

INSTALLATION INSTRUCTIONS

⚠ WARNING

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

⚠ CAUTION

Danger of sharp metallic edges. Can cause injury. Take care when servicing unit to avoid accidental contact with sharp edges.

KHA180 (15-TON) KHA240 (20-TON)

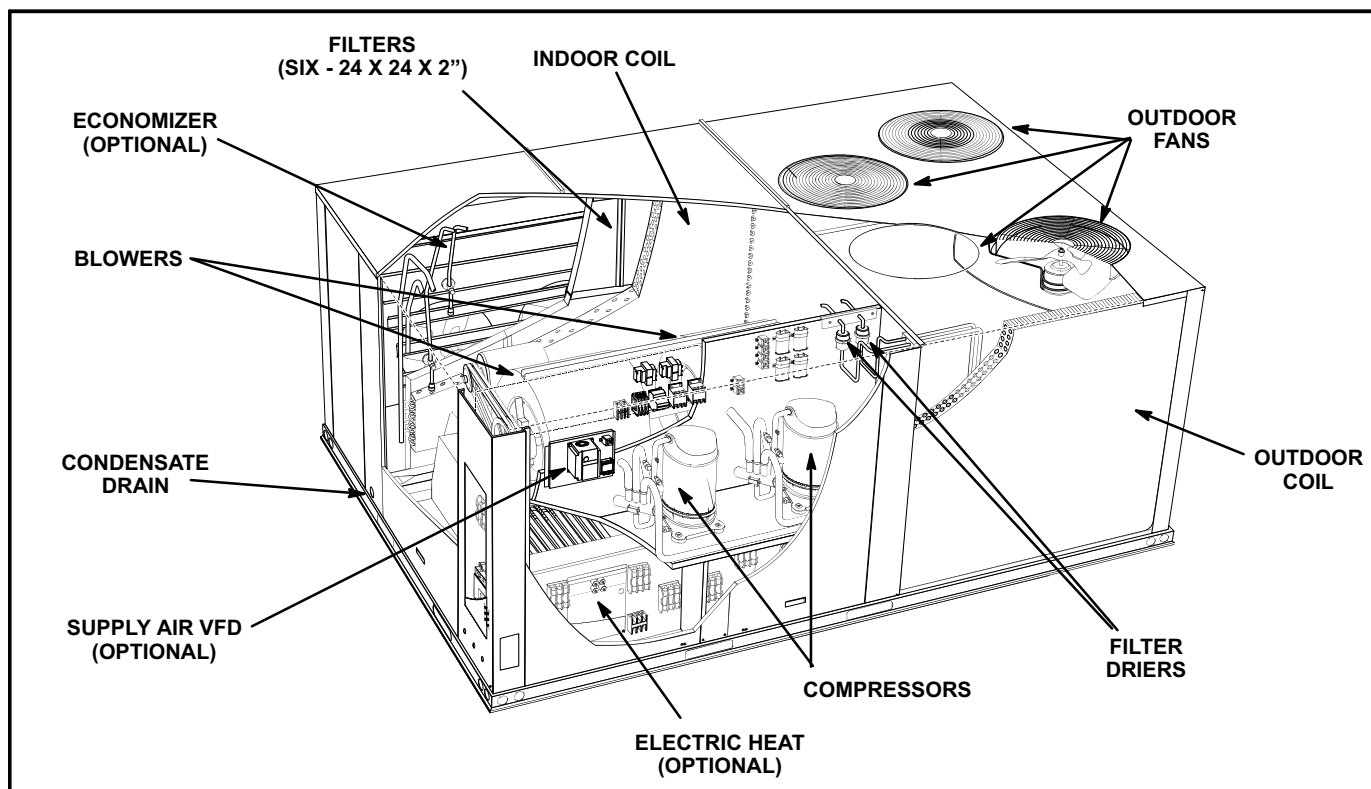
HEAT PUMP UNITS
506916-01
4/2012
Supersedes 1/2012

**RETAIN THESE INSTRUCTIONS
FOR FUTURE REFERENCE**

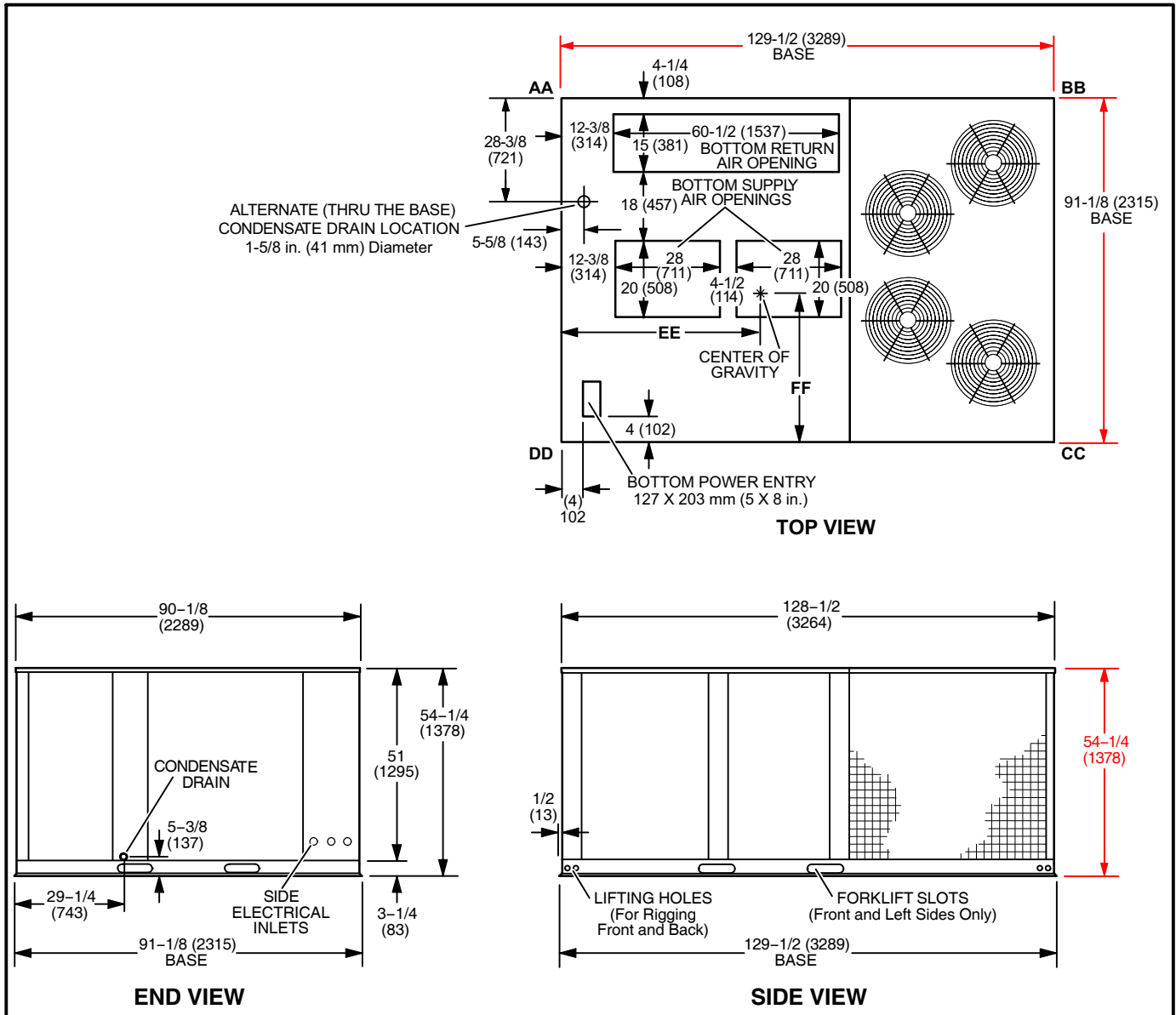
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KHA180 & 240 Parts Arrangement



KHA180 & 240 Dimensions



Shipping and Packing List

Package 1 of 1 contains:

- 1- Assembled unit

Check unit for shipping damage. Receiving party should contact last carrier immediately if shipping damage is found.

General

These instructions are intended as a general guide and do not supersede local codes in any way. Authorities having jurisdiction should be consulted before installation.

KHA units have 15- and 20-ton cooling capacities. Optional electric heat is available.

Optional Multi-Stage Air Volume (MSAV™) units are available. The blower will operate at lower speeds when cooling demand is low and increase to higher speeds when cooling demand is high. Refer to MSAV™ Start-Up section.

Availability of units and options varies by brand.

Requirements

The KHA unit is ETL certified for outdoor installations only at the clearances to combustibles listed on unit nameplate and in figure 1.

Installation of KHA heat pumps must conform with standards in National Fire Protection Association (NFPA) "Standard for Installation of Air Conditioning and Ventilating Systems NFPA No. 90A," "Standard for

Installation of Residence Type Warm Air Heating and Air conditioning Systems NFPA No. 90B," local municipal building codes and manufacturer's installation instructions.

