INSTALLATION INSTRUCTIONS

Elite® Series XP16 Units

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

HEAT PUMPS
506640-01
12/10
Supersedes 11/10

Technical Publications
Litho U.S.A.

RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE

NOTICE TO INSTALLER

BRAZING LINE SET TO SERVICE VALVES

It is imperative to follow the brazing technique illustrated starting on page 11 to avoid damaging the service valve's internal seals.

⚠ WARNING

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

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

⚠ IMPORTANT

The Clean Air Act of 1990 bans the intentional venting of refrigerant (CFCs, HFCs, and HCFCs) as of July 1, 1992. Approved methods of recovery, recycling or reclaiming must be followed. Fines and/or incarceration may be levied for noncompliance.

⚠ IMPORTANT

This unit must be matched with an indoor coil as specified in Lennox XP16 Engineering Handbook. Coils previously charged with HCFC-22 must be flushed.

⚠ CAUTION

Physical contact with metal edges and corners while applying excessive force or rapid motion can result in personal injury. Be aware of, and use caution when working near these areas during installation or while servicing this equipment.

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Shipping and Packing List

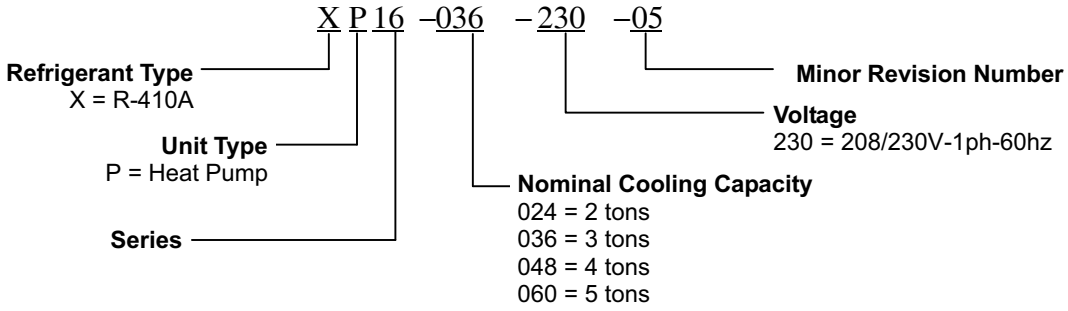
Check unit for shipping damage. Consult last carrier immediately if damage is found.

1 - Assembled outdoor unit

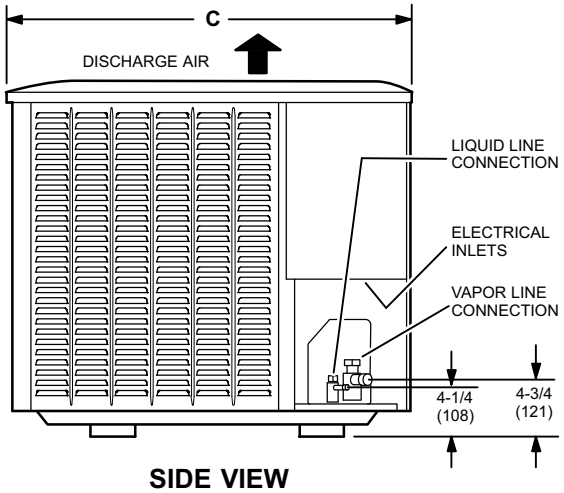
General

The XP16 outdoor unit uses HFC-410A refrigerant. This unit must be installed with a matching indoor blower coil and line set as outlined in the XP16 Lennox Engineering Handbook. Elite® Series outdoor units are designed for use in check / expansion valve (CTXV) systems only and are not to be used with other refrigerant flow control devices. An indoor coil check / expansion valve approved for use with HFC-410A must be ordered separately and installed prior to operating the unit.

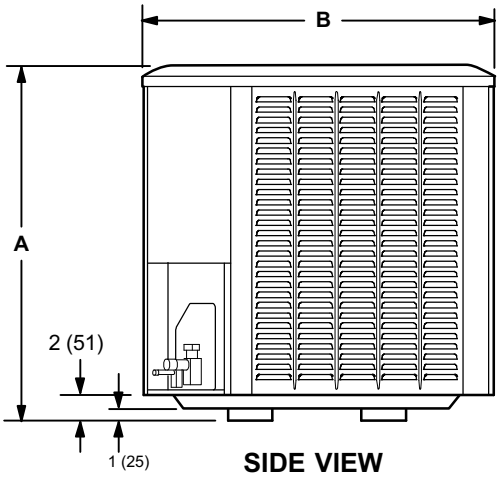
Model Number Identification



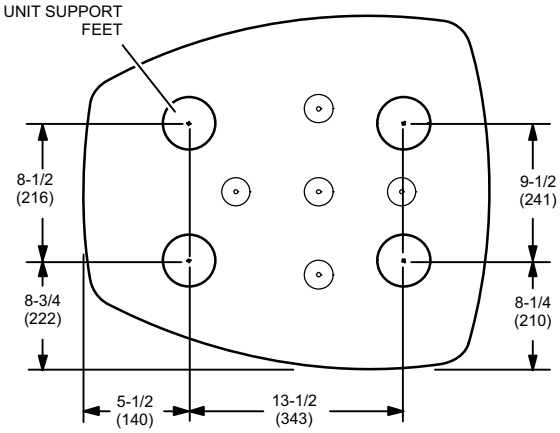
Unit Dimensions - inches (mm)



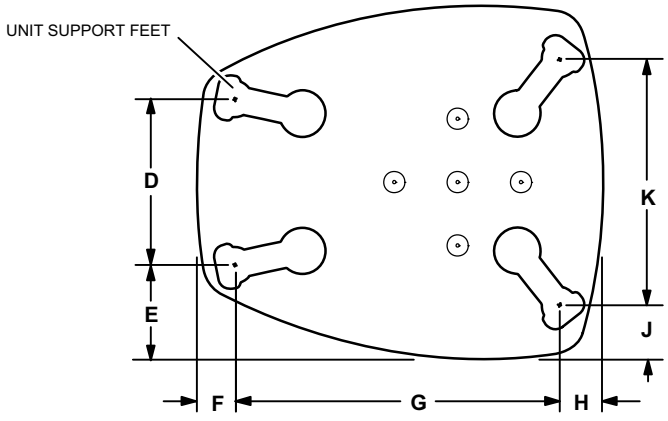
SIDE VIEW



SIDE VIEW



XP16-024 BASE SECTION



XP16 BASE WITH LEGS

Mode Number	A	B	C	D	E	F	G	H	J	K
XP16-024-230	35 (889)	27 (686)	28 (711)	-	-	-	-	-	-	-
XP16-036-230	39 (991)	30-1/2 (775)	35 (889)	13-7/8 (352)	7-3/4 (197)	3-1/4 (83)	27-1/8 (689)	3-5/8 (92)	4-1/2 (114)	20-5/8 (524)
XP16-048-230	35 (889)	35-1/2 (902)	39-1/2 (1003)	16-7/8 (429)	8-3/4 (222)	3-1/8 (79)	30-3/4 (781)	4-5/8 (117)	3-3/4 (95)	26-7/8 (683)
XP16-060-230	45 (1143	35-1/2 (902)	39-1/2 (1003)							

Typical Unit Parts Arrangement

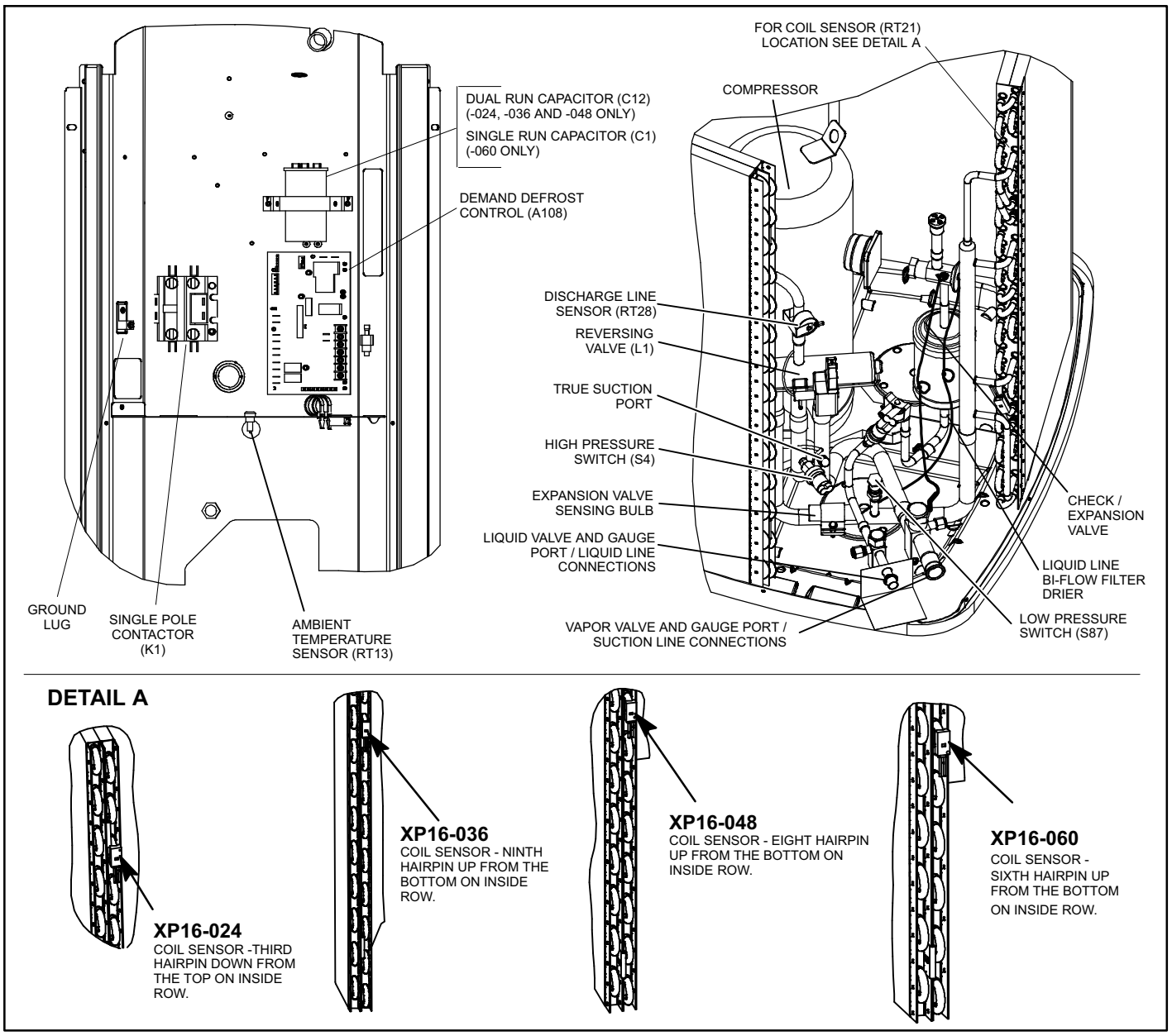


Figure 1. Unit Parts Arrangement

Caps and Fasteners Torque Requirements

⚠ IMPORTANT

Only use Allen wrenches of sufficient hardness (50Rc - Rockwell Harness Scale minimum). Fully insert the wrench into the valve stem recess.

Service valve stems are factory-torqued (from 9 ft-lbs for small valves, to 25 ft-lbs for large valves) to prevent refrigerant loss during shipping and handling. Using an Allen wrench rated at less than 50Rc risks rounding or breaking off the wrench, or stripping the valve stem recess.

See the Lennox Service and Application Notes Corp.0807-L5 (C-08-1) for further details and information.

When servicing or repairing HVAC equipment and components, ensure the fasteners are appropriately tightened. Table 1 list torque values for various caps and fasteners.

Table 1. Torque Requirements

Parts	Recommended Torque	
Service valve cap	8 ft.- lb.	11 NM
Sheet metal screws	16 in.- lb.	2 NM
Machine screws #10	28 in.- lb.	3 NM
Compressor bolts	90 in.- lb.	10 NM
Gauge port seal cap	8 ft.- lb.	11 NM

Operating Gauge Set and Service Valves

⚠ IMPORTANT

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

OPERATING SERVICE VALVES

The liquid and vapor line service valves are used for refrigerant recovery, flushing, leak testing, evacuating, weighing in refrigerant and optimizing system charge.

Each valve is equipped with a service port which has a factory-installed valve core. Figure 2 provides information on how to access and operate both angle- and ball-type service valves.

USING MANIFOLD GAUGE SET

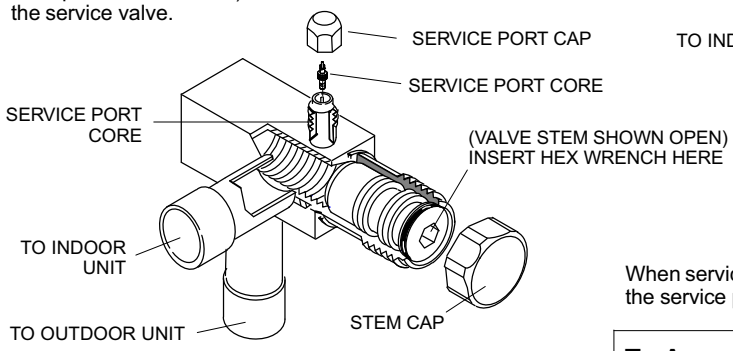
When checking the system charge, only use a manifold gauge set that features low-loss anti-blow back fittings.

Manifold gauge set used for HFC-410A refrigerant systems must be capable of handling the higher system operating pressures. The manifold gauges should be rated for:

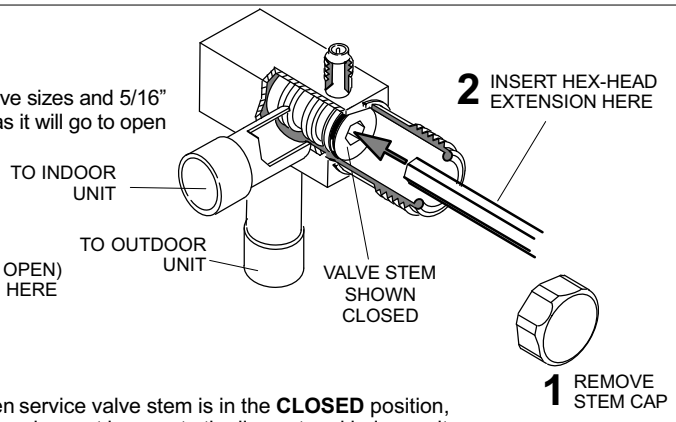
- High side — Pressure range of 0 - 800 pound-force per square inch gauge (psig)
- Low side — Use with 30” vacuum to 250 psig with dampened speed to 500 psig
- Manifold gauge set hoses must be rated for use to 800 psig of pressure with a 4000 psig burst rating.

Operating Angle-Type Service Valve:

1. Remove stem cap with an appropriately sized wrench.
2. Use a service wrench with a hex-head extension (3/16” for liquid line valve sizes and 5/16” for vapor line valve sizes) to back the stem out counterclockwise as far as it will go to open the service valve.



When service valve is **OPEN**, the service port is open to line set, indoor and outdoor unit.



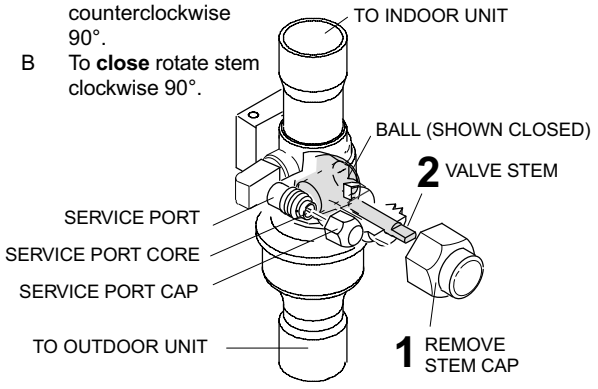
When service valve stem is in the **CLOSED** position, the service port is open to the line set and indoor unit.

Operating Ball-Type Service Valve:

1. Remove stem cap with an appropriately sized wrench.
2. Use an appropriately sized wrenched to open.

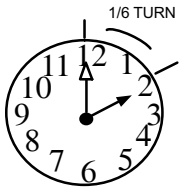
A To **open** rotate stem counterclockwise 90°.

B To **close** rotate stem clockwise 90°.



To Access Service Port:

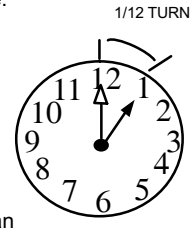
A service port cap protects the service port core from contamination and serves as the primary leak seal.



1. Remove service port cap with an appropriately sized wrench.
2. Connect gauge set to service port.
3. When testing is completed, replace service port cap and tighten as follows:
   - With torque wrench: Finger tighten and torque cap per table 1.
   - Without torque wrench: Finger tighten and use an appropriately sized wrench to turn an additional 1/6 turn clockwise.

Reinstall Stem Cap:

Stem cap protects the valve stem from damage and serves as the primary seal. Replace the stem cap and tighten as follows:



- With Torque Wrench: Finger tighten and then torque cap per table 1.
- Without Torque Wrench: Finger tighten and use an appropriately sized wrench to turn an additional 1/12 turn clockwise.

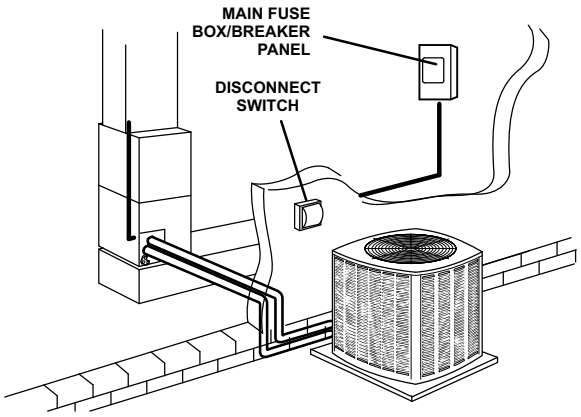
NOTE — A label with specific torque requirements may be affixed to the stem cap. If the label is present, use the specified torque.

Figure 2. Angle and Ball-Type Service Valves

Recovering Refrigerant from Existing System

1 DISCONNECT POWER

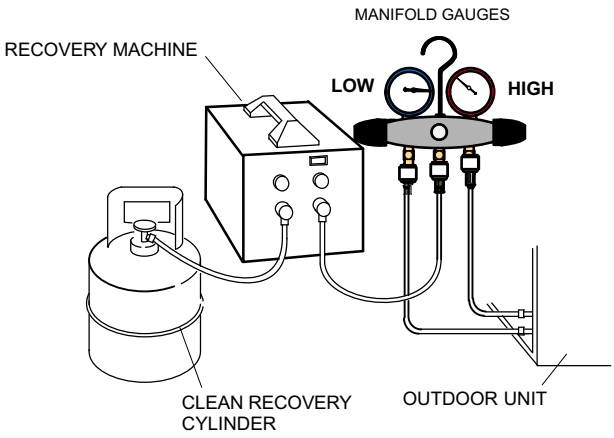
Disconnect all power to the existing outdoor unit at the disconnect switch and/or main fuse box/breaker panel.



2 CONNECT MANIFOLD GAUGE SET

Connect a manifold gauge set, clean recovery cylinder and a recovery machine to the service ports of the existing unit..

NOTE — Use the recovery machine instructions to make the correct manifold gauge set connections for recovery refrigerant. The illustration below is a typical connection.



3 RECOVERING REFRIGERANT

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

METHOD 1:

Use **Method 1** if the existing outdoor unit is **not** equipped with shut-off valves, or if the unit is **not** operational and you plan to **use the existing HCFC-22** to flush the system.

Recover all HCFC-22 refrigerant from the existing system using a recovery machine and clean recovery cylinder. Check gauges after shutdown to confirm that the entire system is completely void of refrigerant.

METHOD 2:

Use **Method 2** if the existing outdoor unit is equipped with manual shut-off valves, and you plan to **use new HCFC-22 refrigerant** to flush the system.

Perform the following task:

A Start the existing HCFC-22 system in the cooling mode and close the liquid line valve.

B Use the compressor to pump as much of the existing HCFC-22 refrigerant into the outdoor unit until the outdoor system is full. Turn the outdoor unit main power OFF and use a recovery machine to remove the remaining refrigerant from the system.

NOTE — It may be necessary to bypass the low pressure switches (if equipped) to ensure complete refrigerant evacuation.

C When the low side system pressures reach 0 psig, close the vapor line valve.

D Check gauges after shutdown to confirm that the valves are not allowing refrigerant to flow back into the low side of the system.

METHOD 2 LIMITATIONS

NOTE — When using **Method 2**, the listed devices below **could prevent** full system charge recovery into the outdoor unit:

- Outdoor unit's high or low-pressure switches (if applicable) when tripped can cycle the compressor **OFF**.
- Compressor can stop pumping due to tripped internal pressure relief valve.
- Compressor has internal vacuum protection that is designed to unload the scrolls (compressor stops pumping) when the pressure ratio meets a certain value or when the suction pressure is as high as 20 psig. (**Compressor suction pressures should never be allowed to go into a vacuum. Prolonged operation at low suction pressures will result in overheating of the scrolls and permanent damage to the scroll tips, drive bearings and internal seals.**)

Once the compressor can not pump down to a lower pressure due to any of the above mentioned system conditions, shut off the vapor valve. Turn OFF the main power to unit and use a recovery machine to recover any refrigerant left in the indoor coil and line set.

Figure 3. Refrigerant Recovery

⚠ IMPORTANT

The Environmental Protection Agency (EPA) prohibits the intentional venting of HFC refrigerants during maintenance, service, repair and disposal of appliance. Approved methods of recovery, recycling or reclaiming must be followed.

⚠ WARNING

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

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

New Outdoor Unit Placement

⚠ CAUTION

In order to avoid injury, take proper precaution when lifting heavy objects.

Remove existing outdoor unit prior to placement of new outdoor unit. See *Unit Dimensions* on page 2 for sizing mounting slab, platforms or supports. Refer to figure 4 for mandatory installation clearance requirements.

POSITIONING CONSIDERATIONS

Consider the following when positioning the unit:

- Some localities are adopting sound ordinances based on the unit's sound level registered from the adjacent property, not from the installation property. Install the unit as far as possible from the property line.
- When possible, do not install the unit directly outside a window. Glass has a very high level of sound transmission. For proper placement of unit in relation to a window see the provided illustration in figure 5, detail A.

PLACING UNIT ON SLAB

When installing unit at grade level, the top of the slab should be high enough above grade so that water from higher ground will not collect around the unit. The slab should have a slope tolerance as described in figure 5, detail B.

