

⚠ WARNING

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

⚠ CAUTION

As with any mechanical equipment, contact with sharp sheet metal edges can result in personal injury. Take care while handling this equipment and wear gloves and protective clothing.

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INSTALLATION INSTRUCTIONS

KHA/KHB092 (7-1/2 TON)
KHA/KHB102 (8-1/2 TON)
KHA120 (10 TON)
KHB122 (10 TON)
KHA150 (12-1/2 TON)

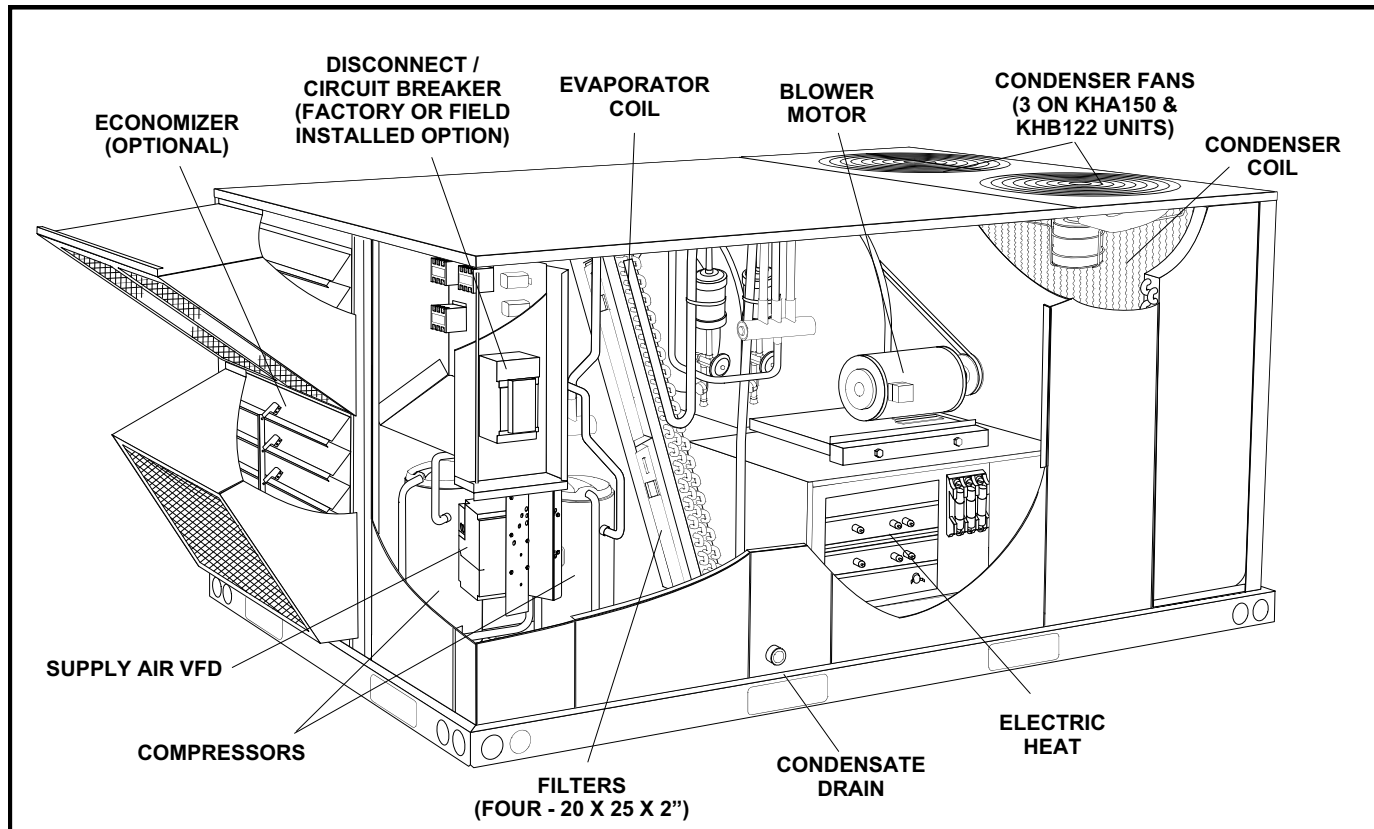
HEAT PUMP PACKAGED UNITS

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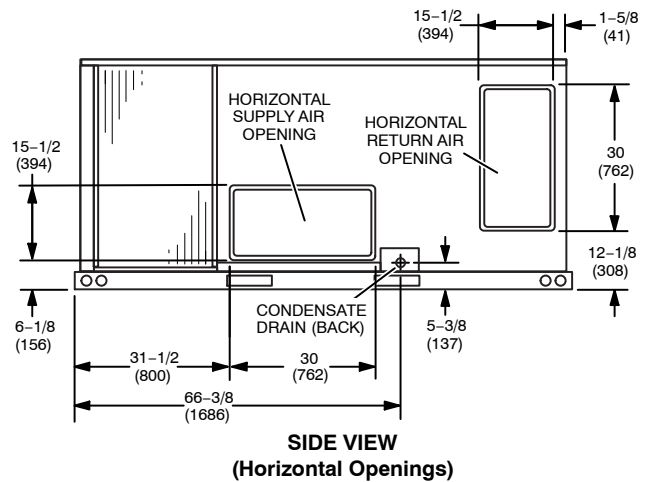
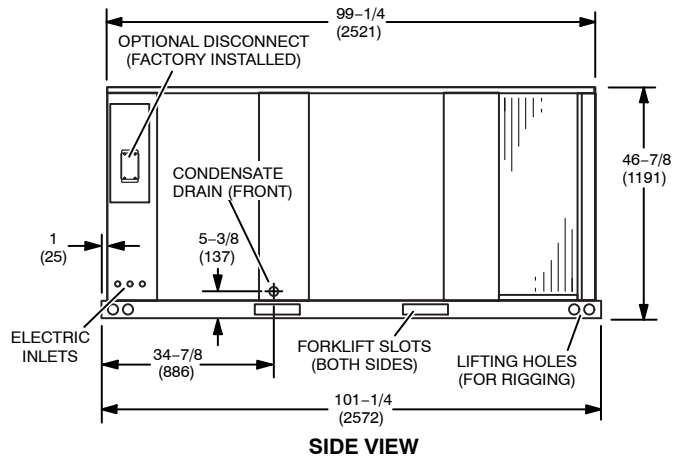
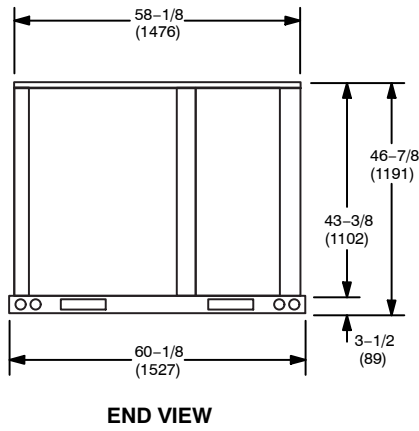
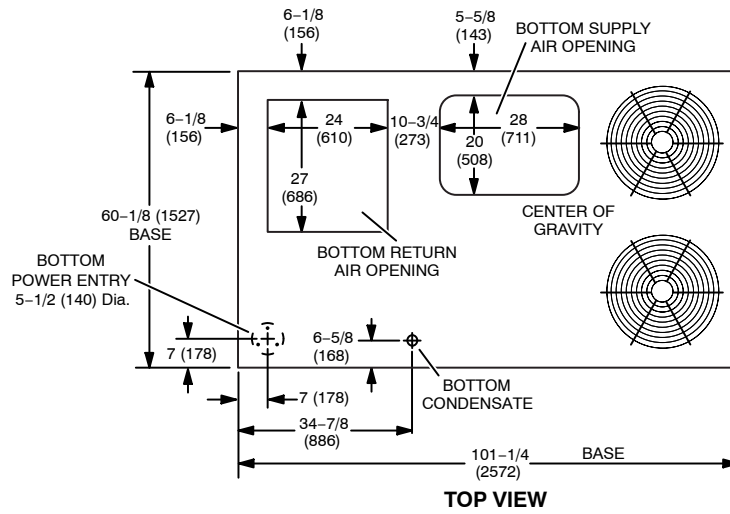
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RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE

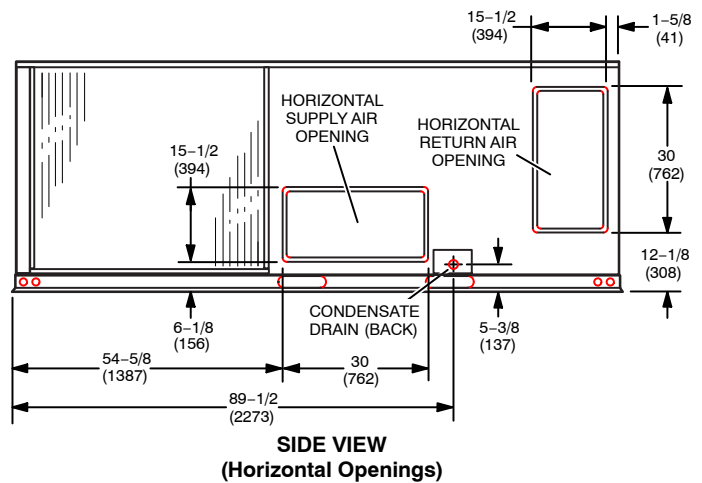
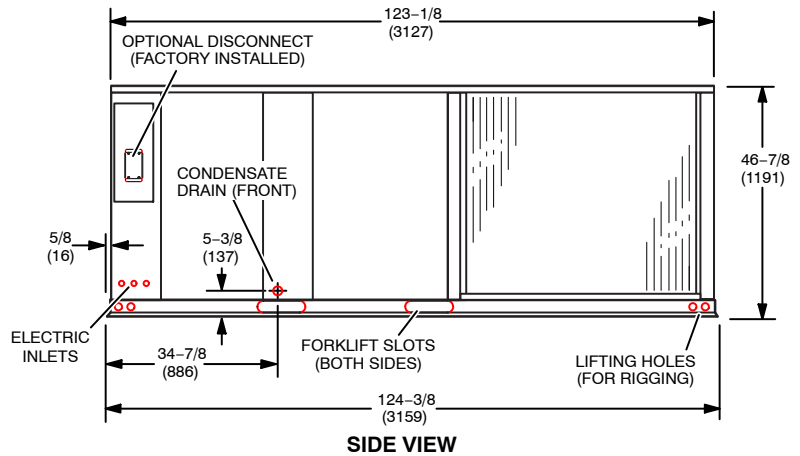
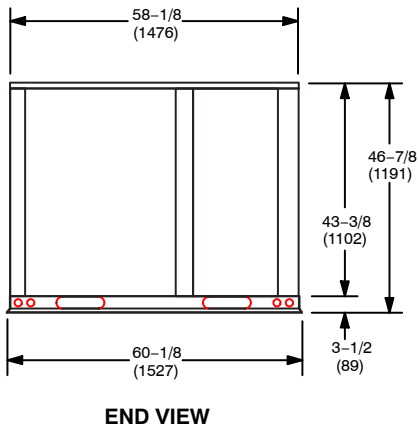
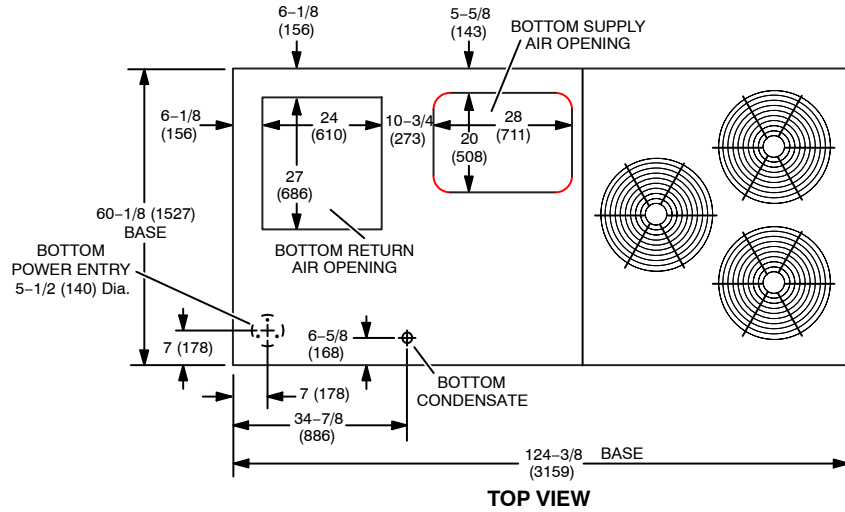
KHA092, 102, 120, 150 & KHB092, 102, 122 PARTS ARRANGEMENT



KHA092, 102, 120 & KHB092, 102 DIMENSIONS



KHA150 & KHB122 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 7-1/2, 8-1/2, 10, and 12-1/2 ton cooling capacities. KHB units have 7-1/2, 8-1/2, and 10-ton cooling capacities. Optional electric heat is available.