The National Electric Code (ANSI/NFPA No. 70-1984) is available from:

National Fire Protection Association
470 Atlantic Avenue
Boston, MA 02210

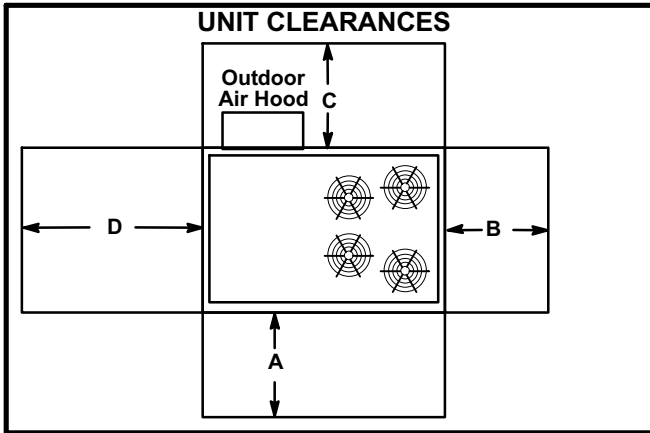


FIGURE 1

¹ Unit Clearance	A in.(mm)	B in.(mm)	C in.(mm)	D in.(mm)	Top Clearance
Service Clearance	45 (1143)	36 (914)	36 (914)	66 (1676)	Unob- structed
Minimum Opera- tion Clearance	45 (1143)	36 (914)	36 (914)	41 (1041)	Unob- structed

Note - Entire perimeter of unit base requires support when elevated above mounting surface.

¹ **Service Clearance** - Required for removal of serviceable parts.

Minimum Operation Clearance - Required clearance for proper unit operation.

The KHA unit is ETL/CSA certified as a heat pump with cooling and with or without auxiliary electric heat for non-residential use only at the clearances to combustible materials as listed on the unit nameplate and in figure 1.

Installation of ETL/CSA certified units must conform with current standard C273.5 "Installation Requirements for Heat Pumps" and applicable local codes. Authorities having jurisdiction should be consulted before installation.

Use of this unit as a construction heater or air conditioner is not recommended during any phase of construction. Very low return air temperatures, harmful vapors and operation of the unit with clogged or misplaced filters will damage the unit.

If this unit has been used for heating or cooling of buildings or structures under construction, the following conditions must be met or the warranty will be void:

- A room thermostat must control the unit. The use of fixed jumpers that will provide continuous heating or cooling is not allowed.
- A pre-filter must be installed at the entry to the return air duct.
- The return air duct must be provided and sealed to the unit.
- Return air temperature range between 55°F (13°C) and 80°F (27°C) must be maintained.
- Air filters must be replaced and pre-filter must be removed upon construction completion.
- The unit components, duct system, air filters and evaporator coil must be thoroughly cleaned following final construction clean-up.
- The unit operating conditions (including airflow, cooling operation, and heating operation) must be verified according to these installation instructions.

⚠ WARNING

Electric shock hazard and danger of explosion. Can cause injury, death or product or property damage. Turn off gas and electrical power to unit before performing any maintenance or servicing operations on the unit. Follow lighting instructions attached to unit when putting unit back into operation and after service or maintenance.

⚠ NOTICE

Roof Damage!
This system contains both refrigerant and oil. Some rubber roofing material may absorb oil, causing the rubber to swell. Bubbles in the rubber roofing material can 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.

⚠ IMPORTANT

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

Unit Support

NOTE - Securely fasten roof frame to roof per local codes.

A-Downflow Discharge Application

Roof Mounting with LARMF18/36

- 1- The LARMF18/36 roof mounting frame must be installed, flashed and sealed in accordance with the instructions provided with the frame.
- 2- The LARMF18/36 roof mounting frame should be square and level to 1/16" per linear foot (5mm per linear meter) in any direction.
- 3- Duct must be attached to the roof mounting frame and not to the KHA unit; supply and return plenums must be installed before setting the unit.
- 4- Trim and discard any pieces of exposed insulation which extend past the edges of the roof mounting frame.

Installer's Roof Mounting Frame

Many types of roof frames can be used to install the KHA unit, depending upon different roof structures. Items to keep in mind when using the building frame or supports are:

- 1- The KHA base is fully enclosed and insulated, so an enclosed frame is not required.
- 2- The frames or supports must be constructed with non-combustible materials and should be square and level to 1/16" per linear foot (5mm per linear meter) in any direction.
- 3- Frame or supports must be high enough to prevent any form of moisture from entering unit. Recommended minimum frame height is 14" (356mm).
- 4- Duct must be attached to the roof mounting frame and not to the KHA unit. Supply and return plenums must be installed before setting the unit.
- 5- Units require support along all four sides of unit base. Supports must be constructed of steel or suitably treated wood materials.

NOTE-When installing an KHA unit on a combustible surface for downflow discharge applications, the LARMF18/36 roof mounting frame is required.

B-Horizontal Discharge Applications

- 1- Units installed in horizontal airflow applications must use an LARMFH18/36 horizontal roof mounting frame. The supply air duct connects to the horizontal supply air opening on the LARMFH18/36. The return air duct connects to the unit horizontal return air opening. Refer to unit dimensions.
- 2- Specified installation clearances must be maintained when installing KHA units. Refer to figure 1.

- 3- Top of support slab should be at least 4" (102mm) above the finished grade and located so no run-off water from higher ground can collect around the unit.
- 4- Units require support along all four sides of unit base. Supports must be constructed of steel or suitably treated wood materials.

Duct Connection

All exterior ducts, joints, and openings in roof or building walls must be insulated and weatherproofed with flashing and sealing compounds in accordance with applicable codes. Any duct passing through an unconditioned space must be insulated.

! CAUTION

In downflow applications, do not drill or punch holes in base of unit. Leaking in roof may occur if unit base is punctured.

Rigging Unit For Lifting

- 1- Detach wooden base protection before rigging.
- 2- Connect rigging to the unit base using both holes in each corner. See figure 2.
- 3- All panels must be in place for rigging.
- 4- Place field-provided H-style pick in place just above top edge of unit. Frame must be of adequate strength and length. (H-style pick prevents damage to top of unit.)

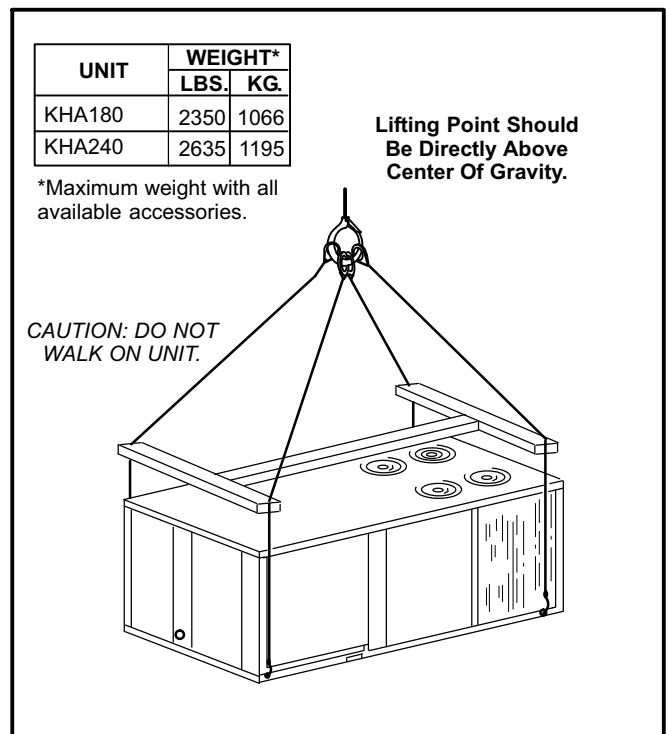


FIGURE 2

Condensate Drains

Remove plug and make drain connection to the 1" N.P.T. drain coupling provided on unit. A trap must be installed between drain connection and an open vent for proper condensate removal. See figure 3 or 4. It is sometimes acceptable to drain condensate onto the roof or grade; however, a tee should be fitted to the trap to direct condensate downward. The condensate line must be vented. Check local codes concerning condensate disposal. Refer to pages 2 and 3 for condensate drain location.

Note - The drain pan is made with a glass reinforced engineered plastic capable of withstanding typical joint torque but can be damaged with excessive force. Tighten pipe nipple hand tight and turn an additional quarter turn.

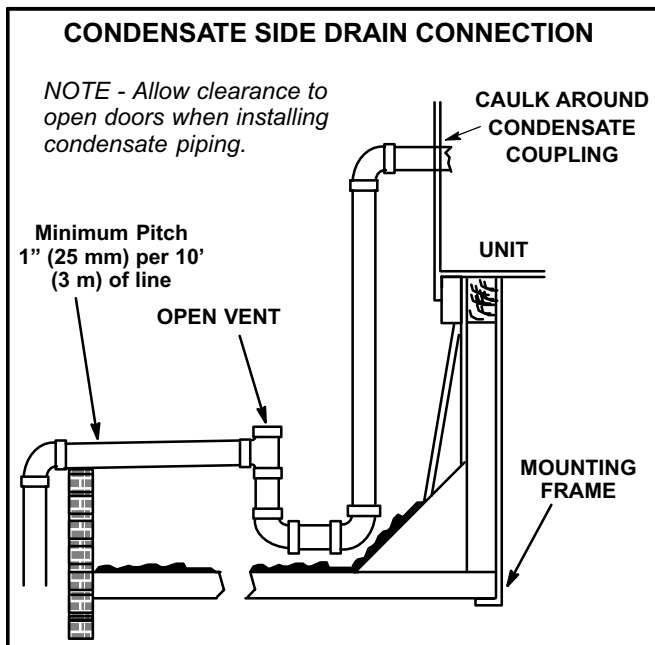


FIGURE 3

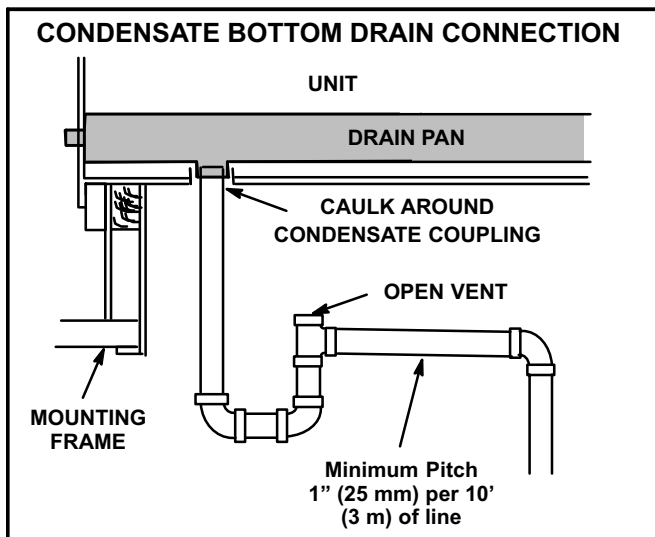


FIGURE 4

Electrical Connections

⚠ WARNING



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

POWER SUPPLY

Do not apply power or close disconnect switch until installation is complete. Refer to start-up directions.

