

**CB31MV SERIES UNIT
INCLUDING ECB29/31 ELECTRIC HEAT**

The CB31MV is a high efficiency residential split system blower/coil featuring a variable speed motor (VSM) controlled by an electronic blower drive control (BDC).

CB31MV series units are designed to be matched with Lennox two-speed or single-speed condensing units and heat pumps. Several models are available in sizes ranging from 3 through 5 tons. All units are equipped with factory installed check and expansion valve for cooling or heat pump applications.

ECB29/31 electric heat is available in several voltages and kW sizes, and can be field installed in the cabinets.

Some CB31MV applications may include the optional Efficiency Plus Comfort Management Control (CCB1). The control is installed indoors adjacent to the indoor thermostat. Its purpose is to vary indoor blower speed in response to indoor dehumidification demand. When a two-speed outdoor unit is used, compressor speed can also be controlled by the CCB1 in response to indoor dehumidification demand. The CCB1 can control the compressor speed, only if there is a demand for cooling from the indoor thermostat.

Information contained in this manual is intended for use by experienced HVAC service technicians only. All specifications are subject to change. Procedures outlined in this manual are presented as a recommendation only and do not supersede or replace local or state codes.

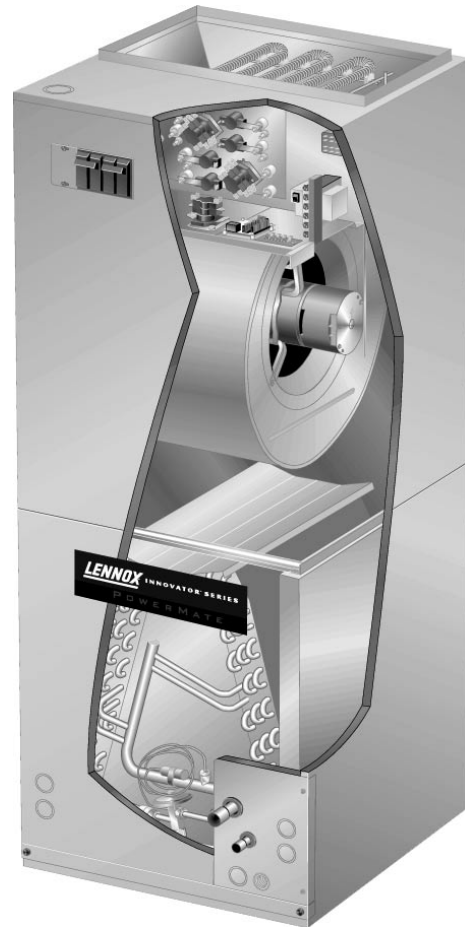


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**ELECTROSTATIC DISCHARGE (ESD)
Precautions and Procedures**

⚠ CAUTION

Electrostatic discharge can affect electronic components. Take precautions during unit installation and service to protect the unit's electronic controls. Precautions will help to avoid control exposure to electrostatic discharge by putting the unit, the control and the technician at the same electrostatic potential. Neutralize electrostatic charge by touching hand and all tools on an unpainted unit surface before performing any service procedure.

SPECIFICATIONS -CB31MV

Model Number		CB31MV-41	CB31MV-51	CB31MV-65	
Evaporator Coil	Net face area — ft. ² (m ²)	5.0 (0.46)	7.22 (0.67)	7.22 (0.67)	
	Tube outside diameter — in. (mm)	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	
	Number of rows	3	3	3	
	Fins per inch (fins per m)	12 (472)	12 (472)	12 (472)	
	Suct. (vapor) line conn. - in. (mm) sweat	3/4 (19)	7/8 (22.2)	1-1/8 (28)	
	Liquid line conn. — in. (mm) sweat	3/8 (9.5)	3/8 (9.5)	3/8 (9.5)	
Condensate drain connection (fpt) — in. (mm)		(2) 3/4 (19)	(2) 3/4 (19)	(2) 3/4 (19)	
Nominal cooling capacity — tons (kW)		3 (10.6)	4 (14.1)	5 (17.6)	
Refrigerant		HCFC-22			
Blower wheel nominal diameter x width — in. (mm)		10 x 8 (254 x 203)	12 x 9 (305 x 229)	12 x 9 (305 x 229)	
Blower motor output — hp (W)		1/2 (373)	1 (746)	1 (746)	
††Number and size of filters	in.	(1) 20 x 20 x 1	(1) 20 x 24 x 1		
	mm	(1) 508 x 508 x 25	(1) 508 x 610 x 25		
Electrical characteristics (60hz)		208/230v - 1ph			
Shipping weight — lbs. (kg) 1 package		183 (83)	212 (96)	212 (96)	
↘ Optional Accessories (Must Be Ordered Extra) ↙					
Side Return Unit Stand (Up-Flow Only) - Shipping weight - lbs. (kg)		45K32 - 6 (3)			
Wall Hanging Bracket Kit (Up-Flow Only) - Shipping wt. - lbs. (kg)		45K30 - 3 (1)			
Down-Flow Combustible Base - Shipping weight - lbs. (kg)		34J73 - 8 (4)			
Electric Heat Capacity (1 phase)	ECB29-5, ECB29-5CB	*Output - Btuh (kW)	18,000 (5.3)	18,000 (5.3)	18,000 (5.3)
		†A.F.U.E.	100%	100%	100%
	ECB29-8, ECB29-8CB	*Output - Btuh (kW)	29,000 (8.5)	29,000 (8.5)	30,000 (8.8)
		†A.F.U.E.	100%	100%	100%
	ECB31-10, ECB31-10CB	*Output - Btuh (kW)	35,000 (10.3)	36,000 (10.5)	37,000 (10.8)
		†A.F.U.E.	100%	100%	100%
	ECB29-12.5CB	*Output - Btuh (kW)	44,000 (12.9)	45,000 (13.2)	46,000 (13.5)
		†A.F.U.E.	100%	100%	100%
	ECB29-15CB	*Output - Btuh (kW)	52,000 (15.2)	53,000 (15.5)	54,000 (15.8)
		†A.F.U.E.	100%	100%	100%
	ECB31-20CB	*Output - Btuh (kW)	70,000 (20.5)	70,000 (20.5)	71,000 (20.8)
		†A.F.U.E.	100%	100%	100%
	ECB29-25CB	*Output - Btuh (kW)	----	87,000 (25.5)	88,000 (25.8)
		†A.F.U.E.	----	100%	100%

†Annual Fuel Utilization Efficiency based on U.S. DOE test procedures and according to FTC labeling regulations.

††Disposable frame type filter.

*Includes additional blower motor heat capacity.

CB31MV PARTS ARRANGEMENT

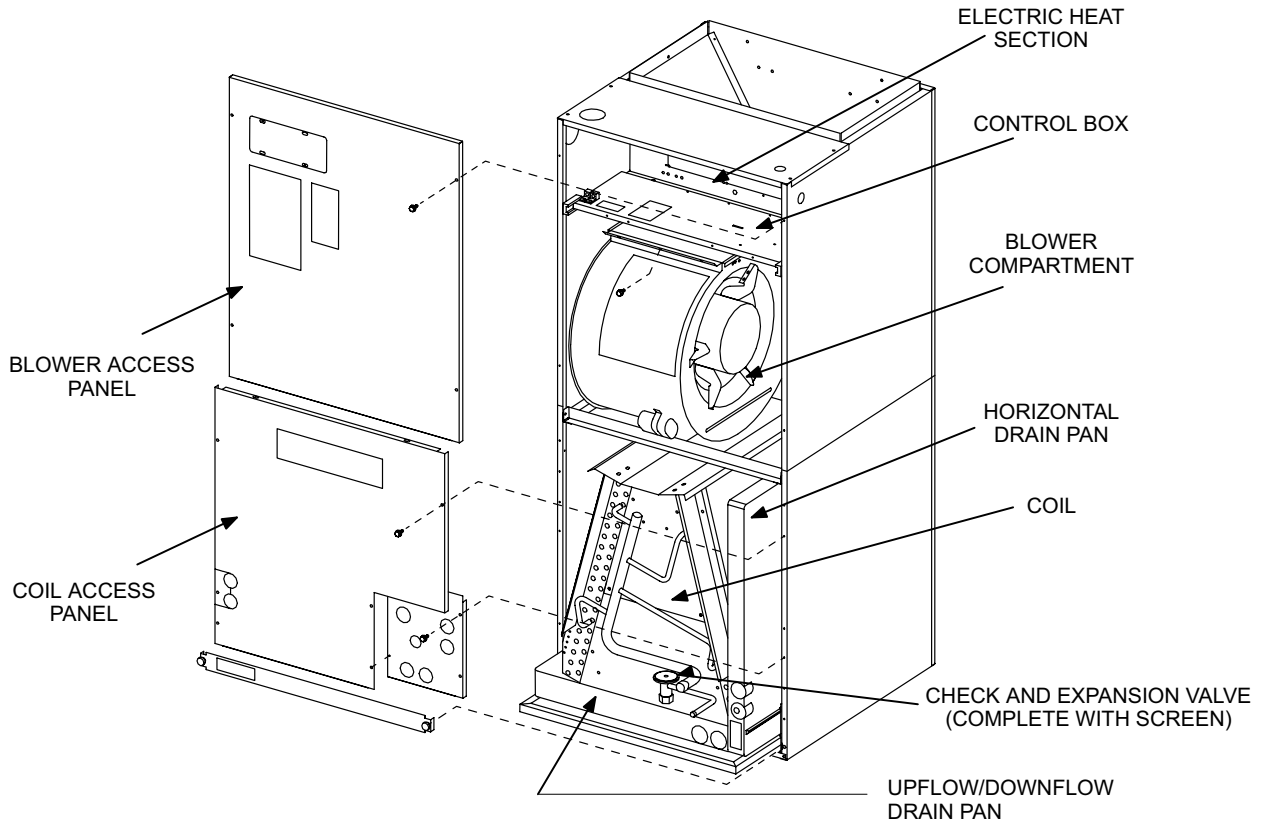


FIGURE 1

CB31MV CONTROL BOX

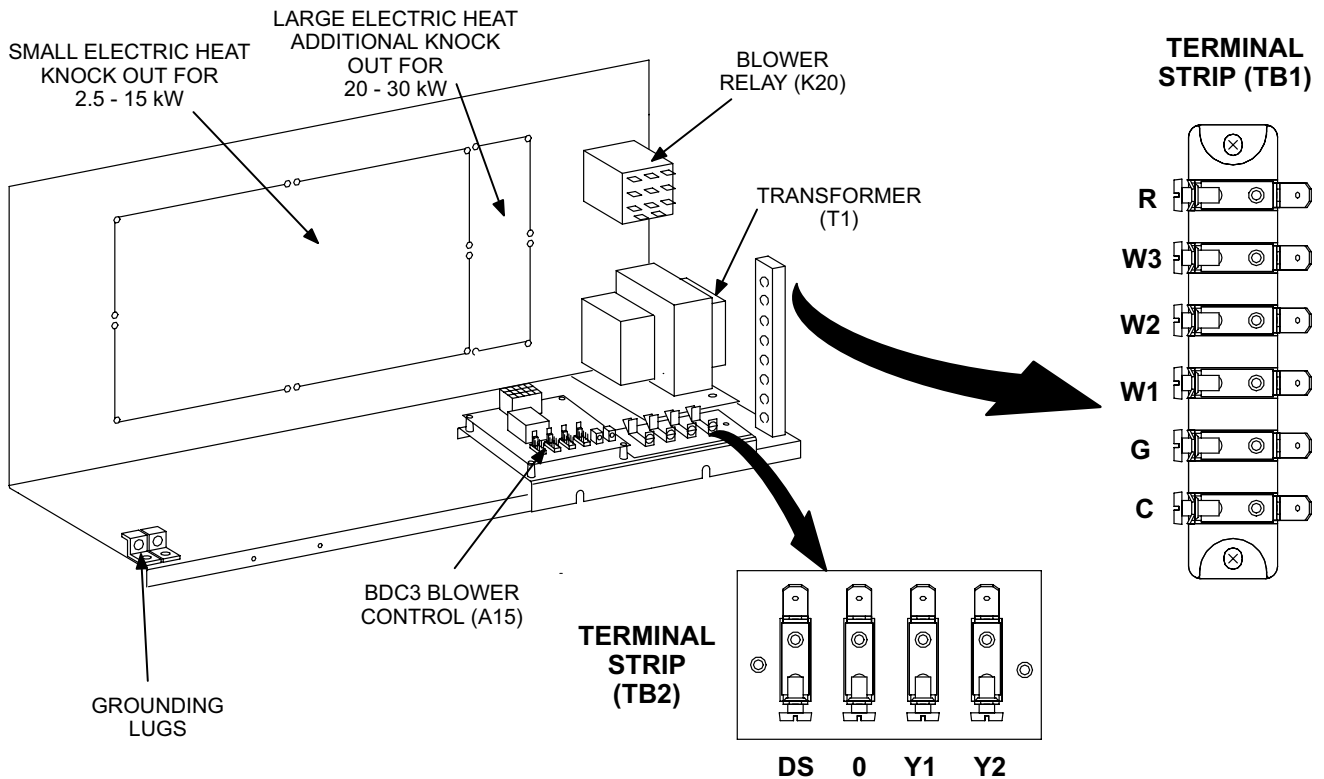


FIGURE 2

I-APPLICATION

All major blower coil components must be matched according to Lennox recommendations for the unit to be covered under warranty. Refer to the Engineering Handbook for approved system matchups. A misapplied system will cause erratic operation and can result in early unit failure. The units come with factory installed check and expansion valve for all applications. It has been installed internally and is accessible if required.

II-UNIT COMPONENTS

A-Control Box

The CB31MV control box is shown in figure 2. Line voltage and electric heat connections are made in the control box. Optional electric heat fits through an opening located in the center of the control box. When electric heat is not used, knockout plates cover the opening. The electric heat control arrangement is detailed in the electric heat section of this manual.

B-Terminal Strips (TB1 and TB2)

All CB31MV units are equipped with two low voltage terminal strips (TB1 and TB2) located in the control box. See figure 2. The strips are used for making up all indoor thermostat wires.

On-Board Jumpers.

CB31MV units manufactured January 2002 and later.

All CB31MV units manufactured January 2002 and later, will have factory installed jumpers connecting DS to Y1, R to O and Y1 to Y2. These jumpers will have to be removed in certain unit application. See the table below.

Application	Remove Jumpers
Harmony II, CCB1 or SignatureStat	DS to Y1
Heat Pump	R to O
Two-Stage Cooling	Y1 to Y2

C-Transformer (T1)

All CB31MV series units use a single line voltage to 24VAC transformer mounted in the control box. The transformer supplies power to the control circuits in the indoor and outdoor unit. Transformers on all CB31MV-1 units and CB31MV-51, -61-2 units are rated at 70VA. Transformers on CB31MV-41-2 units are rated at 40VA. 208/240VAC single-phase transformers use two primary voltage taps as shown in figure 3.

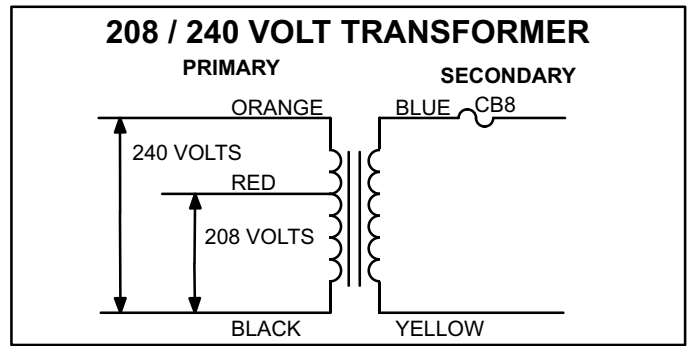


FIGURE 3

D-Circuit Breaker (CB8) -1 units

All transformers used in the CB31MV-1 series units are equipped with internal secondary voltage overcurrent protection. Each transformer uses a manual re-set circuit breaker (CB8) located on the transformer. The circuit breaker is connected in series with the blue secondary voltage wire and is rated at 3.5 Amps.

E-Fuse (F1) -2 units

The transformer used in all CB31MV-2 units is protected by an inline fuse (F1). The fuse is rated at 32 volts and 3 amps.

F-Plastic Drain Pans

Both upflow/downflow and horizontal drain pans are provided and installed on the CB31MV units. The drain pans are made from fiberglass-filled plastic. The drain hole is used for right-hand air discharge only, and must be plugged when the unit is configured for left-hand air discharge (see page 24 for horizontal left-hand application). Each pan has a set of connections, one for a primary drain and one for an auxiliary drain.

G-Coil

All CB31MV series units have dual slab coils arranged in an "A" configuration. Each coil has two or three rows of copper tubes fitted with ripple-edge aluminum fins. A check and expansion valve complete with screen feeds multiple parallel circuits through the coils. The coil is designed to easily slide out of the unit cabinet.

H-Blower Relay (K20)

All units use SPDT relay to energize the blower motor in response to heating demand. The relay coil is energized when the 1st stage electric heat relay closes. When K20 is energized, its N.O. contacts close to energize jackplug JP46 pin 2 (located on blower drive control A15). When JP46-2 is energized, the blower drive control immediately energizes the blower on heating speed. Heating speed will override cooling speed. K20-2 will energize the economizer if used (refer to wiring diagram.)

Optional electric heating elements are sequenced so blower relay K20 operates on a first on/last off basis.

I-Variable Speed Blower Motor (B3)

CB31MV series units use a single-phase VSM (variable-speed motor, see figure 4). A solid-state controller is attached to the motor.

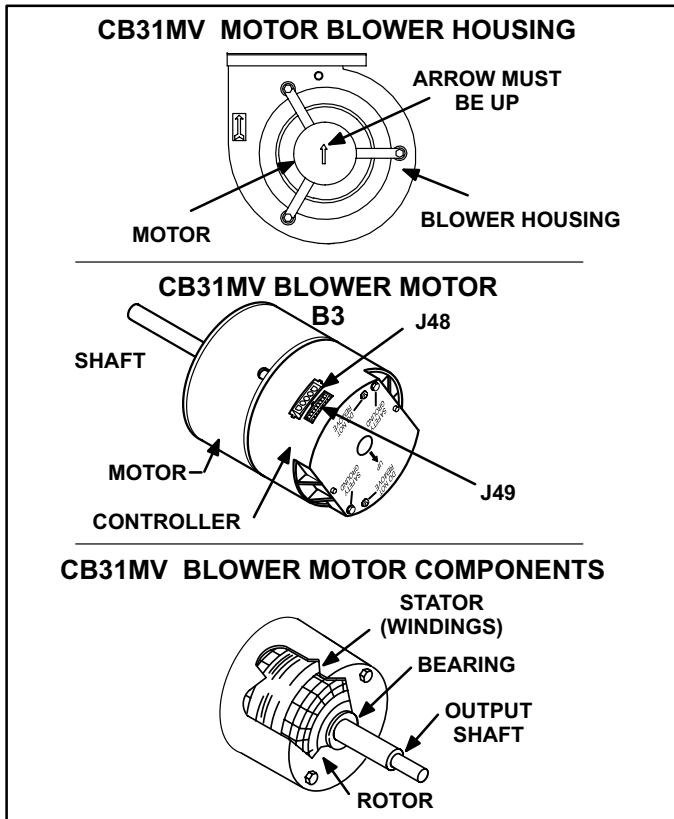


FIGURE 4

J-BDC3 Blower Control Board (A15)

CFM on the CB31MV unit is controlled by the BDC3 board (A15) located in the control box. CFM can be obtained by positioning jumpers (**COOL**, **HEAT** and **ADJUST**) on the BDC3 board. The jumpers are labeled 1,2,3, and 4. Each enables a different air volume. Diagnostic LEDs are provided as an aid in identifying the unit's mode of operation. The LEDs are labeled **RUN** and **CFM**. See figure 5.

BLOWER SPEED ADJUSTMENTS

Diagnostic LEDs

“RUN”

RUN indicates there is a demand for the blower motor to run.

“CFM”

CFM LED indicates the CFM the unit is operating according to the jumper settings. The light flashes once for approximately every 100 CFM. For example, if the unit is operating at 1000 CFM, **CFM** LED will flash 10 times. If the CFM is 1150, **CFM** LED will flash 11 full times plus one fast or half flash.

At times the light may appear to flicker or glow. This takes place when the control is communicating with the motor between cycles. This is normal operation.

The appropriate speed according to application and CFM need is selected by moving jumper pins.

Jumper Settings

⚠ IMPORTANT

Before changing jumper setting, make sure the motor has completely stopped. Any jumper setting change will not take place while the motor is running.

Table 1 shows the recommended factory blower speed tap selections for CB31MV series units. These settings are for nominal tonnage match-ups with the CB31MV. When matched with other sizes, it is recommended that the CFM be adjusted to approximately 400 CFM per ton.

TABLE 1
FACTORY BLOWER SPEED TAP SELECTION

CB31MV BLOWER COIL	SPEED TAP SELECTION			
	“COOL”		“HEAT”	
	CONDENS- ING UNIT	HEAT PUMP	*CONDENS- ING UNIT WITH ELECTRIC HEAT ONLY	*HEAT PUMP WITH ELECTRIC HEAT
-41	COOL PIN #3	COOL PIN #3	HEAT PIN #4	HEAT PIN #4
-51	COOL PIN #2	COOL PIN #2	HEAT PIN #1	HEAT PIN #1
-65	COOL PIN #3	COOL PIN #3	HEAT PIN #1	HEAT PIN #1

*Minimum setting for heat.

To change jumper positions, gently pull the jumper off the pins and place it on the desired set of pins. The following section outlines the different jumper selections available and conditions associated with each one. Refer to figure 5 for identification.

After the CFM for each application has been determined, the jumper settings must be adjusted to reflect those given in tables 2 and 3. From tables 2 and 3, determine which row of CFM volumes most closely matches the desired CFM. Once a specific row has been chosen (+, NORMAL, or -), CFM volumes from other rows cannot be used. Below are the descriptions of each of the jumper selections.