Units are equipped with a supply air inverter. KHB122 units are available with high efficiency direct drive blowers. The blower will operate at lower speeds when cooling demand is low and increase to higher speeds when cooling demand is high. Refer to Supply Air Start-Up sections.

Availability of units and options varies by brand.

Requirements

The KHA/KHB unit is ETL/CSA certified for outdoor installations only at the clearances to combustible materials listed on unit nameplate and in figure 1.

Installation of KHA/KHB 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.

⚠ 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.

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

National Fire Protection Association
 1 Batterymarch Park
 PO Box 9101
 Quincy, MA 02269-9101

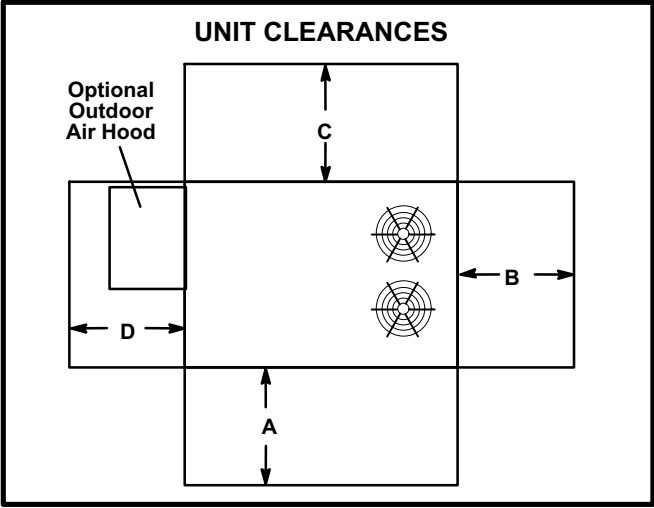


FIGURE 1

¹ Unit Clearance	A in.(mm)	B in.(mm)	C in.(mm)	D in.(mm)	Top Clearance
Service Clearance	60 (1524)	36 (914)	36 (914)	60 (914)	Unob- structed
Minimum Operation Clearance	36 (914)	36 (914)	36 (914)	36 (914)	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/KHB 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 electrical power to unit before performing any maintenance or servicing operations on the unit.

⚠ 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.

⚠ CAUTION

To reduce the likelihood of supply / return air bypass and promote a proper seal with the RTU, duct work / duct drops / diffuser assemblies must be supported independently to the building structure.

A-Downflow Discharge Application

Roof Mounting with C1CURB

- 1- The C1CURB roof mounting frame must be installed, flashed and sealed in accordance with the instructions provided with the frame.
- 2- The C1CURB 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 unit; supply and return plenums must be installed before setting the unit.

Installer's Roof Mounting Frame

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

- 1- The unit 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 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 unit on a combustible surface for downflow discharge applications, the C1CURB roof mounting frame is required.

B-Horizontal Discharge Applications

- 1- Units installed in horizontal airflow applications must use a horizontal conversion kit (K1HECK00).
- 2- Specified installation clearances must be maintained when installing 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 unit.)

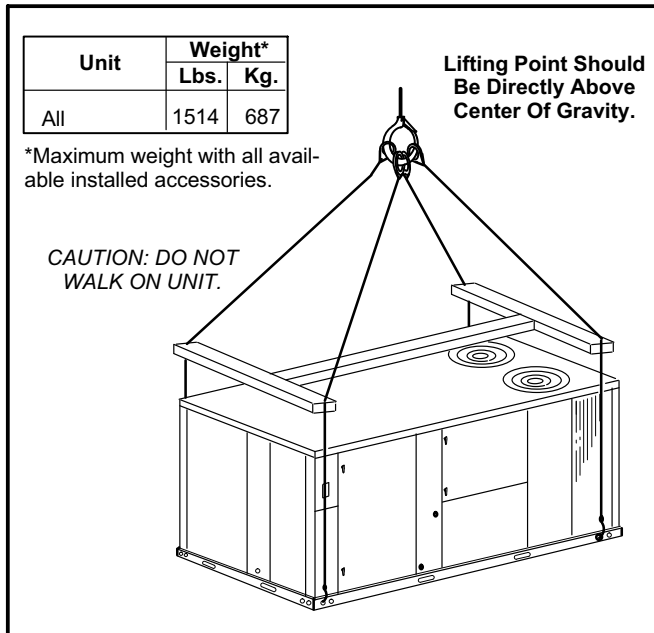


FIGURE 2

Condensate Drains

Make drain connection to the 1" N.P.T. drain coupling provided on unit.

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.

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.

Units are shipped with the drain coupling facing the front of the unit. Condensate can be drained from the back or bottom of the unit with the following modifications. The unit can be installed in either downflow or horizontal air discharge regardless of condensate drain location.

Rear Drain Connection

- 1- Remove heat access door. See figure 5.
- 2- Remove filter access door. Refer to figure 5.
- 3- Remove eight screws holding condensate drain mullion and remove mullion.

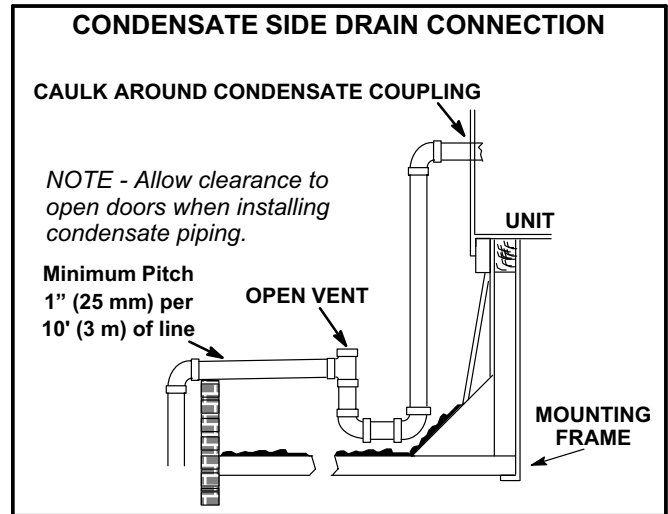


FIGURE 3

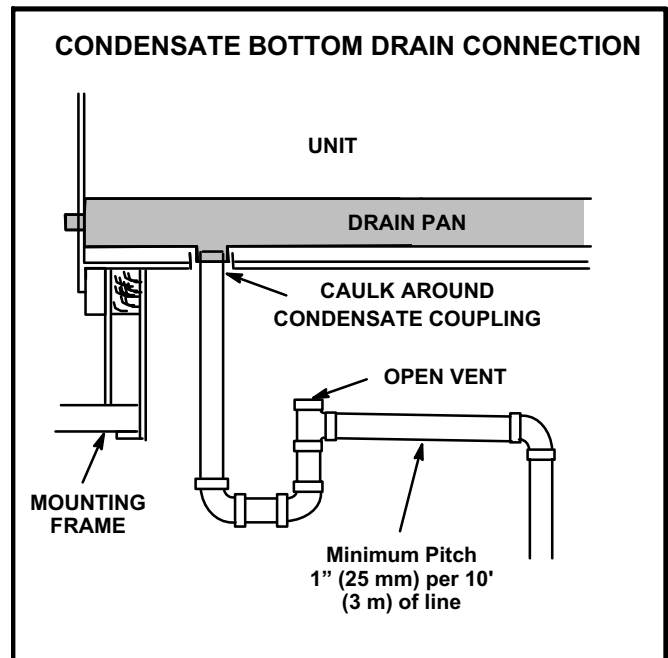


FIGURE 4

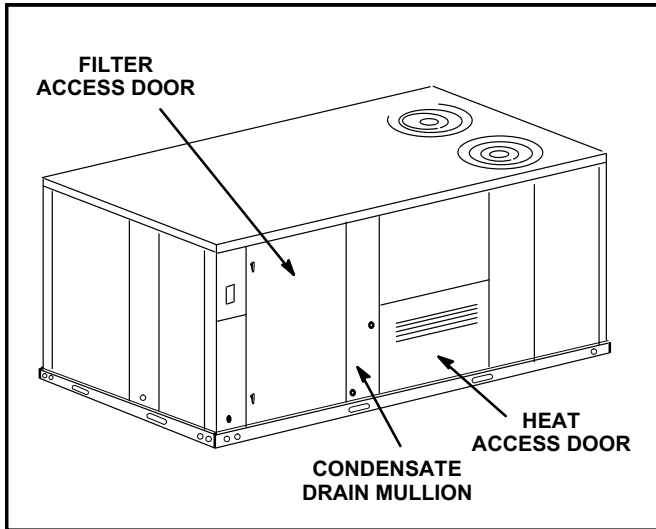


FIGURE 5

- 4- Lift front edge of the drain pan (to clear bottom drain plug) and slide drain pan out of unit. See figure 6.

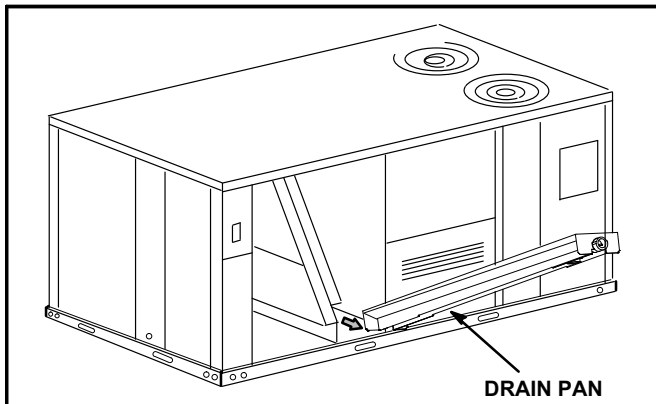


FIGURE 6

- 5- Make sure the cap over the unit bottom drain hole is secure.
- 6- Rotate the drain pan until the downward slope is toward the back of the unit. Slide the drain pan back into the unit. Be careful not to dislodge the cap over the bottom drain hole.
- 7- From the back side of the unit, pull the drain pan coupling through the rear condensate opening.
- 8- Replace the condensate drain mullion and reinstall eight screws.
- 9- Reinstall access doors.

Bottom Drain Connection

- 1- Remove heat access door. See figure 5.
- 2- Remove filter access door. Refer to figure 5.
- 3- Remove eight screws holding condensate drain mullion and remove mullion.
- 4- Lift front edge of the drain pan (to clear bottom drain plug) and slide drain pan out of unit. See figure 6.
- 5- Turn the drain pan upside down and drill a pilot hole through the bottom of the drain pan in the center of the coupling. See figure 7.