Refer to unit nameplate for minimum circuit ampacity and maximum fuse size.

- 1- Units are factory-wired for 240/460/575 volt supply. **For 208V supply**, remove the insulated terminal cover from the 208V terminal on the control transformer. Move the wire from the transformer 240V terminal to the 208V terminal. Place the insulated terminal cover on the unused 240V terminal.
- 2- Route power through the bottom power entry area and connect to L1, L2, and L3 on TB2 in incoming power enclosure. See unit wiring diagram.

CONTROL WIRING

A-Thermostat Location

Room thermostat mounts vertically on a standard 2" X 4" handy box or on any non-conductive flat surface.

Locate thermostat approximately 5 feet (1524mm) above the floor in an area with good air circulation at average temperature. Avoid locating the room thermostat where it might be affected by:

- drafts or dead spots behind doors and in corners
- hot or cold air from ducts
- radiant heat from sun or appliances
- concealed pipes and chimneys

B-Control Wiring

- 1- Route thermostat cable or wires from subbase to unit TB1 in control box (refer to unit dimensions to locate bottom and side power entry).

IMPORTANT - Unless field thermostat wires are rated for maximum unit voltage, they must be routed away from line voltage wiring. Use wire ties located in control area to secure thermostat cable.

Use 18 AWG wire for all applications using remotely installed electro-mechanical and electronic thermostats.

- 2- Install thermostat assembly in accordance with instructions provided with thermostat.
- 3- Connect thermostat wiring to TB1 terminal as shown in figure 5 for electro-mechanical and electronic thermostats. If using other temperature control devices or energy management systems see instructions and wiring diagram provided by manufacturer.

IMPORTANT-Terminal connections at the subbase and TB1 must be made securely. Loose control wire connections may allow unit to operate but not with proper response to room demand.

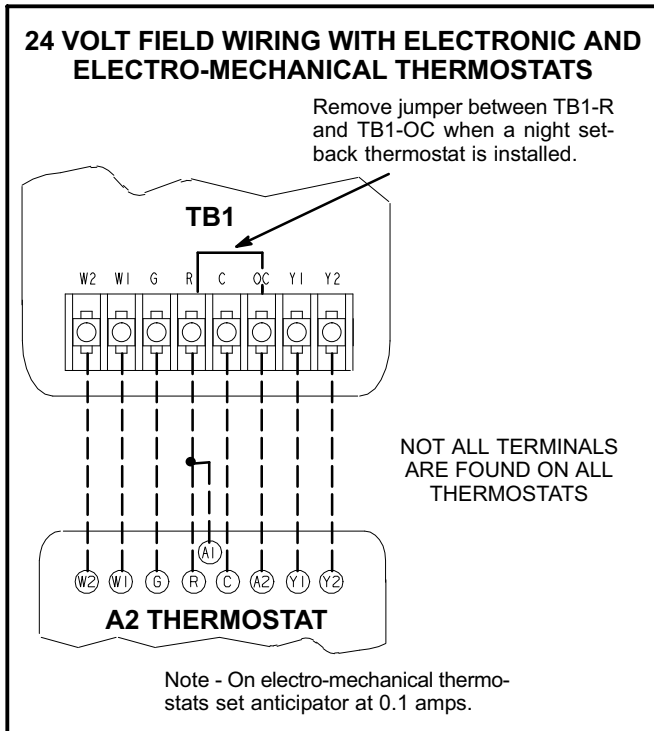


FIGURE 5

Unit Power-Up

A-General

- 1- Make sure that unit is installed in accordance with the installation instructions and applicable codes.
- 2- Inspect all electrical wiring, both field- and factory-installed, for loose connections. Tighten as required.
- 3- Check to ensure that refrigerant lines do not rub against the cabinet or against other refrigerant lines.
- 4- Check voltage at disconnect switch. Voltage must be within range listed on nameplate. If not, consult power company and have voltage condition corrected before starting unit.
- 5- Make sure filters are in place before start-up.
- 6- Apply power to unit.

Blower Operation And Adjustments

A-Three Phase Scroll Compressor Voltage Phasing

Three phase scroll compressors must be phased sequentially to ensure correct compressor and blower rotation and operation. Compressor and blower are wired in phase at the factory. Power wires are color-coded as follows: line 1-red, line 2-yellow, line 3-blue.

- 1- Observe suction and discharge pressures and blower rotation on unit start-up.
- 2- Suction pressure must drop, discharge pressure must rise, and blower rotation must match rotation marking.

If pressure differential is not observed or blower rotation is not correct:

- 3- Disconnect all remote electrical power supplies.
- 4- Reverse any two field-installed wires connected to the line side of TB2. Do not reverse wires at blower contactor.
- 5- Make sure the connections are tight.

Discharge and suction pressures should operate at their normal start-up ranges.

MSAV™ Units - All MSAV units are equipped with a phase monitor located in the control compartment. The phase monitor will detect the phasing of incoming power. If the incoming power is out of phase or if any of the three phases are lost, the indicating LED on the phase monitor will turn red and the unit will not start. In normal operation with correct incoming power phasing, the LED will be green.

B-Blower Operation

Initiate blower demand at thermostat according to instructions provided with thermostat. Unit will cycle on thermostat demand. The following steps apply to applications using a typical electro-mechanical thermostat.

- 1- Set thermostat or temperature control device fan switch to **AUTO** or **ON**. With fan switch in **ON** position, blower will operate continuously. With fan switch in **AUTO** position, the blower will cycle with demand.
- 2- Blower and entire unit will be off when thermostat or temperature control device system switch is in **OFF** position.

C-Blower Access

The blower assembly is secured to a sliding base which allows the entire assembly to be pulled out of the unit. See figure 6.

- 1- Remove the clamp which secures the blower wiring to the blower motor base.
- 2- Remove and retain screws on either side of sliding base. Pull base toward outside of unit. When pulling the base out further than 12" (305mm), disconnect wiring to K3 blower contactor T1, T2, and T3. Pull wiring toward blower to allow enough slack to slide the base out further.
- 3- Slide base back into original position when finished servicing. Replace the clamp and blower wiring in the previous location on the blower motor base. Reconnect wiring to K3 if it was disconnected.
- 4- Replace retained screws on either side of the sliding base.
- 5- Tighten two bolts on motor pulley side.

IMPORTANT - Align top edges of blower motor base and mounting frame base parallel before tightening two bolts on the other side of base. Motor shaft and blower shaft must be parallel.

- 6- Tighten two bolts on other side of base.

D-Determining Unit CFM

IMPORTANT - MSAV™ units are factory-set to run the blower at full speed when there is a blower (G) demand without a heating or cooling demand. Use the following procedure to adjust motor pulley to deliver the full load cooling or heating CFM. See MSAV™ Start-Up section to set blower CFM for all modes once the motor pulley is set.

- 1- The following measurements must be made with a dry indoor coil and with air filters in place. Run blower without a cooling demand. Measure the indoor blower shaft RPM.
- 2- With all access panels in place, measure static pressure external to unit (from supply to return). Blower performance data is based on static pressure readings taken in locations shown in figure 7.

Note - Static pressure readings can vary if not taken where shown.

- 3- Referring to page 10, use static pressure and RPM readings to determine unit CFM. Use page 11 when installing units with any of the optional accessories listed.
- 4- The blower RPM can be adjusted at the motor pulley. Loosen Allen screw and turn adjustable pulley clockwise to increase CFM. Turn counterclockwise to decrease CFM. See figure 6. Tighten Allen screw after adjustment. Do not exceed minimum and maximum number of pulley turns as shown in table 1.

