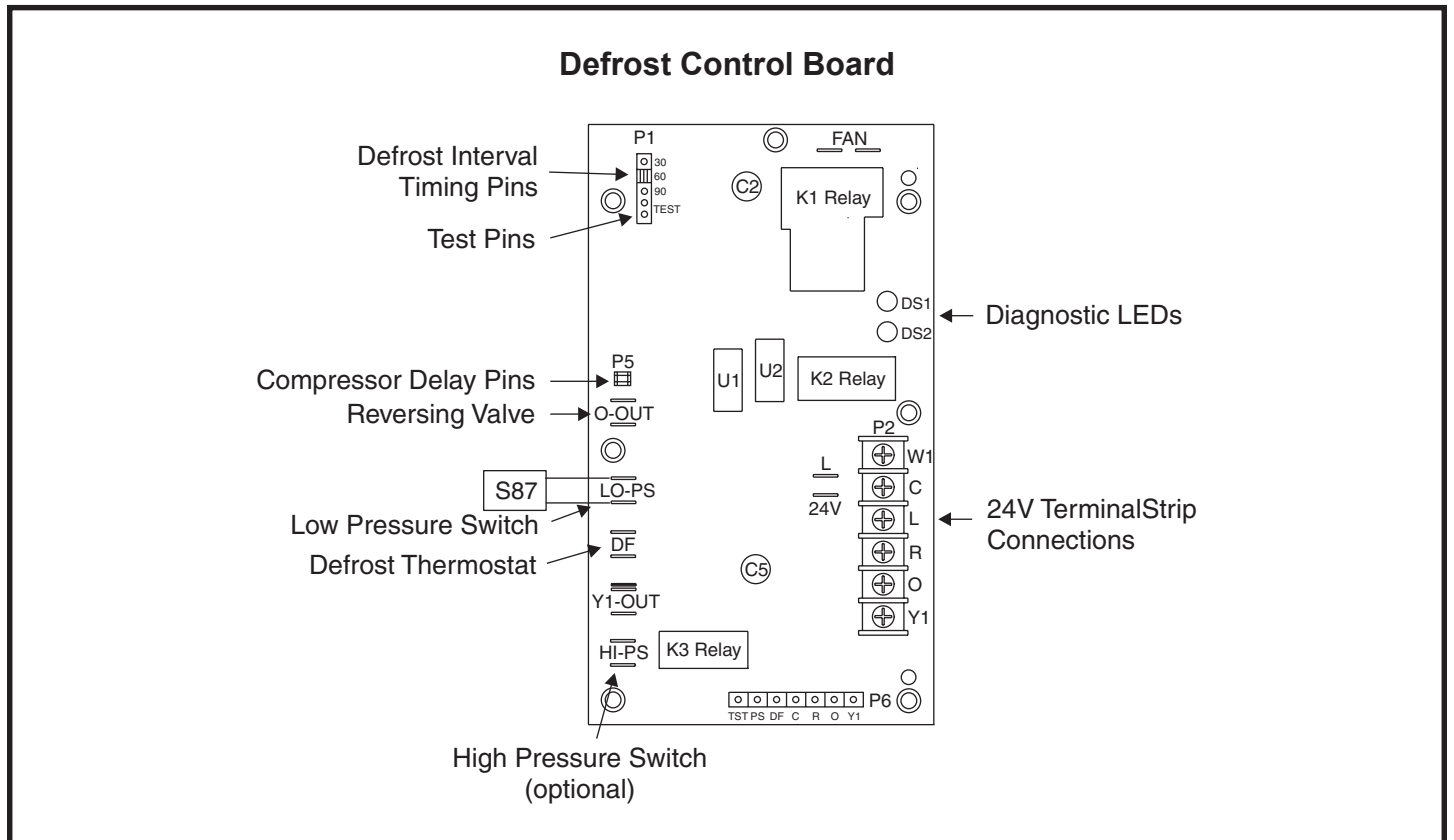


Figure 13

The control provides automatic switching from normal heating operation to defrost mode and back. During the compressor cycle (call for defrost), the control accumulates compressor run time at 30, 60, 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 the 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. The defrost timing jumper is factory installed to provide a 60-minute defrost interval. If the timing selector jumper is not in place, the control defaults to a 90-minute defrost interval. The maximum defrost period is 14 minutes and cannot be adjusted.

