INSTALLATION INSTRUCTIONS

HP29-090 (7.5 TON)
HP29-120 (10 TON)

HEAT PUMPS
504,342M
11/2000
See unit nameplate for manufacturer and address.

Technical Publications
Litho U.S.A.

Table of Contents

Shipping & Packing List

1 - Assembled heat pump unit

Check the unit for shipping damage. If you find any damage, immediately contact the last carrier.

General Information

These instructions are intended as a general guide and do not supersede national or local codes in any way. Consult authorities having jurisdiction installation.

IMPORTANT

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

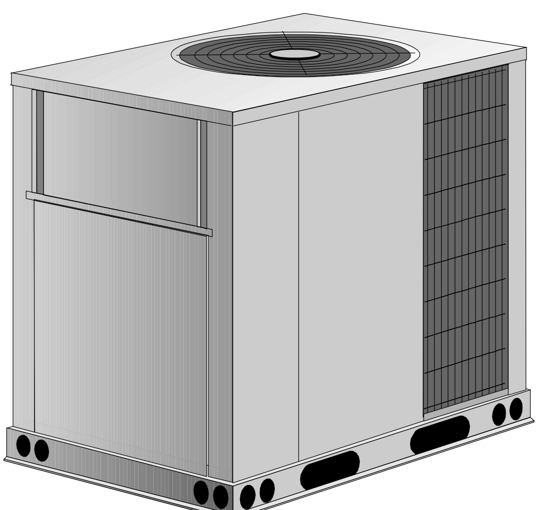
IMPORTANT

The Clean Air Act of 1990 bans the intentional venting of refrigerant (CFC's and HCFC'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.

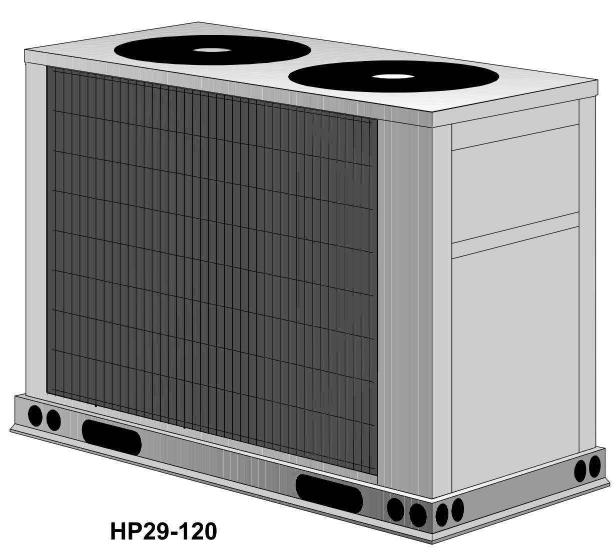
CAUTION

As with any mechanical equipment, personal injury can result from contact with sharp sheet metal edges. Be careful when you handle this equipment.

RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE



HP29-090

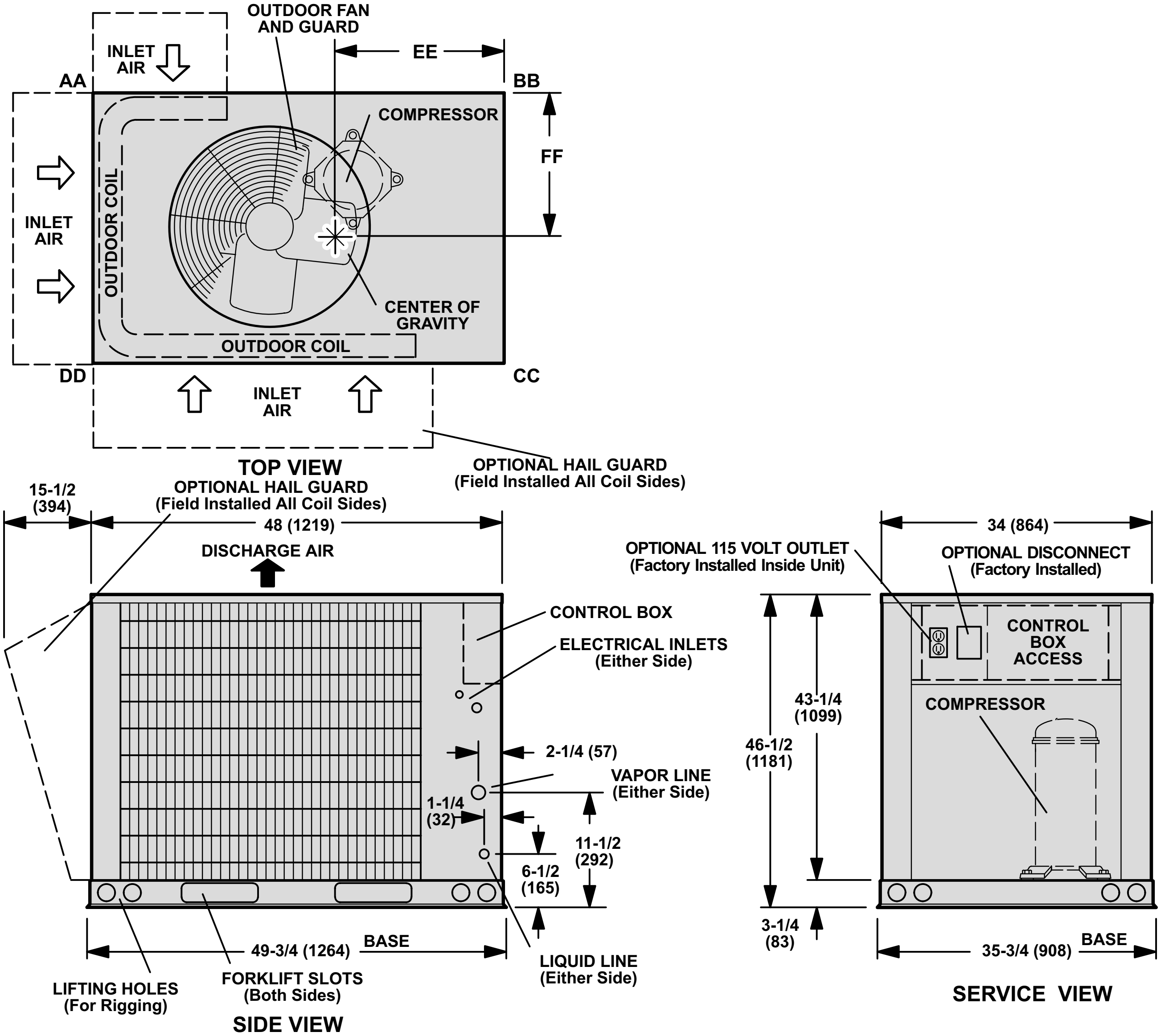


HP29-120

HP29-090 Series Dimensions - inches (mm)

Model No.	CORNER WEIGHT AA		BB		CC		DD	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg
HP29-090	121	55	146	66	130	59	109	49

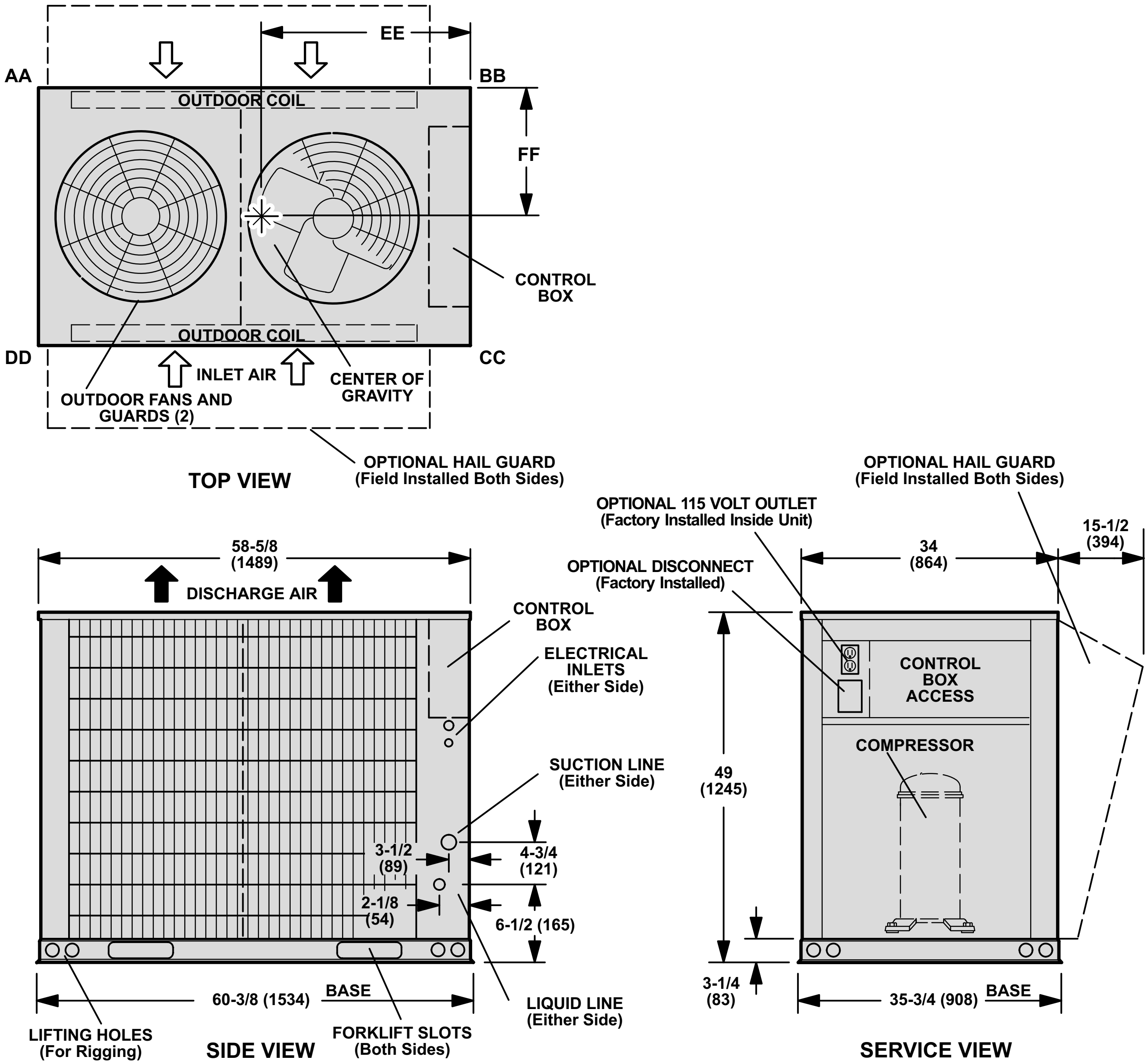
Model No.	CENTER OF GRAVITY EE		FF	
	inch	mm	inch	mm
HP29-090	22-1/2	572	19	483



HP29-120 Series Dimensions - inches (mm)

CORNER WEIGHT								
Model No.	AA		BB		CC		DD	
	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg
HP29-120	130	59	183	83	183	83	130	59

CENTER OF GRAVITY				
Model No.	EE		FF	
	inch	mm	inch	mm
HP29-120	25	635	17-3/4	451