NOTE — If necessary for stability, anchor unit to slab as described in figure 5, detail D.

ELEVATING THE UNIT

Units are outfitted with elongated support feet as illustrated in figure 5, detail C.

If additional elevation is necessary, raise the unit by extending the height of the unit support feet. This may be achieved by using a 2 inch (50.8mm) schedule 40 female threaded adapter.

The specified coupling will fit snuggly into the recessed portion of the feet. Use additional 2 inch (50.8mm) Schedule 40 male threaded adaptors which can be threaded into the female threaded adaptors to make additional adjustments to the level of the unit.

NOTE — Keep the height of extenders short enough to ensure a sturdy installation. If it is necessary to extend further, consider a different type of field-fabricated framework that is sturdy enough for greater heights.

ROOF MOUNTING

Install the unit a minimum of 6 inches (152 mm) above the roof surface to avoid ice build-up 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. See figure 5, detail F for other roof top mounting considerations.

NOTICE

Roof Damage!

This system contains both refrigerant and oil. Some rubber roofing material may absorb oil and cause the rubber to swell when it comes into contact with oil. The rubber will then bubble and could cause leaks. Protect the roof surface to avoid exposure to refrigerant and oil during service and installation. Failure to follow this notice could result in damage to roof surface.

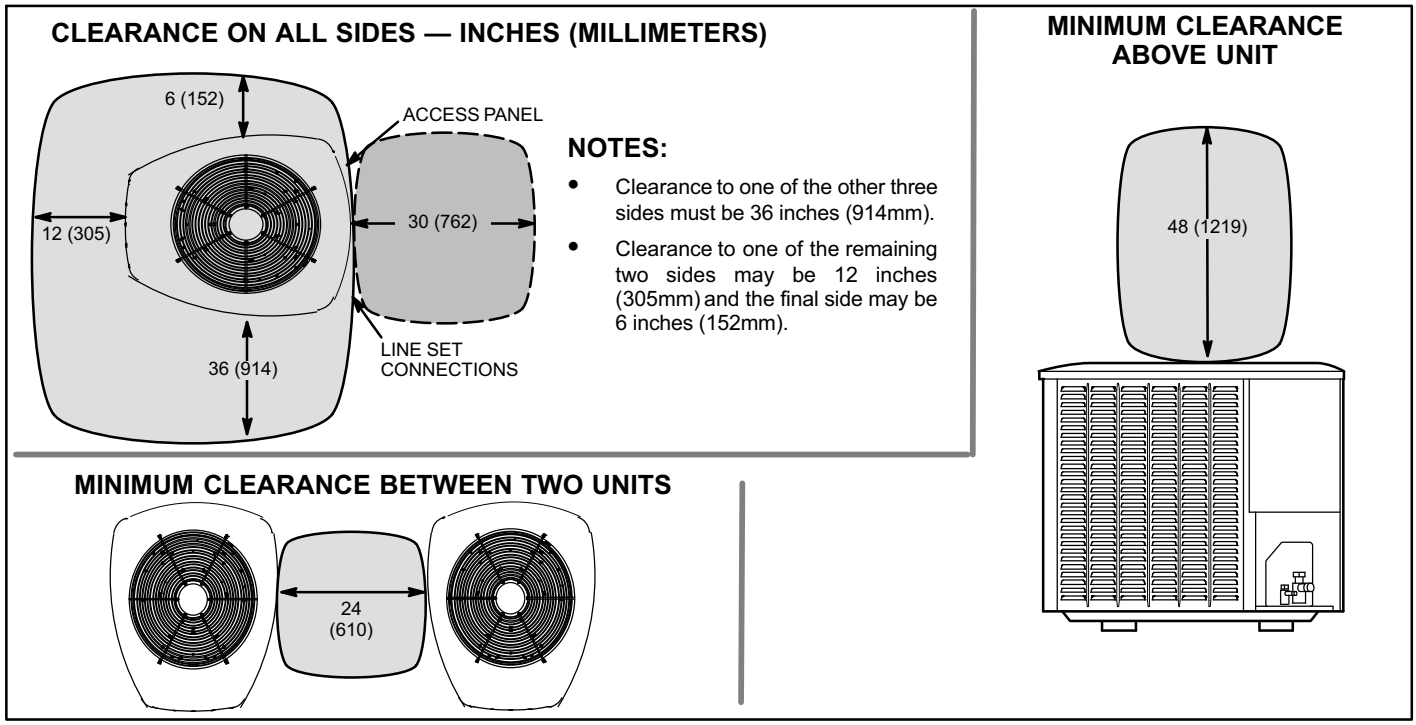
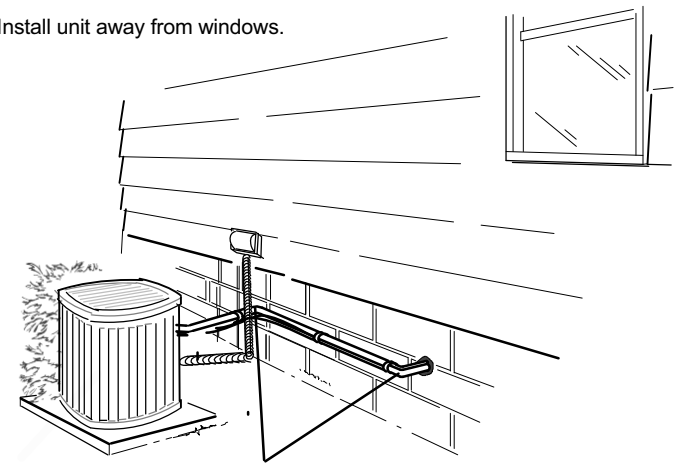


Figure 4. Installation Clearances

DETAIL A— Outside Unit Placement

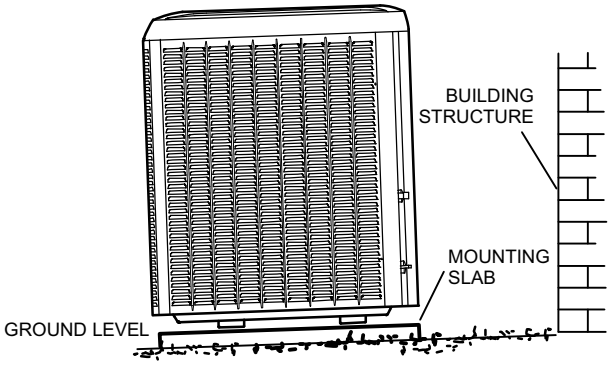
Install unit away from windows.



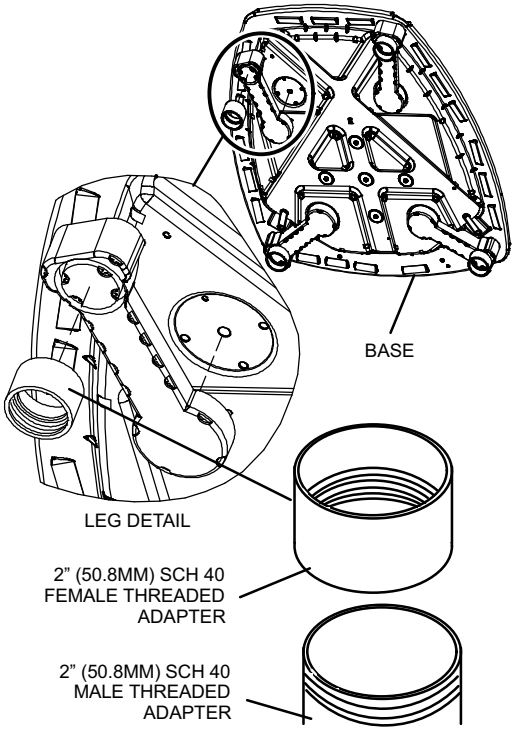
TWO 90° ELBOWS INSTALLED IN LINE SET WILL REDUCE LINE SET VIBRATION.

DETAIL B— Slab Mounting at Ground Level

Install unit level or, if on a slope, maintain slope tolerance of two (2) degrees (or two inches per five feet [50 mm per 1.5 m]) away from building structure.

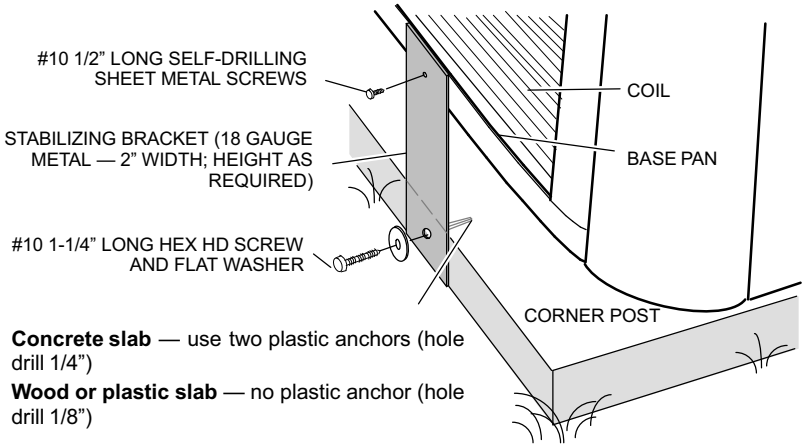


DETAIL C — Elevated Slab Mounting using Feet Extenders



Use additional 2" SCH 40 male threaded adapters which can be threaded into the female threaded adapters to make additional adjustments to the level of the unit.

DETAIL D— Slab Side Mounting



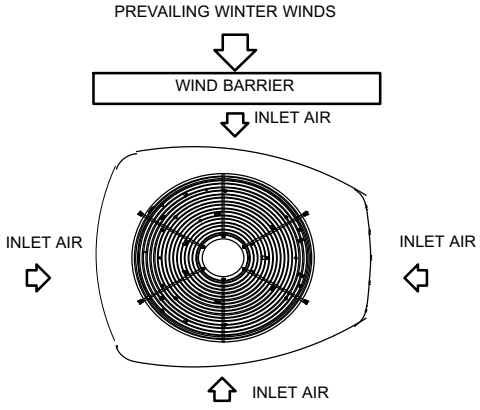
Concrete slab — use two plastic anchors (hole drill 1/4")

Wood or plastic slab — no plastic anchor (hole drill 1/8")

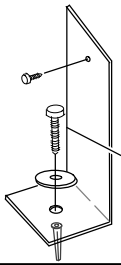
Stabilizing bracket (18 gauge metal — 2" (50.8mm) width; height as required); bend to form right angle as exampled below.

DETAIL F— Roof Top Mounting

If unit coil cannot be mounted away from prevailing winter winds, a wind barrier should be constructed. Size barrier at least the same height and width as outdoor unit. Mount barrier 24 inches (610 mm) from the sides of the unit in the direction of prevailing winds as illustrated.



DETAIL E — Deck Top Mounting



One bracket per side (minimum). For extra stability, two brackets per side, two inches (51mm) from each corner.

SAME FASTENERS AS SLAB SIDE MOUNTING.

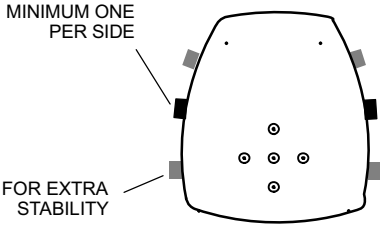


Figure 5. Placement, Slab Mounting and Stabilizing Unit

Removing and Installing Panels

LOUVERED PANEL REMOVAL

Remove the louvered panels as follows:

1. Remove two screws, allowing the panel to swing open slightly.
2. Hold the panel firmly throughout this procedure. Rotate bottom corner of panel away from hinged corner post until lower three tabs clear the slots as illustrated in **detail B.**
3. Move panel down until lip of upper tab clears the top slot in corner post as illustrated in **detail A**.

LOUVERED PANEL INSTALLATION

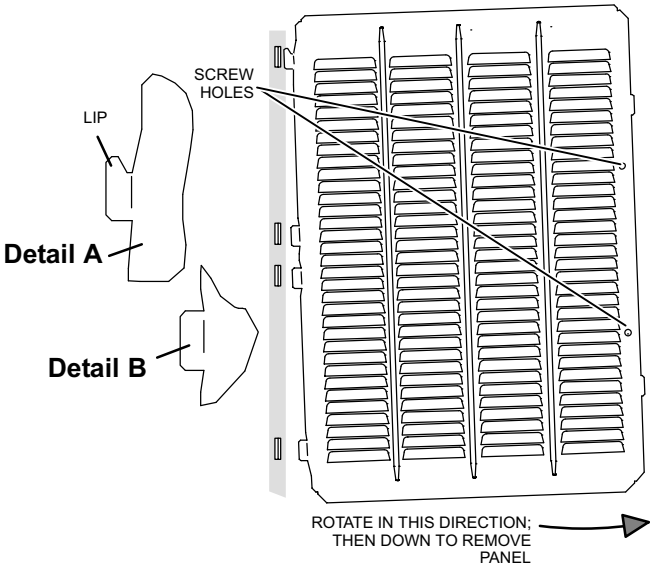
Position the panel almost parallel with the unit as illustrated in **detail D** with the screw side as close to the unit as possible.

Then, in a continuous motion:

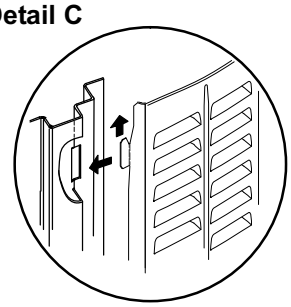
1. Slightly rotate and guide the lip of top tab inward as illustrated in **detail A** and **C**; then upward into the top slot of the hinge corner post.
2. Rotate panel to vertical to fully engage all tabs.
3. Holding the panel's hinged side firmly in place, close the right-hand side of the panel, aligning the screw holes.
4. When panel is correctly positioned and aligned, insert the screws and tighten.

IMPORTANT! DO NOT ALLOW PANELS TO HANG ON UNIT BY TOP TAB. TAB IS FOR ALIGNMENT AND NOT DESIGNED TO SUPPORT WEIGHT OF PANEL.

PANEL SHOWN SLIGHTLY ROTATED TO ALLOW TOP TAB TO EXIT (OR ENTER) TOP SLOT FOR REMOVING (OR INSTALLING) PANEL.



Detail C



MAINTAIN MINIMUM PANEL ANGLE (AS CLOSE TO PARALLEL WITH THE UNIT AS POSSIBLE) WHILE INSTALLING PANEL.

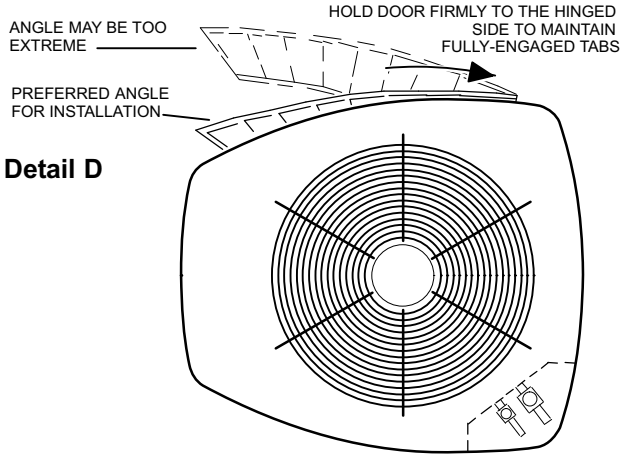


Figure 6. Removing and Installing Panels

⚠ WARNING

To prevent personal injury, or damage to panels, unit or structure, be sure to observe the following:

While installing or servicing this unit, carefully stow all removed panels out of the way, so that the panels will not cause injury to personnel, nor cause damage to objects or structures nearby, nor will the panels be subjected to damage (e.g., being bent or scratched).

While handling or stowing the panels, consider any weather conditions, especially windy conditions, that may cause panels to be blown around and battered.

Line Set Requirements

This section provides information on: installation of new or replacement line set.

- Adding Polyol ester oil requirements
- New or replacement line set installation
- Using existing line set.

ADDING POLYOL ESTER OIL REQUIREMENTS

⚠ IMPORTANT

Mineral oils are not compatible with HFC-410A If oil must be added, it must be a Polyol Ester oil.

The compressor is charged with sufficient Polyol Ester oil (POE) for line set lengths up to 50 feet. Recommend adding oil to system based on the amount of refrigerant charge in the system. Systems with 20 pounds or less of refrigerant required no oil to be added.

For systems over 20 pounds - add one ounce for every five (5) pounds of HFC-410A refrigerant.

Recommended topping-off POE oils are Mobil EAL ARCTIC 22 CC or ICI EMKARATE™ RL32CF.

NEW OR REPLACEMENT LINE SET INSTALLATION

Field refrigerant piping consists of both liquid and vapor lines from the outdoor unit to the indoor coil. Use Lennox L15 (sweat, non-flare) series line set, or field-fabricated refrigerant line sizes as specified in table 2.

If refrigerant lines are routed through a wall, then seal and isolate the opening so vibration is not transmitted to the building. Pay close attention to line set isolation during installation of any HVAC system. When properly isolated from building structures (walls, ceilings. floors), the refrigerant lines will not create unnecessary vibration and subsequent sounds. See figure 7 for recommended installation practices.

NOTE — When installing refrigerant lines longer than 50 feet, see the Lennox Refrigerant Piping Design and Fabrication Guidelines, CORP. 9351-L9, or contact Lennox Technical Support Product Applications for assistance. To obtain the correct information from Lennox, be sure to communicate the following information:

- Model (XP16) and size of unit (e.g. -036).
- Line set diameters for the unit being installed as listed in table 2 and total length of installation.
- Number of elbows vertical rise or drop in the piping.

USING EXISTING LINE SET

Things to consider:

- Liquid line that meter the refrigerant, such as RFC1 liquid line, **must not** be used in this application.
- Existing line set of proper size as listed in table 2 may be reused.
- If system was previously charged with HCFC-22 refrigerant, then existing line set must be flushed (see *Flushing Line Set and Indoor Coil* on page 14).

If existing line set is being used, then proceed to *Brazing Connections* on page 11.

⚠ IMPORTANT

Lennox highly recommends changing line set when converting the existing system from HCFC-22 to HFC-410A If that is not possible and the line set is the proper size as reference in table 2, use the procedure outlined under *Flushing Line Set and Indoor Coil* on page 13.

⚠ IMPORTANT

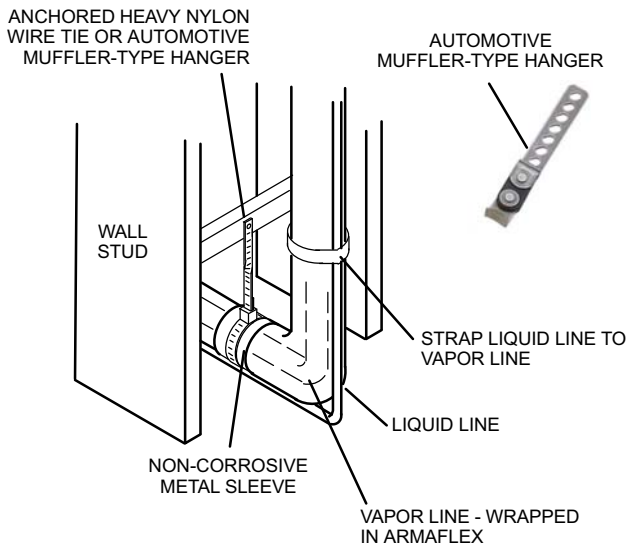
If this unit is being matched with an approved line set or indoor unit coil which was previously charged with mineral oil, or if it is being matched with a coil which was manufactured before January of 1999, the coil and line set must be flushed prior to installation. Take care to empty all existing traps. Polyol ester (POE) oils are used in Lennox units charged with HFC-410A refrigerant. Residual mineral oil can act as an insulator, preventing proper heat transfer. It can also clog the expansion device, and reduce the system performance and capacity.
Failure to properly flush the system per the instructions below will void the warranty.

Table 2. Refrigerant Line Set — Inches (mm)

Model	Field Connections		Recommended Line Set		
	Liquid Line	Suction Line	Liquid Line	Suction Line	L15 Line Set
XP16-024-230	3/8” (10 mm)	3/4” (19 mm)	3/8” (10 mm)	3/4” (19 mm)	L15-41 — 15 ft. - 50 ft. (4.6m - 15 m)
XP16-036-230	3/8” (10 mm)	7/8” (22 mm)	3/8” (10 mm)	7/8” (22 mm)	L15-65 — 15 ft. - 50 ft. (4.6 m - 15 m)
XP16-048-230					
XP16-060-230	3/8” (10 mm)	1-1/8” (29 mm)	3/8” (10 mm)	1-1/8” (29 mm)	Field Fabricated
NOTE — Some applications may required a field provided 7/8” to 1-1/8” adapter					

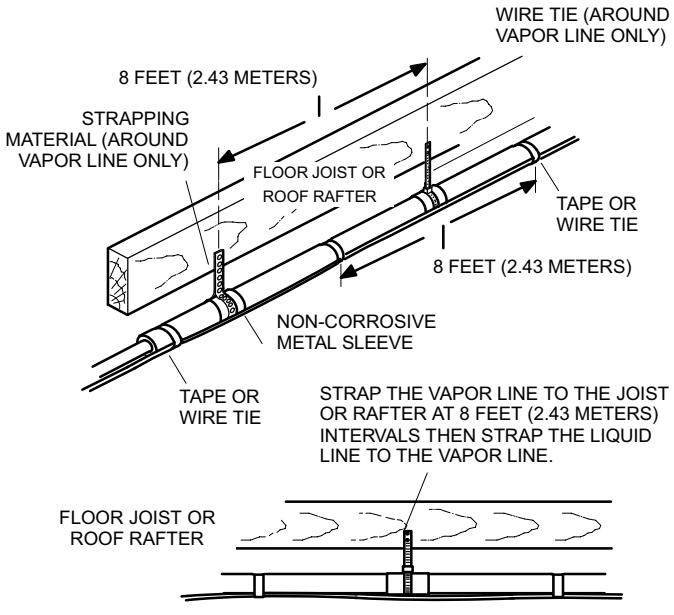
Line Set Isolation — The following illustrations are examples of proper refrigerant line set isolation:

REFRIGERANT LINE SET — TRANSITION FROM VERTICAL TO HORIZONTAL



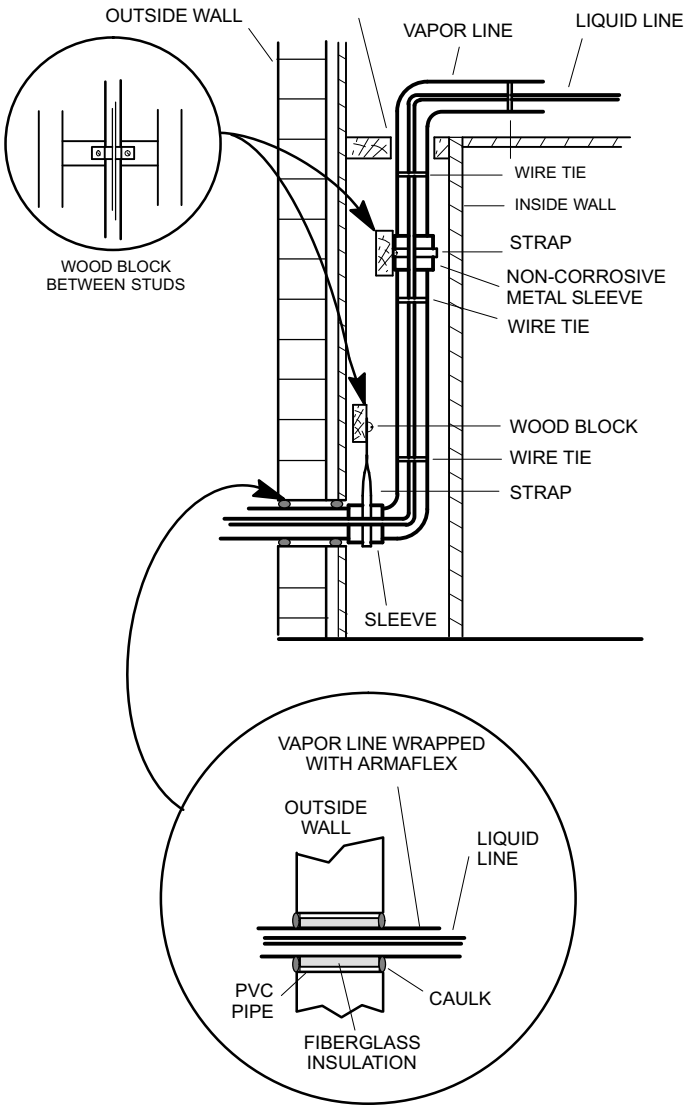
REFRIGERANT LINE SET — INSTALLING HORIZONTAL RUNS

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



REFRIGERANT LINE SET — INSTALLING VERTICAL RUNS (NEW CONSTRUCTION SHOWN)

NOTE — Insulate liquid line when it is routed through areas where the surrounding ambient temperature could become higher than the temperature of the liquid line or when pressure drop is equal to or greater than 20 psig.