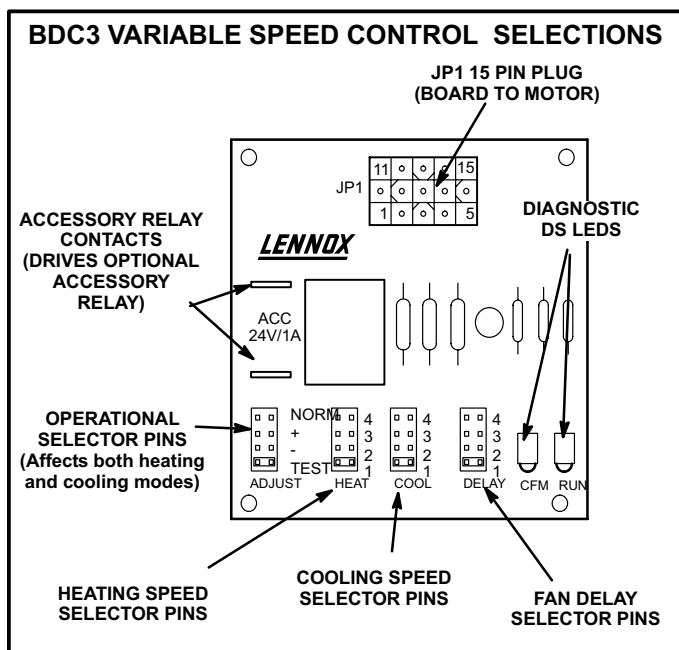


FIGURE 5

“ADJUST”

The **ADJUST** pins allow the motor to run at normal speed, approximately 10% higher, or approximately 10% lower than normal speed. Tables 2 and 3 give three rows (+, NORMAL, and -) with their respective CFM volumes. Notice that the normal adjustment setting for heat speed position #3 is 1315 CFM. The + adjustment setting for that position is 1445 CFM and for the - adjustment setting is 1185 CFM. After the adjustment setting has been determined, chose the remainder speed jumper settings from those offered in the table in that row.

The TEST pin is available to bypass the BDC3 control and run the motor at approximately 70% to test that the motor is operational. This is beneficial primarily in troubleshooting. G must be energized for motor to run.

“COOL”

The **COOL** jumper is used to determine the CFM during either 1) cooling or 2) heat pump operation without a call for electric heat. These jumper selections are activated for cooling when Y2 and DS terminals in the CB31MV are energized and for heating when Y2 is energized.

Applications **without** the Lennox SignatureStat™ or Efficiency Plus™ CCB1 humidity control will provide 70% of the **COOL** CFM during first-stage cooling for two-speed outdoor units. Units built prior to August 2002 will provide either 60% (-51 & -65 series units) or 65% (-41 series units) of the **COOL** CFM during first-stage cooling for two-speed outdoor units. 100% of **COOL** CFM is provided for systems with a single-speed outdoor unit.

NOTE: For two speed heat pumps, blower will operate at 60%, 65% or 70% of **COOL** selection. For single speed heat pumps blower will operate at 100% of **COOL** selection until supplemental electric heat is demanded. At that time, the blower will operate at the **HEAT** speed selected. This arrangement provides for warmer supply air during heat pump operation only.

“HEAT”

The **HEAT** jumper is used to determine CFM during a W1 demand for electric heat operation. These jumper selections are activated when W1 is energized with or without a Y1 demand for heat pump compressor.

“DELAY”

The **DELAY** jumper is used to set the specific motor fan mode of operation during cooling. Depending on the application, one of four fan options may be chosen by moving the jumper pins to the appropriate set of pins. Options 1, 2, 3, or 4 will have an increased dehumidification effect on the system. Option 1 will have the least effect and option 4 will have the greatest effect.

Applications with the EfficiencyPlus CCB1 humidity control create different CFM volumes. For example, during a first-stage cooling call (two-speed outdoor unit) with no demand from the CCB1, the air volume is 40% of the **COOL** jumper selection. For a normal **COOL** (Pin #2 setting for CB31MV-41), the CFM is 1125; the reduced speed is 450 CFM (1125 x 40% = 450). This arrangement provides for additional dehumidification during standard first stage cooling. See tables 10 and 11 for various scenarios concerning use of the CCB1 humidity control and the CB31MV series unit.

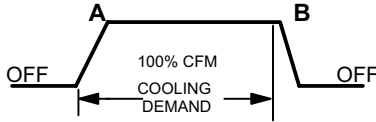
Applications with the Lennox SignatureStat but no demand for dehumidification will operate as follows: during a first-stage cooling call (two-speed outdoor unit) the air volume is 70% of the **COOL** jumper selection. For a normal **COOL** (Pin #2 setting for CB31MV-41), the CFM is 1125; the reduced speed is 788 CFM (1125 x 70% = 788). This arrangement provides for additional dehumidification during standard first stage cooling. See tables 12 and 13 for various scenarios concerning use of the SignatureStat and the CB31MV series unit.

For applications with Harmony II® zone control, the blower CFM volume is determined by the Harmony II control center. The minimum blower speed is predetermined at 650 CFM for -41 series units and 850 CFM for -51 and -65 series units. This speed is not adjustable. See footnotes in tables 2 and 3. With the thermostat set for “Continuous Fan” and without a call for heating or cooling, the CB31MV will provided 50% of the **COOL** CFM selected.

CB31MV units built prior to February 2003

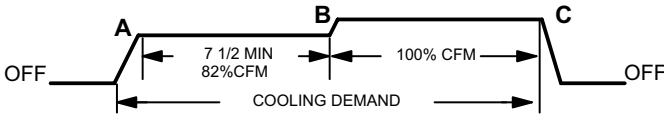
#1 Pins Jumpered

- A- Motor runs at 100% until demand is satisfied.
- B- Once demand is met, motor ramps down to stop.



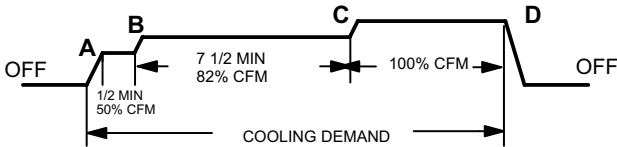
#2 Pins Jumpered

- A- Motor runs at 82% for approximately 7-1/2 minutes. If demand has not been satisfied after 7-1/2 minutes -
- B- motor runs at 100% until demand is satisfied.
- C- Once demand is met, motor ramps down to stop.



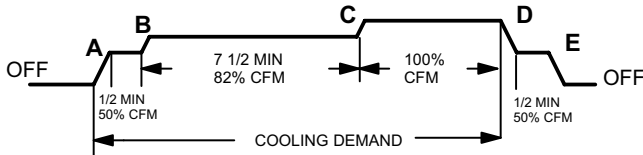
#3 Pins Jumpered

- A- Motor runs at 50% for 1/2 minute.
- B- Motor then runs at 82% for approximately 7-1/2 minutes. If demand has not been satisfied after 7-1/2 minutes.
- C- Motor runs at 100% until demand is satisfied.
- D- Once demand is met, motor ramps down to off.



#4 Pins Jumpered

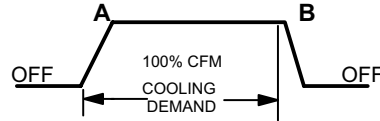
- A- Motor runs at 50% for 30 seconds.
- B- Motor then runs at 82% for approximately 7-1/2 minutes. If demand has not been satisfied after 7-1/2 minutes.
- C- Motor runs at 100% until demand is satisfied.
- D- Once demand is met, motor runs at 50% for 30 seconds then -
- E- Motor ramps down to stop.



CB31MV units built February 2003 and later

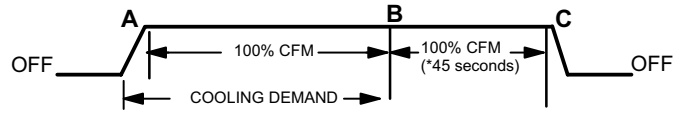
#1 Pins Jumpered

- A- Motor runs at 100% until demand is satisfied.
- B- Once demand is met, motor ramps down to stop.



#2 Pins Jumpered

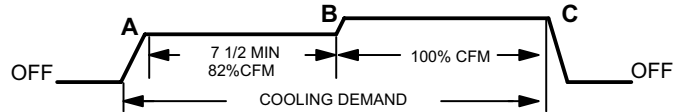
- A- Motor runs at 100% until demand is satisfied.
- B- Once demand is met, motor runs at 100% for 45* seconds.
- C- Motor ramps down to stop.



* CB31MV units date coded prior to 2-2006 will delay 60 seconds

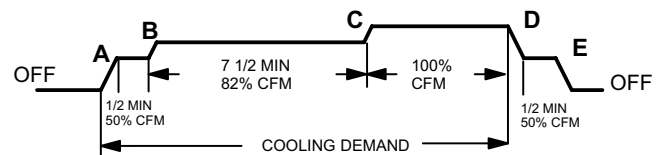
#3 Pins Jumpered

- A- Motor runs at 82% for approximately 7-1/2 minutes. If demand has not been satisfied after 7-1/2 minutes -
- B- Motor runs at 100% until demand is satisfied.
- C- Once demand is met, motor ramps down to stop.



#4 Pins Jumpered

- A- Motor runs at 50% for 30 seconds.
- B- Motor then runs at 82% for approximately 7-1/2 minutes. If demand has not been satisfied after 7-1/2 minutes,
- C- Motor runs at 100% until demand is satisfied.
- D- Once demand is met, motor runs at 50% for 30 seconds.
- E- Motor ramps down to stop.



III-Troubleshooting The VSM

DO

- Check motor, controls, wiring and connections thoroughly before replacing.
- Use proper replacement parts for motor and control model numbers.
- Keep duct static to a minimum.
- Size equipment properly.
- Check orientation before inserting motor connector.

DON'T

- Automatically assume the motor is bad.
- Locate connectors above 7 and 4 o'clock positions.
- Replace a control or motor number with an unauthorized replacement.
- Use high pressure drop filters.
- Use restricted returns.
- Oversize systems then compensate with low airflow.

MOISTURE CHECK

- Connectors should point downward.
- Arrange harness with drip loop under motor.
- Check condensate drain plug.
- Check for airflow (too much latent capacity).
- Check for undercharged condition.
- Check for plug leaks in return ducts, cabinet.

VSM CHECK

Kit #70J11 can be used to check the VSM. The kit is available at the Lennox parts center. If not using the kit, follow the procedure below. These settings and jumper placements will bypass the BDC3 control board and confirm correct VSM operation.

*60/65/70% of Cool speed

- Disconnect power to the unit.
- Change delay pin setting on the BDC3 board to #1
- Remove wires from terminal strips in control box.
- Install jumpers between "R" and "Y1" and "R" and "G"
- Turn on power to unit. Blower should operate on 60/65/70% of cool speed.
- When check is complete disconnect power and replace delay setting to original position.

**Reduced blower speed is 65% of COOL for the -036 UNITS; 60% of COOL for -048 and -060 series units manufactured prior to August 2002 and 70% COOL for ALL units manufactured August 2002 and later.*

Cool speed

- Disconnect power to unit.
- Change delay pin setting on the BDC3 board to #1
- Remove wires from terminal strips in control box.
- Install jumpers between "R" and "Y1", "R" and "Y2", "R" and "DS" and "R" and "G".
- Turn on power to unit. Blower should operate on cool speed.
- When check is complete disconnect power and replace delay setting to original position.

Heat Speed

- Disconnect power to the unit.
- Change delay pin setting on the BDC3 board to #1
- Remove wires from terminal strips in control box.
- Install jumper between "R" and "W1".
- Turn on power to unit. Blower should operate on heat speed.
- When check is complete disconnect power and replace delay setting to original position.

Symptom	Cause/Procedure
Motor rocks slightly when starting	This is normal start-up for the VSM
Motor will not start, no movement	Check power at motor. Check low voltage (24vac R to C) at motor. Check low voltage connection (G, Y, R, C) at motor. Check for unseated pins on motor harness. Test with temporary jumper between R-G. Check motor for tight shaft. Run moisture check.
Motor rocks, but won't start	Check for loose or compliant motor mount. Make sure blower wheel is tight on shaft.
Motor starts, but varies up and down or intermittent	Check line voltage for variation or "sag." Check low voltage connections (G, Y, R, C) at motor. Check for unseated pins in motor harness. Check "DS" on terminal strip for CFM command. Check system controls thermostat. Perform moisture check.
Motor "Hunts" or "Puffs" at high CFM	If removing panel or filter reduces "Puffing" reduce restriction or reduce max airflow.
Stays at low CFM despite system call for cool or heat CFM	Check low voltage thermostat wires and connections. Verify fan is not in delay mode. Check "R" missing/not connected to motor. Perform VSM check.
Stays at high CFM	Check "R" connection at motor. Check fan delay, wait until complete. Perform VSM check.
Blower will not shut off	Current leakage from controls into G, Y or W? Check for Triac switched thermostat or solid state relay.
Air noise	Check for proper airflow setting. Check/replace filter. Use low pressure drop filter. Check/correct duct restrictions.
Noisy Blower or cabinet	Check for loose blower housing, panels, etc. If high static causing noise, check for air whistling through seams in ducts, cabinets or panels. Check cabinet/duct for deformation.
Motor failure has occurred and moisture is present	Replace motor and perform moisture check.

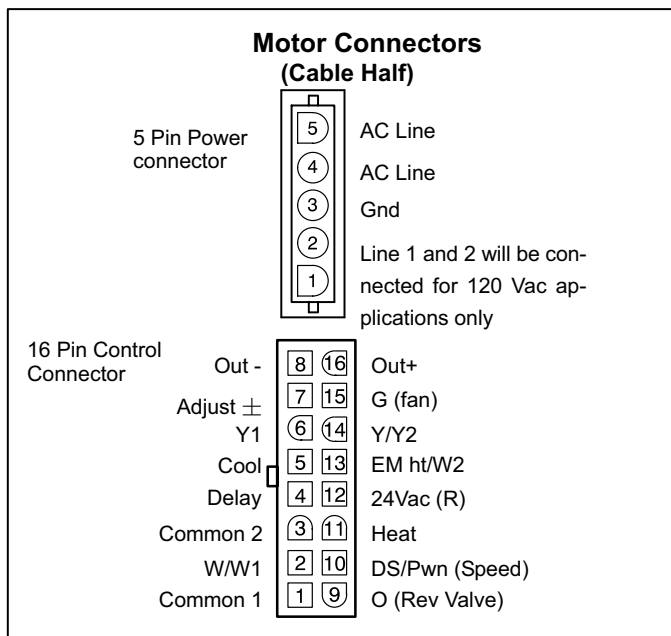


FIGURE 6

**Notes on 5 Pin AC Line Connection
(See Figure 6)**

- The VSM connects directly to the line.
- Pins 1 & 2 are jumpered in the harness for 115V operation.
- Make sure power is off before inserting power connector.
- Plug is polarized.

**Notes on 16 Pin Control Connection
(See Figure 6)**

- Control functions (G, Y1, Y2) may be active at greater than .5 x control transformer voltage.
- Do not apply 24vac to either "Out" pin (8 or 16).
- High voltage on control pins will destroy motor.
- Make sure pins are fully seated in connector and housing.
- Verify common connection from transformer (C or B) to C1, C2 (Pin 1 and Pin 3).
- Once common is verified, test motor by applying 24vac (R) to control pins.

**TABLE 2
BLOWER DATA - CB31MV**

**CB31MV-41 BLOWER PERFORMANCE
0 through 0.80 in. w.g. (0 Through 200 Pa) External Static Pressure Range**

"ADJUST" Jumper Setting	BDC3 Jumper Speed Positions															
	"HEAT" Speed								"COOL" Speed*							
	1		2		3		4		1		2		3		4	
	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s
+	1230	580	1335	630	1445	680	1545	730	1090	515	1225	580	1380	650	1545	730
NORM	1120	530	1215	575	1315	620	1400	660	975	460	1125	530	1275	600	1400	660
—	1010	475	1200	565	1185	560	1265	595	900	425	1000	470	1135	535	1265	595

NOTES — The effect of static pressure, filter and electric heater resistance is included in the air volumes listed.
 *First Stage (two-speed units only) cooling is approximately 70% (65% for units built prior to August 2002) of the COOL speed rating. Production units September 2005 and later; continuous blower speed for is approximately 38% of COOL speed setting. Earlier production units continuous blower speed is approximately 50% of COOL speed setting.
 Lennox Harmony II Zone Control Applications - Minimum blower speed is approximately 650 cfm (305 L/s).

CB31MV-41 BLOWER MOTOR WATTS AT "+" (Plus) BDC3 SETTING

BDC3 Jumper Speed Positions		Motor Watts @ Various External Static Pressures - in. wg. (Pa) ("Adjust" Jumper at "+" Setting)									
		0 (0)	0.1 (25)	0.2 (50)	0.3 (75)	0.4 (100)	0.5 (125)	0.6 (150)	0.7 (175)	0.8 (200)	
"HEAT" Speed	Tap 1	220	235	265	290	310	335	360	385	465	
	Tap 2	285	305	330	355	380	405	430	450	475	
	Tap 3	345	365	405	430	455	485	515	545	570	
	Tap 4	470	495	515	530	545	560	575	595	610	
"COOL" Speed	Tap 1	145	165	200	225	250	275	300	325	350	
	Tap 2	225	245	265	290	320	350	370	395	410	
	Tap 3	305	325	350	390	420	445	475	505	535	
	Tap 4	470	495	515	530	545	560	575	595	610	

CB31MV-41 BLOWER MOTOR WATTS AT "NORM" BDC3 SETTING

BDC3 Jumper Speed Positions		Motor Watts @ Various External Static Pressures - in. wg. (Pa) ("Adjust" Jumper at NORM Setting)									
		0 (0)	0.1 (25)	0.2 (50)	0.3 (75)	0.4 (100)	0.5 (125)	0.6 (150)	0.7 (175)	0.8 (200)	
"HEAT" Speed	Tap 1	155	185	215	240	265	285	300	335	355	
	Tap 2	225	245	270	295	325	345	370	390	415	
	Tap 3	275	290	315	340	375	400	420	445	465	
	Tap 4	320	345	375	405	435	460	485	515	540	
"COOL" Speed	Tap 1	120	140	160	190	210	230	255	275	300	
	Tap 2	160	190	220	240	265	290	320	340	365	
	Tap 3	255	270	295	320	345	375	400	420	445	
	Tap 4	320	345	375	405	435	460	485	515	540	

CB31MV-41 BLOWER MOTOR WATTS AT "-" (Minus) BDC3 SETTING

BDC3 Jumper Speed Positions		Motor Watts @ Various External Static Pressures - in. wg. (Pa) ("Adjust" Jumper at "-" Setting)									
		0 (0)	0.1 (25)	0.2 (50)	0.3 (75)	0.4 (100)	0.5 (125)	0.6 (150)	0.7 (175)	0.8 (200)	
"HEAT" Speed	Tap 1	120	135	165	185	205	225	245	265	300	
	Tap 2	140	165	195	215	245	270	300	315	335	
	Tap 3	185	210	240	265	285	310	330	360	385	
	Tap 4	245	255	290	310	335	355	380	405	430	
"COOL" Speed	Tap 1	90	110	135	155	180	195	210	230	250	
	Tap 2	120	140	160	185	215	235	255	275	295	
	Tap 3	160	190	225	240	275	295	320	350	380	
	Tap 4	245	255	290	310	335	355	380	405	430	

TABLE 3
BLOWER DATA - CB31MV
CB31MV-51 AND CB31MV-65 BLOWER PERFORMANCE
0 through 0.80 in. w.g. (0 Through 200 Pa) External Static Pressure Range

"ADJUST" Jumper Setting	BDC3 Jumper Speed Positions															
	"HEAT" Speed								"COOL" Speed*							
	1		2		3		4		1		2		3		4	
	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s
+	1850	875	1960	925	2090	985	2150	1015	1625	765	1820	860	2055	970	2145	1010
NORM	1705	805	1800	850	1900	895	2005	945	1425	670	1625	765	1805	850	2005	945
—	1560	735	1625	765	1720	810	1770	835	1205	570	1375	650	1555	735	1725	815

NOTES — The effect of static pressure, filter and electric heater resistance is included in the air volumes listed.
*First Stage (two-speed units only) cooling is approximately 70% (60% for units built prior to August 2002) of COOL speed rating. Production units September 2005 and later; continuous blower speed for is approximately 38% of COOL speed setting. Earlier production units continuous blower speed is approximately 50% of COOL speed setting.
Lennox Harmony II Zone Control Applications - Minimum blower speed is approximately 850 cfm (400 L/s).