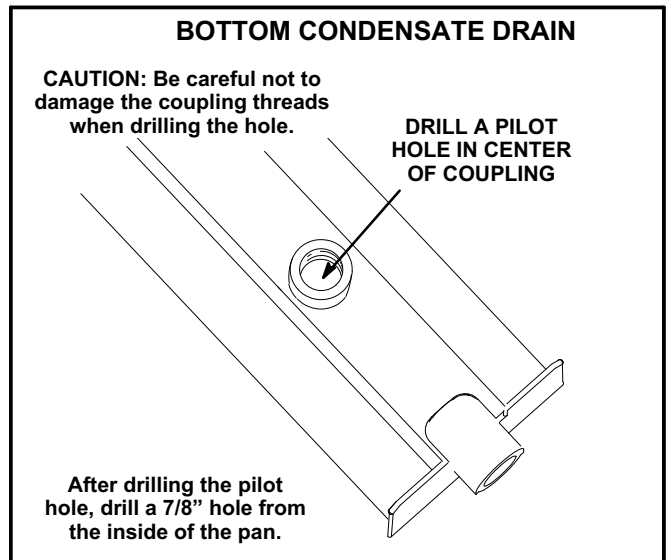


FIGURE 7

- 6- From the inside of the pan, use a Vari-Bit® bit to enlarge the hole to 7/8". Do not damage coupling threads.
- 7- Remove the cap over the unit bottom drain hole.
- 8- Slide the drain pan back into the unit.
- 9- From the back side of the unit, pull the drain pan coupling through the rear condensate opening.
- 10- From the front side of the unit, move the drain pan until the bottom coupling settles into the unit bottom drain opening. Once in place, check to make sure the coupling is still positioned through the rear condensate drain hole.
- 11- Use a field-provided 1" plug to seal side drain connection.
- 12- Replace the condensate drain mullion and reinstall eight screws.
- 13- Reinstall access doors.

Electrical Connections

POWER SUPPLY

A-Wiring

Route field wiring in conduit between bottom power entry disconnect. See figure 8. This does not supersede local codes or authorities having jurisdiction.

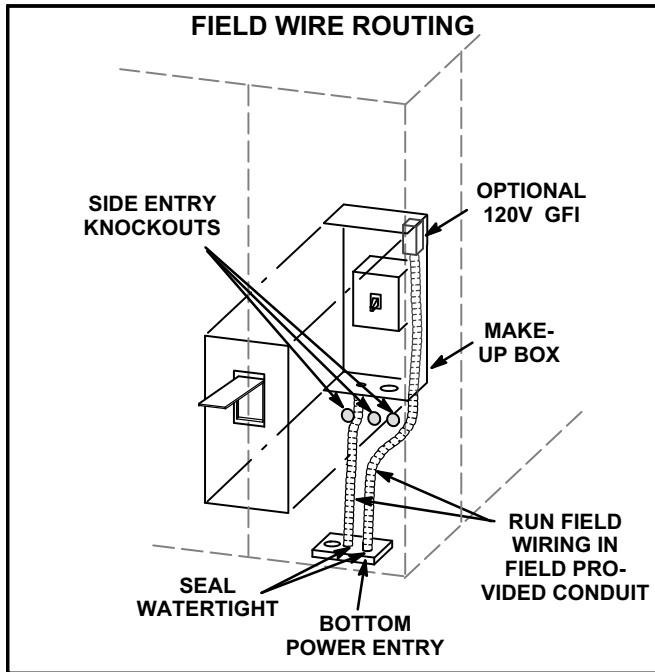


FIGURE 8

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- 230,460,575 volt units are factory wired. **For 208V supply**, disconnect the pink wire (230V) at all control power transformer(s). Reconnect the pink wire to terminal marked 208 on power transformer(s). Tape the exposed end of the 230V pink wire.
- 2- Route power through the bottom power entry area and connect to L1, L2, and L3 on the bottom of F4 in the control box. Route power to TB2 on units equipped with electric heat. Route power to S48 disconnect switch when the option is factory-installed. See unit wiring diagram.
- 3- Connect separate 120v wiring to optional GFCI outlet pigtails. Route field wiring in conduit between bottom power entry and GFCI. See figure 8.

B-Unbalanced Three-Phase Voltage - VFD Units Only

Units equipped with an optional inverter (VFD) are designed to operate on balanced, three-phase power. Operating units on unbalanced three-phase power will reduce the reliability of all electrical components in the unit. Unbalanced power is a result of the power delivery system supplied by the local utility company.

Factory-installed inverters are sized to drive blower motors with an equivalent current rating using balanced three-phase power. When unbalanced three-phase power is supplied; the installer must replace the existing factory-installed inverter with an inverter that has a higher current rating to allow for the imbalance. Use table 1 to determine the appropriate replacement inverter.

TABLE 1
INVERTER UP-SIZING

Factory-Installed Inverter HP	Replacement Inverter HP
2	5
3	7-1/2
5	10

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 (1524 mm) 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

IMPORTANT - Unless field thermostat wires are rated for maximum unit voltage, they must be routed away from line voltage wiring.

B-Control Wiring

- 1- Route thermostat cable or wires from subbase to unit 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 near the front of the control section 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 board on the lower side of the controls hat section. Wire as shown in figure 9 for electro-mechanical and electronic thermostats. If using other temperature control devices or energy management systems see instructions and wiring diagram provided by manufacturer.
- 4- Verify the unit configuration DIP switch settings match the nameplate

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

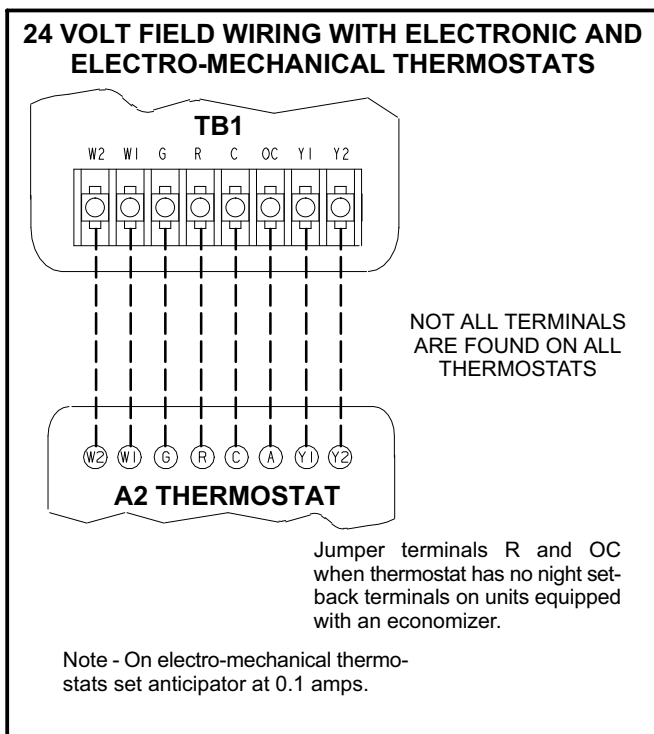


FIGURE 9

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 main unit power connection. 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- Make sure there is no heating, cooling, or blower demand from thermostat. Apply power to unit.
- 7- *KHB Units Only* -
Verify the FCB (A191) fan control board DIP switch settings are correct. Use the model number on the unit nameplate and figure 10. The FCB is in the control section above the compressors.

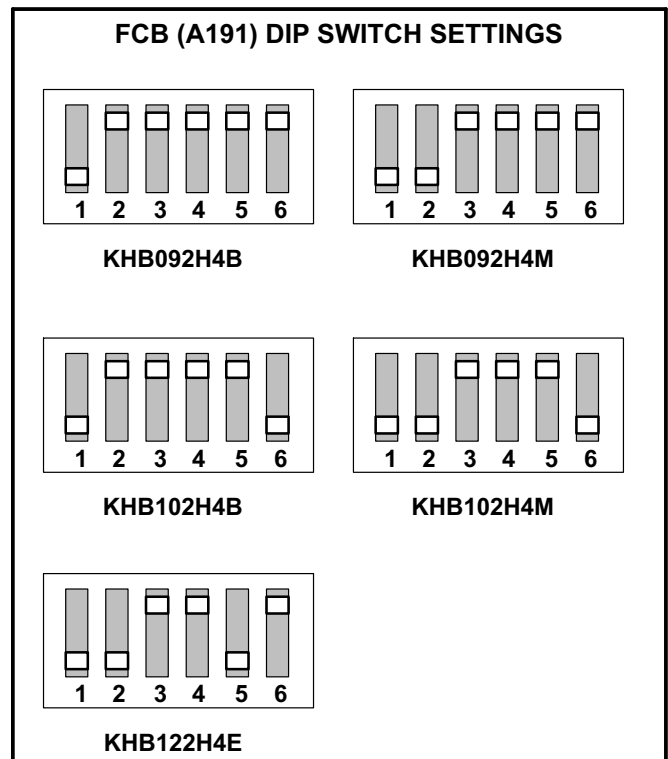


FIGURE 10

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.

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

- 2- Suction pressure must drop, discharge pressure must rise, and blower rotation must match rotation marking.
- 3- Disconnect all remote electrical power supplies.

- 4- Reverse any two field-installed wires connected to the line side of K3, TB2 or F4. Do not reverse wires at blower contactor or compressors.
- 5- Make sure the connections are tight.

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

Belt-Driven Supply Air Inverter Units - 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- Blower operation is manually set at the thermostat subbase fan switch. With fan switch in **ON** position, blowers will operate continuously.
- 2- With fan switch in **AUTO** position, the blowers will cycle with demand. Blowers and entire unit will be off when system switch is in **OFF** position.

C-Blower Access

The blower assembly is secured to a sliding frame which allows the blower motor to be pulled out of the unit. See figure 11 and 12.