HP29-090 Unit Parts Arrangement

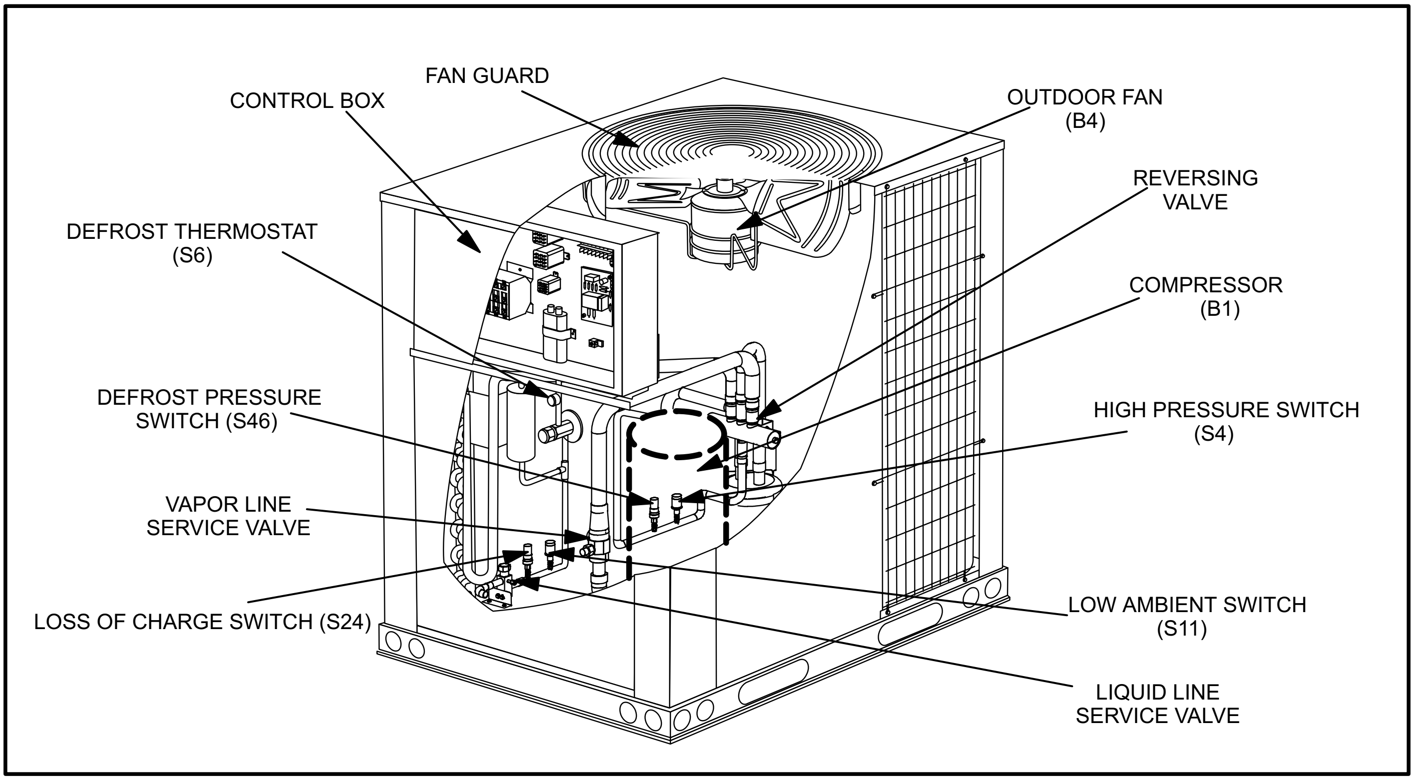


FIGURE 1

HP29-120 Unit Parts Arrangement

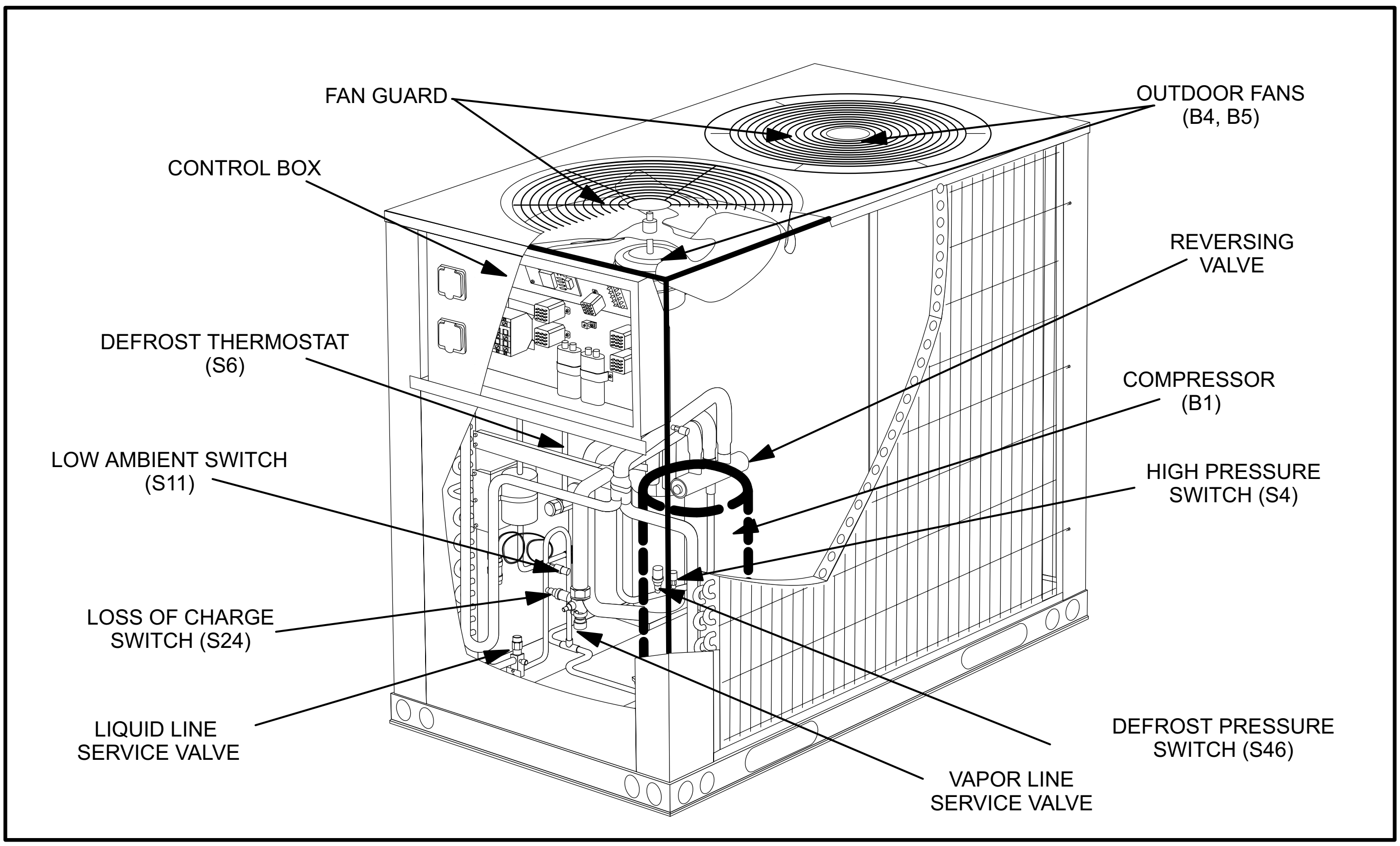


FIGURE 2

HP29-090 Control Box Arrangement

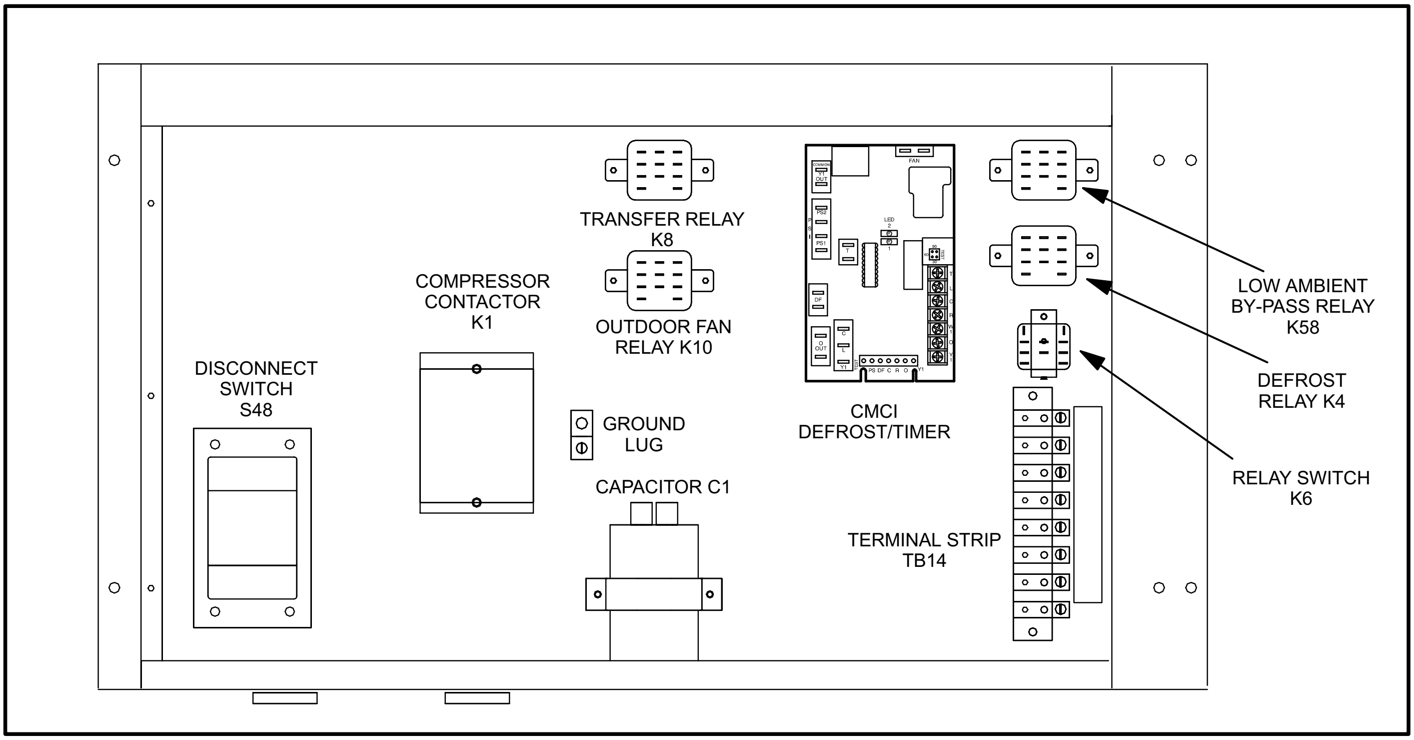


FIGURE 3

HP29-120 Control Box Arrangement

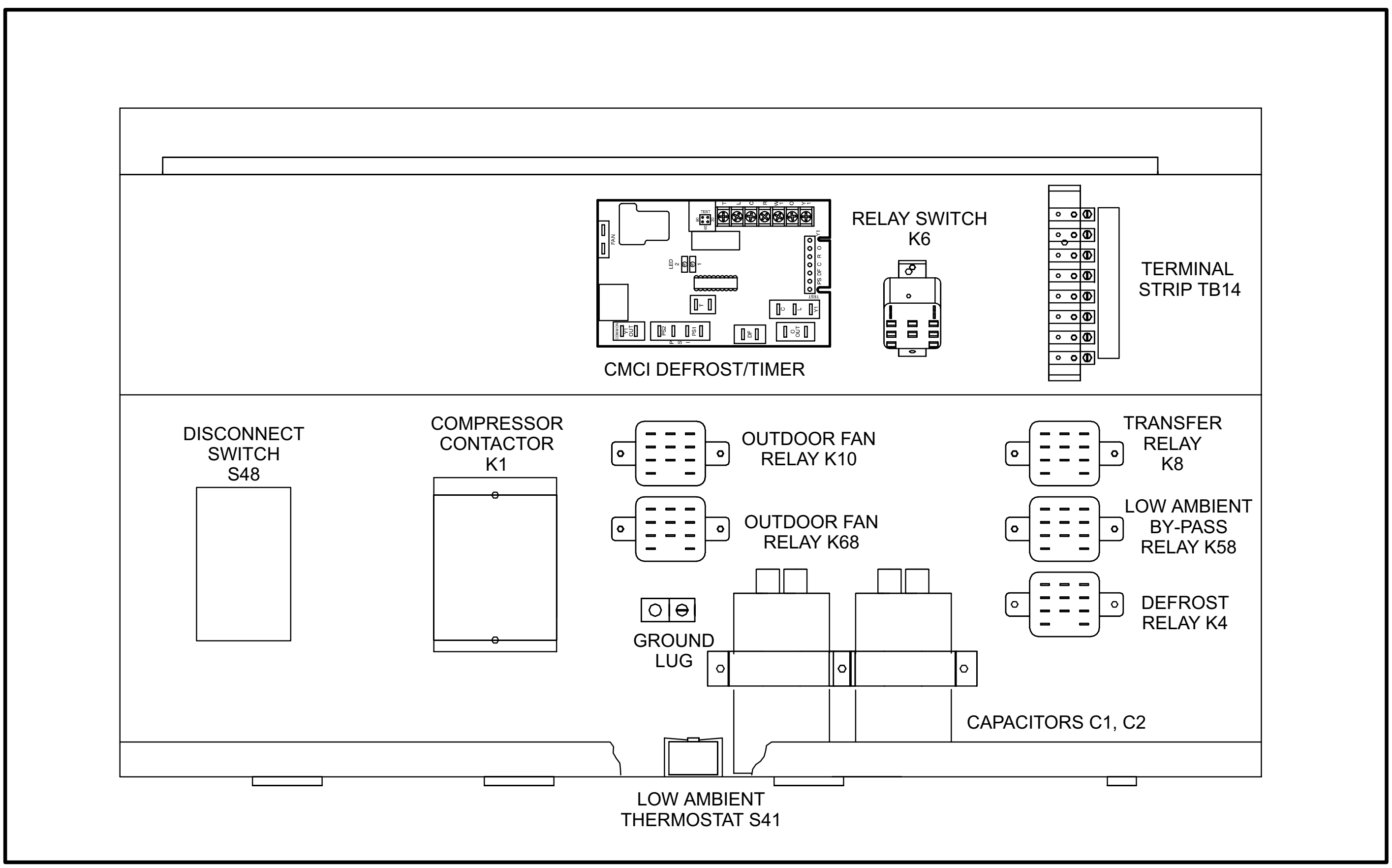


FIGURE 4

⚠ WARNING

Product contains fiberglass wool.

Disturbing the insulation in this product during installation, maintenance, or repair will expose you to fiberglass wool dust. Breathing this may cause lung cancer. (Fiberglass wool is known to the State of California to cause cancer.)

Fiberglass wool may also cause respiratory, skin, and eye irritation.

To reduce exposure to this substance or for further information, consult material safety data sheets available from address shown below, or contact your supervisor.

Lennox Industries Inc.

P.O. Box 799900
Dallas, TX 75379-9900

Setting the Unit

Refer to unit dimensions on page 1 for sizing mounting slab, platforms or supports. Refer to figure 5 for installation clearances.

Slab Mounting

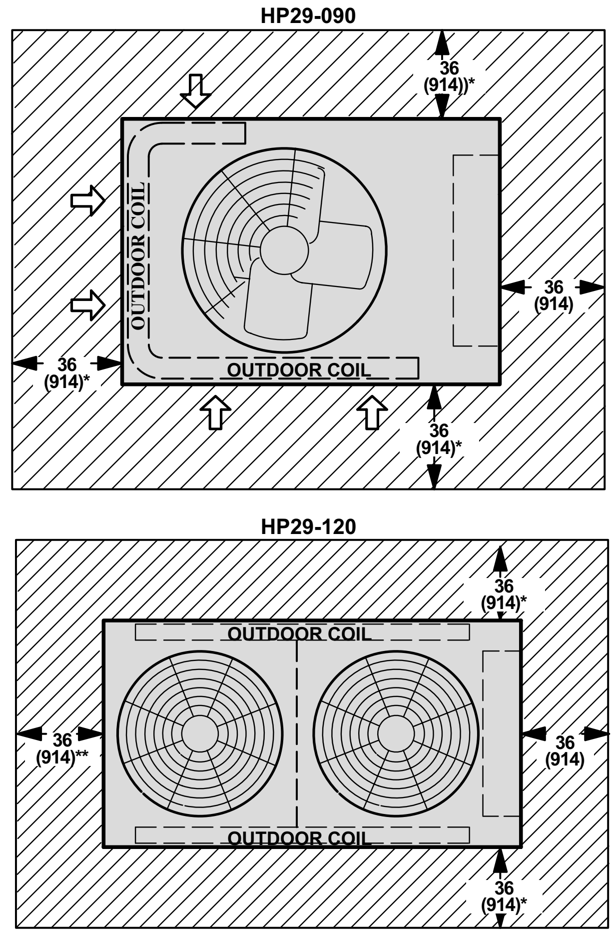
When installing unit at grade level, install on a level slab high enough above grade to allow adequate drainage of water. Top of slab should be located so run-off water from higher ground will not collect around unit.

Roof Mounting

Install unit at a minimum of 4 inches above surface of the roof. Care must be taken to ensure weight of unit is properly distributed over roof joists and rafters. Either redwood or steel supports are recommended.

INSTALLATION CLEARANCES

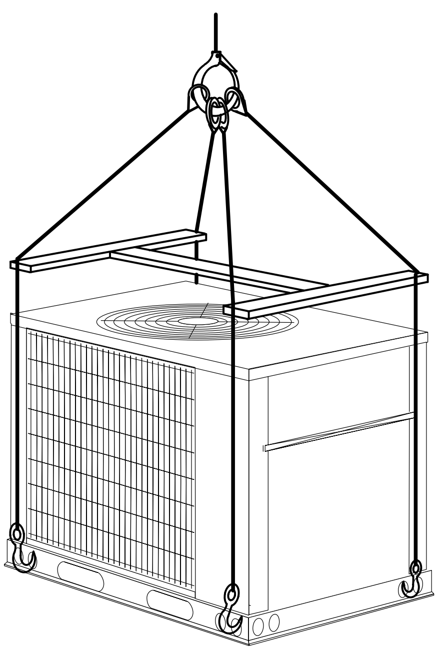
NOTE - 48 IN. (1219 mm) clearance required on top of unit.