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

Figure 7. Line Set Installation

Brazing Connections

Use the procedures outline in figures 8 and 9 for brazing line set connections to service valves.

⚠ WARNING

Polyol Ester (POE) oils used with HFC-410A refrigerant absorb moisture very quickly. It is very important that the refrigerant system be kept closed as much as possible. DO NOT remove line set caps or service valve stub caps until you are ready to make connections.

⚠ WARNING

Danger of fire. Bleeding the refrigerant charge from only the high side may result in pressurization of the low side shell and suction tubing. Application of a brazing torch to a pressurized system may result in ignition of the refrigerant and oil mixture - Check the high and low pressures before applying heat.

⚠ WARNING

When using a high pressure gas such as dry nitrogen to pressurize a refrigeration or air conditioning system, use a regulator that can control the pressure down to 1 or 2 psig (6.9 to 13.8 kPa).

⚠ CAUTION

Brazing alloys and flux contain materials which are hazardous to your health.

Avoid breathing vapors or fumes from brazing operations. Perform operations only in well-ventilated areas.

Wear gloves and protective goggles or face shield to protect against burns.

Wash hands with soap and water after handling brazing alloys and flux.

⚠ IMPORTANT

Allow braze joint to cool before removing the wet rag from the service valve. Temperatures above 250ºF can damage valve seals.

⚠ IMPORTANT

Use silver alloy brazing rods with 5% minimum silver alloy for copper-to-copper brazing. Use 45% minimum alloy for copper-to-brass and copper-to-steel brazing.

⚠ WARNING

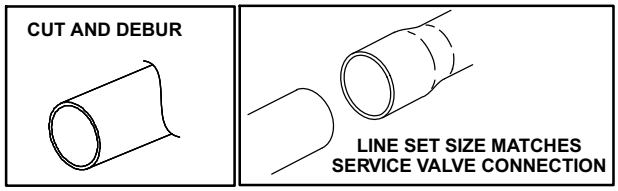
Fire, Explosion and Personal Safety Hazard.

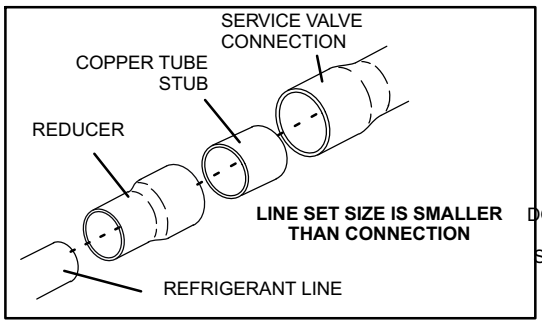
Failure to follow this warning could result in damage, personal injury or death.

Never use oxygen to pressurize or purge refrigeration lines. Oxygen, when exposed to a spark or open flame, can cause fire and/or an explosion, that could result in property damage, personal injury or death.

1 CUT AND DEBUR

Cut ends of the refrigerant lines square (free from nicks or dents) and debur the ends. The pipe must remain round. Do not crimp end of the line.

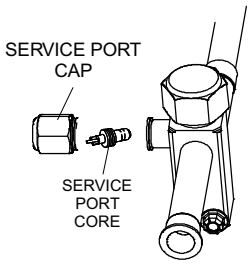




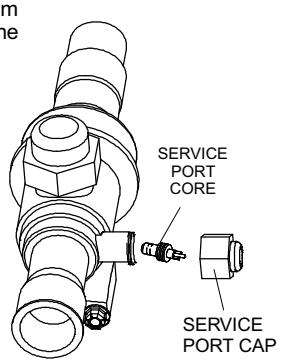
DO NOT CRIMP SERVICE VALVE CONNECTOR WHEN PIPE IS SMALLER THAN CONNECTION

2 CAP AND CORE REMOVAL

Remove service cap and core from both the suction / vapor and liquid line service ports.



LIQUID LINE SERVICE VALVE



SUCTION / VAPOR LINE SERVICE VALVE

3 ATTACH THE MANIFOLD GAUGE SET FOR BRAZING LIQUID AND SUCTION / VAPOR LINE SERVICE VALVES

Flow regulated nitrogen (at 1 to 2 psig) through the low-side refrigeration gauge set into the liquid line service port valve, and out of the suction / vapor line service port valve.

A Connect gauge set low pressure side to liquid line service valve (service port).

B Connect gauge set center port to bottle of nitrogen with regulator.

C Remove core from valve in suction / vapor line service port to allow nitrogen to escape.

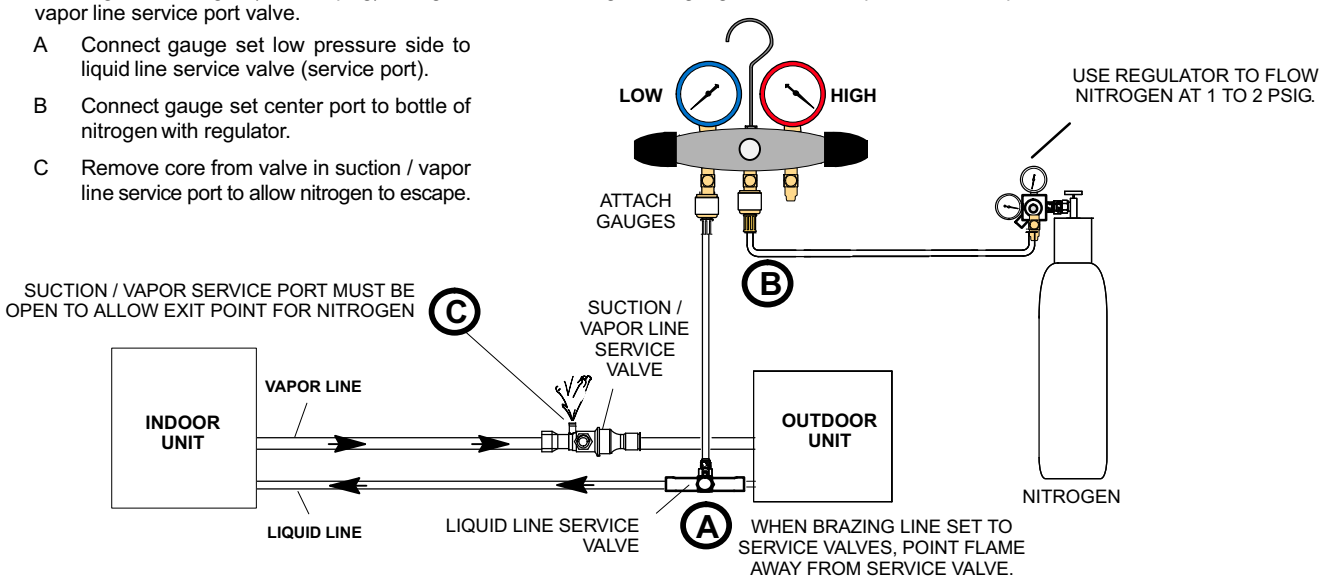
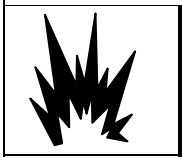


Figure 8. Brazing Procedures

⚠ WARNING



When using a high pressure gas such as dry nitrogen to pressurize a refrigeration or air conditioning system, use a regulator that can control the pressure down to 1 or 2 psig (6.9 to 13.8 kPa).

4 WRAP SERVICE VALVES

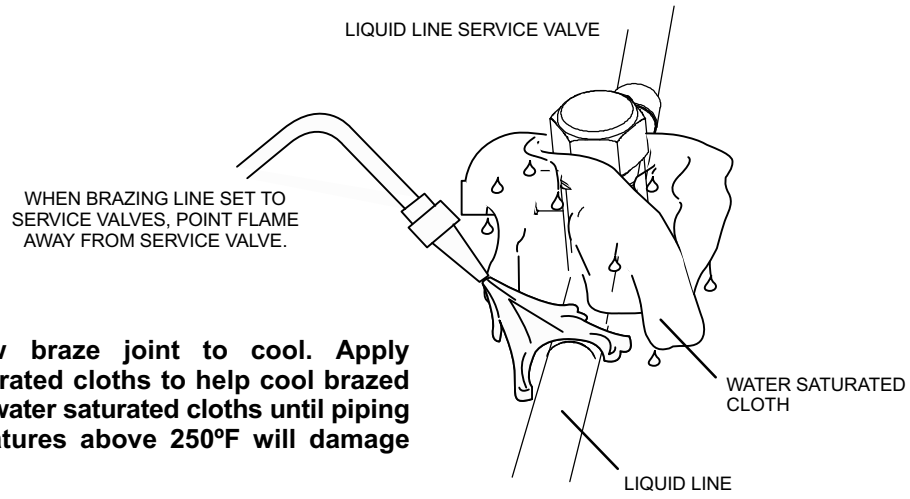
To help protect service valve seals during brazing, wrap water saturated cloths around service valve bodies and copper tube stubs. Use additional water saturated cloths underneath the valve body to protect the base paint.

5 FLOW NITROGEN

Flow regulated nitrogen (at 1 to 2 psig) through the refrigeration gauge set into the valve stem port connection on the liquid service valve and out of the suction / vapor valve stem port. See steps **3A, 3B** and **3C** on manifold gauge set connections

6 BRAZE LINE SET

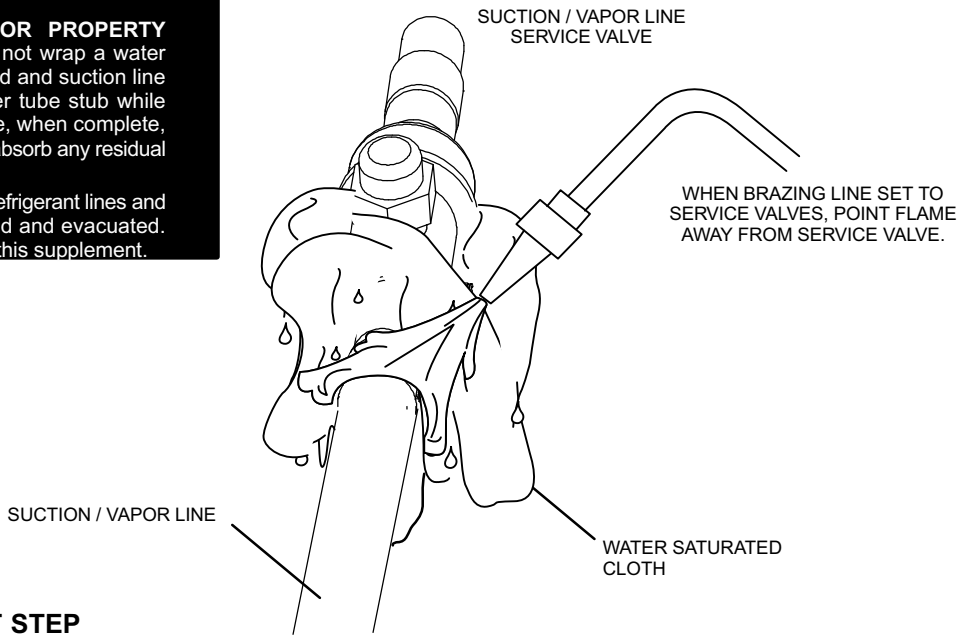
Wrap both service valves with water saturated cloths as illustrated here and as mentioned in step 4, before brazing to line set. Water saturated cloths must remain water saturated throughout the brazing and cool-down process.



IMPORTANT — Allow braze joint to cool. Apply additional water saturated cloths to help cool brazed joint. Do not remove water saturated cloths until piping has cooled. Temperatures above 250ºF will damage valve seals.

WARNING

1. **FIRE, PERSONAL INJURY, OR PROPERTY DAMAGE** may result if you do not wrap a water saturated cloth around both liquid and suction line service valve bodies and copper tube stub while brazing in the line set! The braze, when complete, must be quenched with water to absorb any residual heat.
2. Do not open service valves until refrigerant lines and indoor coil have been leak-tested and evacuated. Refer to procedures provided in this supplement.



7 PREPARATION FOR NEXT STEP

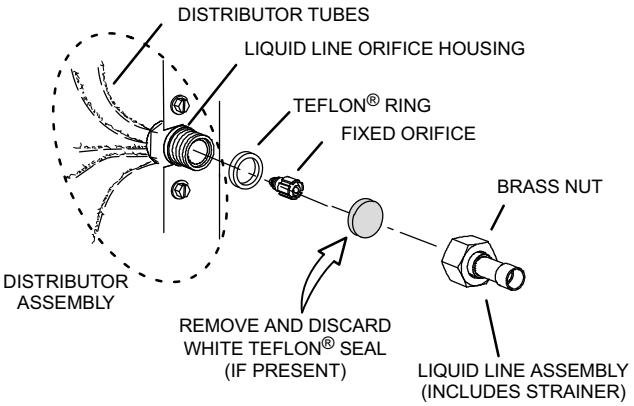
After all connections have been brazed, disconnect manifold gauge set from service ports. Apply additional water saturated cloths to both service valves to cool piping. Once piping is cool, remove all water saturated cloths.

Figure 9. Brazing Procedures (continued)

Indoor Refrigerant Metering Device Removal and Flushing Line Set and Indoor Coil

Flushing is only required when the existing system used HCFC-22 refrigerant. If the existing system used HFC-410a, then remove the original indoor coil metering device and proceed to ***Installing New Indoor Metering Device*** on page 15.

1A TYPICAL EXISTING FIXED ORIFICE REMOVAL PROCEDURE (UNCASED COIL SHOWN)



A On fully cased coils, remove the coil access and plumbing panels.

B Remove any shipping clamps holding the liquid line and distributor assembly.

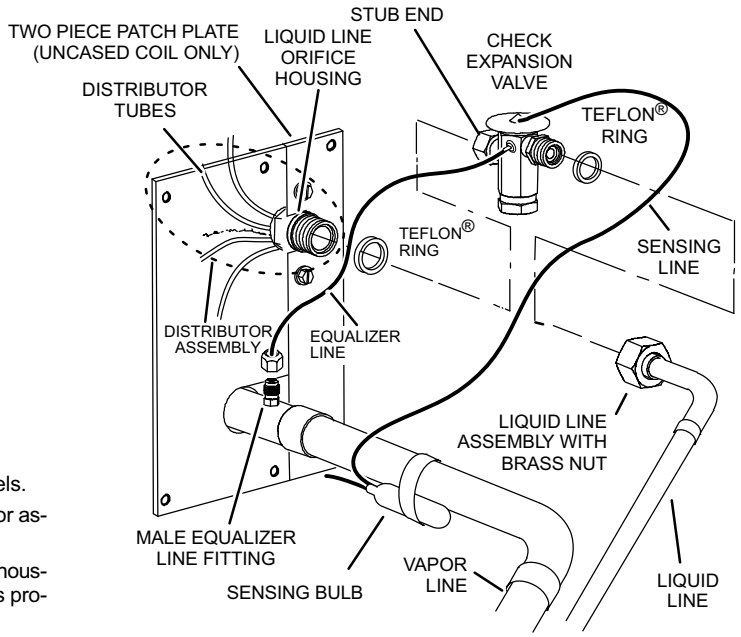
C Using two wrenches, disconnect liquid line from liquid line orifice housing. Take care not to twist or damage distributor tubes during this process.

D Remove and discard fixed orifice, valve stem assembly if present and Teflon® washer as illustrated above.

E Use a field-provided fitting to temporary reconnect the liquid line to the indoor unit's liquid line orifice housing.

OR

1B TYPICAL EXISTING EXPANSION VALVE REMOVAL PROCEDURE (UNCASED COIL SHOWN)



A On fully cased coils, remove the coil access and plumbing panels.

B Remove any shipping clamps holding the liquid line and distributor assembly.

C Disconnect the equalizer line from the check expansion valve equalizer line fitting on the vapor line.

D Remove the vapor line sensing bulb.

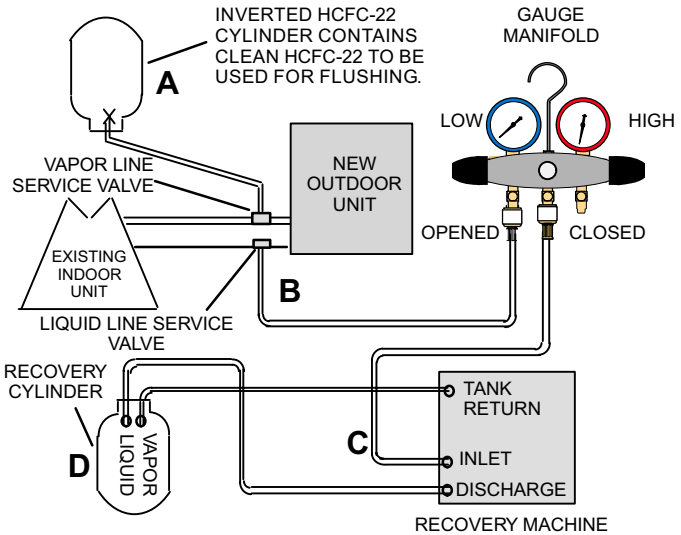
E Disconnect the liquid line from the check expansion valve at the liquid line assembly.

F Disconnect the check expansion valve from the liquid line orifice housing. Take care not to twist or damage distributor tubes during this process.

G Remove and discard check expansion valve and the two Teflon® rings.

H Use a field-provided fitting to temporary reconnect the liquid line to the indoor unit's liquid line orifice housing.

2 CONNECT GAUGES AND EQUIPMENT FOR FLUSHING PROCEDURE



A Inverted HCFC-22 cylinder with clean refrigerant to the vapor service valve.

B HCFC-22 gauge set (low side) to the liquid line valve.

C HCFC-22 gauge set center port to inlet on the recovery machine with an empty recovery tank to the gauge set.

D Connect recovery tank to recovery machines per machine instructions.

3 FLUSHING LINE SET

The line set and indoor unit coil must be flushed with at least the same amount of clean refrigerant that previously charged the system. Check the charge in the flushing cylinder before proceeding.

A Set the recovery machine for liquid recovery and start the recovery machine. Open the gauge set valves to allow the recovery machine to pull a vacuum on the existing system line set and indoor unit coil.

B Invert the cylinder of clean HCFC-22 and open its valve to allow liquid refrigerant to flow into the system through the vapor line valve. Allow the refrigerant to pass from the cylinder and through the line set and the indoor unit coil before it enters the recovery machine.

C After all of the liquid refrigerant has been recovered, switch the recovery machine to vapor recovery so that all of the HCFC-22 vapor is recovered. Allow the recovery machine to pull down to 0 the system.

D Close the valve on the inverted HCFC-22 drum and the gauge set valves. Pump the remaining refrigerant out of the recovery machine and turn the machine off.

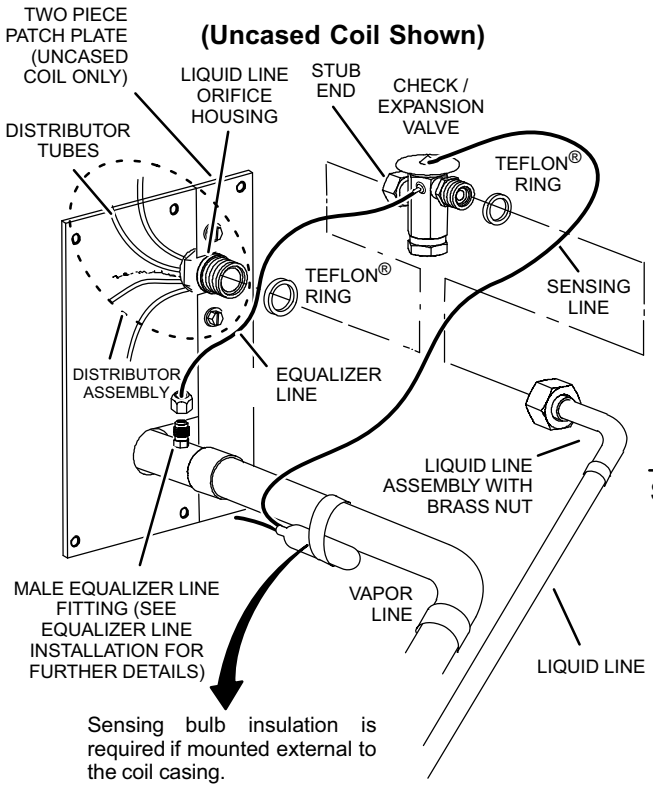
Figure 10. Removing Indoor Refrigerate Metering Device and Flushing Procedures

Installing New Indoor Metering Device

This outdoor unit is designed for use in HFC-410A systems that use a check / expansion valve metering device (purchased separately) at the indoor coil.