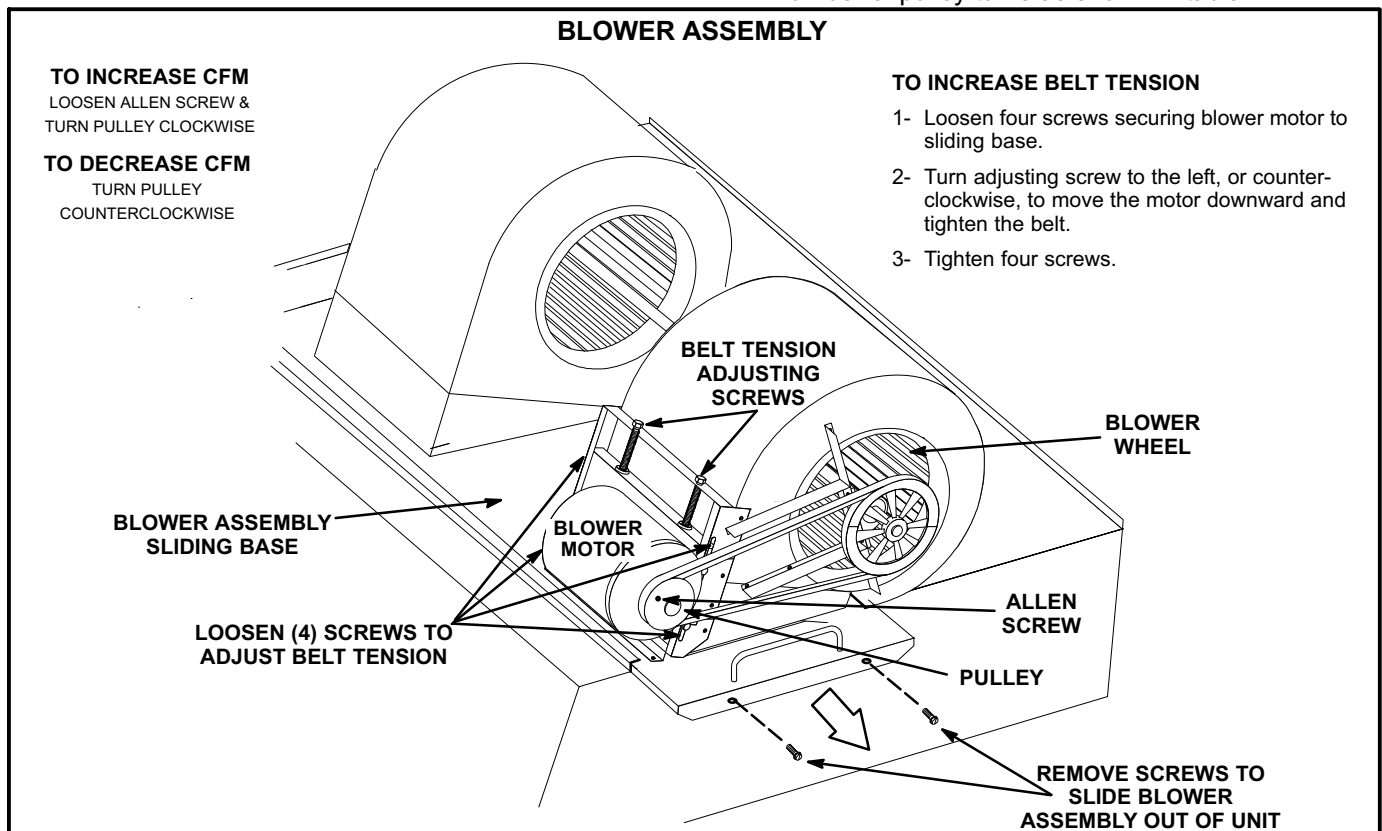


FIGURE 6

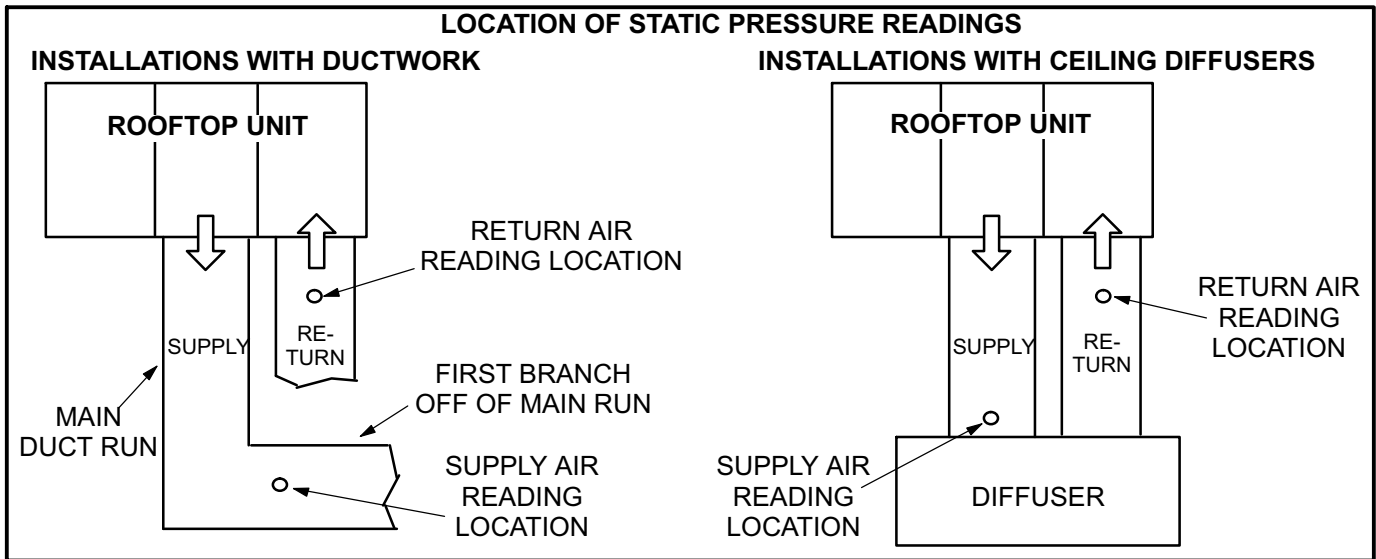


FIGURE 7

**TABLE 1
MINIMUM AND MAXIMUM PULLEY ADJUSTMENT**

Belt	Minimum Turns Open	Maximum Turns Open
A Section	No minimum	5
B Section	1*	6

*No minimum number of turns open when B belt is used on pulleys 6" O.D. or larger.

E-Blower Belt Adjustment

Maximum life and wear can be obtained from belts only if proper pulley alignment and belt tension are maintained. Tension new belts after a **24-48** hour period of operation. This will allow belt to stretch and seat grooves. Make sure blower and motor pulley are aligned as shown in figure 8.

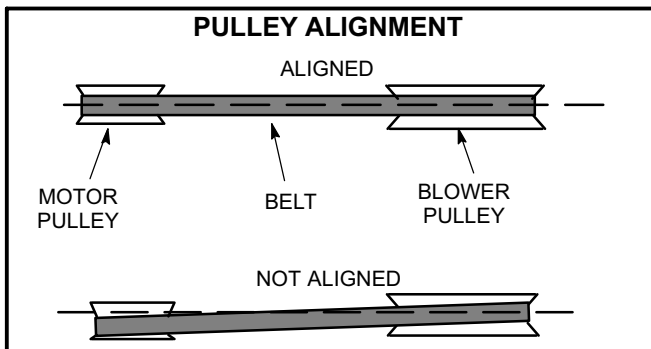


FIGURE 8

1- Loosen four screws securing blower motor to sliding base. See figure 6.

2- *To increase belt tension -*

Turn belt tension adjusting screw to the left, or counterclockwise, to tighten the belt. This increases the distance between the blower motor and the blower housing.

To loosen belt tension -

Turn the adjusting screw to the right, or clockwise to loosen belt tension.

F-Check Belt Tension

Overtensioning belts shortens belt and bearing life. Check belt tension as follows:

- 1- Measure span length X. See figure 9.
- 2- Apply perpendicular force to center of span (X) with enough pressure to deflect belt 1/64" for every inch of span length or 1.5mm per 100mm of span length.

Example: Deflection distance of a 40" span would be 40/64" or 5/8".

Example: Deflection distance of a 400mm span would be 6mm.

- 3- Measure belt deflection force. For a used belt, the deflection force should be 5 lbs. (35kPa) . A new belt deflection force should be 7 lbs. (48kPa).

A force below these values indicates and undertensioned belt. A force above these values indicates an overtensioned belt.

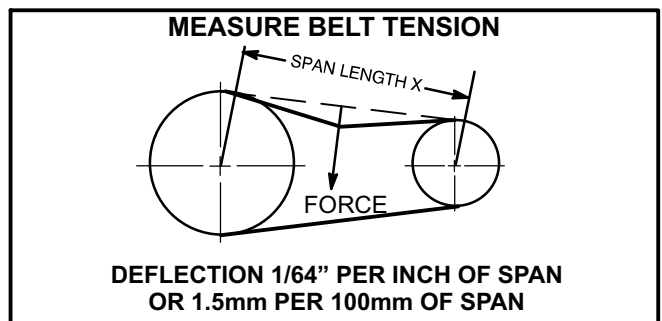


FIGURE 9

G-Field-Furnished Blower Drives

For field-furnished blower drives, use pages 9 and 10 to determine BHP and RPM required. Reference page 10 to determine the drive number and table 2 to determine the manufacturer's model number.

BLOWER DATA

BLOWER TABLE INCLUDES RESISTANCE FOR BASE UNIT ONLY WITH DRY INDOOR COIL & AIR FILTERS IN PLACE FOR ALL UNITS ADD:

- 1 - Wet indoor coil air resistance of selected unit.
- 2 - Any factory installed options air resistance (electric heat, economizer, etc.)
- 3 - Any field installed accessories air resistance (electric heat, duct resistance, diffuser, etc.)