***One of the these clearance distances may be reduced to 18” (457 mm).**
****This clearance may be reduced to 12” (305 mm).**

FIGURE 5

RIGGING INSTRUCTIONS



UNIT	*WEIGHT	
	LBS.	KG.
HP29-090	506	230
HP29-120	626	284

*Maximum weight with all available factory-installed accessories.

LIFTING POINT SHOULD BE DIRECTLY ABOVE CENTER OF GRAVITY

CAUTION - Do not walk on unit.

IMPORTANT - ALL PANELS MUST BE IN PLACE FOR RIGGING.

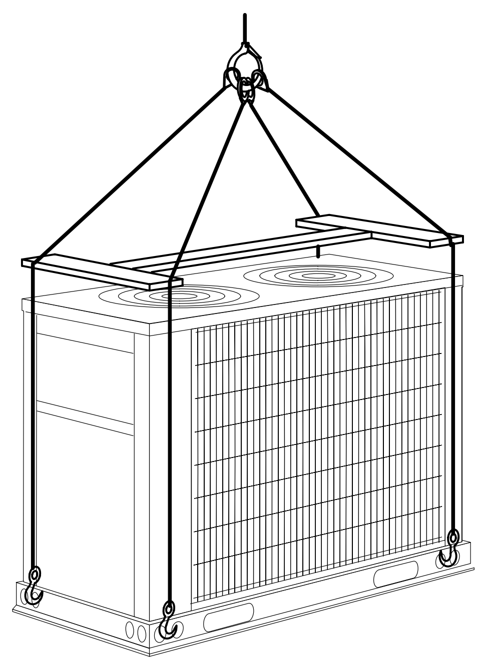


FIGURE 6

Rigging the Unit for Lifting

Rig unit for lifting by attaching four cables to holes in unit base rail. See figure 6.

1 - Detach wooden base protection before rigging.
2 - Connect rigging to the unit base using both holes in each corner.
3 - All panels must be in place (with spreader bars) for rigging.
4 - Place field-provided spreader bars in place just above top edge of unit. The frame must be of adequate strength and length. (Spreader bars prevent damage to top of unit.)

Electrical

Wiring must conform to current standards of the National Electric Code (NEC), Canadian Electrical Code (CEC) and local codes. Refer to the blower coil or furnace installation instructions for additional wiring application diagrams and refer to unit rating plate for minimum circuit ampacity and maximum overcurrent protection size.

⚠WARNING

Unit must be grounded in accordance with national and local codes.
Electric Shock Hazard.
Can cause injury or death.

Line Voltage

To facilitate conduit, knockouts are provided in cabinet panel. Refer to figure 7 for field wiring diagram.

NOTE - Units are approved for use with copper conductors only.

24V, Class II Circuit

24V, Class II circuit connections are made up below control box. Route wire in conduit to bottom of control box.

NOTE - A complete unit wiring diagram is located inside the control box panel.