See the *Lennox XP16 Engineering Handbook* for approved check / expansion valve kit match-ups. The check / expansion valve device can be installed either internal or external to the indoor coil. In applications where an uncased coil is being installed in a field-provided plenum, install the check / expansion valve in a manner that will provide access for field servicing of the check / expansion valve (see figure 11).

INDOOR EXPANSION VALVE INSTALLATION



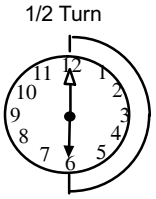
A Remove the field-provided fitting that temporarily reconnected the liquid line to the indoor unit's distributor assembly.

B Install one of the provided Teflon® rings around the stubbed end of the check / expansion valve and lightly lubricate the connector threads and expose surface of the Teflon® ring with refrigerant oil.

C Attach the stubbed end of the expansion valve to the liquid line orifice housing. Finger tighten and use an appropriately sized wrench to turn an additional 1/2 turn clockwise as illustrated in the figure above, or 20 ft-lb.

D Place the remaining Teflon® washer around the other end of the check / expansion valve. Lightly lubricate connector threads and expose surface of the Teflon® ring with refrigerant oil.

E Attach the liquid line assembly to the check / expansion valve. Finger tighten and use an appropriately sized wrench to turn an additional 1/2 turn clockwise as illustrated in the figure above or 20 ft-lb.

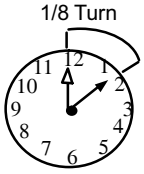


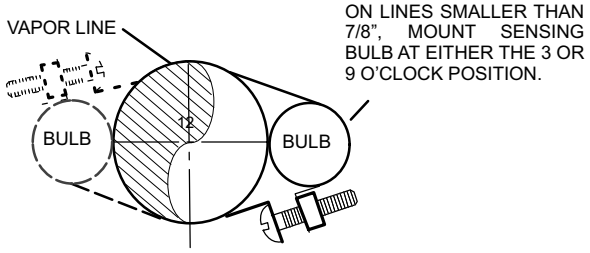
SENSING BULB INSTALLATION

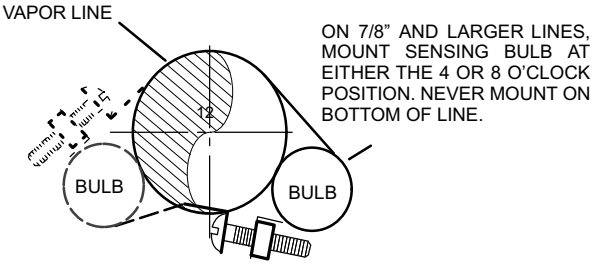
A Attach the vapor line sensing bulb in the proper orientation as illustrated to the right using the clamp and screws provided.

NOTE — Confirm proper thermal contact between vapor line and expansion bulb before insulating the sensing bulb once installed.

B Connect the equalizer line from the check / expansion valve to the equalizer vapor port on the vapor line. Finger tighten the flare nut plus 1/8 turn (7 ft-lbs) as illustrated below.







NOTE — NEVER MOUNT ON BOTTOM OF LINE.

EQUALIZER LINE INSTALLATION

Remove and discard either the flare seal cap or flare nut with copper flare seal bonnet from the equalizer line port on the vapor line as illustrated in the figure to the right.

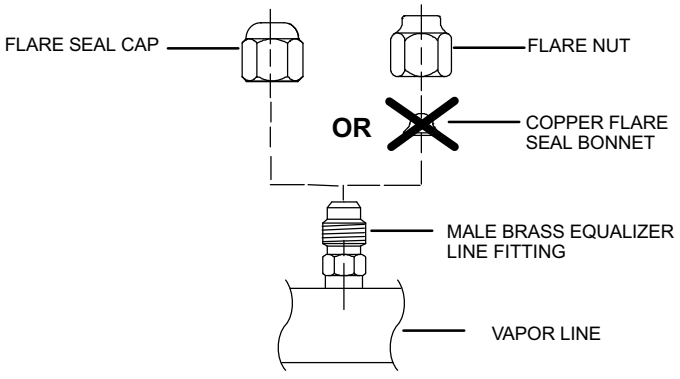


Figure 11. Installing Indoor Check / Expansion Valve

Leak Test Line Set and Indoor Coil

⚠ IMPORTANT

Leak detector must be capable of sensing HFC refrigerant.

CONNECT GAUGE SET

A Connect an HFC-410A manifold gauge set high pressure hose to the vapor valve service port.

NOTE — 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.

B With both manifold valves closed, connect the cylinder of HFC-410A refrigerant to the center port of the manifold gauge set.

NOTE — Later in the procedure, the HFC-410A container will be replaced by the nitrogen container.

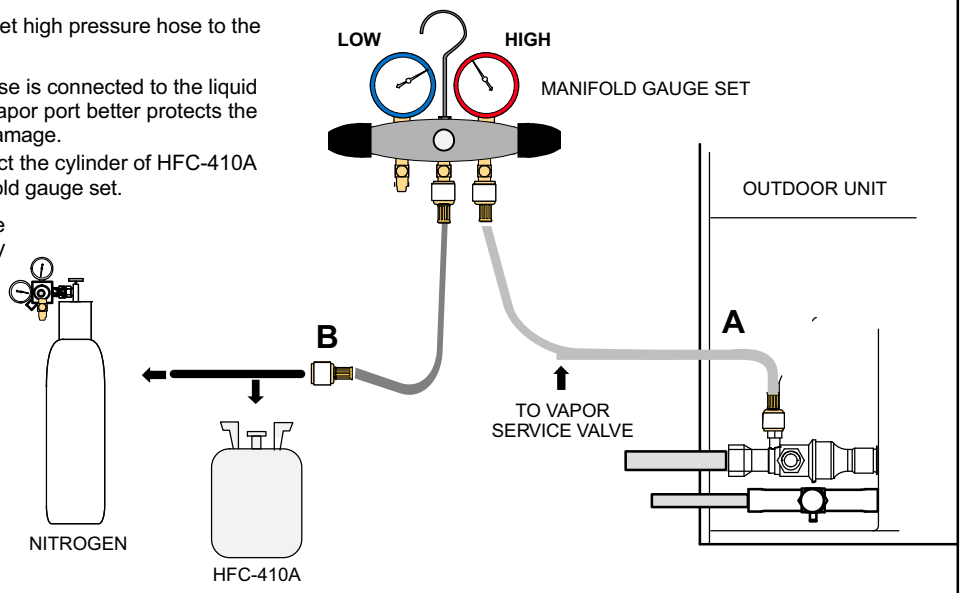


Figure 12. Manifold Gauge Set Connections for Leak Testing

TEST FOR LEAKS

After the line set has been connected to the indoor and outdoor units, check the line set connections and indoor unit for leaks. Use the following procedure to test for leaks:

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

Evacuating Line Set and Indoor Coil

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

1 CONNECT GAUGE SET

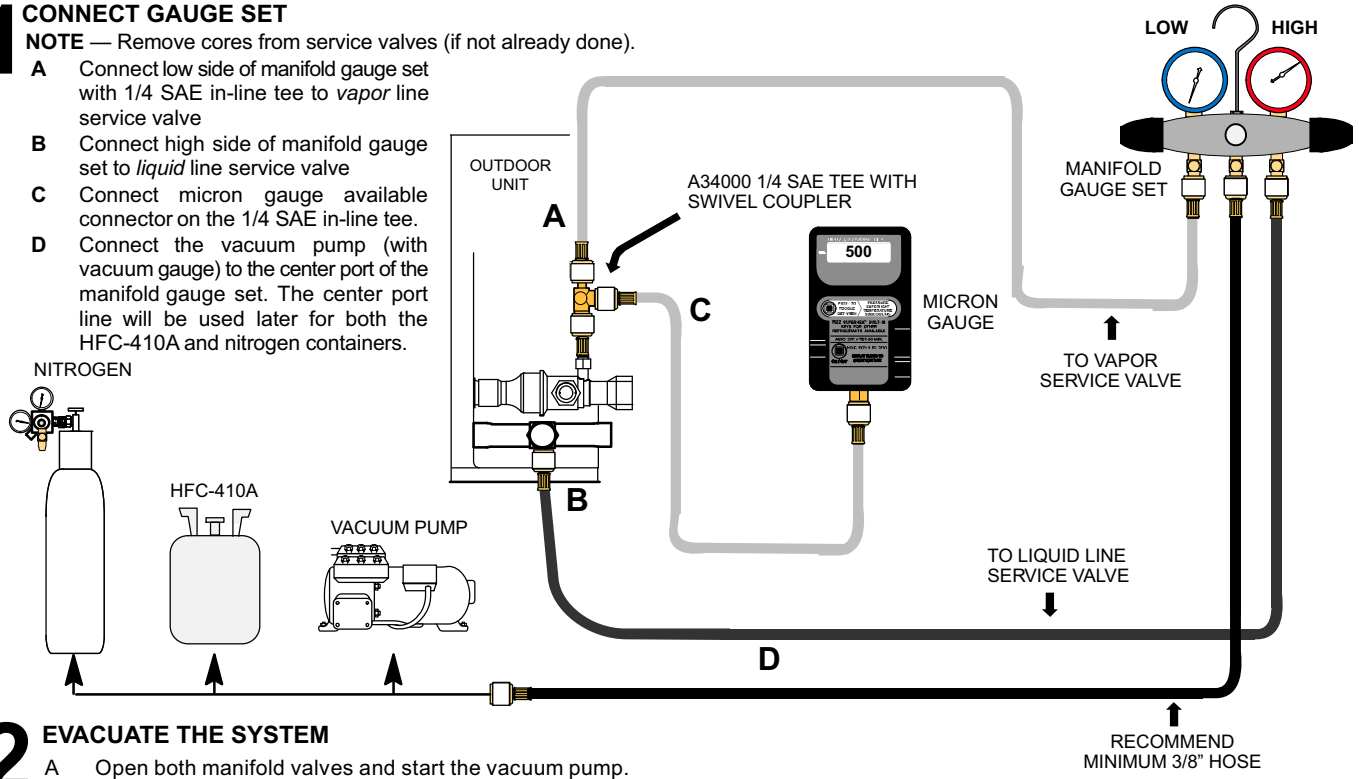
NOTE — Remove cores from service valves (if not already done).

A Connect low side of manifold gauge set with 1/4 SAE in-line tee to *vapor* line service valve

B Connect high side of manifold gauge set to *liquid* line service valve

C Connect micron gauge available connector on the 1/4 SAE in-line tee.

D Connect the vacuum pump (with vacuum gauge) to the center port of the manifold gauge set. The center port line will be used later for both the HFC-410A and nitrogen containers.



2 EVACUATE THE SYSTEM

A Open both manifold valves and start the vacuum pump.

B Evacuate the line set and indoor unit to an **absolute pressure** of 23,000 microns (29.01 inches of mercury).

NOTE *— During the early stages of evacuation, it is desirable to close the manifold gauge valve at least once. A rapid rise in pressure indicates a relatively large leak. If this occurs,* ***repeat the leak testing procedure****.*

NOTE *— The term* ***absolute pressure*** *means the total actual pressure within a given volume or system, above the absolute zero of pressure. Absolute pressure in a vacuum is equal to atmospheric pressure minus vacuum pressure.*

C When the absolute pressure reaches 23,000 microns (29.01 inches of mercury), perform the following:

- Close manifold gauge valves
- Close valve on vacuum pump and turn off vacuum pump
- Disconnect manifold gauge center port hose from vacuum pump
- Attach manifold center port hose to a dry nitrogen cylinder with pressure regulator set to 150 psig (1034 kPa) and purge the hose.
- Open manifold gauge valves to break the vacuum in the line set and indoor unit.
- Close manifold gauge valves.

D Shut off the dry nitrogen cylinder and remove the manifold gauge hose from the cylinder. Open the manifold gauge valves to release the dry nitrogen from the line set and indoor unit.

E Reconnect the manifold gauge to the vacuum pump, turn the pump on, and continue to evacuate the line set and indoor unit until the absolute pressure does not rise above 500 microns (29.9 inches of mercury) within a 20-minute period after shutting off the vacuum pump and closing the manifold gauge valves.

F When the absolute pressure requirement above has been met, disconnect the manifold hose from the vacuum pump and connect it to an upright cylinder of HFC-410A refrigerant. Open the manifold gauge valve 1 to 2 psig in order to release the vacuum in the line set and indoor unit.

G Perform the following:

- Close manifold gauge valves.
- Shut off HFC-410A cylinder.
- Reinstall service valve cores by removing manifold hose from service valve. Quickly install cores with core tool while maintaining a positive system pressure.
- Replace stem caps and secure finger tight, then tighten an additional one-sixth (1/6) of a turn as illustrated.

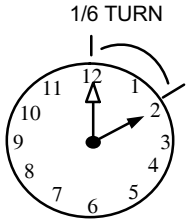


Figure 13. Evacuating Line Set and Indoor Coil

⚠ IMPORTANT

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

⚠ WARNING

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

Electrical Connections

In the U.S.A., wiring must conform with current local codes and the current National Electric Code (NEC). In Canada, wiring must conform with current local codes and the current Canadian Electrical Code (CEC).

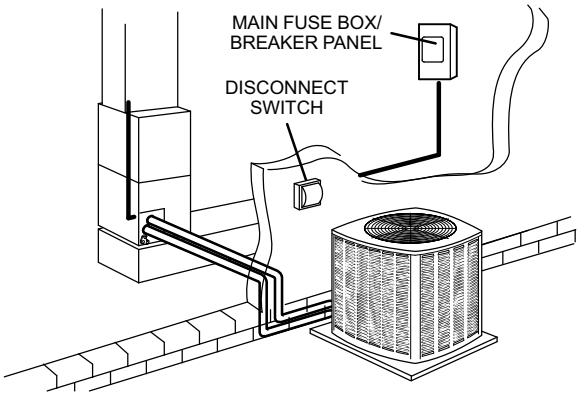
Refer to the furnace or air handler installation instructions for additional wiring application diagrams and refer to unit nameplate for minimum circuit ampacity and maximum overcurrent protection size.

24VAC TRANSFORMER

Use the transformer provided with the furnace or air handler for low-voltage control power (24VAC - 40 VA minimum)

1 SIZE CIRCUIT AND INSTALL DISCONNECT SWITCH

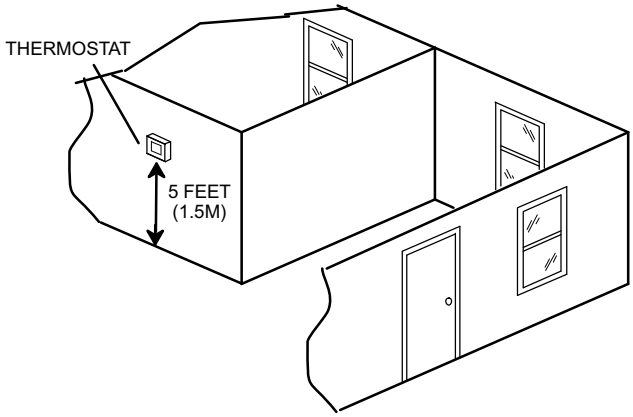
Refer to the unit nameplate for minimum circuit ampacity, and maximum fuse or circuit breaker (HACR per NEC). Install power wiring and properly sized disconnect switch.



NOTE — Units are approved for use only with copper conductors. Ground unit at disconnect switch or to an earth ground.

2 INSTALL THERMOSTAT

Install room thermostat (ordered separately) on an inside wall approximately in the center of the conditioned area and 5 feet (1.5m) from the floor. It should not be installed on an outside wall or where it can be affected by sunlight or drafts.



NOTE — 24VAC, Class II circuit connections are made in the control panel.

⚠ WARNING

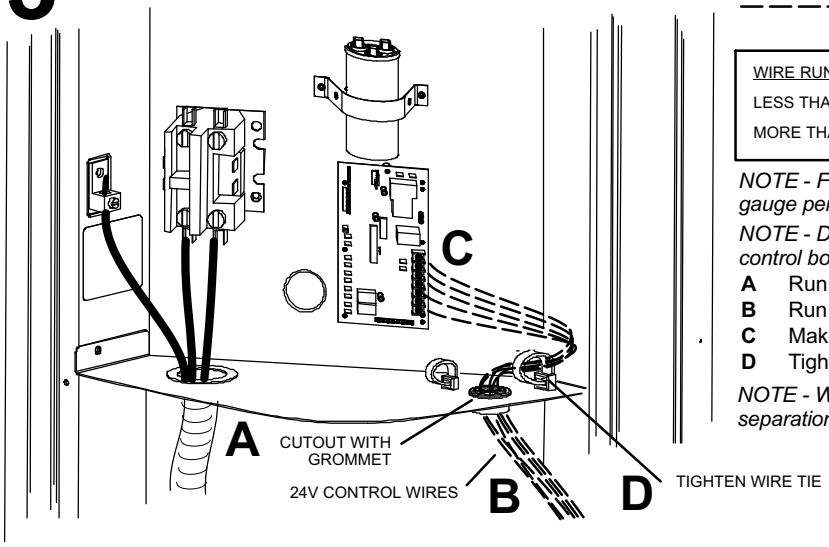
Electric Shock Hazard. Can cause injury or death. Unit must be grounded in accordance with national and local codes.

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.

3 LOW VOLTAGE CONNECTIONS

HIGH VOLTAGE FIELD WIRING

LOW VOLTAGE (24V) FIELD WIRING



WIRE RUN LENGTH	AWG#	INSULATION TYPE
LESS THAN 100' (30 METERS)	18	TEMPERATURE RATING
MORE THAN 100' (30 METERS)	16	35ºC MINIMUM.

NOTE - For proper voltages, select thermostat wire (control wires) gauge per table above.

NOTE - Do not bundle any excess 24VAC control wires inside control box.

A Run 24VAC control wires through cutout with grommet.
B Run 24VAC control wires through wire tie.
C Make 24VAC control wire connections.
D Tighten wire tie to security 24V control wiring.

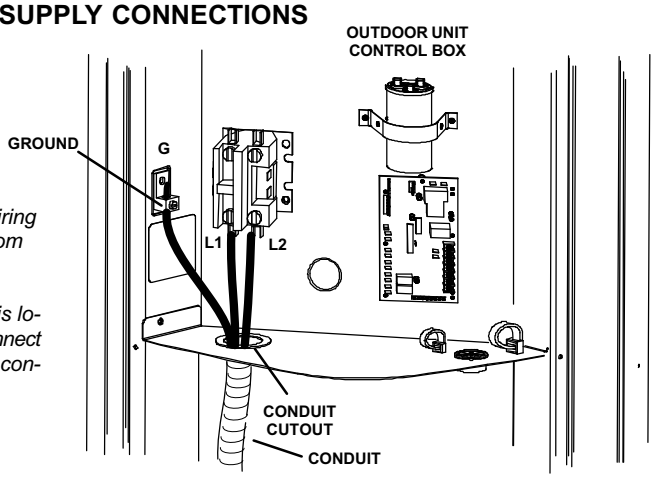
NOTE - Wire tie provides low voltage wire strain relief and to maintain separation of field installed low and high voltage circuits.

Install low voltage wiring from outdoor to indoor unit and from thermostat to indoor unit as illustrated. See figures 14 and 15 for typical field connections when connecting unit to either a CBX32MV or CBX40UHV in non-communicating mode. For connections to other Lennox air handlers or furnaces, see the ComfortSense® 7000 installation instruction for further match component wiring illustrations.

4 HIGH VOLTAGE POWER SUPPLY CONNECTIONS

NOTE - Any excess high voltage field wiring should be trimmed and secured away from any low voltage field wiring.

NOTE - To facilitate a conduit, a cutout is located in the bottom of the control box. Connect conduit to the control box using a proper conduit fitting.