A test option is provided for troubleshooting. The test mode may be started any time the unit is in the heating mode and the defrost thermostat is closed or jumpered. If the jumper is in the TEST position at power up, the control will ignore the test pins. When the jumper is placed across the TEST pins for 2 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 reapplied.

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

NOTE: The 30-second “off” cycle is not functional when jumpering the TEST pins.

Time Delay

The timed-off delay is 5 minutes long. The delay helps to protect the compressor from short cycling in case the power to the unit is interrupted or a pressure switch opens. The delay is bypassed by placing the timer select jumper across the TEST pins for 0.5 seconds.

Pressure Switch Circuit

The defrost control includes a low pressure (loss of charge pressure) switch. A high pressure switch (optional) can be connected to the board’s HI PS terminals (see Figure 13 on page 15).

During a single demand cycle, the defrost control will lock out the unit after the fifth time that the circuit is interrupted by any pressure switch wired to the control board. In addition, the diagnostic LEDs will indicate a locked-out pressure switch after the fifth occurrence of an open pressure switch (see Table 10). The unit will remain locked out until power to the board is interrupted, then re-established, 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 as follows:

- During the TEST mode
- During the defrost cycle
- During the 90-second start-up period
- 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.

Diagnostic LEDs

The defrost board uses two LEDs for diagnostics. The LEDs flash a specific sequence according to the condition as shown in Table 10.

Defrost Control Board Diagnostic LEDs

Mode	Green LED (DS2)	Red LED (DS1)
No Power to Board	Off	Off
Normal Operation/ Power to Board	Simultaneous Slow Flash	
Anti-Short Cycle Lockout	Alternating Slow Flash	
Low Pressure Switch Fault	Off	Slow Flash
Low Pressure Switch Lockout	Off	On
High Pressure Switch Fault	Slow Flash	Off
High Pressure Switch Lockout	On	Off

Table 10

MAINTENANCE

⚠ WARNING

Before performing maintenance operations on system, turn the electric power to unit OFF at disconnect switch(es). Unit may have multiple power supplies. Electrical shock could cause personal injury or death.

Before the start of each heating and cooling season, the following service checks should be performed by a qualified service technician.

- Inspect and clean outdoor and indoor coils. The outdoor coil may be flushed with a water hose.
- NOTE: It may be necessary to flush the outdoor coil more frequently if it is exposed to substances which are corrosive or which block airflow across the coil (such as pet urine, cottonwood seeds, etc...).
- Visually inspect the refrigerant lines and coils for leaks.
 - Check wiring for loose connections.
 - Check voltage at the indoor and outdoor units (with units operating).
 - Check amperage draw at the outdoor fan motor, compressor, and indoor blower motor. Values should be compared with those given on unit nameplate.
 - Check, clean (or replace) indoor unit filters.
 - Check the refrigerant charge and gauge the system pressures.
 - Check the condensate drain line for free and unobstructed flow. Clean drain line, if necessary.
 - Adjust blower speed for cooling. Measure the pressure drop over the coil to determine the correct blower CFM.
 - Belt drive blowers: Check drive belt for wear and proper tensions.

If insufficient cooling is reported, the unit should be gauged and refrigerant charge checked (see **Refrigerant Charging** on page 11).

HOMEOWNER INFORMATION

In order to ensure peak performance, your system must be properly maintained. Clogged filters and blocked airflow prevent your unit from operating at its most efficient level.

WARNING

Turn all electric power to unit OFF at disconnect switch(es) before performing any maintenance operations on system. Unit may have multiple power supplies. Electrical shock could cause personal injury or death.

- Ask your dealer to show you where the indoor unit's filter is located. It will be either at the indoor unit (installed internal or external to the cabinet) or behind a return air grille in the wall or ceiling. Check the filter monthly and clean or replace it as needed.
- Disposable filters should be replaced with a filter of the same type and size. If you are unsure of the filter you need for your system, contact your dealer.
- Many indoor units are equipped with reusable foam filters. These filters can be cleaned with a mild soap and water solution. Rinse the filter thoroughly and let dry completely before returning to unit or grille.