CB31MV-51 AND CB31MV-65 BLOWER MOTOR WATTS AT "+" (Plus) BDC3 SETTING

BDC3 Jumper Speed Positions		Motor Watts @ Various External Static Pressures - in. wg. (Pa) ("Adjust" Jumper at "+" Setting)									
		0 (0)	0.1 (25)	0.2 (50)	0.3 (75)	0.4 (100)	0.5 (125)	0.6 (150)	0.7 (175)	0.8 (200)	
"HEAT" Speed	Tap 1	455	505	540	585	630	665	710	745	780	
	Tap 2	555	595	645	675	730	780	820	865	895	
	Tap 3	680	720	770	820	865	900	945	985	1030	
	Tap 4	730	780	825	870	920	970	1020	1055	1110	
"COOL" Speed	Tap 1	300	335	370	410	435	465	500	535	575	
	Tap 2	425	475	500	545	585	635	670	710	745	
	Tap 3	625	660	705	755	810	850	885	940	970	
	Tap 4	700	750	800	845	895	940	990	1030	1080	

CB31MV-51 AND CB31MV-65 BLOWER MOTOR WATTS AT "NORM" BDC3 SETTING

BDC3 Jumper Speed Positions		Motor Watts @ Various External Static Pressures - in. wg. (Pa) ("Adjust" Jumper at NORM Setting)									
		0 (0)	0.1 (25)	0.2 (50)	0.3 (75)	0.4 (100)	0.5 (125)	0.6 (150)	0.7 (175)	0.8 (200)	
"HEAT" Speed	Tap 1	360	385	425	465	495	525	565	600	635	
	Tap 2	400	440	485	520	555	595	640	670	705	
	Tap 3	480	520	560	605	640	685	765	785	805	
	Tap 4	580	625	665	710	760	800	835	875	925	
"COOL" Speed	Tap 1	215	235	275	295	330	360	400	430	465	
	Tap 2	310	335	375	405	440	465	500	530	565	
	Tap 3	415	445	490	535	565	605	650	675	715	
	Tap 4	580	610	655	695	740	785	830	870	910	

CB31MV-51 AND CB31MV-65 BLOWER MOTOR WATTS AT "-" (Minus) BDC3 SETTING

BDC3 Jumper Speed Positions		Motor Watts @ Various External Static Pressures - in. wg. (Pa) ("Adjust" Jumper at "-" Setting)									
		0 (0)	0.1 (25)	0.2 (50)	0.3 (75)	0.4 (100)	0.5 (125)	0.6 (150)	0.7 (175)	0.8 (200)	
"HEAT" Speed	Tap 1	265	305	340	370	410	440	460	505	540	
	Tap 2	320	350	395	420	450	475	515	545	580	
	Tap 3	375	410	435	470	515	545	575	610	645	
	Tap 4	400	435	480	525	555	595	640	670	700	
"COOL" Speed	Tap 1	140	170	195	215	250	275	300	335	360	
	Tap 2	200	230	260	285	315	355	385	415	450	
	Tap 3	280	315	340	380	415	445	465	505	540	
	Tap 4	375	420	440	475	515	550	575	610	645	

IV-OPTIONAL ECB29/31 ELECTRIC HEAT

A-Matchups and Ratings

Tables 5 and 6 show all approved CB31MV to ECB29/ECB31 matchups and electrical ratings.

B-Electric Heat Components

ECB29/31 parts arrangement is shown in figures 7 through 11. All electric heat sections consist of components mounted to the electric heat vestibule panel and electric heating elements exposed directly to the airstream. 208/230V electric heat sections may be equipped with circuit breakers. The circuit breakers are designated by CB in the model number.

1-Primary(S15) & Secondary(S20) Temperature Limits

Both the primary (S15) and secondary (S20) limits are located on the electric heat vestibule panel and are exposed directly to the airstream through an opening in the panel. The high temperature limits are SPST N.C. limits with the primary limit being an auto-reset limit and the secondary limit being a "one-time" limit. One-time limits must be replaced when opened. The limits are factory set and are not adjustable.

208/230 Volt Electric Heat Sections

Each stage of the 208/230 electric heat is protected by a primary (S15) and secondary (S20) high temperature limit. Both S15 and S20 are located in the same housing. Each stage uses the same style of limits. Both the primary and secondary limits are wired in series with a heat element. When either S15 or S20 opens, the corresponding heat element is de-energized. All other heating elements remain energized. The primary high temperature limit opens at $150^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($65.5^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$) on a temperature rise and automatically resets at $110^{\circ}\text{F} \pm 9^{\circ}\text{F}$ ($43.3^{\circ}\text{C} \pm 5.0^{\circ}\text{C}$) on a temperature fall. The secondary high temperature limit opens at $333^{\circ}\text{F} \pm 10^{\circ}\text{F}$ ($167.2^{\circ}\text{C} \pm 5.6^{\circ}\text{C}$) on a temperature rise. If the secondary limit opens it must be replaced.

2-Electric Heat Sequencer Relays

(K32, K33, K34, K35, and K116) (208/230 volt only)

Relays K32, K33, K34, K35 and K116 are N.O. sequencer relays with a resistive element for a coil and a bi-metal disk which actuates the contacts. The relays are located on the electric heat vestibule panel and are energized by a 24V heating demand (W1, W2, and W3) via jack/plug 2 (J2), which is used to connect electric heat to the blower coil control circuit. When energized, the internal resistance heats the bi-metal disk causing the con-

tacts to close. When the relay is de-energized, the disk cools and the contacts open. The relays energize different stages of heat, as well as the blower. The blower is always first on and last off.

3-Circuit Breaker (CB1, CB2, and CB3) (208/230 volt only)

Line voltage connections are made to circuit breakers CB1, CB2, and CB3 in the electric heat sections with circuit breakers (designated by CB in the model numbers). Table 4 shows the amp rating for each circuit breaker used. Single-phase electric heat uses two pole circuit breakers; while three-phase electric heat uses three pole circuit breakers.

TABLE 4

ECB29 /31CIRCUIT BREAKERS			
UNIT	CB1 AMPS	CB2 AMPS	CB3 AMPS
ECB29-5CB-1 (P)	30 AMP	---	---
ECB29-8CB-1 (P)	50 AMP	---	---
ECB31-10CB-1 (P)	40 AMP	30 AMP	---
ECB29-12.5CB-1 (P)	25 AMP	50 AMP	---
ECB29-15CB-1 (P)	30 AMP	60 AMP	---
ECB31-20CB-1 (P)	40 AMP	30 AMP	---
ECB29-25CB-1 (P)	50 AMP	50 AMP	50 AMP
ECB29-30CB-1 (P)	60 AMP	60 AMP	60 AMP
ECB29-15CB-1 (Y)	60 AMP	---	---
ECB29-20CB-1 (Y)	40 AMP	35 AMP	---
ECB29-25CB-1 (Y)	50 AMP	35 AMP	---

Note: Do not remove patch plate or insulation on units without circuit breakers!!

4-Terminal Strip (TB2) 208/230 volt only

For the electric heat sections without circuit breakers or fuses, line voltage connections are made to terminal strip TB2. The terminal strip is located in the lower left corner of the electric heat vestibule panel. Single-phase electric heat uses two pole terminal strips; while three-phase electric heat uses three pole terminal strips.

5-Heating Elements (HE1 through HE6)

Heating elements are composed of helix wound bare nichrome wire exposed directly to the airstream. The elements are supported by insulators mounted to the wire frame. For single phase applications, one element is used per stage. Each stage is energized independently by the corresponding relay located on the electric heat vestibule arranged in a three phase delta. Once energized, heat transfer is instantaneous. High temperature protection is provided by primary and secondary high temperature limits.

TABLE 5

CB31MV-41 - ELECTRIC HEAT DATA

SINGLE PHASE ELECTRIC HEAT

		CB31MV-41									
kW	lbs.	Model Number	Number of Steps	Volts Input	kW Input	Btuh Input	Blower Motor Full Load Amps	Minimum Circuit Ampacity		Maximum Fuse Size	
								Circuit 1	Circuit 2	Circuit 1	Circuit 2
5 kW	4 lbs.	ECB29-5 (28K31) Terminal Block	1 step	208	3.8	12,800	4.3	28	---	30	---
				220	4.2	14,300	4.3	31	---	35	---
		ECB29-5CB (28K32) 30A Circuit breaker	230	4.6	15,700	4.3	31	---	35	---	
			240	5.0	17,100	4.3	31	---	35	---	
6 kW	4 lbs.	ECB29-6 (47L22) Terminal Block	1 step	208	4.5	15,400	4.3	32	---	35	---
				220	5.0	17,100	4.3	37	---	40	---
		ECB29-6CB (47L23) 35A Circuit breaker	230	5.5	18,800	4.3	37	---	40	---	
			240	6.0	20,500	4.3	37	---	40	---	
8 kW	5 lbs.	ECB29-8 (28K33) Terminal Block	2 steps	208	6.0	20,500	4.3	41	---	45	---
				220	6.7	22,900	4.3	47	---	50	---
		ECB29-8CB (28K34) 45A Circuit breaker	230	7.3	25,100	4.3	47	---	50	---	
			240	8.0	27,300	4.3	47	---	50	---	
9 kW	5 lbs.	ECB299CB (10L11) 50A Circuit breaker	2 steps	208	6.8	23,100	4.3	46	---	50	---
				220	7.6	25,800	4.3	52	---	60	---
		ECB29EH-9CB (91K67) 50A Circuit breaker	230	8.3	28,200	4.3	52	---	60	---	
			240	9.0	30,700	4.3	52	---	60	---	
12.5 kW	10 lbs.	ECB29-12.5CB (28K37) (1) 25A & (1) 50A Circuit breaker	3 steps	208	9.4	32,000	4.3	24	31	25	45
				220	10.5	35,800	4.3	27	35	30	50
		ECB29EH-12.5CB (91K68) (1) 25A & (1) 50A Circuit breaker	230	11.5	39,200	4.3	27	35	30	50	
			240	12.5	42,600	4.3	27	35	30	50	
15 kW	12 lbs.	ECB29-15CB (28K38) (1) 30A & (1) 60A Circuit breaker	3 steps	208	11.3	38,400	4.3	28	37	30	50
				220	12.6	43,000	4.3	31	42	35	60
		ECB29EH-15CB (91K69) (1) 30A & (1) 60A Circuit breaker	230	13.8	47,000	4.3	31	42	35	60	
			240	15.0	51,200	4.3	31	42	35	60	
20 kW	19 lbs.	ECB29-20CB (11L31) (1) 50A & (1) 60A Circuit breaker	4 steps	208	15.0	51,200	4.3	47	41	50	60
				220	16.8	57,300	4.3	52	46	60	60
		ECB29EH-20CB (91K70) (1) 50A & (1) 60A Circuit breaker	230	18.4	62,700	4.3	52	46	60	60	
			240	20.0	68,200	4.3	52	46	60	60	
		THREE PHASE ELECTRIC HEAT									
		CB31MV-41									
8 kW	5 lbs.	ECB29-8 (28K42) Terminal Block	3 steps	208	6.0	20,500	4.3	26	---	30	---
				220	6.7	22,900	4.3	29	---	30	---
				230	7.3	25,100	4.3	29	---	30	---
				240	8.0	27,300	4.3	29	---	30	---
10 kW	6 lbs.	ECB29-10 (28K43) Terminal Block	3 steps	208	7.5	25,600	4.3	31	---	35	---
				220	8.4	28,700	4.3	35	---	35	---
				230	9.2	31,400	4.3	35	---	35	---
				240	10.0	34,100	4.3	35	---	35	---
15 kW	12 lbs.	ECB29-15CB (28K44) 50A Circuit breaker	3 steps	208	11.3	38,400	4.3	44	---	45	---
				220	12.6	43,000	4.3	50	---	50	---
				230	13.5	47,000	4.3	50	---	50	---
				240	15.0	51,200	4.3	50	---	50	---
20 kW	19 lbs.	ECB29-20CB (28K45) (2) 35A Circuit breaker	6 steps	208	15.0	51,200	4.3	31	21	35	30
				220	16.8	57,300	4.3	35	24	35	35
				230	18.4	62,700	4.3	35	24	35	35
				240	20.0	68,200	4.3	35	24	35	35

① Electric heater capacity only — does not include additional blower motor heat capacity.

② Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements. Use wires suitable for at least 167°F (75°C).

④ Bold text indicates that the circuit breaker on "CB" circuit breaker models must be replaced with size noted. See Optional Circuit Breaker table for catalog numbers.

NOTE - Circuit 1 Minimum Circuit Ampacity includes the Blower Motor Full Load Amps.

TABLE 6

CB31MV-51 AND CB31MV-65 - ELECTRIC HEAT DATA

SINGLE PHASE ELECTRIC HEAT

CB31MV-51 and CB31MV-65

	Model Number	Number of Steps	Volts Input	kW Input	① Btuh Input	Blower Motor Full Load Amps	③ Minimum Circuit Ampacity			Maximum Fuse Size		
							Circuit 1	Circuit 2	Circuit 3	Circuit 1	Circuit 2	Circuit 3
5 kW 4 lbs.	ECB29-5 (28K31) Terminal Block ECB29-5CB (28K32) 30A Circuit breaker	1 step	208	3.8	12,800	9.1	34	---	---	40	---	---
			220	4.2	14,300	9.1	37	---	---	45	---	---
			230	4.6	15,700	9.1	37	---	---	45	---	---
			240	5.0	17,100	9.1	37	---	---	45	---	---
6 kW 4 lbs.	ECB29-6 (47L22) Terminal Block ECB29-6CB (47L23) 35A Circuit breaker	1 step	208	4.5	15,400	9.1	36	---	---	45	---	---
			220	5.0	17,100	9.1	43	---	---	50	---	---
			230	5.5	18,800	9.1	43	---	---	50	---	---
			240	6.0	20,500	9.1	43	---	---	50	---	---
8 kW 5 lbs.	ECB29-8 (28K33) Terminal Block ECB29-8CB (28K34) 45A Circuit breaker	2 steps	208	6.0	20,500	9.1	47	---	---	50	---	---
			220	6.7	22,900	9.1	53	---	---	60	---	---
			230	7.3	25,100	9.1	53	---	---	60	---	---
			240	8.0	27,300	9.1	53	---	---	60	---	---
9 kW 5 lbs.	ECB29-9CB (10L11) 50A Circuit breaker ECB29EH-9CB (91K67) 50A Circuit breaker	2 steps	208	6.8	23,100	9.1	52	---	---	60	---	---
			220	7.6	25,800	9.1	58	---	---	60	---	---
			230	8.3	28,200	9.1	58	---	---	60	---	---
			240	9.0	30,700	9.1	58	---	---	60	---	---
12.5 kW 10 lbs.	ECB29-12.5CB (28K37) (1) 25A & (1) 50A Circuit breaker ECB29EH-12.5CB (91K68) (1) 25A & (1) 50A Circuit breaker	3 steps	208	9.4	32,000	9.1	30	31	---	④40	④45	---
			220	10.5	35,800	9.1	33	35	---	④45	50	---
			230	11.5	39,200	9.1	33	35	---	④45	50	---
			240	12.5	42,600	9.1	33	35	---	④45	50	---
15 kW 12 lbs.	ECB29-15CB (28K38) (1) 30A & (1) 60A Circuit breaker ECB29EH-15CB (91K69) (1) 30A & (1) 60A Circuit breaker	3 steps	208	11.3	38,400	9.1	34	37	---	40	④50	---
			220	12.6	43,000	9.1	37	42	---	45	60	---
			230	13.5	47,000	9.1	37	42	---	45	60	---
			240	15.0	51,200	9.1	37	42	---	45	60	---
20 kW 19 lbs.	ECB29-20CB (11L31) (1) 50A & (1) 60A Circuit breaker ECB29EH-20CB (91K70) (1) 50A & (1) 60A Circuit breaker	4 steps	208	15.0	51,200	9.1	53	41	---	60	60	---
			220	16.8	57,300	9.1	58	46	---	60	60	---
			230	18.4	62,700	9.1	58	46	---	60	60	---
			240	20.0	68,200	9.1	58	46	---	60	60	---
25 kW 19 lbs.	ECB29-25CB (28K40) (3) 50A Breakers	6 steps	208	18.8	64,100	9.1	49	31	31	50	④45	④45
			220	21.0	71,700	9.1	54	35	35	60	50	50
			230	23.0	78,300	9.1	54	35	35	60	50	50
			240	25.0	85,300	9.1	54	35	35	60	50	50
THREE PHASE ELECTRIC HEAT APPLICATIONS												
8 kW 5 lbs.	ECB29-8 (28K42) Terminal block	3 steps	208	6.0	20,500	9.1	32	---	---	40	---	---
			220	6.7	22,900	9.1	35	---	---	40	---	---
			230	7.3	25,100	9.1	35	---	---	40	---	---
			240	8.0	27,300	9.1	35	---	---	40	---	---
10 kW 6 lbs.	ECB29-10 (28K43) Terminal block	3 steps	208	7.5	25,600	9.1	37	---	---	45	---	---
			220	8.4	28,700	9.1	41	---	---	50	---	---
			230	9.2	31,400	9.1	41	---	---	50	---	---
			240	10.0	34,100	9.1	41	---	---	50	---	---
15 kW 12 lbs.	ECB29-15CB (28K44) 50A Circuit breaker	3 steps	208	11.3	38,400	9.1	50	---	---	60	---	---
			220	12.6	43,000	9.1	56	---	---	60	---	---
			230	13.5	47,000	9.1	56	---	---	60	---	---
			240	15.0	51,200	9.1	56	---	---	60	---	---
20 kW 19 lbs	ECB29-20CB (28K45) (2) 35A Circuit breakers	6 steps	208	15.0	51,200	9.1	37	21	---	④45	④30	---
			220	16.8	57,300	9.1	41	24	---	④50	35	---
			230	18.4	62,700	9.1	41	24	---	④50	35	---
			240	20.0	68,200	9.1	41	24	---	④50	35	---
25 kW 19 lbs	ECB29-25CB (28K46) (2) 45A Circuit breakers	6 steps	208	18.8	64,100	9.1	44	27	---	50	④40	---
			220	21.0	71,700	9.1	49	30	---	④60	45	---
			230	23.0	78,300	9.1	49	30	---	④60	45	---
			240	25.0	85,300	9.1	49	30	---	④60	45	---

① Electric heater capacity only — does not include additional blower motor heat capacity.
 ③ Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements. Use wires suitable for at least 167°F (75°C).
 ④ Bold text indicates that the circuit breaker on "CB" circuit breaker models must be replaced with size noted. See Optional Circuit Breaker table for catalog numbers.
 NOTE - Circuit 1 Minimum Circuit Ampacity includes the Blower Motor Full Load Amps.