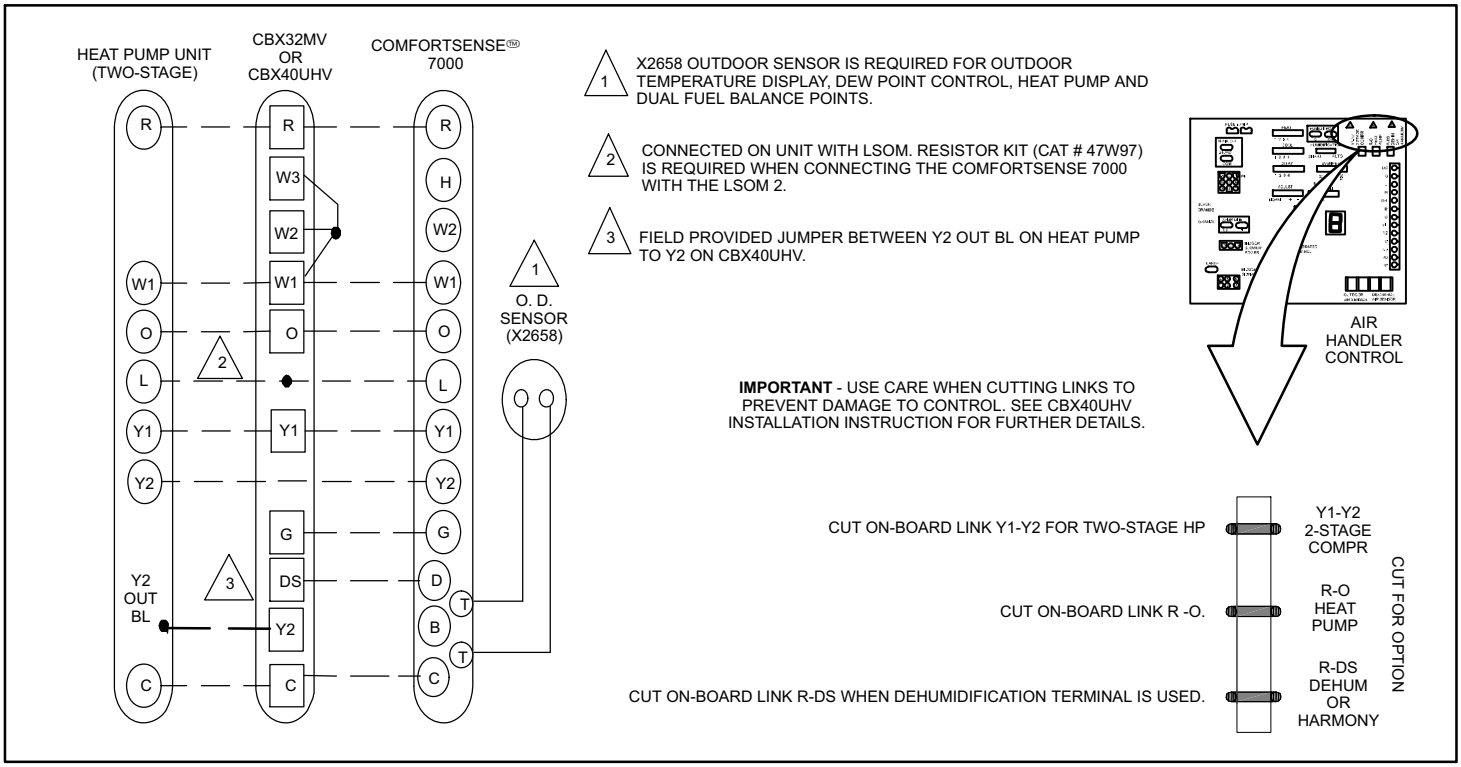


Figure 14. Typical Field Wiring — Heat Pump Application with CBX32MV or CBX40UHV

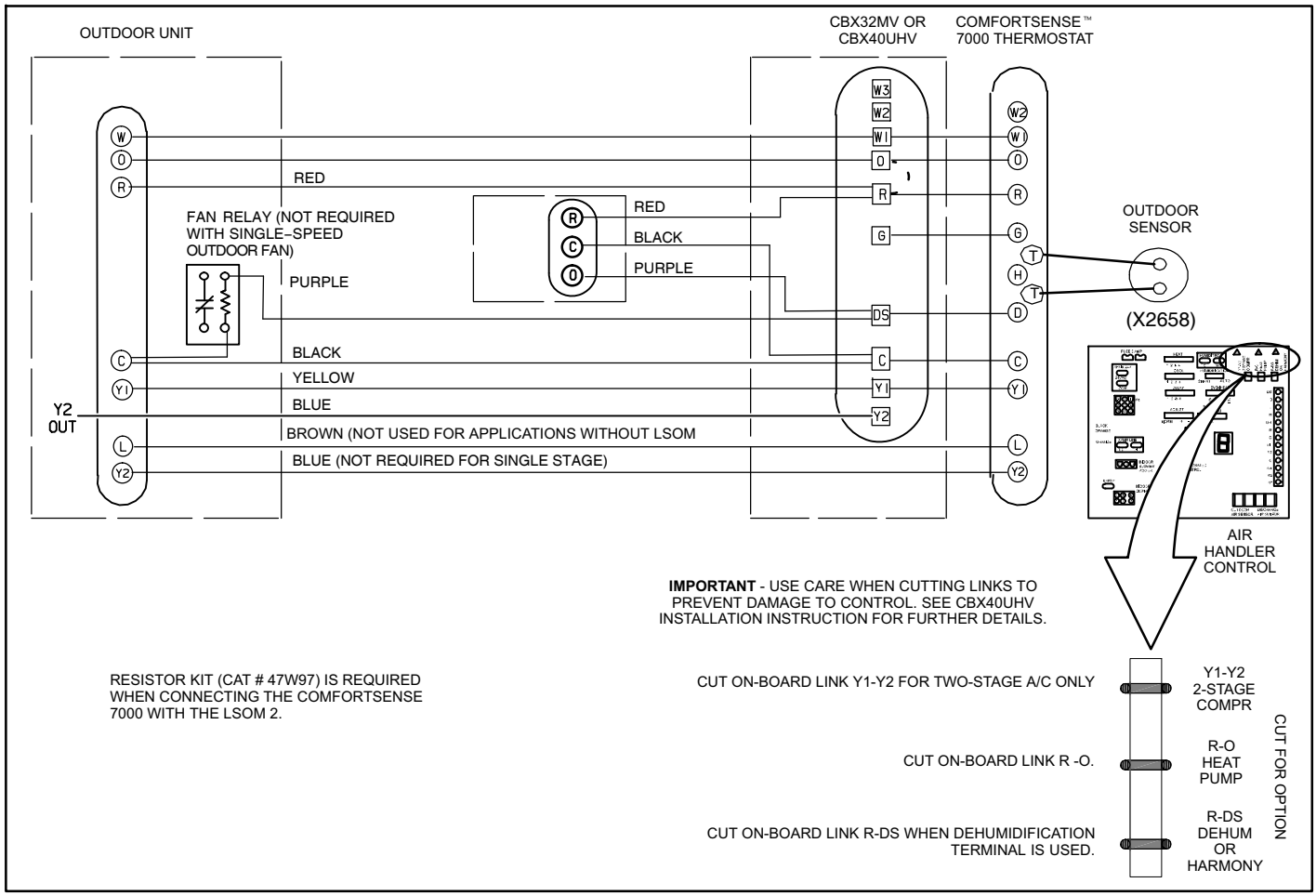


Figure 15. Heat Pump Application — Humiditrol ® and Second-Stage Outdoor Fan Relay Wiring with CBX32MV or CBX40UHV

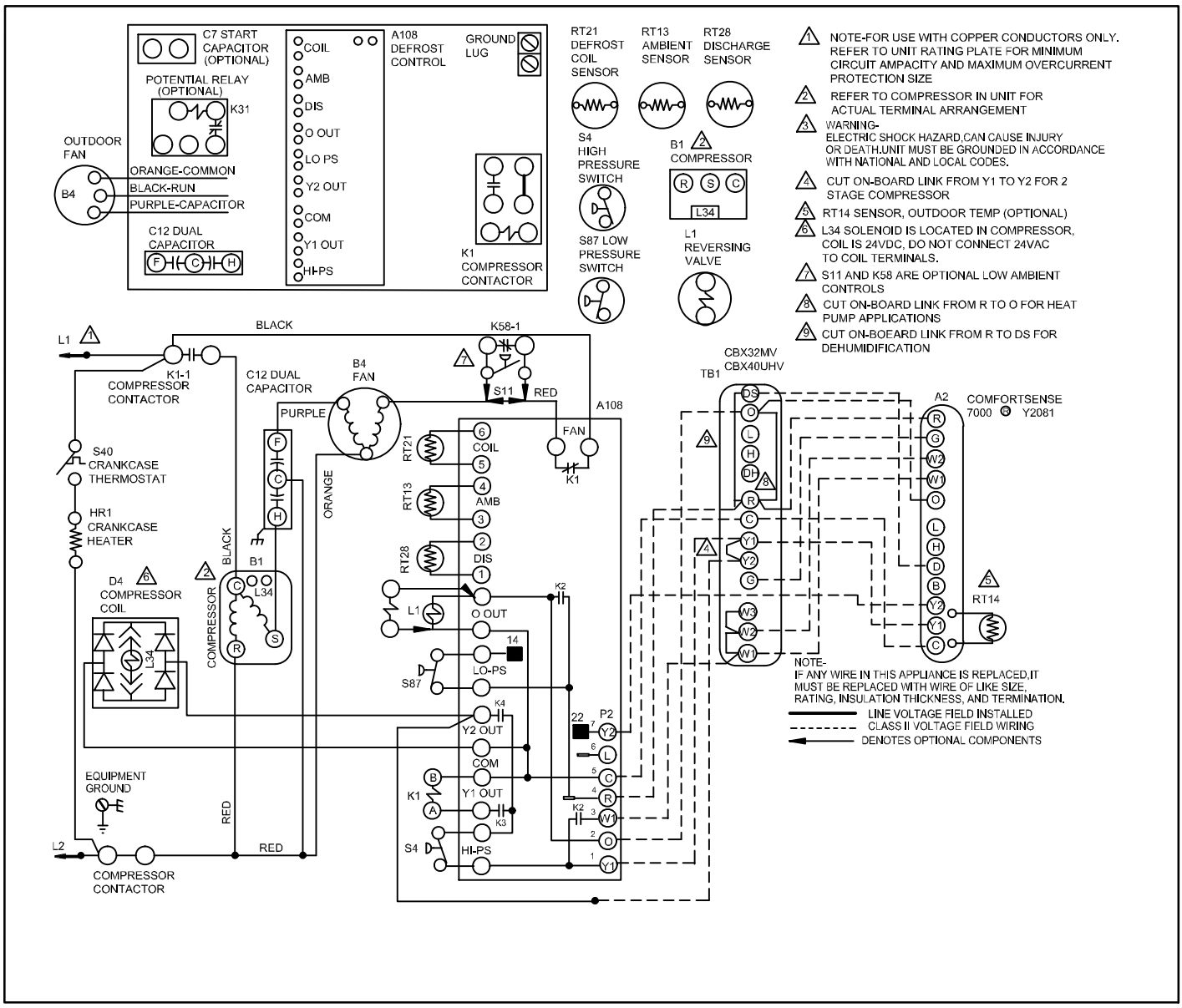


Figure 16. Typical Unit Wiring Diagram (-024, -036 and -048 Only)

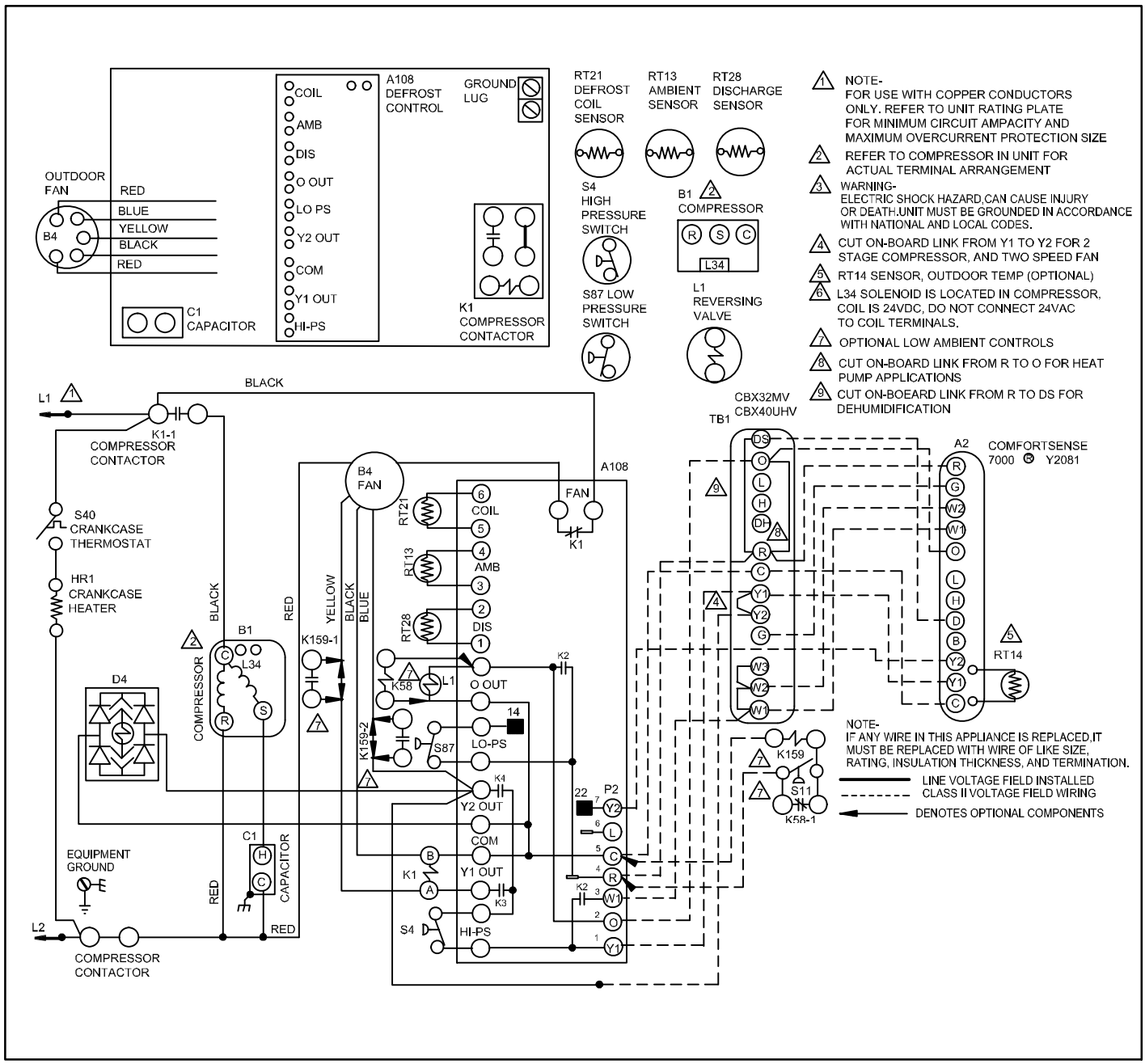


Figure 17. Typical Unit Wiring Diagram (-060 Only)

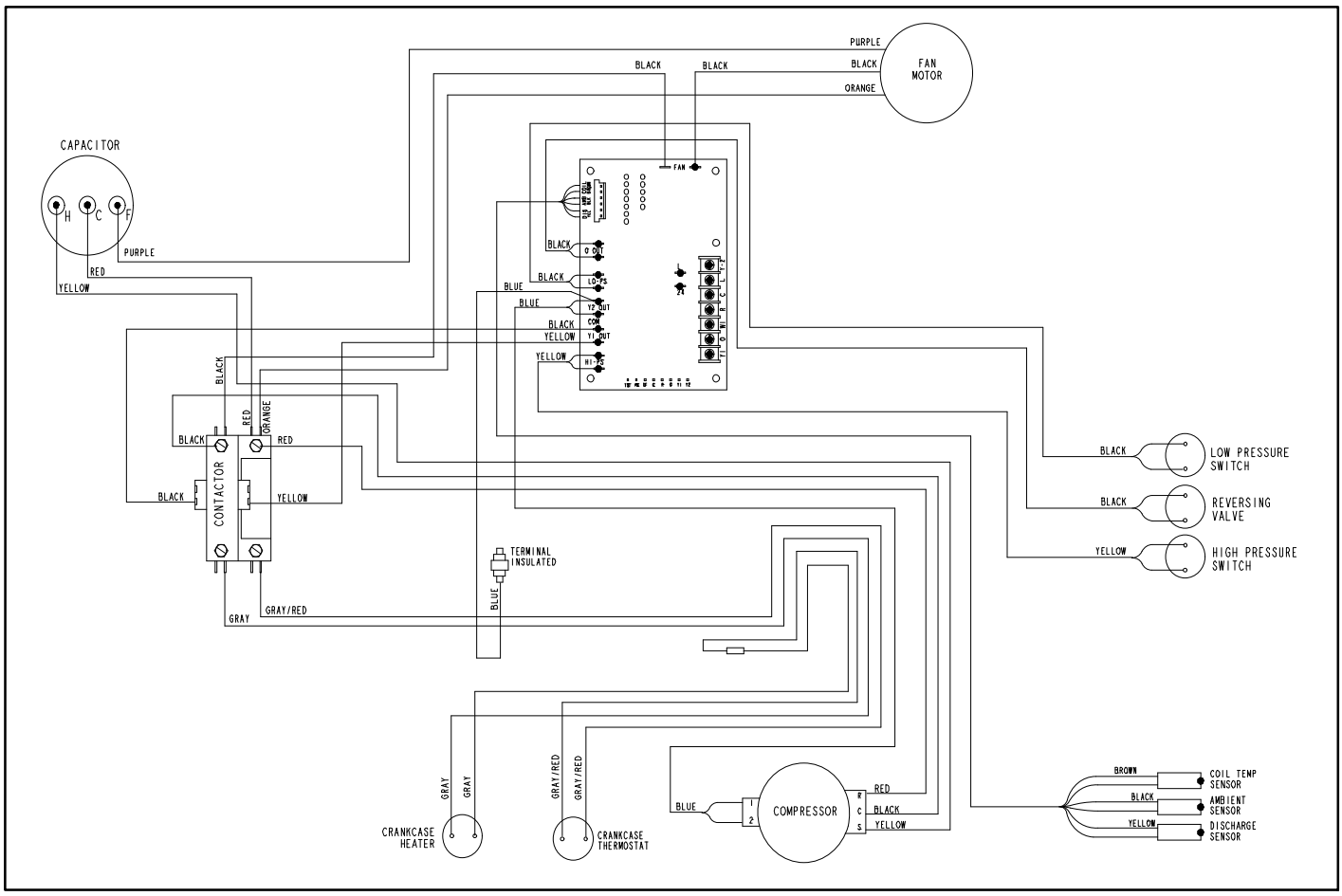


Figure 18. Typical Factory Wiring Diagram (No Field Modifications)

Unit Start-Up

⚠ IMPORTANT

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.

UNIT START-UP

1. Rotate fan to check for binding.
2. Inspect all factory- and field-installed wiring for loose connections.
3. Verify that the manifold gauge set is connected as illustrated in figure 21. Use a temperature sensor positioned near the liquid line service port as illustrated in figure 21 which will be required later when using the subcooling method for optimizing the system refrigerant charge.
4. Replace the stem caps and tighten to the value listed in table 1.
5. Check voltage supply at the disconnect switch. The voltage must be within the range listed on the unit's nameplate. If not, do not start the equipment until you have consulted with the power company and the voltage condition has been corrected.
6. Open both the liquid and vapor line service valves to release the refrigerant charge contained in outdoor unit into the system.
7. Use figure 19 to determine next step in system preparation.

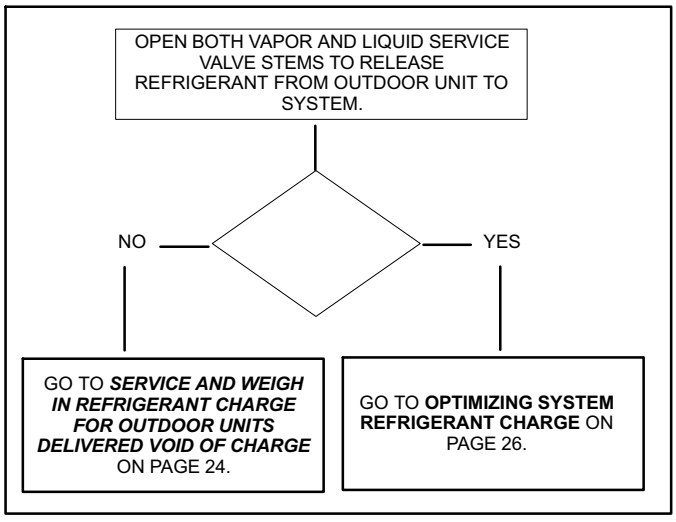


Figure 19. Outdoor Unit Factory Charge

Service and Weigh In Refrigerant for Outdoor Units Delivered Void of Charge

The following procedures are only required if it has been determine that the new outdoor unit is void of charge. Skip to the next section if refrigerant charge is present.

LEAK CHECK, REPAIR AND EVACUATE

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

1. Leak check system using procedures provided on page 16. Repair any leaks discovered during leak test.
2. Evacuate the system using procedure provided in figure 13.
3. Use nitrogen to break the vacuum and install a new filter drier in the system.
4. Evacuate the system again using procedure in figure 12.

CONNECT MANIFOLD GAUGE SET AND WEIGH IN CHARGE

After the evacuation procedure, reconnect the manifold gauge set as illustrated in figure 21.

NOTE - Temperature sensor illustrated in figure 21 is not required for initial system weigh in charging.

1. Close manifold gauge set valves and connect the center hose to a cylinder of HFC-410A. Set for liquid phase charging.
2. Connect the manifold gauge set's low pressure side to the **true suction port**.
3. Connect the manifold gauge set's high pressure side to the **liquid line service port**.
4. Connect the center hose of the gauge set to a **cylinder of HFC-410A** and purge the hose. Then, place the cylinder upside down on a scale.
5. Check that fan rotates freely.
6. Inspect all factory- and field-installed wiring for loose connections.
7. Open the high side manifold gauge valve and weigh in liquid refrigerant. Use figure 20 in calculating the correct weigh-in charge.
8. Close manifold gauge valves.
9. Monitor the system to determine the amount of moisture remaining in the oil. It may be necessary to replace the bi-flow filter drier several times to achieve the required dryness level. If system dryness is not verified, the compressor will fail in the future.
10. Continue to ***Optimizing System Refrigerant Charge*** on page 26 to optimize the system charge using subcooling method.

WEIGH-IN CHARGING

CALCULATING SYSTEM CHARGE FOR OUTDOOR UNIT VOID OF CHARGE

If the system is void of refrigerant, first, locate and repair any leaks and then weigh in the refrigerant charge into the unit. To calculate the total refrigerant charge:

Amount specified on nameplate		Adjust amount. for variation in line set length listed on line set length table below.		Additional charge specified per indoor unit match listed on page 28.		Total Charge
_____	±	_____	+	_____	=	_____

Refrigerant Charge per Line Set Length

LIQUID LINE SET DIAMETER	OUNCES PER 5 FEET (G PER 1.5 M) ADJUST FROM 15 FEET (4.6 M) LINE SET*
3/8" (9.5 MM)	3 OUNCE PER 5' (85 G PER 1.5 M)

*If line length is greater than 15 ft. (4.6 m), add this amount. If line length is less than 15 ft. (4.6 m), subtract this amount.

NOTE — Insulate liquid line when it is routed through areas where the surrounding ambient temperature could become higher than the temperature of the liquid line or when pressure drop is equal to or greater than 20 psig.

NOTE — The above nameplate is for illustration purposes only. Go to actual nameplate on outdoor unit for charge information.

