LENNOX
Service Literature

UNIT INFORMATION

Corp 1904-L1
Revised 04/2022

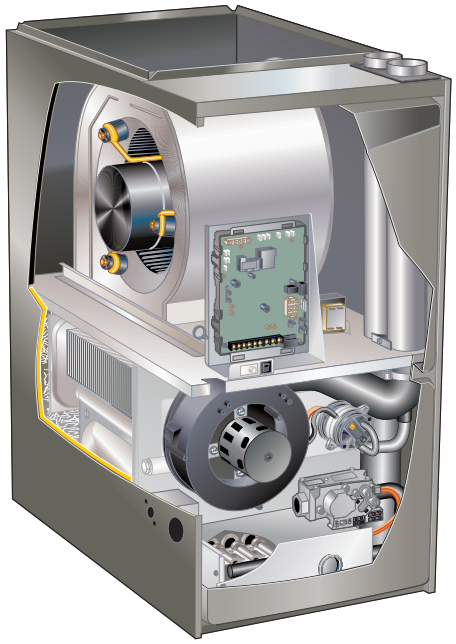
ML296DFV(X)

ML296DFV(X) SERIES UNITS

ML296DFV(X) series units are 90% efficiency gas furnaces used for downflow applications only, manufactured with Lennox Duralok heat exchangers formed of aluminized steel. ML296DFV(X) units are available in heating capacities of 44,000 to 88,000 Btuh and cooling applications up to 5 tons. Refer to Engineering Handbook for proper sizing.

Units are factory equipped for use with natural gas. Kits are available for conversion to LPG operation. ML296DFV(X) unit meets the California Nitrogen Oxides (NOx) Standards and California Seasonal Efficiency requirements. All units use a redundant gas valve to assure safety shut-off as required by C.S.A.

All specifications in this manual 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. In the absence of local or state codes, the guidelines and procedures outlined in this manual (except where noted) are recommendations only and do not constitute code.



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⚠ WARNING

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

⚠ CAUTION

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

SPECIFICATIONS

Gas Heating Performance		**Model No.**	**ML296DF045XV36B**	**ML296DF070XV48B**	**ML296DF090XV60C**
		AHRI Reference No.	202575917	202575918	202575919
		[1] AFUE	96%	96%	96%
	High Fire	Input - Btuh	44,000	66,000	88,000
		Output - Btuh	43,000	64,000	85,000
		Temperature rise range - °F	35-65	35-65	40-70
		Gas Manifold Pressure (in. w.g.) Nat. Gas / LPG/Propane	3.5 / 10.0	3.5 / 10.0	3.5 / 10.0
	Low Fire	Input - Btuh	29,000	43,000	57,000
		Output - Btuh	28,000	42,000	56,000
		Temperature rise range - °F	20 - 50	25 - 55	30 - 60
		Gas Manifold Pressure (in. w.g.) Nat. Gas / LPG/Propane	1.7 / 4.5	1.7 / 4.5	1.7 / 4.5
High static - in. w.g.		Heating	0.8	0.8	0.8
		Cooling	1.0	1.0	1.0
Connections in.		Intake / Exhaust Pipe (PVC)	2 / 2	2 / 2	2 / 2
		Gas pipe size IPS	1/2	1/2	1/2
		Condensate Drain Trap (PVC pipe) - i.d.	3/4	3/4	3/4
		with furnished 90° street elbow	3/4 slip x 3/4 Mipt	3/4 slip x 3/4 Mipt	3/4 slip x 3/4 Mipt
		with field supplied (PVC coupling) - o.d.	3/4 slip x 3/4 MPT	3/4 slip x 3/4 MPT	3/4 slip x 3/4 MPT
Indoor Blower		Wheel nom. diameter x width - in.	10 x 9	11 x10	11 x 11
		Motor output - hp	1/2	3/4	1.0
		Tons of add-on cooling	3	4	5
		Air Volume Range - cfm	545 - 1360	575 - 1800	753 - 1982
Electrical Data		Voltage	120 volts - 60 hertz - 1 phase		
		Blower motor full load amps	7.7	10.1	12.8
		Maximum overcurrent protection	15	20	20
Shipping Data		lbs. - 1 package	131	138	166

NOTE - Filters and provisions for mounting are not furnished and must be field provided.

[1] Annual Fuel Utilization Efficiency based on DOE test procedures and according to FTC labeling regulations. Isolated combustion system rating for non-weatherized furnaces.

OPTIONAL ACCESSORIES

NOTE - FURNACES CANNOT BE TWINNED!

			"B" Width Models	"C" Width Models
CABINET ACCESSORIES				
Downflow Combustible Flooring Base			**11M60**	**11M61**
High Performance Economizer (Commercial Only)			**10U53**	**10U53**
CONDENSATE DRAIN KITS				
Condensate Drain Heat Cable		6 ft.	**26K68**	**26K68**
		24 ft.	**26K69**	**26K69**
Crawl Space Vent Drain Kit		US	**51W18**	**51W18**
		Canada	**15Z70**	**15Z70**
CONTROLS				
M30 Smart Wi-Fi Thermostat			**15Z69**	**15Z69**
Remote Outdoor Temperature Sensor			**X2658**	**X2658**
Night Service Kit			**23H99**	**23H99**
FILTERS				
[1] **Downflow Filter Cabinet**			**51W07**	**51W08**
		No. and Size of filter - in.	(2) 16 x 20 x 1	(2) 16 x 20 x 1
TERMINATION KITS				
See Installation Instructions for specific venting information.				
Direct Vent	Concentric	US - 2 in.	**71M80**	**69M29**
		3 in.	**- - -**	**60L46**
		Canada - 2 in.	**44W92**	**44W92**
		3 in.	**- - -**	**44W93**
	Flush-Mount	US - 2, 2-1/2 or 3 in.	**51W11**	**51W11**
		Canada - 2, 2-1/2 or 3 in.	**51W12**	**51W12**
	Wall - Close Couple	US - 2 in.	**22G44**	**- - -**
		3 in.	**44J40**	**44J40**
		Canada - 2 in.	**30G28**	**- - -**
		3 in.	**81J20**	**81J20**
	Roof Termination Flashing Kit (no vent pipe - 2 flashings)	2 in.	**15F75**	**15F75**
		3 in.	**44J41**	**44J41**
VENTING				
Flue Coupling		2 in.	**17H92**	**17H92**
[2] **Left Side Vent Kit**		2 or 3 in.	**87W73**	**87W73**

[1] Cleanable polyurethane, frame-type filter.

[2] NOTE - The curved exhaust pipe furnished with the Left Side Vent Kit counts as one additional 2 in. diameter 90° elbow. When using 3 in. diameter pipe, the furnished curved exhaust pipe and field provided fittings to transition from 2 in. to 3 in. count as 20 feet of equivalent pipe on all units.

NOTE - Termination Kits (**44W92**, **44W93**, **30G28**, **51W12**, **81J20**) and Crawl Space Vent Drain Kit (**15Z70**) are certified to ULC S636 standard for use in Canada only.

BLOWER DATA

ML296DF045XV36B BLOWER PERFORMANCE (less filter)

0 through 0.8 in. w.g. (Heating) and 0 through 1.0 in. w.g. (Cooling) External Static Pressure Range

"ADJUST" Switch Positions	Speed Switch Positions							
	Second Stage "HEAT" Speed - cfm				Second Stage "COOL" Speed - cfm			
	D	C	[1] B	A	D	C	B	[1] A
+	770	860	945	1045	915	1100	1200	1320
[1] NORM	710	780	860	960	845	1010	1110	1215
—	635	710	775	855	750	905	995	1100
"ADJUST" Switch Positions	First Stage "HEAT" Speed - cfm				First Stage "COOL" Speed - cfm			
	D	C	[1] B	A	D	C	B	[1] A
+	700	760	855	940	625	785	860	965
[1] NORM	645	690	775	855	585	710	770	870
—	590	630	700	765	545	660	705	780

[1] Factory default jumper setting.

NOTES - The effect of static pressure is included in air volumes shown.
First stage HEAT is approximately **91%** of the same second stage HEAT speed position.
First stage COOL (two-stage air conditioning units only) is approximately **70%** of the same second stage COOL speed position.
Continuous Fan Only speed is approximately **38%** of the same second stage COOL speed position.
Lennox Harmony III™ Zoning System Applications - Minimum blower speed is 300 cfm.

BLOWER DATA

ML296DF070XV48B BLOWER PERFORMANCE (less filter)

BOTTOM RETURN AIR

0 through 0.8 in. w.g. (Heating) and 0 through 1.0 in. w.g. (Cooling) External Static Pressure Range

"ADJUST" Switch Positions	Speed Switch Positions							
	Second Stage "HEAT" Speed - cfm				Second Stage "COOL" Speed - cfm			
	D	C	[1] B	A	D	C	B	[1] A
+	1135	1300	1450	1620	1125	1360	1580	1805
[1] NORM	1025	1175	1325	1475	1020	1220	1435	1650
—	930	1060	1185	1315	920	1110	1290	1500
"ADJUST" Switch Positions	First Stage "HEAT" Speed - cfm				First Stage "COOL" Speed - cfm			
	D	C	[1] B	A	D	C	B	[1] A
+	855	945	1050	1185	770	970	1105	1275
[1] NORM	770	810	960	1085	700	850	1010	1160
—	680	725	820	970	615	755	875	1045

[1] Factory default jumper setting.

NOTES - The effect of static pressure is included in air volumes shown.
First stage HEAT is approximately **73%** of the same second stage HEAT speed position.
First stage COOL (two-stage air conditioning units only) is approximately **70%** of the same second stage COOL speed position.
Continuous Fan Only speed is approximately **38%** of the same second stage COOL speed position.
Lennox Harmony III™ Zoning System Applications - Minimum blower speed is 380 cfm.

BLOWER DATA

ML296DF090XV60C BLOWER PERFORMANCE (less filter)

BOTTOM RETURN AIR, RETURN AIR FROM BOTH SIDES OR RETURN AIR FROM BOTTOM AND ONE SIDE

0 through 0.8 in. w.g. (Heating) and 0 through 1.0 in. w.g. (Cooling) External Static Pressure Range

"ADJUST" Switch Positions	Speed Switch Positions							
	Second Stage "HEAT" Speed - cfm				Second Stage "COOL" Speed - cfm			
	D	C	[1] B	A	D	C	B	[1] A
+	1430	1555	1725	1865	1350	1550	1755	1985
[1] NORM	1300	1415	1570	1685	1240	1445	1635	1815
—	1195	1275	1415	1515	1120	1290	1455	1630
"ADJUST" Switch Positions	First Stage "HEAT" Speed - cfm				First Stage "COOL" Speed - cfm			
	D	C	[1] B	A	D	C	B	[1] A
+	1175	1275	1415	1505	985	1130	1280	1440
[1] NORM	1075	1165	1295	1375	905	1035	1180	1315
—	980	1045	1160	1240	835	940	1070	1195

[1] Factory default jumper setting.

NOTES - The effect of static pressure is included in air volumes shown.
First stage HEAT is approximately **80%** of the same second stage HEAT speed position.
First stage COOL (two-stage air conditioning units only) is approximately **70%** of the same second stage COOL speed position.
Continuous Fan Only speed is approximately **38%** of the same second stage COOL speed position.
Lennox Harmony III™ Zoning System Applications - Minimum blower speed is 460 cfm.

PARTS IDENTIFICATION

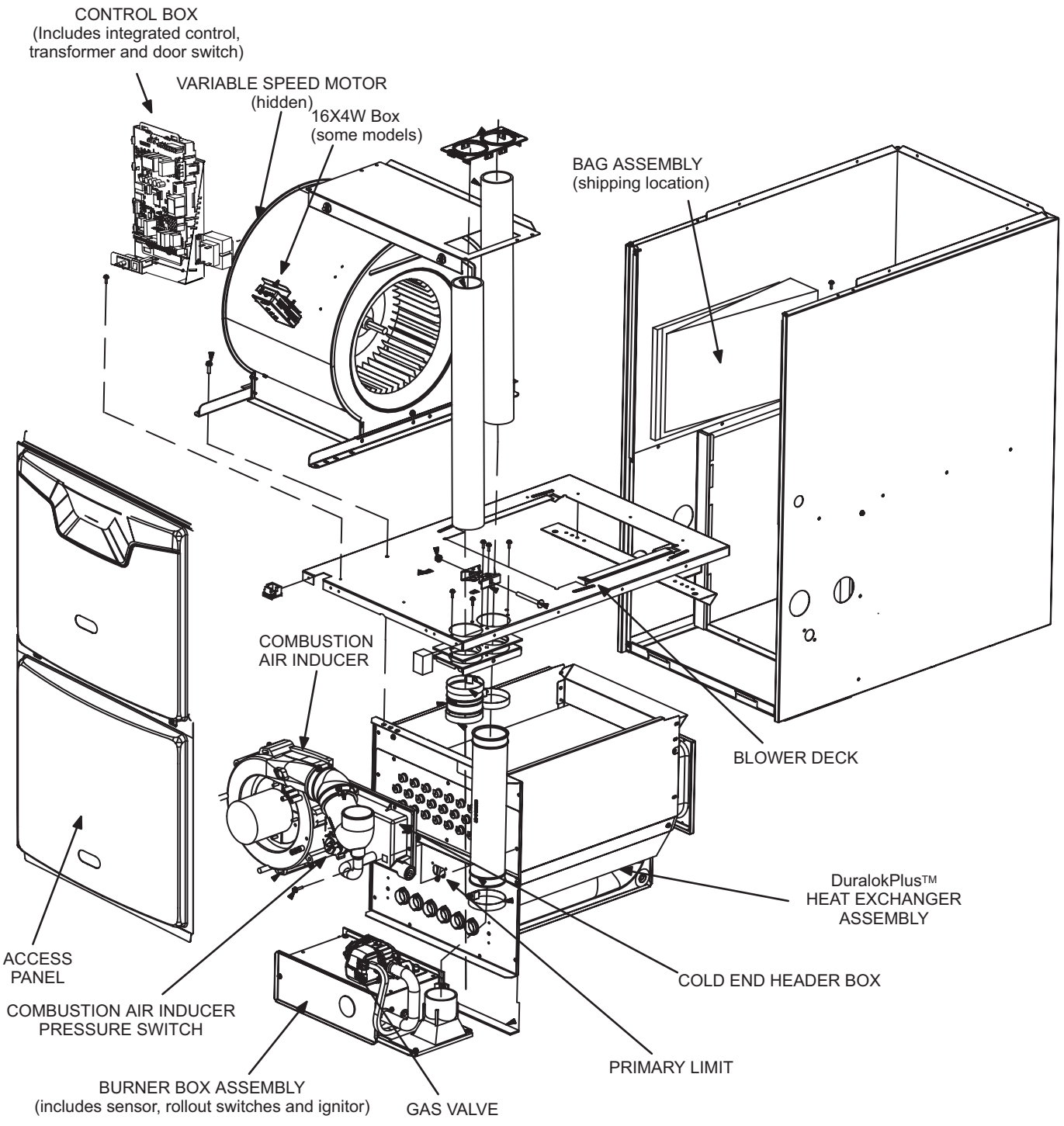


FIGURE 1

I-UNIT COMPONENTS

ML296DFV(X) unit components are shown in FIGURE 1. The gas valve, combustion air inducer and burners can be accessed by removing the access panel. Electrical components are in the control box (FIGURE 2) found in the blower section.

ELECTROSTATIC DISCHARGE (ESD)
Precautions and Procedures

⚠ CAUTION

Electrostatic discharge can affect electronic components. Take precautions to neutralize electrostatic charge by touching your hand and tools to metal prior to handling the control.

A- Control Box

1. Control Transformer (T1)

A transformer located in the control box provides power to the low voltage section of the unit. Transformers on all models are rated 40VA with a 120V primary and a 24V secondary.

2. Door Interlock Switch (S51)

A door interlock switch rated 14A at 125VAC is wired in series with line voltage. When the inner blower access panel is removed the unit will shut down.

Control Box Components

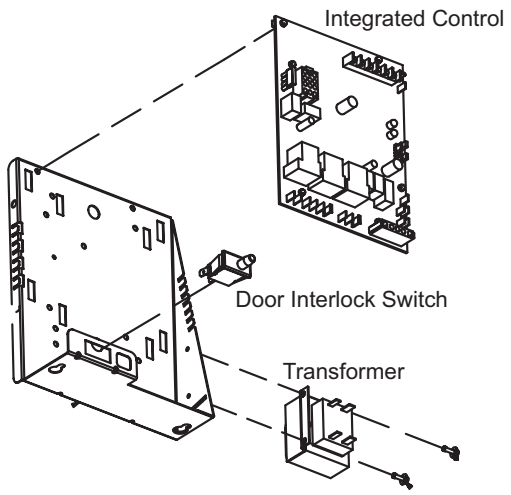


FIGURE 2

⚠ WARNING

Shock hazard.

Disconnect power before servicing. Integrated control is not field repairable. If control is inoperable, simply replace entire control. Can cause injury or death. Unsafe operation will result if repair is attempted.

3. Integrated Control (A92)

Units are equipped with a two-stage, variable speed integrated control. The system consists of a ignition / blower control (FIGURE 3) with control pin designations in TABLE 3, TABLE 4 and ignitor. The control and ignitor work in combination to ensure furnace ignition and ignitor durability. The control provides gas ignition, safety checks and indoor blower control with two-stage gas heating. The furnace combustion air inducer, gas valve and indoor blower are controlled in response to various system inputs such as thermostat signal, pressure and limit switch signal and flame signal.

The furnace has a built-in, self-diagnostic capability. If a system problem occurs, a fault code is shown by a red LED on the control. The control continuously monitors its own operation and the operation of the system. If a failure occurs, the LED will indicate the failure code. The flash codes are presented in TABLE 2.

Fault Code History Button

The control stores the last five fault codes in memory. A pushbutton switch is located on the control. When the pushbutton switch is pressed and released, the control flashes the stored fault codes. The most recent fault code is flashed first; the oldest fault code is flashed last. To clear the fault code history, press and hold the pushbutton switch in for more than 5 seconds before releasing.

Single Stage Thermostat Operation

The automatic heat staging option allows a single stage thermostat to be used with two stage furnace models. To activate this option, move the jumper pin (FIGURE 3) to desired setting (5 minutes or 10 minutes). The furnace will start on 1st stage heat and stay at 1st stage heat for the duration of the selected time before switching to 2nd stage heat. W1 on the integrated control must be connected to W1 on the thermostat.

High Heat State LED

A **green** LED is provided on the control board to indicate high heat state (TABLE 1).

CFM LED

An amber LED is provided on the control board to display CFM. To determine what CFM the motor is delivering at any time, count the number of times the amber LED flashes. Each flash signifies 100 CFM; count the flashes and multiply by 100 to determine the actual CFM delivered (for example: 5 flashes x 100 = 500 CFM).

TABLE 1

High Heat State Green LED	
LED Status	**Description**
LED Off	No demand for high heat
LED On	High heat demand, operating normally
LED Flashing	High heat demand, high pressure switch not closed

TABLE 2

Diagnostic Codes Red LED	
LED Status	**Description**
LED Off	No power to control or control hardware fault detected.
LED On	Normal operation.
1 Flash	Flame present with gas vavle de-energized.
2 Flashes	Pressure switch closed with combustion air inducer de-energized.
3 Flashes	Low-fire pressure, rollout or limit switch open.
4 Flashes	Primary limit switch open.
5 Flashes	Not used
6 Flashes	Pressure switch cycle lockout.
7 Flashes	Lockout, burners fail to light.
8 Flashes	Lockout, buners lost flame too many times.
9 Flashes	Line voltage polarity incorrect.

TABLE 3	
Control 5 Pin Terminal Designation	
PIN #	**Function**
1	Ignitor (Hot)
2	Combustion Air Inducer High Speed
3	Combustion Air Inducer Low Speed
4	Combustion Air Inducer Neutral
5	Ignitor Neutral

Airflow Adjustments

Cooling Mode

The units are factory set for the highest airflow for each model. Adjustments can be made to the cooling airflow by repositioning the jumper plug marked COOL – A, B, C, D (FIGURE 3). To determine what CFM the motor is delivering at any time, count the number of times the amber LED on the control board flashes. Each flash signifies 100 CFM; count the flashes and multiply by 100 to determine the actual CFM delivered (for example: 5 flashes x 100 = 500 CFM).

Heating Mode

These units are factory set to run at the middle of the heating rise range as shown on the unit rating plate. If higher or lower rise is desired, reposition the jumper plug marked HEAT - A, B, C, D (FIGURE 3) . To determine what CFM the motor is delivering at any time, count the number of times the amber LED on the control board flashes. Each flash signifies 100 CFM; count the flashes and multiply by 100 to determine the actual CFM delivered (for example: 5 flashes x 100= 500.

TABLE 4

12 Pin Terminal Designation	
Pin #	**Function**
1	Gas Valve Second Stage
2	Second Stage Prove Switch
3	Rollout Switch In
4	Ground
5	24V Hot
6	Primary Limit In
7	Gas Valve First Stage
8	Gas Valve Common
9	24V Neutral
10	Ground
11	Rollout Switch Out
12	First Stage Prove Switch

Fan on / off delay

On a call for heat there is a 30 second fan on delay after igntion.When the call for heat is satisfied, the gas valve and combustion air blower shut down. The circulating air blower continues to run for selected blower off delay time (60/90/120/180 sec) before ramping down and shutting off. The fan on delay is 30 seconds and not adjustabe.

NOTE - *The fan off delay on ML296-55 and earlier units is factory set at 120 seconds and NON- ADJUSTABLE.*

Adjust Tap

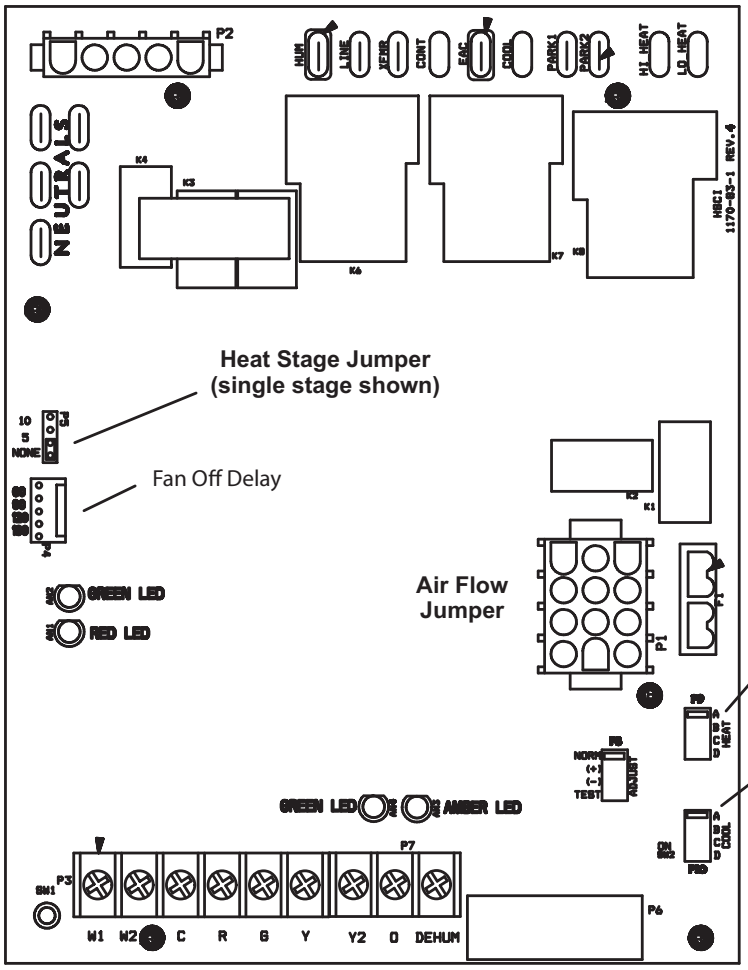
Airflow amounts may be increased or decreased by 10% by moving the ADJUST jumper plug (FIGURE 3) from the NORM position to the (+) or (-) position. Changes to the ADJUST tap will affect both cooling and heating airflows. The TEST position on the ADJUST tap is not used.