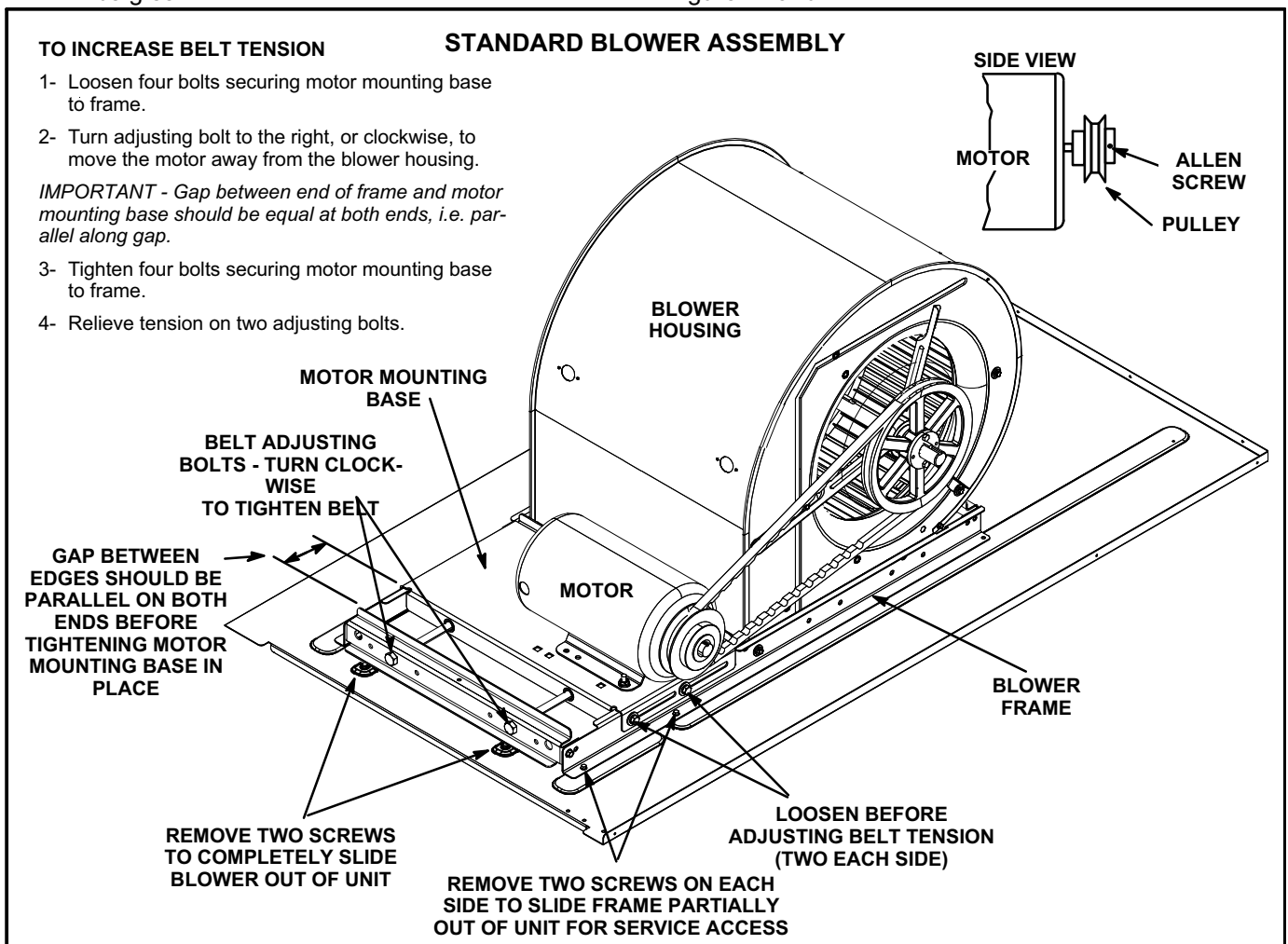


FIGURE 11

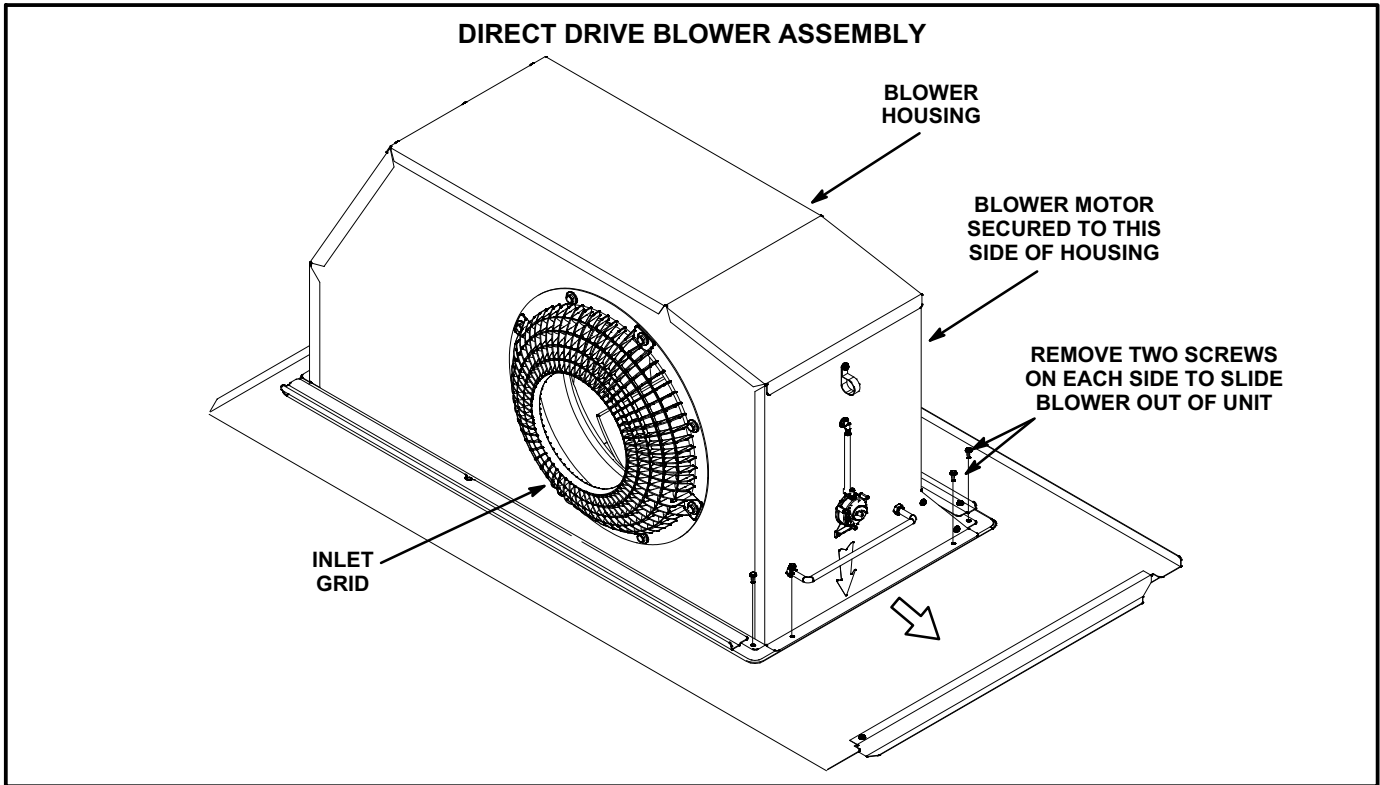


FIGURE 12

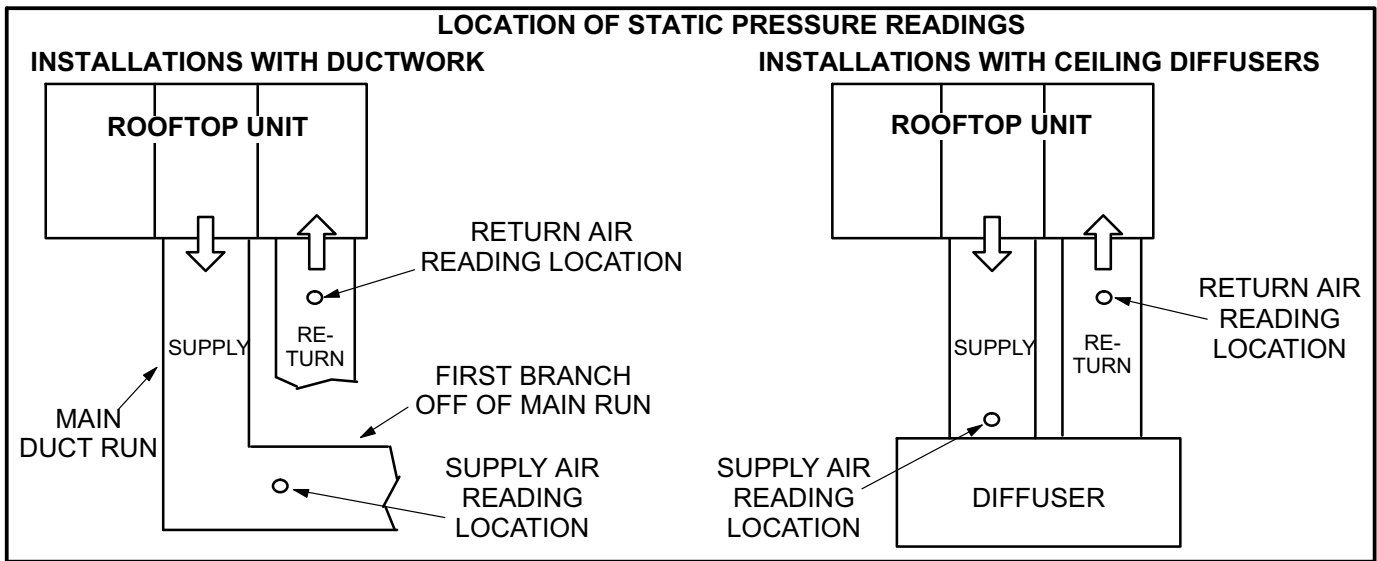


FIGURE 13

Belt Drive Blowers

- 1- Loosen the reusable wire tie which secures the blower wiring to the blower motor mounting plate.
- 2- Remove and retain screws on either side of sliding frame. Pull frame toward outside of unit.
- 3- Slide frame back into original position when finished servicing. Reattach the blower wiring in the previous location on the blower motor base using the wire tie.
- 4- Replace retained screws on either side of the sliding frame.

Direct Drive Blowers

- 1- Loosen the reusable wire tie which secures the controls and high voltage blower wiring to the blower housing.
- 2- Remove and retain screws in front and on either side of blower housing. Pull frame toward outside of unit.
- 3- Slide frame back into original position when finished servicing. Reattach the blower wiring in the previous location on the blower motor base using the wire tie.
- 4- Replace retained screws in front and on either side of the blower housing.

D-Determining Unit CFM

IMPORTANT - Belt-driven supply air inverter 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 *Belt-Driven Supply Air Inverter Start-Up* section to set blower CFM for all modes once the motor pulley is set.

IMPORTANT - Direct drive variable blower unit CFM is determined by the Fan Control board. Refer to the *Direct Drive Supply Air Blower Start-Up* section.

- 1- The following measurements must be made with a dry indoor coil. Run blower without a cooling demand. Measure the indoor blower shaft RPM. Air filters must be in place when measurements are taken.
- 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 13.

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

- 3- Referring to page 14, 15, or 16, use static pressure and RPM readings to determine unit CFM. Use page 17 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 11. Do not exceed minimum and maximum number of pulley turns as shown in table 2.

**TABLE 2
MINIMUM AND MAXIMUM PULLEY ADJUSTMENT**

Belt	Minimum Turns Open	Maximum Turns Open
A Section	0	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 in the pulley grooves. Make sure blower and motor pulleys are aligned as shown in figure 14.

- 1- Loosen four bolts securing motor base to mounting frame. See figure 11.

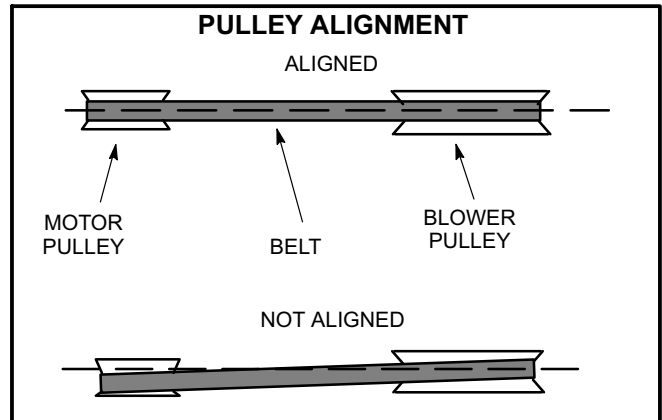


FIGURE 14

- 2- *To increase belt tension* - Turn both adjusting bolts to the right, or clockwise, to move the motor outward and tighten the belt. This increases the distance between the blower motor and the blower housing.

To loosen belt tension -

Turn the adjusting bolts to the left, or counterclockwise to loosen belt tension.

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

- 3- Tighten two bolts on each side of the motor mounting base. This secures the mounting base to the frame.
- 4- Relieve tension adjusting bolts.

F-Check Belt Tension

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

- 1- Measure span length X. See figure 15.
- 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 new 2 and 3hp belt, the deflection force should be 5.0-7.0 lbs. (35-48kPa). For a new 5hp belt, the deflection force should be 7-10lbs. (48-69kPa).