Figure 20. Using HFC-410A Weigh In Method

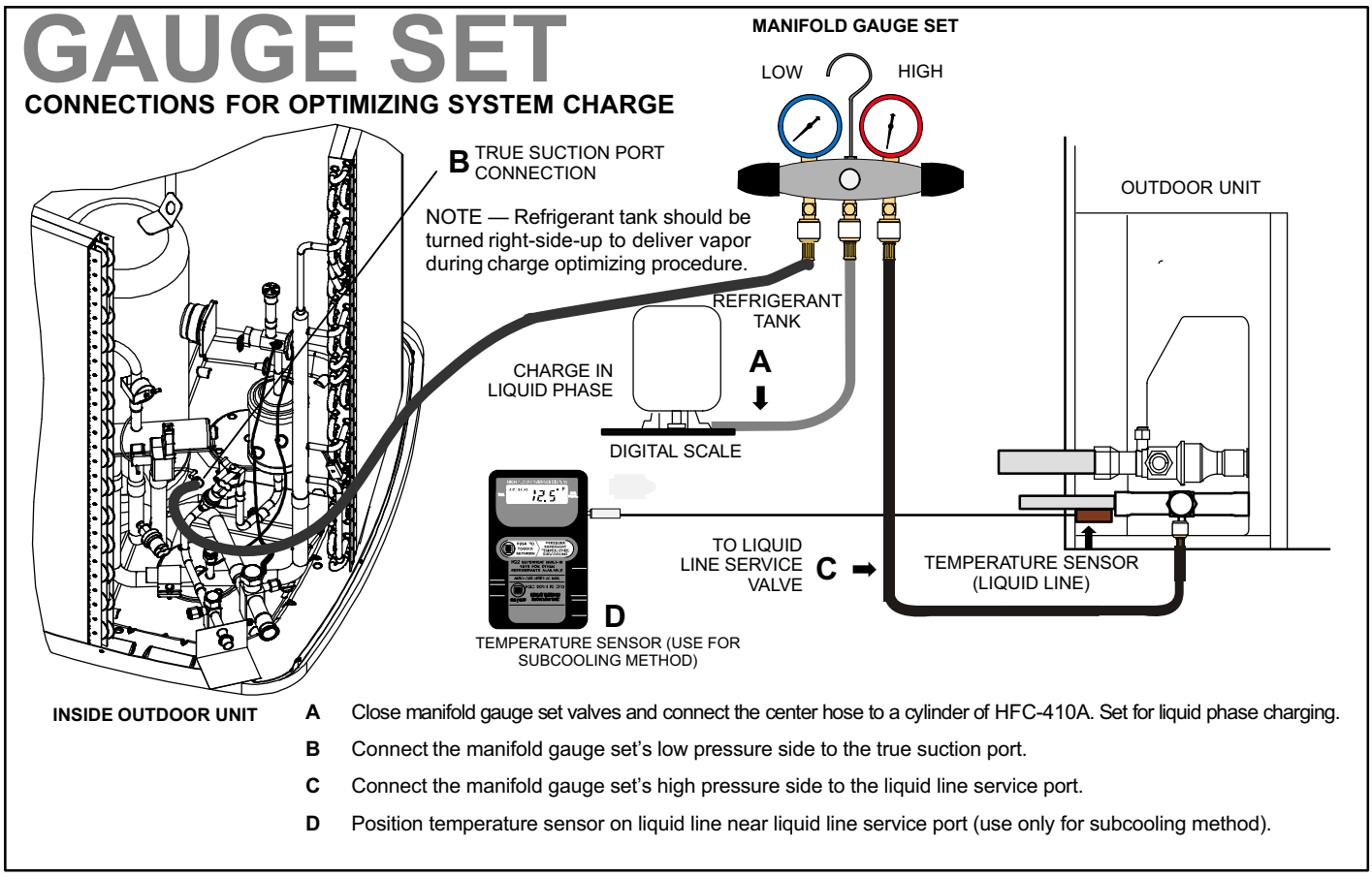
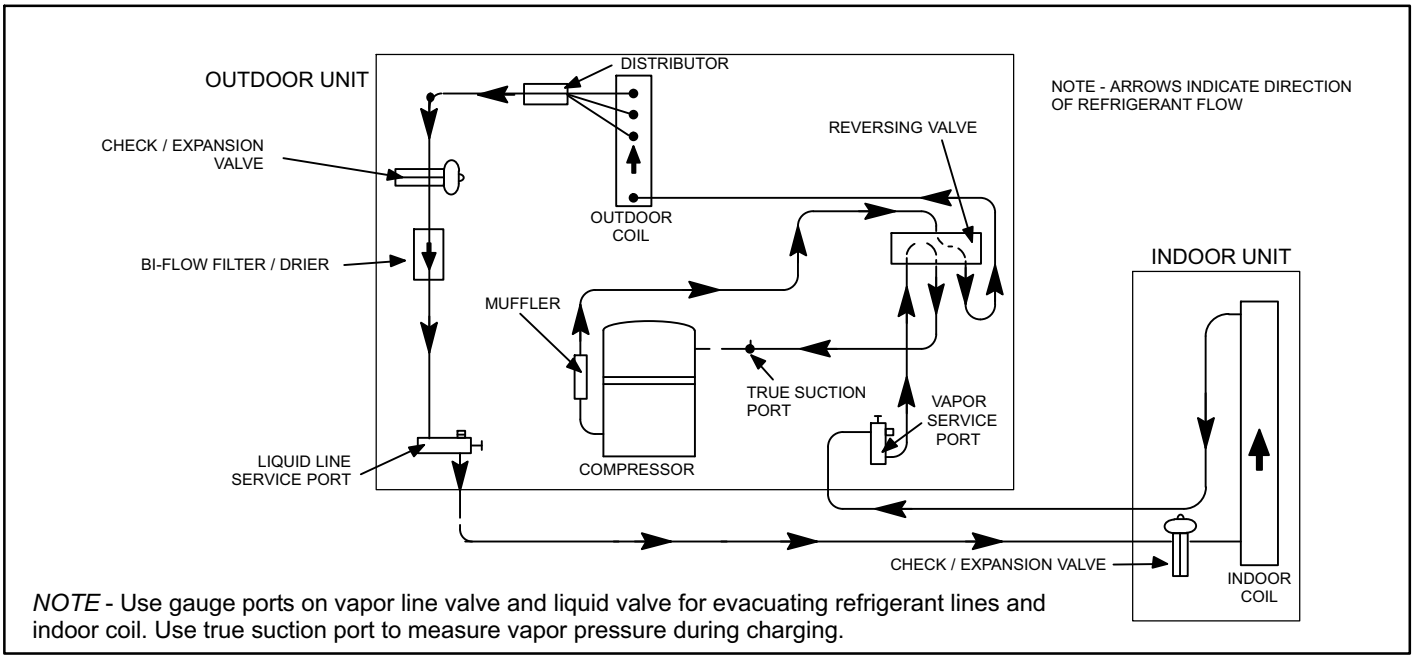


Figure 21. Gauge Set Connections for Adding Refrigerant



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

Figure 22. Heat Pump Cooling Cycle

Optimizing System Refrigerant Charge

This section provides instructions on optimizing the system charge. This section includes:

- Optimizing procedure
- Adjusting indoor airflow
- Using subcooling method
- Approved matched components, targeted subcooling (SC) values and add charge values
- Normal operating pressures
- Temperature pressures

OPTIMIZING PROCEDURE

1. Move the low-side manifold gauge hose from the vapor line service valve to the true suction port (see figure 21).

2. Set the thermostat for either cooling or heating demand. Turn on power to the indoor unit and close the outdoor unit disconnect switch to start the unit.

3. Allow unit to run for five minutes to allow pressures to stabilize.

4. Check the airflow as instructed under *Adjusting Indoor Airflow* to verify or adjust indoor airflow for maximum efficiency. Make any air flow adjustments before continuing with the optimizing procedure.

5. Use **subcooling method to optimize the system charge (see figure 24)**. Adjust charge as necessary.

ADJUSTING INDOOR AIRFLOW

Heating Mode Indoor Airflow Check

(Only use when indoor unit has electric heat)

Indoor blower airflow (CFM) may be calculated by energizing electric heat and measuring:

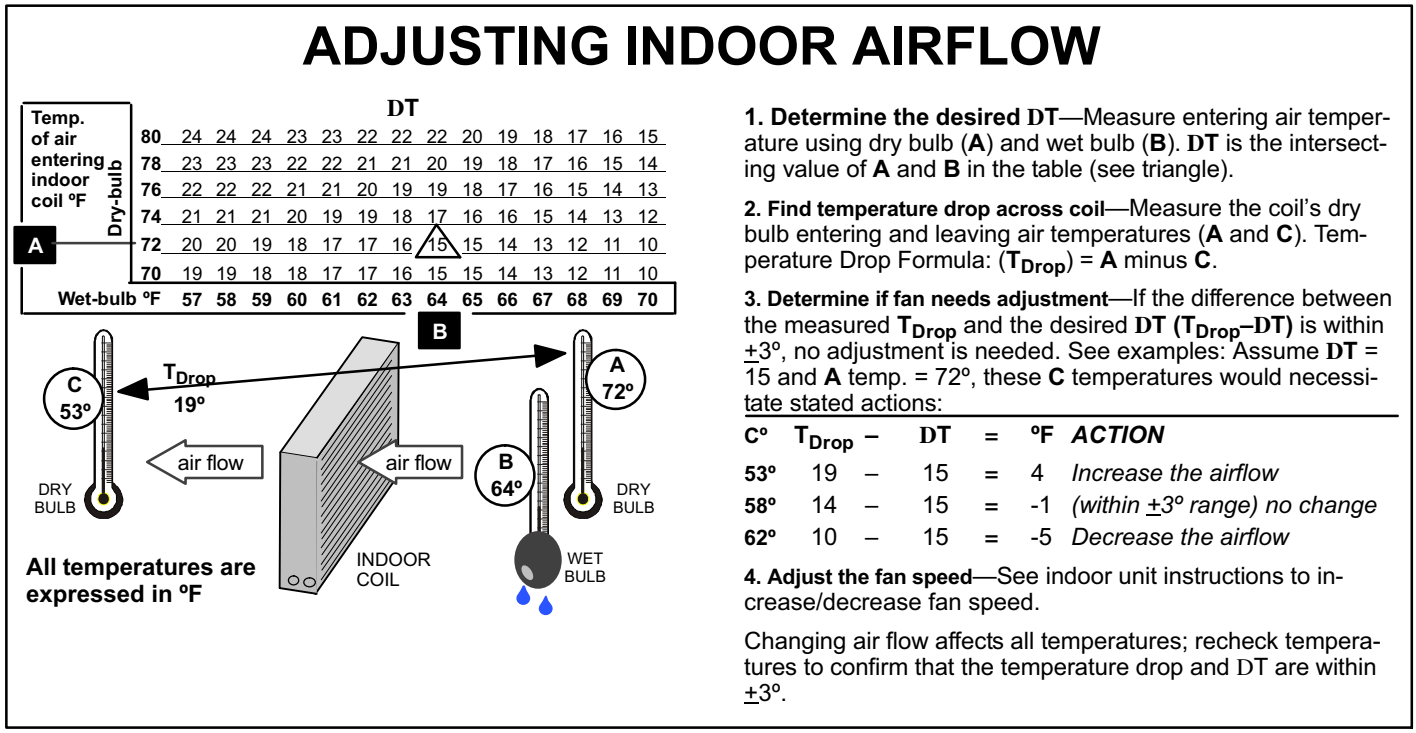
- Temperature rise between the return air and supply air temperatures at the indoor coil blower unit,
- Measuring voltage supplied to the unit,
- Measuring amperage being drawn by the heat unit(s).

Then, apply the measurements taken in the following formula to determine CFM:

$$\text{CFM} = \frac{\text{Amps x Volts x 3.41}}{\text{1.08 x Temperature rise (F)}}$$

Cooling Mode Indoor Airflow Check

Check airflow using the Delta-T (DT) process using figure 23.



1. Determine the desired DT—Measure entering air temperature using dry bulb (**A**) and wet bulb (**B**). **DT** is the intersecting value of **A** and **B** in the table (see triangle).

2. Find temperature drop across coil—Measure the coil's dry bulb entering and leaving air temperatures (**A** and **C**). Temperature Drop Formula: (T_{Drop}) = **A** minus **C**.

3. Determine if fan needs adjustment—If the difference between the measured T_{Drop} and the desired **DT** (T_{Drop}–**DT**) is within ±3°, no adjustment is needed. See examples: Assume **DT** = 15 and **A** temp. = 72°, these **C** temperatures would necessitate stated actions:

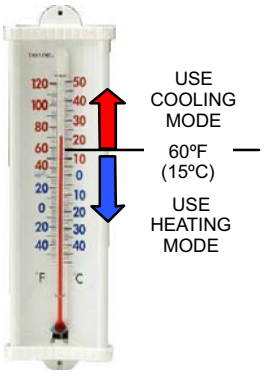
C°	T_{Drop}	–	DT	=	°F	*ACTION*
53°	19	–	15	=	4	*Increase the airflow*
58°	14	–	15	=	-1	*(within ±3° range) no change*
62°	10	–	15	=	-5	*Decrease the airflow*

4. Adjust the fan speed—See indoor unit instructions to increase/decrease fan speed.

Changing air flow affects all temperatures; recheck temperatures to confirm that the temperature drop and DT are within ±3°.

Figure 23. Checking Airflow over Indoor Coil Using Delta-T Formula

OPTIMIZE CHARGE USING SUBCOOLING METHOD



1. Check liquid and vapor line pressures. Compare pressures with either second-stage heat or cooling mode normal operating pressures listed in table 7. Table 7 is a general guide and expect minor pressures variations. Significant pressure differences may indicate improper charge or other system problem.

2. Decide whether to use cooling or heating mode based on current outdoor ambient temperature:

   A Use **COOLING MODE** when:
   - Outdoor ambient temperature is ***60°F (15.5°C) and above***.
   - Indoor return air temperature range is between **70 to 80°F (21-27°C)**. This temperature range is what the target subcooling values are base upon in tables **3** through **6**.

   If indoor return air temperature is not within reference range, set thermostat to cooling mode and a setpoint of **68ºF (20ºC)**. This should place the outdoor unit into second-stage (high-capacity) **cooling** mode. When operating and temperature pressures have stabilized, continue to step 3.

   B Use **HEATING MODE** when:
   - Outdoor ambient temperature is ***59°F (15.0°C) and below***.
   - Indoor return air temperature range is between **65-75°F (18-24°C)**. This temperature range is what the target subcooling values are base upon in tables **3** through **6**.

   If indoor return air temperature is not within reference range, set thermostat to heating mode and a setpoint of **77ºF (25ºC)**. This should place the outdoor unit into second-stage (high-capacity) **heating** mode. When operating and temperature pressures have stabilized, continue to step 3.

3. Read the liquid line pressure; then find its corresponding temperature pressure listed in table 8 and record it in the **SATº** space to the left.

4. Read the liquid line temperature; record in the **LIQº** space to the left.

SATº _____

5. Subtract **LIQº** temperature from **SATº** temperature to determine subcooling; record it in **SCº** space to the left..

LIQº – _____

6. Compare **SCº** results with tables 3 through 6 (either **Heating** or **Cooling** mode column), also consider any additional charge required for line set lengths longer than 15 feet and/or unit matched component combinations (**Add Charge** column).

SCº = _____

7. If subcooling value is:

   A **GREATER** than shown for the applicable unit match component, **REMOVE** refrigerant;

   B **LESS** than shown for the applicable unit match component, **ADD** refrigerant.

8. If refrigerant is added or removed, repeat steps 3 through 6 to verify charge.

9. Close all manifold gauge set valves and disconnect gauge set from outdoor unit.

10. Replace the stem and service port caps and tighten as specified in *Operating Service Valves* on page 2.

11. Recheck voltage while the unit is running. Power must be within range shown on the nameplate.

Figure 24. Using HFC-410A Subcooling Method — Second Stage (High Capacity)

APPROVED MATCHED SYSTEM COMPONENTS, TARGETED SUBCOOLING (SC) VALUES AND ADD CHARGE VALUES

Listed below are the **approved matched system components** (air handlers and indoor coils), **targeted subcooling** and **add charge** values for the XP16. This information is also listed on the unit charging sticker located on the outdoor unit access panel.

Subcooling values listed in the following tables are based on outdoor ambient air temperature of:

- **60°F (15.5°C) and above** for cooling mode
- **59°F (15.0°C) and below** for heating mode.

Table 3. XP16–024–230

Indoor Air Handers and Coils	Heating Mode ±5ºF	Cooling Mode ±1ºF	*Add Charge	
	Subcooling		lb.	oz.
CBX26UH-024	45	6	0	15
CBX27UH-024-230	20	7	0	9
CBX27UH-030-230	17	7	1	3
CBX32MV-024/030	20	7	0	9
CBX32MV-036	17	7	1	3
CBX40UHV-024	17	7	1	3
CBX40UHV-030	17	7	1	3
CBX40UHV-036	17	7	1	3
CH33-31B	31	8	1	12
CR33-30/36A/B/C	45	4	0	0
CX34-31A/B	24	7	1	11
CX34-38A/B	18	8	1	10

Table 4. XP16–036–230

Indoor Air Handers and Coils	Heating Mode ±5ºF	Cooling Mode ±1ºF	*Add Charge	
	Subcooling		lbs.	oz.
CBX26UH-036	50	5	0	0
CBX27UH-036-230	22	7	0	9
CBX27UH-042-230	24	11	3	0
CBX32M-036	22	7	0	9
CBX32MV-036	22	7	0	9
CBX32MV-048	24	11	3	0
CBX40UHV-030	22	7	0	9
CBX40UHV-036	22	7	0	9
CBX40UHV-042	24	11	3	0
CBX40UHV-048	24	11	3	0
CH33-43B	13	10	2	7
CH33-48C	37	11	2	11
CH33-43C	37	11	2	11
CR33-48B/C	49	7	0	9
CX34-43B/C	29	9	2	11
CX34-50/60C	29	9	2	11

Table 5. XP16–048–230

Indoor Air Handers and Coils	Heating Mode ±5ºF	Cooling Mode ±1ºF	*Add Charge	
	Subcooling		lbs.	oz.
CBX26UH-048-230	10	8	1	4
CBX27UH-048-230	19	9	1	4
CBX27UH-060-230	13	14	3	3
CBX32M-048	19	9	1	4
CBX32M-060	14	9	1	11
CBX32MV-048	19	9	1	4
CBX32MV-060	14	9	1	11
CBX32MV-068	9	8	1	11
CBX40UHV-048	19	9	1	4
CBX40UHV-060	14	9	1	11
CH23-68	24	10	1	12
CH33-49C	19	9	2	5
CH33-50/60C	19	9	2	5
CH33-60D	13	8	0	0
CH33-62D	11	9	1	4
CR33-50/60C	15	7	0	10
CR33-60D	15	7	0	10
CX34-60D	14	8	1	0
CX34-62D	9	9	1	6
CX34-62C	8	9	1	9

Table 6. XP16–060–230

Indoor Air Handers and Coils	Heating Mode ±5ºF	Cooling Mode ±1ºF	*Add Charge	
	Subcooling		lbs.	oz.
CBX26UH-060	20	9	4	13
CBX27UH-060-230	10	6	2	3
CBX32M-060	17	6	1	12
CBX32MV-060	17	6	1	12
CBX32MV-068	15	7	2	1
CBX40UHV-060	17	6	1	12
CH23-682	37	9	2	10
CH33-50/60C	33	8	1	0
CH33-62D	15	7	1	4
CR33-50/60C	24	7	0	0
CR33-60D	24	7	0	0
CX34-62C	21	9	2	16
CX34-62D	13	7	1	4

*Amount of charge required in additional to charge shown on unit nameplate. (Remember to consider line set length difference.)

NORMAL OPERATING PRESSURES

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

Typical pressures only, expressed in psig (**liquid +/- 10** and vapor **+/- 5 psig**); matched indoor component (air handler or coil), indoor air quality, and indoor load will cause the pressures to vary.

Table 7. Normal Operating Pressures*

Normal Operating Pressures - Cooling								
XP16	-024		-036		-048		-060	
°F (°C)**	Liq	Vap	Liq	Vap	Liq	Vap	Liq	Vap
First Stage (Low Capacity) Pressure								
65 (18.3)	226	144	220	141	224	143	230	137
75 (23.9)	260	145	254	144	259	143	267	139
85 (29.4)	301	148	295	148	302	147	311	141
95 (35.0)	346	151	340	150	346	149	357	144
105 (40.6)	396	153	389	153	396	152	398	147
115 (46.1)	451	156	444	156	450	155	453	149
Second Stage (High Capacity) Pressure								
65 (18.3)	241	140	232	129	238	138	232	131
75 (23.9)	279	142	269	136	278	140	276	133
85 (29.4)	321	144	312	140	321	142	320	136
95 (35.0)	369	146	346	142	372	144	367	138
105 (40.6)	421	148	409	145	424	147	421	141
115 (46.1)	480	151	465	148	481	149	479	144
Normal Operating Pressures - Heating								
First Stage (Low Capacity) Pressure								
50 (10)	312	112	350	115	336	114	385	108
60 (15.5)	330	130	372	136	363	135	414	126
Second Stage (High Capacity) Pressure								
20 (-7.0)	299	64	321	61	289	57	332	59
30 (-1.0)	312	79	347	74	294	69	349	67
40 (4.4)	325	93	367	90	321	80	361	75
50 (10)	344	110	387	110	341	110	383	85
60 (15.5)	358	128	395	131	361	128	425	122

** *Temperature of air entering outdoor coil.*

TEMPERATURE PRESSURES

Compute subcooling by determining saturated condensing temperature from temperature pressure chart. Subtract from liquid temperature entering TXV.

Table 8. HFC-410A Temperature (°F) - Pressure (Psig)

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

System Operation

⚠ IMPORTANT

Some scroll compressor have internal vacuum protector that will unload scrolls when suction pressure goes below 20 psig. A hissing sound will be heard when the compressor is running unloaded. Protector will reset when low pressure in system is raised above 40 psig. DO NOT REPLACE COMPRESSOR.