Continuous Blower Operation

The comfort level of the living space can be enhanced when using this feature by allowing continuous circulation of air between calls for cooling or heating. The circulation of air occurs at half the full cooling airflow rate.

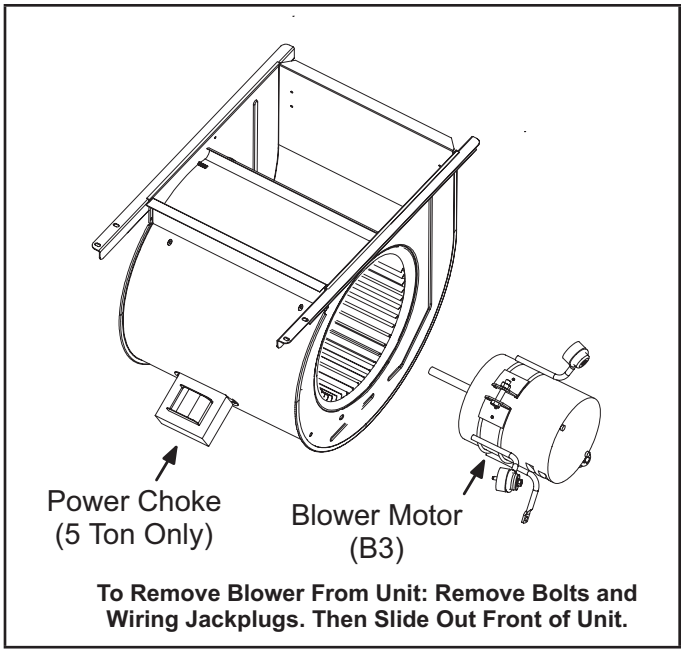
To engage the continuous blower operation, place the fan switch on the thermostat into the ON position. A call for fan from the thermostat closes R to G on the ignition control board. The control waits for a 1 second thermostat delay before responding to the call for fan by ramping the circulating blower up to 50% of the cooling speed. When the call for continuous fan is satisfied, the control immediately ramps down the circulating blower.

INTEGRATED CONTROL



TERMINAL DESIGNATIONS
HUM -Humidifier (120VAC)
Line - Input (120VAC)
XFMR - Transformer (120VAC)
EAC - Indoor Air Accessory (120VAC)
Cool - Cool Speed (120VAC)
Park 1 - Dead terminal for alternate speed tap
Park 2 - Dead terminal for alternate speed tap

FIGURE 3



To Remove Blower From Unit: Remove Bolts and Wiring Jackplugs. Then Slide Out Front of Unit.

FIGURE 4

Blower Motor (B3)

Blower motors are manufactured by GenTeq and Nidec. See FIGURE 5 and FIGURE 6. Motors operate the same and are only different in physical appearance. They are both three-phase, electronically controlled DC brushless motors (controller converts single-phase AC to three-phase DC), with a permanent magnet type rotor (FIGURE 5). Because these motors have a permanent magnet rotor it does not need brushes like conventional DC motors.

Internal components for both manufactured motors are similarand shown in FIGURE 7. The stator windings are split into three poles which are electrically connected to the controller. This arrangement allows motor windings to turn on and off in sequence by the controller.

A solid-state controller is attached to the motor. The controller is primarily an AC to DC converter. Converted DC power is used to drive the motor. The controller contains a microprocessor which monitors varying conditions inside the motor (such as motor workload). The controller on the NIDEC / Emerson motor includes the 16X4W control with three LED's PW, RX and TX located on the face for troubleshooting. Figure 6 shows the location of the 16X4W and table 5 the LED codes. The 16X4W may be located on the indoor blower housing on some models.

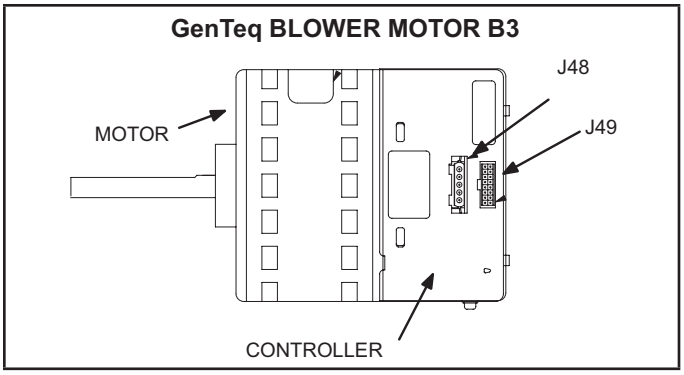


FIGURE 5

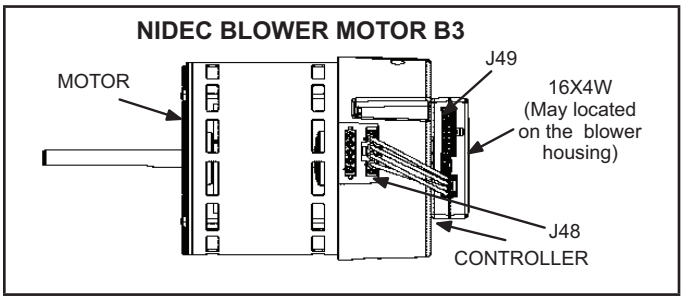


FIGURE 6

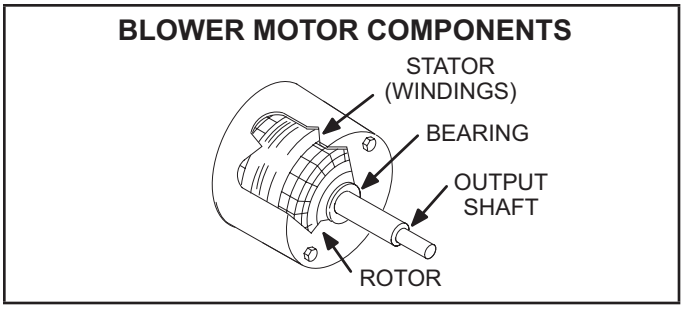


FIGURE 7

The controller uses sensing devices to sense what position the rotor is in at any given time. By sensing the position of the rotor and then switching the motor windings on and off in sequence, the rotor shaft turns the blower.

All blower motors use single phase power. An external run capacitor is not used. The motor uses permanently lubricated ball-type bearings.

Internal Operation

Each time the controller switches a stator winding (FIGURE 7) on and off, it is called a "pulse." The length of time each pulse stays on is called the "pulse width." By varying the pulse width (FIGURE 10), the controller varies motor speed (called "pulsewidth modulation"). This allows for precise control of motor speed and allows the motor to compensate for varying load conditions as sensed by the controller. In this case, the controller monitors the static workload on the motor and varies motor rpm in order to maintain constant airflow (cfm).

TABLE 5

Nidec / Emerson Motor Only

PW LED	RX LED	TX LED	Motor Blower	Action
Off	Blink	Blink	Not Rotating	Normal
Blink	Blink	Blink	Rotating	Normal. PW blink is 100cfm/blink
Blink	Off	Blink	Not Rotating	Verify 16X4W and motor control hp match. Verify power to motor control. Turn off power for 1 minute then restart. If motor still does not rotate replace the controller.
Off	Off	Off	Not Rotating	Verify power to the 16X4W. Turn off power then restart. If LED's are still out, replace controller.

Motor rpm is continually adjusted internally to maintain constant cfm. The controller monitors the static work load on the motor and motor amp-draw to determine the amount of rpm adjustment. Blower rpm may be adjusted any amount in order to maintain a constant cfm as shown in Blower Ratings Tables. The cfm remains relatively stable over a broad range of static pressure. Since the blower constantly adjusts rpm to maintain a specified cfm, motor rpm is not rated. Hence, the terms "cool speed" , "heat speed " or "speed tap" in this manual, on the unit wiring diagram and on blower B3, refer to blower cfm regardless of motor rpm.

The unit control indicates the desired cfm. The blower will maintain the desired cfm as long as external static pressure does not exceed 0.8". If the system exceeds this amount, the blower may enter a "cut back", mode wherein it then slows down to protect itself from electrical damage. During this "cut back" mode the unit control will still indicate the same desired cfm regardless of actual motor rpm.

When Harmony is used, speed taps are overridden and a PWM signal generated by the Harmony controller continuously varies motor speed based upon zone demands.

Initial Power Up

When line voltage is applied to B3, there will be a large inrush of power lasting less than 1/4 second. This inrush charges a bank of DC filter capacitors inside the controller. If the disconnect switch is bounced when the disconnect is closed, the disconnect contacts may become welded. Try not to bounce the disconnect switch when applying power to the unit.

Motor Start-Up

When B3 begins start-up, the motor gently vibrates back and forth for a moment. This is normal. During this time the electronic controller is determining the exact position of the rotor. Once the motor begins turning, the controller slowly eases the motor up to speed (this is called "soft-start"). The motor may take as long as 10-15 seconds to reach full speed.

If the motor does not reach 200rpm within 13 seconds, the motor shuts down. Then the motor will immediately attempt a restart. The shutdown feature provides protection in case of a frozen bearing or blocked blower wheel. The motor may attempt to start eight times. If the motor does not start after the eighth try, the controller locks out. Reset controller by momentarily turning off power to unit.

The DC filter capacitors inside the controller are connected electrically to the speed tap wires. The capacitors take approximately 5 minutes to discharge when the disconnect is opened. For this reason it is necessary to wait at least 5 minutes after turning off power to the unit before attempting to change speed taps.

⚠ DANGER

Disconnect power from unit and wait at least five minutes to allow capacitors to discharge before attempting to adjust motor speed tap settings. Failure to wait may cause personal injury or death.

External Operation (Speed Tap Priority)

FIGURE 8 and FIGURE 9 show the two quick-connect jacks (J48 and J49) which connect the motor to the ML296DFV. Jack J48 is the power plug and jack J49 connects the unit controls to the motor.

Jack J48 is the power plug. Line voltage must be applied to J48 pins 4 and 5 in order for the motor to operate. When using 120VAC pins 1 and 2 must be jumpered. Jack J49 connects the unit controls to the motor. The motor assigns priority to J49 pin 2 so that if a call for cooling and a call for heating are concurrent, heating call overrides and the blower operates on high speed heating tap.

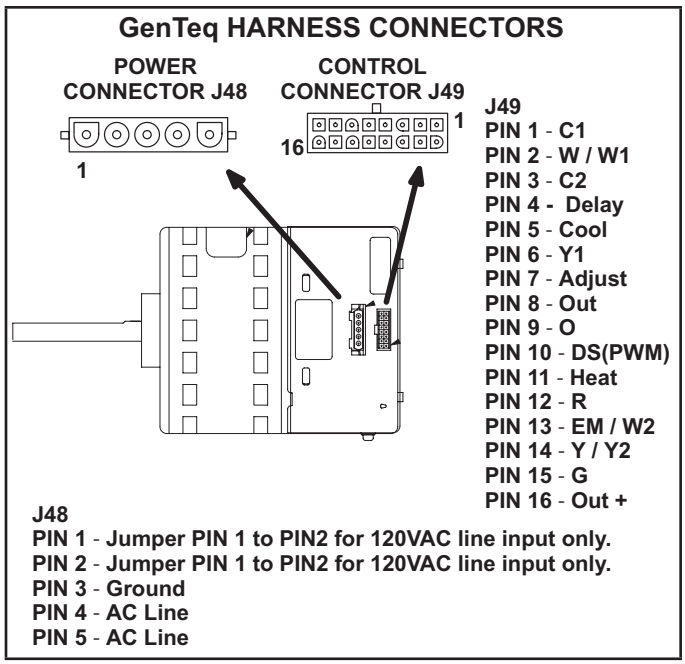


FIGURE 8

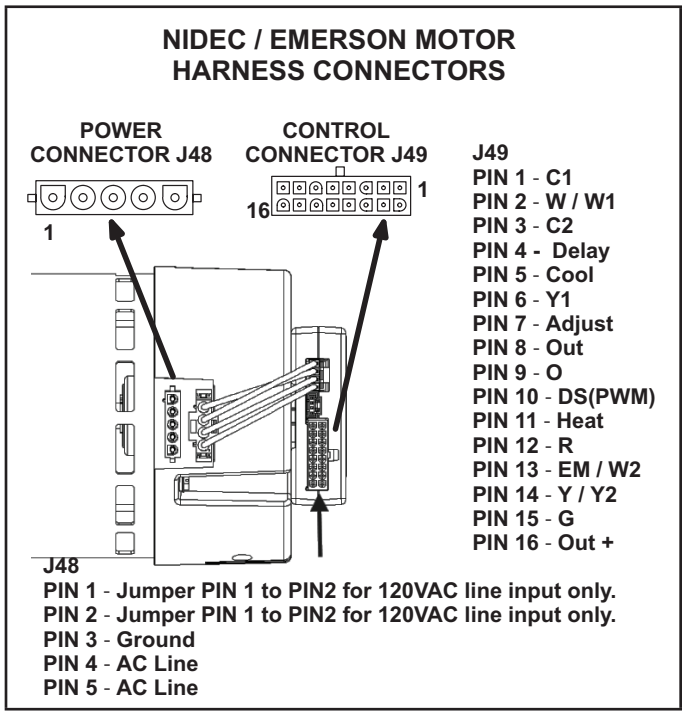


FIGURE 9

Power Choke (L13)

A choke coil is used on 5 ton 1 hp units. The choke is located on the blower housing and is used to suppress transient current spikes.

Precautions

If the furnace or its electronically controlled blower motor is improperly or inadequately grounded, it may cause television interference (commonly known as RFI or radio frequency interference).

This interference is caused by internal switching frequencies of the motor controller. TV interference may show up as small specks or lines which randomly appear on the TV screen accompanied by pops or clicks in the sound. Before attempting any service, make sure the indoor unit is causing the interference. To check, disconnect power to indoor unit then check TV for continued signs of interference.

TV interference may be stopped by making sure the motor is solidly grounded to the cabinet (metal to metal) and by making sure the cabinet is solidly grounded. If TV interference persists, make sure the television (and all affected RF appliances) are moved away from the furnace. Also make sure affected appliances are connected to a separate electrical circuit.

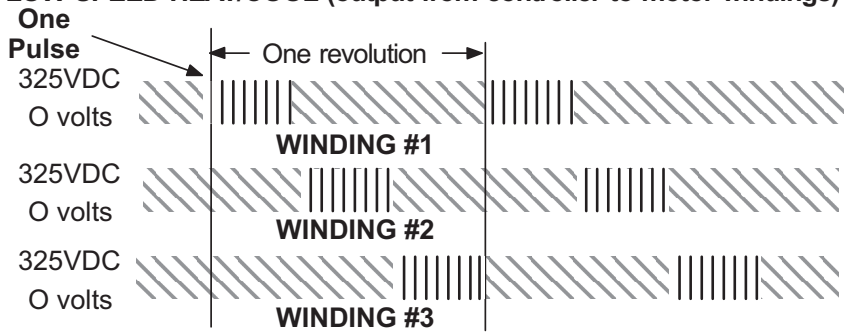
MOTOR SPEED CONTROL WITH D.C. PULSE-WIDTH MODULATION

Motor speed is determined by the size of the electrical pulse sent to the motor windings. The longer the pulse, the faster the motor.

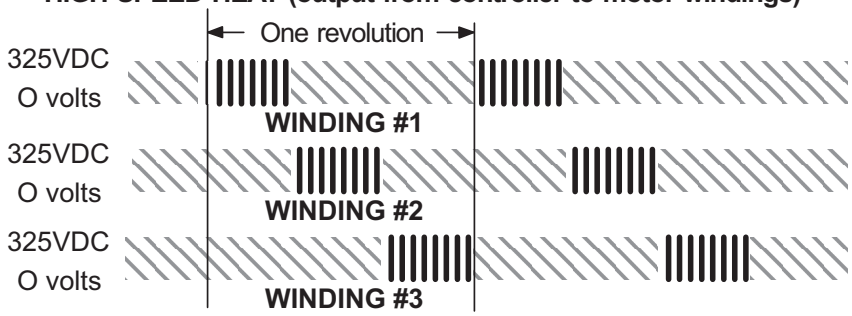
OUTPUT FROM CONTROLLER TO MOTOR WINDINGS		
WINDINGS TURNED OFF	**WINDINGS TURNED ON**	
	ON PULSE	**OFF PULSE**

The frequency of the pulses to the windings is 20KHz.
DO NOT ATTEMPT TO MEASURE THESE VOLTAGES.

LOW SPEED HEAT/COOL (output from controller to motor windings)



HIGH SPEED HEAT (output from controller to motor windings)



HIGH SPEED COOL (output from controller to motor windings)

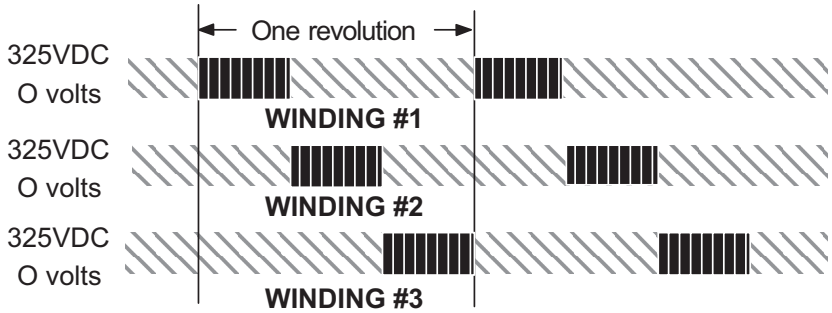


FIGURE 10

C- Heating Components

1. Ignitor

The ignitor is made of durable silicon nitride. Ignitor longevity is enhanced by controlling voltage to the ignitor. The integrated control provides a regulated 120 volts to the ignitor for a consistent ignition and long ignitor life. Ohm value should be 39 to 70. See FIGURE 11 for ignitor location and FIGURE 12 for ignitor check out.

NOTE - *The ML296DFV(X) furnace contains electronic components that are polarity sensitive. Make sure that the furnace is wired correctly and is properly grounded.*

2. Flame Sensor

A flame sensor is located on the left side of the burner support. See figure 11. The sensor tip protrudes into the flame envelope of the left-most burner. The sensor can be removed for service without removing any part of the burners. During operation, flame is sensed by current passed through the flame and sensing electrode. The SureLight control allows the gas valve to remain open as long as flame signal is sensed. See TABLE 6 for flame signal.

TABLE 6

Flame Signal in Microamps

Normal	Low	Drop Out
1.5 or greater	1.0 or less	0.5

3. Gas Valve

The valve (FIGURE 48) is internally redundant to assure safety shut-off. If the gas valve must be replaced, the same type valve must be used.

24VAC terminals and gas control knob are located on the valve. A wire harness connects the terminals from the gas valve to the electronic ignition control. 24V applied to the terminals energizes the valve.

Inlet and outlet pressure taps are located on the valve. A regulator adjustment screw is located on the valve

LPG change over kits are available from Lennox. Kits include burner orifices and a gas valve.

4. Flame Rollout Switches (S47)

Flame rollout switch is a high temperature limit located on top of the burner box, one on each side.- See FIGURE 11. The limit is a N.C. SPST manual-reset limit. When S47 senses rollout, the circuit breaks and the ignition control immediately stops ignition and closes the gas valve. Rollout can be caused by a blocked heat exchanger, flue or lack of combustion air. The switch is factory set to trip (open) at 210°F and cannot be adjusted. The switch can be manually reset. To manually reset a tripped switch, push the reset button located on the control.

5. Burners

All units use inshot burners. Burners are factory set and require no adjustment. Always operate the unit with the burner box front panel in place. Each burner uses an orifice (see TABLE 19 for orifice size) that is precisely matched to the burner input. Burners can be removed as a one piece assembly for service. If burner assembly has been removed, it is critical to align center of each burner to the center of the clamshell when re-installing. See more detail in Section VI- MAINTENANCE.