FIELD WIRING DIAGRAM -- HP29 WITH AUXILIARY ELECTRIC HEAT

FIELD WIRING DIAGRAM -- HP29 WITHOUT AUXILIARY ELECTRIC HEAT

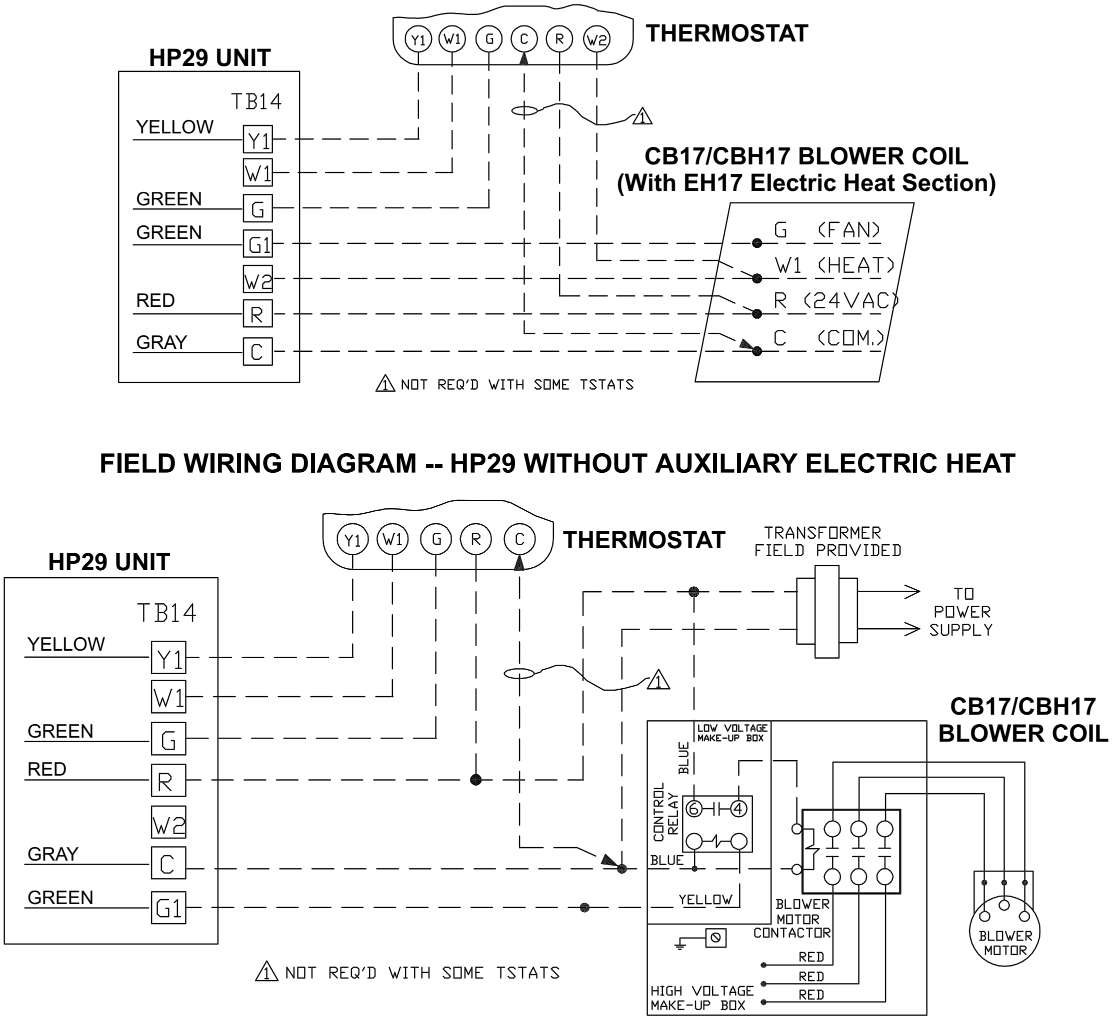


FIGURE 7

TYPICAL UNIT WIRING DIAGRAM HP29-090

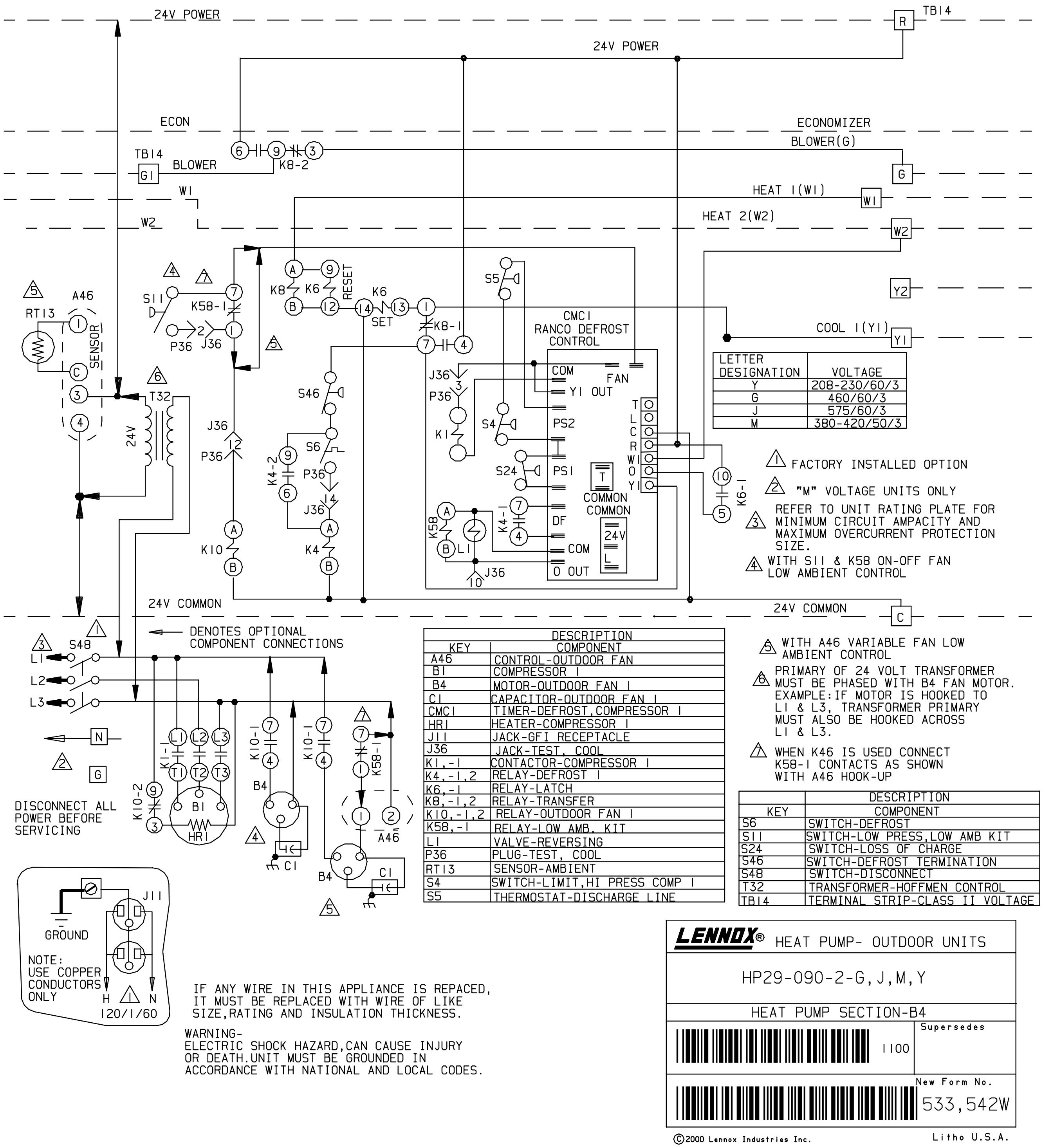
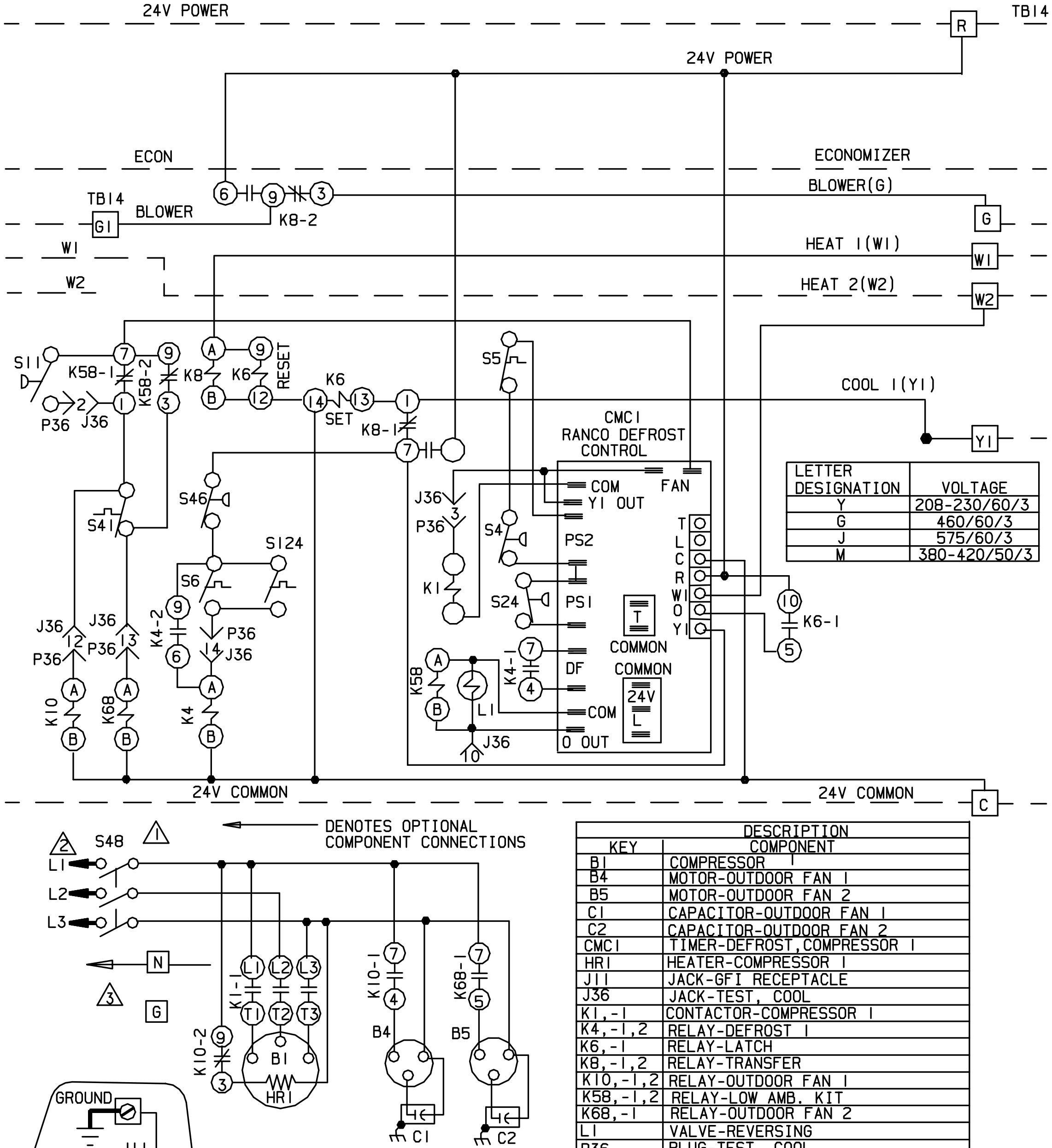


FIGURE 8

TYPICAL UNIT WIRING DIAGRAM HP29-120



LETTER DESIGNATION	VOLTAGE
Y	208-230/60/3
G	460/60/3
J	575/60/3
M	380-420/50/3

KEY	DESCRIPTION COMPONENT
B1	COMPRESSOR 1
B4	MOTOR-OUTDOOR FAN 1
B5	MOTOR-OUTDOOR FAN 2
C1	CAPACITOR-OUTDOOR FAN 1
C2	CAPACITOR-OUTDOOR FAN 2
CMC1	TIMER-DEFROST,COMPRESSOR 1
HR1	HEATER-COMPRESSOR 1
J11	JACK-GFI RECEPTACLE
J36	JACK-TEST, COOL
K1,-1	CONTACTOR-COMPRESSOR 1
K4,-1,2	RELAY-DEFROST 1
K6,-1	RELAY-LATCH
K8,-1,2	RELAY-TRANSFER
K10,-1,2	RELAY-OUTDOOR FAN 1
K58,-1,2	RELAY-LOW AMB. KIT
K68,-1	RELAY-OUTDOOR FAN 2
L1	VALVE-REVERSING
P36	PLUG-TEST, COOL
S4	SWITCH-LIMIT,HI PRESS COMP 1
S5	THERMOSTAT-DISCHARGE LINE
S6	SWITCH-DEFROST
S11	SWITCH-LOW PRESS,LOW AMB KIT
S24	SWITCH-LOSS OF CHARGE
S41	THERMOSTAT-LOW AMBIENT KIT
S46	SWITCH-DEFROST TERMINATION
S48	SWITCH-DISCONNECT
S124	SWITCH-DEFROST,AUX.
TB14	TERMINAL STRIP-CLASS II VOLTAGE

⚠1 FACTORY INSTALLED OPTION

⚠2 REFER TO UNIT RATING PLATE FOR MINIMUM CIRCUIT AMPACITY AND MAXIMUM OVERCURRENT PROTECTION SIZE

IF ANY WIRE IN THIS APPLIANCE IS REPLACED, IT MUST BE REPLACED WITH WIRE OF LIKE SIZE, RATING AND INSULATION THICKNESS.

⚠3 "M" VOLTAGE UNITS ONLY

DISCONNECT ALL POWER BEFORE SERVICING

FOR USE WITH COPPER CONDUCTORS ONLY

LENNOX® HEAT PUMP-OUTDOOR UNITS

HP29-120-2-G,J,M,Y

HEAT PUMP SECTION-B4

1100 Supersedes

New Form No. 533,543W

FIGURE 9

Plumbing

Field refrigerant piping consists of liquid and vapor lines from the heat pump unit. Piping may be brought into the unit through either side. Remove the knockouts on the mullions and install the provided rubber grommets into the piping holes. Remove the plugs from the liquid and vapor lines. Refer to table 1 for field-fabricated refrigerant line sizes for runs up to 50 linear feet (15 m).

TABLE 1
REFRIGERANT LINE SIZES

UNIT	LIQUID LINE	VAPOR LINE
HP29-090	5/8 in. (16 mm)	1-3/8 in. (35 mm)
HP29-120	5/8 in. (16 mm)	1-3/8 in. (35 mm)

Refrigerant Line Brazing Procedure

1 - End of refrigerant line must be cut square, kept round, free from nicks or dents and deburred (I.D. and O.D.)

2 - Wrap a wet cloth around the valve body when brazing to prevent possible heat damage to the valve core and port.

3 - Install filter drier, provided with unit, in the liquid line as close as possible to the expansion device.