This section addresses:

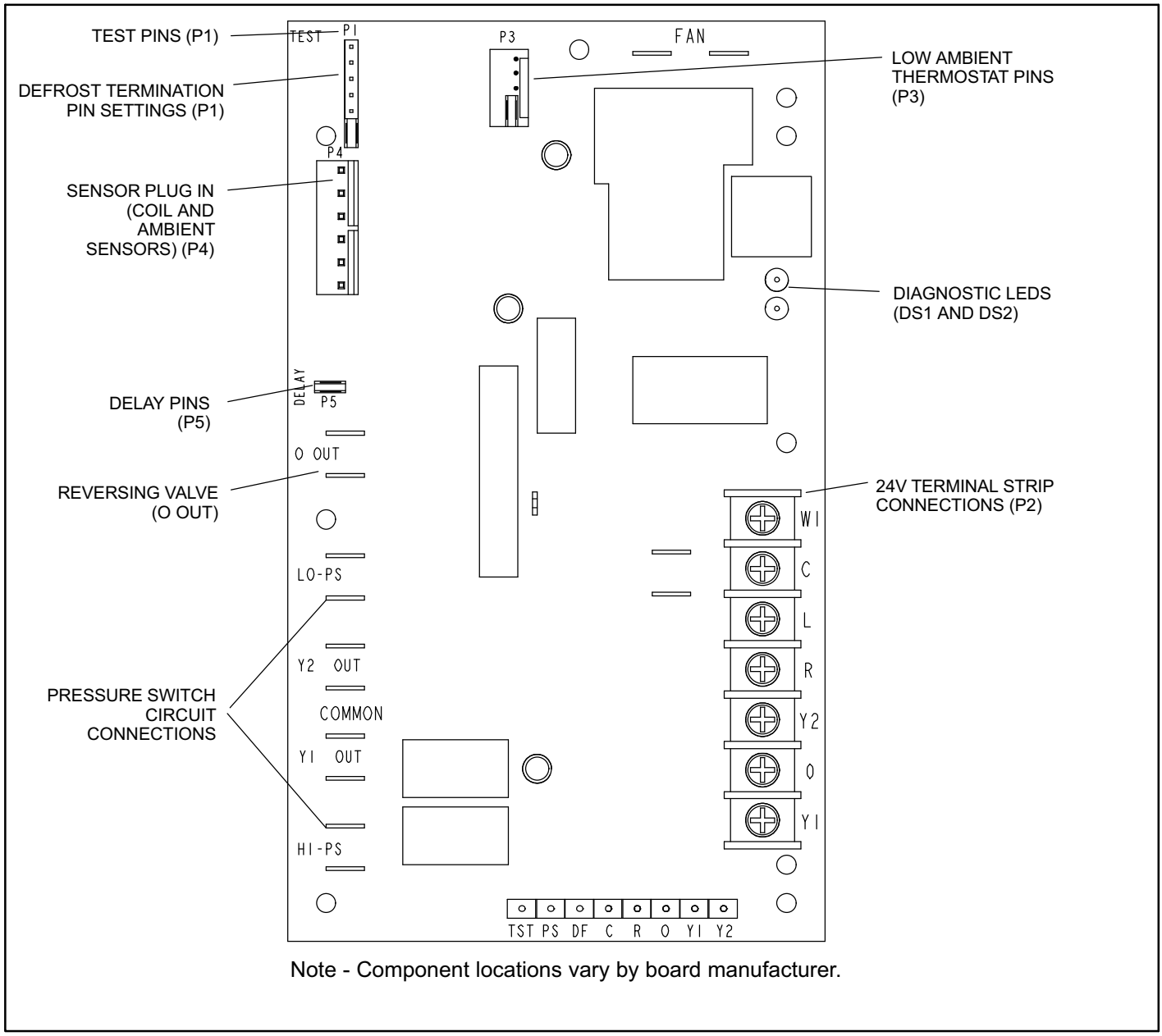
- Unit components (sensors, temperature switch, pressure switches and demand defrost control)
- Second-stage operation

UNIT COMPONENTS

Demand Defrost Control (A108)

The demand defrost control measures differential temperatures to detect when the system is performing poorly because of ice build-up on the outdoor coil. The controller *self-calibrates* when the defrost system starts and after each system defrost cycle. The demand defrost control's: components are shown in figure 25.

- Demand defrost control connections, jumpers and LED locations are shown in figure 25.
- Demand defrost control connections, jumpers and LED descriptions are listed on table 9.
- Demand defrost control status, fault and lockout LEDs are listed in table 10.



Note - Component locations vary by board manufacturer.

Figure 25. Demand Defrost Control (A108)

Table 9. Demand Defrost Control (A108) Inputs, Outputs and Configurable Settings

Control Locations	Control Label or Description	Purpose	Function
P1	TEST	Test Mode	*See Test Mode on page 39 for further details.*
P1	50, 70, 90, 100	Defrost Temperature Termination Shunt (Jumper) Pins	The demand defrost control as illustrated in figure 25 has valid selections which are: 50, 70, 90, and 100°F (10, 21, 32 and 38°C). The shunt termination pin is factory set at 50°F (10°C). If the temperature shunt is not installed, the default termination temperature is 90°F (32°C).
P2	W1	24VAC Thermostat Input / Output	24VAC input / output from indoor thermostat to indoor unit.
	C	24VAC Common	24VAC common
	L	Thermostat Service Light	Thermostat service light connection.
	R	24VAC	24VAC
	Y2	Thermostat Input	Controls the second stage operation of the unit.
	O	Thermostat Input	Reversing valve solenoid.
	Y1	Thermostat Input	Controls the operation of the unit.
P3	55, 50, 45, 40	Low Ambient Thermostat Pins	Provides selection of the Y2 compressor lock-in temperature. Valid options are 40, 45, 50 and 55 degrees Fahrenheit.
P4	DIS-YEL	Coil Sensor	(P4-5) Ground connection for outdoor coil temperature sensor. (P4-6) Connection for outdoor coil temperature sensor.
	AMB-BLACK	Ambient Sensor	(P4-3) Ground connection for outdoor ambient temperature sensor. (P4-4) Connection for outdoor ambient temperature sensor.
	COIL-BROWN	Discharge Sensor	*No discharge sensor is used; replaced by 10K resistor.*
P5	DELAY	Delay Mode	The demand defrost control has a field-selectable function to reduce occasional sounds that may occur while the unit is cycling in and out of the defrost mode. When a jumper is installed on the DELAY pins, the compressor will be cycled off for 30 seconds going in and out of the defrost mode. Units are shipped with jumper installed on DELAY pins. *NOTE - The 30 second off cycle is NOT functional when TEST pins on P1 are jumpered.*
P6	TST, PS DF, C, R, O, Y1, Y2	Factory Test Connectors	No field use.
DS1	RED LED	Diagnostic LED	Valid states for demand defrost control two LEDs are OFF, ON and FLASHING which indicate diagnostics conditions that are described in table 10.
DS2	GREEN LED		
FAN	TWO CONNECTORS	Condenser Fan Operation	These two connections provide power for the condenser fan.
O OUT	O OUT	24 VAC output	24 VAC output connection for reversing valve.
LO-PS	LO-PS	Low-Pressure Switch	When the low pressure switch trips, the demand defrost control will cycle off the compressor, and the strike counter in the demand defrost control will count one strike. The low pressure switch is ignored under the following conditions: • during the defrost cycle and 90 seconds after the termination of defrost • when the average ambient sensor temperature is below 0°F (-18°C) • for 90 seconds following the start up of the compressor • during TEST mode
Y2 OUT	Y2 OUT	24 VAC Output	24 VAC output for second stage compressor solenoid.
Y1 OUT	Y1 OUT	24 VAC Common Output	24 VAC common output, switched for enabling compressor contactor.
HS-PS	HS-PS	High-Pressure Switch	When the high pressure switch trips, the demand defrost control will cycle off the compressor, and the strike counter in the demand defrost control will count one strike.
L	L	Service Light Output	24VAC service light output.
24V	24V	24 Volt output	24VAC typically used to supply power to the Lennox System Operation Monitor (LSOM). Not used in this system.

DEMAND DEFROST CONTROL (A108) DIAGNOSTIC LEDS

The state (Off, On, Flashing) of two LEDs on the demand defrost control (DS1 [Red] and DS2 [Green]) indicate diagnostics conditions that are described in table 10.

Table 10. Demand Defrost Control (A108) Diagnostic LEDs

DS1 and DS2 System Status, Fault and Lockout Codes					
DS2 Green	**DS1 Red**	**Type**	**Condition/Code**	**Possible Cause(s)**	**Solution**
OFF	OFF	Status	Power problem	No power (24V) to demand defrost control terminals R and C or demand defrost control failure.	[1] Check control transformer power (24V). [2] If power is available to demand defrost control and LED(s) do not light, replace demand defrost control.
Simultaneous SLOW Flash		Status	Normal operation	Unit operating normally or in standby mode.	None required.
Alternating SLOW Flash		Status	5-minute anti-short cycle delay	Initial power up, safety trip, end of room thermostat demand.	None required (jumper **TEST** pins to override)
Simultaneous FAST Flash		Fault	Ambient Sensor Problem	Sensor being detected open or shorted or out of temperature range. Demand defrost control will revert to time/temperature defrost operation. (System will still heat or cool).	
Alternating FAST Flash		Fault	Coil Sensor Problem	Sensor being detected open or shorted or out of temperature range. Demand defrost control will not perform demand or time/temperature defrost operation. (System will still heat or cool).	
ON	ON	Fault	Demand Defrost Control Failure	Indicates that demand defrost control has internal component failure. Cycle 24VAC power to demand defrost control. If code does not clear, replace demand defrost control.	
OFF	SLOW Flash	Fault	Low Pressure Fault	[1] Restricted air flow over indoor or outdoor coil. [2] Improper refrigerant charge in system. [3] Improper metering device installed or incorrect operation of metering device. [4] Incorrect or improper sensor location or connection to system.	[1] Remove any blockages or restrictions from coils and/or fans. Check indoor and outdoor fan motor for proper current draws. [2] Check system charge using subcooling method. [3] Check system operating pressures and compare to unit subcooling tables in this instruction or located on unit access panel. [4] Make sure all pressure switches and sensors have secure connections to system to prevent refrigerant leaks or errors in pressure and temperature measurements.
OFF	ON	Lockout	Low Pressure Lockout		
SLOW Flash	OFF	Fault	High Pressure Fault		
ON	OFF	Lockout	High Pressure Lockout		
SLOW Flash	ON	Fault	Discharge Line Temperature Fault	This code detects shorted sensor or high discharge temperatures. If the discharge line temperature exceeds a temperature of 285ºF (140ºC) during compressor operation, the demand defrost control will de-energize the compressor contactor output (and the defrost output if active). The compressor will remain off until the discharge temperature has dropped below 225ºF (107ºC).	
FAST Flash	ON	Lockout	Discharge Line Temperature Lockout		
OFF	Fast Flash	Fault	Discharge Sensor Fault	The demand defrost control detects open sensor or out of temperature sensor range. This fault is detected by allowing the unit to run for 90 seconds before checking sensor resistance. If the sensor resistance is not within range after 90 seconds, the demand defrost control will count one fault. After 5 faults, the demand defrost control will lockout.	
Fast Flash	OFF	Lockout	Discharge Sensor Lockout		
(Each fault adds 1 strike to that code's counter; 5 strikes per code = LOCKOUT)					

High Pressure Switch (S4)

When the high pressure switch trips, the demand defrost control will cycle off the compressor, and the strike counter in the demand defrost control will count one strike. High Pressure (auto reset) - trip at 590 psig, reset at 418.

Low Pressure Switch (S87)

When the low pressure switch trips, the demand defrost control will cycle off the compressor, and the strike counter in the demand defrost control will count one strike. Low pressure switch (auto reset) - trip at 25 psig, reset at 40 psig.

The low pressure switch is ignored under the following conditions:

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

Ambient Sensor (RT13)

The ambient sensor considers outdoor temperatures below -35°F (-37°C) or above 120°F (48°C) as a fault. If the ambient sensor is detected as being open, shorted or out of the temperature range of the sensor, the demand defrost control will not perform demand defrost operation. The demand defrost control will revert to time/temperature defrost operation and will display the appropriate fault code. Heating and cooling operation will be allowed in this fault condition.

Coil Sensor (RT21)

Coil Sensor—The coil temperature sensor considers outdoor temperatures below -35°F (-37°C) or above 120°F (48°C) as a fault. If the coil temperature sensor is detected as being open, shorted or out of the temperature range of the sensor, the demand defrost control will not perform demand or time/temperature defrost operation and will display the appropriate fault code. Heating and cooling operation will be allowed in this fault condition.

High Discharge Temperature Sensor (RT28)

If the discharge line temperature exceeds a temperature of 285°F (140°C) during compressor operation, the demand defrost control will de-energize the compressor contactor output (and the defrost output, if active). The compressor will remain off until the discharge temperature has dropped below 225°F (107°C) and the 5-minute anti-short cycle delay has been satisfied. This sensor has two fault and lockout codes:

1. If the demand defrost control recognizes five high discharge line temperature faults during a single (Y1) compressor demand, it reverts to a lockout mode and displays the appropriate code. This code detects shorted sensor or high discharge temperatures. Code on demand defrost control is *Discharge Line Temperature Fault and Lockout*.
2. If the demand defrost control recognizes five temperature sensor range faults during a single (Y1) compressor demand, it reverts to a lockout mode and displays the appropriate code. The demand defrost control detects open sensor or out-of-temperature sensor range. This fault is detected by allowing the unit to run for 90 seconds before checking sensor resistance. If the sensor resistance is not within range after 90 seconds, the demand defrost control will count one fault. After five faults, the demand defrost control will lockout. Code on demand defrost control is *Discharge Sensor Fault and Lockout*.

The discharge line sensor, which covers a range of 150°F (65°C) to 350°F (176°C), is designed to mount on a ½" refrigerant discharge line.

NOTE - Within a single room thermostat demand, if 5-strikes occur, the demand defrost control *will lockout the unit.* demand defrost control *24 volt power R must be cycled OFF or the TEST pins on demand defrost control must be shorted between 1 to 2 seconds to reset the* demand defrost control*.*

Crankcase Heater (HR1) and Crankcase Thermostat Switch (S40)

The reference models are equipped with a 70 watt, belly band type crankcase heater. HR1 prevents liquid from accumulating in the compressor. HR1 is controlled by a thermostat located on the liquid line. When liquid line temperature drops below 50° F the thermostat closes energizing HR1. The thermostat will open, de-energizing HR1 once liquid line temperature reaches 70° F .

Liquid Line Bi-Flow Filter Drier

The unit is equipped with a large-capacity biflow filter drier which keeps the system clean and dry. If replacement is necessary, order another of like design and capacity. The replacement filter drier must be suitable for use with HFC-410A refrigerant.

The replacement filter drier must be suitable for use with HFC-410A refrigerant.

SECOND-STAGE OPERATION

If the demand defrost control (A108) receives a call for second-stage compressor operation Y2 in heating or cooling mode and the first-stage compressor output is active, the second-stage compressor solenoid output will be energized.

If first-stage compressor output is active in heating mode and the outdoor ambient temperature is below the selected compressor lock-in temperature, the second-stage compressor solenoid output will be energized without the Y2 input. If the jumper is not connected to one of the temperature selection pins on **P3** (40, 45, 50, 55°F), the default lock-in temperature of 40°F (4.5°C) will be used.

The demand defrost control de-energizes the second-stage compressor solenoid output immediately when the Y2 signal is removed or the outdoor ambient temperature is 5°F above the selected compressor lock-in temperature, or the first-stage compressor output is de-energized for any reason.

Defrost System

This section addresses:

- Emergency Heat
- Defrost System Overview
- Defrost Control Connections, Jumper Settings and Features
- Operational Mode Overview (Calibration, Normal and Defrost)
- Defrost Cycle Actuation

EMERGENCY HEAT (AMBER LIGHT)

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

Emergency heat is usually used during an outdoor unit shutdown, 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 (10°C). System should be left in the emergency heat mode at least six hours to allow the crankcase heater sufficient time to prevent compressor slugging.

DEFROST SYSTEM OVERVIEW

The control monitors ambient temperature, outdoor coil temperature, and total run time to determine when a defrost cycle is required. The coil temperature probe is designed with a spring clip to allow mounting to the outside coil tubing. The location of the coil sensor is important for proper defrost operation.

NOTE - The demand defrost control accurately measures the performance of the system as frost accumulates on the outdoor coil. This typically will translate into longer running time between defrost cycles as more frost accumulates on the outdoor coil before the demand defrost control *initiates defrost cycles.*

DEFROST CONTROL CONNECTIONS, JUMPERS SETTINGS AND FEATURES

Pressure Switch 5-Strike Lockout

The internal control logic of the demand defrost control counts the pressure switch trips only while the Y1 (Input) line is active. If a pressure switch opens and closes four times during a Y1 (Input), the control logic will reset the pressure switch trip counter to zero at the end of the Y1 (Input). If the pressure switch opens for a fifth time during the current Y1 (Input), the control will enter a lockout condition.

The 5-strike pressure switch lockout condition can be reset by cycling OFF the 24-volt power to the demand defrost control or by shorting the **TEST** pins between 1 to 2 seconds. All timer functions (run times) will also be reset.

If a pressure switch opens while the Y1 Out line is engaged, a 5-minute short cycle will occur after the switch closes.

Demand Defrost Control Pressure Switch Connections

The unit's automatic reset pressure switches (LO PS - S87 and HI PS - S4) are factory-wired into the demand defrost control on the LO-PS and HI-PS terminals, respectively.

Demand Defrost Control Sensors

Sensors connect to the demand defrost control through a field-replaceable harness assembly that plugs into the demand defrost control as illustrated in figure 1. Through the sensors, the demand defrost control detects outdoor ambient, coil, and discharge temperature fault conditions. As the detected temperature changes, the resistance across the sensor changes.

Testing Demand Defrost Control Sensors

Sensor resistance values can be checked by ohming across pins shown in table 11.

Table 11. Sensor Temperature /Resistance Range

Sensor	Temperature Range °F (°C)	Resistance values range (ohms)	Pins/Wire Color
Outdoor	-35 (-37) to 120 (48)	280,000 to 3750	3 & 4 (Black)
Coil	-35 (-37) to 120 (48)	280,000 to 3750	5 & 6 (Brown)
Discharge (if applicable)	24 (-4) to 350 (176)	41,000 to 103	1 & 2 (Yellow)
Note: Sensor resistance increases as sensed temperature decreases.			

Tables 12 and 13 shows how the resistance varies as the temperature changes for various types of sensors.

NOTE - When checking the ohms across a sensor, be aware that a sensor showing a resistance value that is not within the range shown in table 11, may be performing as designed. However, if a shorted or open circuit is detected, then the sensor may be faulty and the sensor harness will need to be replaced.

Defrost Temperature Termination Jumper Settings (P1)

The demand defrost control selections are: 50, 70, 90, and 100°F (10, 21, 32 and 38°C). The shunt termination pin is factory set at 50°F (10°C). If temperature shunt is not installed, default termination temperature is 90°F (32°C).

Test Pins (P1) Function

Placing the jumper on the field test pins (P1) allows the technician to:

- Clear short cycle lockout
- Clear five-strike fault lockout
- Cycle the unit in and out of defrost mode
- Place the unit in defrost mode to clear the coil

See figure 27 for flowchart of test pin (P1) operations.

Compressor Delay Mode (P5)

The demand defrost control has a field-selectable function to reduce occasional sounds that may occur while the unit is cycling in and out of the defrost mode. When a jumper is installed on the **DELAY** pins, the compressor will be cycled off for 30 seconds going in and out of the defrost mode. Units are shipped with jumper installed on **DELAY** pins.

NOTE - The 30 second off cycle is NOT functional when jumpering the TEST pins.

OPERATIONAL MODE OVERVIEW

The demand defrost control has three basic operational modes. Those modes are:

1. **Calibration Mode** — The demand defrost control is considered uncalibrated when power is applied to the demand defrost control, after cool mode operation, or if the coil temperature exceeds the termination temperature when it is in heat mode (see figure 26 for further details).
2. **Normal Mode** — The demand defrost control monitors the **O** line, to determine the system operating mode (heat/cool), outdoor ambient temperature, coil temperature (outdoor coil) and compressor run time to determine when a defrost cycle is required.

   Calibration of the demand defrost control occurs after a defrost cycle to ensure that there is no ice on the coil. During calibration, the temperature of both the coil and the ambient sensor are measured to establish the temperature differential which is required to allow a defrost cycle.
3. **Defrost Mode** — The following paragraphs provide a detailed description of the defrost system operation.

DEFROST CYCLE ACTUATION

The demand defrost control initiates a defrost cycle based on either frost detection or time.

1. **Frost Detection** — If the compressor runs longer than 30 minutes and the actual difference between the clear coil and frosted coil temperatures exceeds the maximum difference allowed by the demand defrost control, a defrost cycle will be initiated.
2. **Time** — If six hours of heating mode compressor run time has elapsed since the last defrost cycle while the coil temperature remains below 35°F (2°C), the demand defrost control will initiate a defrost cycle.

Actuation

When the reversing valve is de-energized, the Y1 circuit is energized, and the coil temperature is below 35°F (2°C), the demand defrost control logs the compressor run time. If the demand defrost control is not calibrated, a defrost cycle will be initiated after 30 minutes of heating mode compressor run time. The control will attempt to self-calibrate after this (and all other) defrost cycle(s).

Calibration success depends on stable system temperatures during the 20-minute calibration period. If the demand defrost control fails to calibrate, another defrost cycle will be initiated after 45 minutes of heating mode compressor run time. Once the demand defrost control is calibrated, it initiates a demand defrost cycle when the difference between the clear coil and frosted coil temperatures exceeds the maximum difference allowed by the control or after six hours of heating mode compressor run time has been logged since the last defrost cycle.

Termination

The defrost cycle ends when the coil temperature exceeds the termination temperature or after 14 minutes of defrost operation. If the defrost is terminated by the 14-minute timer, another defrost cycle will be initiated after 30 minutes of run time.