The filter and all access panels must be in place any time the unit is in operation.

- Some systems are equipped with an electronic air cleaner, designed to remove the majority of airborne particles from the air passing through the cleaner. If your system includes an electronic air cleaner, ask your dealer for maintenance instructions.
- Inspect and clean indoor coil. The indoor evaporator coil is equipped with a drain pan to collect condensate formed as the system removes humidity from the inside air. Have your dealer show you the location of the drain line and how to check for obstructions. This also applies to an auxiliary drain, if one is installed.
- Inspect and clean outdoor coil: Make sure no obstructions restrict airflow to the outdoor unit. Leaves, trash, or shrubs crowding the unit can cause it to work harder and use more energy. Keep shrubbery trimmed away from the unit and periodically check for debris which collects around the unit.

The outdoor coil may require frequent cleaning, depending on environmental conditions. Clean the outdoor coil with a nonpressurized water hose to remove surface contaminants and debris. It may be necessary to flush the outdoor coil more frequently if it is exposed to substances which are corrosive or

which block airflow across the coil (such as pet urine, cottonwood seeds, etc...).

Heat Pump Operation

Heat pump units have several characteristics you should be aware of:

- Heat pumps satisfy heating demand by delivering large amounts of *warm* air into the living space. This is quite different from gas-fired, oil-fired, or electric furnaces which deliver lower volumes of considerably *hotter* air to heat the space.
- Do not be alarmed if you notice frost on the outdoor coil in the winter months. Frost develops on the outdoor coil during the heating cycle when temperatures are below 45°F. An electronic control activates a defrost cycle lasting 5 to 15 minutes at preset intervals to clear the outdoor coil of the frost. A shift in sound type does occur during the defrost mode.
- During the defrost cycle, you may notice steam rising from the unit. This is a normal occurrence. The thermostat may engage auxiliary heat during the defrost cycle to satisfy a heating demand. The unit will return to normal operation at the conclusion of the defrost cycle.

In case of extended power outage...

If the outdoor temperature is below 50°F and power to the outdoor unit has been interrupted for 6 hours or longer, observe the following when restoring power to the heat pump system.

- Set the room thermostat selector to the "Emergency Heat" setting to obtain temporary heat for a minimum of 6 hours. This will allow system refrigerant pressures and temperatures enough time to return to a stabilized condition.
- In the Emergency Heat mode, all heating demand is satisfied by auxiliary heat; heat pump operation is locked out. After a 6-hour "warmup" period, the thermostat can then be switched to the "Heat" setting and normal heat operation may resume.

Thermostat Operation

Though your thermostat may vary somewhat from the description below, its operation will be similar.

Temperature Setting Levers

Most heat pump thermostats have two temperature selector levers: one for heating and one for cooling. Set the levers or dials to the desired temperature setpoints for both heating and cooling. Avoid frequent temperature

adjustment; turning the unit off and back on before pressures equalize puts stress on unit compressor.

Fan Switch

In AUTO or INT (intermittent) mode, the blower operates only when the thermostat calls for heating or cooling. This mode is generally preferred when humidity control is a priority. The ON or CONT mode provides continuous indoor blower operation, regardless of whether the compressor or auxiliary heat are operating. This mode is required when constant air circulation or filtering is desired.

System Switch

Set the system switch for heating, cooling, or auto operation. The auto mode allows the heat pump to automatically switch from heating mode to cooling mode to maintain predetermined comfort settings. Many heat pump thermostats are also equipped with an emergency heat mode which locks out heat pump operation and provides temporary heat supplied by the auxiliary heat.

Indicating Light

Most heat pump thermostats have an amber light which indicates when the heat pump is operating in the emergency heat mode.

Temperature Indicator

The temperature indicator displays the actual room temperature.

Programmable Thermostats

Your system may be controlled by a programmable thermostat. These thermostats provide the added feature of programmable time-of-day setpoints for both heating and cooling. Refer to the user's information manual provided with your particular thermostat for operation details.