Refrigerant Line Limitations

Unit applications with line set lengths up to 50 linear feet (15 m) (excluding equivalent length of fittings) may be installed using refrigerant line sizes as outlined in table 1. **Refrigerant lines from 50 to 100 linear feet (15 to 30 m) should be sized in accordance with the following section.** The maximum line length is 100 feet (30 m).

Maximum suction rise must not exceed 45 linear feet (13.7 m) and maximum liquid head must not exceed 45 linear feet (13.7 m).

Refer to the refrigerant piping guideline manual (Corp. 9351-L9) if line lengths exceed 50 feet (15 m). In these applications, you must install a liquid line solenoid valve at the evaporator coil. In addition, use expansion valves only (RFC and cap-tube expansion devices are not acceptable). In applications where the lines exceed 75 feet (23 m), install the solenoid valve with a non-recycling pump-down control.

*NOTE - When refrigerant line solenoid valves are installed, velocities should not exceed 300 fpm **(1.5 m/s)** in order to avoid liquid line hammer.*

All units are equipped with a low ambient (head pressure) control to allow for cooling down to 0°F (-18°C).

Due to the additional refrigerant required to fill the lines, the likelihood of slugging is greatly increased with lines that are over 50 feet (15 m) in length. An incremental increase in liquid line size results in a 40 to 50 percent increase in liquid to fill the line. Therefore, it is desirable to use the smallest liquid line size possible.

Pipe Sizing, Line Layout and Design [Line set lengths from 50 - 100 linear feet (15 - 30 m)]

Start by making a sketch of the system showing relative locations of the heat pump unit and the indoor coil, length of each piping segment, elbows, tees, valves, etc. This information will be used to determine the equivalent length of the piping run. Also, take note of any difference in elevation between the outdoor and indoor units. Vapor and liquid lift must be considered to ensure proper pipe sizing.

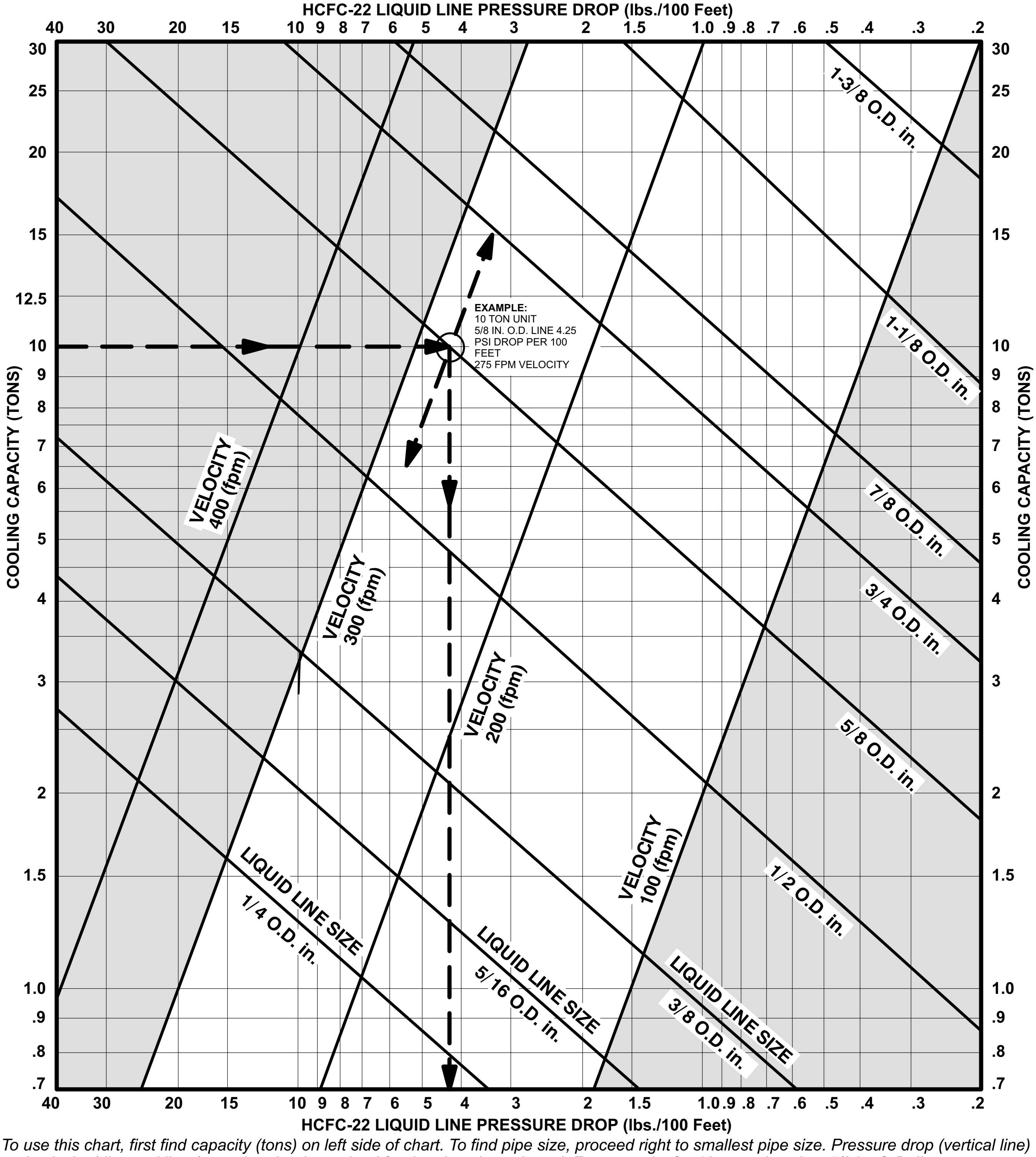
Liquid Line Function and Design

The liquid line must convey a full column of liquid from the outdoor unit to the metering device at the indoor coil without flashing. In order to ensure this, liquid line pressure drop and pressure across the expansion device and distributor must be considered.

TABLE 2
HCFC-22 SATURATION TEMPERATURES
(Condensing Temperatures at Different Pressures)

HCFC-22 Pressure Temperature Table (Psig)									
Degrees F (°C)	HCFC22	Degrees F (°C)	HCFC22	Degrees F (°C)	HCFC22	Degrees F (°C)	HCFC22	Degrees F (°C)	HCFC22
-40 (-41)	0.6	18 (-8)	41.1	36 (2)	63.3	75 (24)	133.4	120 (49)	262.5
-30 (-34)	4.9	20 (-7)	43.3	38 (3)	66.1	80 (27)	145.0	125 (52)	280.7
-20 (-28)	10.2	22 (-6)	45.5	40 (4)	69.0	85 (29)	157.2	130 (54)	299.7
-10 (-23)	16.6	24 (-4)	47.9	45 (7)	76.6	90 (32)	170.0	135 (57)	319.6
0 (-18)	24.1	26 (-3)	50.3	50 (10)	84.7	95 (35)	183.6	140 (60)	340.3
10 (-12)	32.9	28 (-2)	52.7	55 (13)	93.3	100 (38)	197.9	145 (63)	362.0
12 (-11)	34.9	30 (-1)	55.2	60 (16)	102.4	105 (41)	212.9	150 (66)	384.6
14 (-10)	36.9	32 (0)	57.8	65 (18)	112.2	110 (43)	228.6	155 (68)	406.3
16 (-9)	39.0	34 (1)	60.5	70 (21)	122.5	115 (46)	245.2	160 (71)	433.3

HCFC-22 LIQUID LINE PRESSURE DROP/VELOCITY
At 45°F Evaporating Temperature and 125°F Condensing Temperature



To use this chart, first find capacity (tons) on left side of chart. To find pipe size, proceed right to smallest pipe size. Pressure drop (vertical line) and velocity (diagonal lines) can then be determined for the pipe size selected. For example, for 10 ton unit, select 5/8 in. O.D. line.

NOTE - Shaded area denotes unacceptable velocity range.

FIGURE 10

TABLE 3

Equivalent Length in Feet of Straight Pipe for Valves and Fittings						
Line Size O.D. in.	Globe Valve	Angle Valve	90° Long* Radius Elbow	45° Long* Radius Elbow	Tee Line	Tee Branch
3/8	7	4	0.8	0.3	0.5	1.5
1/2	9	5	0.9	0.4	0.6	2.0
5/8	12	6	1.0	0.5	0.8	2.5
3/4	14	7	1.3	0.6	0.9	3.0
7/8	15	8	1.5	0.7	1.0	3.5
1-1/8	22	12	1.8	0.9	1.5	4.5
1-3/8	28	15	2.4	1.2	1.8	6.0
1-5/8	35	17	2.8	1.4	2.0	7.0
2-1/8	45	22	3.9	1.8	3.0	10
2-5/8	51	26	4.6	2.2	3.5	12

Long radius elbow. Multiply factor by 1.5 for short radius elbow equivalent length.

Lennox equipment above five tons in capacity typically operates at a saturated condensing temperature of 125°F (280psi per table 2). Lennox equipment is designed to hold a charge allowing 10°F subcooling at 95°F ambient. The condensing temperature and the subcooling are used to calculate the maximum allowable pressure drop as detailed below.

NOTE - 95°F ambient is an arbitrary temperature chosen to represent typical summer operating conditions used to calculate maximum allowable pressure drop. This temperature (and the corresponding subcooling) may vary with regional climate.

Example -- Calculating maximum allowable pressure drop: Find the maximum allowable liquid line pressure drop of a unit operating at 10°F subcooling and 125°F (280 psi) condensing temperature. Subtract 10°F subcooling temperature from 125°F condensing temperature to equal 115°F subcooled liquid temperature (245 psi / point at which flash gas will begin to form). Subtract 245 psi subcooled pressure from 280 psi condensing pressure to find a maximum allowable pressure drop of 35 psi.

To calculate actual pressure drop in the liquid line, calculate pressure drop due to friction and pressure drop due to vertical lift and add the two.

Pressure drop due to friction in the pipe or other devices must all be considered. Pressure drop ratings for different pipe sizes are given in figure 10. Pressure drop ratings of field-installed devices are typically supplied by the manufacturer.

Pressure drop due to vertical lift (1/2 pound per foot) is typically high and can be a limiting factor in the design of the system.

The liquid refrigerant pressure must be sufficient to produce the required flow through the expansion device. Liquid refrigerant (free of flash gas) should be delivered to the expansion valve at a minimum of 175psi to ensure the 100 psi necessary to produce full refrigerant flow at the rated capacity.

Example -- Liquid Line Pipe Sizing

Given: 10-ton heat pump unit on ground level with a 10-ton indoor coil on the third level above ground and a total of 96 linear feet of piping. Unit is charged with 10°F subcooling at 125°F condensing temperature (280 psi HCFC-22 liquid). Refer to figure 11.

Find: Select tube size from figure 10.

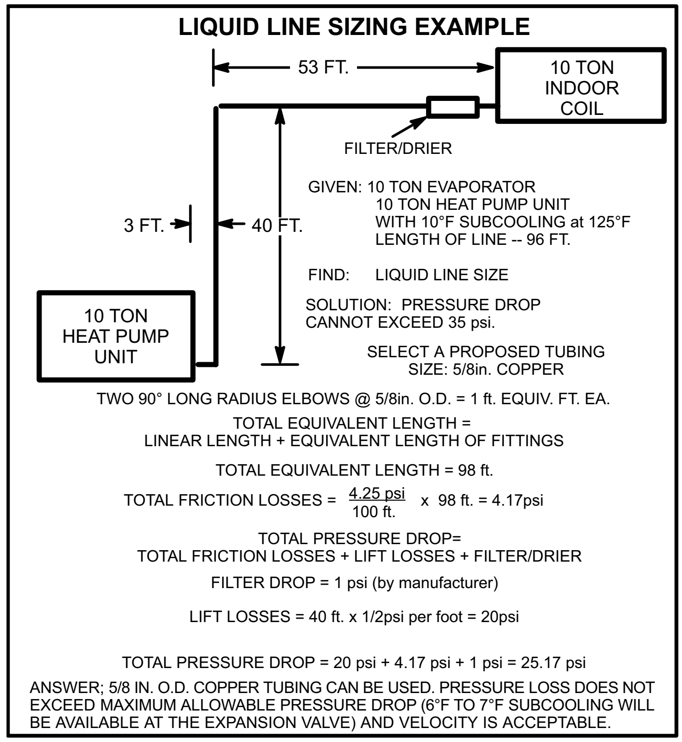


FIGURE 11

Figure 10 illustrates the relationship between liquid line sizing, pressure drop per 100 feet, velocity range and tonnage. Enter figure 10 from the left and extend to the right to the smallest tube size that will not exceed 300 fpm velocity.