6. Primary Limit Control (S10)

The primary limit (S10) is located in the heating vestibule panel. When excess heat is sensed in the heat exchanger, the limit will open. If the limit is open, the furnace control energizes the supply air blower and closes the gas valve. The limit automatically resets when unit temperature returns to normal. The switch must reset within three minutes or the SureLight control will go into Watch guard for one hour. The switch is factory set and cannot be adjusted. The switch may have a different set point for each unit model number. See Lennox Repair Parts Handbook if limit switch must be replaced,

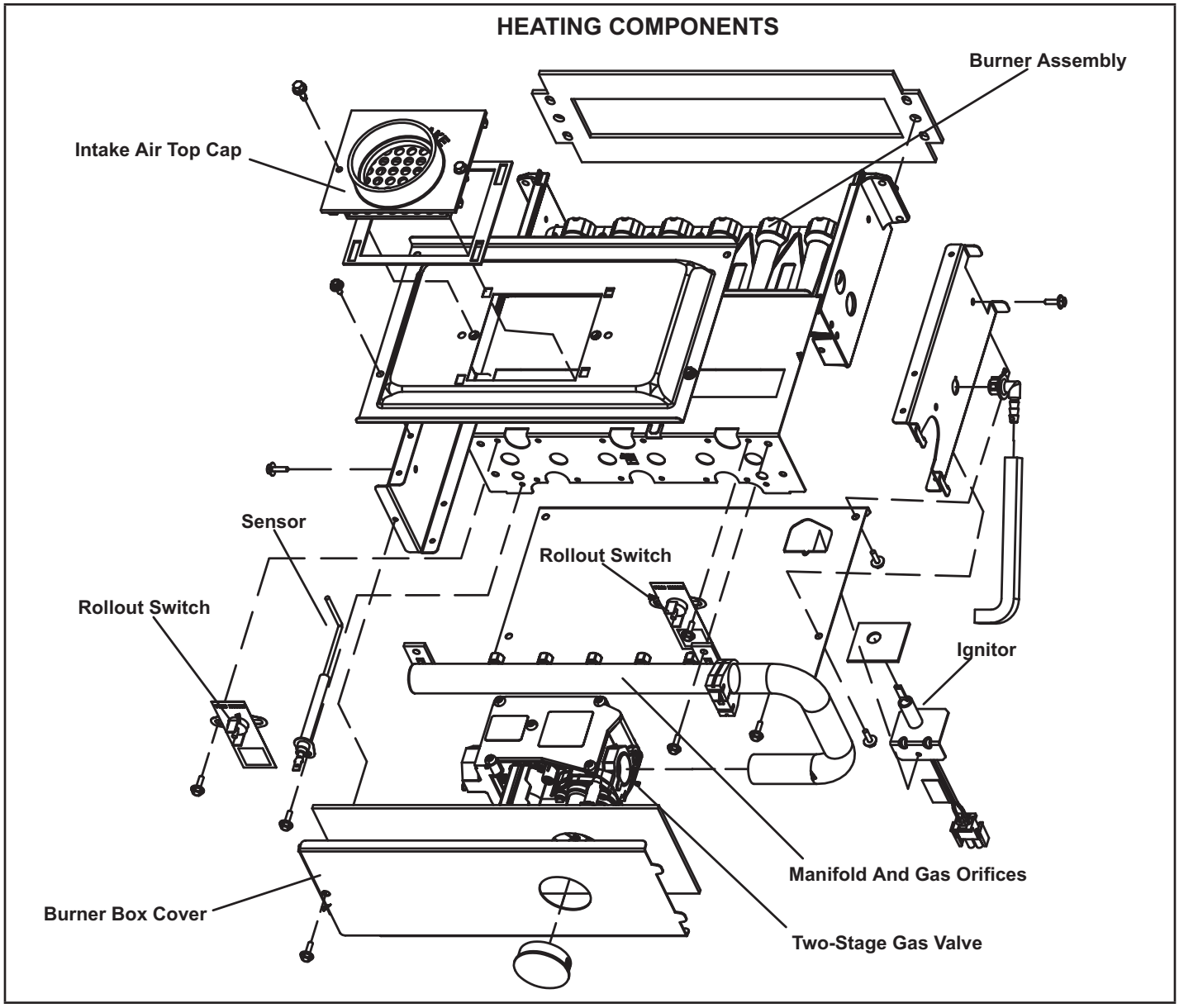
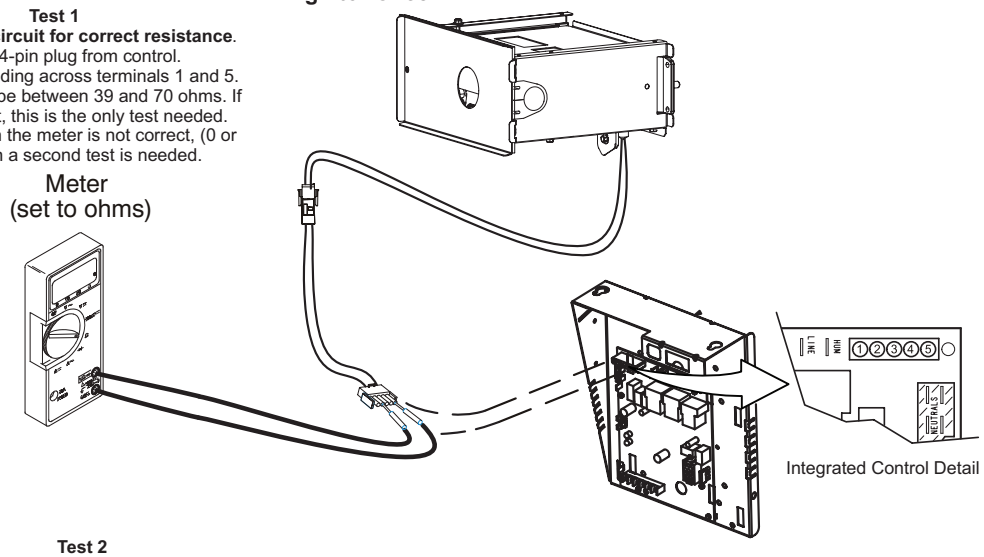

HEATING COMPONENTS
Burner Assembly
Intake Air Top Cap
Sensor
Rollout Switch
Rollout Switch
Ignitor
Manifold And Gas Orifices
Burner Box Cover
Two-Stage Gas Valve

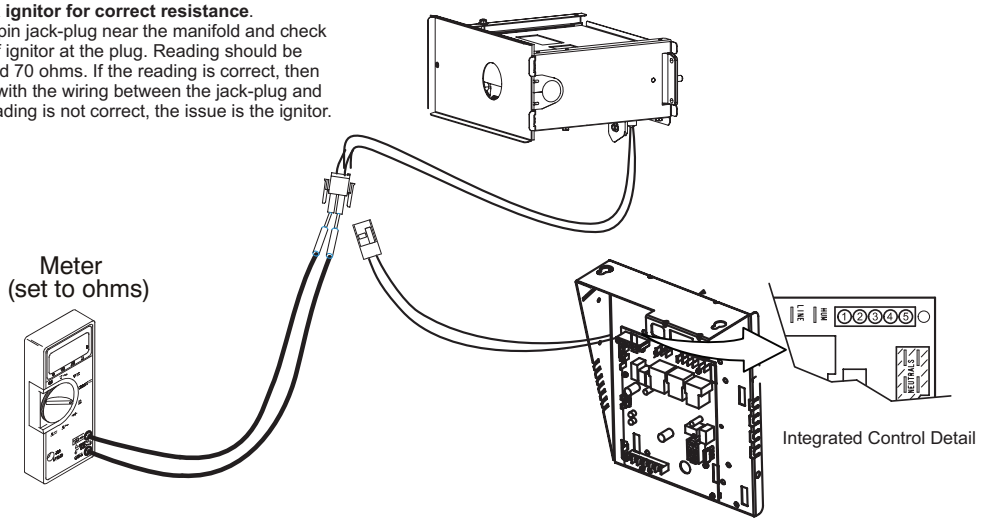
FIGURE 11

Ignitor Check

Test 1
Check ignitor circuit for correct resistance.
Remove 4-pin plug from control.
Check ohms reading across terminals 1 and 5.
Reading should be between 39 and 70 ohms. If value is correct, this is the only test needed.
If the reading on the meter is not correct, (0 or infinity) then a second test is needed.



Test 2
Check ignitor for correct resistance.
Seperate the 2-pin jack-plug near the manifold and check resistance of ignitor at the plug. Reading should be between 39 and 70 ohms. If the reading is correct, then the problem is with the wiring between the jack-plug and the control. If reading is not correct, the issue is the ignitor.



Test 3
Check ignitor for correct voltage
Insert meter probes into terminals 1 and 5 (use small diameter probes in order not to damage plug).
Check voltage during 20 second ignitor warm up period.
Voltage should read 120 volts ± 10%. If voltage reads below these values, check for correct supply voltage to furnace.

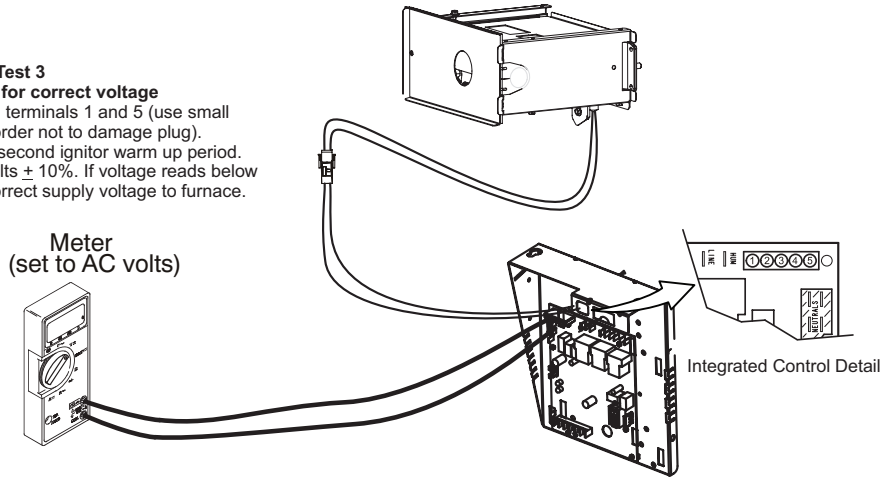


FIGURE 12

7. Combustion Air Inducer (B6) and Cold End Header Box

All ML296DFV(X) units use a two-stage combustion air inducer to move air through the burners and heat exchanger during heating operation. The blower uses a 120VAC motor.

The motor operates during all heating operation and is controlled by integrated control control A92. The inducer also operates for 15 seconds before burner ignition (prepurge) and for 5 seconds after the gas valve closes (postpurge). The inducer operates on low speed during firststage heat, then switches to high speed for second stage heat.

NOTE - *Each furnace model uses a unique CAI. Refer to Lennox Repair Parts listing for correct inducer for replacement.*

The combustion air inducer is installed on the cold end header box. The cold end header box is a single piece made of hard plastic. The box has an internal channel where the combustion air inducer creates negative pressure at unit start up. The channel contains an orifice used to regulate flow created by the combustion air inducer.

The box has pressure taps for the combustion air inducer pressure switch hoses. The pressure switch measures the pressure differential across the combustion air inducer orifice or difference in the channel and the box. If replacement is necessary the gaskets used to seal the box to the vestibule panel and the combustion air inducer to the box, must also be replaced.

A proving switch connected to the combustion air inducer orifice plate is used to prove inducer operation. The combustion air inducer orifice will be different for each model. See TABLE 7 for orifice sizes. The pressure switch measures the pressure differential across the combustion air inducer orifice. When the proving switch opens, the furnace control (A92) immediately closes the gas valve to prevent burner operation.

TABLE 7

ML296DFV(X) Unit	C.A.I. Orifice Size
-045	0.700
-070	0.920
-090	1.100

8. Combustion Air Inducer Pressure Switch (S18)

ML296DFV(X) series units are equipped with a dual combustion air pressure switch (first and second stage) located on the combustion air inducer orifice bracket. See FIGURE 13. The switch is connected to the combustion air inducer housing by means of a flexible silicone hose. It monitors negative air pressure in the combustion air inducer housing.

The switches are a single-pole single-throw proving switch electrically connected to the integrated control. The purpose of the switch is to prevent burner operation if the combustion air inducer is not operating or if the flue becomes obstructed.

On heat demand (first or second stage) the switch senses that the combustion air inducer is operating. It closes a circuit to the integrated control when pressure inside the combustion air inducer decreases to a certain set point. Set points vary depending on unit size. See TABLE 8. The pressure sensed by the switch is negative relative to atmospheric pressure. If the flue becomes obstructed during operation, the switch senses a loss of negative pressure (pressure becomes more equal with atmospheric pressure) and opens the circuit to the furnace control and gas valve. A bleed port on the switch allows relatively dry air in the vestibule to purge switch tubing, to prevent condensate build up.

COMBUSTION AIR PRESSURE SWITCH

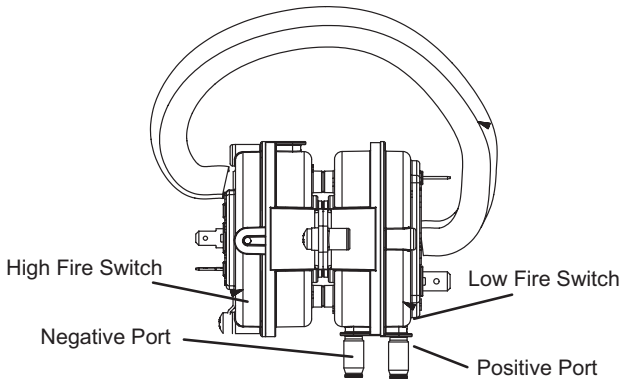


FIGURE 13

NOTE - *The switch is factory set and is not field adjustable. It is a safety shut-down control in the furnace and must not be by-passed for any reason. If switch is closed or bypassed, the control will not initiate ignition at start up.*

TABLE 8

ML296DFV (X) Unit	Set Point Low Heat	Set Point High Heat
-045	0.35	0.60
-070	0.45	0.81
-090	0.45	0.81

Pressure Switch Check

To check pressure switch differential, refer to and use the provided fittings and tubing to follow the steps below.

1 - Remove thermostat demand and allow unit to cycle off.

2 - Remove the tubing from the negative side (red and black or red) and positive side (black) of the pressure switch (leave both connected to cold end header box).

3 - Take the 2” length square tubing and connect to the positive (+) side of the pressure switch. Take the 10” length square tubing and tee into the tubing from the positive side of the cold end header box and the other side of the 2” square tubing. Connect the other end of the 10” square tubing the the positive (+) side of the measuring device.

4 - Take a second piece the 2” length square tubing and connect to the negative (-) side of the pressure switch. Take a second piece of 10” length square tubing and tee into the tubing from the negative (-) side of the cold end header box and the other side of the 2” square tubing. Connect the other end of the 10” square tubing the the negative (-) side of the measuring device.

5 - Operate unit and observe manometer reading. Readings will change as heat exchanger warms.

a. Take one reading immediately after start-up.

b. Take a second reading after unit has reached steady state (approximately 5 minutes). This will be the pressure differential.

The pressure differential should be at least 0.15” greater than those listed in the table 8. Readings in table are the set points or “break points”.

6 - Remove thermostat demand and allow to cycle off.

7 - Replace original pressure switch tubing.

NOTE - *Pressure differential values (set point) in table are the ”break”, or ”open” specifications. ”Make”, or ”close” pressure differentials are 0.15” greater than the set points listed in table.*

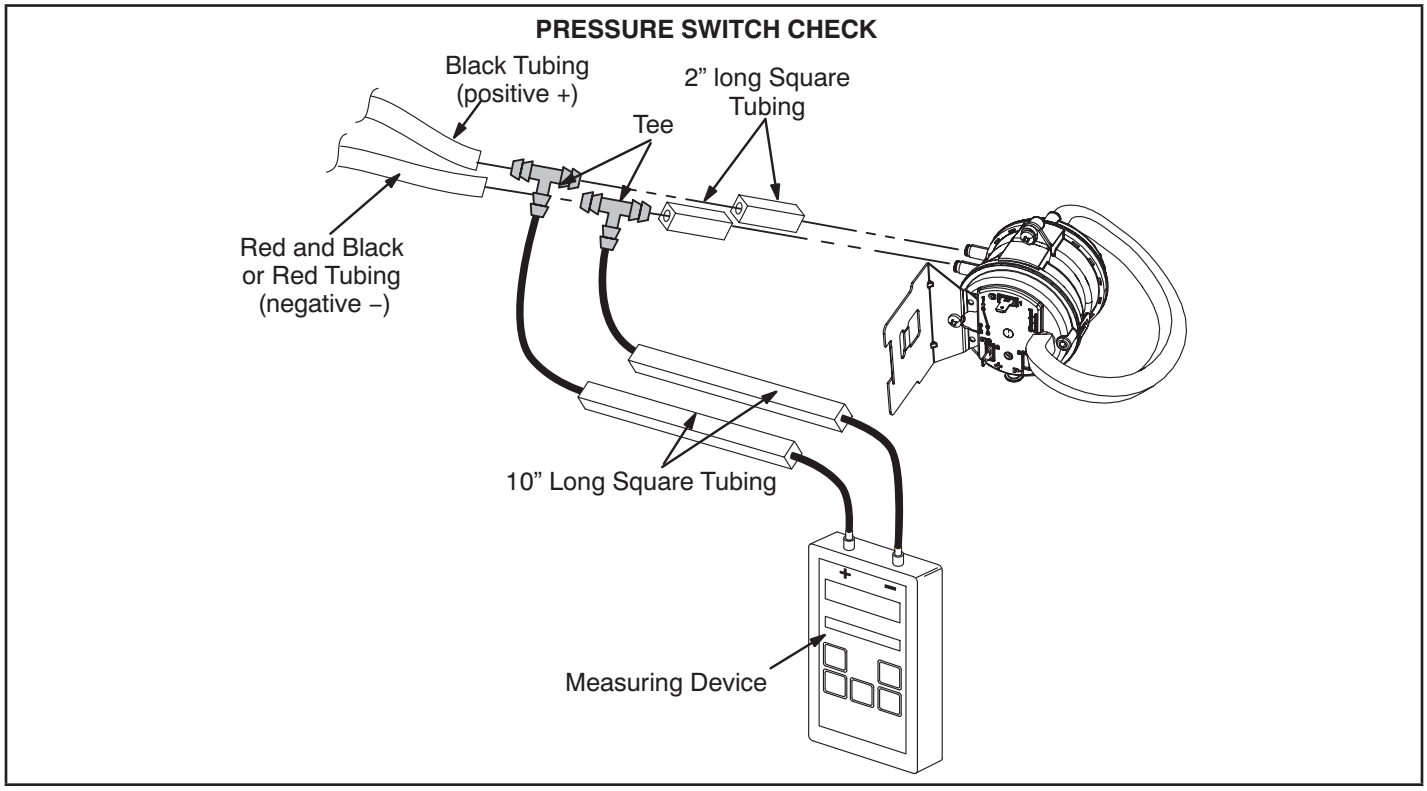


FIGURE 14

Pipe & Fittings Specifications

All pipe, fittings, primer and solvent cement must conform with American National Standard Institute and the American Society for Testing and Materials (ANSI/ASTM) standards. The solvent shall be free flowing and contain no lumps, undissolved particles or any foreign matter that adversely affects the joint strength or chemical resistance of the cement. The cement shall show no gelation, stratification, or separation that cannot be removed by stirring. Refer to the TABLE 9 for approved piping and fitting materials.

⚠ CAUTION

Solvent cements for plastic pipe are flammable liquids and should be kept away from all sources of ignition. Do not use excessive amounts of solvent cement when making joints. Good ventilation should be maintained to reduce fire hazard and to minimize breathing of solvent vapors. Avoid contact of cement with skin and eyes.

TABLE 9

PIPING AND FITTINGS SPECIFICATIONS

Schedule 40 PVC (Pipe)	D1785
Schedule 40 PVC (Cellular Core Pipe)	F891
Schedule 40 PVC (Fittings)	D2466
Schedule 40 CPVC (Pipe)	F441
Schedule 40 CPVC (Fittings)	F438
SDR-21 PVC or SDR-26 PVC (Pipe)	D2241
SDR-21 CPVC or SDR-26 CPVC (Pipe)	F442
Schedule 40 ABS Cellular Core DWV (Pipe)	F628
Schedule 40 ABS (Pipe)	D1527
Schedule 40 ABS (Fittings)	D2468
ABS-DWV (Drain Waste & Vent) (Pipe & Fittings)	D2661
PVC-DWV (Drain Waste & Vent) Pipe & Fittings)	D2665
PRIMER & SOLVENT CEMENT	**ASTM SPECIFICATION**
PVC & CPVC Primer	F656
PVC Solvent Cement	D2564
CPVC Solvent Cement	F493
ABS Solvent Cement	D2235
PVC/CPVC/ABS All Purpose Cement For Fittings & Pipe of the same material	D2564, D2235, F493
ABS to PVC or CPVC Transition Solvent Cement	D3188

TABLE 9 Continued

CANADA PIPE & FITTING & SOLVENT CEMENT	**MARKING**
PVC & CPVC Pipe and Fittings	ULCS636
PVC & CPVC Solvent Cement	
ABS to PVC or CPVC Transition Cement	
POLYPROPYLENE VENTING SYSTEM	
PolyPro® by Duravent	
InnoFlue® by Centrotherm	
UL 1738 CERTIFIED GAS VENTING SYSTEM	
IPEX System1738 Schedule 40 PVC Pipes and Fittings	UL1738
IPEX System1738 PVC FGV Cement & Primer	

⚠ IMPORTANT

Exhaust and intake connections are made of PVC. Use PVC primer and solvent cement when using PVC vent pipe. When using ABS vent pipe, use transitional solvent cement to make connections to the PVC fittings in the unit.

Use PVC primer and solvent cement or ABS solvent cement meeting ASTM specifications, refer to Table 9. As an alternate, use all purpose cement, to bond ABS, PVC, or CPVC pipe when using fittings and pipe made of the same materials. Use transition solvent cement when bonding ABS to either PVC or CPVC

Low temperature solvent cement is recommended during cooler weather. Metal or plastic strapping may be used for vent pipe hangers. Uniformly apply a liberal coat of PVC primer for PVC or use a clean dry cloth for ABS to clean inside socket surface of fitting and male end of pipe to depth of fitting socket.

Canadian Applications Only - *Pipe, fittings, primer and solvent cement used to vent (exhaust) this appliance must be certified to ULC S636 and supplied by a single manufacturer as part of an approved vent (exhaust) system. In addition, the first three feet of vent pipe from the furnace flue collar must be accessible for inspection.*

Venting Options

The ML296DFV is shipped with vent exhaust / air intake connection at the top cap. See figure 15. Using parts provided, the furnace may be field modified to have these connections on the right side of the furnace cabinet. See FIGURE 17 and follow the steps below. For left side venting order kit 87W73.

1 - Remove inner blower door.

2 - Loosen hose clamps which attach rubber fittings to the white PVC pipes inside the vestibule area. See FIGURE 15.

3 - Loosen the clamp which secures the pipes at the blower deck. See FIGURE 15.

4 - Remove white PVC pipes, slide up and out thru the top cap.

5 - Remove the black plastic fitting in top cap which previously aligned the PVC pipes.

6 - Remove the remaining parts of the pipe clamp at the blower deck.

7 - Remove the sheet metal patch plate on the side of the cabinet which covers the openings for side venting option. Save screws for reuse.

8 - Re-use the patch plate to cover the hole in the top cap. See FIGURE 16. Remove the 2 screws which secure the top cap to the furnace on the right side and re-install securing the right edge of the patch plate and the right side of the top cap to the furnace. Use 2 self-drilling sheet metal screws (provided) to finish securing the left edge of the patch plate on the left side.

9 - Use a utility knife to cut out the cabinet insulation for the right side vent / air intake.

10 - Install the two 90° street elbows (provided) through the side of the cabinet. The male side of each elbow should extend down through the blower deck and connect to the rubber fittings below. Once the elbows are properly positioned, tighten each clamp.

11 - Peel protective backing from side vent sealing gaskets (2) and apply to side vent sealing plates (2) as shown in FIGURE 17.

12 - Install the side vent sealing plates and gaskets on the exterior of the cabinet as shown in FIGURE 17. Secure with six mounting screws (four reused and two provided from bag assembly). Holes are pre-punched in the parts and cabinet, no drilling is required.

13 - Install sheet metal screws (provided) to seal extra two holes in cabinet not used with side vent clamps.

⚠ IMPORTANT

Side vent sealing plates and side vent sealing gaskets must be used when converting to right side venting. Failure to use gaskets and plates may lead to improper operation of unit.