Preservice Check

If your system fails to operate, check the following before calling for service:

- Check to see that all electrical disconnect switches are ON.
- Make sure the thermostat temperature selector is properly set.
- Make sure the thermostat system switch is properly set.
- Replace any blown fuses, or reset circuit breakers.
- Make sure unit access panels are in place.
- Make sure air filter is clean.
- Locate unit model number and have it handy before calling.

Start-Up and Performance Checklist

Job Name _____ Job No. _____ Date _____

Job Location _____ City _____ State _____

Installer _____ City _____ State _____

Unit Model No. _____ Serial No. _____

Service Technician _____ Nameplate Voltage _____

Rated Load Ampacity _____ Compressor Amperage _____ Outdoor Fan _____

Maximum Fuse or Circuit Breaker _____

Electrical Connections Tight? Indoor Filter Clean? Supply Voltage (Unit Off) _____

Indoor Blower RPM _____ S.P. Drop Over Indoor (Dry) _____

Outdoor Coil Entering Air Temperature _____ Voltage with Compressor Operating _____

Outdoor Fan Checked?

Cooling

Liquid Line Pressure _____ Suction Line Pressure _____ Refrigerant Charge Checked?

Heating

Liquid Line Pressure _____ Suction Line Pressure _____ Refrigerant Charge Checked?

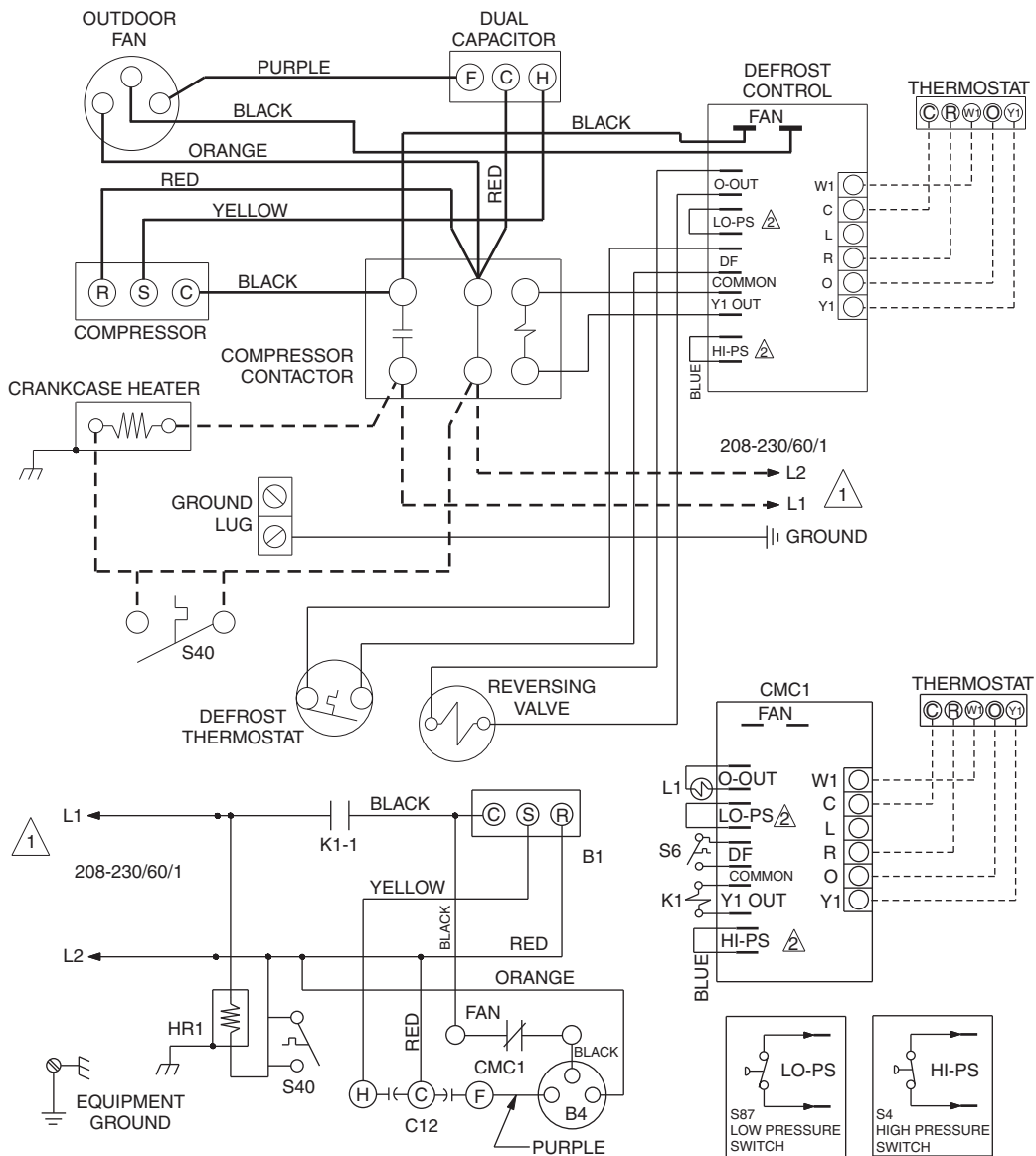
Refrigerant Lines: Leak Checked? Properly Insulated?