Solution: For a 10-ton system, 5/8 inch O.D. line with 4.25 psi per 100 feet drop (per figure 10) is selected. Now, calculate pressure drop due to friction and liquid lift to determine if this is a good selection.

The total friction drop for the application will include 96 feet of 5/8 inch O.D. pipe plus 1 equivalent foot per elbow (two elbows) to equal 98 equivalent feet.

In a 10-ton system, expect 4.25 psi drop per 100 feet of 5/8 inch O.D. copper (per figure 10). Multiply 4.25/100 by 98 equivalent feet to calculate the total friction loss of 4.17 psi.

Add the pressure drop caused by vertical lift. When HCFC-22 refrigerant is used, there is 1/2 psi pressure drop per foot of vertical lift. ***In this application, which has a 40-foot (12 m) vertical lift, add a 20 psi pressure drop because of the lift.***

Finally, consider the impact of the filter drier to the liquid, line which has a 1 psi pressure drop (this number provided by manufacturer).

Add the three components of pressure drop together to find that the total pressure drop in this 5/8 inch line equals 25.17 psi which is well within our acceptable range. The 5/8 inch line, therefore, is a good selection because it is well below the maximum allowable pressure drop, is in a satisfactory velocity range, uses minimum refrigerant and provides sufficient pressure at the expansion valve.

Alternative Sizing: Suppose 3/4 inch O.D. line with 1.6 psi drop per 100 feet had been selected. The total equivalent length is equal to the linear length (96 feet) plus the equivalent length of the fittings (from table 3, two 90° ells at 1.25 feet each). The total equivalent length is 98.5 feet. The total friction drop would have been 1.6/100 multiplied by 98.5 = 1.57 psi. When the pressure drop due to lift (20 psi) and the filter drier (1 psi) are added we find that the total pressure drop for 3/4 inch line equals 22.57 psi.

Though the 3/4 inch line provides a lower pressure drop, the larger diameter pipe will require more refrigerant which will increase the risk of refrigerant slugging. In addition, the smaller line will be less costly. The smaller line should be used.

Vapor Line Function and Design

The vapor line returns refrigerant vapor and oil from the evaporator to the compressor. Vapor line design is critical. The design must minimize pressure loss in order to achieve maximum unit efficiency and provide adequate oil return to the compressor under all conditions.

Because oil separates from refrigerant in the evaporator, the vapor velocity must be adequate to sweep the oil along the pipe. Horizontal vapor lines require a minimum of 800 fpm velocity for oil entrainment. In order to ensure oil entrainment, vapor line risers require a minimum velocity of 1200 fpm (1500 fpm is preferred) regardless of the length of the riser.

Figure 14 illustrates the relationship between vapor line sizing, pressure drop, velocity and cooling capacity. Use this chart to determine vapor line pressure drop and velocity. As the pipe size increases, so does the capacity required to ensure oil entrainment.

Vertical lift has no significant effect on system capacity. However, systems lose approximately 1 percent of capacity for every pound of pressure drop due to friction in the vapor line. In order to calculate capacity loss, first estimate pressure drop in the total equivalent length of the piping run (refer to figure 14). Capacity ratings given in the Lennox Engineering Handbook include the loss for a 25 feet refrigerant line. Therefore, subtract the pressure loss of 25 feet of piping from the total calculated for your particular application.

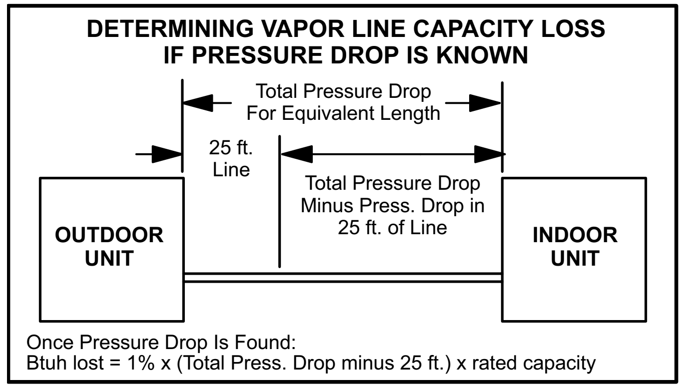


FIGURE 12

When an indoor coil is located above or on the same level as the heat pump, the vapor line must rise to the top of the evaporator. See figure 13. This helps prevent liquid from migrating to the compressor during the off cycle. Traps should also be installed at the bottom of all vertical risers for migration protection in the off cycle.

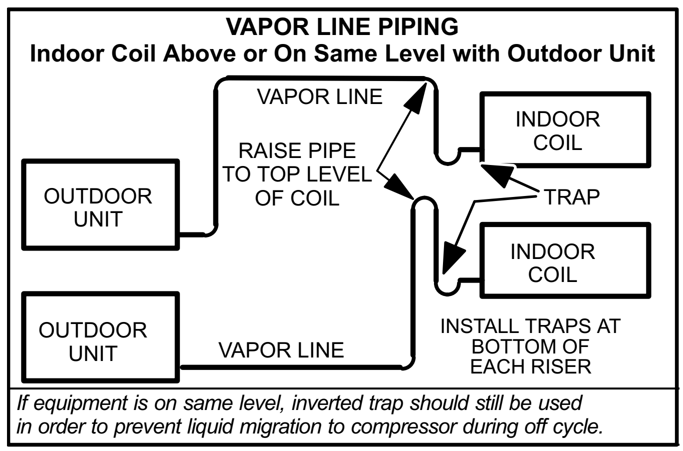
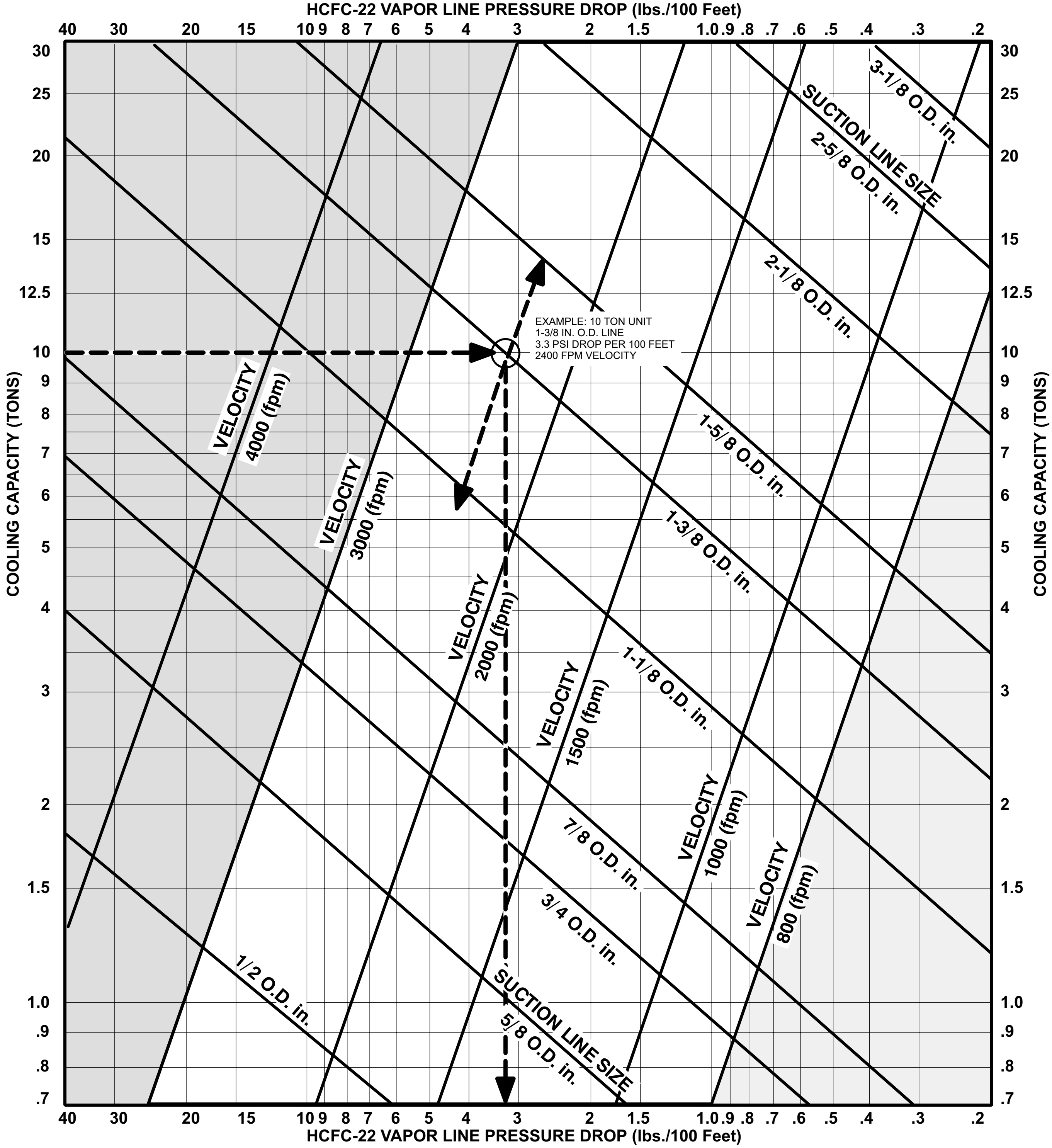


FIGURE 13

Horizontal vapor lines should be level or slightly sloped toward the heat pump unit. Pipe must avoid dips or low spots that can collect oil. For this reason, hard copper should be used, especially on long horizontal runs.

As with liquid line sizing, begin by making a sketch of the layout complete with fittings, driers, valves etc. Measure the linear length of each line and determine the number of ells, tees, valves, driers etc. Add equivalent length of fittings (table 3) to linear length of pipe to get total equivalent length used in determining friction loss. Again, refer to manufacturer's data for pressure drop information on accessory components. The resultant pressure drop must be considered.

HCFC-22 VAPOR LINE PRESSURE DROP/VELOCITY PER 100 FT. OF LINE
At 45°F Evaporating Temperature and 125°F Condensing Temperature



To use this chart, first find capacity (tons) on left side of chart. To find pipe size, proceed right to smallest pipe size. Pressure drop (vertical line) and velocity (diagonal lines) can then be determined for the pipe size selected. For example, for 10 ton unit, select 1-3/8 in. O.D. line.
NOTE - Shaded area denotes unacceptable velocity range.

FIGURE 14

Example -- Vapor Line Pipe Sizing

Given: 7-1/2 ton heat pump with indoor coil lower than outdoor coil. Application includes 82 linear feet of piping and 4 ells. There is a 20-foot vertical lift and 62 feet of horizontal run. Refer to figure 15.

Find: Select tube size from figure 14.

Solution: 1-1/8 inch O.D. line with 6 psi per 100 feet pressure drop and 2900 fpm velocity is selected. Now, calculate pressure drop due to friction to determine if this is a good selection.

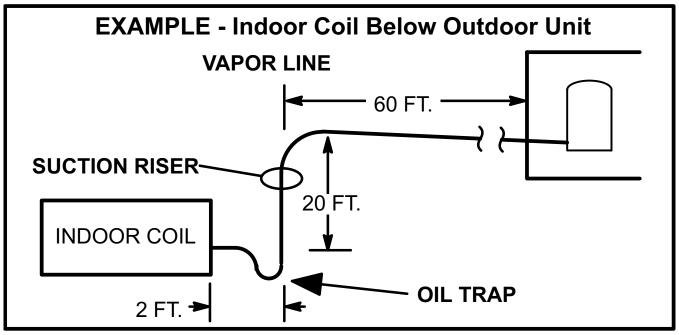


FIGURE 15

From table 3, four ells at 1.8 equivalent feet each equals 7.2 equivalent feet. When added to the 82 feet of pipe, the total equivalent feet becomes 89.2 feet (round up to 90 feet).