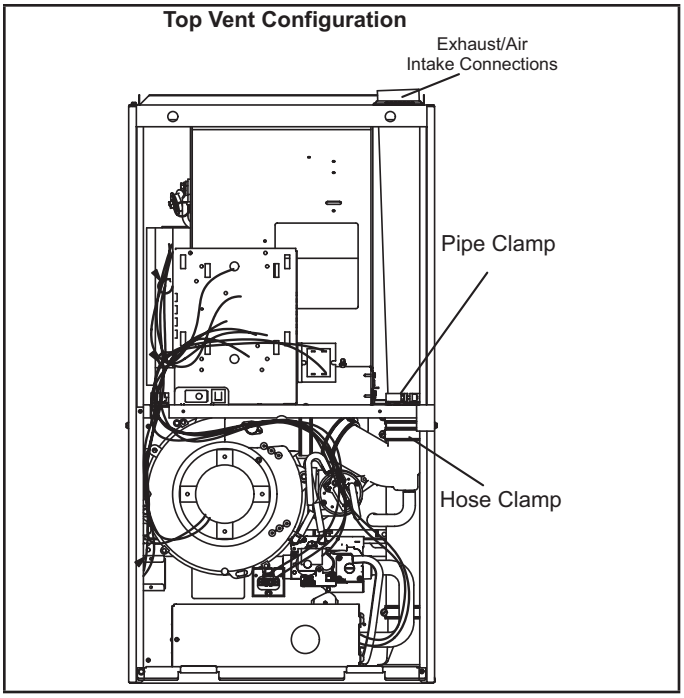


FIGURE 15

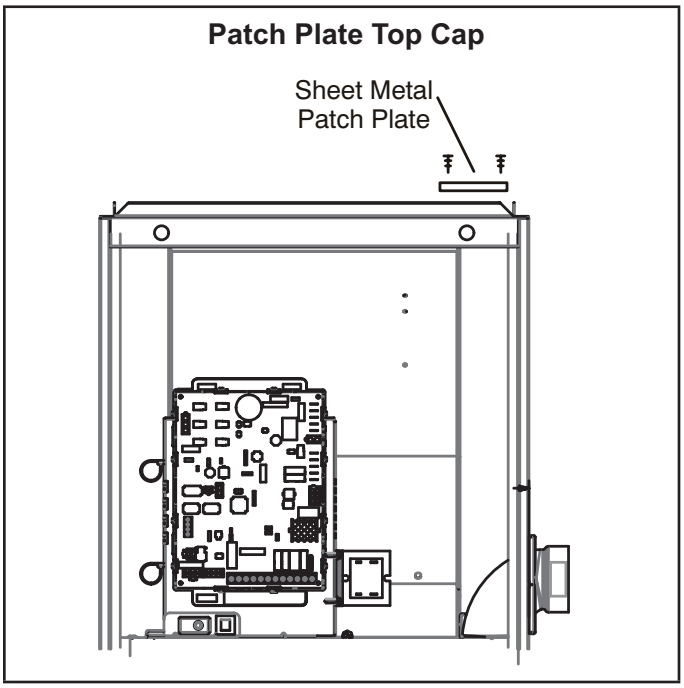


FIGURE 16

Right Side Vent Configuration

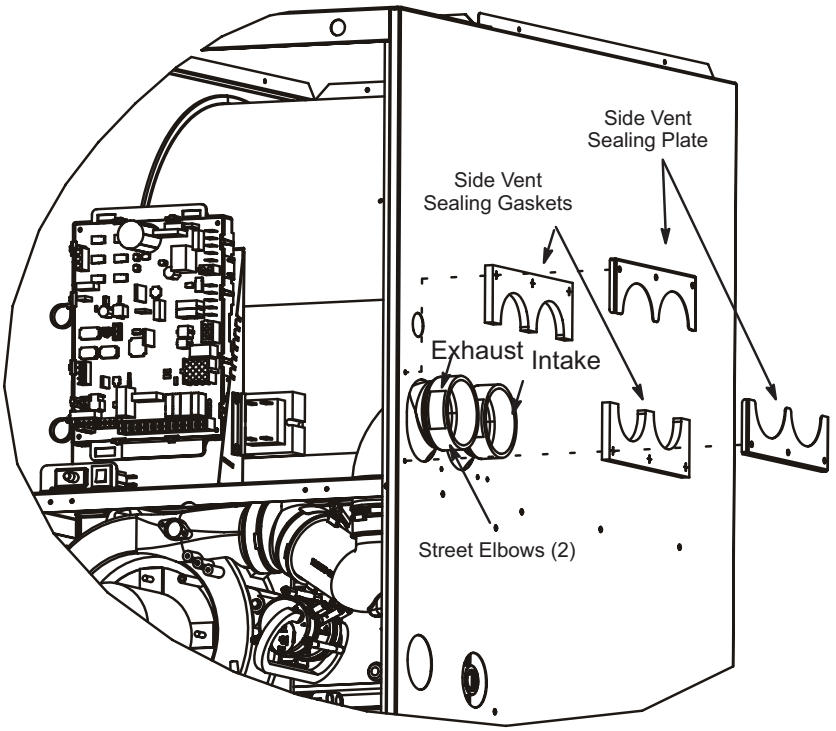


FIGURE 17

TABLE 10

OUTDOOR TERMINATION USAGE*

Input Size	Vent Pipe Dia. in.	STANDARD				CONCENTRIC		
		Flush Mount Kit	Wall Kit		Field Fabricated	1-1/2 inch	2 inch	3 inch
			2 inch	3 inch				
		51W11 (US) 51W12 (CA)	22G44 (US) 430G28 (CA)	44J40 (US) 481J20 (CA)		71M80 (US) 444W92 (CA)	69M29 (US) 444W92 (CA)	60L46 (US) 444W93 (CA)
045	[6]1-1/2	[3]YES	YES	[1]YES	[5] YES	[2] YES	N/A	N/A
	2	[3]YES	YES	[1]YES	[5] YES	[2] YES		
	2-1/2	[3]YES	YES	[1]YES	[5] YES	[2] YES		
	3	[3]YES	YES	[1]YES	[5] YES	[2] YES		
070	[6]1-1/2	[3]YES	YES	[1]YES	[5] YES	[2] YES		
	2	[3]YES	YES	[1]YES	[5] YES	[2] YES		
	2-1/2	[3]YES	YES	[1]YES	[5] YES	[2] YES		
	3	[3]YES	YES	[1]YES	[5] YES	[2] YES		
090	2	[3]YES	N/A	YES	[5] YES	N/A	YES	YES
	2-1/2	[3]YES		YES	[5] YES		YES	YES
	3	[3]YES		YES	[5] YES		YES	YES

NOTE - Standard Terminations do not include any vent pipe or elbows external to the structure. Any vent pipe or elbows external to the structure must be included in total vent length calculations. See vent length tables.

* Kits must be properly installed according to kit instructions.

1Requires field-provided outdoor 1-1/2” exhaust accelerator.

2Concentric kits 71M80 and 44W92 include 1-1/2” outdoor accelerator, when used with 045 and 070 input models. 1-1/2 in pipe must transition to 2 in pipe when used with a concentric kit.

3 Flush mount kits 51W11 and 51W12 includes 1-1/2 in. outdoor exhaust accelerator, required when used with 045, 070 and 090 input models. 1-1/2 in pipe must transition to 2 in pipe when used with the flushmount kit.

4 Termination kits 30G28, 44W92, 4493 and 81J20 are certified to ULC S636 for use in Canada only.

5 See TABLE 15 for vent accelerator requirements.

6 2 in to 1-1/2 in reducer required must be field provided.

Joint Cementing Procedure

All cementing of joints should be done according to the specifications outlined in ASTM D 2855.

NOTE - *A sheet metal screw may be used to secure the intake pipe to the connector, if desired. Use a drill or self tapping screw to make a pilot hole.*

⚠ DANGER

DANGER OF EXPLOSION!

Fumes from PVC glue may ignite during system check. Allow fumes to dissipate for at least 5 minutes before placing unit into operation.

1 - Measure and cut vent pipe to desired length.

2 - Debur and chamfer end of pipe, removing any ridges or rough edges. If end is not chamfered, edge of pipe may remove cement from fitting socket and result in a leaking joint.

NOTE - *Check the inside of vent pipe thoroughly for any obstruction that may alter furnace operation.*

3 - Clean and dry surfaces to be joined.

4 - Test fit joint and mark depth of fitting on outside of pipe.

5 - Uniformly apply a liberal coat of PVC primer for PVC or use a clean dry cloth for ABS to clean inside socket surface of fitting and male end of pipe to depth of fitting socket.

6 - Promptly apply solvent cement to end of pipe and inside socket surface of fitting. Cement should be applied lightly but uniformly to inside of socket. Take care to keep excess cement out of socket. Apply second coat to end of pipe.

NOTE - *Time is critical at this stage. Do not allow primer to dry before applying cement.*

7 - Immediately after applying last coat of cement to pipe, and while both inside socket surface and end of pipe are wet with cement, forcefully insert end of pipe into socket until it bottoms out. Turn PVC pipe 1/4 turn during assembly (but not after pipe is fully inserted) to distribute cement evenly. DO NOT turn ABS or cellular core pipe.

NOTE - *Assembly should be completed within 20 seconds after last application of cement. Hammer blows should not be used when inserting pipe.*

8 - After assembly, wipe excess cement from pipe at end of fitting socket. A properly made joint will show a bead around its entire perimeter. Any gaps may indicate an improper assembly due to insufficient solvent.

9 - Handle joints carefully until completely set.

Venting Practices

1 - In areas where piping penetrates joists or interior walls, hole must be large enough to allow clearance on all sides of pipe through center of hole using a hanger.

2 - When furnace is installed in a residence where unit is shut down for an extended period of time, such as a vacation home, make provisions for draining condensate collection trap and lines.

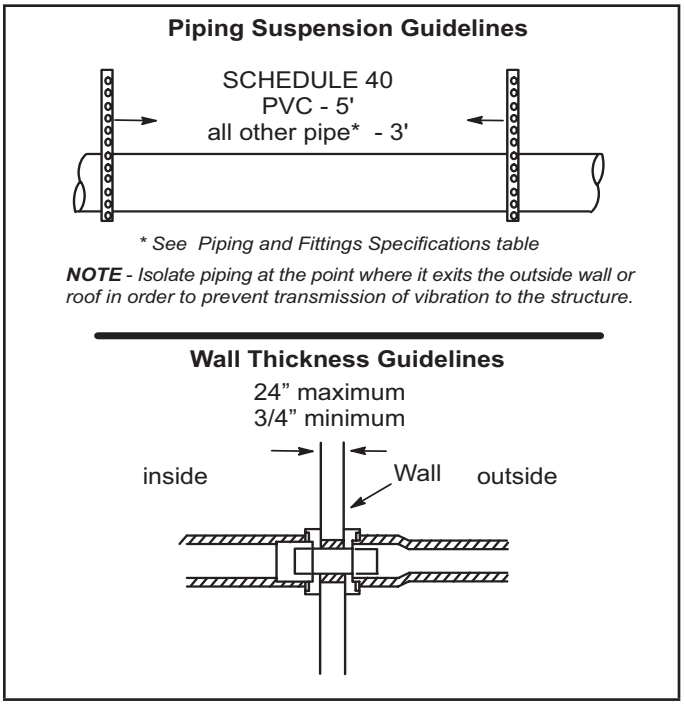
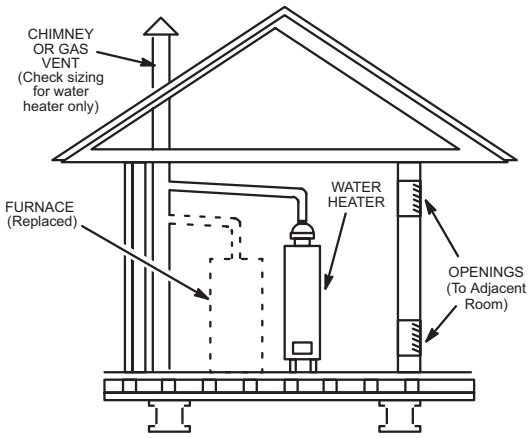


FIGURE 18

Removal of the Furnace from Common Vent

In the event that an existing furnace is removed from a venting system commonly run with separate gas appliances, the venting system is likely to be too large to properly vent the remaining attached appliances. Conduct the following test while each appliance is operating and the other appliances (which are not operating) remain connected to the common venting system. If the venting system has been installed improperly, you must correct the system as indicated in the general venting requirements section.

REPLACING FURNACE THAT WAS PART OF A COMMON VENT SYSTEM



If replacing a furnace which was commonly vented with another gas appliance, the size of the existing vent pipe for that gas appliance must be checked. Without the heat of the original furnace flue products, the existing vent pipe is probably oversized for the single water heater or other appliance. The vent should be checked for proper draw with the remaining appliance.

FIGURE 19

⚠ WARNING

CARBON MONOXIDE POISONING HAZARD

Failure to follow the steps outlined below for each appliance connected to the venting system being placed into operation could result in carbon monoxide poisoning or death.

The following steps shall be followed for each appliance connected to the venting system being placed into operation, while all other appliances connected to the venting system are not in operation:

1 - Seal any unused openings in the common venting system.

2 - Inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage, restriction, leakage, corrosion, or other deficiencies which could cause an unsafe condition.

3 - Close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliances not connected to the common venting system.Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

4 - Follow the lighting instructions. Turn on the appliance that is being inspected. Adjust the thermostat so that the appliance operates continuously.

5 - After the main burner has operated for 5 minutes, test for leaks of flue gases at the draft hood relief opening. Use the flame of a match or candle.

6 - After determining that each appliance connected to the common venting system is venting properly, (step 3) return all doors, widows, exhaust fans, fireplace dampers, and any other gas-burning appliances to their previous mode of operation.

7 - If a venting problem is found during any of the preceding tests, the common venting system must be modified to correct the problem.

Resize the common venting system to the minimum vent pipe size determined by using the appropriate tables in Appendix G. These are in the current standards of the National Fuel Gas Code ANSI Z223.1.

Exhaust Piping (FIGURE 21 and FIGURE 22)

Route piping to outside of structure. Continue with installation following instructions given in piping termination section.

⚠ WARNING

Carbon Monoxide Poisoning Hazard

Cutting or altering exhaust or air intake pipes, which are located in the blower compartment, could result in Carbon Monoxide Poisoning or Death.

⚠ CAUTION

Do not discharge exhaust into an existing stack or stack that also serves another gas appliance. If vertical discharge through an existing unused stack is required, insert PVC pipe inside the stack until the end is even with the top or outlet end of the metal stack.

⚠ CAUTION

The exhaust vent pipe operates under positive pressure and must be completely sealed to prevent leakage of combustion products into the living space.

Vent Piping Guidelines

NOTE - *Lennox has approved the use of DuraVent® and Centrotherm manufactured vent pipe and terminations as an option to PVC. When using the PolyPro® by DuraVent or InnoFlue® by Centrotherm venting system the vent pipe requirements stated in the unit installation instruction – minimum & maximum vent lengths, termination clearances, etc. – apply and must be followed. Follow the instructions provided with PoyPro by DuraVent and InnoFlue by Centrotherm venting system for assembly or if requirements are more restrictive. The PolyPro by Duravent and InnoFlueby Centrotherm venting system must also follow the uninsulated and unconditioned space criteria listed in TABLE 13 .*

The ML296DFV can be installed as either a Non-Direct Vent or a Direct Vent gas central furnace.

NOTE - *In Non-Direct Vent installations, combustion air is taken from indoors or ventilated attic or crawlspace and flue gases are discharged outdoors. In Direct Vent installations, combustion air is taken from outdoors and flue gases are discharged outdoors.*

Intake and exhaust pipe sizing -- Size pipe according to TABLE 11 (minimum length permitted) and TABLE 12 (maximum length permitted). Count all elbows inside and outside the home.

TABLE 11

MINIMUM VENT PIPE LENGTHS

ML296DFV MODEL	MIN. VENT LENGTH*
045, 070, 090	15 ft or 5ft plus 2 elbows or 10 ft plus 1 elbow

*Any approved termination may be added to the minimum length listed. Two 45 degree elbows are equivalent to one 90 degree elbow.

Regardless of the diameter of pipe used, the standard roof and wall terminations described in section Exhaust Piping Terminations should be used. Exhaust vent termination pipe is sized to optimize the velocity of the exhaust gas as it exits the termination. Refer to TABLE 15.

In some applications which permit the use of several different sizes of vent pipe, a combination vent pipe may be used. Contact Lennox' Application Department for assistance in sizing vent pipe in these applications.

⚠ IMPORTANT

Do not use screens or perforated metal in exhaust or intake terminations. Doing so will cause freeze-ups and may block the terminations.

NOTE - *It is acceptable to use any pipe size which fits within the guidelines allowed in TABLE 12.*

NOTE - *All horizontal runs of exhaust pipe must slope back toward unit. A minimum of 1/4" (6mm) drop for each 12" (305mm) of horizontal run is mandatory for drainage.*

NOTE - *Lennox offers a glueless vent adapter kit 17H92 as an option for exhaust exiting at the furnace top cap coupling.*

NOTE - *Exhaust pipe MUST be glued to furnace exhaust fittings.*

NOTE - *Exhaust piping should be checked carefully to make sure there are no sags or low spots.*

NOTE - *If right side venting option is used, you must include the elbow at the furnace in the elbow count. If transitioning to 3" dia pipe, this elbow equates to 20' of equivalent vent length for all models.*

Use the following steps to correctly size vent pipe diameter.

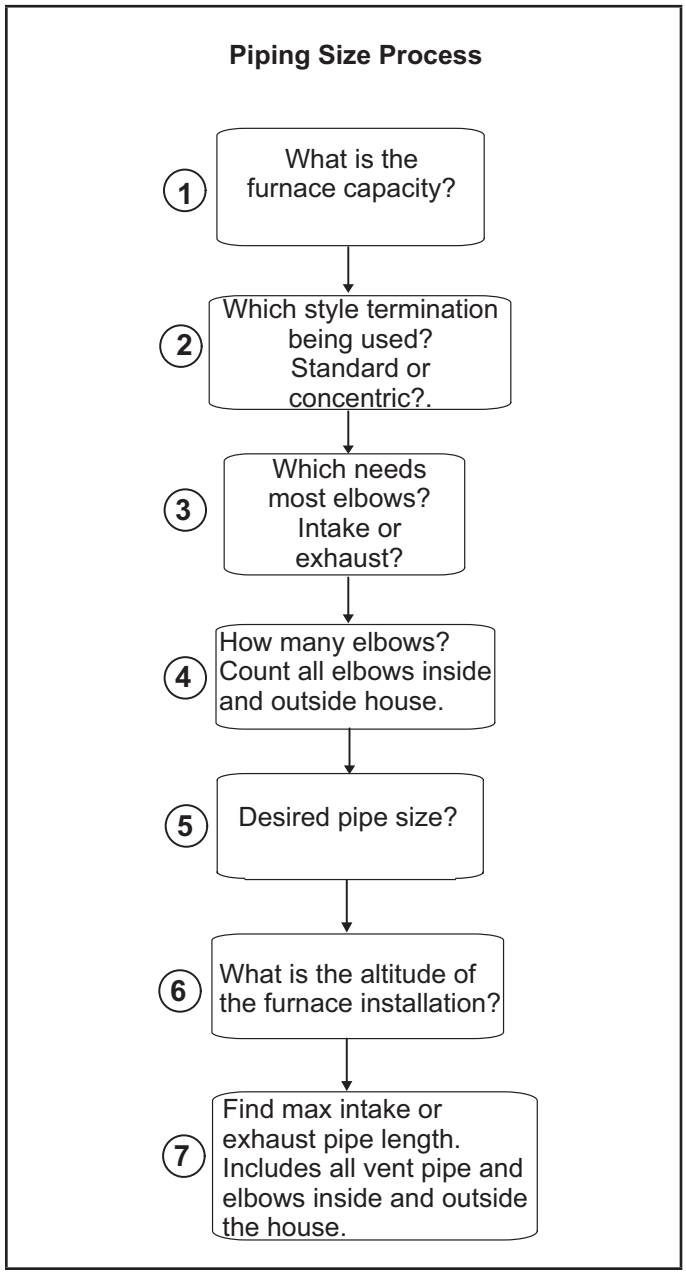


FIGURE 20

TABLE 12

Maximum Allowable Intake or Exhaust Vent Length

Size intake and exhaust pipe length separately. Values in table are for Intake OR Exhaust, not combined total. Both Intake and Exhaust must be same pipe size. NOTE - Additional vent pipe and elbows used to terminate the vent pipe outside the structure must be included in the total vent length calculation.

STANDARD TERMINATION AT ELEVATION 0 - 4500 ft.

Pipe Size		1-1/2 in.			2 in.			2-1/2 in.			3 in.		
	Input	045	070	090	045	070	090	045	070	090	045	070	090
No. of 90 ELL	1	20	15	N/A	71	56	34	105	105	83	128	127	108
	2	15	10	N/A	66	51	29	100	100	78	123	122	103
	3	10	N/A	N/A	61	46	24	95	95	73	118	117	98
	4	N/A	N/A	N/A	56	41	19	90	90	68	113	112	93
	5	N/A	N/A	N/A	51	36	14	85	85	63	108	107	88
	6	N/A	N/A	N/A	46	31	9	80	80	58	101	102	83
	7	N/A	N/A	N/A	41	26	4	75	75	53	98	97	78
	8	N/A	N/A	N/A	36	21	N/A	70	70	48	93	92	73
	9	N/A	N/A	N/A	31	16	N/A	65	65	43	88	87	68
	10	N/A	N/A	N/A	26	11	N/A	60	60	38	83	82	63

STANDARD TERMINATION ELEVATION 4501 - 10,000 ft.

Pipe Size		1-1/2 in.			2 in.			2-1/2 in.			3 in.		
	Input	045	070	090	045	070	090	045	070	090	045	070	090
No. of 90 ELL	1	20	15	N/A	71	56	34	105	105	83	128	127	108
	2	15	10	N/A	66	51	29	100	100	78	123	122	103
	3	10	N/A	N/A	61	46	24	95	95	73	118	117	98
	4	N/A	N/A	N/A	56	41	19	90	90	68	113	112	93
	5	N/A	N/A	N/A	51	36	14	85	85	63	108	107	88
	6	N/A	N/A	N/A	46	31	9	80	80	58	103	102	83
	7	N/A	N/A	N/A	41	26	4	75	75	53	98	97	78
	8	N/A	N/A	N/A	36	21	N/A	70	70	48	93	92	73
	9	N/A	N/A	N/A	31	16	N/A	65	65	43	88	87	68
	10	N/A	N/A	N/A	26	11	N/A	60	60	38	83	82	63

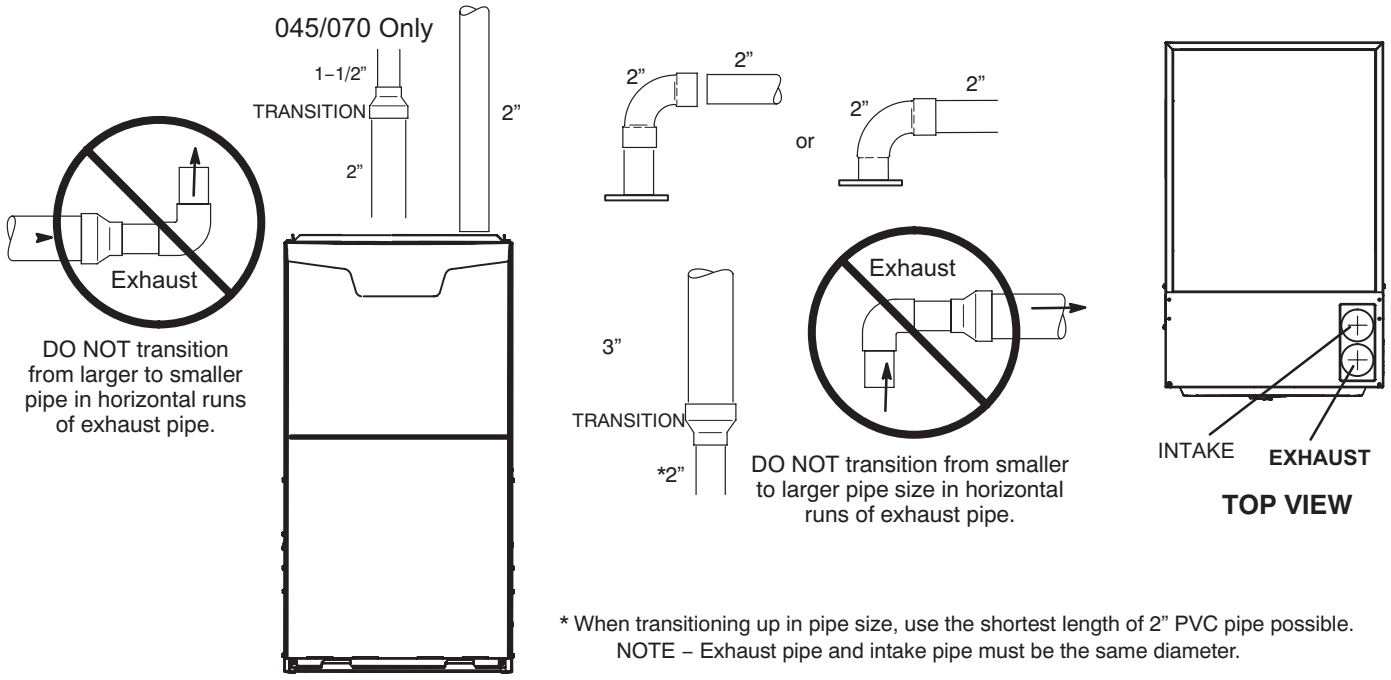
CONCENTRIC TERMINATION AT ELEVATION 0 - 4500 ft.