**ECB29-5, -5CB 208/230 SINGLE-PHASE
ELECTRIC HEAT VESTIBULE PARTS ARRANGEMENT**

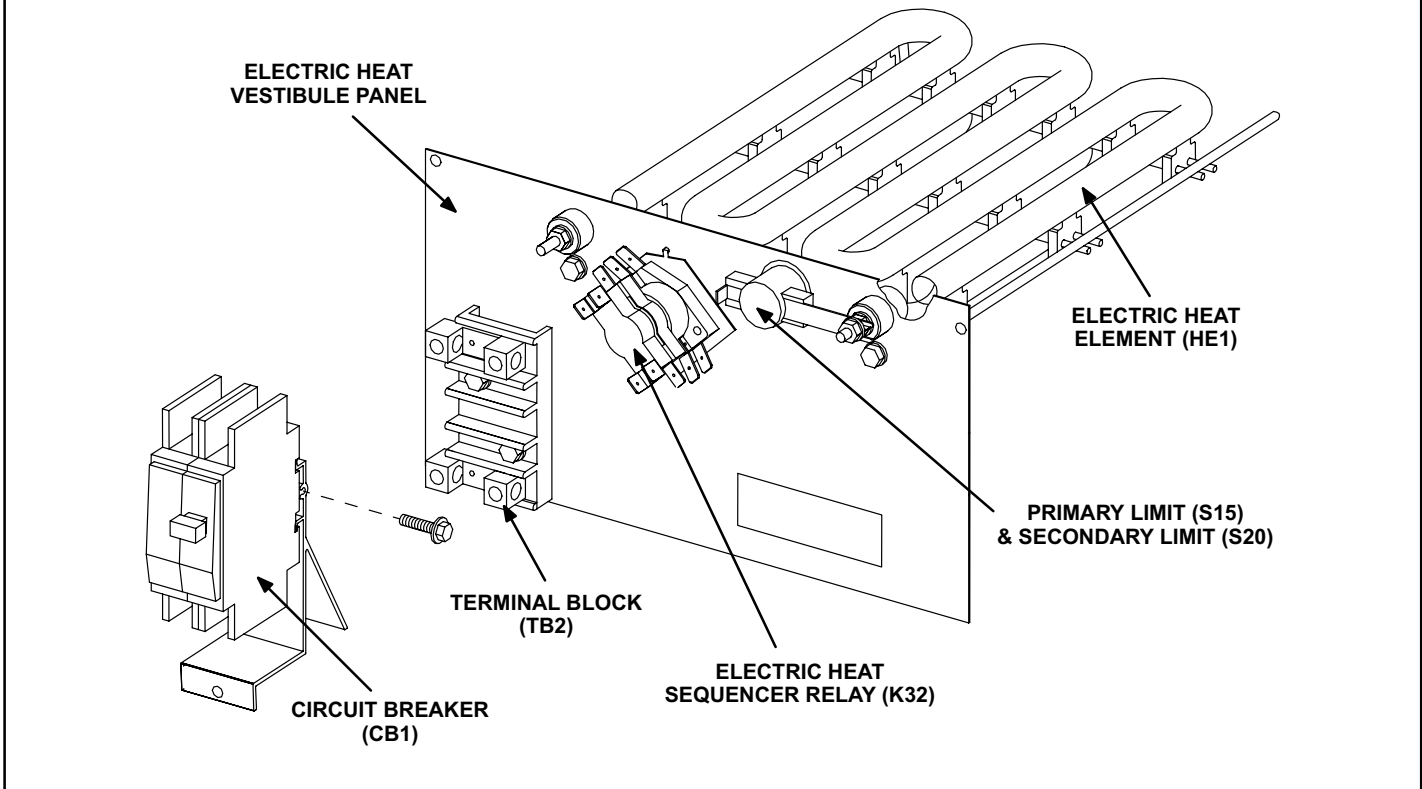


FIGURE 7

**ECB29-8, -8CB AND ECB31-10, -10CB 208/230 SINGLE-PHASE
ELECTRIC HEAT VESTIBULE PARTS ARRANGEMENT**

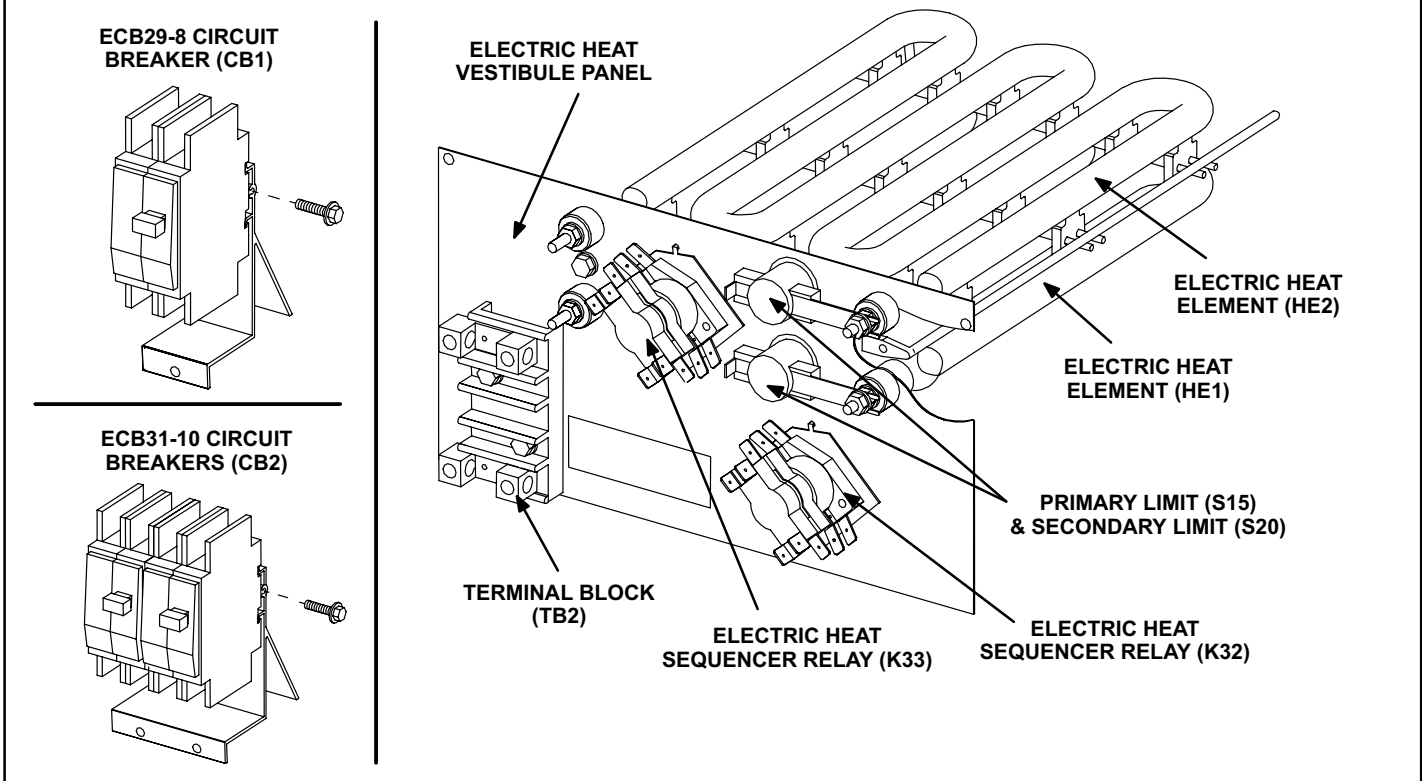


FIGURE 8

**ECB29-8,-10 208/230 THREE-PHASE
ECB29-12.5CB, -15CB 208/230 SINGLE & THREE-PHASE
ELECTRIC HEAT VESTIBULE PARTS ARRANGEMENT**

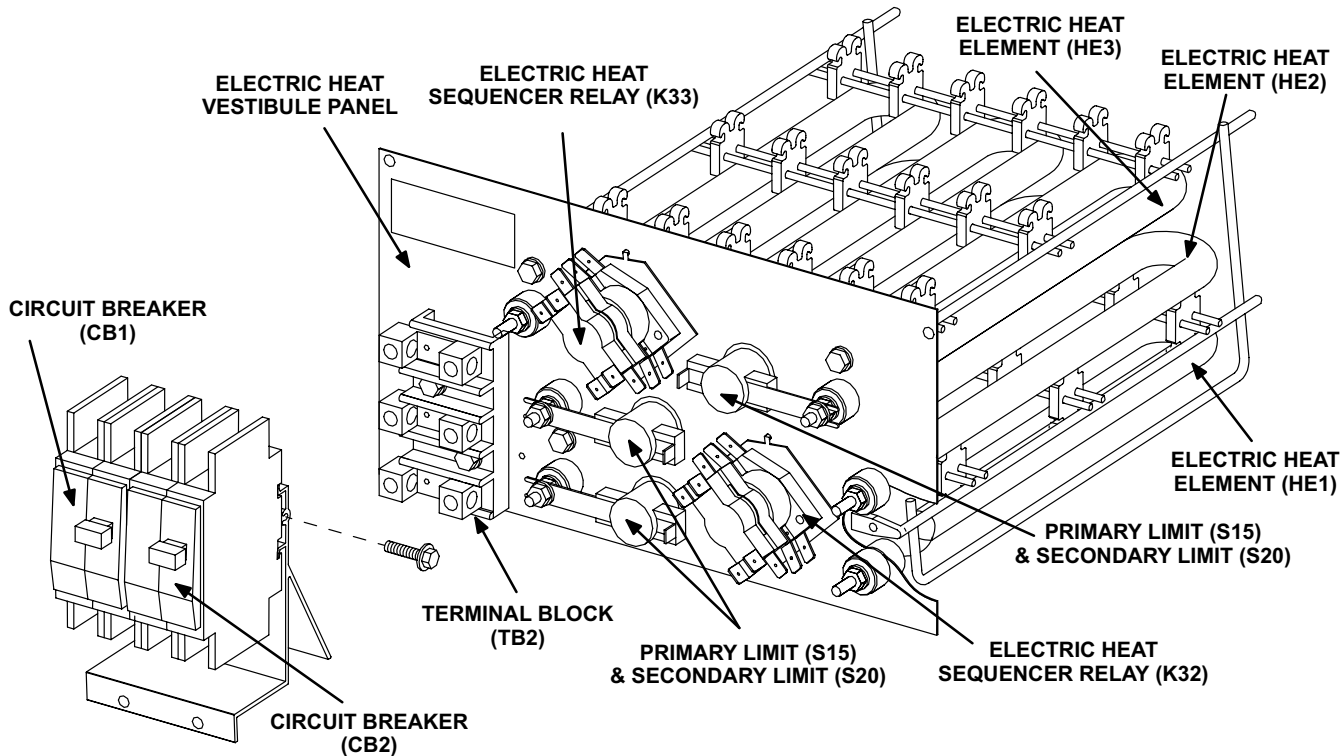


FIGURE 9

**ECB31-20CB 208/230 SINGLE-PHASE
ELECTRIC HEAT VESTIBULE PARTS ARRANGEMENT**

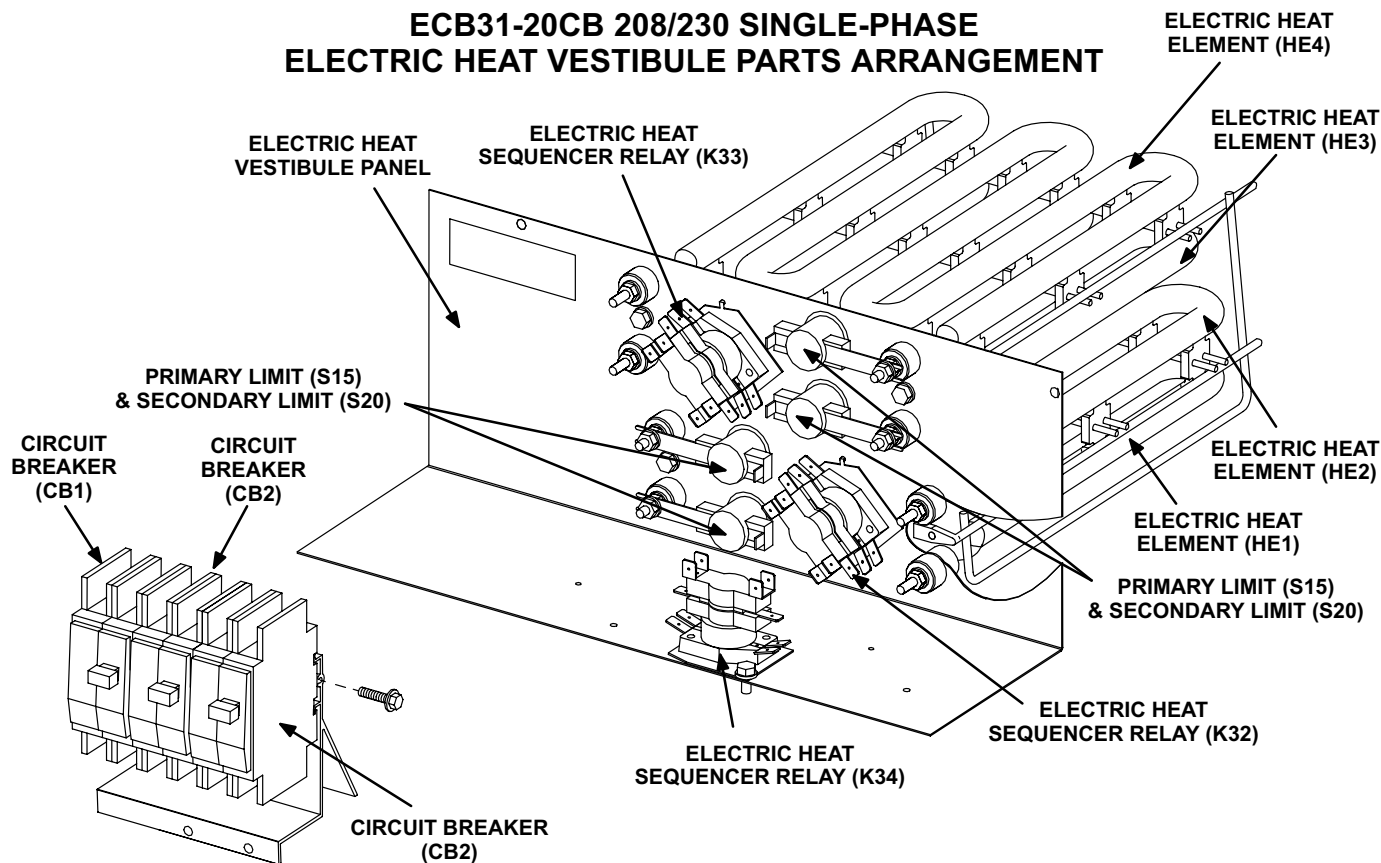


FIGURE 10

**ECB29-20CB,-25CB 208/230 THREE-PHASE
ECB29-25CB, -208/230 SINGLE-PHASE
ELECTRIC HEAT VESTIBULE PARTS ARRANGEMENT**

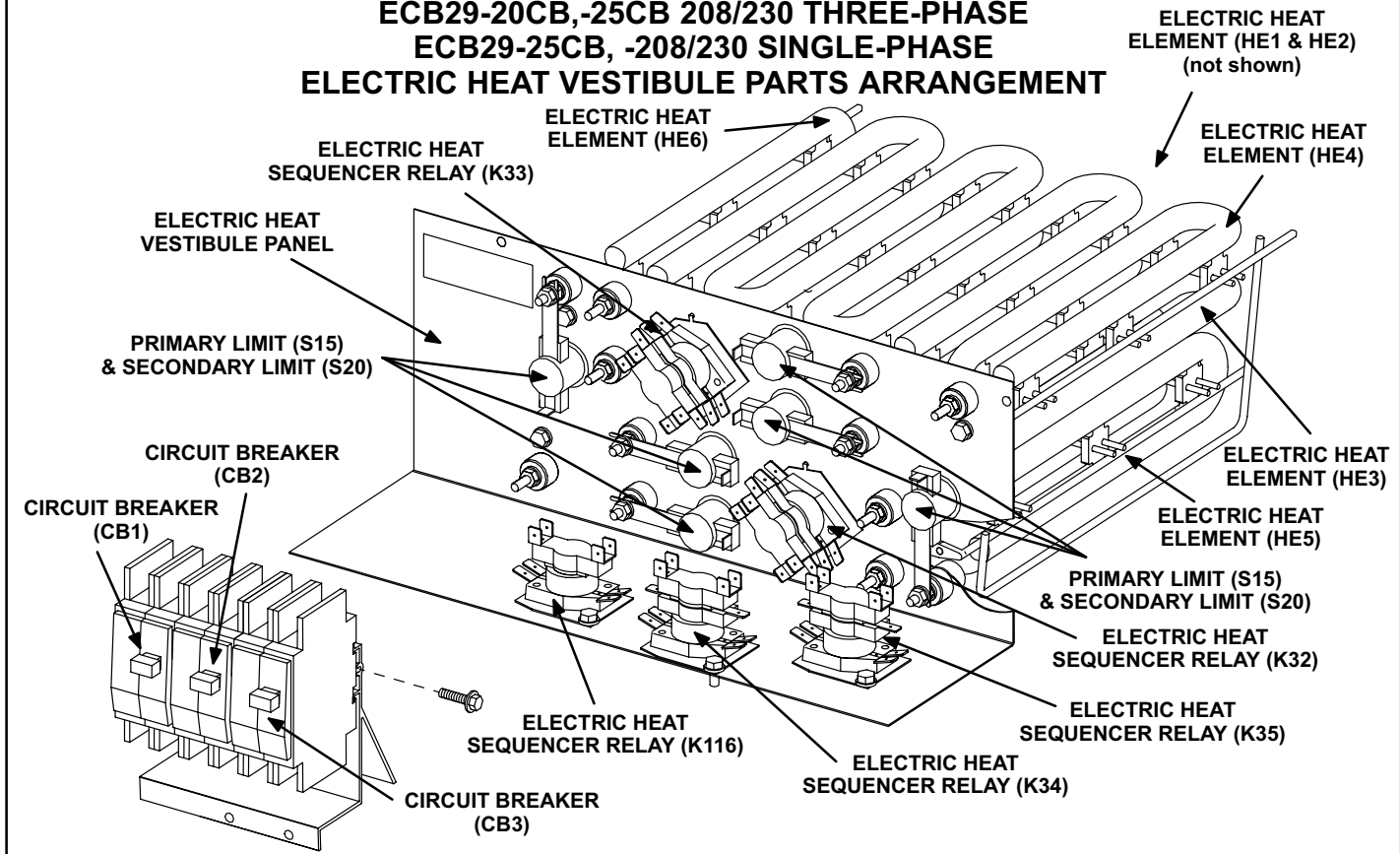


FIGURE 11

V- OPTIONAL HUMIDITY CONTROL (A20)

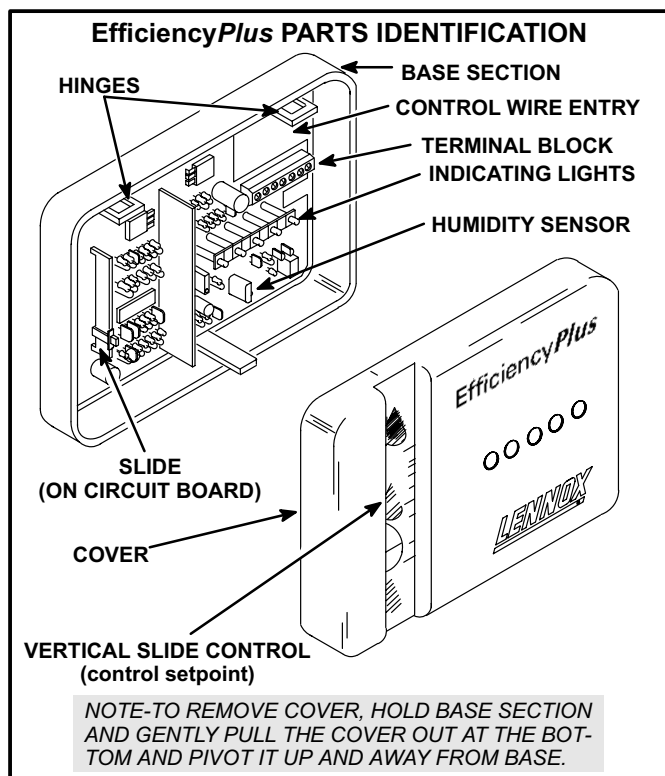


FIGURE 12

A-CCB1

Optional Comfort Control Board (CCB1) A20 may be installed adjacent to the indoor thermostat (figure 12). The control monitors indoor humidity conditions and creates a dehumidification demand in response to indoor humidity just as the thermostat creates a cooling demand in response to indoor temperature. The CCB1 works in combination with the indoor thermostat to adjust compressor speed and indoor blower speed. Although the control provides a dehumidification demand, only the thermostat can directly control compressor operation. The CCB1 cannot call for a compressor cycle by itself.

Principles of Cooling with Drier Air

The humidity comfort range for humans is between 40% and 60% relative humidity (RH). A vertical slide on the control allows the humidity setpoint to be adjusted within that comfort range. 50% RH is the recommended initial setpoint until personal comfort level is established. The personal comfort level will vary with humidity as with temperature. For example, if air at 75°F and 50% RH is changed to 60% RH, the air will “feel” much warmer. Likewise, if the air is

reduced to 40% RH, it will “feel” much cooler.

Even when inactive, the body evaporates a large amount of moisture away from the skin. This evaporation produces a cooling effect (during wintertime this phenomenon is called “wind-chill”). Dry air is capable of absorbing more moisture away from the skin thereby increasing the cooling effect.

When the CCB1 senses that the indoor humidity level is above the control setpoint, the control places the CB31MV and outdoor unit in a dehumidification mode (in order to take advantage of the dry air cooling effect).

To produce drier air, the CB31MV will slow down the speed of the air crossing the indoor coil. Because the air is moving much slower than normal, the indoor coil is allowed more time to remove moisture from the air (a higher percentage of the air passing over the coil is cooled to its dew point removing more moisture). At the same time the two-speed outdoor unit will switch to high-speed to produce a colder indoor coil. The colder indoor coil and slower moving air combine to produce drier supply air.

NOTE-The indoor blower speed is reduced in order to slow the air speed across the indoor coil. The supply air exiting the unit may not feel as forceful. This is normal. Remember that when the unit is in dehumidification mode, the comfort level is increased because the unit is producing cooler, drier air.

The exact sequence of operation to produce cooler, drier air is described in the following section.

Operation

The CCB1 operates only during cooling mode. During normal cooling operation, when there is no indoor humidity demand, the unit operates as a straight two-speed cooling system. First stage thermostat demand energizes the compressor and indoor blower on low speed. Increased cooling demand energizes the compressor and indoor blower on high speed.

The control is equipped with a row of orange LED lights on its face which indicate the amount of relative humidity demand present. When one or more LEDs are lit, the control signals the CB31MV to begin dehumidification mode. Tables 10 and 11 show system response to thermostat and CCB1 demand.

Calibration Precautions

Extreme care should be taken to avoid exposing the CCB1 to fumes from household chemicals. The humidity sensing element in the CCB1 is a precise component which can be damaged or the calibration changed by household chemicals and cleaning agents. Make sure all household chemicals are stored in a different room in the building. Also, use only mild diluted soapy water when cleaning the CCB1 cover or the area surrounding the CCB1. The sensing element cannot be field calibrated. The CCB1 contains no field repairable parts and must be replaced when damaged in this manner.

Agents which can damage the CCB1 include alcohol, benzene, chlorine and chlorine based solutions, acetone (nail polish remover), bug sprays and other household cleaners.

Calibration can also be adversely affected by the placement of the CCB1 with respect to the indoor thermostat, exterior doors and windows and supply air registers. Most thermostats have anticipation resistors which give off heat. If the CCB1 is installed directly above the indoor thermostat, the humidity sensor calibration will be thrown off. If the CCB1 is installed directly above the indoor thermostat, it should be relocated to the side of the thermostat. Refer to CCB1 installation instructions.

Other Conditions Which Adversely Affect CCB1 Performance

Blower speed selection can adversely affect CCB1 performance. Higher blower speeds should be selected to provide maximum sensible cooling, while lower blower speeds should be selected to provide maximum humidity removal. Refer to CB31MV and CCB1 installation instructions.

It is recommended that the indoor blower be left in AUTO mode at all times. During dehumidification mode, the indoor coil and drain pan may become saturated with moisture. If the indoor blower is left in ON mode, much of that moisture can be re-evaporated into the living space between thermostat demands. This can create a constant demand for humidity removal and may cause extended compressor run times. Refer to table 7 for jumpers per application. CB31MV units manufactured January 2002 and later, will have factory installed jumpers. Remove jumpers not used.

TABLE 7

JUMPERS REQUIRED			
Without CCB1 Humidity Control	Heat Pump	Single Speed	DS to Y1 and Y1 to Y2
		Two Speed	DS to Y1
	Condensing Unit	Single Speed	DS to Y1 and Y1 to Y2 and O to R
		Two Speed	DS to Y1 and O to R
With CCB1 Humidity Control	Heat Pump	Single Speed	Y1 to Y2
		Two Speed	None
	Condensing Unit	Single Speed	Y1 to Y2 and O to R
		Two Speed	O to R

The CCB1 may become indefinitely latched in the dehumidification mode when power to the unit is turned off. This condition can be caused by turning off power while dehumidification demand is present, then turning on power when dehumidification demand is satisfied. If the CCB1 becomes stuck in this manner, it can be reset by removing thermostat demand then moving the CCB1 slide switch all the way down and back up to its setpoint.

How to unlatch CCB1

- 1- Force a cooling demand by setting thermostat to COOL mode and by moving thermostat lever to lowest position.
- 2- Move CCB1 slide control down to 40% relative humidity. CCB1 lights should come on.
- 3- Now, move CCB1 slide control back up to 60% relative humidity. The lights should go off.
- 4- Remove thermostat demand by moving thermostat lever to cycle unit off.