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

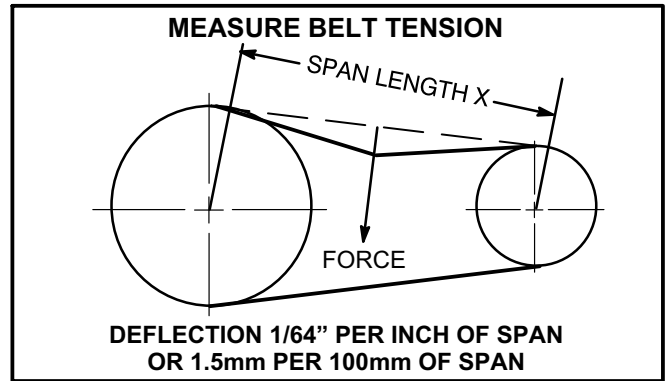


FIGURE 15

G-Field-Furnished Blower Drives

For field-furnished blower drives, use pages 14 through 15 to determine BHP and RPM required. Reference page 17 to determine the drive number. Reference table 3 for drive component manufacturer's numbers.

BLOWER DATA

KHA092 BELT DRIVE BLOWER – BASE UNIT

BLOWER TABLE INCLUDES RESISTANCE FOR BASE UNIT ONLY (NO HEAT SECTION) WITH DRY INDOOR COIL AND AIR FILTERS IN PLACE. FOR ALL UNITS ADD:

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

Then determine from blower table blower motor output required.

See page 17 for blower motors and drives.

See page 17 for wet coil and option/accessory air resistance data.

MINIMUM AIR VOLUME REQUIRED FOR USE WITH OPTIONAL ELECTRIC HEAT (Maximum Static Pressure - 2.0 in. w.g.)

7.5 kW, 15 kW, 22.5 kW, 30 kW and 45 kW - 2800 cfm

Total Air Volume cfm	Total Static Pressure – in. w.g.																									
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2		2.2		2.4		2.6	
	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
1750	583	0.09	627	0.06	673	0.09	723	0.06	777	0.45	834	0.82	892	1.13	943	1.28	990	1.38	1038	1.44	1084	1.60	1131	1.79	1179	2.25
2000	593	0.11	636	0.07	682	0.10	731	0.22	784	0.60	840	0.96	898	1.26	948	1.38	996	1.47	1045	1.57	1092	1.71	1140	1.92	1188	2.32
2250	604	0.15	645	0.11	690	0.15	739	0.39	790	0.74	846	1.08	901	1.34	953	1.48	1002	1.57	1052	1.70	1100	1.86	1149	2.09	1197	2.42
2500	615	0.19	655	0.15	699	0.20	747	0.55	797	0.89	851	1.20	906	1.44	959	1.58	1009	1.68	1059	1.83	1108	2.01	1158	2.26	1206	2.52
2750	626	0.23	666	0.19	709	0.37	755	0.71	805	1.03	858	1.32	912	1.55	966	1.70	1017	1.81	1067	1.97	1117	2.17	1166	2.44	1215	2.71
3000	637	0.27	677	0.24	719	0.55	764	0.87	813	1.18	866	1.45	920	1.67	975	1.82	1026	1.96	1076	2.13	1126	2.35	1176	2.63	1225	2.92
3250	650	0.31	688	0.43	730	0.73	775	1.04	823	1.34	875	1.60	930	1.81	985	1.97	1036	2.12	1086	2.31	1136	2.54	1186	2.83	1235	3.13
3500	663	0.35	700	0.63	741	0.92	786	1.22	834	1.50	886	1.76	942	1.96	997	2.14	1048	2.31	1097	2.51	1147	2.75	1196	3.04	1245	3.35
3750	676	0.57	714	0.84	754	1.12	798	1.41	846	1.68	899	1.93	956	2.14	1010	2.32	1060	2.51	1109	2.72	1158	2.98	1207	3.27	1255	3.58

BLOWER DATA

KHA102, 120, 150 & KHB092, 102 BELT DRIVE BLOWER – BASE UNIT

BLOWER TABLE INCLUDES RESISTANCE FOR BASE UNIT ONLY (NO HEAT SECTION) WITH DRY INDOOR COIL AND AIR FILTERS IN PLACE. FOR ALL UNITS ADD:

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

Then determine from blower table blower motor output required.

See page 17 for blower motors and drives.

See page 17 for wet coil and option/accessory air resistance data.

MINIMUM AIR VOLUME REQUIRED FOR USE WITH OPTIONAL ELECTRIC HEAT (Maximum Static Pressure - 2.0 in. w.g.)

7.5kW, 15 kW, 22.5 kW, 30 kW and 45 kW - 2800 cfm

60 kW - 4000 cfm

Total Air Volume cfm	Total Static Pressure – in. w.g.																										
	0.2		0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2		2.2		2.4		2.6		
	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	RPM
1750	480	0.19	548	0.39	618	0.57	689	0.70	758	0.81	824	0.92	885	1.07	941	1.23	992	1.40	1039	1.55	1084	1.70	1128	1.85	1156	2.08	
2000	492	0.27	560	0.47	629	0.64	700	0.77	768	0.88	832	1.00	892	1.16	946	1.32	995	1.48	1041	1.65	1085	1.81	1127	1.97	1160	2.13	
2250	505	0.35	573	0.55	643	0.72	713	0.85	780	0.97	842	1.10	900	1.25	952	1.42	999	1.59	1044	1.76	1087	1.93	1127	2.10	1164	2.27	
2500	520	0.45	588	0.64	658	0.81	727	0.94	793	1.07	853	1.21	909	1.37	959	1.54	1005	1.71	1048	1.89	1089	2.07	1127	2.25	1166	2.42	
2750	536	0.55	604	0.74	674	0.91	743	1.05	806	1.19	865	1.34	919	1.50	968	1.67	1012	1.86	1053	2.04	1092	2.23	1129	2.41	1167	2.60	
3000	553	0.66	622	0.85	692	1.02	760	1.17	821	1.32	878	1.48	930	1.64	977	1.83	1020	2.02	1059	2.21	1096	2.41	1133	2.60	1170	2.79	
3250	572	0.77	641	0.98	712	1.15	778	1.32	837	1.48	892	1.64	942	1.81	988	2.00	1028	2.20	1066	2.41	1102	2.61	1138	2.81	1174	3.01	
3500	592	0.90	663	1.12	733	1.31	798	1.48	854	1.65	907	1.82	955	1.99	999	2.19	1038	2.41	1074	2.63	1109	2.84	1144	3.04	1180	3.24	
3750	614	1.04	687	1.28	756	1.48	818	1.66	872	1.83	922	2.01	969	2.19	1010	2.41	1048	2.64	1084	2.87	1118	3.09	1152	3.29	1188	3.50	
4000	639	1.22	712	1.47	780	1.67	838	1.85	890	2.03	939	2.22	983	2.42	1023	2.65	1060	2.90	1095	3.14	1128	3.36	1162	3.57	1198	3.77	
4250	666	1.42	740	1.68	804	1.88	859	2.06	909	2.25	956	2.45	998	2.67	1036	2.92	1072	3.18	1106	3.42	1139	3.65	1172	3.86	1208	4.07	
4500	697	1.65	769	1.91	829	2.10	881	2.28	929	2.48	973	2.71	1013	2.95	1050	3.22	1085	3.48	1118	3.73	1151	3.96	1184	4.17	1221	4.39	
4750	729	1.91	798	2.15	854	2.34	903	2.53	948	2.75	991	3.00	1030	3.27	1065	3.55	1099	3.81	1132	4.06	1164	4.29	1198	4.51	1235	4.74	
5000	763	2.18	826	2.41	878	2.60	925	2.81	968	3.05	1009	3.33	1046	3.61	1081	3.90	1114	4.17	1146	4.42	1178	4.65	1212	4.87	1250	5.09	
5250	797	2.47	854	2.69	903	2.90	947	3.12	989	3.39	1028	3.69	1064	3.99	1098	4.28	1130	4.55	1162	4.80	1194	5.02	1228	5.24	1266	5.47	
5500	830	2.78	882	3.00	927	3.22	969	3.48	1010	3.77	1047	4.09	1083	4.40	1116	4.69	1147	4.96	1179	5.20	1211	5.42	1246	5.63	---	---	
5750	861	3.11	908	3.34	951	3.58	992	3.87	1031	4.19	1068	4.52	1102	4.84	1134	5.12	1165	5.38	1196	5.61	---	---	---	---	---	---	
6000	890	3.45	935	3.71	976	3.98	1016	4.31	1053	4.65	1089	4.99	1122	5.30	1153	5.58	---	---	---	---	---	---	---	---	---	---	
6250	918	3.84	961	4.12	1001	4.43	1040	4.79	1076	5.14	1110	5.48	---	---	---	---	---	---	---	---	---	---	---	---	---	---	

BLOWER DATA

KHB122 DIRECT DRIVE BLOWER ALL MODELS – BASE UNIT

BLOWER TABLE INCLUDES RESISTANCE FOR BASE UNIT ONLY (NO HEAT SECTION) WITH DRY INDOOR COIL AND AIR FILTERS IN PLACE.

FOR ALL UNITS ADD:

- 1 – Wet indoor coil air resistance of selected unit.
 - 2 – Any factory installed options air resistance (heat section, economizer, etc.)
 - 3 – Any field installed accessories air resistance (duct resistance, diffuser, etc.)
- See page 17 for wet coil and option/accessory air resistance data.

MINIMUM AIR VOLUME REQUIRED FOR USE WITH OPTIONAL ELECTRIC HEAT (Maximum Static Pressure - 2.0 in. w.g.)

15 kW, 22.5 kW, 30 kW, 45 kW - 2750 cfm

60 kW - 3500 cfm

Total Air Volume cfm	Total Static Pressure - in. w.g.													
	0.2		0.4		0.6		0.8		1.0		1.2		1.4	
	RPM	Watts	RPM	Watts	RPM	Watts	RPM	Watts	RPM	Watts	RPM	Watts	RPM	Watts
1750	711	188	771	279	836	366	905	453	975	544	1044	640	1109	737
2000	752	242	812	332	876	420	944	510	1011	606	1075	709	1138	812
2250	799	300	860	389	923	479	988	575	1052	678	1113	787	1171	896
2500	853	362	914	453	976	548	1038	650	1097	761	1154	877	1209	990
2750	914	434	974	529	1033	629	1091	739	1146	858	1199	979	1250	1098
3000	980	513	1037	614	1092	720	1146	837	1198	961	1247	1088	1295	1215
3250	1048	598	1101	705	1153	819	1203	941	1251	1071	1298	1206	1343	1343
3500	1116	693	1166	809	1214	931	1261	1060	1307	1198	1351	1341	1395	1489
3750	1185	806	1232	931	1277	1063	1322	1201	1365	1348	1407	1499	1448	1657
4000	1254	937	1299	1072	1341	1214	1383	1363	1424	1518	1464	1679	1503	1844
4250	1324	1089	1366	1234	1406	1386	1445	1545	1484	1708	1522	1876	1559	2046
4500	1395	1262	1433	1417	1471	1579	1508	1745	1544	1913	1581	2084	1616	2256
4750	1465	1455	1501	1619	1536	1787	1571	1957	1606	2128	1641	2299	1675	2470
5000	1534	1666	1568	1834	1602	2004	1635	2174	1668	2345	1701	2514	1735	2682
5250	1603	1887	1635	2055	1667	2224	1699	2392	1731	2559	1763	2724	---	---
5500	1671	2110	1702	2275	1733	2441	1764	2605	---	---	---	---	---	---
5750	1738	2325	1768	2488	---	---	---	---	---	---	---	---	---	---