Pipe Size		1-1/2 in.			2 in.			2-1/2 in.			3 in.		
	Input	045	070	090	045	070	090	045	070	090	045	070	090
No. of 90 ELL	1	15	10	N/A	63	48	32	95	95	79	111	111	104
	2	10	N/A	N/A	58	43	27	90	90	74	106	106	99
	3	N/A	N/A	N/A	53	38	22	85	85	69	101	91	94
	4	N/A	N/A	N/A	48	33	17	80	80	64	96	96	89
	5	N/A	N/A	N/A	43	28	12	75	75	59	91	91	84
	6	N/A	N/A	N/A	38	23	7	70	70	54	96	86	79
	7	N/A	N/A	N/A	33	18	2	65	65	49	81	81	74
	8	N/A	N/A	N/A	28	13	N/A	60	60	44	76	76	69
	9	N/A	N/A	N/A	23	8	N/A	55	55	39	71	71	64
	10	N/A	N/A	N/A	18	3	N/A	50	50	34	66	66	59

CONCENTRIC TERMINATION ELEVATION 4501 - 10,000 ft.

Pipe Size		1-1/2 in.			2 in.			2-1/2 in.			3 in.		
	Input	045	070	090	045	070	090	045	070	090	045	070	090
No. of 90 ELL	1	15	10	N/A	63	48	32	95	95	79	111	111	104
	2	10	N/A	N/A	58	43	27	90	90	74	106	106	99
	3	N/A	N/A	N/A	53	38	22	85	85	69	101	101	94
	4	N/A	N/A	N/A	48	33	17	80	80	64	96	96	89
	5	N/A	N/A	N/A	43	28	12	75	75	59	91	91	84
	6	N/A	N/A	N/A	38	23	7	70	70	54	86	86	79
	7	N/A	N/A	N/A	33	18	2	65	65	49	81	81	74
	8	N/A	N/A	N/A	28	13	N/A	60	60	44	76	76	69
	9	N/A	N/A	N/A	23	8	N/A	55	55	39	71	71	64
	10	N/A	N/A	N/A	18	3	N/A	50	50	34	66	66	59

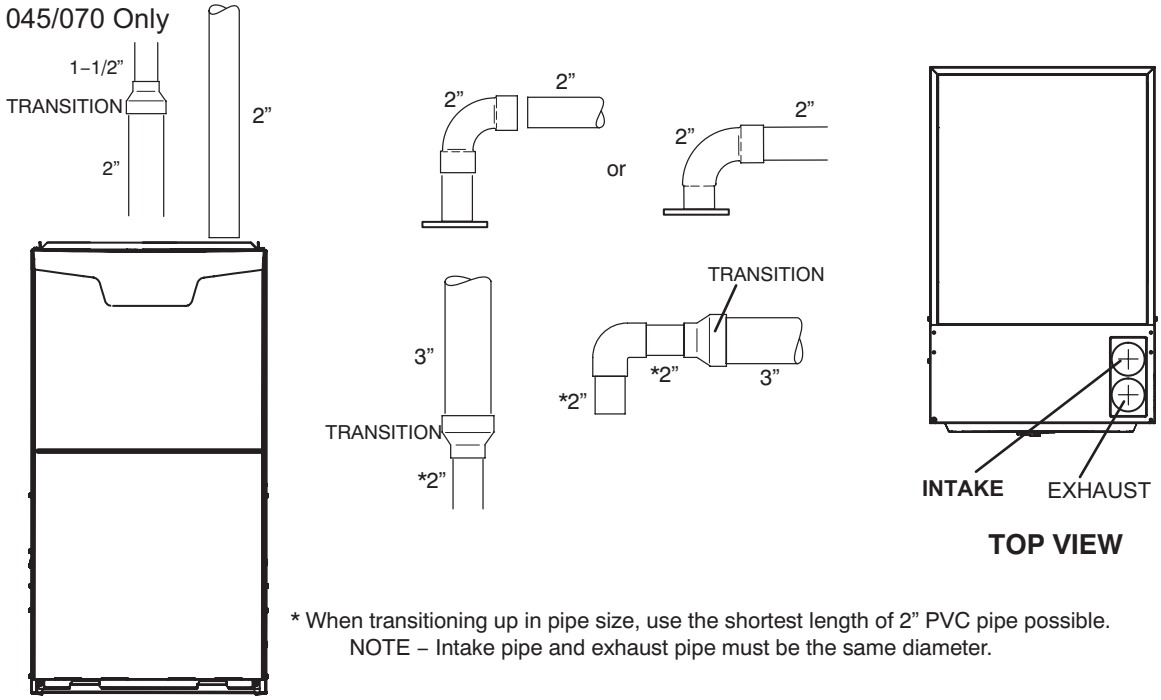
TYPICAL *EXHAUST* PIPE CONNECTIONS



* When transitioning up in pipe size, use the shortest length of 2" PVC pipe possible.
NOTE – Exhaust pipe and intake pipe must be the same diameter.

FIGURE 21

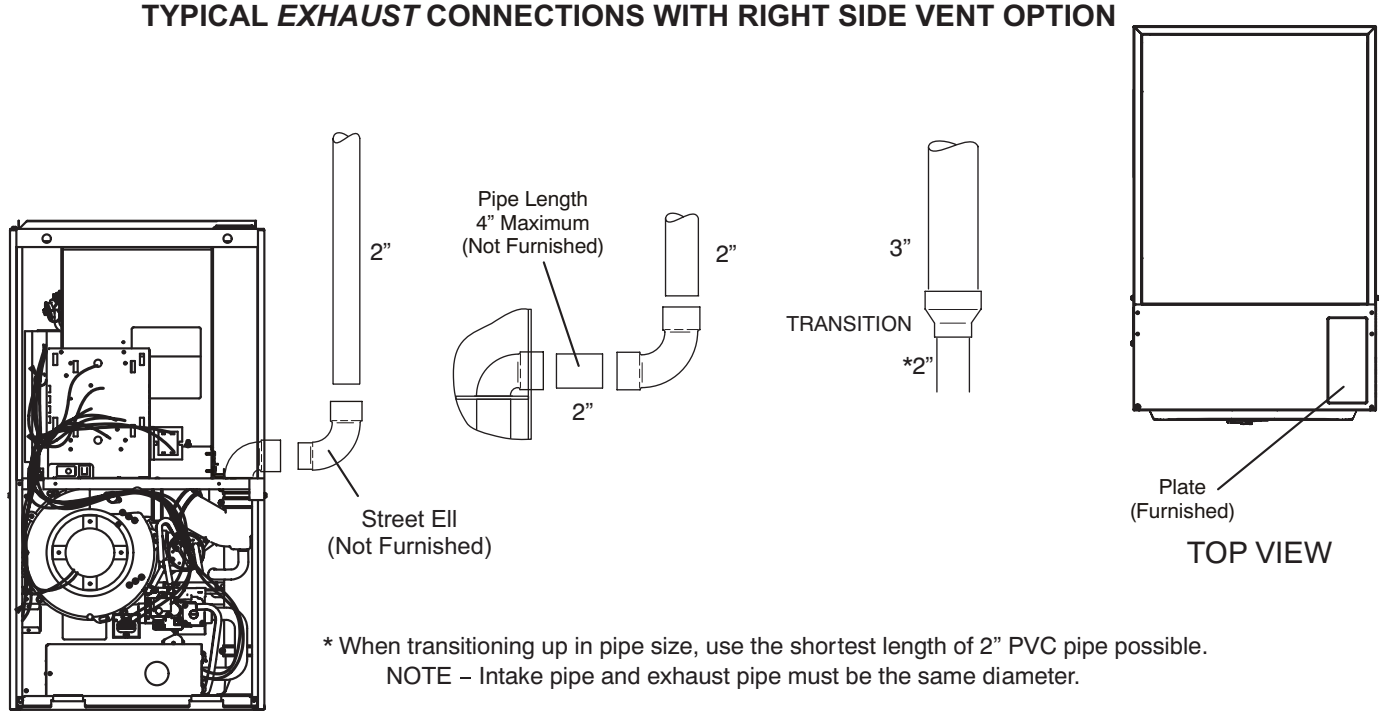
TYPICAL *INTAKE* PIPE CONNECTIONS



* When transitioning up in pipe size, use the shortest length of 2" PVC pipe possible.
NOTE – Intake pipe and exhaust pipe must be the same diameter.

FIGURE 22

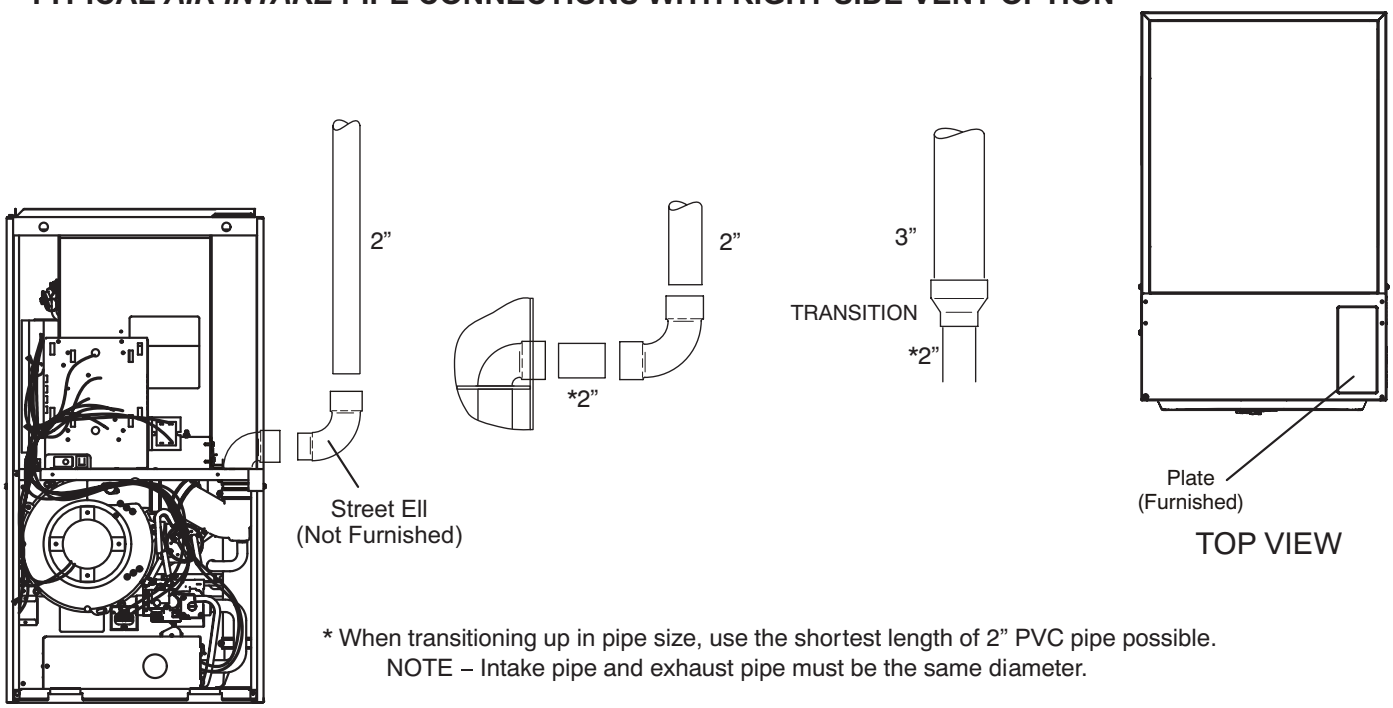
TYPICAL *EXHAUST* CONNECTIONS WITH RIGHT SIDE VENT OPTION



* When transitioning up in pipe size, use the shortest length of 2” PVC pipe possible.
NOTE – Intake pipe and exhaust pipe must be the same diameter.

Figure 23

TYPICAL *AIR INTAKE* PIPE CONNECTIONS WITH RIGHT SIDE VENT OPTION



* When transitioning up in pipe size, use the shortest length of 2” PVC pipe possible.
NOTE – Intake pipe and exhaust pipe must be the same diameter.

Figure 24

Intake Piping

The ML296DFV furnace may be installed in either **direct vent** or **non-direct vent** applications. In non-direct vent applications, when intake air will be drawn into the furnace from the surrounding space, the indoor air quality must be considered. Guidelines listed in Combustion, Dilution and Ventilation Air section must be followed.

Follow the next two steps when installing the unit in Direct Vent applications, where combustion air is taken from outdoors and flue gases are discharged outdoors. The provided air intake screen must not be used in direct vent applications (outdoors).

1 - Use cement or a sheet metal screw to secure the intake pipe to the inlet air connector.

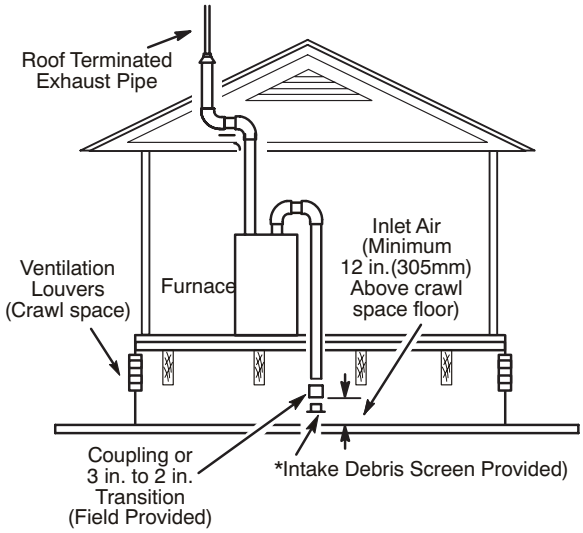
2 - If intake air is drawn from a ventilated crawlspace (FIGURE 25) or ventilated attic (FIGURE 26) the exhaust vent length must not exceed those listed in TABLE 14. If 3" diameter pipe is used, reduce to 2" diameter pipe to accommodate the debris screen.

3 - Route piping to outside of structure. Continue with installation following instructions given in general guide lines for piping terminations and intake and exhaust piping terminations for direct vent sections. Refer to TABLE 12 for pipe sizes.

⚠ CAUTION

If this unit is being installed in an application with combustion air coming in from a space serviced by an exhaust fan, power exhaust fan, or other device which may create a negative pressure in the space, take care when sizing the inlet air opening. The inlet air opening must be sized to accommodate the maximum volume of exhausted air as well as the maximum volume of combustion air required for all gas appliances serviced by this space.

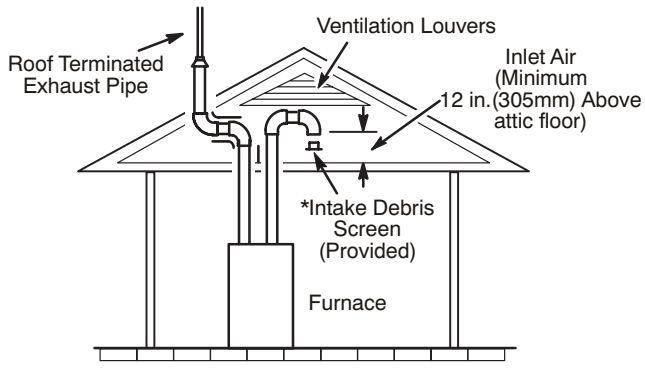
EQUIPMENT IN CONFINED SPACE
(Inlet Air from Ventilated Crawlspace and Outlet Air to Outside)



***NOTE**-The inlet and outlet air openings shall each have a free area of at least one square inch per 4,000 Btu (645mm^2 per 1.17kW) per hour of the total input rating of all equipment in the enclosure.*

FIGURE 25

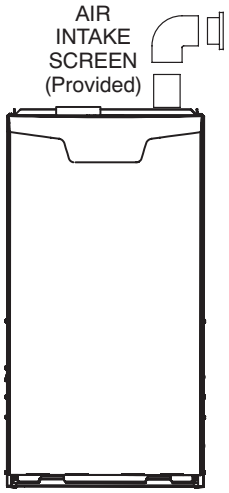
EQUIPMENT IN CONFINED SPACE
(Inlet Air from Ventilated Attic and Outlet Air to Outside)



***NOTE**-The inlet and outlet air openings shall each have a free area of at least one square inch per 4,000 Btu (645mm^2 per 1.17kW) per hour of the total input rating of all equipment in the enclosure.*

FIGURE 26

TYPICAL AIR INTAKE PIPE CONNECTIONS
NON–DIRECT VENT APPLICATIONS



***NOTE** - Air intake screen and elbow may be rotated, so that screen may be positioned to face forward or to either side.*

FIGURE 27

Follow the next two steps when installing the unit in **Non-Direct Vent** applications where combustion air is taken from indoors and flue gases are discharged outdoors.

1 - Use field-provided materials and the factory-provided air intake screen to route the intake piping as shown in FIGURE 27. Maintain a minimum clearance of 3" (76mm) around the air intake opening. The air intake opening (with the protective screen) should always be directed forward, or sideways.

2 - Use cement to secure the intake pipe to the connector, if desired.

General Guidelines for Vent Terminations

In Non-Direct Vent applications, combustion air is taken from indoors and the flue gases are discharged to the outdoors. The ML296DFV is then classified as a non-direct vent, Category IV gas furnace.

In Direct Vent applications, combustion air is taken from outdoors and the flue gases are discharged to the outdoors. The ML296DFV is then classified as a direct vent, Category IV gas furnace.

In both Non-Direct Vent and Direct Vent applications, the vent termination is limited by local building codes. In the absence of local codes, refer to the current National Fuel Gas Code ANSI Z223-1/NFPA 54 in U.S.A., and current CSA-B149 Natural Gas and Propane Installation Codes in Canada for details. Position termination according to location given in FIGURE 29 or FIGURE 30. In addition, position termination so it is free from any obstructions and 12" above the average snow accumulation.

At vent termination, care must be taken to maintain protective coatings over building materials (prolonged exposure to exhaust condensate can destroy protective coatings). It is recommended that the exhaust outlet not be located within 6 feet (1.8m) of an outdoor AC unit because the condensate can damage the painted coating.

***NOTE -** See TABLE 13 for maximum allowed exhaust pipe length without insulation in unconditioned space during winter design temperatures below 32°F (0°C). If required exhaust pipe should be insulated with 1/2" (13mm) Armaflex or equivalent. In extreme cold climate areas, 3/4" (19mm) Armaflex or equivalent may be necessary. Insulation must be protected from deterioration. Armaflex with UV protection is permissable. Basements or other enclosed areas that are not exposed to the outdoor ambient temperature and are above 32 degrees F (0°C) are to be considered conditioned spaces.*

⚠ IMPORTANT

Do not use screens or perforated metal in exhaust terminations. Doing so will cause freeze-ups and may block the terminations.

⚠ IMPORTANT

For Canadian Installations Only: In accordance to CSA International B149 installation codes, the minimum allowed distance between the combustion air intake inlet and the exhaust outlet of other appliances shall not be less than 12 inches (305mm).

TABLE 13

Maximum Allowable Exhaust Vent Pipe Length (in ft.[3]) Without Insulation In Unconditioned Space For Winter Design Temperatures Two - Stage High Efficiency Furnace

Winter Design Tempera-tures1 °F (°C)	Vent Pipe Diameter	Unit Input Size					
		045		070		090	
		PVC	[2]PP	PVC	[2]PP	PVC	[2]PP
32 to 21 (0 to -6)	1-1/2	22	n/a	20	n/a	n/a	n/a
	2 in	21	18	33	30	46	42
	2-1/2 in	16	n/a	26	n/a	37	n/a
	3 in	12	12	21	21	30	30
20 to 1 (-7 to -17)	1-1/2	12	n/a	20	n/a	n/a	n/a
	2 in	11	9	19	17	28	25
	2-1/2 in	7	n/a	14	n/a	21	n/a
	3 in	2	2	9	9	16	16
0 to -20 (-18 to -29)	1-1/2	8	n/a	13	n/a	n/a	n/a
	2 in	6	4	12	10	19	16
	2-1/2 in	1	n/a	7	n/a	13	n/a
	3 in	1	1	2	2	8	8

1Refer to 99% Minimum Design Temperature table provided in the current edition of the ASHRAE Fundamentals Handbook.

2 Poly-Propylene vent pipe (PP) by Duravent and Centrotherm.

3 Vent length in table is equivalent length. Consider each elbow as 5ft. of linear length.

NOTE - Concentric terminations are the equivalent of 5' and should be considered when measuring pipe length.

NOTE - Maximum uninsulated vent lengths listed may include the termination(vent pipe exterior to the structure) and cannot exceed 5 linear feet or the maximum allowable intake or exhaust vent length listed in TABLE 12 or TABLE 14 which ever is less.

NOTE - If insulation is required in an unconditioned space, it must be located on the pipe closest to the furnace. See FIGURE 28.