Multiply 6/100 by 90 equivalent feet to calculate total friction loss of 5.4 psi.

Use figure 14 to calculate the pressure drop in 25 feet of 1-1/8 inch line. Multiply 6/100 by 25 feet to calculate friction loss of 1.5 psi. This loss has already been included in the capacity given in Lennox' Engineering Handbook, so it should be subtracted from the total.

The capacity lost in the "total equivalent length" of the refrigerant line (using figures 12 and 14) equals 1 percent x (5.4 - 1.5) x 90,000.
Btuh lost= 0.01 x (3.9) x 90,000 = 3510
Capacity loss for the line selected is approximately 3.9 percent.

The preceding calculation shows that this is a workable system, but it will result in losses in both capacity and efficiency.

Alternative Sizing: Using the same (7-1/2 ton) example, this time select 1-3/8 inch O.D. line. 1-3/8 inch O.D. line with 2 psi per 100 feet pressure drop has 1760 fpm velocity. Now calculate pressure drop due to friction loss to determine if this is a better selection.

From figure 3, four ells at 2.4 equivalent feet each equals 9.6 equivalent feet. When added to the 82 feet of pipe, the total equivalent feet becomes 91.6 feet (round up to 92 feet).

Multiply 2/100 by 92 equivalent feet to calculate total friction loss of 1.8 psi.

Use figure 14 to calculate the pressure drop in 25 feet of 1-3/8 inch line. Multiply 2/100 by 25 feet to calculate friction loss of 0.5 psi. This loss has already been included in the capacity given in Lennox' Engineering Handbook, so it should be subtracted from the total.

The capacity lost in the "total equivalent length" of the refrigerant line (using figures 12 and 14) equals 1 percent x (1.8 - 0.5) x 90,000.
Btuh lost= 0.01 x (1.3) x 90,000 = 1170
Capacity loss for the line selected is approximately 1.3 percent.

The conditions in this example will allow either 1-1/8 inch or 1-3/8 inch vapor line to be used, since capacity loss is minimized and velocity is sufficient to return oil to the compressor.

Service Valves

The liquid line and vapor line service valves and gauge ports are accessible inside of the unit. These gauge ports are used for leak testing, evacuating, charging and checking charge.

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

Liquid Line Service Valve

All HP29 units use liquid line service valves as shown in figure 16. A Schrader valve is factory installed. A service port is supplied to protect the Schrader valve from contamination and serve as the primary leak seal.

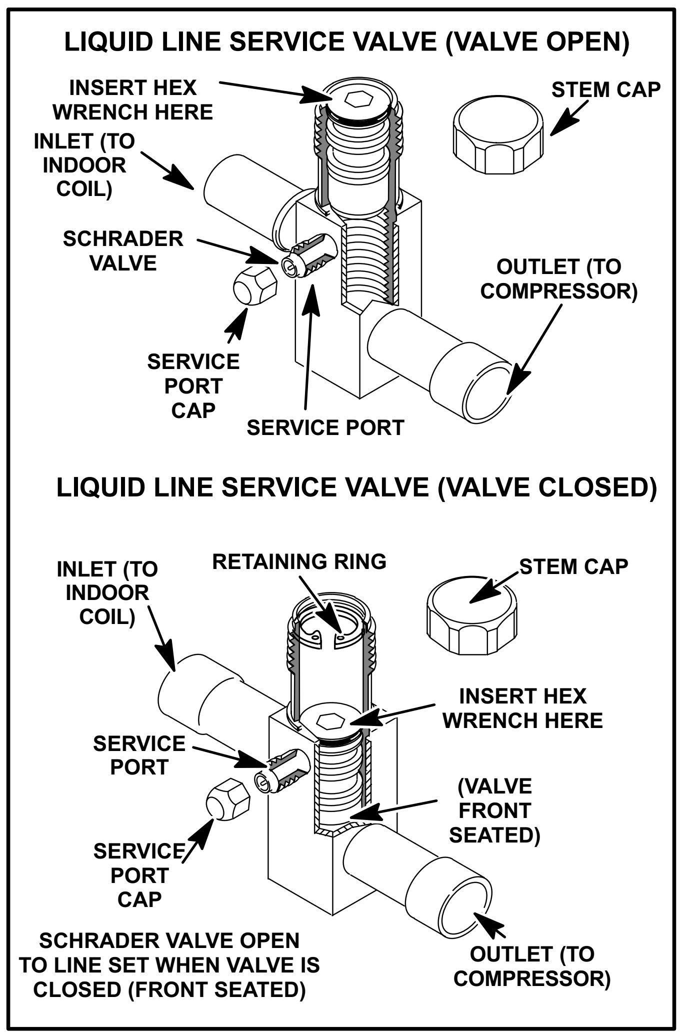


FIGURE 16

To Access Schrader Port:

1 - Remove 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 Line Service Valve:

1 - Remove stem cap with an adjustable wrench.
2 - Using service wrench and 5/16 inch hex head extension back the stem out counterclockwise until the valve stem just touches the retaining ring.
3 - Replace stem cap. Tighten finger tight, then tighten an additional 1/6 turn.

WARNING

Do not attempt to backseat this valve. Attempts to backseat this valve will cause snap ring to explode from valve body under pressure of refrigerant. Personal injury and unit damage will result.

To Close Liquid Line Service Valve:

1 - Remove stem cap with an adjustable wrench.
2 - Using service wrench and 5/16 inch hex head extension, turn stem clockwise to seat the valve. Tighten firmly.
3 - Replace stem cap and tighten finger tight, then tighten an additional 1/6 turn.

Vapor Line Service Valve

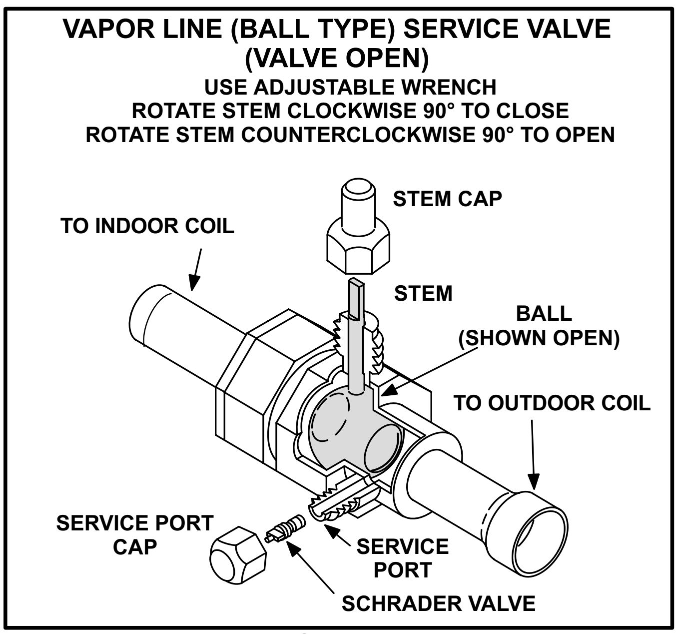


FIGURE 17

All HP29 units are equipped with a full-service ball valve on the vapor line, as shown in figure 17. One service port that contains a Schrader valve core is present in this valve. A cap is also provided to seal off the service port. The valve is not rebuildable so it must always be replaced if failure has occurred.

Opening the Vapor Line Service Valve

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

Closing the Vapor Line Service Valve

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

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

Never use oxygen to pressurize refrigeration or air conditioning system. Oxygen will explode on contact with oil and could cause personal injury. When using high pressure gas such as nitrogen or CO2 for this purpose, be sure to 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 the hoses to the service ports With both manifold valves closed, open the valve on the HCFC-22 cylinder (vapor only). Open the liquid line and vapor line service valves.
2 - Open the high pressure side of the manifold to allow HCFC-22 into the line set, indoor unit, and the outdoor unit. Weigh in a trace amount of HCFC-22. *[A trace amount is a maximum of 2 ounces (57g) refrigerant 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 HCFC-22 cylinder.
3 - Connect a cylinder of nitrogen with a pressure regulating valve to the center port of the manifold gauge set.
4 - Connect the high pressure hose of the manifold gauge set to the service port of the vapor line valve. *(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.)*
5 - Connect the nitrogen cylinder to the center port on the manifold gauge set.
6 - Adjust 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 short period of time, open a system port to make sure the refrigerant added is adequate to be detected. (Amounts of refrigerant will vary with line lengths.) Check all joints for leaks, then purge the nitrogen and HCFC-22 mixture. Correct any leaks and recheck.

Evacuation & Dehydration

⚠ IMPORTANT

Units are shipped with a holding charge of dry air and helium which must be removed before the unit is evacuated and charged with refrigerant.

Evacuating the system of noncondensables is critical for proper operation of the unit. Noncondensables are gases 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.

1 - Connect manifold gauge set to the service valve ports as follows: low pressure gauge to vapor line service valve; high pressure gauge to liquid line service valve.
IMPORTANT - Compressors (as with any refrigerant compressor) should never be used to evacuate a refrigeration or air conditioning system.
NOTE - A temperature vacuum gauge, mercury vacuum or thermocouple gauge should be used. The usual Bourdon tube gauges are inaccurate in the vacuum range.

2 - Open the vapor line and liquid line valves to evacuate the unit.

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 outdoor unit, the line set, and the indoor unit to an **absolute pressure** of 23 mm of mercury or approximately 1 inch 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, the leak testing procedure must be repeated.
*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 mm 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.

⚠ 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, indoor unit, and the outdoor unit.

8 - Reconnect the manifold gauge to the vacuum pump. Turn the pump on and continue to evacuate the outdoor unit, line set, and indoor unit. Evacuate until the absolute pressure does not rise above .5 mm (500 microns) of mercury within a 20-minute period after you shut off the vacuum pump and close the manifold gauge valves.

10- 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 HCFC-22 refrigerant. Open the manifold gauge valves to break the vacuum in the outdoor unit, line set, and indoor unit. Close manifold gauge valves. Shut off HCFC-22 cylinder and remove the manifold gauge set.

Start-Up

⚠ IMPORTANT

Crankcase heater should be energized 24 hours before unit start-up to prevent compressor damage as a result of slugging.

1 - Rotate the fan to check for frozen bearings or binding.

2 - Inspect all factory and field-installed wiring for loose connections.

3 - Refer to charging section to accurately charge and check the charge on this unit.

4 - Check voltage supply at the disconnect switch. The voltage must be within range listed on unit nameplate. If not, do not start equipment until the power company has been consulted and the voltage condition corrected.

5 - Set thermostat for a cooling demand, turn on power to blower and close heat pump unit disconnect switch to start.

6 - Recheck unit voltage with unit running. Power must be within range shown on unit nameplate. Check amperage draw of unit. Refer to unit nameplate for correct running amps.

Three-Phase Compressor Rotation

Three-phase scroll compressors must be phased sequentially to ensure that the compressor rotates and operates correctly. When the compressor starts, a rise in discharge and drop in suction pressures indicate proper compressor phasing and operation. If discharge and suction pressures do not perform normally, follow the steps below to correctly phase in the unit.

1 - Disconnect the power to the unit.
2 - Reverse any two field power leads to the unit.
3 - Reconnect the power to the unit.

The discharge and suction pressures should operate within their normal start-up ranges.

NOTE - The compressor's noise level will be significantly higher when the phasing is incorrect. The compressor will not provide cooling when the unit is not correctly phased. Continued backward operation of the compressor to due to incorrect phasing will cause the compressor to cycle on internal protector.