Total Air Volume cfm	Total Static Pressure - in. w.g.											
	1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	Watts	RPM	Watts	RPM	Watts	RPM	Watts	RPM	Watts	RPM	Watts
1750	1172	833	1231	932	1287	1039	1340	1156	1391	1283	1442	1426
2000	1197	913	1253	1019	1306	1135	1357	1261	1407	1398	1457	1547
2250	1227	1003	1280	1117	1330	1242	1379	1378	1428	1525	1477	1680
2500	1261	1103	1311	1226	1360	1361	1407	1507	1454	1663	1501	1826
2750	1299	1219	1347	1350	1394	1494	1440	1649	1485	1813	1530	1982
3000	1342	1346	1388	1487	1432	1640	1476	1803	1520	1973	1563	2146
3250	1388	1485	1432	1638	1475	1800	1517	1969	1558	2143	1600	2319
3500	1437	1643	1479	1805	1519	1975	1560	2148	1600	2325	1640	2502
3750	1489	1821	1528	1990	1567	2164	1605	2340	1645	2517	1685	2693
4000	1541	2014	1579	2187	1616	2364	1654	2540	1693	2715	1732	2887
4250	1596	2218	1632	2393	1668	2569	1705	2742	1743	2913	---	---
4500	1652	2429	1687	2603	1722	2775	1759	2944	---	---	---	---
4750	1709	2641	1743	2811	1778	2979	---	---	---	---	---	---
5000	1768	2850	---	---	---	---	---	---	---	---	---	---
5250	---	---	---	---	---	---	---	---	---	---	---	---
5500	---	---	---	---	---	---	---	---	---	---	---	---
5750	---	---	---	---	---	---	---	---	---	---	---	---

BLOWER DATA

FACTORY INSTALLED BELT DRIVE KIT SPECIFICATIONS

Nominal hp	Maximum hp	Drive Kit Number	RPM Range
2	2.3	1	590 - 890
2	2.3	2	800 - 1105
2	2.3	3	795 - 1195
3	3.45	4	730 - 970
3	3.45	5	940 - 1200
3	3.45	6	1015 - 1300
5	5.75	10	900 - 1135
5	5.75	11	1040 - 1315
5	5.75	12	1125 - 1425

POWER EXHAUST FAN PERFORMANCE

Return Air System Static Pressure	Air Volume Exhausted
in. w.g.	cfm
0	3175
0.05	2955
0.10	2685
0.15	2410
0.20	2165
0.25	1920
0.30	1420
0.35	1200

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

Air Volume cfm	Wet Indoor Coil		Electric Heat	Economizer	Filters		Return Air Adaptor Plate
	KHA092	KHA102, 120, 150 KHB092, 102, 122			MERV 8	MERV 13	
1750	0.03	0.04	0.03	0.05	0.01	0.03	0.00
2000	0.04	0.05	0.03	0.06	0.01	0.03	0.00
2250	0.05	0.06	0.04	0.08	0.01	0.04	0.00
2500	0.05	0.07	0.04	0.11	0.01	0.05	0.00
2750	0.06	0.08	0.05	0.12	0.02	0.05	0.00
3000	0.07	0.10	0.06	0.13	0.02	0.06	0.02
3250	0.08	0.11	0.06	0.15	0.02	0.06	0.02
3500	0.09	0.12	0.09	0.15	0.03	0.07	0.04
3750	0.10	0.14	0.09	0.15	0.03	0.08	0.07
4000	0.11	0.15	0.09	0.19	0.04	0.08	0.09
4250	0.13	0.17	0.13	0.19	0.04	0.09	0.11
4500	0.14	0.19	0.14	0.22	0.04	0.09	0.12
4750	0.15	0.20	0.17	0.25	0.05	0.10	0.16
5000	0.16	0.22	0.20	0.29	0.06	0.10	0.18
5250	0.17	0.24	0.22	0.32	0.06	0.11	0.19
5500	0.19	0.25	0.25	0.34	0.07	0.12	0.22
5750	0.20	0.27	0.31	0.45	0.07	0.12	0.25
6000	0.22	0.29	0.33	0.52	0.08	0.13	0.27

**TABLE 3
MANUFACTURER'S NUMBERS**

DRIVE NO.	DRIVE COMPONENTS					
	ADJUSTABLE SHEAVE		FIXED SHEAVE		BELT	
	BROWNING NO.	OEM PART NO.	BROWNING NO.	OEM PART NO.	BROWNING NO.	OEM PART NO.
1	1VP34x7/8	31K6901	AK61x1	100244-20	AX54	100245-25
2	1VP40x7/8	79J0301	AK59x1	31K6801	AX55	100245-26
3	1VP34x7/8	31K6901	AK46x1	100244-17	AX52	100245-33
4	1VP44x7/8	53J9601	AK74x1	100244-21	AX58	100245-34
5	1VP50x7/8	98J0001	AK69x1	37L4701	AX58	100245-34
6	1VP50x7/8	98J0001	AK64x1	12L2501	AX57	100245-28
10	1VP50x1-1/8	P-8-1977	BK77x1	49K4001	BX59	59A5001
11	1VP50x1-1/8	P-8-1977	BK67x1	100244-24	BX57	78L5301
12	1VP50x1-1/8	P-8-1977	BK62x1	100244-23	BX56	100245-11

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. Both outdoor fans are energized with a W1 demand.

Note - L1 and L2 reversing valves are de-energized in the heating mode.

KHA/KHB Units With Optional Electric Heat -

An increased heating demand (W2) will energize electric heat. Electric heat is also energized during the defrost cycle (W1) to maintain discharge air temperature.

Cooling Start-Up

▲ IMPORTANT

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

A-Start-Up

Note - Refer to the Supply Air Blower or Inverter Start-Up section.

1- 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 L1 reversing valve solenoid and compressor 1. An increased cooling demand Y2 will initiate L2 reversing valve solenoid and compressor 2.

Units With Optional Economizer -

The optional economizer will start on a first stage (Y1) cooling demand when outdoor air enthalpy is suitable. An increased cooling demand (Y2) will energize compressors 1.

2- Refrigerant circuits are factory charged with HCFC-410A refrigerant. See unit rating plate for correct amount of charge.

3- Units contain two refrigerant circuits or systems. See figure 16 or 17.

REFRIGERANT STAGES - TWO FANS

KHA092S, 102S, 120S:

Y1 Demand = Outdoor Fans 1 & 2 Energized

Y2 Demand = Both fans continue to operate

KHB092H, 102H:

Y1 Demand = Outdoor Fan 1 Low Speed and
Outdoor Fan 2 Low Speed

Y2 Demand = Outdoor Fan 1 High Speed and
Outdoor Fan 2 High Speed

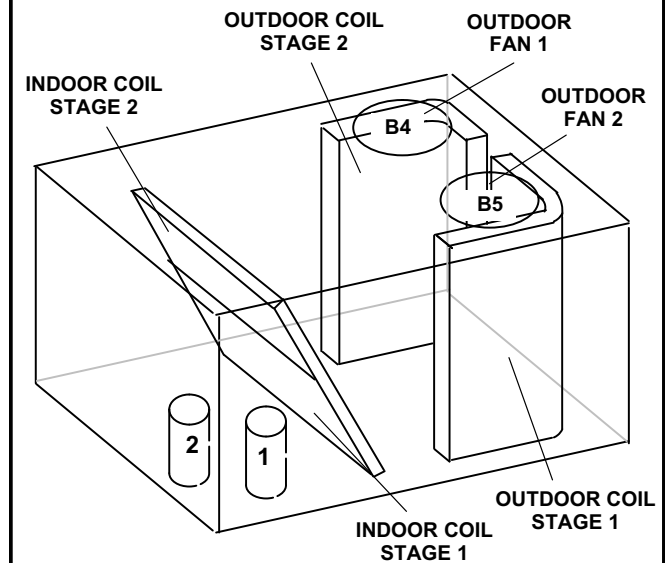


FIGURE 16

REFRIGERANT STAGES - THREE FANS

KHA150S:

Y1 Demand = Outdoor Fan 1, 2, & 3 Energized

Y2 Demand = All fans continue to operate

KHB122H:

Y1 Demand = Outdoor Fan 1 Low Speed and
Outdoor Fan 2 Low Speed and
Outdoor Fan 3 Low Speed

Y2 Demand = Outdoor Fan 1 High Speed and
Outdoor Fan 2 High Speed and
Outdoor Fan 3 High Speed

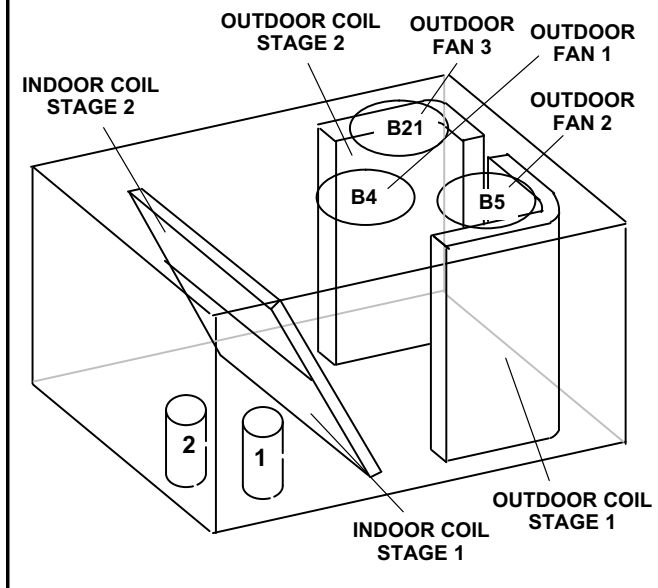


FIGURE 17

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:

- 1- Attach gauge manifolds and operate unit in cooling mode with economizer disabled until system stabilizes (approximately five minutes).
- 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 tables 4 through 10 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.**

TABLE 4
KHA092S NORMAL OPERATING PRESSURES

Outdoor Coil Entering Air Temp	CIRCUIT 1		CIRCUIT 2	
	Dis-charge ±10 psig	Suction ±5 psig	Dis-charge ±10 psig	Suction ±5 psig
65° F	253	139	252	139
75° F	291	141	290	140
85° F	333	144	332	143
95° F	378	146	377	145
105° F	428	149	428	149
115° F	483	153	483	151

TABLE 5
KHB092H NORMAL OPERATING PRESSURES

Outdoor Coil Entering Air Temp	CIRCUIT 1		CIRCUIT 2	
	Dis-charge ±10 psig	Suction ±5 psig	Dis-charge ±10 psig	Suction ±5 psig
65° F	250	140	257	142
75° F	287	143	295	145
85° F	329	146	336	147
95° F	371	148	382	150
105° F	423	151	435	153
115° F	472	154	486	156

TABLE 6
KHA102S NORMAL OPERATING PRESSURES

Outdoor Coil Entering Air Temp	CIRCUIT 1		CIRCUIT 2	
	Dis-charge ±10 psig	Suction ±5 psig	Dis-charge ±10 psig	Suction ±5 psig
65° F	258	132	258	135
75° F	299	136	299	138
85° F	340	140	340	143
95° F	388	144	387	147
105° F	439	149	439	150
115° F	490	154	494	153

TABLE 7
KHB102H NORMAL OPERATING PRESSURES

Outdoor Coil Entering Air Temp	CIRCUIT 1		CIRCUIT 2	
	Dis-charge ±10 psig	Suction ±5 psig	Dis-charge ±10 psig	Suction ±5 psig
65° F	257	136	261	139
75° F	296	139	298	142
85° F	335	141	339	144
95° F	384	144	390	147
105° F	431	147	441	149
115° F	485	150	495	152

**TABLE 8
KHA120S NORMAL OPERATING PRESSURES**

Outdoor Coil Entering Air Temp	CIRCUIT 1		CIRCUIT 2	
	Dis-charge ±10 psig	Suction ±5 psig	Dis-charge ±10 psig	Suction ±5 psig
65° F	261	128	264	131
75° F	299	131	303	131
85° F	342	134	346	135
95° F	387	137	393	138
105° F	436	140	444	144
115° F	489	143	497	147

**TABLE 9
KHB122H NORMAL OPERATING PRESSURES**

Outdoor Coil Entering Air Temp	CIRCUIT 1		CIRCUIT 2	
	Dis-charge ±10 psig	Suction ±5 psig	Dis-charge ±10 psig	Suction ±5 psig
65° F	248	131	251	134
75° F	284	134	287	136
85° F	322	136	329	139
95° F	371	139	381	142
105° F	416	142	429	144
115° F	470	145	488	148

**TABLE 10
KHA150S NORMAL OPERATING PRESSURES**

Outdoor Coil Entering Air Temp	CIRCUIT 1		CIRCUIT 2	
	Dis-charge ±10 psig	Suction ±5 psig	Dis-charge ±10 psig	Suction ±5 psig
65° F	245	130	250	131
75° F	284	134	289	135
85° F	326	137	330	137
95° F	371	140	374	140
105° F	419	144	420	143
115° F	470	147	469	145

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.