Then determine from blower table blower motor output and drive required.

See page 10 for wet coil and option/accessory air resistance data.

See page 10 for factory installed drive kit specifications.

MINIMUM AIR VOLUME REQUIRED FOR USE WITH OPTIONAL ELECTRIC HEAT

All units require 6000 cfm minimum air with electric heat.

Air Volume cfm	TOTAL STATIC PRESSURE - Inches Water Gauge (Pa)																									
	0.20		0.40		0.60		0.80		1.00		1.20		1.40		1.60		1.80		2.00		2.20		2.40		2.60	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3250	405	0.40	520	0.60	615	0.85	695	1.10	765	1.30	830	1.60	890	1.85	950	2.10	1005	2.35	1060	2.60	1115	2.85	1170	3.10	1225	3.35
3500	415	0.45	530	0.70	620	0.95	700	1.20	775	1.45	840	1.70	900	2.00	965	2.25	1030	2.50	1095	2.75	1160	3.00	1225	3.25	1290	3.50
3750	425	0.50	540	0.75	630	1.05	710	1.30	780	1.60	845	1.85	905	2.15	960	2.45	1025	2.70	1090	2.95	1155	3.20	1220	3.45	1285	3.70
4000	435	0.55	545	0.85	635	1.10	715	1.40	785	1.70	850	2.00	910	2.30	965	2.60	1030	2.85	1095	3.10	1160	3.35	1225	3.60	1290	3.85
4250	445	0.60	555	0.90	645	1.25	725	1.55	795	1.85	855	2.15	915	2.45	970	2.80	1035	3.05	1095	3.30	1160	3.55	1225	3.80	1290	4.05
4500	455	0.70	565	1.00	655	1.35	730	1.65	800	2.00	865	2.35	925	2.65	980	3.00	1040	3.25	1100	3.50	1165	3.75	1230	4.00	1295	4.25
4750	470	0.75	575	1.10	660	1.45	740	1.80	810	2.15	870	2.50	930	2.85	985	3.20	1045	3.45	1105	3.70	1170	3.95	1235	4.20	1300	4.45
5000	480	0.85	585	1.25	670	1.60	750	1.95	815	2.30	880	2.70	940	3.05	995	3.40	1055	3.65	1115	3.90	1180	4.15	1245	4.40	1310	4.65
5250	495	0.95	595	1.35	680	1.70	755	2.10	825	2.50	890	2.90	945	3.25	1000	3.65	1060	3.85	1120	4.10	1185	4.35	1250	4.60	1315	4.85
5500	505	1.05	605	1.45	690	1.85	765	2.25	835	2.65	895	3.05	955	3.45	1010	3.85	1070	4.05	1130	4.30	1195	4.55	1260	4.80	1325	5.00
5750	520	1.15	615	1.60	700	2.00	775	2.45	840	2.85	905	3.25	965	3.65	1020	4.05	1080	4.25	1140	4.50	1205	4.75	1270	5.00	1335	5.20
6000	530	1.30	630	1.75	710	2.15	785	2.60	850	3.05	910	3.45	970	3.90	1025	4.35	1090	4.55	1150	4.80	1215	5.05	1280	5.30	1345	5.50
6250	545	1.40	640	1.90	720	2.35	795	2.80	860	3.25	920	3.70	975	4.15	1030	4.60	1095	4.80	1160	5.05	1225	5.30	1290	5.55	1355	5.80
6500	560	1.55	650	2.05	730	2.50	805	3.00	870	3.45	930	3.95	985	4.40	1040	4.85	1105	5.05	1170	5.30	1235	5.55	1300	5.80	1365	6.05
6750	570	1.70	665	2.20	745	2.70	815	3.20	880	3.70	940	4.20	995	4.65	1045	5.10	1110	5.35	1175	5.60	1240	5.85	1305	6.10	1370	6.35
7000	585	1.85	675	2.35	755	2.90	825	3.40	890	3.95	950	4.45	1005	4.95	1055	5.40	1115	5.65	1180	5.90	1245	6.15	1310	6.40	1375	6.65
7250	600	2.00	690	2.60	765	3.10	835	3.65	900	4.15	955	4.65	1015	5.25	1065	5.75	1125	5.95	1190	6.20	1250	6.45	1315	6.70	1380	6.95
7500	615	2.20	700	2.75	775	3.30	845	3.85	910	4.45	965	4.95	1020	5.50	1075	6.05	1135	6.25	1200	6.50	1260	6.75	1325	7.00	1390	7.25
7750	630	2.40	715	3.00	790	3.55	855	4.10	920	4.70	975	5.25	1030	5.80	1080	6.35	1140	6.55	1205	6.80	1265	7.05	1330	7.30	1400	7.55
8000	640	2.55	725	3.20	800	3.80	865	4.35	930	4.95	985	5.50	1040	6.10	1090	6.70	1150	6.90	1215	7.15	1275	7.40	1340	7.65	1410	7.90
8250	655	2.80	740	3.40	810	4.00	880	4.65	940	5.25	995	5.85	1050	6.45	1100	7.05	1160	7.25	1225	7.50	1285	7.75	1350	8.00	1420	8.25
8500	670	3.00	750	3.65	825	4.30	890	4.90	950	5.55	1005	6.15	1060	6.80	1110	7.40	1170	7.60	1230	7.85	1295	8.10	1360	8.35	1430	8.60
8750	685	3.25	765	3.90	835	4.55	900	5.20	960	5.85	1015	6.45	1070	7.15	1120	7.75	1180	7.95	1245	8.20	1310	8.45	1375	8.70	1440	8.95
9000	700	3.50	780	4.20	850	4.85	910	5.50	970	6.15	1025	6.80	1080	7.50	1130	8.15	1190	8.35	1255	8.60	1320	8.85	1385	9.10	1450	9.35
9250	715	3.75	790	4.45	860	5.15	925	5.85	985	6.55	1040	7.20	1090	7.85	1140	8.55	1200	8.75	1265	9.00	1330	9.25	1395	9.50	1460	9.75
9500	730	4.00	805	4.75	875	5.45	935	6.15	995	6.90	1050	7.60	1100	8.25	1150	8.95	1210	9.15	1275	9.40	1340	9.65	1405	9.90	1470	10.15
9750	745	4.30	820	5.05	885	5.75	950	6.55	1005	7.20	1060	7.95	1110	8.65	1160	9.40	1220	9.60	1285	9.85	1350	10.10	1415	10.35	1480	10.60
10,000	760	4.60	835	5.40	900	6.15	960	6.85	1015	7.60	1070	8.35	1120	9.05	1170	9.80	1230	10.00	1295	10.25	1360	10.50	1425	10.75	1490	11.00
10,250	775	4.90	845	5.65	910	6.45	970	7.20	1030	8.00	1080	8.75	1135	9.55	1180	10.25	1240	10.45	1305	10.70	1370	10.95	1435	11.20	1500	11.45
10,500	790	5.20	860	6.00	925	6.85	985	7.65	1040	8.40	1095	9.20	1145	10.00	1190	10.70	1250	10.95	1315	11.15	1380	11.40	1445	11.65	1510	11.90
10,750	805	5.55	875	6.40	940	7.25	1000	8.05	1055	8.85	1105	9.65	1155	10.45	1200	11.20	1260	11.45	1325	11.70	1390	11.95	1455	12.20	1520	12.20
11,000	820	5.90	890	6.80	950	7.60	1010	8.45	1065	9.30	1115	10.05	1165	10.90	1210	12.00	1270	12.25	1335	12.50	1400	12.75	1465	13.00	1530	12.50

BLOWER DATA

FACTORY INSTALLED BELT DRIVE KIT SPECIFICATIONS

Nominal hp	Maximum hp	Drive Kit Number	RPM Range
3	3.45	1	535 - 725
3	3.45	2	710 - 965
5	5.75	3	685 - 856
5	5.75	4	850 - 1045
5	5.75	5	945 - 1185
7.5	8.63	6	850 - 1045
7.5	8.63	7	945 - 1185
7.5	8.63	8	1045 - 1285
10	11.50	7	945 - 1185
10	11.50	10	1045 - 1285
10	11.50	11	1135 - 1365

NOTE - Using total air volume and system static pressure requirements determine from blower performance tables rpm and motor output required. Maximum usable output of motors furnished are shown. In Canada, nominal motor output is also maximum usable motor output. If motors of comparable output are used, be sure to keep within the service factor limitations outlined on the motor nameplate.

FACTORY INSTALLED OPTIONS/FIELD INSTALLED ACCESSORY AIR RESISTANCE - in. w.g.