Charging

Units are shipped with a holding charge of dry air and/or helium. which must be removed before the unit is evacuated and charged with refrigerant. In new installations, the recommended and most accurate method of charging is to weigh the refrigerant into the unit as outlined in table 4 and the following procedure.

Weighing in the Charge
(TXV Systems, < 60°F Outdoor Temperature)

1 - Recover the refrigerant from the unit.
2 - Conduct a leak check, then evacuate as previously outlined.
3 - Weigh in the factory charge as shown on the outdoor unit's rating plate.

Checking Charge Using Normal Operating Pressures

If weighing facilities are not available, or if charge needs to be checked, use the following method:

1 - Attach gauge manifolds and operate unit in cooling mode until system stabilizes (approximately five minutes).
2 - Use a thermometer to accurately measure the outdoor ambient temperature.
3 - Apply the outdoor temperature to table 5 to determine normal operating pressures.
4 - Compare the normal operating pressures to the pressures obtained from the gauges. Minor variations in these pressures may be expected due to differences in installations. Significant differences could mean that the system is not properly charged or that a problem exists with some component in the system. Correct any system problems before proceeding.
5 - Use approach method to confirm the readings, or adjust the refrigerant charge.

Charge Verification

The refrigerant charge can be verified using the approach method if the outdoor ambient temperature is 60°F or above. If the outdoor ambient temperature is below 60°F, you must weigh the refrigerant into the unit to ensure proper charging.

TABLE 4

UNIT MODEL NUMBER	MATCHED INDOOR UNIT	HCFC-22 FOR 25 FEET (7.6 m) OF LINE	LIQUID LINE DIAMETER	ADJUSTMENT PER FOOT (.3 m) OF LINE*
HP29-090-2	CB17/CBH17-95	23 lbs. (10.4 kg)	5/8 in. (16 mm)	1.8 oz. (51g)
			3/4 in. (19 mm)	2.6 oz. (74g)
HP29-120-2	CB17/CBH17-135	31 lbs. (14.1 kg)	5/8 in. (16 mm)	1.8 oz. (51g)
			3/4 in. (19 mm)	2.6 oz. (74g)

** If line length is greater than 25 feet (7.62 m), add this amount. If line length is less than 25 feet (7.62 m), subtract this amount.*

NOTE - Refrigerant line sets should not be longer than 100 feet (30.5 m). Refrigerant line losses deduct from the net capacity of the system. Additional refrigerant required for such systems may also upset the refrigerant-to-oil ratio.

TABLE 5
NORMAL OPERATING PRESSURES

Outdoor Coil Entering Air Temperature	HP29-090* Discharge ± 10 psig	HP29-090* Vapor ± 5 psig	HP29-120** Discharge ± 10 psig	HP29-120** Vapor ± 5 psig
65°F (18°C)	188	69	180	64
75°F (24°C)	216	71	206	66
85°F (29°C)	248	72	236	67
95°F (35°C)	283	74	269	69
105°F (41°C)	319	76	304	70
115°F (46°C)	360	78	345	72

** HP29-090 tested with CB17/CBH17-95V. **HP29-120 tested with CB17/CBH17-135V.*

Approach Method of Charge Verification
(Expansion Valve Systems, $\geq$ 60°F Outdoor Temp.)

The approach method should be used to verify the charge after the normal operating pressures have been confirmed to be within the ranges given in table 5. Do not use the approach method if system pressures do not match the pressures given in table 5. The approach method is not valid for grossly over- or undercharged systems. After you have taken the outdoor ambient and liquid line temperature readings **with the unit operating in high speed**, subtract the outdoor ambient temperature from the liquid line temperature to determine the Approach Temperature. **(Liquid line °F - Outdoor Ambient °F = Approach temperature)** The resulting difference (Approach Temperature) should agree with the values given in table 6. If not, add refrigerant to lower the approach temperature or recover refrigerant from the system to increase the approach temperature.

TABLE 6
APPROACH METHOD

Model No.	Liquid Temp. Minus Ambient Temp. °F (°C)
HP29-090	9.2 + 1 (5.0 + .5)
HP29-120	11.3 + 1 (6.0 + .5)

Note - For best results, the same thermometer should be used to check both outdoor ambient and liquid temperatures.

System Operation

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

HP29 units are equipped with external, belly-band crankcase heaters. The crankcase heater should be energized 24 hours before unit start-up to prevent compressor damage as a result of slugging.

The scroll compressor manufacturer stipulates that all heat pumps are to be equipped with an SPST high temperature discharge line thermostat. If the discharge line ever reaches or exceeds 275±5°F, the thermostat will open the compressor circuit. The switch automatically resets as the line temperature decreases to 225±5°F.

HP29 units are equipped with a high pressure switch that is located in the discharge line of the compressor. The switch (SPST, manual reset, normally closed) removes power from the compressor when discharge pressure rises above factory setting at 410 ± 10 psi.

HP29 units are equipped with a loss of charge switch that is located in the liquid line immediately after the condenser coil. The switch (SPST, auto-reset, normally closed) removes power from the compressor when the liquid line pressure drops below the 25±5 psig setting. The switch automatically resets once the pressure reaches 55±5 psig.

Each outdoor unit is equipped with a bypass relay which switches control of the outdoor fan(s) to the low ambient pressure switch (and low ambient thermostat on HP29-120) during low ambient operation. The bypass relay is wired parallel to the compressor reversing valve and is only energized during the cooling cycle.

Each HP29 heat pump is equipped with a low ambient pressure switch which cycles the outdoor fan during low ambient operation. The normally closed switch opens when liquid line pressure drops to 150 ± 10 psig. The switch automatically resets when the liquid line pressure rises to 275 ± 10 psig.

HP29-120 units are equipped with a surface-mounted low ambient thermostat (normally closed) which cycles one outdoor fan during low ambient cooling operation. The switch opens on temperature fall at 55 ± 5°F and automatically resets when temperature rises to 65 ± 5°F.

The **defrost thermostat, defrost pressure switch** and the **defrost control** work together to ensure that the heat pump outdoor coil does not ice excessively during the heating mode.

The **defrost thermostat** is located on the liquid line between the check/expansion valve and the distributor. When the liquid line temperature drops below 35°F, the switch closes and signals the **defrost control** that a defrost cycle is needed. If the defrost thermostat is still closed after the field-selected compressor run time (30, 60 or 90 minutes) has been completed, a defrost cycle begins. The defrost cycle is limited to a maximum of 14 minutes*. The defrost cycle is terminated by the defrost pressure switch.* The **defrost pressure switch** is located on the heating cycle vapor line (cooling/defrost cycle discharge line). The normally closed switch opens on a pressure rise at 275 ± 10 psi to terminate a defrost cycle. The pressure switch automatically resets.

The defrost control includes a pressure switch safety circuit that allows for the application of an additional pressure switch. The defrost control will lock out unit operation on the third instance (during one demand cycle) that any auto-reset switch opens this circuit. The diagnostic LEDs will indicate a pressure switch lockout. Refer to typical unit diagram for application of an optional loss of charge switch.

The defrost control also provides terminal connections for an ambient thermistor and a service light. Refer to figure 18 for defrost control parts arrangement and compressor run timing pin adjustment. Table 7 details defrost control diagnostic LED codes.

TABLE 7
DEFROST CONTROL BOARD DIAGNOSTIC CODES

Mode	LED #1	LED #2
Normal Operation/ Power to board	Simultaneous Flash	Simultaneous Flash
Time Delay to Protect Compressor	Alternating Flash	Alternating Flash
Pressure Switch Open	Off	On
Pressure Switch Lockout	On	Off
Board Malfunction	On	On

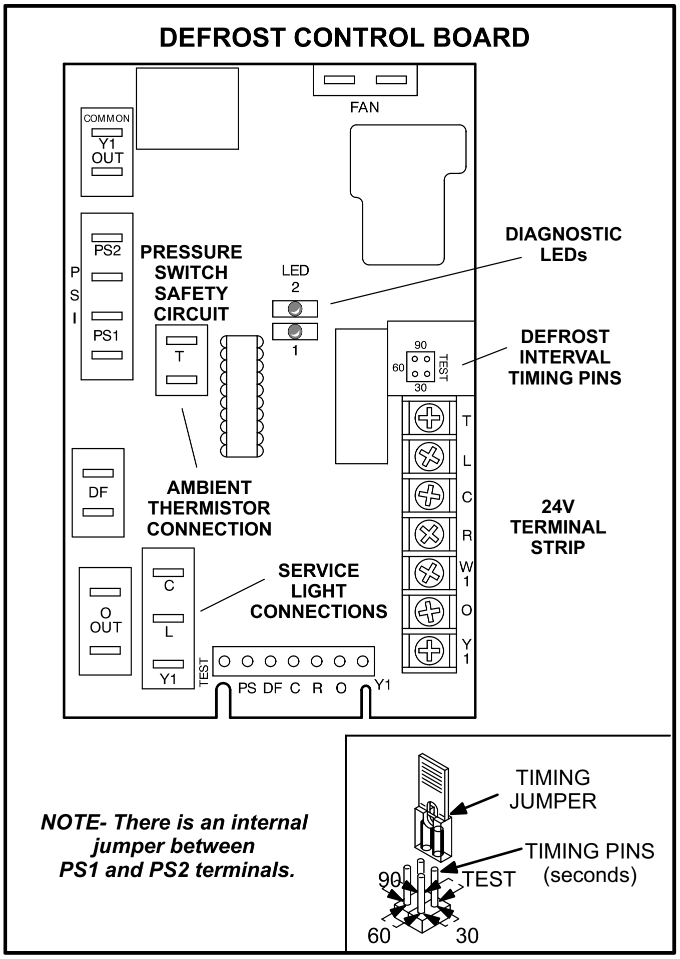


FIGURE 18

Maintenance

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

Outdoor Unit

1 - Clean and inspect the condenser coil. You can flush the coil with a water hose.
2 - The outdoor fan motor is prelubricated and sealed. No further lubrication is necessary.
3 - Visually inspect connecting lines and coils for evidence of oil leaks.
4 - Check wiring for loose connections.
5 - Check for correct voltage at the unit while the unit is operating and while it is off.
6 - Check amp-draw of the outdoor fan motor.
Unit nameplate _________ Actual ____________ .
Check amp-draw of the compressor.
Unit nameplate _________ Actual ____________ .
NOTE - If the owner complains of insufficient cooling, gauge the unit and check the refrigerant charge. Refer to section on refrigerant charging in this instruction.

Indoor Coil

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

Indoor Unit

1 - Clean or change filters.
2 - Adjust the blower speed for cooling. 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 - On belt drive blowers, check the belt for wear and proper tension.
4 - Check all wiring for loose connections.
5 - Check for correct voltage at the unit (blower operating).
6 - Check amp-draw on blower motor.
Unit nameplate_________ Actual ____________.

⚠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.

Job Name ____________ Job No. ____________ Date ____________
Job Location ____________ City ____________ State ____________
Installer ____________ City ____________ State ____________
Nameplate Voltage ____________ Amps: ____________
Unit Model No. ____________ Serial No. ____________ Technician ____________
Minimum Circuit Ampacity ____________ Supply Amps: __ Condenser Fan Amps: ____________
Maximum Overcurrent Protection Size ____________ Compressor Amps: ____________
Electrical Connections Tight? ☐ Indoor Filter Clean? ☐
Supply Voltage (Unit Off) ____________ Indoor Blower RPM ____________
COOLING SECTION
Refrigerant Lines:
Leak Checked? ☐
Service Valves Fully Opened? ☐
Properly Insulated? ☐
Outdoor Fan Checked? ☐
Liquid Service Valve Caps Tight? ☐
Suction Service Valve Caps Tight? ☐
Voltage With Compressor Operating ____________
Blower interlocked with compressor? ☐
S.P. Drop Over Evaporator (Dry)
Condenser Entering Air Temperature ____________
Discharge Pressure ____________ Suction Pressure ____________
Refrigerant Charge Checked? ☐
Compressor Rotation Checked? ☐
THERMOSTAT
Calibrated? ☐ Properly Set? ☐ Level? ☐