Applications with the Efficiency*Plus* CCB1 humidity control create different CFM volumes. For example, during a first-stage cooling call (two-speed outdoor unit) with no demand from the CCB1, the air volume is 40% of the **COOL** jumper selection. For a normal **COOL** (Pin #2 setting for CB31MV-41), the CFM is 1125; the reduced speed is 450 CFM ($1125 \times 40\% = 450$). This arrangement provides for additional dehumidification during first stage cooling. See tables 10 and 11 for various scenarios concerning use of the CCB1 humidity control and the CB31MV series unit.

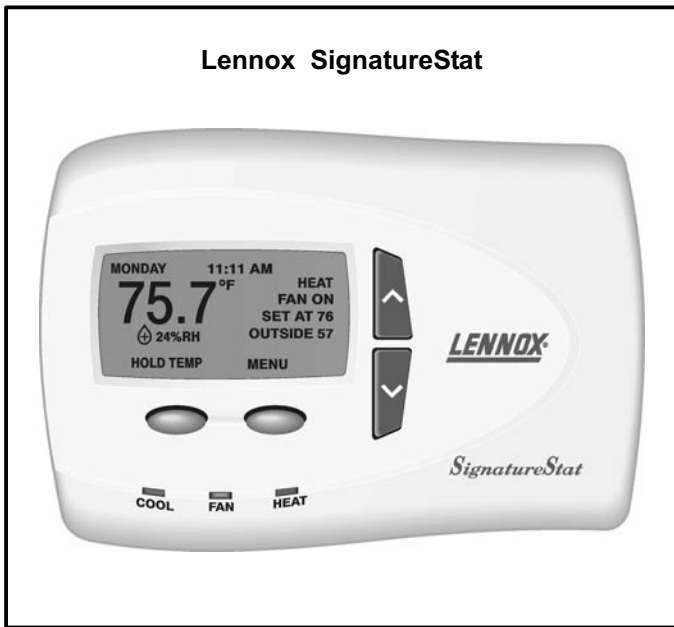


FIGURE 13

B-SignatureStat™

The Lennox SignatureStat can be installed in place of the indoor thermostat (figure 12). The SignatureStat monitors indoor humidity conditions and creates a dehumidification demand in response to indoor humidity just as it creates a cooling demand in response to indoor temperature. The SignatureStat adjusts compressor speed and indoor blower speed to maintain humidity at a comfortable a level.

Principles of Cooling with Drier Air

The humidity comfort range for humans is between 40% and 60% relative humidity (RH). 50% RH is the recommended initial setpoint until personal comfort level is established. The personal comfort level will vary with humidity as with temperature. For example, if air at 75°F and 50% RH is changed to 60% RH, the air will “feel” much warmer. Likewise, if the air is reduced to 40% RH, it will “feel” much cooler.

Even when inactive, the body evaporates a large amount of moisture away from the skin. This evaporation produces a cooling effect (during wintertime this phenomenon is called “wind-chill”). Dry air is capable of absorbing more moisture away from the skin thereby increasing the cooling effect.

When the SignatureStat senses that the indoor humidity level is above the control setpoint, the control places the CB31MV and outdoor unit in a dehumidification mode (in order to take advantage of the dry air cooling effect).

To produce drier air, the CB31MV will slow down the speed of the air crossing the indoor coil. Because the air is moving much slower than normal, the indoor coil is allowed more time to remove moisture from the air (a higher percentage of the air passing over the coil is cooled to its dew point removing more moisture). At the same time the two-stage outdoor unit will switch to high-speed to produce a colder indoor coil. The colder indoor coil and slower moving air combine to produce drier supply air.

NOTE-The indoor blower speed is reduced in order to slow the air speed across the indoor coil. The supply air exiting the unit may not feel as forceful. This is normal. Remember that when the unit is in dehumidification mode, the comfort level is increased because the unit is producing cooler, drier air.

The exact sequence of operation to produce cooler, drier air is described in the following section.

Other Conditions Which Adversely Affect SignatureStat Performance

Blower speed selection can adversely affect SignatureStat performance. Higher blower speeds should be selected to provide maximum sensible cooling, while lower blower speeds should be selected to provide maximum humidity removal. Refer to CB31MV and SignatureStat installation instructions.

It is recommended that the indoor blower be left in AUTO mode at all times. During dehumidification mode, the indoor coil and drain pan may become saturated with moisture. If the indoor blower is left in ON mode, much of that moisture can be re-evaporated into the living space between thermostat demands. This can create a constant demand for humidity removal and may cause extended compressor run times. Refer to table 8 for jumpers per application. CB31MV units manufactured January 2002 and later, will have factory installed jumpers. Remove jumpers not used.

TABLE 8

JUMPERS REQUIRED			
Humidity Control OFF	Heat Pump	Single Speed	DS to Y1 and Y1 to Y2
		Two Speed	DS to Y1
	Condensing Unit	Single Speed	DS to Y1 and Y1 to Y2 and O to R
		Two Speed	DS to Y1 and O to R
Humidity Control ON	Heat Pump	Single Speed	Y1 to Y2
		Two Speed	None
	Condensing Unit	Single Speed	Y1 to Y2 and O to R
		Two Speed	O to R

Operation

Dehumidification is provided only when the thermostat is in cool mode. Dehumidification D terminal wires to variable-speed blower (reverse logic/active on low signal 24VAC). When the unit is in heating mode, the dehumidification function is off. The default mode for dehumidification is OFF and needs to be activated during installation.

The D terminal is active whenever the SignatureStat is powered, EXCEPT when there is a dehumidification demand. This means that the D terminal has 24V on it even in HEAT and OFF modes.

Basic Mode: Dehumidification only with a cooling demand. COOL is on, then D is active (reverse logic, off), and G is on (if not already on), Y1 and Y2 (if available) is on.

Precision Mode: Dehumidification with or without Cooling demand. D is active (reverse logic, off), and G, Y1, and Y2 (if available) are on. Note that H is inactive (off) during dehumidification. The D terminal controls dehumidification. When a dehumidification demand is present, the D terminal becomes de-energized. Otherwise, 24VAC is present in off mode and heating mode unless there is a call for dehumidification. Tables 12 and 13 show system response to SignatureStat demand.

Dehumidify Mode Screen

NOTE - Basic or Precision mode must be turned on before you can adjust the dehumidify level on the SignatureStat™.

1 - From the home screen press MENU.

2 - Use the UP or DOWN button to highlight DEHUMIDIFY. See figure 14.

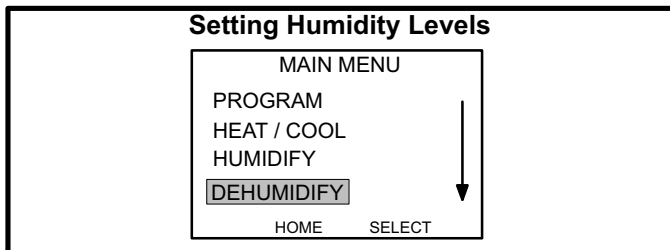


FIGURE 14

3 - Press SELECT to choose MODE.

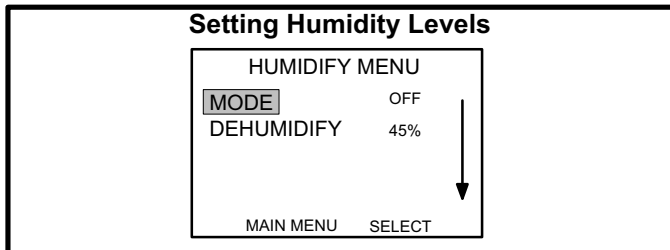


FIGURE 15

4 - To turn off dehumidification control entirely, select OFF. (The default setting for dehumidification is OFF.)

To turn on basic dehumidification mode, select BASIC. To turn on precision dehumidification mode, select PRECISION.

See figure 16.

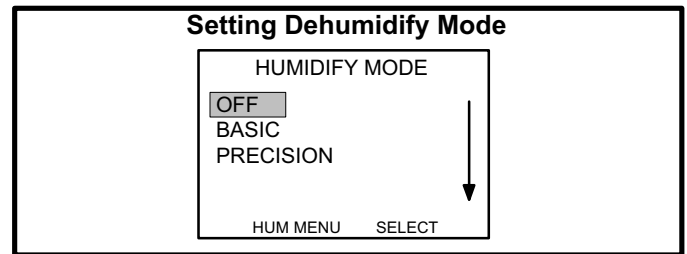


FIGURE 16

5 - The Humidity Menu appears. Basic (BAS) is displayed on the right hand of the screen. Now you can program the dehumidity percentage that you want.

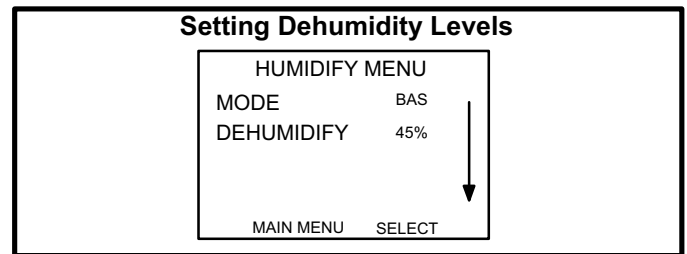


FIGURE 17

Dehumidity Sensor Settings

The dehumidity sensor settings have minimum and maximum settings. The sensor settings can be adjusted in 1% increments. See table 9.

TABLE 9

Dehumidity Setpoint Range	
Minimum setting	45%
Maximum setting	60%

1 - On the humidity menu press the up or down button to again highlight DEHUMIDIFY. See figure 18.

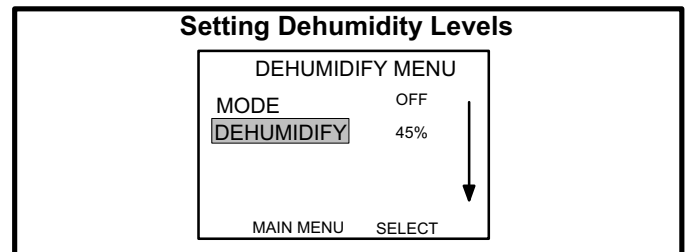


Figure 18

2 - Use the up and down button to adjust the humidity level. See figure 19.

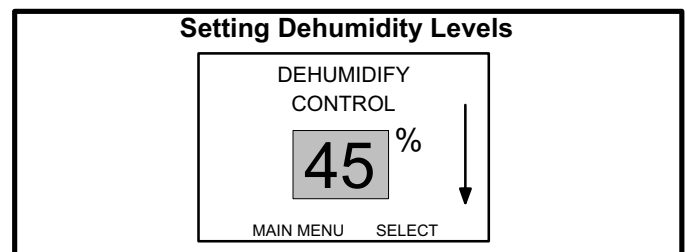


Figure 19

**TABLE 10
TYPICAL CB31MV, CCB1 and TWO-SPEED OUTDOOR UNIT OPERATING SEQUENCE**

OPERATING SEQUENCE		SYSTEM DEMAND		SYSTEM RESPONSE		
System Condition	Step	Thermostat Demand	*Relative Humidity (EfficiencyPlus Lights)	*** Compressor Speed	Blower CFM (COOL)	Comments
Normal operation	1	Y1	Acceptable (None)	Low	40% of COOL	Compressor demand and indoor blower speed follow thermostat demand.
	2	Y2	Acceptable (None)	High	COOL	
Call for humidity removal during 1st stage thermostat demand.	1	Y1	Acceptable (None)	Low	40% of COOL	Dehumidification mode begins with next thermostat demand after initial thermostat demand is satisfied.
	2	Y1	Change to Slightly over setpoint (1)	Low	40% of COOL	
	3	Demand Satisfied	Slightly over setpoint (1)	Off	Off	
	4	Y1	Slightly over setpoint (1)	High	**60%/65% of COOL	
Significant increase in humidity during thermostat demand.	1	Y1	Acceptable (None)	Low	40% of COOL	If humidity increases significantly over setpoint or if slide switch is moved significantly, unit will immediately go into dehumidification mode (in presence of thermostat demand).
	2	Y1	Change to Significantly over setpoint (2 or more)	High	**60%/65% of COOL	
Humidity demand satisfied during thermostat demand.	1	Y1	Over Setpoint	High	**60%/65% of COOL	When humidity demand is satisfied, blower immediately shifts to the COOL CFM in order to hasten the end of the cycle. Unit can only shift out of high speed compressor operation at beginning of next cycle.
	2	Y1	Change to Acceptable (None)	High	COOL	
	3	None	Acceptable (None)	Off	Off	
	4	Y1	Acceptable (None)	Low	40% of COOL	
Call for humidity removal during 2nd stage thermostat demand.	1	Y2	Acceptable (None)	High	COOL	Blower immediately changes speed in response to thermostat demand.
	2	Y2	Change to Slightly over setpoint (1)	High	**60%/65% of COOL	
	3	Y2	Acceptable (None)	High	COOL	
*Call for 1st stage cooling after call for humidity removal.	1	None	Slightly over setpoint (1)	Off	Off	Dehumidification mode (high speed compressor) begins with next thermostat demand after initial demand is satisfied.
	2	Y1	Slightly over setpoint (1)	Low	40% of COOL	
Call for 2nd stage cooling after call for humidity removal.	1	None	Slightly over setpoint (1)	Off	Off	Reduced blower speed (dehumidification speed) begins immediately with thermostat demand.
	2	Y2	Slightly over setpoint (1)	High	**60%/65% of COOL	
Call for cooling after significant increase in humidity.	1	None	Significantly over setpoint (2 or more)	Off	Off	If humidity increases significantly over setpoint or if slide switch is moved, unit immediately goes into dehumidification mode (in presence of thermostat demand).
	2	Y1 or Y2	Significantly over setpoint (2 or more)	High	**60%/65% of COOL	
Humidity demand satisfied between thermostat demands (unit off cycle).	1	None	Over setpoint (1 or more)	Off	Off	While unit is not operating (no thermostat demand) slide switch is moved down and back up. Blower and compressor operate at high speed until next thermostat demand.
	2	Y1 or Y2	Change to Acceptable (None)	High	COOL	

Note-When changing unit mode of operation from cooling to heating, indicating lights that are on will stay on until the first thermostat heating demand.

*IMPORTANT-If power to unit is turned on with CCB1 calling for humidity removal, outdoor unit may be locked into high speed indefinitely. To reset, move humidity slide switch all the way down then back up to desired setpoint (with unit running)

** Reduced blower speed is 65% of COOL for the -41 units; 60% of COOL for -51 and -65 series units.

***If the two-speed control on a two-speed outdoor unit is set for LATCH 2 (15 minutes) or LATCH 3 (30 minutes), the compressor will latch into high speed after a Y1 demand has occurred for that period of time.

**TABLE 11
TYPICAL CB31MV, CCB1 and SINGLE SPEED OUTDOOR UNIT OPERATING SEQUENCE**

OPERATING SEQUENCE		SYSTEM DEMAND			SYSTEM RESPONSE	
System Condition	Step	Thermostat Demand	Relative Humidity (EfficiencyPlus Lights)		Blower CFM (COOL)	Comments
Normal operation	1	Y1	Acceptable (None)		COOL	Compressor demand and indoor blower speed follow thermostat demand.
Call for humidity removal during call for cooling.	1	Y1	Acceptable (None)		COOL	Dehumidification mode begins when relative humidity is greater than setpoint.
	2	Y1	Change over setpoint		*60%/65% of COOL	
Humidity demand satisfied during thermostat demand.	1	Y1	Over Setpoint		*60%/65% of COOL	When humidity demand is satisfied, blower immediately shifts to the COOL CFM in order to hasten the end of the cycle.
	2	Y1	Change to Acceptable (None)		COOL	
*Call for cooling after call for humidity removal.	1	None	Over setpoint		Off	Dehumidification mode begins when relative humidity is greater than setpoint.
	2	Y1	Over setpoint		*60%/65% of COOL	
Humidity demand satisfied between thermostat demands (unit off cycle).	1	None	Over setpoint (1 or more)		Off	While unit is not operating (no thermostat demand) slide switch is moved down and back up. Blower operates at COOL CFM.
	2	Y1	Change to Acceptable (None)		COOL	

Note-When changing unit mode of operation from cooling to heating, indicating lights that are on will stay on until the first thermostat heating demand.

* Reduced blower speed is 65% of COOL for the -41 units; 60% of COOL for -51 and -65 series units.

**TABLE 12
CB31MV, SignatureStat and SINGLE STAGE OUTDOOR UNIT**

OPERATING SEQUENCE		SYSTEM DEMAND							SYSTEM RESPONSE			
System Condition	Step	Thermostat Demand					Relative Humidity		Compressor	Blower CFM (COOL)	Comments	
		Y1		O	G	W	1	Status				D
NO CALL FOR DEHUMIDIFICATION												
Normal Operation	1	On		On	On			Acceptable	24 VAC	High	100%	Compressor and indoor blower follow thermostat demand
BASIC MODE (only active on a Y1 thermostat demand)												
Normal Operation	1	On		On	On			Acceptable	24 VAC	High	100%	SignatureStat energizes Y1 and de-energizes D on a call for dehumidification
Dehumidification Call	2	On		On	On			Demand	0 VAC	High	60%/65%*	
PRECISION MODE (operates independent of a Y1 thermostat demand)												
Normal Operation	1	On		On	On			Acceptable	24 VAC	High	100%	Dehumidification mode begins when humidity is greater than set point
Dehumidification call	2	On		On	On			Demand	0 VAC	High	60%/65%*	
Dehumidification call ONLY	1	On		On	On			Demand	0 VAC	High	60%/65%*	SignatureStat will try to maintain room humidity setpoint by allowing the room space to maintain a cooler room thermostat setpoint**
Jumpers at indoor unit with a single stage outdoor unit With Condensing unit - Y1 to Y2 and R to O With Heat Pump - Y1 to Y2												

Lennox SignatureStat used for these applications are 51M26 - 1 heat / 1 cool or 51M28 - 2 heat / 2 cool heat pump

*During dehumidification, cooling blower speed is as follows: 65% of COOL cfm for -41units, 60% COOL cfm for -51 and -61 units

** In Precision mode, Signature thermostat built BEFORE October 2003 will maintain the room temperature up to 3°F (1.8°C) cooler than room thermostat setting. Precision thermostat built AFTER October 2003 will maintain the room temperature up to 2°F (1.2°C) cooler than the room thermostat setting.

**TABLE 13
CB31MV, SignatureStat and TWO STAGE OUTDOOR UNIT**

OPERATING SEQUENCE		SYSTEM DEMAND							SYSTEM RESPONSE			
System Condition	Step	Thermostat Demand					Relative Humidity		Compressor	Blower CFM (COOL)	Comments	
		Y1	Y2	O	G	W 1	W 2	Status				D
NO CALL FOR DEHUMIDIFICATION												
Normal Operation - Y1	1	On		On	On			Acceptable	24 VAC	Low	70%	Compressor and indoor blower follow thermostat demand
Normal Operation - Y2	2	On	On	On	On			Acceptable	24 VAC	High	100%	
ROOM THERMOSTAT CALLS FOR FIRST STAGE COOLING												
<i>BASIC MODE (only active on a Y1 thermostat demand)</i>												
Normal Operation	1	On		On	On			Acceptable	24 VAC	Low	70%	SignatureStat energizes Y2 and de-energizes D on a call for dehumidification
Dehumidification Call	2	On	On	On	On			Demand	24 VAC	High	60%/65%*	
<i>PRECISION MODE (operates independent of a Y1 thermostat demand)</i>												
Normal Operation	1	On		On	On			Acceptable	24 VAC	Low	70%	Dehumidification mode begins when humidity is greater than set point
Dehumidification call	2	On	On	On	On			Demand	0 VAC	High	60%/65%*	
Dehumidification call ONLY	1	On	On	On	On			Demand	0 VAC	High	60%/65%*	SignatureStat will try to maintain room humidity setpoint by allowing the room space to maintain a cooler room thermostat setpoint**
ROOM THERMOSTAT CALLS FOR FIRST AND SECOND STAGE COOLING												
<i>BASIC MODE (only active on a Y1 thermostat demand)</i>												
Normal Operation	1	On	On	On	On			Acceptable	24 VAC	High	100%	SignatureStat energizes Y2 and de-energizes D on a call for dehumidification
Dehumidification Call	2	On	On	On	On			Demand	0 VAC	High	60%/65%*	
<i>PRECISION MODE (operates independent of a Y1 thermostat demand)</i>												
Normal Operation	1	On	On	On	On			Acceptable	24 VAC	High	100%	Dehumidification mode begins when humidity is greater than set point
Dehumidification call	2	On	On	On	On			Demand	0 VAC	High	60%/65%*	
Dehumidification call ONLY	1	On	On	On	On			Demand	0 VAC	High	60%/65%*	SignatureStat will try to maintain room humidity setpoint by allowing the room space to maintain a cooler room thermostat setpoint**
		Jumpers at indoor unit with a two stage outdoor unit With Condensing unit - R to O With Heat Pump - none										SignatureStat will try to maintain room humidity setpoint by allowing the room space to maintain a cooler room thermostat setpoint**

Lennox SignatureStat used for these applications are 51M27 - 2 heat / 2 cool or 51M28 - 2 heat / 2 cool heat pump.

*During dehumidification cooling blower speed is as follows: 65% of COOL cfm for -41 units, 60% COOL cfm for -51 and -61 units

** In Precision mode, Signature thermostat built BEFORE October 2003 will maintain the room temperature up to 3°F (1.8°C) cooler than room thermostat setting. Precision thermostat built AFTER October 2003 will maintain the room temperature up to 2°F (1.2°C) cooler than the room thermostat setting.

VI-CONFIGURATION MODIFICATIONS

CB31MV unit may be installed in the upflow, downflow, horizontal right-hand discharge or horizontal left-hand discharge orientation.

The units come from the factory ready for upflow or horizontal right-hand discharge installation. If the unit needs to be modified from its original configuration, use the following procedures. All procedures assume the unit has not been modified from the factory.