C-Charge Verification - Approach Method - AHRI Testing

- Using the same thermometer, compare liquid temperature to outdoor ambient temperature.
Approach Temperature = Liquid temperature (at condenser outlet) minus ambient temperature.
- Approach temperature should match values in table 11. 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 tables 4 through 10 as a guide for typical operating pressures.

**TABLE 11
APPROACH TEMPERATURE**

Unit	Liquid Temp. Minus Ambient Temp.	
	1st Stage	2nd Stage
092S	10°F ± 1 (5.6°C ± 0.5)	10°F ± 1 (5.6°C ± 0.5)
092H, 102S & H	8°F ± 1 (4.4°C ± 0.5)	9°F ± 1 (5.0°C ± 0.5)
120S	6°F ± 1 (3.3°C ± 0.5)	7°F ± 1 (3.9°C ± 0.5)
122H, 150S	6°F ± 1 (3.3°C ± 0.5)	6°F ± 1 (3.3°C ± 0.5)

D-Compressor Controls

- 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).
- 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).
- Crankcase Heater (HR1, HR2)
Compressors have belly band compressor oil heaters which must be on 24 hours before running compressors. Energize by setting thermostat so that there is no cooling demand, to prevent compressor from cycling, and apply power to unit.
- 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
- Defrost Termination Switches (S46, S104)
Defrost pressure switches open to terminate defrost when vapor (discharge pressure during cooling and defrost) pressure reaches 450 psig (3103 kPa).
- Defrost Controls (CMC1)
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 pressure reaches 450 ± 10 psi.
Electric heat is energized during defrost to maintain discharge air temperature.

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 18.

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.

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 12

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

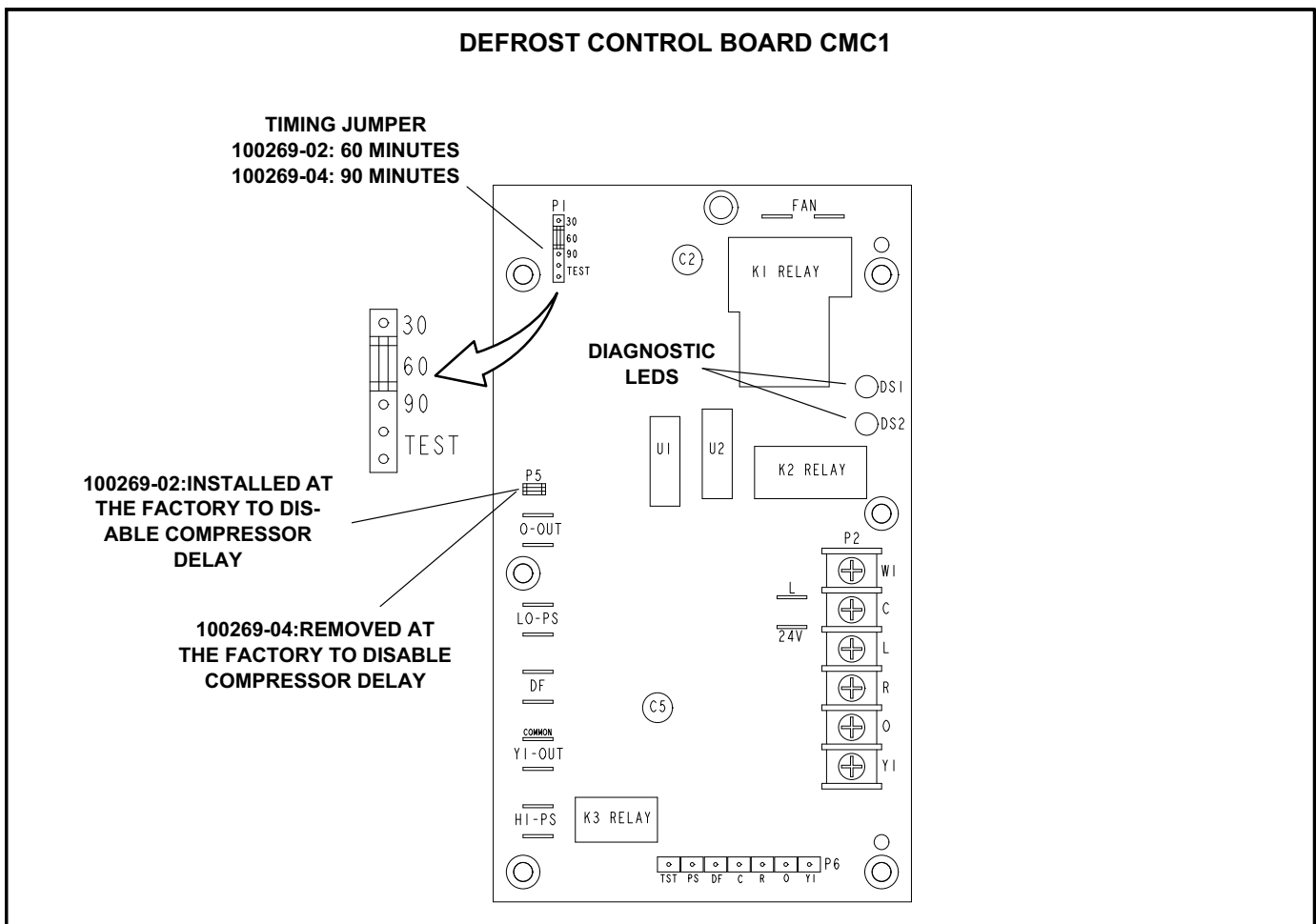


FIGURE 18

KHA Belt Drive Supply Air Inverter Start-Up

A-General

- 1- Units are equipped with an inverter (variable frequency drive or VFD) which provides 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.
- 2- Units will operate at high speed during ventilation (blower "G" only signal) but can be adjusted to operate at low speed.
- 3- 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 19.

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 19.

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.

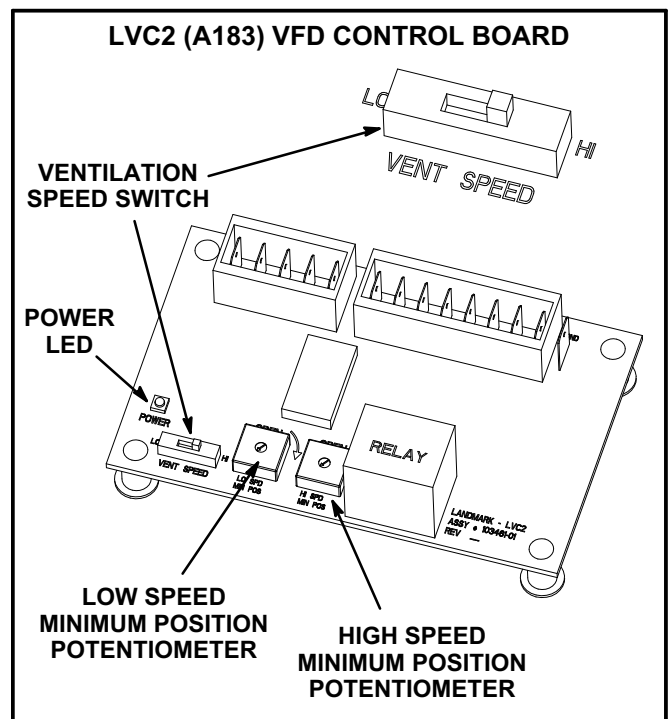


FIGURE 19

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 20.

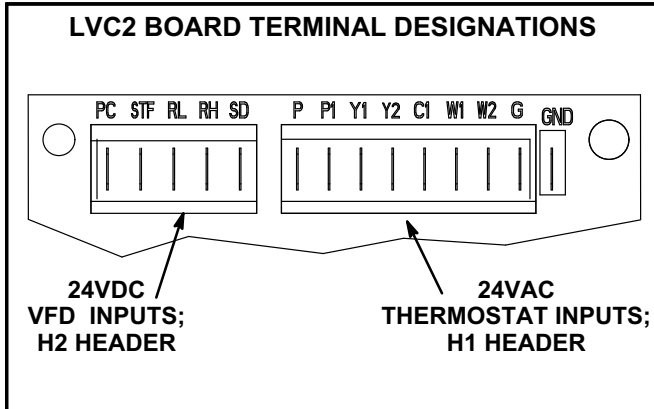


FIGURE 20

- 4- If there is no thermostat signal, troubleshoot back toward the thermostat.
- 5- Check the power LED on the board. See figure 19.
- 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 13.

9- If all inputs are correct and the unit still does not operate as intended, replace LVC2 board.

**TABLE 13
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	

KHB092H & 102H Belt Drive Supply Air Inverter Start-Up

A-General

Units are equipped with an inverter (variable frequency drive or VFD) which provides 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.

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 FCB control board to “LO”. See figure 21.

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 FCB control board to adjust minimum damper position. See figure 21.

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 FCB control board to “HI”.
- 3- Rotate the high speed potentiometer on the FCB control board to set the high speed minimum damper position.

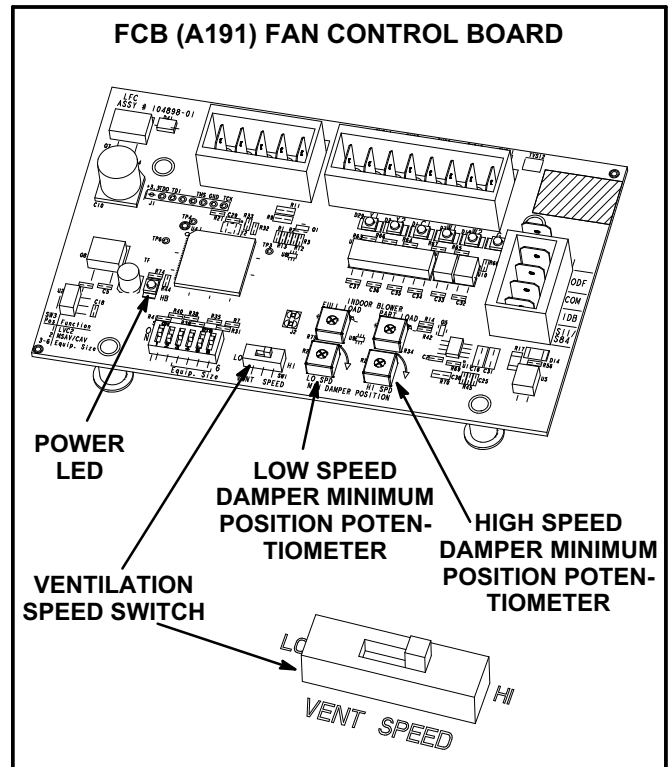


FIGURE 21

- 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 FCB control board to “LO”.
- 3- Rotate the low speed potentiometer on the FCB 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.