Air Volume cfm	Wet Indoor Coil		Electric Heat	Econo mizer	Filters		Horizontal Roof Curb
	180S	240S			MERV 8	MERV 13	180S, 240S
3250	0.01	0.03	---	---	0.01	0.04	0.04
3500	0.01	0.03	---	---	0.01	0.04	0.05
3750	0.01	0.03	---	---	0.01	0.04	0.05
4000	0.02	0.04	---	---	0.01	0.04	0.06
4250	0.02	0.04	---	---	0.01	0.05	0.07
4500	0.02	0.05	---	---	0.01	0.05	0.07
4750	0.02	0.05	---	---	0.02	0.05	0.08
5000	0.02	0.05	---	---	0.02	0.06	0.08
5250	0.02	0.06	---	---	0.02	0.06	0.09
5500	0.02	0.07	---	---	0.02	0.06	0.10
5750	0.03	0.07	---	---	0.02	0.07	0.11
6000	0.03	0.08	0.01	---	0.03	0.07	0.11
6250	0.03	0.08	0.01	0.01	0.03	0.07	0.12
6500	0.03	0.09	0.01	0.02	0.03	0.08	0.13
6750	0.04	0.10	0.01	0.03	0.03	0.08	0.14
7000	0.04	0.10	0.01	0.04	0.04	0.08	0.15
7250	0.04	0.11	0.01	0.05	0.04	0.09	0.16
7500	0.05	0.12	0.01	0.06	0.04	0.09	0.17
8000	0.05	0.13	0.02	0.09	0.05	0.10	0.19
8500	0.06	0.15	0.02	0.11	0.05	0.10	0.21
9000	0.07	0.16	0.04	0.14	0.06	0.11	0.24
9500	0.08	0.18	0.05	0.16	0.07	0.12	0.26
10,000	0.08	0.20	0.06	0.19	0.07	0.12	0.29
10,500	0.09	0.22	0.09	0.22	0.08	0.13	0.31
11,000	0.11	0.24	0.11	0.25	0.09	0.14	0.34

**TABLE 2
MANUFACTURER'S NUMBERS**

Drive No.	H.P.	DRIVE COMPONENTS									
		RPM		ADJUSTABLE SHEAVE		FIXED SHEAVE		BELTS		SPLIT BUSHING	
		Min	Max	Supplier No.	OEM Part No.	Supplier No.	OEM Part No.	Supplier No.	OEM Part No.	Supplier No.	OEM Part No.
1	3	535	725	1VP40x7/8	79J0301	BK95X1-7/16	80K1601	BX59	59A5001	N/A	N/A
2	3	710	965	1VP40x7/8	79J0301	BK72x1-7/16	100244-13	BX56	63K0501	N/A	N/A
3	5	685	865	1VP50x1-1/8	P-8-1977	BK100x1-7/16	39L1301	BX61	93J9801	N/A	N/A
4	5	850	1045	1VP65x1-1/8	100239-03	BK110H	100788-06	BX65	100245-08	H-1-7/16	49M6201
5	5	945	1185	1VP60x1-1/8	41C1301	BK90H	100788-04	BX61	93J9801	H-1-7/16	49M6201
6	7.5	850	1045	1VP65x1-3/8	78M7101	BK110H	100788-06	BX66	97J5901	H-1-7/16	49M6201
7	7.5, 10	945	1185	1VP60x1-3/8	78L5501	BK90H	100788-04	BX63	97J5501	H-1-7/16	49M6201
8	7.5	1045	1285	1VP65x1-3/8	78M7101	BK90H	100788-04	BX64	97J5801	H-1-7/16	49M6201
10	10	1045	1285	1VP65x1-3/8	78M7101	1B5V86	78M8301	5VX670	100245-21	B-1-7/16	100246-01
11	10	1135	1365	1VP65x1-3/8	78M7101	1B5V80	100240-05	5VX660	100245-20	B-1-7/16	100246-01

Cooling Start-Up

A-Start-Up

MSAV™ Units - Refer to the MSAV™ Start-Up section.

- 1- Remove coil covers before starting unit.
- 2- Set thermostat or temperature control device fan switch to **AUTO** or **ON**. Set thermostat or temperature control device to initiate a first-stage cooling demand.

A first-stage (Y1) cooling demand will energize compressor 1 and outdoor fans 1 & 2. An increased cooling demand (Y2) will initiate compressor 2 and outdoor fans 3 & 4. On units with an economizer, when outdoor air is acceptable, a first-stage demand will energize the economizer; a second-stage demand will energize compressor 1 and outdoor fans 1 & 2.

- 3- Refrigerant circuits are factory charged with R-410A refrigerant. See unit rating plate for correct amount of charge.
- 4- Units contain two refrigerant circuits or systems. See figure 10.

B-Refrigerant Charge and Check

WARNING-Do not exceed nameplate charge under any condition.

This unit is factory charged and should require no further adjustment. If the system requires additional refrigerant, reclaim the charge, evacuate the system, and add required nameplate charge.

*NOTE - System charging is not recommended below 60°F (15°C). In temperatures below 60°F (15°C), the charge **must** be weighed into the system.*

If weighing facilities are not available, or to check the charge, use the following procedure:

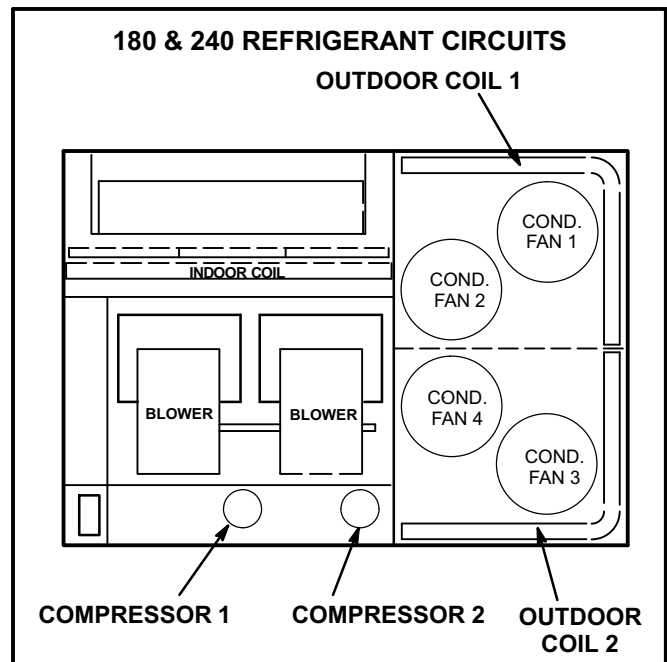


FIGURE 10

- 1- Attach gauge manifolds and operate unit in cooling mode with economizer disabled until system stabilizes (approximately five minutes). Make sure all outdoor air dampers are closed.
- 2- Check each system separately with all stages operating.
- 3- Use a thermometer to accurately measure the outdoor ambient temperature.
- 4- Apply the outdoor temperature to table 3 or 4 to determine normal operating pressures. Pressures are listed for sea level applications at 80°F dry bulb and 67°F wet bulb return air.
- 5- Compare the normal operating pressures to the pressures obtained from the gauges. Minor variations in these pressures may be expected due to

differences in installations. Significant differences could mean that the system is not properly charged or that a problem exists with some component in the system. **Correct any system problems before proceeding.**

- 6- If discharge pressure is high, remove refrigerant from the system. If discharge pressure is low, add refrigerant to the system.
 - Add or remove charge in increments.
 - Allow the system to stabilize each time refrigerant is added or removed.
- 7- Use the following approach method along with the normal operating pressures to confirm readings.

**TABLE 3
KHA180 NORMAL OPERATING PRESSURES**

Outdoor Coil Entering Air Temp	Circuit 1		Circuit 2	
	Dis. ± 10 psig	Suc. ± 5 psig	Dis. ± 10 psig	Suc. ± 5 psig
65°F	270	138	270	135
75°F	312	139	312	135
85°F	356	142	356	136
95°F	403	144	404	138
105°F	455	147	458	140
115°F	512	147	515	145

**TABLE 4
KHA240 NORMAL OPERATING PRESSURES**

Outdoor Coil Entering Air Temp	Circuit 1		Circuit 2	
	Dis. ± 10 psig	Suc. ± 5 psig	Dis. ± 10 psig	Suc. ± 5 psig
65°F	275	135	278	135
75°F	315	138	318	136
85°F	359	140	364	138
95°F	407	142	413	140
105°F	457	144	466	141
115°F	517	146	527	145

C-Charge Verification - Approach Method - AHRI Testing

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

Approach Temperature = Liquid temperature (at condenser outlet) minus ambient temperature.
- 2- Approach temperature should match values in table 5. An approach temperature greater than value shown indicates an undercharge. An approach temperature less than value shown indicates an overcharge.
- 3- The approach method is not valid for grossly over or undercharged systems. Use table 3 or 4 as a guide for typical operating pressures.

**TABLE 5
APPROACH TEMPERATURES**

Unit	Liquid Temp. Minus Ambient Temp.	
	1st Stage	2nd Stage
180 & 240	12°F ± 1 (6.7°C ± 0.5)	12°F ± 1 (6.7°C ± 0.5)

D-Compressor Controls

- 1- High Pressure Switches (S4, S7)

Compressor circuits are protected by a high pressure switch which cuts out at 640 psig ± 10 psig (4413 kPa ± 70 kPa).
- 2- Freezestats (S49, S50)

Switches de-energize compressors when indoor coil temperature falls below 29°F (-2°C) to prevent coil freeze-up. Switches reset when indoor coil temperature reaches 58°F (15°C).
- 3- Defrost Switches (S6, S9)

Defrost switches close to initiate defrost when liquid line temperature falls to 35°F (1.7°C). The defrost switch is located on the liquid line between the outdoor expansion valve and the distributor
- 4- Defrost Termination Switches (S46, S104)

Defrost pressure switches open to terminate defrost when vapor line (discharge pressure during cooling and defrost) pressure reaches 450 psig (3103 kPa).
- 5- Defrost Controls (CMC1, CMC2)

Defrost is liquid line temperature initiated and operates for 14 minutes unless terminated by vapor line pressure drop.