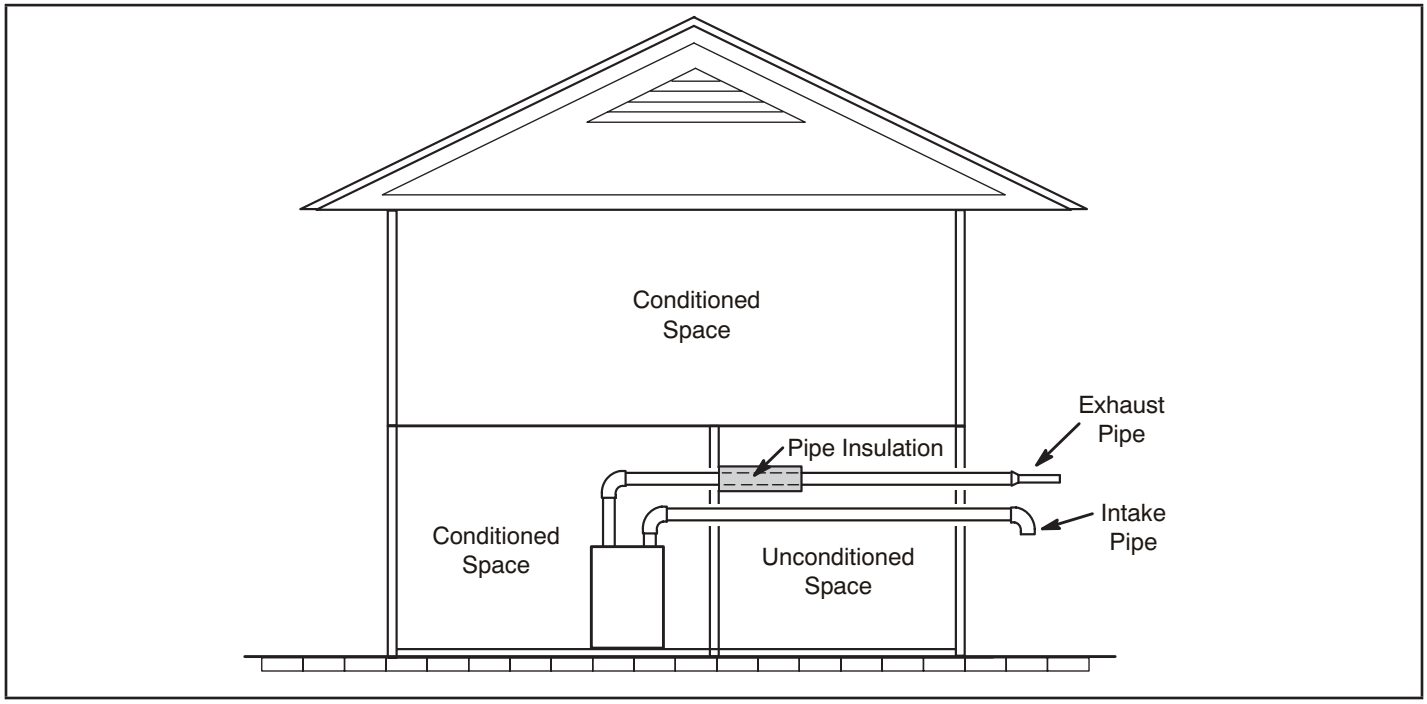


FIGURE 28

TABLE 14

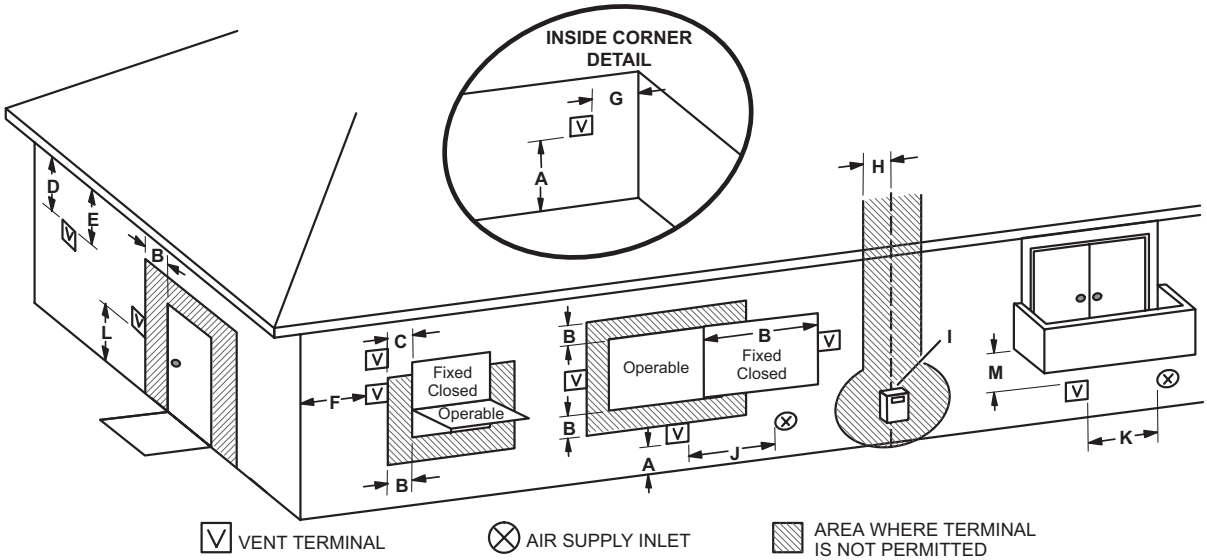
Maximum Allowable Exhaust Vent Length Using Ventilated Attic or Crawl Space For Intake Air in Feet

NOTE - Additional vent pipe and elbows used to terminate the vent pipe outside the structure must be included in the total vent length calculation.

Standard Termination at Elevation 0 - 10,000 ft

Number Of 90° Elbows Used	1-1/2			2” Pipe			2-1/2” Pipe				3” Pipe		
	Model			Model			Model				Model		
	045	070	090	045	070	090	045	070	090	110	045	070	090
1	15	10	n/a	61	46	24	90	90	68	33	108	107	88
2	10	n/a		56	41	19	85	85	63	28	103	102	83
3	n/a			51	36	14	80	80	58	23	98	97	78
4				46	31	9	75	75	53	18	93	92	73
5				41	26	4	70	70	48	13	88	87	68
6				36	21	n/a	65	65	43	8	81	82	63
7				31	16		60	60	38	3	78	77	58
8				26	11		55	55	33	n/a	73	72	53
9				21	6		50	50	28		68	67	48
10				16	1		45	45	23		63	62	43

VENT TERMINATION CLEARANCES
FOR NON-DIRECT VENT INSTALLATIONS IN THE US AND CANADA



		US Installations[1]	Canadian Installations[2]
A =	Clearance above grade, veranda, porch, deck or balcony	12 inches (305mm) or 12 in. (305mm) above average snow accumulation.	12 inches (305mm) or 12 in. (305mm) above average snow accumulation.
B =	Clearance to window or door that may be opened	4 feet (1.2 m) below or to side of opening; 1 foot (30cm) above opening	6 inches (152mm) for appliances <10,000 Btuh (3kw), 12 inches (305mm) for appliances > 10,000 Btuh (3kw) and <100,000 Btuh (30kw), 36 inches (.9m) for appliances > 100,000 Btuh (30kw)
C =	Clearance to permanently closed window	* 12”	* 12”
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (610 mm) from the center line of the terminal	* Equal to or greater than soffit depth.	* Equal to or greater than soffit depth.
E =	Clearance to unventilated soffit	* Equal to or greater than soffit depth.	* Equal to or greater than soffit depth.
F =	Clearance to outside corner	* No minimum to outside corner	* No minimum to outside corner
G =	Clearance to inside corner	*	*
H =	Clearance to each side of center line extended above meter / regulator assembly	* 3 feet (.9m) within a height 15 feet (4.5m) above the meter / regulator assembly	3 feet (.9m) within a height 15 feet (4.5m) above the meter / regulator assembly
I =	Clearance to service regulator vent outlet	* 3 feet (.9m)	3 feet (.9m)
J =	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	4 feet (1.2 m) below or to side of opening; 1 foot (30 cm) above opening	6 inches (152mm) for appliances <10,000 Btuh (3kw), 12 inches (305mm) for appliances > 10,000 Btuh (3kw) and <100,000 Btuh (30kw), 36 inches (.9m) for appliances > 100,000 Btuh (30kw)
K =	Clearance to mechanical air supply inlet	3 feet (.9m) above if within 10 feet (3m) horizontally	6 feet (1.8m)
L =	Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.1m)†	7 feet (2.1m)†
M =	Clearance under veranda, porch, deck or balcony	*12 inches (305mm)‡	12 inches (305mm)‡

[1] In accordance with the current ANSI Z223.1/NFPA 54 Natural Fuel Gas Code
[2] In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code

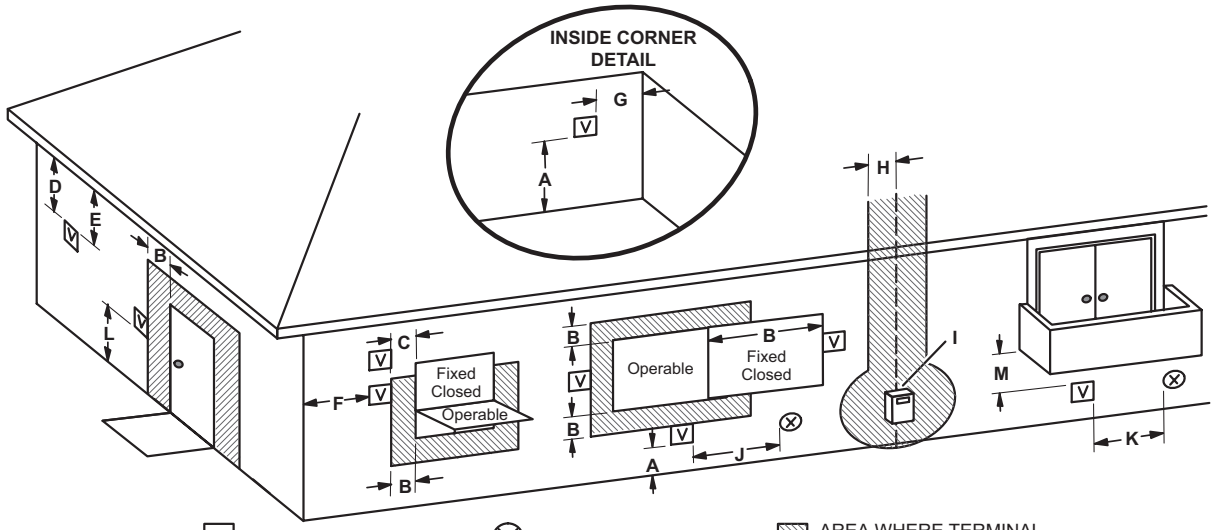
† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ Permitted only if veranda, porch, deck or balcony is fully open on a minimum of two sides beneath the floor. Lennox recommends avoiding this location if possible.

*For clearances not specified in ANSI Z223.1/NFPA 54 or CSA B149.1, clearance will be in accordance with local installation codes and the requirements of the gas supplier and these installation instructions.”

FIGURE 29

VENT TERMINATION CLEARANCES
FOR DIRECT VENT INSTALLATIONS IN THE US AND CANADA



V VENT TERMINAL ⊗ AIR SUPPLY INLET AREA WHERE TERMINAL IS NOT PERMITTED

		US Installations[1]	Canadian Installations[2]
A =	Clearance above grade, veranda, porch, deck or balcony	12 inches (305mm) or 12 in. (305mm) above average snow accumulation.	12 inches (305mm) or 12 in. (305mm) above average snow accumulation.
B =	Clearance to window or door that may be opened	6 inches (152mm) for appliances <10,000 Btuh (3kw), 9 inches (228mm) for appliances > 10,000 Btuh (3kw) and <50,000 Btuh (15 kw), 12 inches (305mm) for appliances > 50,000 Btuh (15kw)	6 inches (152mm) for appliances <10,000 Btuh (3kw), 12 inches (305mm) for appliances > 10,000 Btuh (3kw) and <100,000 Btuh (30kw), 36 inches (.9m) for appliances > 100,000 Btuh (30kw)
C =	Clearance to permanently closed window	* 12”	* 12”
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (610mm) from the center line of the terminal	* Equal to or greater than soffit depth	* Equal to or greater than soffit depth
E =	Clearance to unventilated soffit	* Equal to or greater than soffit depth	* Equal to or greater than soffit depth
F =	Clearance to outside corner	* No minimum to outside corner	* No minimum to outside corner
G =	Clearance to inside corner	*	*
H =	Clearance to each side of center line extended above meter / regulator assembly	3 feet (.9m) within a height 15 feet (4.5m) above the meter / regulator assembly	3 feet (.9m) within a height 15 feet (4.5m) above the meter / regulator assembly
I =	Clearance to service regulator vent outlet	* 3 feet (.9m)	3 feet (.9m)
J =	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	6 inches (152mm) for appliances <10,000 Btuh (3kw), 9 inches (228mm) for appliances > 10,000 Btuh (3kw) and <50,000 Btuh (15 kw), 12 inches (305mm) for appliances > 50,000 Btuh (15kw)	6 inches (152mm) for appliances <10,000 Btuh (3kw), 12 inches (305mm) for appliances > 10,000 Btuh (3kw) and <100,000 Btuh (30kw), 36 inches (.9m) for appliances > 100,000 Btuh (30kw)
K =	Clearance to mechanical air supply inlet	3 feet (.9m) above if within 10 feet (3m) horizontally	6 feet (1.8m)
L =	Clearance above paved sidewalk or paved driveway located on public property	* 7 feet (2.1m)	7 feet (2.1m)†
M =	Clearance under veranda, porch, deck or balcony	*12 inches (305mm)‡	12 inches (305mm)‡

[1] In accordance with the current ANSI Z223.1/NFPA 54 Natural Fuel Gas Code

[2] In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ Permitted only if veranda, porch, deck or balcony is fully open on a minimum of two sides beneath the floor. Lennox recommends avoiding this location if possible.

*For clearances not specified in ANSI Z223.1/NFPA 54 or CSA B149.1, clearance will be in accordance with local installation codes and the requirements of the gas supplier and these installation instructions.”

FIGURE 30

Details of Intake and Exhaust Piping Terminations for Direct Vent Installations

NOTE - In Direct Vent installations, combustion air is taken from outdoors and flue gases are discharged to outdoors.

NOTE - Flue gas may be slightly acidic and may adversely affect some building materials. If any vent termination is used and the flue gasses may impinge on the building material, a corrosion-resistant shield (minimum 24 inches square) should be used to protect the wall surface. If the optional tee is used, the protective shield is recommended. The shield should be constructed using wood, plastic, sheet metal or other suitable material. All seams, joints, cracks, etc. in the affected area should be sealed using an appropriate sealant. See FIGURE 34.

Intake and exhaust pipes may be routed either horizontally through an outside wall or vertically through the roof. In attic or closet installations, vertical termination through the roof is preferred. FIGURE 31 through FIGURE 39 show typical terminations.

1 - Vent terminations are not required to be in the same pressure zone. You may exit the intake on one side of the structure and the exhaust on another side (figure 32). You may exit the exhaust out the roof and the intake out the side of the structure (FIGURE 33).

2 - Intake and exhaust pipes should be placed as close together as possible at termination end (refer to illustrations). Maximum separation is 3" (76mm) on roof terminations and 6" (152mm) on side wall terminations.

NOTE - *When venting in different pressure zones, the maximum separation requirement of intake and exhaust pipe DOES NOT apply.*

3 - On roof terminations, the intake piping should terminate straight down using two 90° elbows (FIGURE 31).

4 - Exhaust piping must terminate straight out or up as shown. A reducer may be required on the exhaust piping at the point where it exits the structure to improve the velocity of exhaust away from the intake piping. See TABLE 15.

TABLE 15

EXHAUST PIPE TERMINATION SIZE REDUCTION

MODEL	Termination Pipe Size
*045 and 070	1-1/2" (38MM)
*090	2" (51MM)

*-045, -070 and -090 units with the flush mount termination must use the 1-1/2"accelerator supplied with the kit.

5 - On field-supplied terminations for side wall exit, exhaus piping may extend a maximum of 12 inches (305mm) for 2" PVC and 20 inches (508mm) for 3" (76mm) PVC beyond the outside wall. Intake piping should be as short as possible. See FIGURE 34.

NOTE - *Care must be taken to avoid recirculation of exhaust back into intake pipe.*

6 - On field supplied terminations, a minimum distance between the end of the exhaust pipe and the end of the intake pipe without a termination elbow is 8" and a minimum distance of 6" with a termination elbow. See FIGURE 34.

7 - If intake and exhaust piping must be run up a side wall to position above snow accumulation or other obstructions, piping must be supported. At least one bracket must be used within 6" from the top of the elbow and then every 24" (610mm) as shown in FIGURE 34, to prevent any movement in any direction. When exhaust and intake piping must be run up an outside wall, the exhaust piping must be terminated with pipe sized per TABLE 15.The intake piping may be equipped with a 90° elbow turndown. Using turndown will add 5 feet (1.5m) to the equivalent length of the pipe.

8 - A multiple furnace installation may use a group of up to four terminations assembled together horizontally, as shown in FIGURE 37.

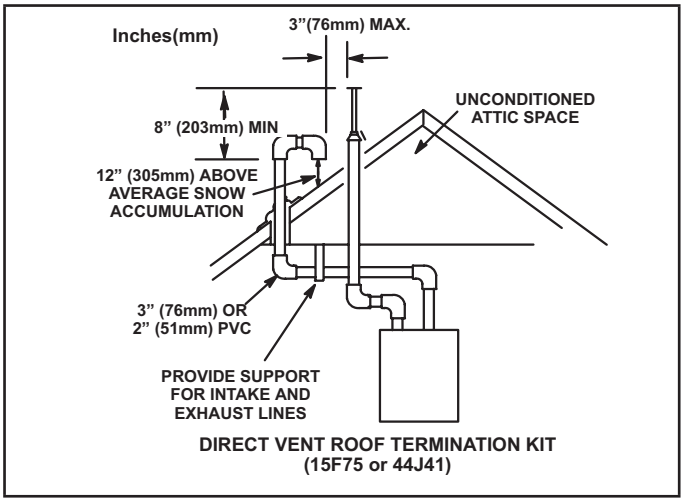


FIGURE 31

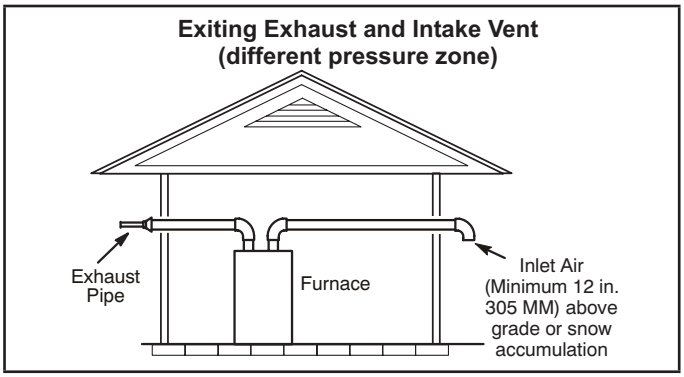


FIGURE 32

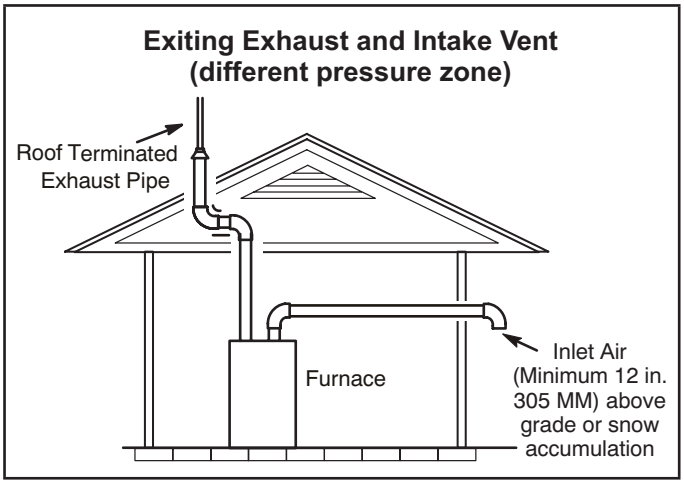
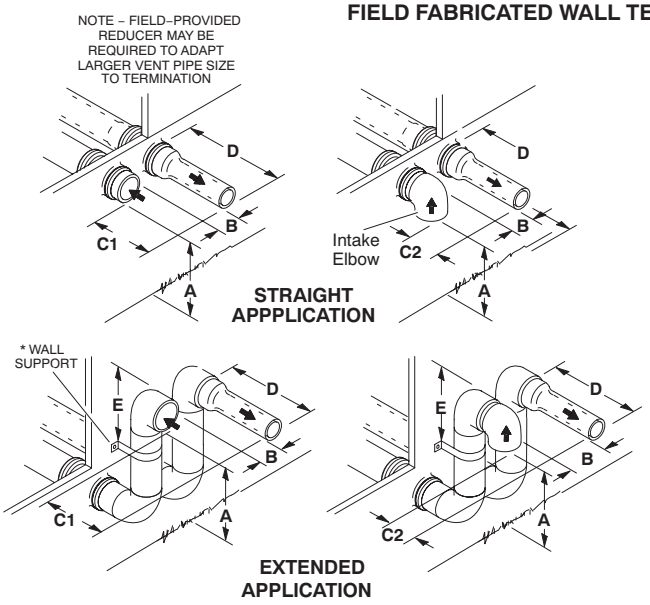


FIGURE 33

FIELD FABRICATED WALL TERMINATION



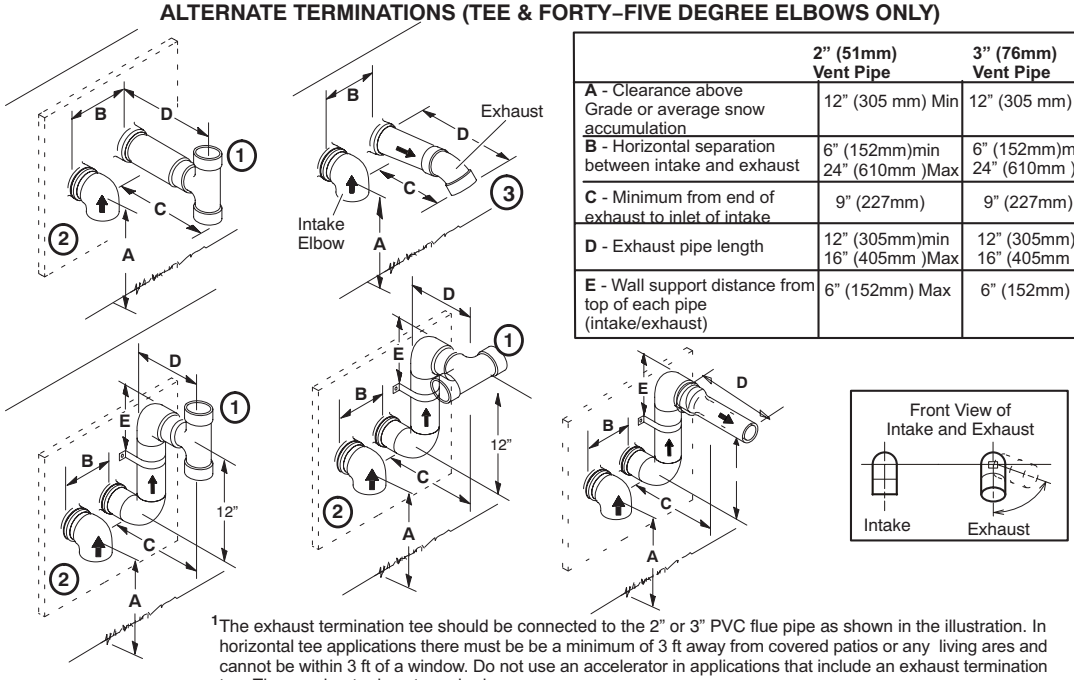
	2” (51mm) Vent Pipe	3” (76mm) Vent Pipe
A– Minimum clearance above grade or average snow accumulation	12” (305 mm)	12” (305 mm)
B– Maximum horizontal separation between intake and exhaust	6” (152 mm)	6” (152 mm)
C1 -Minimum from end of exhaust to inlet of intake	8” (203 mm)	8” (203 mm)
C2 -Minimum from end of exhaust to inlet of intake	6” (152 mm)	6” (152 mm)
D– Maximum exhaust pipe length	12” (305 mm)	20” (508 mm)
E– Maximum wall support distance from top of each pipe (intake/exhaust)	6” (152 mm)	6” (152 mm)

See maximum allowable venting tables for venting lengths with this arrangement.

***** Use wall support every 24” (610 mm). Use two wall supports if extension is greater than 24” (610 mm) but less than 48” (1219 mm).

NOTE – One wall support must be within 6” (152 mm) from top of each pipe (intake and exhaust) to prevent movement in any direction.