A-Disassembly of CB31MV Cabinet

For tight applications where a modular design is an advantage, the CB31MV unit can be easily disassembled and reassembled. By removing four screws, the coil lifts off so the unit is in two parts. To disassemble the CB31MV, use the following procedure.

- 1- Remove the two black screws located just above the seam in the top half of the unit.
- 2- Remove the front access panel and remove the two screws on the inside of the top half of the cabinet on both sides.
- 3- Lift the top section apart from the bottom section.
- 4- To lighten the cabinet for lifting, the blower and coil assemblies can also be removed.
- 5- Reassemble once the cabinet is in place.

B-Upflow Application

- 1- Discard drip shields, if applicable. The shields are used for downflow applications only and are located with the foam pads on top of unit.
- 2- For best efficiency and air flow, the horizontal drain pan should be removed from units in upflow configurations.
- 3- After removing horizontal drain pan, place unit in desired location. Set unit so that it is level. Connect return and supply air plenums as required using sheet metal screws. See figure 20.

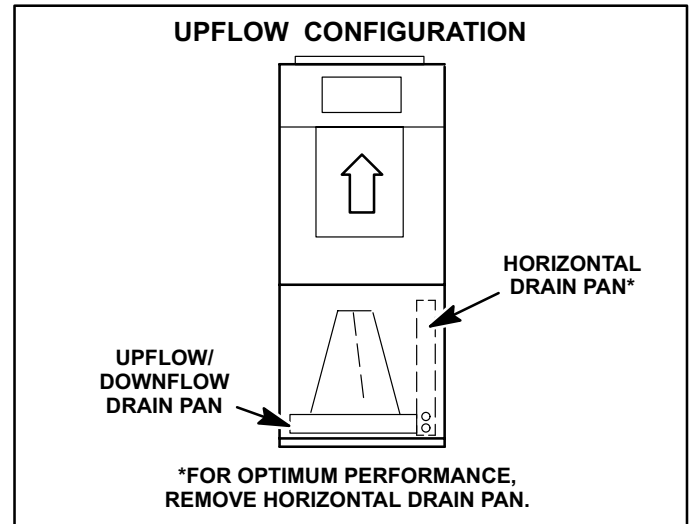


FIGURE 20

C-Downflow Application

- 1- Remove drip shields shipped with the foam pads from top of unit. The shields are used for downflow applications only and may need to be field fabricated if no longer with unit.
- 2- Remove coil assembly from unit.
- 3- Remove horizontal drain pan. See figure 21.

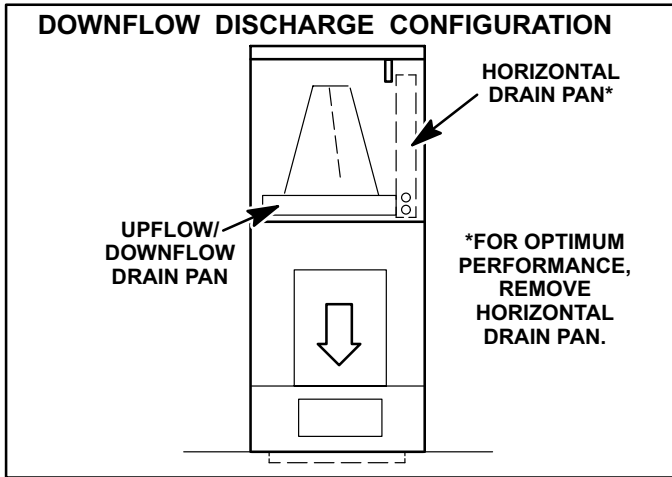


FIGURE 21

- 4- Rotate cabinet 180° from upright. It may be necessary to first remove the blower assembly to lighten the cabinet for lifting.
- 5- Install downflow drip shield firmly in place on inside of coil slab from under drain pan. See figures 22 and 23.

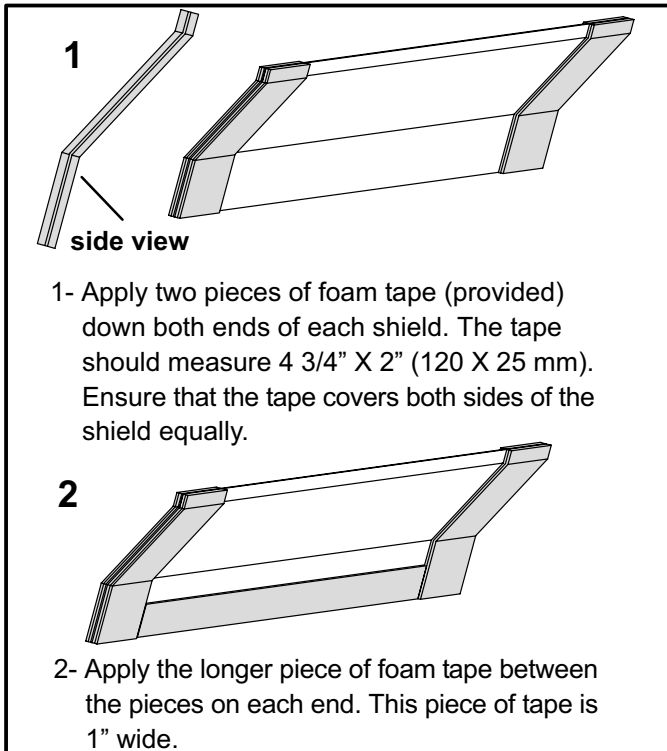


FIGURE 22

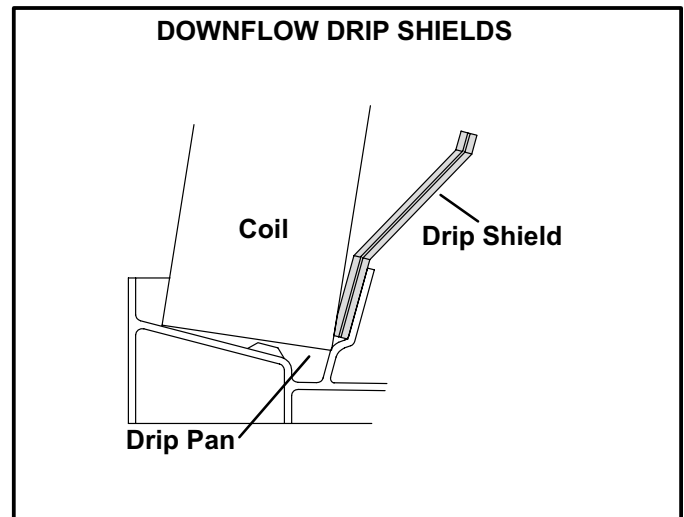


FIGURE 23

- 6- Replace coil assembly and blower if removed. Replace coil access panel. If horizontal drain pan is not removed, depress tab in cabinet support rail to hold horizontal drain pan in place. See figure 21.
- 7- Set unit so that it is level. Connect return and supply air plenums as required using sheet metal screws.

⚠ WARNING

If electric heat section with circuit breakers (ECB29/ECB31) is applied to downflow CB31MV unit, the circuit breakers must be rotated 180° to the UP position. See ECB29/ECB31 installation instructions for more details.

NOTE-For downflow application, metal or class I supply and return air plenums must be used.

For downflow installation on combustible flooring, an additive base must be used. See figure 24.

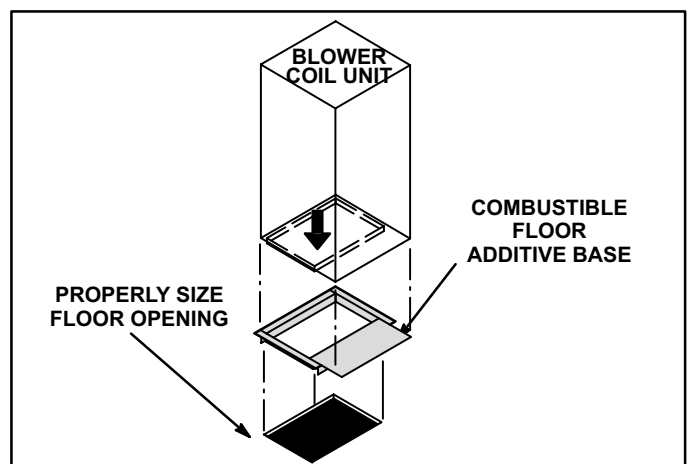


FIGURE 24

Cut an opening appropriately sized for combustible base. Base dimensions are shown in figure 25. After opening has been cut, set the additive base into opening. Connect outlet air plenum to the additive base. Set the unit on the additive base so flanges of the unit drop into the base opening and seal against the insulation strips. Seal around the insulation strips with perma-gum. The unit is now locked in place. Install return air plenum and secure with sheet metal screws.

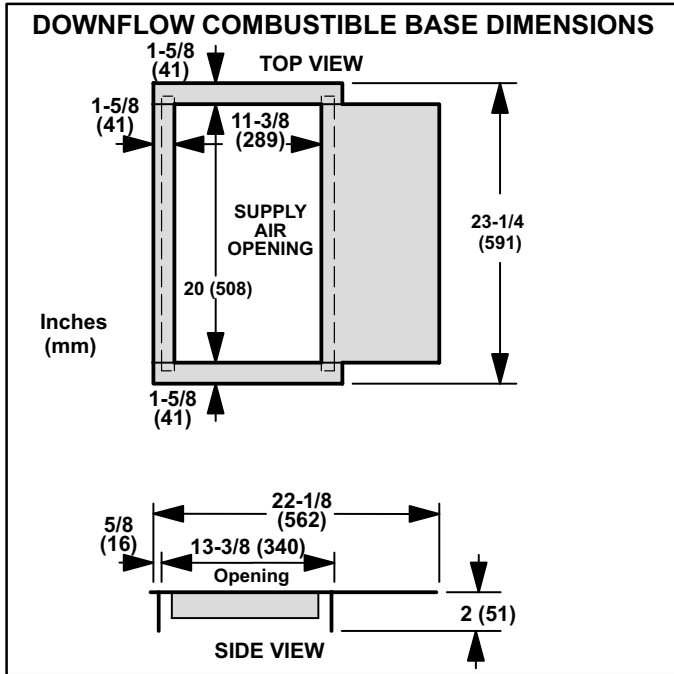


FIGURE 25

D-Horizontal Right-Hand Discharge Application

NOTE-For horizontal applications, a secondary drain pan is recommended. Refer to local codes.

- 1- Discard drip shields, if applicable. The shields are used for downflow applications only.
- 2- Place blower coil on its right side.
- 3- No further adjustment is necessary. Set unit so it is sloped toward the drain pan (1/4" [6mm]). See figure 26.
- 4- If hanging the unit, it must be supported along the entire length of the cabinet. If using chain or strap, use a piece of angle iron or sheet metal attached to the unit (either above or below) so that the full length of the cabinet is supported. Use securing screws no longer than 1/2" (13mm) to avoid damage to coil or filter. See figure 27. Connect return and supply air plenums as required using sheet metal screws.

NOTE-For horizontal applications in high humidity areas, remove the downflow rail closest to the drain pan. Removal of downflow rail will prevent sweating in high humidity areas. To remove rail, remove screw from rail at back of unit and at cabinet support rail. Remove downflow rail then replace screws. Also, seal around the exiting drain pipe, liquid and suction lines to prevent infiltration of humid air.

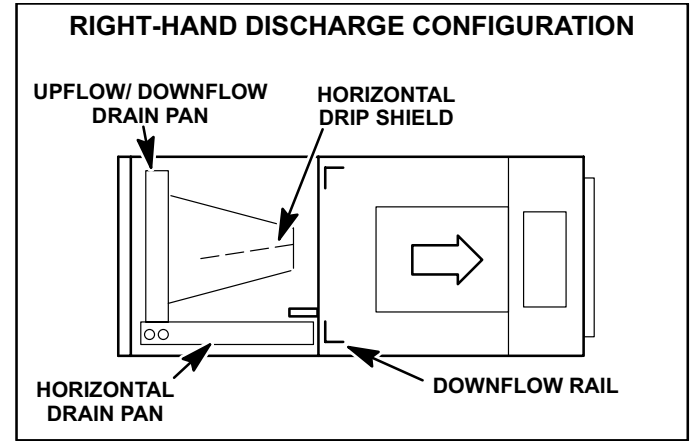


FIGURE 26

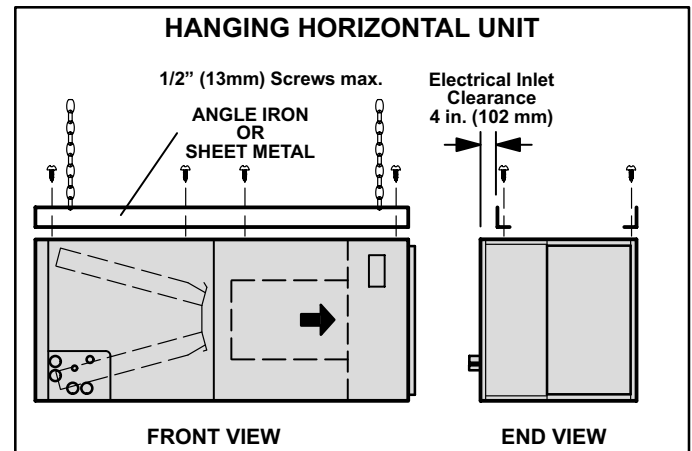


FIGURE 27

⚠ CAUTION

Danger of equipment damage and personal injury. Take care when removing coil assembly from unit installed in right or left-hand applications. Coil may tip into drain pan once clear of cabinet. Support coil when removing.

E-Horizontal Left-Hand Discharge Application

NOTE-For horizontal applications above the ceiling, a secondary drain pan is recommended. Refer to local codes.

- 1- Discard drip shields, if applicable. The shields are used for downflow applications only.
- 2- Pull coil assembly from unit. Pull off the horizontal drain pan.
- 3- Remove drain plugs from back drain holes on horizontal drain pan and re-install them on front holes.
- 4- Rotate drain pan 180° front to back and install it on the opposite side of coil.
- 5- Remove screws from top cap. Remove horizontal drip shield screw located in the center of the back coil end seal. See figure 28.
- 6- Rotate horizontal drip shield 180° front to back.
- 7- Remove plastic plug from left hole on coil front end seal and re-install plug in back hole. Re-install horizontal drip shield screw in front coil end seal. Drip shield should drain downward into horizontal drain pan inside coil.
- 8- Rotate top cap 180° front to back and align with unused screw holes. Holes must align with front and back coil end plates. Note that top cap has a 45° bend on one side and 90° bend on the other. **The 90° bend must be on the same side as the horizontal drain pan.** See figures 28 and 29.

NOTE-Use extreme care when re-installing screws into coil end plate engaging holes. Coil damage could result by misalignment.

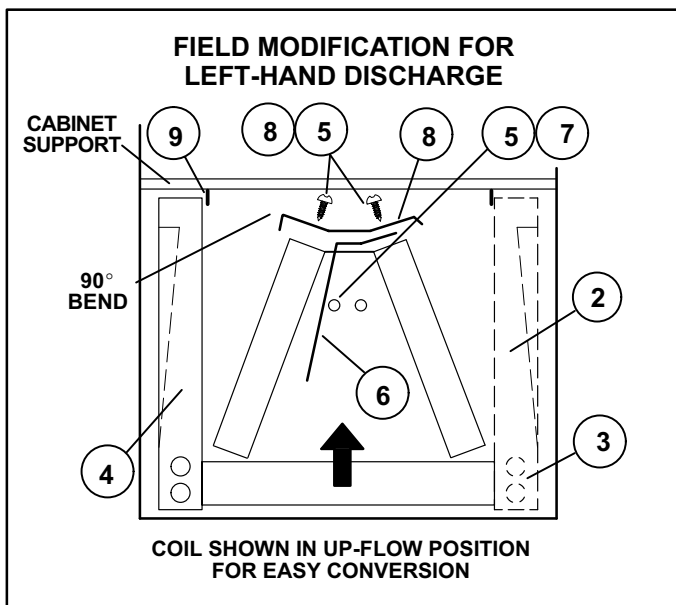


FIGURE 28

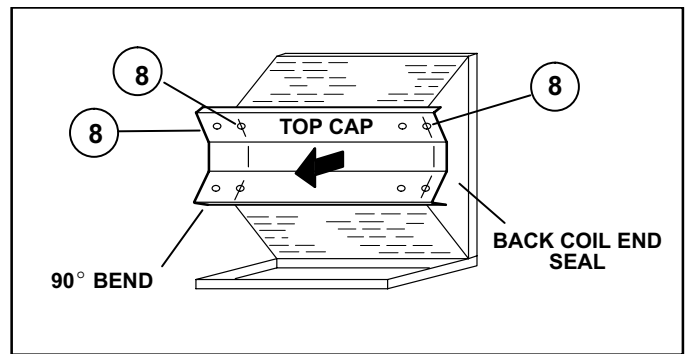


FIGURE 29

- 9- From the upflow position, replace coil assembly. Then flip cabinet 90° to the left and set into place. Replace coil assembly. Secure coil in place by bending down tab on cabinet support rail. See figures 28 and 30.

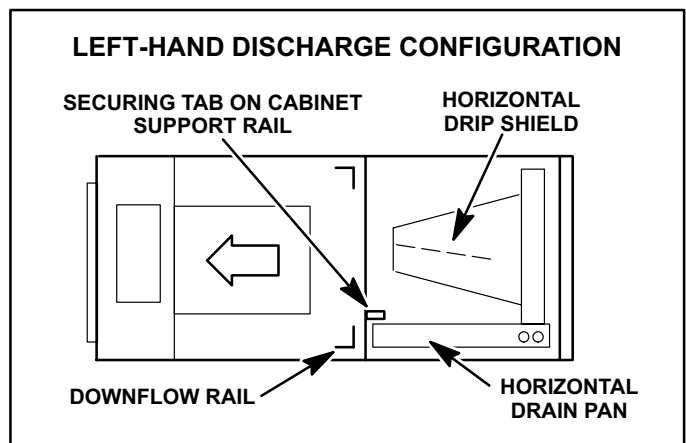


FIGURE 30

*NOTE-For horizontal applications in **high humidity areas**, remove the downflow rail closest to the drain pan. To remove rail, remove screw from rail at back of unit and at cabinet support rail. Remove downflow rail then replace screws. Also, seal around the exiting drain pipe, liquid and suction lines to prevent infiltration of humid air.*

- 10- Flip access door. Knock out the portion of door for the drain pipes and attach to the cabinet with screw provided. Replace access door on the unit.
- 11- Set unit so it is sloped toward the drain pan (1/4" [6mm]). Connect return and supply air plenums as required using sheet metal screws.
- 12- If hanging the unit, it must be supported along the entire length of the cabinet. If using chain or strap, use a piece of angle iron or sheet metal attached to the unit (either above or below) so that the full length of the cabinet is supported. Use securing screws no longer than 1/2" (13mm) to avoid damage to coil or filter. See figure 27. Connect return and supply air plenums as required using sheet metal screws.

F-Condensate Drain

A 5" (127mm) section of PVC pipe is provided with the unit. Cut the pipe in half and use to route the auxiliary and main drains. Connect main condensate drain and route downward to an open drain or sump. Do not connect drain to a closed waste system. Refer to figure 31 for typical condensate trap configuration.

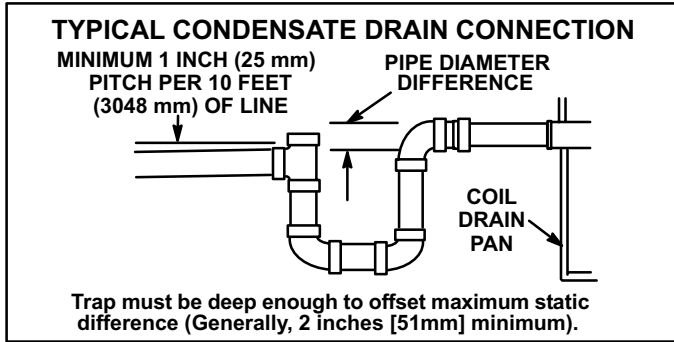


FIGURE 31

It is recommended that the auxiliary drain be connected to a drain line for all units. If auxiliary drain is not connected, it must be plugged with provided cap. **For downflow units, the auxiliary drain MUST be connected and routed to a drain.** See figure 32 for auxiliary and main drain locations.

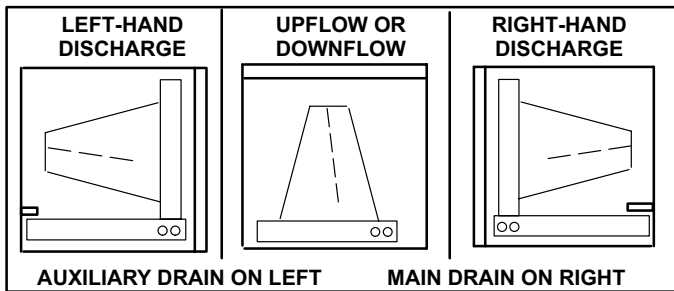


FIGURE 32

The following practices are recommended to ensure condensate removal:

- 1- Drain piping should not be smaller than the drain connections at drain pan.
- 2- A trap must be installed in the main drain line.
- 3- The trap must be deep enough to offset the difference in static pressure between drain pan and atmosphere. Generally, two inches is satisfactory for medium static applications.
- 4- Horizontal runs must be sloped 1" (25mm) per 10 feet (3.1m) of drain line to offset friction.
- 5- An open vent in drain line will sometimes be required due to line length, friction and static pressure.

6- Drains should be constructed in a manner to facilitate future cleaning and not to interfere with filter access. See figure 31.

7- Auxiliary drain should run to an area where homeowner will notice it draining. Refer to local codes.

VII-START-UP - OPERATION

A-Preliminary and Seasonal Checks

- 1- Make sure the unit is installed in accordance with the installation instructions.
- 2- Inspect electrical wiring, both field and factory installed for loose connections. Tighten as required.
- 3- Check voltage at disconnect switch. Voltage must be within range listed on the nameplate. If not, consult the power company and have voltage condition corrected before starting unit.
- 4- Check to ensure that refrigerant lines are in good condition and pipe insulation is intact.
- 5- Inspect condition of condensate drain pan and piping assembly. Disassemble and clean seasonally.