Service Valves: Fully Opened? Caps Tight?

Thermostat: Calibrated? Properly Set? Level?

Sequence of Operation

Heating Correct? Cooling Correct?



- LINE VOLTAGE FACTORY INSTALLED
- LINE VOLTAGE FIELD INSTALLED
- · - · - 24 VOLT FACTORY INSTALLED
- · · · · CLASS II VOLTAGE FIELD INSTALLED

NOTE:

DO NOT CONNECT C (COMMON) CONNECTION BETWEEN THE INDOOR UNIT AND THERMOSTAT EXCEPT WHEN REQUIRED BY THE INDOOR THERMOSTAT. REFER TO THERMOSTAT INSTALLATION INSTRUCTIONS. C (COMMON) CONNECTION BETWEEN INDOOR UNIT AND OUTDOOR UNIT REQUIRED FOR PROPER OPERATION.

WARNING--

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

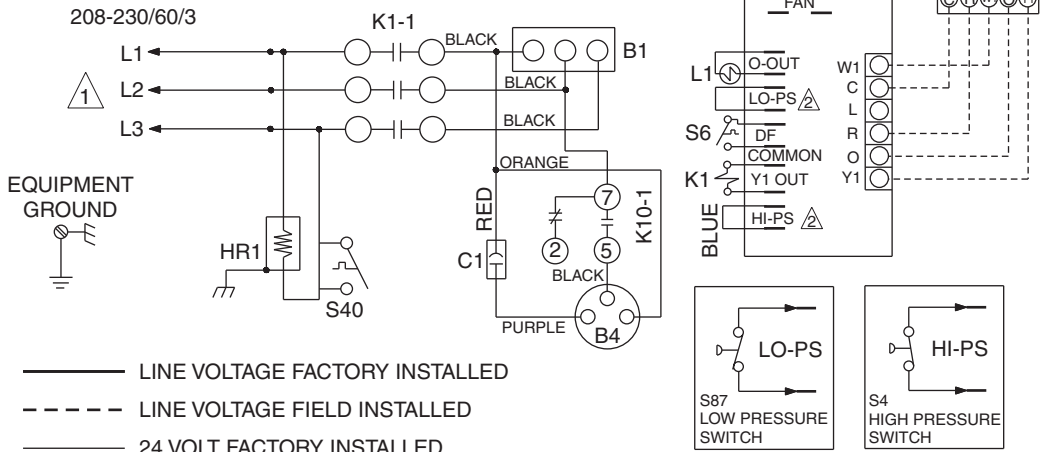
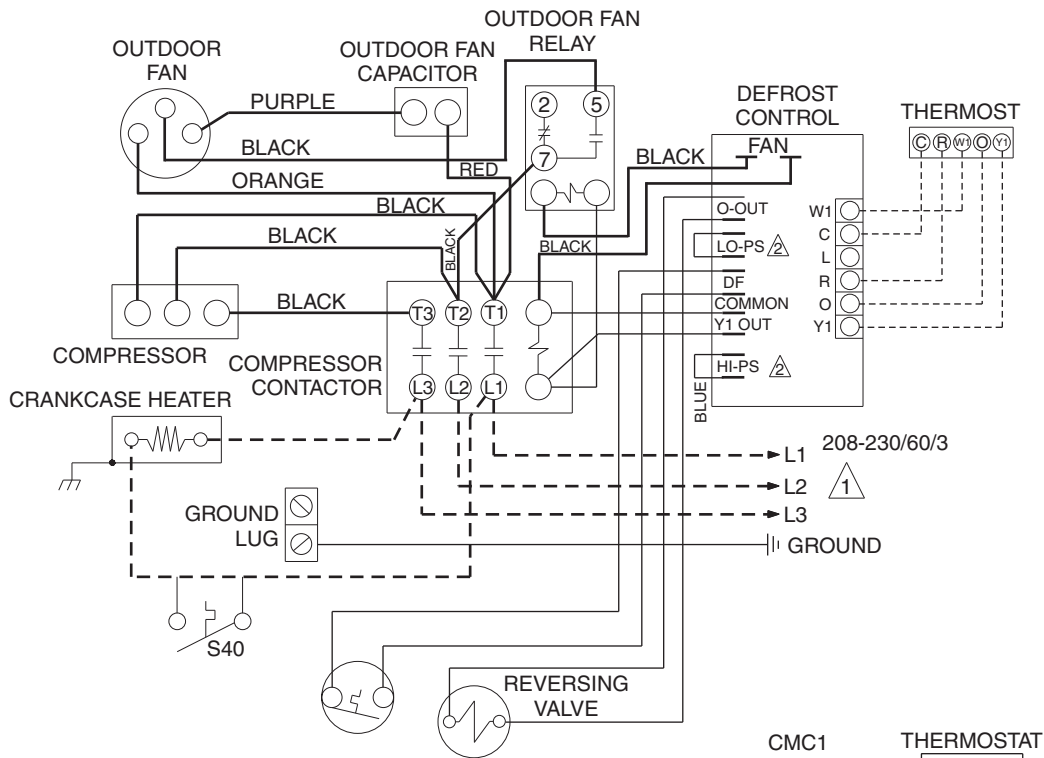
1 FOR USE WITH COPPER CONDUCTORS ONLY. REFER TO UNIT RATING PLATE FOR MINIMUM CIRCUIT AMPACITY AND MAXIMUM OVERCURRENT PROTECTION SIZE.