ALTERNATE TERMINATIONS (TEE & FORTY–FIVE DEGREE ELBOWS ONLY)



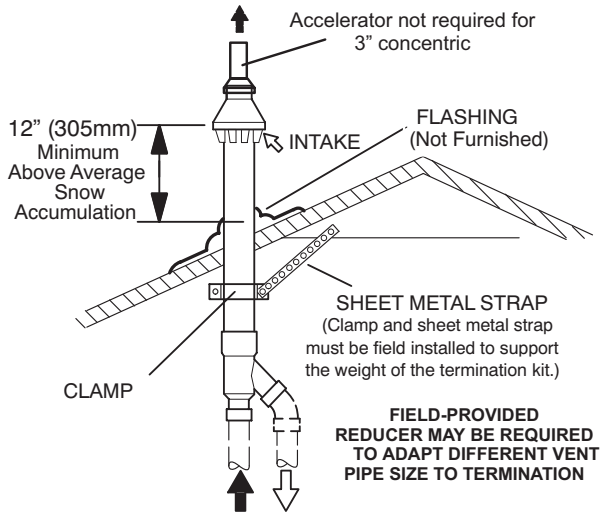
	2” (51mm) Vent Pipe	3” (76mm) Vent Pipe
A - Clearance above Grade or average snow accumulation	12” (305 mm) Min	12” (305 mm) Min
B - Horizontal separation between intake and exhaust	6” (152mm)min 24” (610mm)Max	6” (152mm)min 24” (610mm)Max
C - Minimum from end of exhaust to inlet of intake	9” (227mm)	9” (227mm)
D - Exhaust pipe length	12” (305mm)min 16” (405mm)Max	12” (305mm)min 16” (405mm)Max
E - Wall support distance from top of each pipe (intake/exhaust)	6” (152mm) Max	6” (152mm) Max

[1] The exhaust termination tee should be connected to the 2” or 3” PVC flue pipe as shown in the illustration. In horizontal tee applications there must be be a minimum of 3 ft away from covered patios or any living ares and cannot be within 3 ft of a window. Do not use an accelerator in applications that include an exhaust termination tee. The accelerator is not required.

[2] As required. Flue gas may be acidic and may adversely affect some building materials. If a side wall vent termination is used and flue gases will impinge on the building materials, a corrosion–resistant shield (24 inches square) should be used to protect the wall surface. If optional tee is used, the protective shield is recommended. The shield should be constructed using wood, sheet metal or other suitable material. All seams, joints, cracks, etc. in affected area, should be sealed using an appropriate sealant.

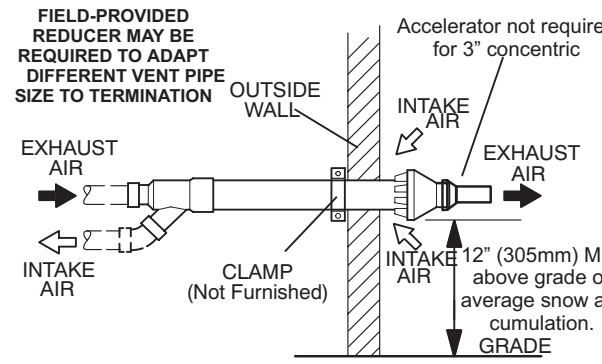
[3] Exhaust pipe 45° elbow can be rotated to the side away from the combustion air inlet to direct exhaust away from adjacent property. The exhaust must never be directed toward the combustion air inlet.

FIGURE 34



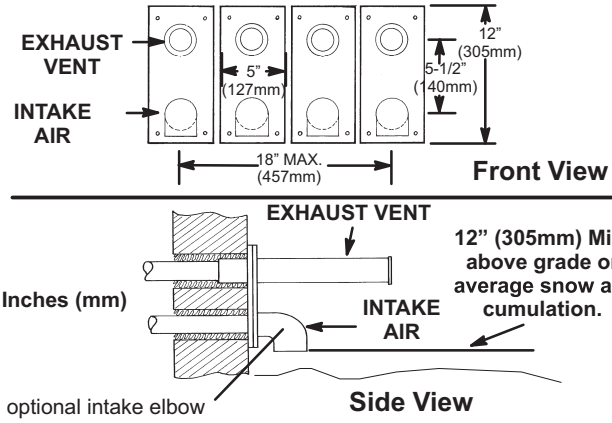
DIRECT VENT CONCENTRIC ROOFTOP TERMINATION
71M80, 69M29 or 60L46 (US)
44W92 or 44W93 (Canada)

FIGURE 35



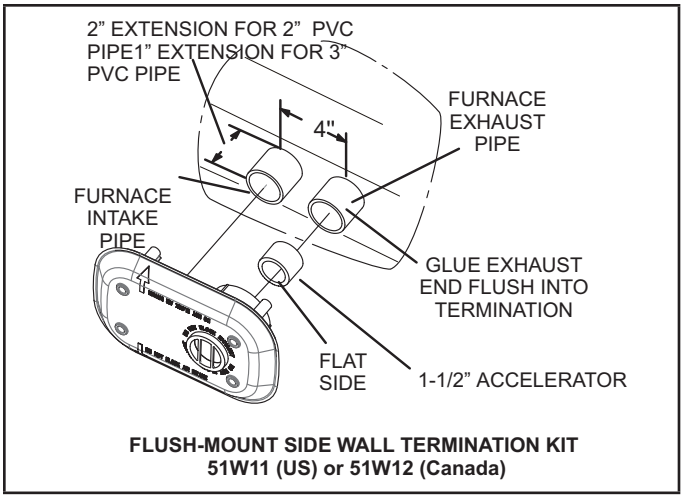
DIRECT VENT CONCENTRIC WALL TERMINATION
71M80, 69M29 or 60L46 (US)
44W92 or 44W93 (Canada)

FIGURE 36



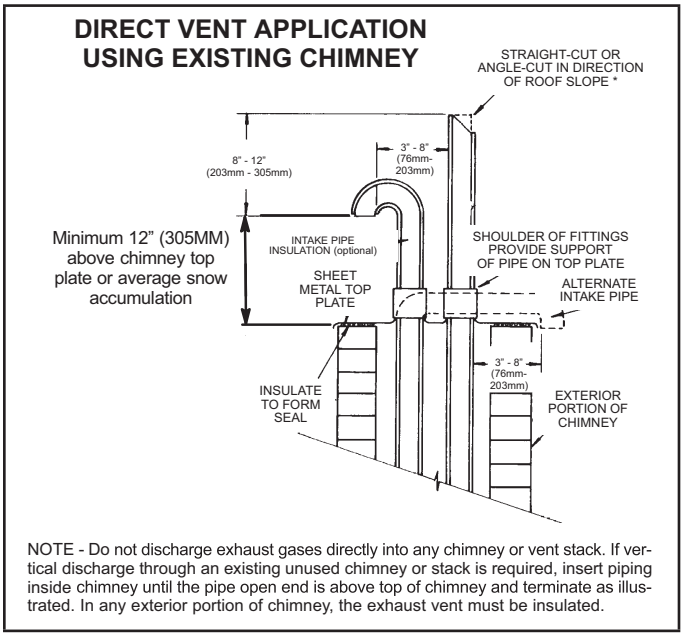
OPTIONAL VENT TERMINATION FOR MULTIPLE UNIT INSTALLATION OF DIRECT VENT WALL TERMINATION KIT
(30G28 or 81J20)

FIGURE 37



FLUSH-MOUNT SIDE WALL TERMINATION KIT
51W11 (US) or 51W12 (Canada)

FIGURE 38



NOTE - Do not discharge exhaust gases directly into any chimney or vent stack. If vertical discharge through an existing unused chimney or stack is required, insert piping inside chimney until the pipe open end is above top of chimney and terminate as illustrated. In any exterior portion of chimney, the exhaust vent must be insulated.

FIGURE 39

Details of Exhaust Piping Terminations for Non-Direct Vent Applications

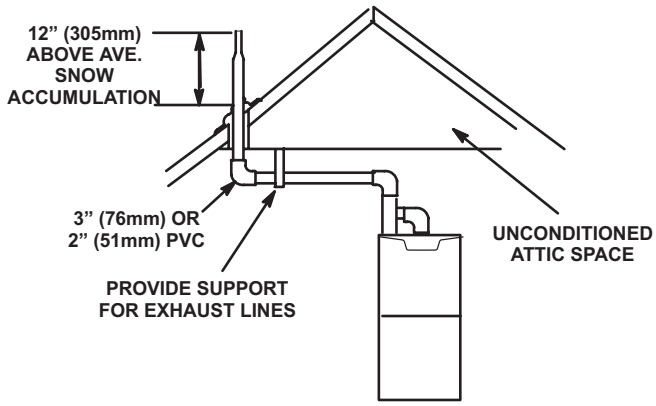
Exhaust pipes may be routed either horizontally through an outside wall or vertically through the roof. In attic or closet installations, vertical termination through the roof is preferred. FIGURE 40 and FIGURE 41 show typical terminations.

1 - Exhaust piping must terminate straight out or up as shown. The termination pipe must be sized as listed in table 15.The specified pipe size ensures proper velocity required to move the exhaust gases away from the building.

2 - On field supplied terminations for side wall exit, exhaust piping may extend a maximum of 12 inches (305mm) for 2” PVC and 20 inches (508mm) for 3” (76mm) PVC beyond the outside wall.

3 - If exhaust piping must be run up a side wall to position above snow accumulation or other obstructions, piping must be supported every 24 inches (610mm). When exhaust piping must be run up an outside wall, any reduction in exhaust pipe size must be done after the final elbow.

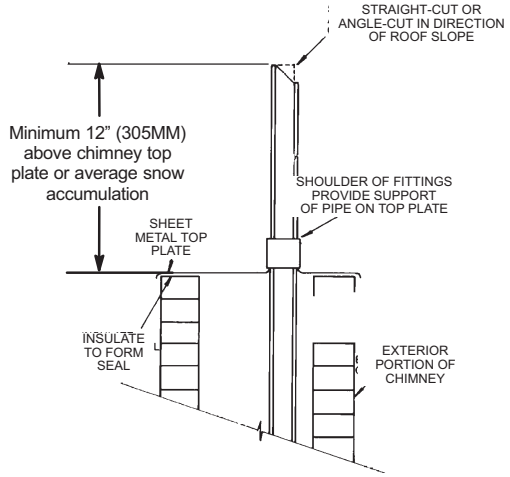
4 - Distance between exhaust pipe terminations on multiple furnaces must meet local codes.



NON-DIRECT VENT ROOF TERMINATION KIT (15F75 or 44J41)

FIGURE 40

NON-DIRECT VENT APPLICATION USING EXISTING CHIMNEY



NOTE - Do not discharge exhaust gases directly into any chimney or vent stack. If vertical discharge through an existing unused chimney or stack is required, insert piping inside chimney until the pipe open end is above top of chimney and terminate as illustrated. In any exterior portion of chimney, the exhaust vent must be insulated.

FIGURE 41

Condensate Piping

This unit is designed for either right- or left-side exit of condensate piping. Refer to FIGURE 42 and FIGURE 44 for condensate trap locations.

CONDENSATE TRAP AND PLUG LOCATIONS

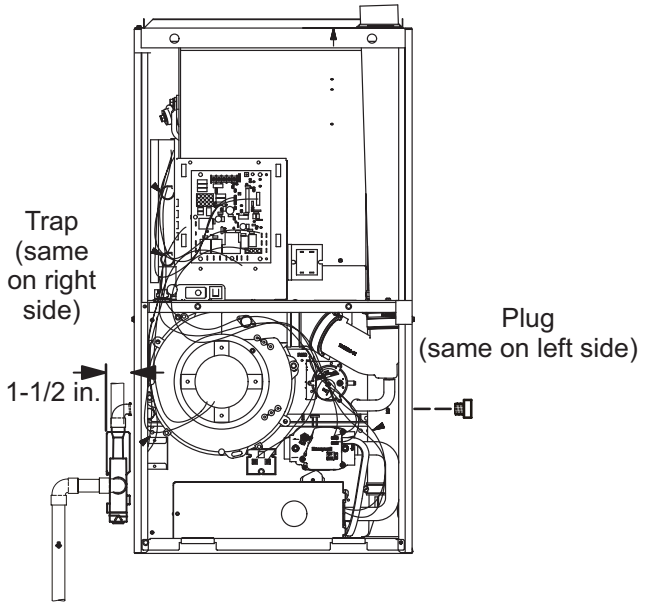


FIGURE 42

1 - Determine which side condensate piping will exit the unit, location of trap, field-provided fittings and length of PVC pipe required to reach available drain.

2 - For furnaces with a 1/2" drain connection use a 3/8 allen wrench and remove plug (FIGURE 42) from the cold end header box at the appropriate location on the side of the unit. Install field-provided 1/2 NPT male fitting into cold end header box. For furnaces with a 3/4" drain connection use a large flat head screw driver or a 1/2" drive socket extension and remove plug. Install provided 3/4 NPT street elbow fitting into cold end header box. Use Teflon tape or appropriate pipe dope.

3 - Install the cap over the clean out opening at the base of the trap. Secure with clamp. See FIGURE 47.

4 - Install drain trap using appropriate PVC fittings, glue all joints. Glue the provided drain trap as shown in FIGURE 47. Route the condensate line to an open drain.

5 - FIGURE 45 shows the furnace and evaporator coil using a separate drain. If necessary, the condensate line from the furnace and evaporator coil can drain together. See FIGURE 46. The field provided vent must be a minimum 1" to a maximum 2" length above the condensate drain outlet connection.

NOTE - *If necessary the condensate trap may be installed up to 5 feet away from the furnace. Piping from furnace must slope down a minimum of 1/4" per ft. toward trap.*

NOTE - *Appropriately sized tubing and barbed fitting may be used for condensate drain. Attach to the drain on the trap using a hose clamp. See FIGURE 43.*

Field Provided Drain Components

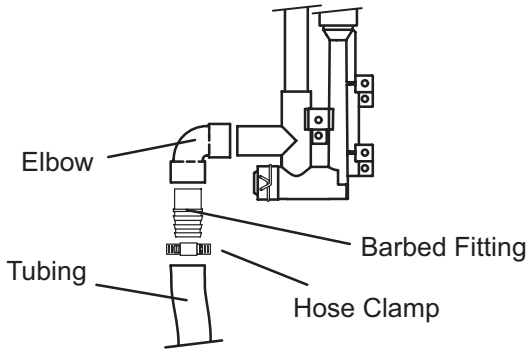


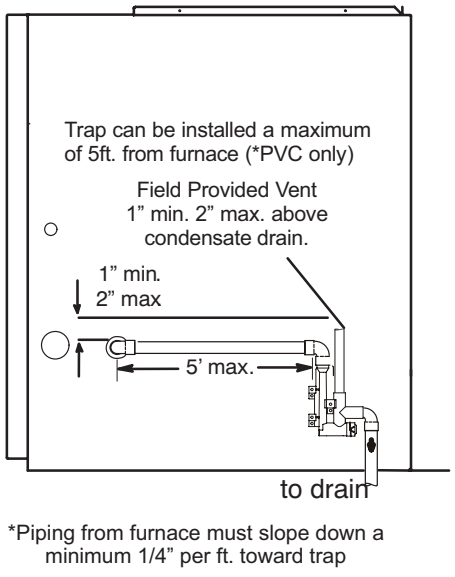
FIGURE 43

6 - If unit will be started immediately upon completion of installation, prime trap per procedure outlined in Unit

7 - Start-Up section.

Condensate line must slope downward away from the trap to drain. If drain level is above condensate trap, condensate pump must be used. Condensate drain line should be routed within the conditioned space to avoid freezing of condensate and blockage of drain line. If this is not possible, a heat cable kit may be used on the condensate trap and line. Heat cable kit is available from Lennox in various lengths; 6 ft. (1.8m) - kit no. 26K68; 24 ft. (7.3m) - kit no. 26K69; and 50 ft. (15.2m) - kit no. 26K70.

CONDENSATE TRAP LOCATION
(shown with right side exit of condensation)



*Piping from furnace must slope down a minimum 1/4” per ft. toward trap

FIGURE 44

Furnace with Evaporator Coil Using a Separate Drain

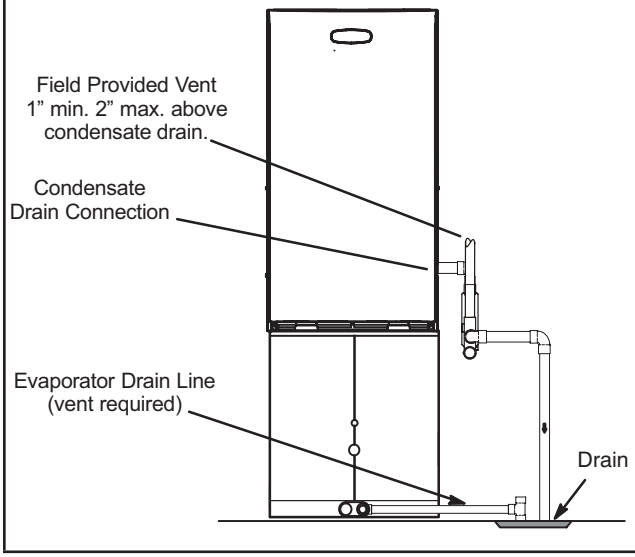


FIGURE 45

⚠ IMPORTANT

When combining the furnace and evaporator coil drains together, the A/C condensate drain outlet must be vented to relieve pressure in order for the furnace pressure switch to operate properly.

⚠ CAUTION

Do not use copper tubing or existing copper condensate lines for drain line.

Furnace with Evaporator Coil Using a Common Drain

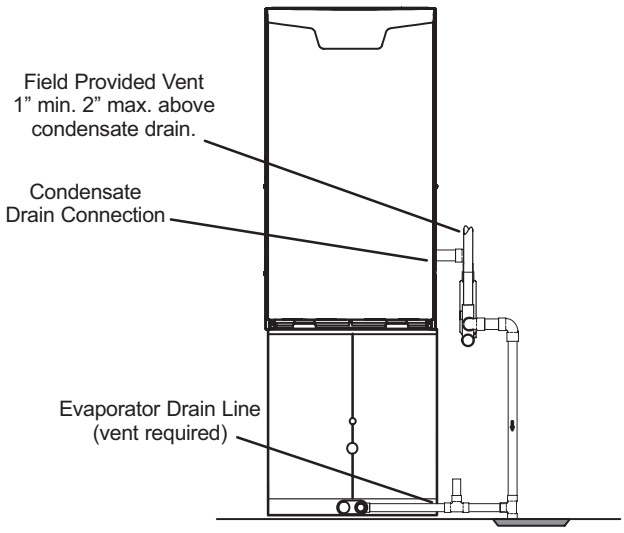


FIGURE 46

TRAP / DRAIN ASSEMBLY USING 1/2" PVC OR 3/4" PVC

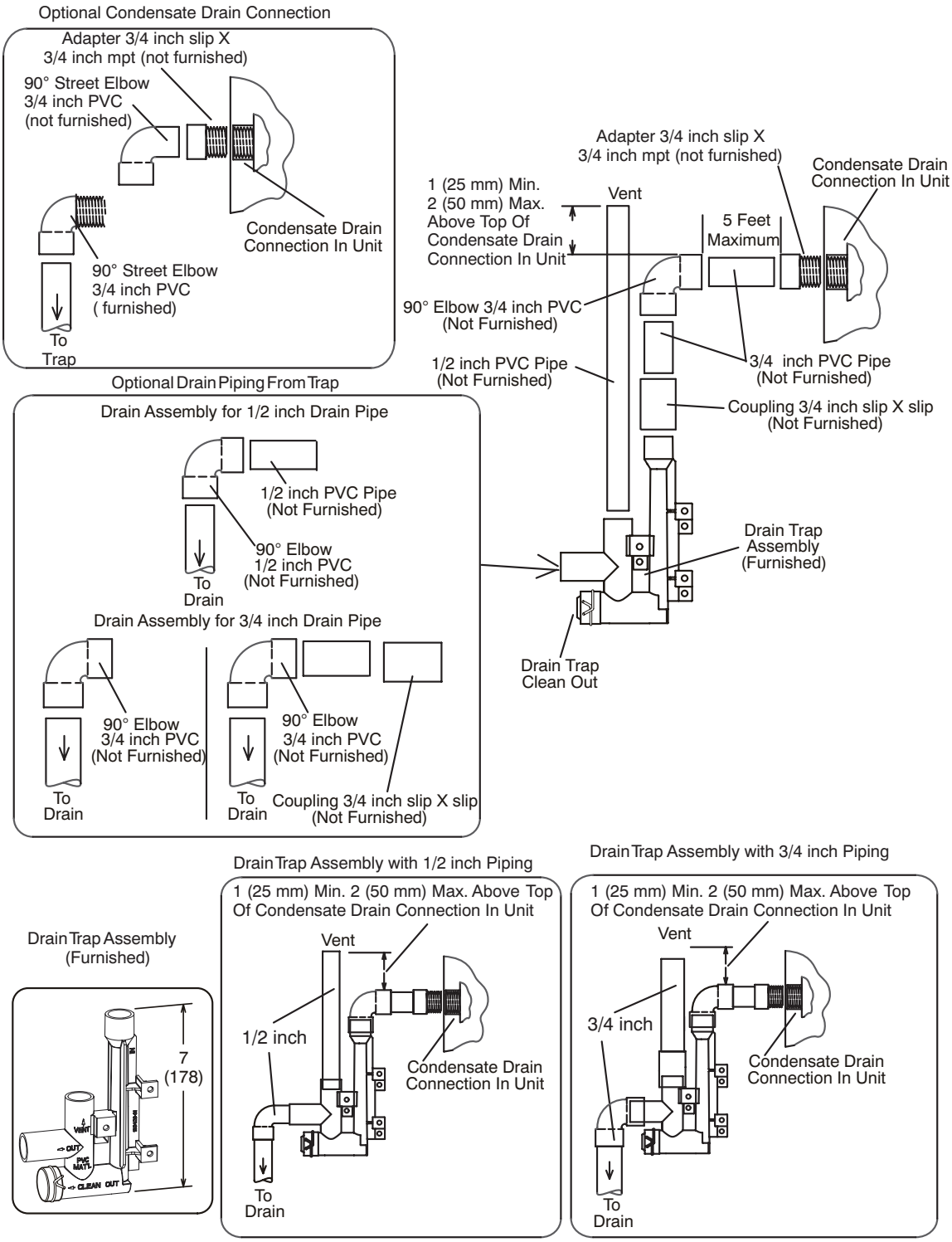


FIGURE 47

III-START-UP

A-Preliminary and Seasonal Checks

1 - Inspect electrical wiring, both field and factory installed for loose connections. Tighten as required.

2 - 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.

3 - Inspect condition of condensate traps and drain assembly. Disassemble and clean seasonally.

B-Heating Start-Up

BEFORE LIGHTING the unit, smell all around the furnace area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

The gas valve on the ML296DFV is equipped with a gas control switch. Use only your hand to move the switch. Never use tools. If the the switch will not move by hand, replace the valve. Do not try to repair it. Force or attempted repair may result in a fire or explosion.

Placing the furnace into operation:

ML296DFV units are equipped with a SureLight® ignition system. Do not attempt to manually light burners on this furnace. Each time the thermostat calls for heat, the burners will automatically light The ignitor does not get hot when there is no call for heat on units with SureLight ignition system.