B-Cooling Start-Up

NOTE-The following is a generalized procedure and does not apply to all thermostat control systems. Electronic thermostat control systems may operate differently.

- 1- Set fan switch to AUTO or ON and move the system selection switch to COOL. Adjust the thermostat to a setting far enough below room temperature to bring on the compressor. Compressor will start and cycle on demand from the thermostat.
- 2- The refrigerant circuit is charged with R-22 refrigerant. See condensing unit rating plate for correct charge amount.
- 3- Refer to the correct condensing unit service manual for more information.

C-Heating Start-Up

- 1- Set the fan switch to AUTO or ON and move the system selection switch to HEAT. Adjust the thermostat setting above room temperature.
- 2- The indoor blower immediately starts and the electric heat will stage on based on sequence timing.

D-Safety or Emergency Shutdown

Turn off unit power at circuit breaker.

E-Extended Period Shutdown

Turn off thermostat or set to "UNOCCUPIED" mode. Turn off power to unit. All access panels and covers must be in place and secured.

The condensate assembly should be clean and dry for extended period shutdown.

VIII-TYPICAL OPERATING CHARACTERISTICS

A-Blower Operation and Adjustment

NOTE- The following is a generalized procedure and does not apply to all thermostat controls.

- 1- Blower operation is dependent on thermostat control system.
- 2- Generally, blower operation is set at thermostat sub-base fan switch. With fan switch in ON position, blower operates continuously. With fan switch in AUTO position, blower cycles with demand.
- 3- In all cases, blower and entire unit will be off when the system switch is in OFF position.

B-External Static Pressure

1. Measure tap locations as shown in figure 33.

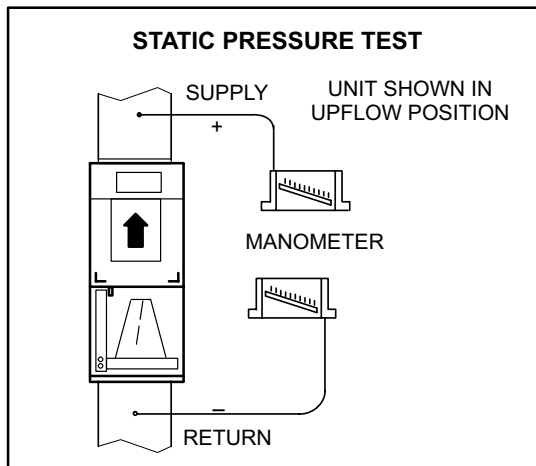


FIGURE 33

2. Punch a 1/4" (6mm) diameter hole in supply and return air plenums. Insert manometer hose flush with inside edge of hole or insulation in the supply plenum only. Seal around the hose with permagum. Connect the other end of the hose to the zero end of the manometer. Leave the other end of the manometer open to the atmosphere.
3. With only the blower motor running and the evaporator coil dry, observe and take note of the manometer reading.
4. Repeat step 2 for the return air plenum. Insert manometer hose to the opposite end of the zero side of the manometer. Leave the zero side of the manometer open to atmosphere.
5. Repeat step 3.
6. Add the **absolute** values of the supply air reading and the return air reading to get the external static pressure of the unit. For example -.20 in.wg. on the return and +.30 in.wg. on the supply result in external static pressure of .50 in.wg. External static should not exceed .80" w.g. (200Pa) Adjust blower motor speed to deliver the air desired according to job requirements.
- 7- Seal around the holes when the check is complete.

IX-MAINTENANCE

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

A-Filters

! IMPORTANT

Filter access panel must be in place during unit operation. Excessive warm air entering the unit may result in water blow-off problems.

To remove filter, loosen the thumb screws holding the filter panel in place. Slide filter out of the guides on either side of cabinet, insert new filter and replace panel. Some models come with a spacer so standard size filters can be used. Filters should be inspected monthly and must be replaced when dirty to ensure proper blower coil operation. See table 14 for replacement filter sizes or see the sticker located on the filter access door specifying the size of the standard throw-away filter which is used with the unit.

TABLE 14

CB31MV FILTER SIZES	
Unit	Filter Size
CB31MV-41	20" X 20" (508mm X 508mm)
CB31MV-51,-65	20" X 24" (508mm X 610mm)

B-Supply Air Blower

- 1- Check and clean blower wheel.
- 2- Motors are prelubricated for extended life; no further lubrication is required.

C-Electrical

- 1- Check all wiring for loose connections.
- 2- Check circuit breaker located in unit control box.
- 3- Check for correct voltage at unit (unit operating).
- 4- Check amp-draw using a True RMS ampmeter. Typical clamp-on ammeters do not read current accurately.
Motor Nameplate _____ Actual _____
- 5- Check to see that heat (if applicable) is operating.

D-Insulation

Outdoor piping insulation should be inspected yearly for deterioration. If necessary, replace with same materials.

X-WIRING SCHEMATIC AND OPERATION SEQUENCE

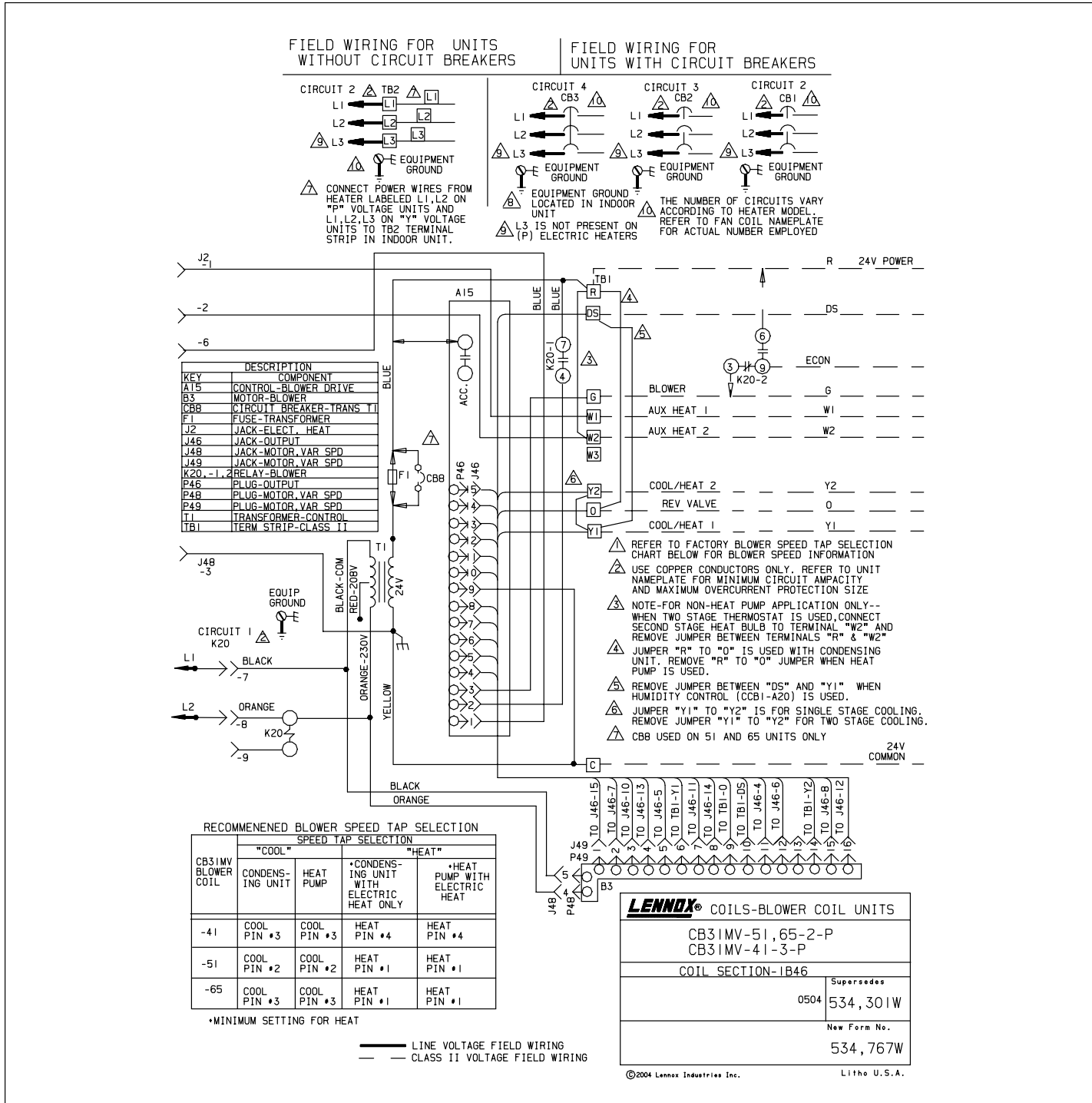


FIGURE 34

A-CB31MV - 208/230V SINGLE PHASE - SEQUENCE OF OPERATION

- Line voltage is routed to transformer T1 and blower motor B3.
- T1 supplies 24VAC to terminal strip TB1, which supplies 24VAC to the indoor thermostat and electric heat, if used.
- When there is a call for heat, W1 of the thermostat energizes the electric heat relay K32 (covered in the electric heat section). After K32 closes, blower relay K20-1 is energized.
- Blower motor B3 is energized on heating speed after K20-1 closes (see electric heat).
- Economizer relay K20-2 (if used) is energized after K32-1 closes (see electric heat section).
- K20-2 closes energizing the economizer with 24VAC.

HEATING

COOLING

- See Table 15 for cooling sequence of operation.

TABLE 15

CB31MV COOLING OPERATION AND JUMPER SUMMARY (OPTIONAL ACCESSORIES) WITHOUT CCB1 WITHOUT SIGNATURESTAT WITHOUT HARMONY			
UNIT	JUMPERS¹	THERMOSTAT DEMAND	BLOWER SPEED
Single Speed Condensing Unit	DS to Y1 Y1 to Y2 O to R	Y1	COOL
Two Speed Condensing Unit	DS to Y1 O to R	Y1	*60%/65%/70% of COOL
		Y2	COOL
Single Speed Heat Pump	DS to Y1 Y1 to Y2	Y1	COOL
Two Speed Heat Pump	DS to Y1	Y1	*60%/65%/70% of COOL
		Y2	COOL
CB31MV COOLING OPERATION AND JUMPER SUMMARY (OPTIONAL ACCESSORIES) WITH CCB1 WITHOUT HARMONY			
UNIT	JUMPERS	THERMOSTAT DEMAND & BLOWER SPEED	
Single Speed Condensing Unit	Y1 to Y2 O to R	See table 11	
Two Speed Condensing Unit	O to R	See table 10	
Single Speed Heat Pump	Y1 to Y2	See table 11	
Two Speed Heat Pump	NONE	See table 10	
CB31MV COOLING OPERATION AND JUMPER SUMMARY (OPTIONAL ACCESSORIES) WITH SIGNATURESTAT WITHOUT HARMONY			
UNIT	JUMPERS	THERMOSTAT DEMAND & BLOWER SPEED	
Single Speed Condensing Unit	Y1 to Y2 O to R	See table 12	
Two Speed Condensing Unit	O to R	See table 13	
Single Speed Heat Pump	Y1 to Y2	See table 12	
Two Speed Heat Pump	NONE	See table 13	
CB31MV COOLING OPERATION AND JUMPER SUMMARY (OPTIONAL ACCESSORIES) WITHOUT CCB1 WITHOUT SIGNATURESTAT WITH HARMONY			
UNIT	JUMPERS	SEQUENCE OF OPERATION	
Single or Two Speed Condensing Unit	O to R	Harmony controls blower speed according to size of demand, through pulse width modulated signal to DS	
Single or Two Speed Heat Pump	NONE	Harmony controls blower speed according to size of demand, through pulse width modulated signal to DS	

NOTE: If using Harmony kit, locate blower relay K20 and remove and tape off any one of four wires. (CAUTION HIGH VOLTAGE)

NOTE: Continuous fan CFM will be 50% of COOL speed. Blower will run on HEAT speed during Heat operation.

**Reduced blower speed is 70% COOL for ALL model units manufactured August 2002 and later.*

Reduced blower speed is 65% of COOL for the -036 UNITS; 60% of COOL for -048 and -060 series units manufactured prior to August 2002.

¹ CB31MV units manufactured January 2002 and later, will have factory installed jumpers. Remove jumpers not used.

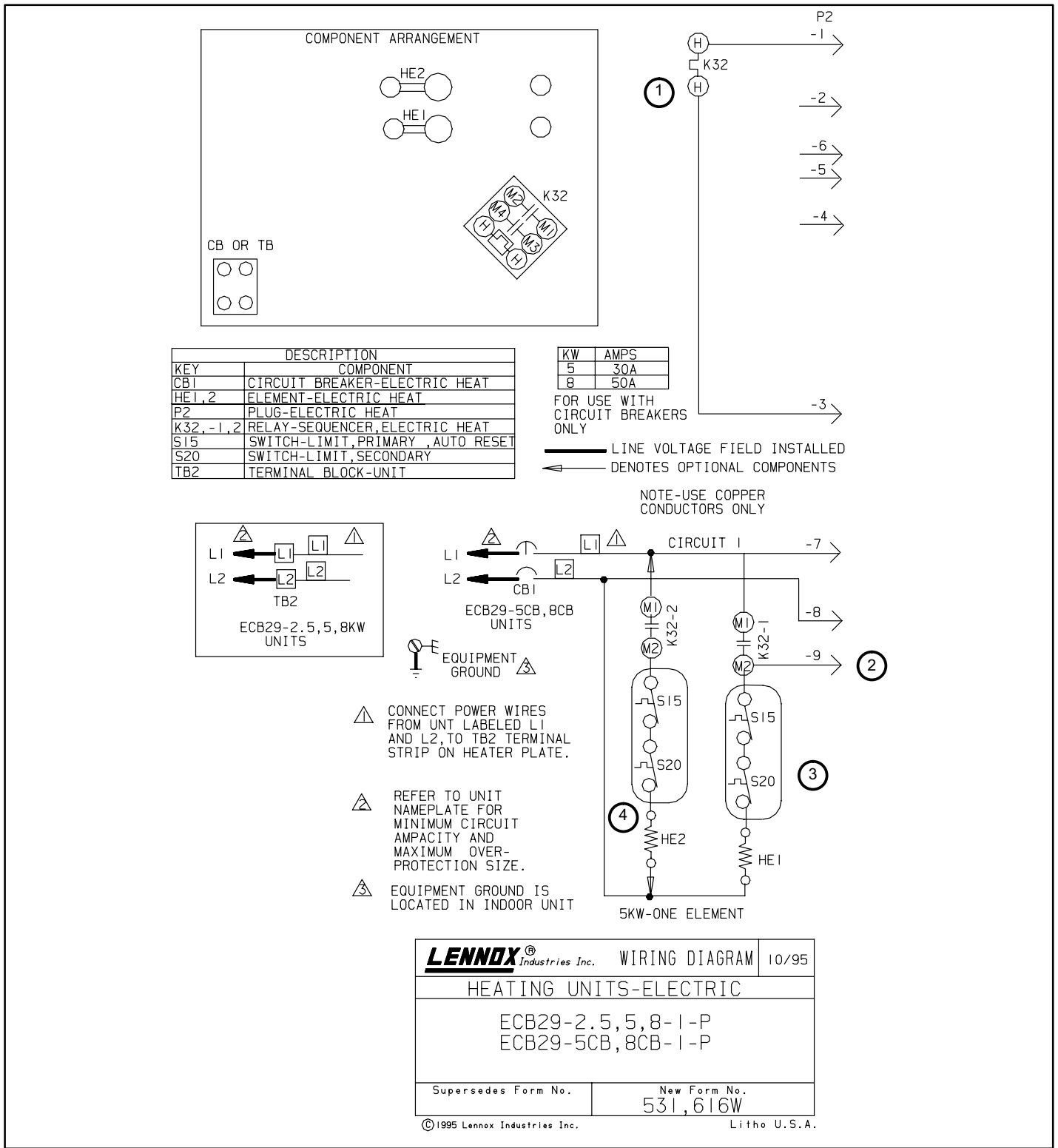


FIGURE 35

B-ECB29-5, -5CB, -8, -8CB - 208/230V SINGLE PHASE - SEQUENCE OF OPERATION

- When there is a call for heat, W1 of the thermostat energizes the electric heat relay K32 with 24VAC.
- When K32-1 closes, the blower is energized on heating speed and economizer heat relay (K20-2) is energized (see unit schematic, figure 26).
- Assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE1 is energized.
- When K32-2 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE2 is energized.

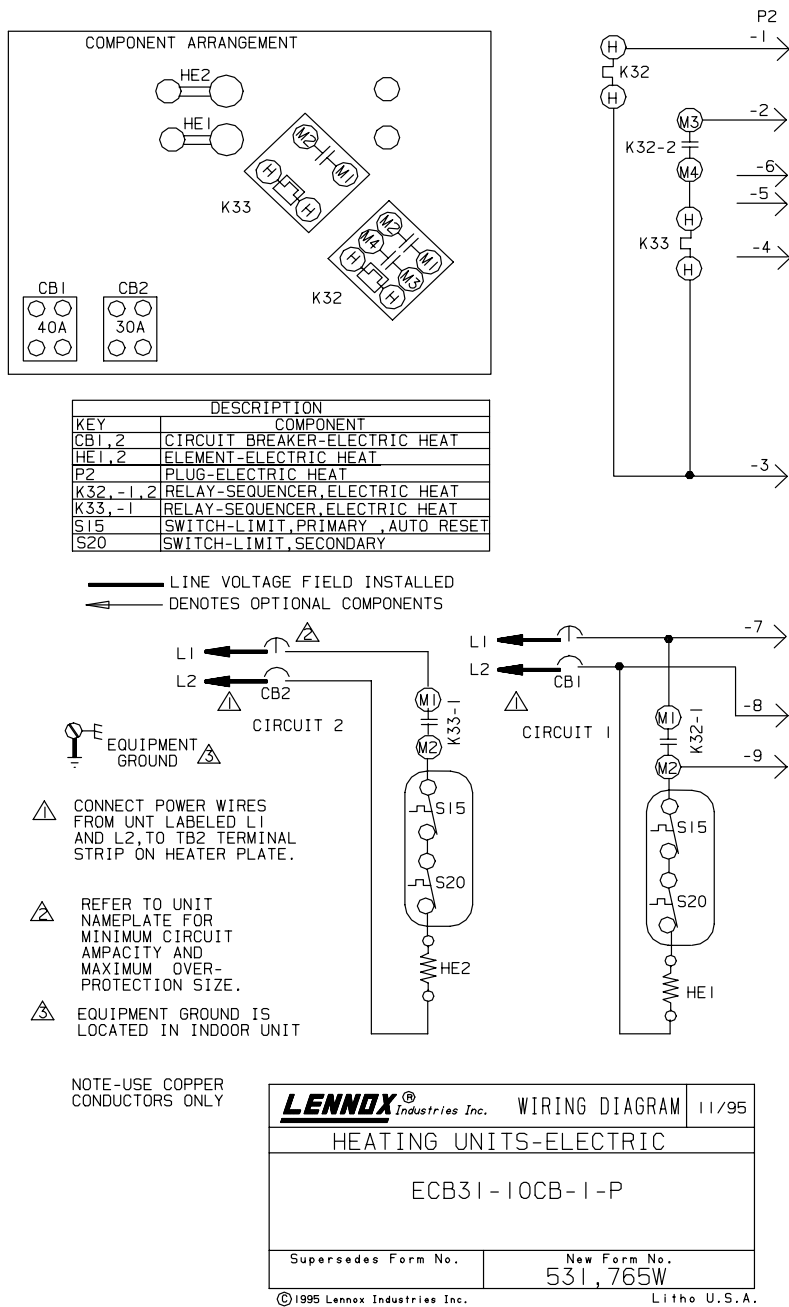


FIGURE 36

C-ECB31-10,10CB - 208/230V SINGLE PHASE - SEQUENCE OF OPERATION

FIRST-STAGE HEAT

1. When there is a call for heat, W1 of the thermostat energizes the electric heat relay K32 with 24VAC.
2. When K32-1 closes, the blower is energized on heating speed and economizer heat relay (K20-2) is energized (see unit schematic figure 26).
3. Assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE1 is energized.

SECOND-STAGE HEAT

(remove jumper between W2 and R)

4. When K32-2 closes, the unit is ready for a second stage heat demand. W2 of the thermostat sends a second stage heat demand, energizing the electric heat relay K33 with 24VAC.
5. When K33-1 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE2 is energized.