When the liquid line temperature drops below 35°F, the defrost switch closes and signals the **defrost control** that a defrost cycle is needed. If the defrost switch is still closed after 60 minutes (default), a defrost cycle begins and operates for 14 minutes. The defrost pressure switch can terminate the defrost cycle before the 14 minutes elapses if vapor line pressure reaches 450 ± 10 psi.
- 6- Electric heat is energized during defrost to maintain discharge air temperature.

Heating Start-Up

- 1- Set thermostat or temperature control device to initiate a first-stage heating demand.

A first-stage heating demand (W1) will energize compressors 1 and 2. All four outdoor fans are energized with a W1 demand.

KHA Units With Optional Electric Heat -
An increased heating demand (W2) will energize electric heat.

Defrost Control Board

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

Compressor Accumulated Run-Time Interval

The defrost control will not energize a defrost cycle unless the unit has been operating in heating mode for an accumulated 60 minutes (default) on 100269-02 boards; 90 minutes (default) on 100269-04 boards. The run time interval can be changed by moving the jumper on the CMC board timing pins. See figure 11.

The defrost interval can be adjusted to 30, 60, or 90 minutes. The defrost timing jumper is factory-installed to provide a 60-minute defrost interval. If the timing selector jumper is not in place, the control defaults to a 90-minute defrost interval.

Note - When adjusting timing pins, set both CMC1 and CMC2 defrost controls to the same defrost interval.

Defrost Test Option

A TEST option is provided for troubleshooting. The TEST mode may be started any time the unit is in the heating

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

Diagnostic LEDs

The defrost board uses two LEDs for diagnostics. The LEDs flash a sequence according to the condition.

TABLE 6

Defrost Control Board Diagnostic LED		
Indicates	LED 1	LED 2
Normal operation / power to board	Synchronized Flash with LED 2	Synchronized Flash with LED 1
Board failure / no power	Off	Off
Board failure	On	On
Pressure switch open	Flash	On

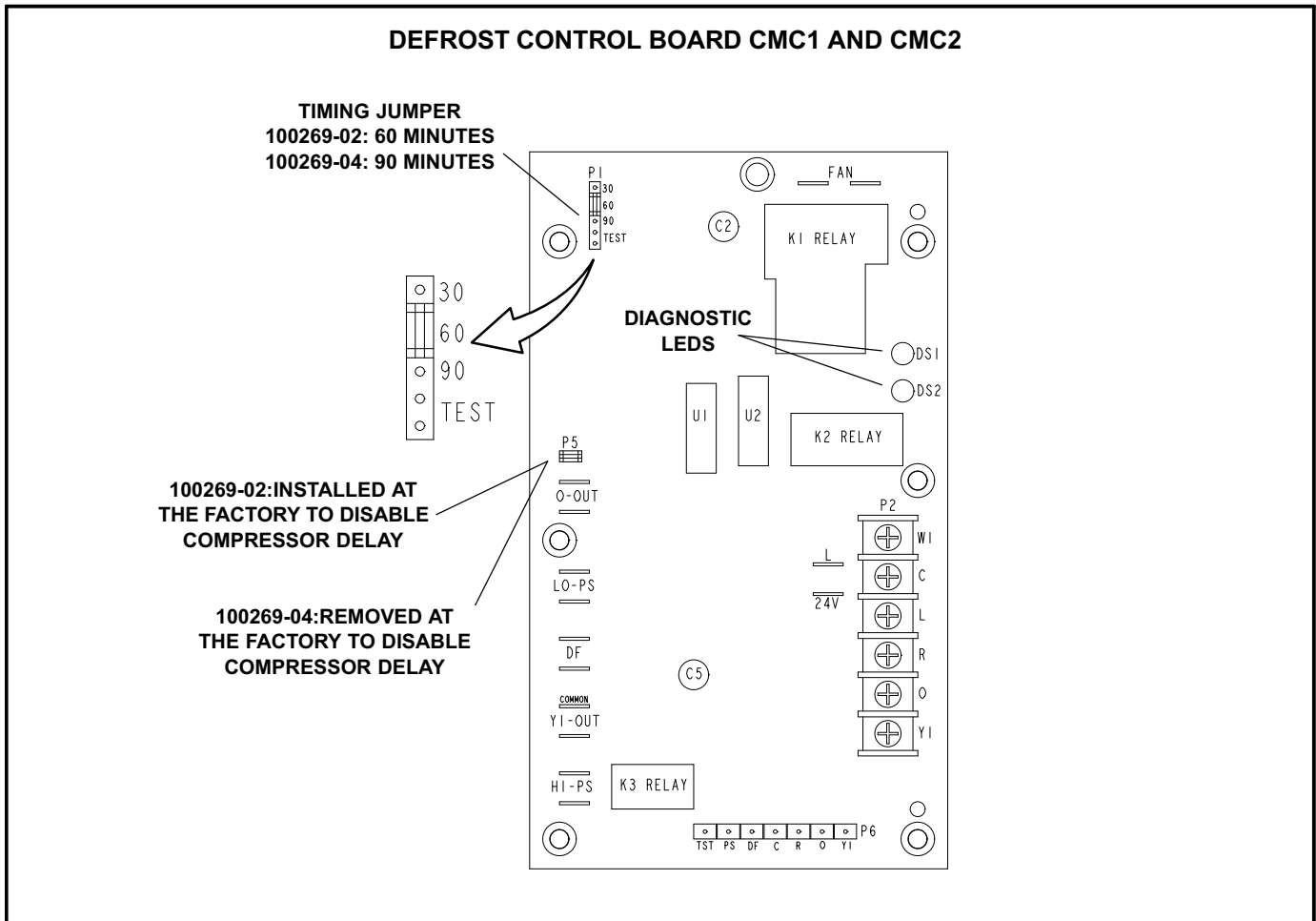


FIGURE 11

MSAV™ Start-Up

A-General

Optional Multi-Stage Air Volume (MSAV™) units are available which provide two blower speeds. The blower will operate at lower speeds when cooling demand is low and higher speeds when cooling demand is high. This results in lower energy consumption.

MSAV™ units will operate at high speed during ventilation (blower “G” only signal) but can be adjusted to operate at low speed.

Low speed is approximately 2/3 of the full speed RPM.

B-Set Maximum Blower CFM

1. Initiate a blower (G) only signal from the room thermostat or control system.
2. Adjust the blower pulley to deliver the full (high speed) CFM in the typical manner. See *Determining Unit CFM* in the Blower Operation and Adjustment section.

C-Set Blower Speed During Ventilation

To save energy during ventilation, the blower speed can be set to low. This is accomplished by changing the ventilation speed switch on the VFD control board to “LO”. See figure 12.

Note - On units equipped with an economizer, set damper minimum position as shown in the next section. After adjusting the low speed minimum position, the ventilation speed switch will be in the “LO” position.

D-Set Damper Minimum Position (Units W/ Economizer)

To maintain required minimum ventilation air volumes when the unit is in the occupied mode, two minimum damper positions must be set. A high and a low speed potentiometer are provided on the VFD control board to adjust minimum damper position. See figure 12.

Set High Speed Minimum Position

1. Initiate a blower (G) only AND occupied demand from the room thermostat or control system.
2. Set the ventilation speed switch on the VFD control board to “HI”.
3. Rotate the high speed potentiometer on the VFD control board to set the high speed minimum damper position.
4. Measure the intake air CFM. If the CFM is lower than the design specified CFM for ventilation air, use the potentiometer to increase the damper percent open. If the CFM is higher than specified, decrease the damper percent open.

Note - Intake air CFM can also be determined using the outdoor air temperature, return air temperature and mixed air temperature. Refer to the economizer or outdoor air damper installation instructions.

Set Low Speed Minimum Position

1. Initiate a blower (G) only AND occupied demand from the room thermostat or control system.
2. Set the ventilation speed switch on the VFD control board to “LO”.
3. Rotate the low speed potentiometer on the VFD control board to set the low speed minimum damper position.
4. Measure the intake air CFM. If the CFM is lower than the design specified CFM for ventilation air, use the potentiometer to increase the damper percent open. If the CFM is higher than specified, decrease the damper percent open.

Note - Intake air CFM can also be determined using the outdoor air temperature, return air temperature and mixed air temperature. Refer to the economizer or outdoor air damper installation instructions.

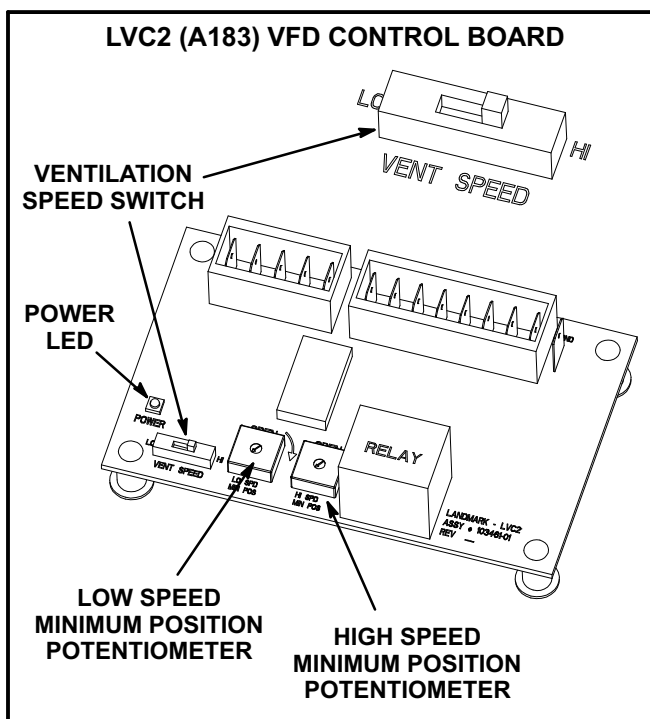


FIGURE 12

Troubleshoot LVC2 Board (A183)

Refer to wiring diagram sections B (unit), C (control) and D (economizer) located on inside of unit panels.