Troubleshoot FCB Board (A191)

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

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

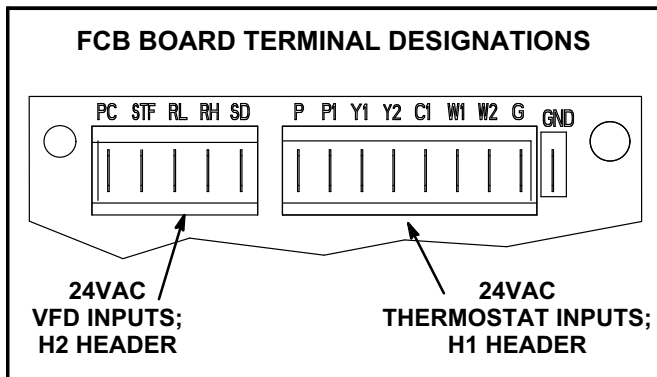


FIGURE 22

- 4- If there is no thermostat signal, troubleshoot back toward the thermostat.
- 5- Check the power LED on the board. See figure 23.
- 6- The LED should be blinking at a 1-second rate when operating normally. If the LED is dim and not blinking, this indicates power is provided but a problem exists with the board.
- 7- If the power LED is not on, check voltage between FCB terminals PC (H2-1) and SD (H2-5). Voltage should read 24VAC.
- 8- If voltage does not read 24VAC, disconnect the H2 header from the FCB VFD inputs terminal block (to make sure the FCB is not shorting 24VAC supply from the inverter). Measure the voltage between the end terminals on the H2 header. If 24VAC is present, replace the FCB board. If no voltage is read, troubleshoot the VFD.

Direct Drive Supply Air Blower Start-Up

A-General

Units are equipped with a direct drive blower which can be set at high and low speed. The blower will operate at lower speeds when demand is low and higher speeds when demand is high. This results in lower energy consumption.

B-Set Blower CFM

See figure 23.

- 1- Initiate a blower (G) only signal from the room thermostat or control system. The blower will operate in high speed.
- 2- Measure the blower RPM and static pressure and use appropriate blower table to calculate supply air CFM. See *Determining Unit CFM* in the Blower Operation and Adjustment section.
- 3- If the resulting CFM is lower than the desired CFM, rotate the fan control board high speed potentiometer clockwise (or counterclockwise if CFM is too high).
- 4- Calculate the CFM and adjust potentiometer as needed to meet desired CFM
- 5- Initiate a blower (G) AND first-stage (Y1) cooling signal from the room thermostat or control system. The blower will operate in low speed.
- 6- Calculate the low speed CFM in the same manner as the high speed CFM.
- 7- Adjust low speed potentiometer as needed to meet desired CFM.

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 FCB control board to "LO". See figure 23.

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 FCB control board to adjust minimum damper position. See figure 19.

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 FCB control board to "HI".
- 3- Rotate the high speed potentiometer on the FCB 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.

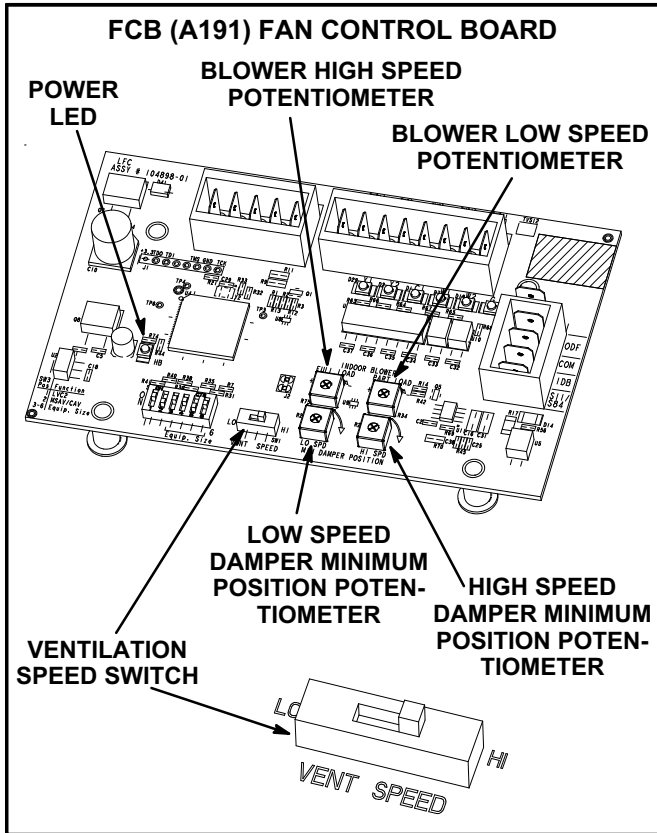


FIGURE 23

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 FCB control board to "LO".
- 3- Rotate the low speed potentiometer on the FCB 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.

Troubleshoot FCB Board (A191)

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

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

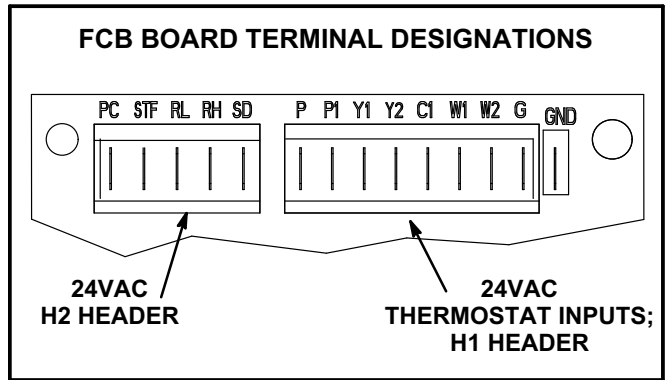


FIGURE 24

- 4- If there is no thermostat signal, troubleshoot back toward the thermostat.
- 5- Check the power LED on the board. See figure 23.
- 6- The LED should be blinking at a 1-second rate when operating normally. If the LED is dim and not blinking, this indicates power is provided but a problem exists with the board.
- 7- If the power LED is not on, check voltage between FCB terminals PC (H2-1) and SD (H2-5). Voltage should read 24VAC.
- 8- If voltage does not read 24VAC, disconnect the H2 header from the FCB terminal block (to make sure the FCB is not shorting 24VAC supply from terminal strip TB1). Measure the voltage between the end terminals on the H2 header. If 24VAC is present, replace the FCB board.

Service

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

⚠ CAUTION

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

A-Lubrication

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

B-Filters

Units are equipped with four 20 X 25 X 2" filters. Filters should be checked monthly 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 25.

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

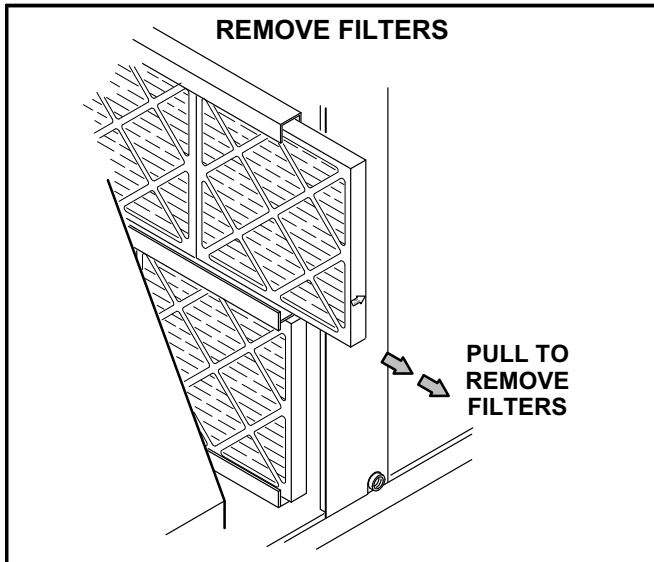


FIGURE 25

C-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.

D-Indoor Coil

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

E-Outdoor Coil

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

Condenser 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 26. Flush coils with water following cleaning.

F-Filter Drier

The unit is equipped with a bi-flow filter drier. If replacement is necessary, order another of like design.

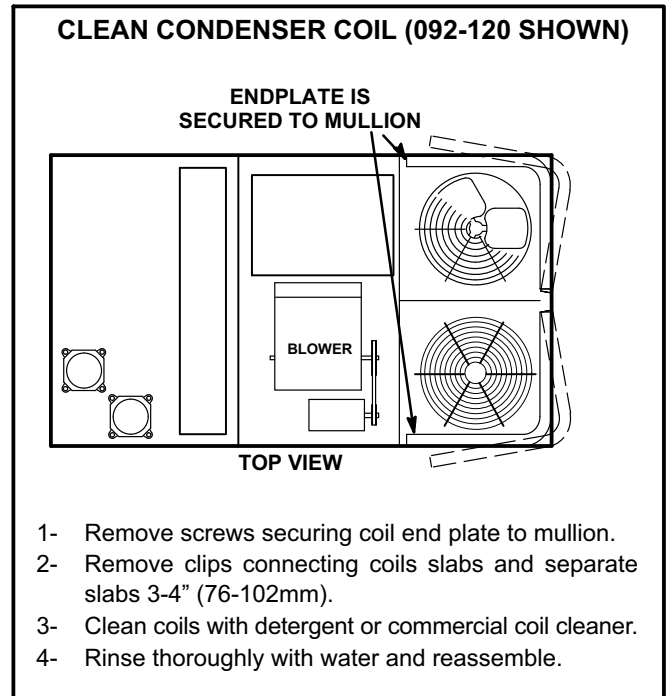


FIGURE 26

START-UP REPORT

Job Name: _____
 Store No. _____ Start-Up Date: _____
 Address: _____
 City: _____ State: _____
 Start-Up Contractor: _____
 Technician: _____
 Model No.: _____
 Serial No.: _____
 RTU No.: _____ Catalog No.: _____

Inspections and Checks			
Damage?	Yes	No	R22 <input type="checkbox"/> R410A <input type="checkbox"/>
If yes, reported to: _____			
Verify factory and field-installed accessories.			
Check electrical connections. Tighten if necessary.			
Supply voltage: L1-L2 _____ L1-L3 _____ L2-L3 _____			
If unit contains a 208-230/240 volt transformer:			
Check primary transformer tap <input type="checkbox"/>			
Transformer secondary voltage: _____			

Cooling Checks												
Compressor Rotation <input type="checkbox"/> Ambient Temp. _____ Return Air Temp. _____ Supply Air Temp. _____												
	Compressor Amps			Compressor Volts			Pressures		Condenser Fan Amps			CC Heater Amps
	L1	L2	L3	L1-L2	L1-L3	L2-L3	Disch.	Suct.	L1	L2	L3	L1
1												
2												
3												
4												

Blower Checks			
Pulley/Belt Alignment	<input type="checkbox"/>	Blower Rotation	<input type="checkbox"/>
Set Screws Tight	<input type="checkbox"/>	Belt Tension	<input type="checkbox"/>
Nameplate Amps: _____		Volts: _____	
Motor	Amps	Volts	
	L1 _____	L1-L2 _____	
	L2 _____	L1-L3 _____	
	L3 _____	L2-L3 _____	

Heating Checks - Electric							
Return Air Temp.: _____ Supply Air Temp.: _____							
Limits Operate: <input type="checkbox"/>							
	Amps						
	L1	L2	L3		L1	L2	L3
1				10			
2				11			
3				12			
4				13			
5				14			
6				15			
7				16			
8				17			
9				18			

Heating Checks - Gas		
Fuel type: Nat. <input type="checkbox"/> LP <input type="checkbox"/> Inlet Pressure: _____ in. w.c.		
Return Air Temp.: _____ Supply Air Temp.: _____		
Altitude: _____ Primary Limits Operate: <input type="checkbox"/>		
CO ₂ %: _____		
Gas Valve	Manifold Pressure	
	Low Fire	High Fire
GV1		
GV2		

Control Type

Accessory Checks	
Power Exhaust Amps	
1 _____	2 _____ None <input type="checkbox"/>
Economizer Operation	
Min. Pos. <input type="checkbox"/>	Motor travel full open/close <input type="checkbox"/>