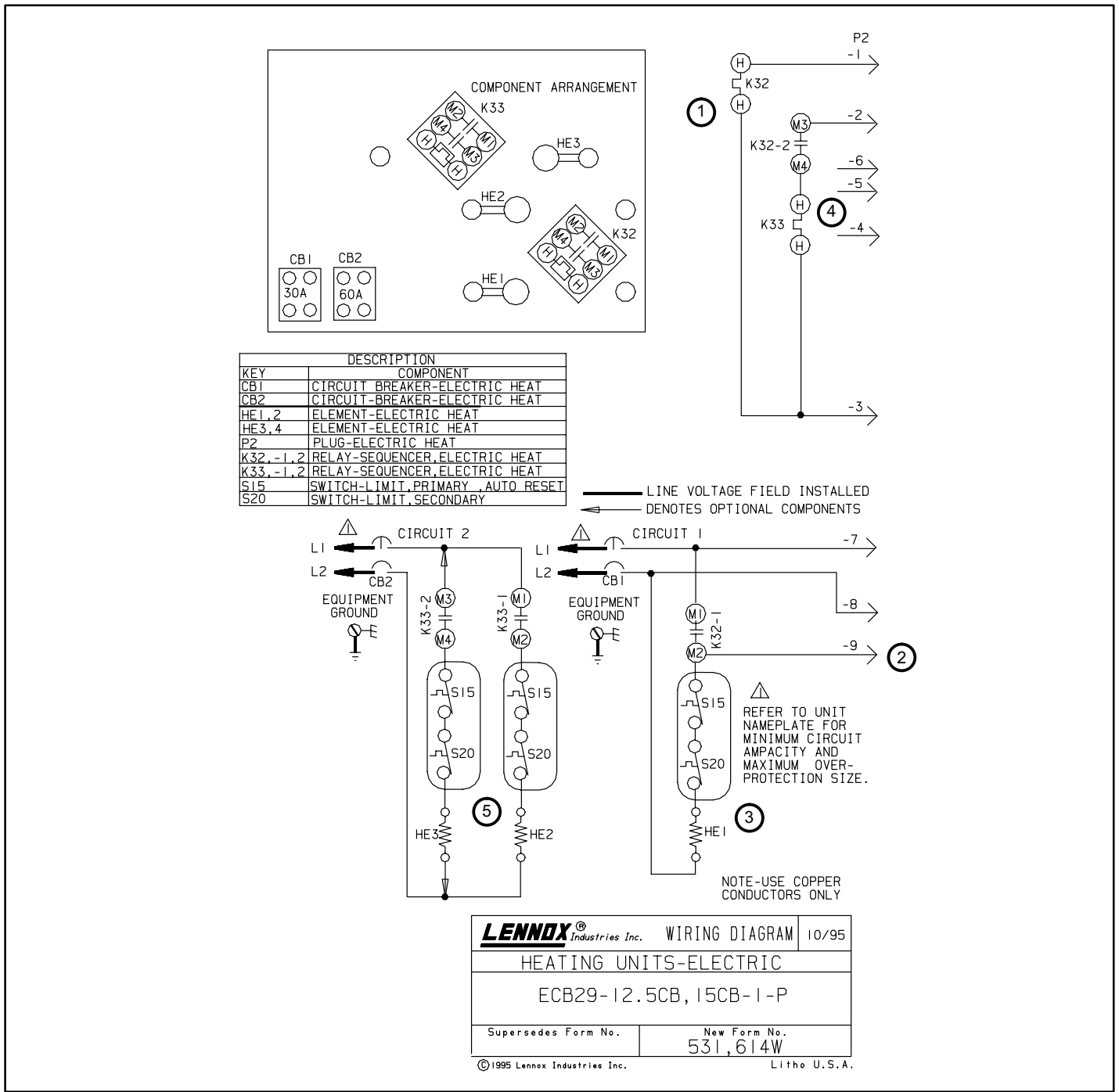


FIGURE 37

D-ECB29-12.5CB, -15CB - 208/230V SINGLE PHASE - SEQUENCE OF OPERATION

FIRST-STAGE HEAT

1. When there is a call for heat, W1 of the thermostat energizes the electric heat relay K32 with 24VAC.
2. When K32-1 closes, the blower is energized on heating speed and economizer heat relay (K20-2) is energized (see unit schematic figure 26).
3. Assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE1 is energized.

SECOND-STAGE HEAT

(remove jumper between W2 and R)

4. When K32-2 closes, the unit is ready for a second stage heat demand. W2 of the thermostat sends a second stage heat demand, energizing the electric heat relay K33 with 24VAC.
5. When K33-1 and K33-2 close, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE2 and HE3 are energized.

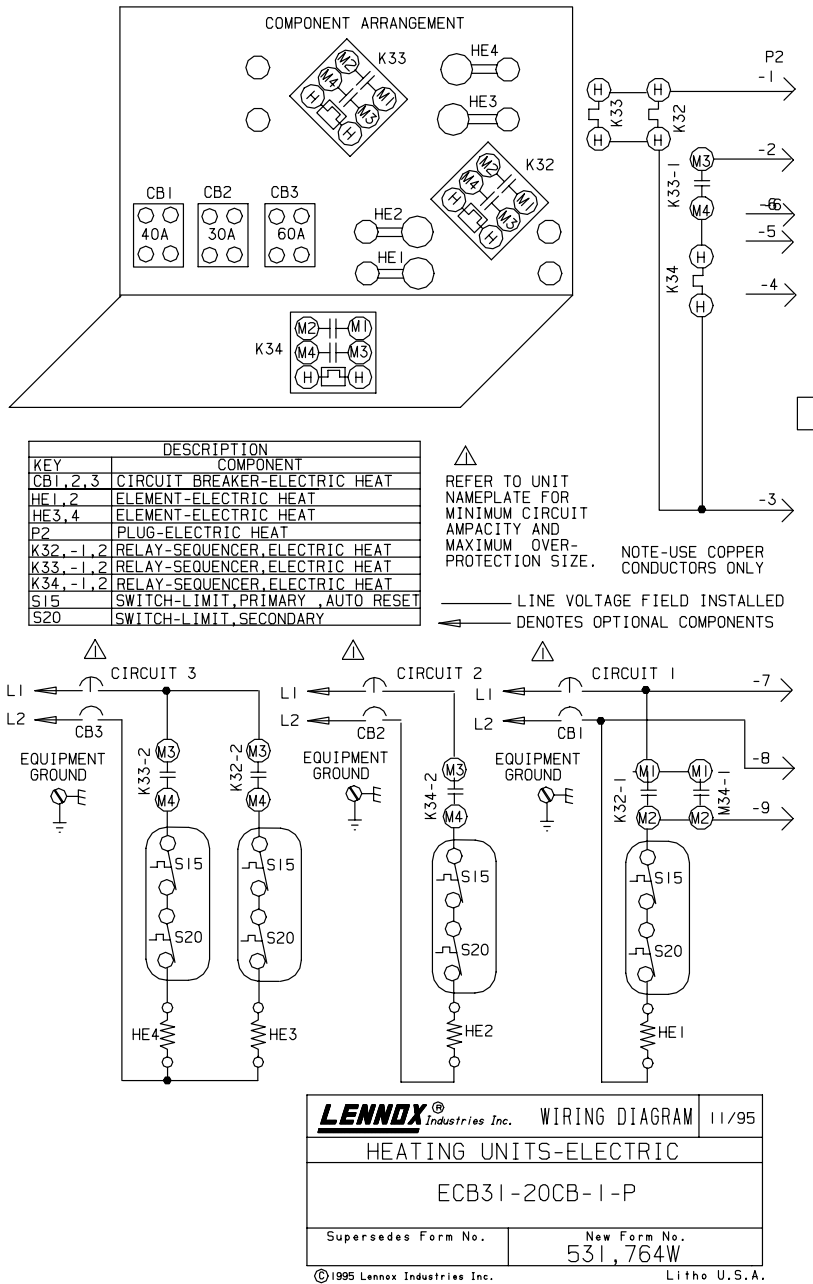


FIGURE 38

E-ECB31-20CB - 208/230V SINGLE PHASE - SEQUENCE OF OPERATION

FIRST-STAGE HEAT

1. When there is a call for heat, W1 of the thermostat energizes the electric heat relays K32 and K33 with 24VAC.
2. When K32-1 closes, the blower is energized on heating speed and economizer heat relay (K20-2) is energized (see unit schematic figure 26).
3. When K32-1 and K32-2 close, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE1 and HE3 are energized.
4. When K33-2 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE4 is energized.

SECOND-STAGE HEAT

(remove jumper between W2 and R)

5. When K33-1 closes, the unit is ready for a second stage heat demand. W2 of the thermostat sends a second stage heat demand, energizing the electric heat relay K34 with 24VAC.
6. When K34-1 closes, the blower (if not energized) is energized on heating speed and economizer heat relay K43 is energized (see 208/230VAC CB schematic).
7. When K34-2 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE2 is energized.

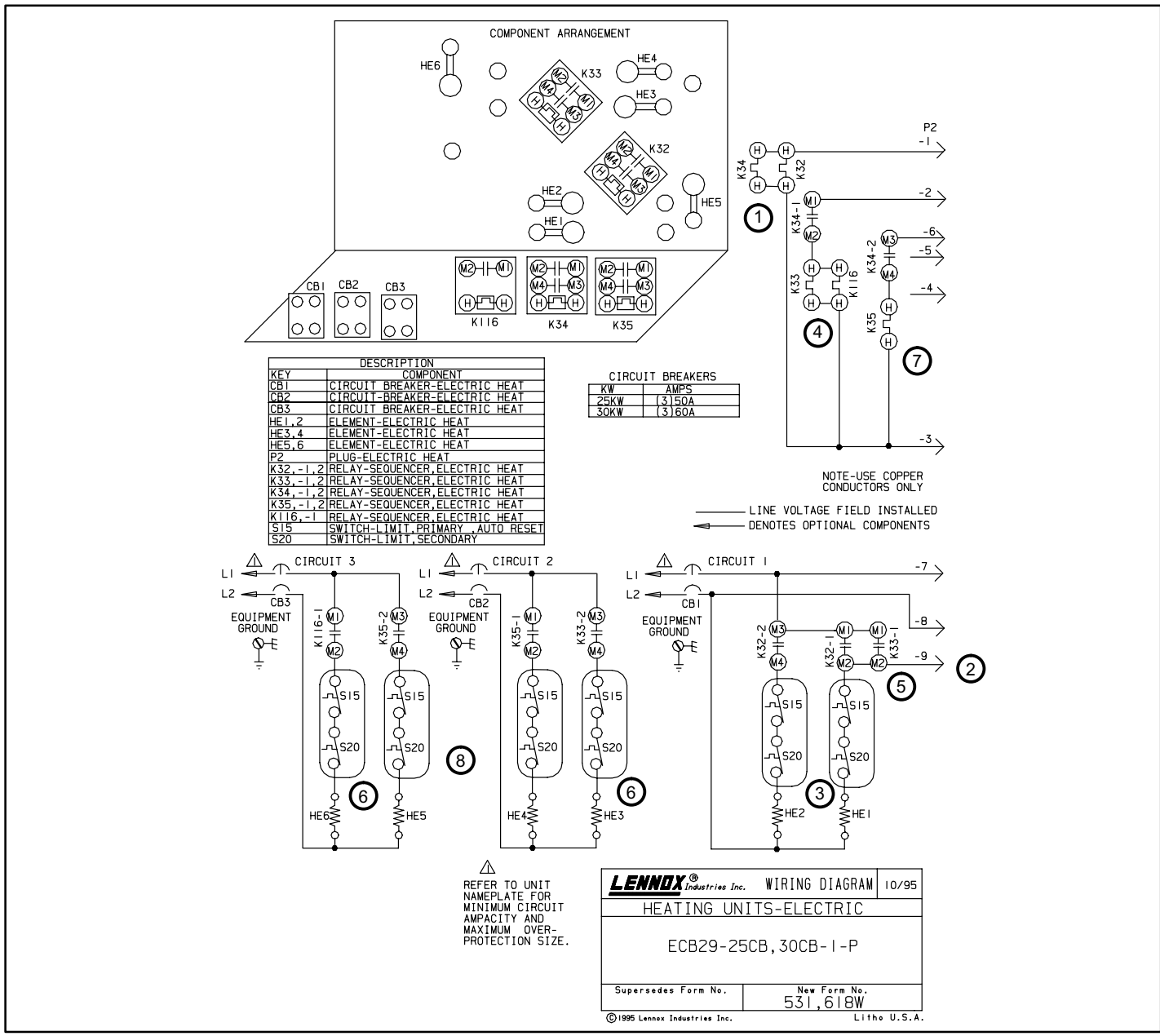


FIGURE 39

F-ECB29-25CB - 208/230V SINGLE PHASE - SEQUENCE OF OPERATION

FIRST-STAGE HEAT

1. When there is a call for heat, W1 of the thermostat energizes the electric heat relays K32 and K34 with 24VAC.
2. When K32-1 closes, the blower is energized on heating speed and economizer heat relay (K20-2) is energized (see unit schematic 26).
3. When K32-1 and K32-2 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE1 and HE2 are energized.

SECOND-STAGE HEAT

(remove jumper between W2 and R)

4. When K34-1 closes, the unit is ready for a second stage heat demand. W2 of the thermostat sends a second stage heat demand, energizing the electric heat relays K33 and K116 with 24VAC.

5. When K33-1 closes, the blower (if not energized) is energized on heating speed and economizer heat relay K43 is energized (see 208/230VAC CB schematic).
6. When K33-2 and K116-1 close, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE3 and HE6 are energized.

THIRD- STAGE HEAT

(remove jumper between W3 and R, if using third stage)

7. When K34-2 closes, the unit is ready for a third stage heat demand. W3, if available, of the thermostat sends a third stage heat demand, energizing the electric heat relay K35 with 24VAC.
8. When K35-1 and K35-2 close, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE4 and HE5 are energized.

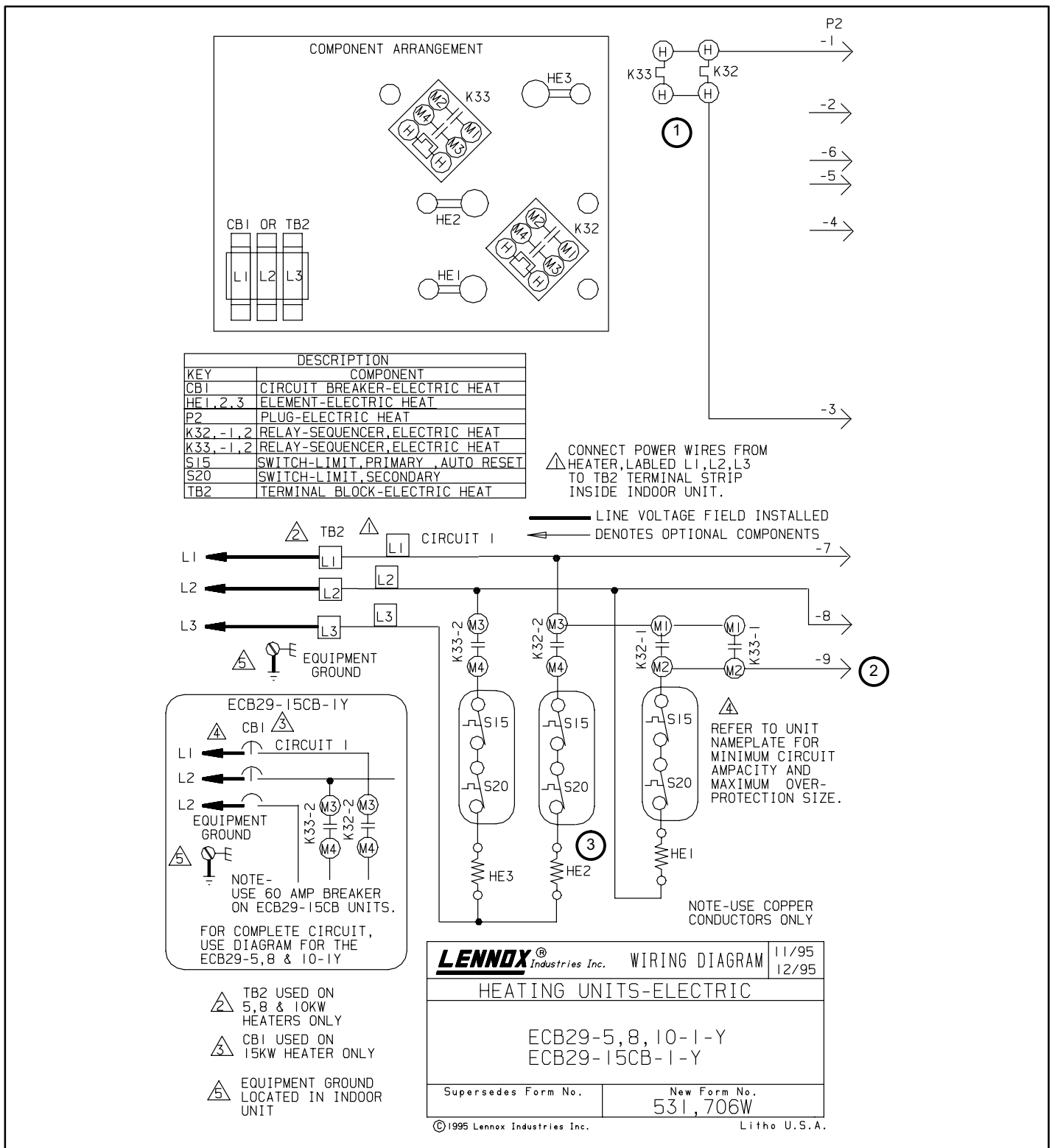


FIGURE 40

G-ECB29-8, -10,-15CB - 208/230V THREE PHASE - SEQUENCE OF OPERATION

1. When there is a call for heat, W1 of the thermostat energizes the electric heat relays K32 and K33 with 24VAC.
2. When K32-1 and/or K33-1 closes, the blower is energized on heating speed and economizer heat relay (K20-2) is energized (see unit schematic figure 26).
3. When K32-1, K32-2, and K33-2 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE1, HE2, and HE3 are energized.

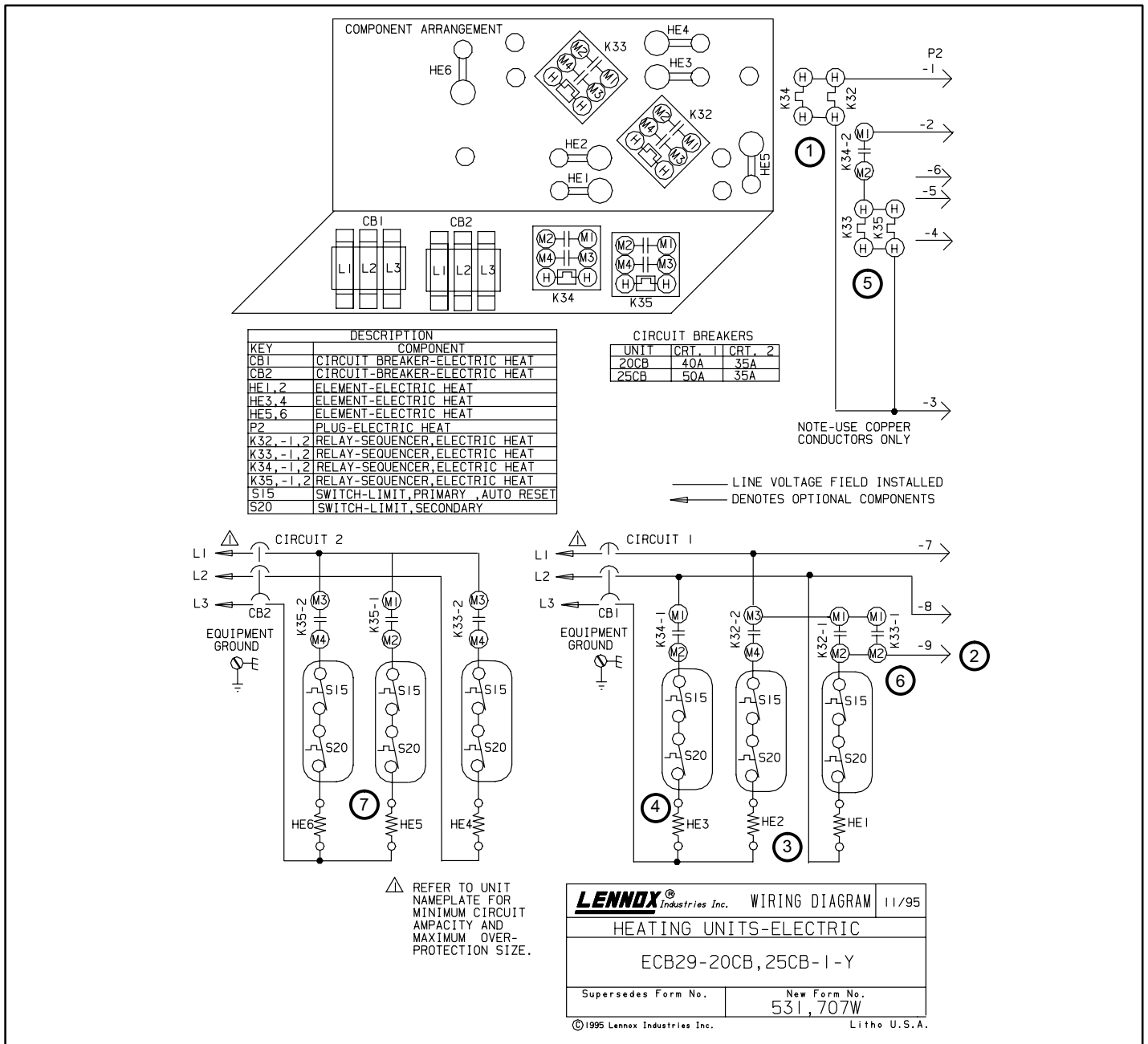


FIGURE 41

H-ECB29-20CB, -25CB - 208/230V THREE PHASE - SEQUENCE OF OPERATION

FIRST-STAGE HEAT

1. When there is a call for heat, W1 of the thermostat energizes the electric heat relays K32 and K34 with 24VAC.
2. When K32-1 closes, the blower is energized on heating speed and economizer heat relay (K20-2) is energized (see unit schematic figure 26).
3. When K32-1 and K32-2 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE 1 and HE2 are energized.
4. When K34-1 closes, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat element HE3 is energized.

SECOND-STAGE HEAT

(remove jumper between W2 and R)

5. When K34-2 closes, the unit is ready for a second stage heat demand. W2 of the thermostat sends a second stage heat demand, energizing the electric heat relays K33 and K35 with 24VAC.
6. When K33-1 closes, the blower (if not energized) is energized on heating speed and economizer heat relay K43 is energized (see 208/230VAC CB schematic).
7. When K33-1, K35-1, and K35-2 contacts close, assuming the N.C. primary (S15) and secondary (S20) limit switches are closed, electric heat elements HE4, HE5, and HE6 are energized.