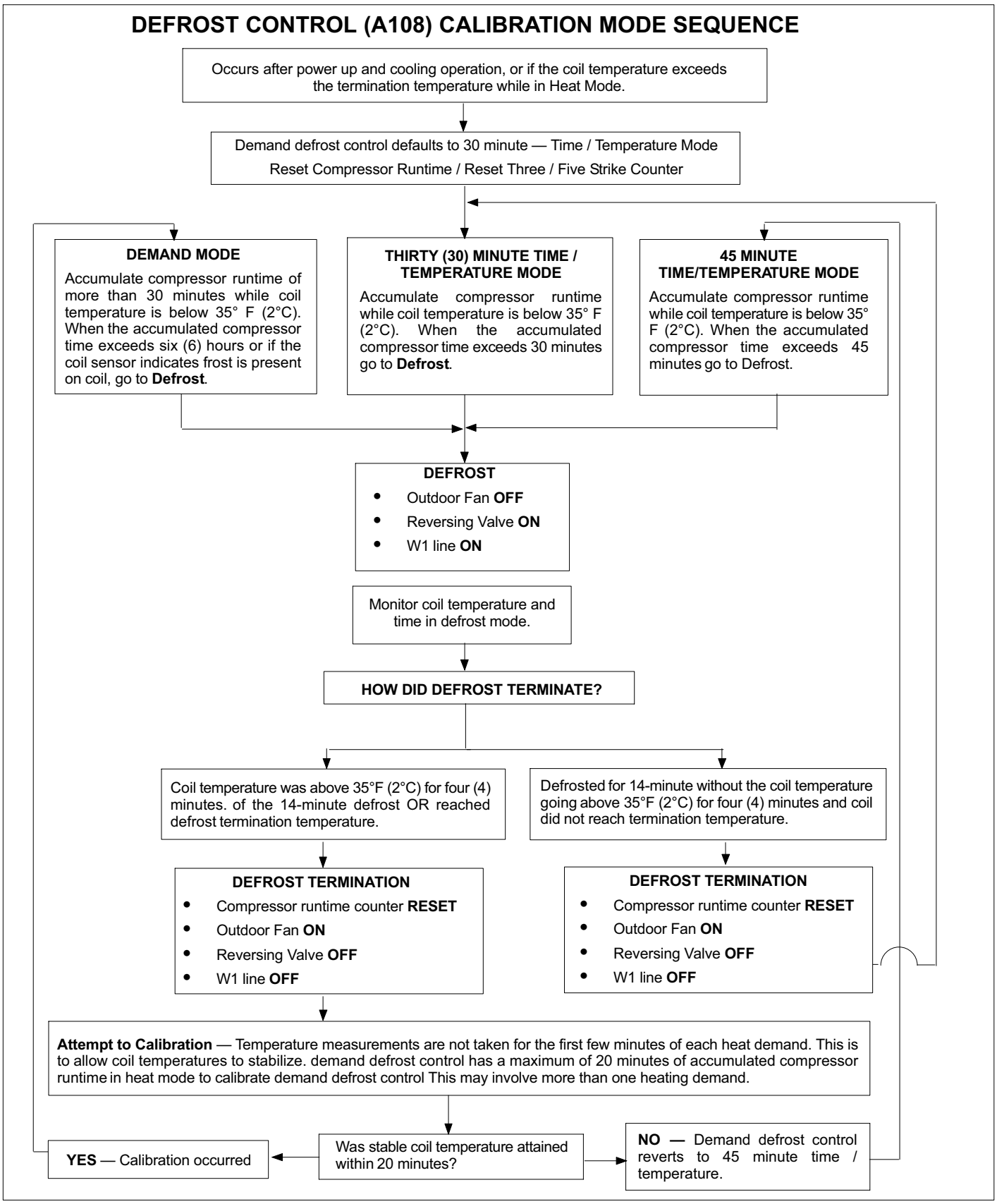


Figure 26. Defrost Calibration

Table 12. Ambient (RT13) and Coil (RT21) Sensors Temperature / Resistance Range

Degrees Fahrenheit	Resistance	Degrees Fahrenheit	Resistance	Degrees Fahrenheit	Resistance	Degrees Fahrenheit	Resistance
136.3	2680	56.8	16657	21.6	44154	-11.3	123152
133.1	2859	56.0	16973	21.0	44851	-11.9	125787
130.1	3040	55.3	17293	20.5	45560	-12.6	128508
127.3	3223	54.6	17616	20.0	46281	-13.2	131320
124.7	3407	53.9	17942	19.4	47014	-13.9	134227
122.1	3592	53.2	18273	18.9	47759	-14.5	137234
119.7	3779	52.5	18607	18.4	48517	-15.2	140347
117.5	3968	51.9	18945	17.8	49289	-15.9	143571
115.3	4159	51.2	19287	17.3	50074	-16.5	146913
113.2	4351	50.5	19633	16.8	50873	-17.2	150378
111.2	4544	49.9	19982	16.3	51686	-17.9	153974
109.3	4740	49.2	20336	15.7	52514	-18.6	157708
107.4	4937	48.5	20695	15.2	53356	-19.3	161588
105.6	5136	47.9	21057	14.7	54215	-20.1	165624
103.9	5336	47.3	21424	14.1	55089	-20.8	169824
102.3	5539	46.6	21795	13.6	55979	-21.5	174200
100.6	5743	46.0	22171	13.1	56887	-22.3	178762
99.1	5949	45.4	22551	12.5	57811	-23.0	183522
97.6	6157	44.7	22936	12.0	58754	-23.8	188493
96.1	6367	44.1	23326	11.5	59715	-24.6	193691
94.7	6578	43.5	23720	11.0	60694	-25.4	199130
93.3	6792	42.9	24120	10.4	61693	-26.2	204829
92.0	7007	42.3	24525	9.9	62712	-27.0	210805
90.6	7225	41.7	24934	9.3	63752	-27.8	217080
89.4	7444	41.1	25349	8.8	64812	-28.7	223677
88.1	7666	40.5	25769	8.3	65895	-29.5	230621
86.9	7890	39.9	26195	7.7	67000	-30.4	237941
85.7	8115	39.3	26626	7.2	68128	-31.3	245667
84.5	8343	38.7	27063	6.7	69281	-32.2	253834
83.4	8573	38.1	27505	6.1	70458	-33.2	262482
82.3	8806	37.5	27954	5.6	71661	-34.1	271655
81.2	9040	37.0	28408	5.0	72890	-35.1	281400
80.1	9277	36.4	28868	4.5	74147	-36.1	291774
79.0	9516	35.8	29335	3.9	75431	-37.1	302840
78.0	9757	35.2	29808	3.4	76745	-38.2	314669
77.0	10001	34.7	30288	2.8	78090	-39.2	327343
76.0	10247	34.1	30774	2.3	79465		
75.0	10496	33.5	31267	1.7	80873		
74.1	10747	33.0	31766	1.2	82314		
73.1	11000	32.4	32273	0.6	83790		
72.2	11256	31.9	32787	0.0	85302		
71.3	11515	31.3	33309	-0.5	86852		
70.4	11776	30.7	33837	-1.1	88440		
69.5	12040	30.2	34374	-1.7	90068		
68.6	12306	29.6	34918	-2.2	91738		
67.7	12575	29.1	35471	-2.8	93452		
66.9	12847	28.6	36031	-3.4	95211		
66.0	13122	28.0	36600	-4.0	97016		
65.2	13400	27.5	37177	-4.6	98870		
64.4	13681	26.9	37764	-5.2	100775		
63.6	13964	26.4	38359	-5.7	102733		
62.8	14251	25.8	38963	-6.3	104746		
62.0	14540	25.3	39577	-6.9	106817		
61.2	14833	24.8	40200	-7.5	108948		
60.5	15129	24.2	40833	-8.2	111141		
59.7	15428	23.7	41476	-8.8	113400		
59.0	15730	23.2	42130	-9.4	115727		
58.2	16036	22.6	42794	-10.0	118126		
57.5	16345	22.1	43468	-10.6	120600		

Table 13. High Discharge Sensor (RT28) Temperature / Resistance Range

Degrees Fahrenheit	Resistance	Degrees Fahrenheit	Resistance	Degrees Fahrenheit	Resistance	Degrees Fahrenheit	Resistance
303.1	183	186.1	1052	136.8	2656	94.5	6613
298.1	195	185.0	1072	136.0	2698	93.6	6739
293.4	207	183.9	1093	135.2	2740	92.8	6869
289.0	220	182.8	1114	134.5	2783	92.0	7002
284.8	232	181.8	1135	133.7	2827	91.2	7139
280.9	245	180.7	1157	132.9	2872	90.3	7281
277.1	258	179.6	1179	132.2	2917	89.5	7426
273.6	270	178.6	1201	131.4	2963	88.6	7575
270.2	283	177.6	1223	130.6	3010	87.8	7729
267.0	297	176.6	1245	129.9	3057	86.9	7888
263.9	310	175.5	1268	129.1	3105	86.0	8051
260.9	323	174.6	1291	128.4	3154	85.2	8220
258.1	336	173.6	1315	127.6	3204	84.3	8394
255.3	350	172.6	1338	126.8	3255	83.4	8574
252.7	364	171.6	1362	126.1	3307	82.5	8759
250.1	378	170.6	1386	125.3	3359	81.6	8951
247.7	391	169.7	1411	124.6	3413	80.7	9149
245.3	405	168.7	1435	123.8	3467	79.8	9354
243.0	420	167.8	1460	123.1	3523	78.8	9566
240.8	434	166.9	1486	122.3	3579	77.9	9786
238.6	448	165.9	1511	121.6	3637	76.9	10013
236.5	463	165.0	1537	120.8	3695	76.0	10250
234.4	478	164.1	1563	120.1	3755	75.0	10495
232.4	492	163.2	1590	119.3	3816	74.1	10749
230.5	507	162.3	1617	118.5	3877	73.1	11014
228.6	523	161.4	1644	117.8	3940	72.1	11289
226.7	538	160.5	1672	117.0	4005	71.1	11575
224.9	553	159.7	1699	116.3	4070	70.0	11873
223.2	569	158.8	1728	115.5	4137	69.0	12184
221.5	584	157.9	1756	114.8	4205	68.0	12509
219.8	600	157.1	1785	114.0	4274	66.9	12848
218.1	616	156.2	1815	113.2	4345	65.8	13202
216.5	632	155.3	1845	112.5	4418	64.7	13573
214.9	649	154.5	1875	111.7	4491	63.6	13961
213.4	665	153.6	1905	111.0	4567	62.5	14368
211.9	682	152.8	1936	110.2	4644	61.3	14796
210.4	698	152.0	1968	109.4	4722	60.2	15246
208.9	715	151.1	1999	108.7	4802	59.0	15719
207.5	732	150.3	2032	107.9	4884	57.8	16218
206.0	750	149.5	2064	107.1	4968	56.6	16744
204.6	767	148.7	2098	106.4	5054	55.3	17301
203.3	785	147.9	2131	105.6	5141	54.0	17891
201.9	803	147.1	2165	104.8	5231	52.7	18516
200.6	821	146.2	2200	104.0	5323	51.4	19180
199.3	839	145.4	2235	103.3	5416	50.0	19887
198.0	857	144.6	2270	102.5	5512	48.6	20641
196.8	876	143.8	2306	101.7	5610	47.2	21448
195.5	894	143.0	2343	100.9	5711	45.7	22311
194.3	913	142.3	2380	100.1	5814		
193.1	932	141.5	2418	99.3	5920		
191.9	952	140.7	2456	98.5	6028		
190.7	971	139.9	2495	97.7	6139		
189.5	991	139.1	2534	96.9	6253		
188.4	1011	138.3	2574	96.1	6370		
187.2	1031	137.6	2615	95.3	6489		

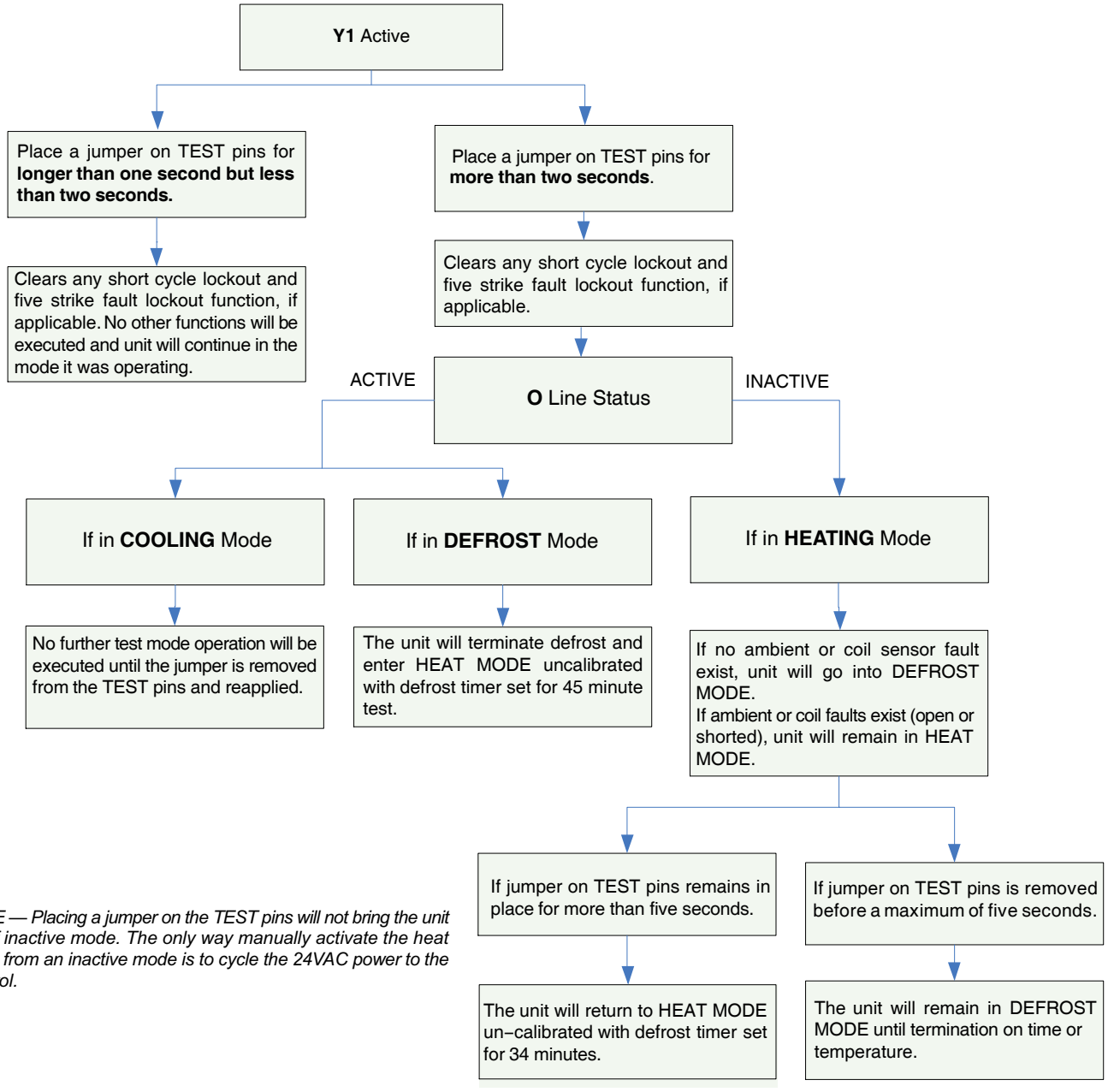
TEST

Placing the jumper on the field test pins (P1) allows the technician to:

- Clear short cycle lockout
- Clear five-strike fault lockout
- Cycle the unit in and out of defrost mode
- Place the unit in defrost mode to clear the coil

When **Y1** is energized and 24V power is being applied to the Control, a test cycle can be initiated by placing a jumper on the Control's **TEST** pins for 2 to 5 seconds. If the jumper remains on the **TEST** pins for longer than five seconds, the Control will ignore the jumpered TEST pins and revert to normal operation.

The Control will initiate one test event each time a jumper is placed on the TEST pins. For each TEST the jumper must be removed for at least one second and then reapplied.



NOTE — Placing a jumper on the TEST pins will not bring the unit out of inactive mode. The only way manually activate the heat pump from an inactive mode is to cycle the 24VAC power to the Control.

Figure 27. Test Pin (P1) Functions

Two-Stage Modulation Compressors Checks

Use this checklist on page 42 to verify part-load and full-load capacity operation of two-stage modulation compressors.

TOOLS REQUIRED

- Refrigeration gauge set
- Digital volt/amp meter
- Electronic temperature thermometer
- On-off toggle switch

⚠ IMPORTANT

This performance check is ONLY valid on systems that have clean indoor and outdoor coils, proper airflow over coils, and correct system refrigerant charge. All components in the system must be functioning proper to correctly perform compressor modulation operational check. (Accurate measurements are critical to this test as indoor system loading and outdoor ambient can affect variations between low and high capacity readings).

PROCEDURE

NOTE - Block outdoor coil to maintain a minimum of 375 psig during testing).

1. Turn main power **OFF** to outdoor unit.
2. Adjust room thermostat set point **5ºF** above the room temperature.
3. Remove control access panel. Install refrigeration gauges on unit. Attach the amp meter to the common (black wire) wire of the compressor harness. Attach thermometer to discharge line as close as possible to the compressor.
4. Turn toggle switch **OFF** and install switch in series with Y2 wire from room thermostat.
5. Cycle main power **ON**.
6. Allow pressures and temperatures to stabilize before taking measurements (may take up to 10 minutes).
7. Record all of the readings for the Y1 demand.
8. Close switch to energize Y2 demand. Verify power is going to compressor solenoid.
9. Allow pressures and temperatures to stabilize before taking measurements (may take up to 10 minutes).
10. Record all of the readings with the Y1 and Y2 demand.
11. If temperatures and pressures change in the direction noted in Two-Stage Modulation Compressor Field Operational Checklist on page 42, the compressor is properly modulating from low to high capacity. (If no amperage, pressures or temperature readings change when this test is performed, the compressor is not modulating between low and high capacity and replacement is necessary).
12. After testing is complete, return unit to original set up.

Maintenance

DEALER

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

Outdoor Unit

1. Clean and inspect outdoor coil (may be flushed with a water hose). Ensure power is off before cleaning.
2. Outdoor unit fan motor is pre-lubricated and sealed. No further lubrication is needed.
3. Visually inspect all connecting lines, joints and coils for evidence of oil leaks.
4. Check all wiring for loose connections.
5. Check for correct voltage at unit (unit operating).
6. Check amp draw on outdoor fan motor.

   Motor Nameplate:_____ **Actual**:_____.
7. Inspect drain holes in coil compartment base and clean if necessary.

NOTE - If insufficient heating or cooling occurs, the unit should be gauged and refrigerant charge should be checked.

Outdoor Coil

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 (e.g., pet urine, cottonwood seeds, fertilizers, fluids that may contain high levels of corrosive chemicals such as salts)

- Outdoor Coil — The outdoor coil may be flushed with a water hose.
- Outdoor Coil (Sea Coast) — Moist air in ocean locations can carry salt, which is corrosive to most metal. Units that are located near the ocean require frequent inspections and maintenance. These inspections will determine the necessary need to wash the unit including the outdoor coil. Consult your installing contractor for proper intervals/procedures for your geographic area or service contract.

Indoor Unit

1. Clean or change filters.
2. Lennox blower motors are prelubricated and permanently sealed. No more lubrication is needed.
3. Adjust blower speed for cooling. Measure the pressure drop over the coil to determine the correct blower CFM. Refer to the unit information service manual for pressure drop tables and procedure.
4. *Belt Drive Blowers* - Check belt for wear and proper tension.
5. Check all wiring for loose connections.
6. Check for correct voltage at unit. (blower operating)
7. Check amp draw on blower motor.

   Motor Nameplate:_____ **Actual**:_____.

Indoor Coil

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

HOMEOWNER

Cleaning of the outdoor unit's coil should be performed by a trained service technician. Contact your dealer and set up a schedule (preferably twice a year, but at least once a year) to inspect and service your outdoor unit. The following maintenance may be performed by the homeowner.

⚠ IMPORTANT

Sprinklers and soaker hoses should not be installed where they could cause prolonged exposure to the outdoor unit by treated water. Prolonged exposure of the unit to treated water (i.e., sprinkler systems, soakers, waste water, etc.) will corrode the surface of steel and aluminum parts and diminish performance and longevity of the unit.

Outdoor Coil

The outdoor unit must be properly maintained to ensure its proper operation.

- Please contact your dealer to schedule proper inspection and maintenance for your equipment.
- Make sure no obstructions restrict airflow to the outdoor unit.
- Grass clippings, leaves, or shrubs crowding the unit can cause the unit to work harder and use more energy.
- Keep shrubbery trimmed away from the unit and periodically check for debris which collects around the unit.

Cleaning of the outdoor unit's coil should be performed by a trained service technician. Contact your dealer and set up a schedule (preferably twice a year, but at least once a year) to inspect and service your outdoor unit.

Routine Maintenance

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.

1. **Air Filter —** Ask your Lennox dealer to show you where your 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.
2. **Disposable Filter —** Disposable filters should be replaced with a filter of the same type and size.

NOTE — If you are unsure about the filter required for your system, call your Lennox dealer for assistance.

3. **Reusable Filter —** Many indoor units are equipped with reusable foam filters. Clean foam filters with a mild soap and water solution; rinse thoroughly; allow filter to dry completely before returning it to the unit or grille.

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

4. **Indoor Unit —** The indoor unit's evaporator coil is equipped with a drain pan to collect condensate formed as your 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 would also apply to an auxiliary drain, if installed.)

Thermostat Operation

See the thermostat homeowner manual for instructions on how to operate your thermostat.

Heat Pump Operation

Your new Lennox heat pump has several characteristics that 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- or oil-fired furnaces or an electric furnace 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 (7°C). An electronic control activates a defrost cycle lasting 5 to 15 minutes at preset intervals to clear the outdoor coil of the frost.
- During the defrost cycle, you may notice steam rising from the outdoor unit. This is a normal occurrence. The thermostat may engage auxiliary heat during the defrost cycle to satisfy a heating demand; however, the unit will return to normal operation at the conclusion of the defrost cycle.

Extended Power Outage

The heat pump is equipped with a compressor crankcase heater which protects the compressor from refrigerant *slugging* during cold weather operation.

If power to your unit has been interrupted for several hours or more, set the room thermostat selector to the EMERGENCY HEAT setting to obtain temporary heat without the risk of serious damage to the heat pump.

In EMERGENCY HEAT mode, all heating demand is satisfied by auxiliary heat; heat pump operation is locked out. After a six-hour compressor crankcase warm-up period, the thermostat can be switched to the HEAT setting and normal heat pump operation may resume.

Preservice Check

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

- Verify room thermostat settings are correct.
- Verify that all electrical disconnect switches are ON.
- Check for any blown fuses or tripped circuit breakers.
- Verify unit access panels are in place.
- Verify air filter is clean.
- If service is needed, locate and write down the unit model number and have it handy before calling.

Accessories

For update-to-date information, see any of the following publications:

- Lennox XP16 Engineering Handbook
- Lennox Product Catalog
- Lennox Price Book

Checklists

Two-Stage Modulation Compressors Field Operational Checklist

Unit Readings	Y1 - First-Stage	Expected results during Y2 demand (Toggle switch On)	Y2 - Second-Stage
COMPRESSOR			
Voltage		Same	
Amperage		Higher	
OUTDOOR UNIT FAN MOTOR			
Amperage		Same or Higher	
TEMPERATURE			
Ambient		Same	
Outdoor Coil Discharge Air		Higher	
Compressor Discharge Line		Higher	
Indoor Return Air		Same	
Indoor Coil Discharge Air		Lower	
PRESSURES			
Suction (Vapor)		Lower	
Liquid		Higher	

XP16 Start-Up and Performance

Customer _____ Address _____

Indoor Unit Model _____ Serial _____

Outdoor Unit Model _____ Serial _____

Notes: _____

_____

START UP CHECKS

Refrigerant Type: _____

1st Stage: Rated Load Amps _____ Actual Amps _____ Rated Volts _____ Actual Volts _____

2nd Stage: Rated Load Amps _____ Actual Amps _____ Rated Volts _____ Actual Volts _____

Outdoor Unit Fan Full Load Amps _____ Actual Amps: 1st Stage _____ 2nd Stage _____

COOLING MODE

Suction Pressure: 1st Stage: _____ 2nd Stage: _____

Liquid Pressure: 1st Stage: _____ 2nd Stage: _____

Supply Air Temperature: 1st Stage: _____ 2nd Stage: _____

Temperature: Ambient: _____ Return Air: _____

System Refrigerant Charge (Refer to manufacturer's information on unit or installation instructions for required subcooling and approach temperatures.)

Subcooling:	A		B	SUBCOOLING
Saturated Condensing Temperature (A) *minus* Liquid Line Temperature (B)		—		=
Approach:	A		B	APPROACH
Liquid Line Temperature (A) *minus* Outdoor Air Temperature (B)		—		=
Indoor Coil Temperature Drop (18 to 22°F)	A		B	COIL TEMP DROP
Return Air Temperature (A) *minus* Supply Air Temperature (B)		—		=