1. Inspect the LVC2 for damaged components. Replace the LVC2 if damaged components are found.
2. Check all wire connections to LVC2; secure if loose.
3. Check for 24VAC signal at the thermostat blower input (G to GND terminal). See figure 13.

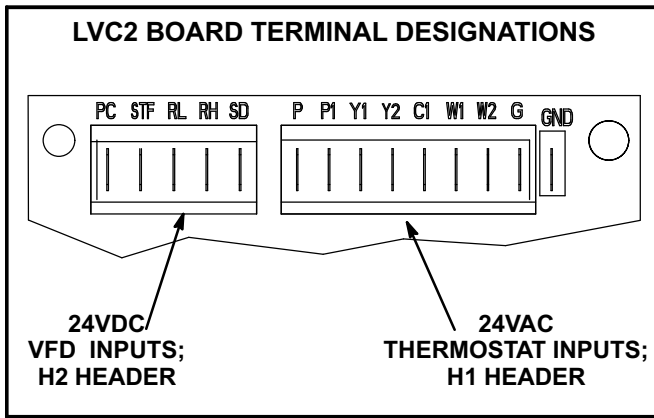


FIGURE 13

4. If there is no thermostat signal, troubleshoot back toward the thermostat.
5. Check the power LED on the board. See figure 12.
6. If the power LED is not on, check voltage between LVC2 terminals PC (H2-1) and SD (H2-5). Voltage should read 24VDC.
7. If voltage does not read 24VDC, disconnect the H2 header from the LVC2 VFD inputs terminal block (to make sure the LVC2 is not shorting 24VDC supply from the inverter). Measure the voltage between the end terminals on the H2 header. If 24VDC is present, replace the LVC2 board. If no voltage is read, troubleshoot the VFD.
8. When LVC2 24VAC thermostat blower (G) input and 24VDC power are present, check the LVC2 low and high speed outputs. The LVC2 uses inverse logic to enable the blower; 1VDC will be read at the enabled blower speed terminal. See table 7.
9. If all inputs are correct and the unit still does not operate as intended, replace LVC2 board.

**TABLE 7
LVC2 BOARD BLOWER OUTPUTS**

Output Terminals	Voltage	Blower Operation
RL-SD	1VDC	Low Speed
RH-SD	24VDC	
RL-SD	24VDC	High Speed
RH-SD	1VDC	
RL-SD	1VDC	Illegal State (replace board)
RH-SD	1VDC	
RL-SD	24VDC	Blower Off (replace board)
RH-SD	24VDC	

Service

⚠ CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

⚠ WARNING

Product contains fiberglass wool.

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

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

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

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

The unit should be inspected once a year by a qualified service technician.

A-Lubrication

All motors are lubricated at the factory. No further lubrication is required.

Blower shaft bearings are prelubricated. For extended bearing life, relubricate at least once every two years with a lithium base grease, such as Alvania 3 (Shell Oil), Chevron BRB2 (Standard Oil) or Regal AFB2 (Texas Oil). Use a hand grease gun for relubrication. Add only enough grease to purge through the bearings so that a bead of grease appears at the seal lip contacts.

B-Filters

Units are equipped with six 24 X 24 X 2" filters. Filters should be checked and replaced when necessary with filters of like kind and size. Take note of air flow direction marking on filter frame when reinstalling filters. See figure 14.

NOTE-Filters must be U.L.C. certified or equivalent for use in Canada.

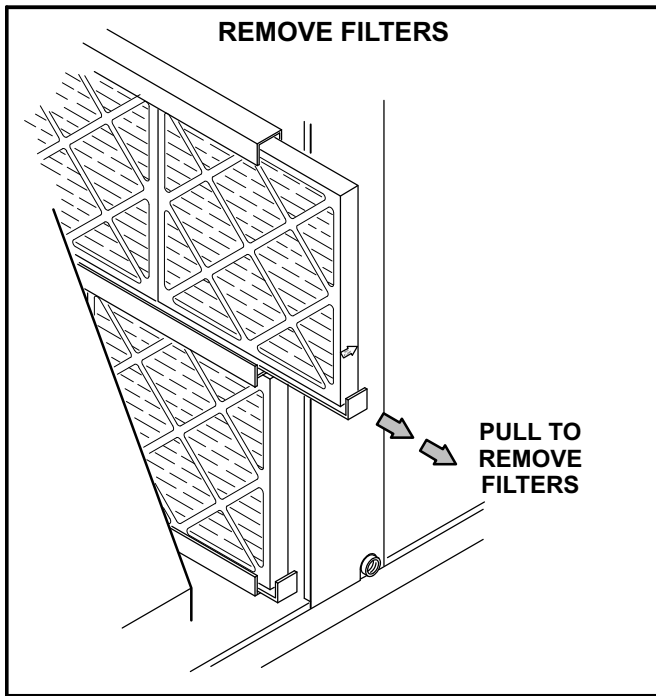


FIGURE 14

C-Indoor Coil

Inspect and clean coil at beginning of each cooling and heating season. Clean using mild detergent or commercial coil cleaner. Flush coil and condensate drain with water taking care not to get insulation, filters and return air ducts wet.

D-Outdoor Coil

Clean outdoor coil annually with detergent or commercial coil cleaner and inspect monthly during the cooling season.

Outdoor coils are made of two formed slabs. Dirt and debris may become trapped between the slabs. To clean between slabs, carefully separate coil slabs and wash them thoroughly. See figure 15. Flush coils with water following cleaning.

Note - Remove all screws and gaskets prior to cleaning procedure and replace upon completion.

E-Supply Air Blower Wheel

Annually inspect supply air blower wheel for accumulated dirt or dust. Turn off power before attempting to remove access panel or to clean blower wheel.

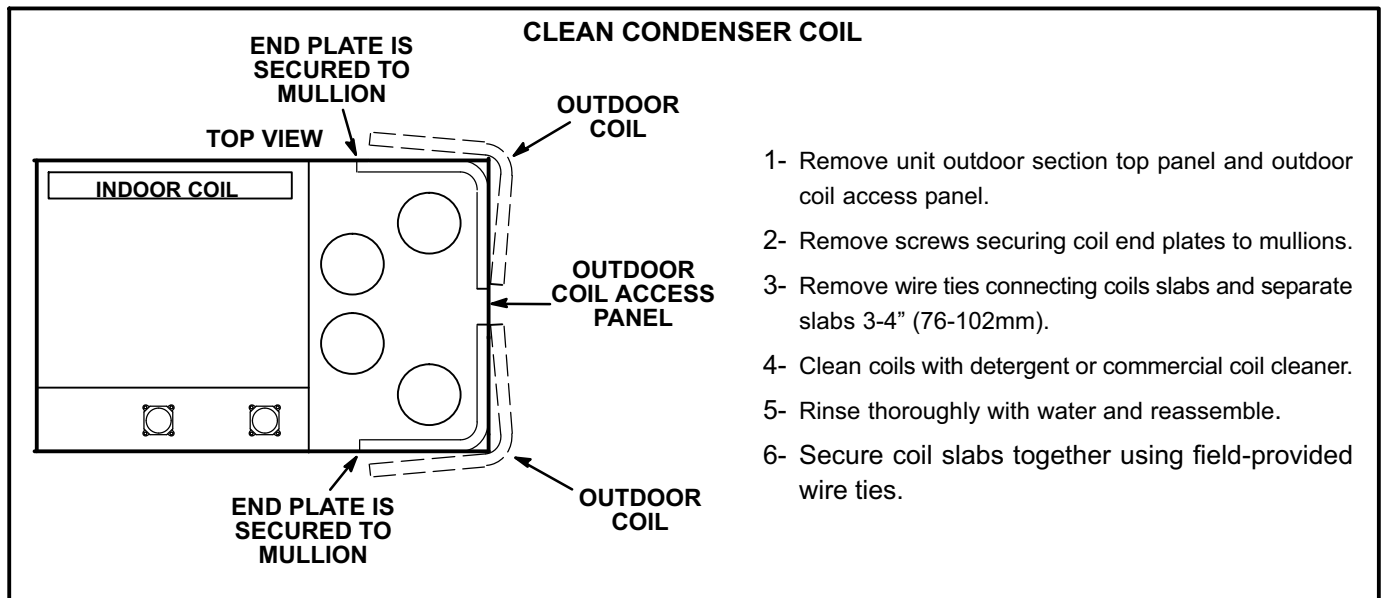


FIGURE 15

- 1- Remove unit outdoor section top panel and outdoor coil access panel.
- 2- Remove screws securing coil end plates to mullions.
- 3- Remove wire ties connecting coils slabs and separate slabs 3-4" (76-102mm).
- 4- Clean coils with detergent or commercial coil cleaner.
- 5- Rinse thoroughly with water and reassemble.
- 6- Secure coil slabs together using field-provided wire ties.