2 CONNECTION MUST BE JUMPERED WHEN OPTIONAL SWITCH IS NOT USED.

DESCRIPTION	
KEY	COMPONENT
B1	COMPRESSOR
B4	MOTOR - OUTDOOR FAN
C12	CAPACITOR - DUAL
CMC1	CONTROL-DEFROST
HR1	HEATER - COMPRESSOR
K1-1	CONTACTOR - COMPRESSOR
L1	VALVE - REVERSING
S4	SWITCH - HIGH PRESSURE
S6	SWITCH - DEFROST
S40	THERMOSTAT - CRANKCASE
S87	SWITCH - LOW PRESSURE

Single Phase Wiring Diagram P/N 46330-002

Figure 14



- LINE VOLTAGE FACTORY INSTALLED
- LINE VOLTAGE FIELD INSTALLED
- 24 VOLT FACTORY INSTALLED
- CLASS II VOLTAGE FIELD INSTALLED

NOTE:
DO NOT CONNECT C (COMMON) CONNECTION BETWEEN THE INDOOR UNIT AND THERMOSTAT EXCEPT WHEN REQUIRED BY THE INDOOR THERMOSTAT. REFER TO THERMOSTAT INSTALLATION INSTRUCTIONS. C (COMMON) CONNECTION BETWEEN INDOOR UNIT AND OUTDOOR UNIT REQUIRED FOR PROPER OPERATION.

- FOR USE WITH COPPER CONDUCTORS ONLY. REFER TO UNIT RATING PLATE FOR MINIMUM CIRCUIT AMPACITY AND MAXIMUM OVERCURRENT PROTECTION SIZE.
- CONNECTION MUST BE JUMPERED WHEN OPTIONAL SWITCH IS NOT USED.

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

DESCRIPTION	
KEY	COMPONENT
B1	COMPRESSOR
B4	MOTOR - OUTDOOR FAN
C1	CAPACITOR - OUTDOOR FAN
CMC1	CONTROL-DEFROST
HR1	HEATER - COMPRESSOR
K1-1	CONTACTOR - COMPRESSOR
K10-1	RELAY - OUTDOOR FAN
L1	VALVE - REVERSING
S4	SWITCH - HIGH PRESSURE
S6	SWITCH - DEFROST
S40	THERMOSTAT - CRANKCASE
S87	SWITCH - LOW PRESSURE

Three Phase Wiring Diagram P/N 48437-001

Figure 15

Limited Warranty

August 1, 1997

This warranty gives you specific legal rights and you may have other rights which vary from state/province to state/province.

Warrantor: Armstrong Air Conditioning Inc., 421 Monroe St., Bellevue, OH 44811

Armstrong Air Conditioning Inc. products are available under the following names: Air Ease, Armstrong Air, American Aire, Concord

Subject to the limitations stated in this warranty, we warrant to the first buyer for use the residential heating, cooling or heat pump unit, when installed, operated and maintained as required by this warranty, to be free of defects in workmanship or material for a period of 5 years in residential installations (1 year in non-residential installations) from the time of installation. We will replace any defective component without cost or expense to you except for the costs of delivery and labor for removal and replacement of the defective component.

The 2SHP13LB Series heat pumps carry a 5-year compressor warranty. The 2SHP13LE Series heat pumps carry a 10-year compressor warranty.

Warranty Begins

The warranty period begins when the installation is complete and the product is ready to operate. You must be able to verify this date whenever a warranty claim is made. Original bill of sale, installer's invoice or other similar document will suffice. If the beginning date cannot be verified, we will consider warranty coverage to begin 6 months after the date the product was shipped from our factory.

Limitations on Implied Warranties

Implied warranties of merchantability or, to the extent applicable, fitness for a particular purpose are limited to 5 years, the same duration as the basic limited written warranty provided herein. Some states/provinces do not allow limitations on how long an implied warranty of merchantability or fitness lasts, so the above limitations or exclusions may not apply to you.

Only Warranty

This written Limited Warranty is the only warranty made by the warrantor; this warranty is in lieu of and excludes all other warranties, express or implied. The warrantor does not authorize any person to provide any other warranty or to assume for it any further obligation in connection with the warranted product.

What is NOT Covered

1. Cabinets or cabinet pieces.
2. Normal maintenance items such as filters, fan belts, fuses or other consumable items.
3. Damage caused by misuse, failure to maintain properly, accidents or acts of God.
4. External wiring, piping, venting or attachment of accessory products not integral to our product, including without limitation, humidifier, air cleaner, vent damper, thermostat or other mechanical devices not manufactured by the warrantor.
5. Products that have been operated in a corrosive atmosphere where a concentration of acids, halogenated hydrocarbons or other corrosive elements causes deterioration to metal surfaces or integral components. NOTE: Operation in a corrosive atmosphere is considered abuse and voids this warranty.
6. Products that have NOT been installed in accordance with our published installation instructions, applicable local, state/provincial or national codes, ACCA published standards.
7. Products that have NOT been installed by competent, qualified installers.
8. Products that have been moved from their original place of installation.

Warranty on Replacement Components

Any replacement component furnished by us will assume the remaining (unused) portion of the Limited Warranty.

Consequential Damages

The warrantor shall not be responsible for any consequential damages caused by any defect in the product. Some state/provinces do not allow the exclusion or limitations of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This product must be installed, used and cared for in accordance with the instruction manual. You are responsible for required periodic maintenance or service, such as changing or cleaning of air filters and lubrication or cleaning of components. Failure to properly install, operate or maintain your unit voids this warranty.