Priming Condensate Trap

The condensate trap should be primed with water prior to start-up to ensure proper condensate drainage. Either pour 10 fl. oz. (300 ml) of water into the trap, or follow these steps to prime the trap:

1 - Follow the lighting instructions to place the unit into operation.

2 - Set the thermostat to initiate a heating demand.

3 - Allow the burners to fire for approximately 3 minutes.

4 - Adjust the thermostat to deactivate the heating demand.

5 - Wait for the combustion air inducer to stop. Set the thermostat to initiate a heating demand and again allow the burners to fire for approximately 3 minutes.

6 - Adjust the thermostat to deactivate the heating demand and again wait for the combustion air inducer to stop. At this point, the trap should be primed with sufficient water to ensure proper condensate drain operation.

⚠ WARNING

If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or death.

Gas Valve Operation (FIGURE 48)

1 - **STOP!** Read the safety information at the beginning of this section.

2 - Set the thermostat to the lowest setting.

3 - Turn off all electrical power to the unit.

4 - This furnace is equipped with an ignition device which automatically lights the burners. Do not try to light the burners by hand.

5 - Remove the upper access panel.

6 - Move gas valve switch to **OFF.** See FIGURE 48.

7 - Wait five minutes to clear out any gas. If you then smell gas, **STOP!** Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions. If you do not smell gas go to next step.

8 - Move gas valve switch to **ON.** See FIGURE 48.

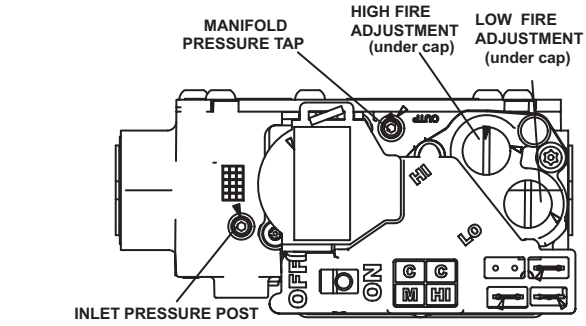


FIGURE 48

9 - Replace the upper access panel.

10 - Turn on all electrical power to to the unit.

11 - Set the thermostat to desired setting.

NOTE - *When unit is initially started, steps 1 through 11 may need to be repeated to purge air from gas line.*

12 - If the appliance will not operate, follow the instructions "Turning Off Gas to Unit" and call your service technician or gas supplier.

Turning Off Gas to Unit

1 - Set the thermostat to the lowest setting.

2 - Turn off all electrical power to the unit if service is to be performed.

3 - Remove the upper access panel.

4 - Move gas valve switch to OFF.

5 - Replace the upper access panel.

Failure To Operate

If the unit fails to operate, check the following:

1 - Is the thermostat calling for heat?

2 - Are access panels securely in place?

3 - Is the main disconnect switch closed?

4 - Is there a blown fuse or tripped breaker?

5 - Is the filter dirty or plugged? Dirty or plugged filters will cause the limit control to shut the unit off.

6 - Is gas turned on at the meter?

7 - Is the manual main shut-off valve open?

8 - Is the internal manual shut-off valve open?

9 - Is the unit ignition system in lockout? If the unit locks out again, inspect the unit for blockages.

IV-HEATING SYSTEM SERVICE CHECKS

A-CSA Certification

All units are CSA design certified without modifications. Refer to the ML296DFV(X) Installation Instruction.

B-Gas Piping

⚠ CAUTION

If a flexible gas connector is required or allowed by the authority that has jurisdiction, black iron pipe shall be installed at the gas valve and extend outside the furnace cabinet. The flexible connector can then be added between the black iron pipe and the gas supply line.

⚠ WARNING

Do not over torque (800 in-lbs) or under torque (350 in-lbs) when attaching the gas piping to the gas valve.

Gas supply piping should not allow more than 0.5”W.C. drop in pressure between gas meter and unit. Supply gas pipe must not be smaller than unit gas connection.

Compounds used on gas piping threaded joints should be resistant to action of liquefied petroleum gases.

C-Testing Gas Piping

⚠ IMPORTANT

In case emergency shutdown is required, turn off the main shut-off valve and disconnect the main power to unit. These controls should be properly labeled by the installer.

When pressure testing gas lines, the gas valve must be disconnected and isolated. Gas valves can be damaged if subjected to more than 0.5 psig (14” W.C.). See FIGURE 49. If the pressure is greater than 0.5psig (14”W.C.), use the manual shut-off valve before pressure testing to isolate furnace from gas supply.

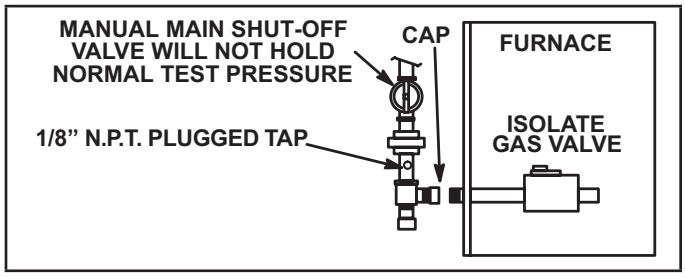


FIGURE 49

When checking piping connections for gas leaks, use preferred means. Kitchen detergents can cause harmful corrosion on various metals used in gas piping. Use of a specialty Gas Leak Detector is strongly recommended. It is available through Lennox under part number 31B2001. See Corp. 8411-L10, for further details.

Do not use matches, candles, flame or any other source of ignition to check for gas leaks.

D-Testing Gas Supply Pressure

An inlet pressure post located on the gas valve provides access to the supply pressure. See FIGURE 48. Back out the 3/32 hex screw one turn, connect a piece of 5/16 tubing and connect to a manometer to measure supply pressure. See TABLE 19 for supply line pressure.

E-Check Manifold Pressure

NOTE - *Pressure test adapter kit (10L34) is available from Lennox to facilitate manifold pressure measurement.*

A manifold pressure post located on the gas valve provides access to the manifold pressure. See FIGURE 48. Back out the 3/32 hex screw one turn, connect a piece of 5/16 tubing and connect to a manometer to measure manifold pressure. To correctly measure manifold pressure, the differential pressure between the positive gas manifold and the negative burner box must be considered.

⚠ IMPORTANT

For safety, connect a shut-off valve between the manometer and the gas tap to permit shut off of gas pressure to the manometer.

1 - Connect the test gauge positive side “+“ to manifold pressure tap on gas valve as noted above.

2 - Tee into the gas valve regulator vent hose and connect to test gauge negative “-”.

3 - Ignite unit on low fire and let run for 5 minutes to allow for steady state conditions.

4 - After allowing unit to stabilize for 5 minutes, record low fire manifold pressure and compare to value given in TABLE 19. If necessary, make adjustment. FIGURE 48 shows location of low fire adjustment screw.

5 - Repeat on high fire and compare to value given in TABLE 19. If necessary, make adjustment. FIGURE 48 shows location of high fire adjustment screw.

6 - Shut unit off and remove manometer as soon as an accurate reading has been obtained.

7 - Start unit and perform leak check. Seal leaks if found.

The gas valve is factory set and should not require adjustment. All gas valves are factory regulated.

F- Proper Gas Flow (Approximate)

Furnace should operate at least 5 minutes before checking gas flow. Determine time in seconds for two revolutions of gas through the meter. (Two revolutions assures a more accurate time.) **Divide by two** and compare to time in TABLE 16. If manifold pressure matches TABLE 19 and rate is incorrect, check gas orifices for proper size and restriction.

NOTE- *To obtain accurate reading, shut off all other gas appliances connected to meter.*

TABLE 16

GAS METER CLOCKING CHART				
ML296 Unit	Seconds for One Revolution			
	Natural		LP	
	1 cu ft Dial	2 cu ft Dial	1 cu ft Dial	2 cu ft Dial
-045	80	160	200	400
-070	55	110	136	272
-090	41	82	102	204
Natural-1000 btu/cu ft LP-2500 btu/cu ft				

⚠ IMPORTANT

For safety, shut unit off and remove manometer as soon as an accurate reading has been obtained. Take care to replace pressure tap plug.

G- Proper Combustion

Furnace should operate minimum 15 minutes with correct manifold pressure and gas flow rate before checking combustion. See sections E- and F-. Take combustion sample beyond the flue outlet. TABLE 17 shows acceptable combustions. **The maximum carbon monoxide reading should not exceed 100 ppm.**

TABLE 17

ML296 Model	CO_2% For Nat		CO_2% For L.P	
	Low Fire	High Fire	Low Fire	High Fire
045	5.6 - 6.6	7.8 - 8.8	6.6 - 7.6	9.1 - 10.1
070	5.5 - 6.5	7.3 - 8.3	6.5 - 7.5	8.6 - 9.6
090	5.9 - 6.9	7.8 - 8.8	6.9 - 7.9	9.1 - 10.1

H- High Altitude

The manifold pressure, gas orifice and pressure switch may require adjustment or replacement to ensure proper operation at higher altitudes. See TABLE 18 for gas conversion and pressure switch kits. See TABLE 19 for manifold pressures

TABLE 18

Conversion Kit and Pressure Switch Requirements at Varying Altitudes

Unit	Natural to LP/Propane	High Altitude Natural Burner Orifice Kit	High Altitude LP/ Propane Burner Orifice Kit	High Altitude Pressure Switch	
	0 - 7500 ft	7501 - 10,000 ft	7501 - 10,000 ft	4501 - 7500 ft	7501 - 10,000 ft
045	*11K51	73W37	*11K46	14A47	14A50
070				14A55	14A56
090				14A54	14A53

*** Conversion requires installation of a gas valve manifold spring which is provided with the gas conversion kit. Pressure switch is factory set. No adjustment necessary. All models use the factory-installed pressure switch from 0-4500 feet (0-1370 m).**

TABLE 19

Manifold and Supply Line Pressure 0-10,000ft.

Unit	Gas	Manifold Pressure in. wg.										Supply Line Pressure in. w.g 0 - 10,000 ft.	
		0 - 4500 ft		4501 - 5500 ft.		5501 - 6500 ft		6501 - 7500 ft		7501 - 10,000 ft			
		Low Fire	High Fire	Low Fire	High Fire	Low Fire	High Fire	Low Fire	High Fire	Low Fire	High Fire	Min	Max
All Sizes	Natural	1.7	3.5	1.6	3.3	1.5	3.2	1.5	3.1	1.7	3.5	4.5	13.0
	LP/ Propane	4.5	10.0	4.2	9.4	4.0	9.1	3.9	8.9	4.5	10.0	11.0	13.0

NOTE - A natural to L.P. propane gas changeover kit is necessary to convert this unit. Refer to the changeover kit installation instruction for the conversion procedure.

I- Proper Ground and Voltage

A poorly grounded furnace can contribute to premature ignitor failure. Use the following procedure to check for ground and voltage to the integrated control.

1 - Measure the AC voltage between Line Neutral (spade terminals) and “C” terminal (low voltage terminal block) on the integrated control. See FIGURE 50. A wide variation in the voltage between Line Neutral and “C” as a function of load indicates a poor or partial ground. Compare the readings to the table below. If the readings exceed the maximum shown in TABLE 20, make repairs before operating the furnace.

2 - In addition, measure the AC voltage from Line Hot to Line Neutral (spade terminals) on the integrated control. See FIGURE 50. This voltage should be in the range of 97 to 132 Vac.

TABLE 20

Furnace Status	Measurement VAC	
	Expected	Maximum
Power On Furnace Idle	0.3	2
CAI / Ignitor Energized	0.75	5
Indoor Blower Energized	Less than 2	10

CHECK VOLTAGE BETWEEN LINE NEUTRAL AND LOW VOLTAGE “C” TERMINAL

CHECK VOLTAGE BETWEEN LINE HOT AND LINE NEUTRAL

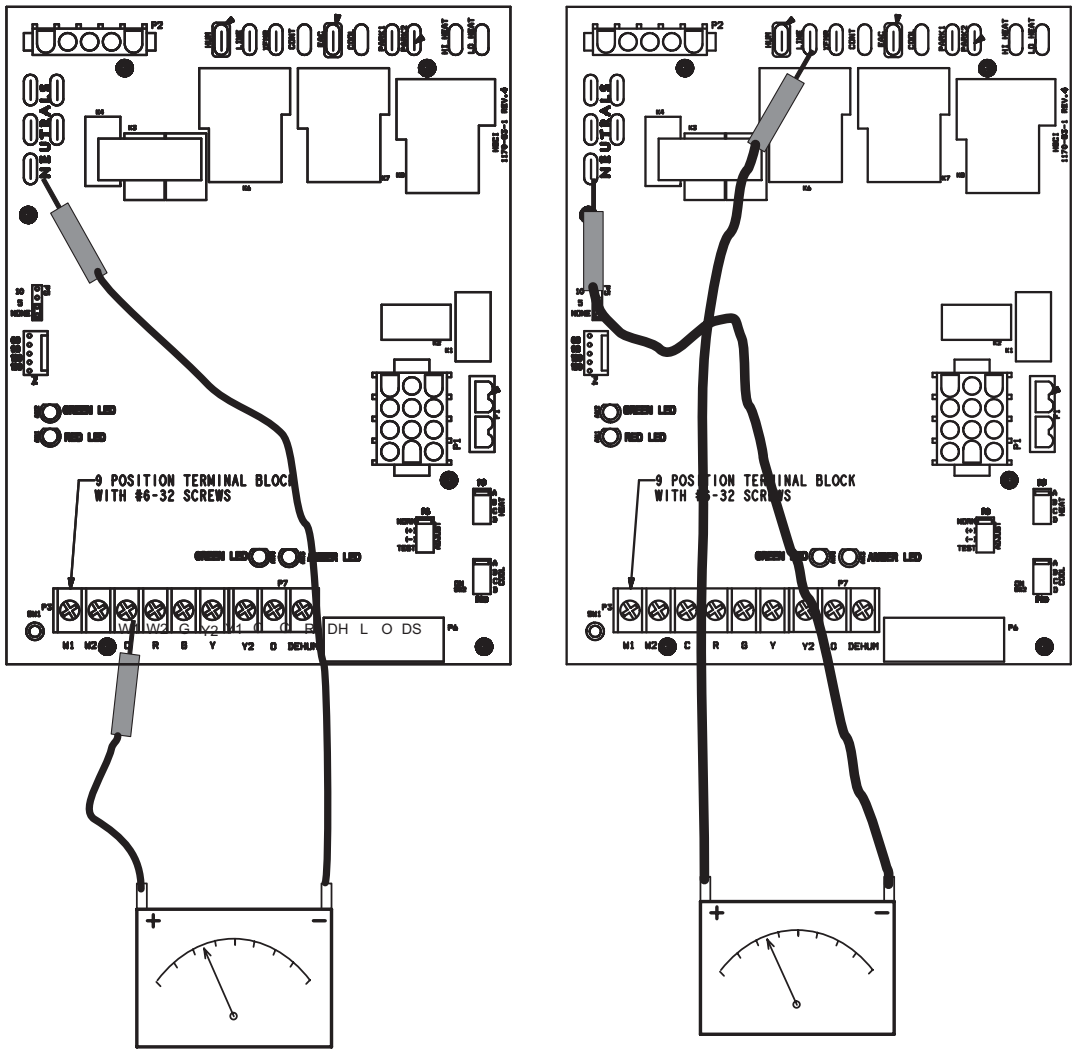


FIGURE 50

V-TYPICAL OPERATING CHARACTERISTICS

A-Blower Operation and Adjustment

1 - Blower operation is dependent on thermostat control system.

2 - Generally, blower operation is set at thermostat subbase fan switch. With fan switch in ON position, blower operates continuously. With fan switch in AUTO position, blower cycles with demand or runs continuously while heating or cooling circuit cycles.

3 - Depending on the type of indoor thermostat, blower and entire unit will be off when the system switch is in OFF position.

B-Temperature Rise (FIGURE 51)

Temperature rise for ML296DFV units depends on unit input, blower speed, blower horsepower and static pressure as marked on the unit rating plate. The blower speed must be set for unit operation within the range of “TEMP. RISE °F” listed on the unit rating plate.

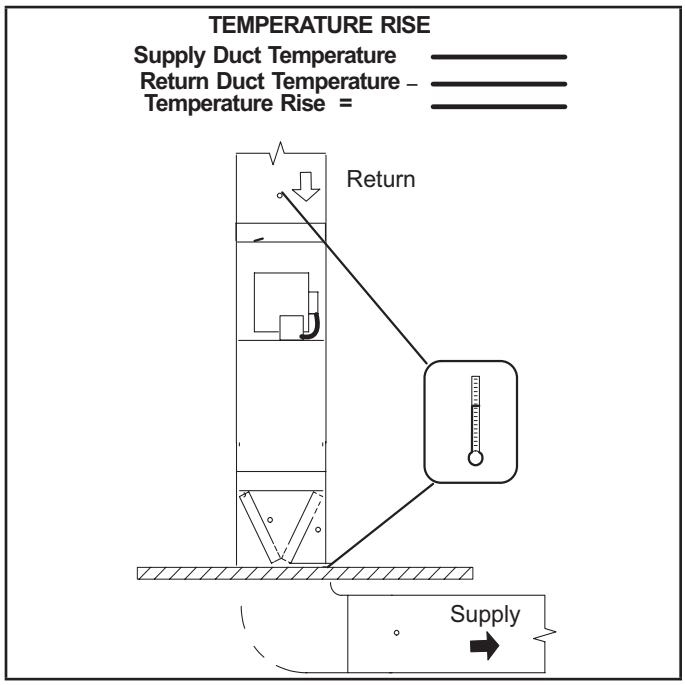


FIGURE 51

C-External Static Pressure

1 - Tap locations shown in FIGURE 52.

2 - Punch a 1/4” diameter hole in supply and return air plenums. Insert manometer hose flush with inside edge of hole or insulation. Seal around the hose with permagum. Connect the zero end of the manometer to the discharge (supply) side of the system. On ducted systems, connect the other end of manometer to the return duct as above.

3 - With only the blower motor running and the evaporator coil dry, observe the manometer reading. Adjust blower motor speed to deliver the air desired according to the job requirements. For heating speed (second stage heat speed) external static pressure drop must not be more than 0.8” W.C. For cooling speed (second stage cool speed) external static pressure drop must not be more than 1.0” W.C.

4 - Seal the hole when the check is complete.

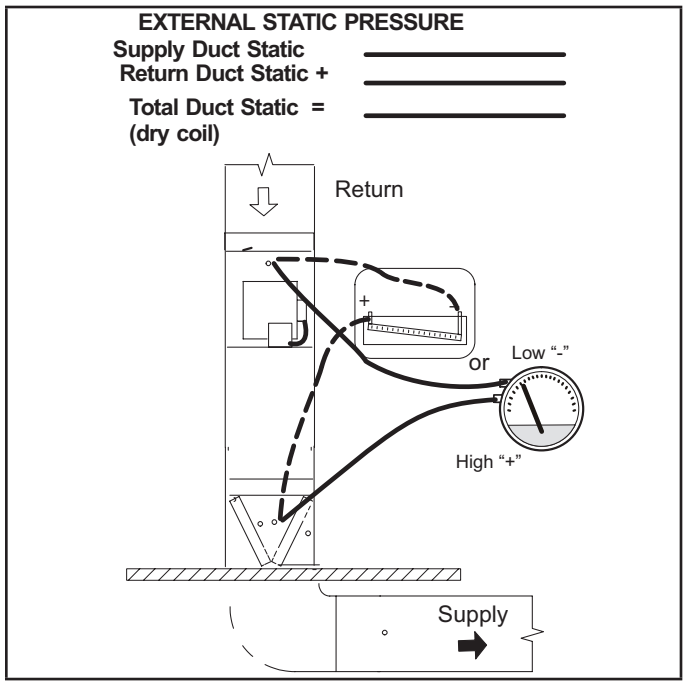


FIGURE 52

VI-MAINTENANCE

⚠ WARNING

ELECTRICAL SHOCK, FIRE,
OR EXPLOSION HAZARD.

Failure to follow safety warnings exactly could result in dangerous operation, serious injury, death or property damage.

Improper servicing could result in dangerous operation, serious injury, death, or property damage. Before servicing, disconnect all electrical power to furnace.

When servicing controls, label all wires prior to disconnecting. Take care to reconnect wires correctly. Verify proper operation after servicing.

At the beginning of each heating season, system should be checked as follows by a qualified service technician:

Blower

Check the blower wheel for debris and clean if necessary. The blower motors are prelubricated for extended bearing life. No further lubrication is needed.

⚠ WARNING

The blower access panel must be securely in place when the blower and burners are operating. Gas fumes, which could contain carbon monoxide, can be drawn into living space resulting in personal injury or death.

Filters

All air filters are installed external to the unit. Filters should be inspected monthly. Clean or replace the filters when necessary to ensure proper furnace operation. TABLE 21 lists recommended filter sizes.

⚠ IMPORTANT

If a highefficiency filter is being installed as part of this system to ensure better indoor air quality, the filter must be properly sized. Highefficiency filters have a higher static pressure drop than standardefficiency glass/foam filters. If the pressure drop is too great, system capacity and performance may be reduced.

The pressure drop may also cause the limit to trip more frequently during the winter and the indoor coil to freeze in the summer, resulting in an increase in the number of service calls.

Before using any filter with this system, check the specifications provided by the filter manufacturer against the data given in the appropriate Lennox Product Specifications bulletin. Additional information is provided in Service and Application Note ACC002 (August 2000).

TABLE 21

Cabinet Width in.	Filter Size in.
17-1/2	16 x 25 x 1 (1)
21	

Exhaust and air intake pipes

Check the exhaust and air intake pipes and all connections for tightness and to make sure there is no blockage.

NOTE - *After any heavy snow, ice or frozen fog event the furnace vent pipes may become restricted. Always check the vent system and remove any snow or ice that may be obstructing the plastic intake or exhaust pipes.*

Electrical

1 - Check all wiring for loose connections.
2 - Check for the correct voltage at the furnace (furnace operating).
3 - Check amp-draw on the blower motor.

Motor Nameplate_____Actual_____

Winterizing and Condensate Trap Care

1 - Turn off power to the furnace.
2 - Have a shallow pan ready to empty condensate water.
3 - Remove the clean out cap from the condensate trap and empty water. Inspect the trap then reinstall the clean out cap.

Condensate Hose Screen (FIGURE 53)

Check the condensate hose screen for blockage and clean if necessary.

1 - Turn off power to the unit.
2 - Remove hose from cold end header box. Twist and pull screen to remove.
3 - Inspect screen and rinse with tap water if needed.
4 - Reinstall screen and turn on power to unit.

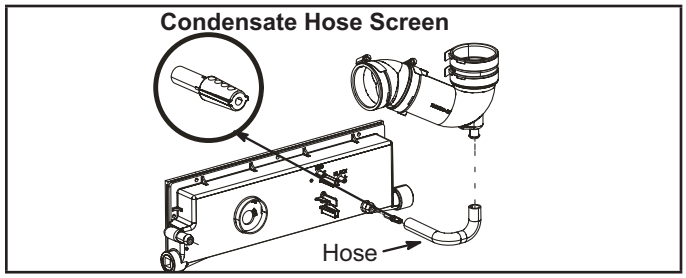


FIGURE 53

Cleaning Heat Exchanger

If cleaning the heat exchanger becomes necessary, follow the below procedures and refer to FIGURE 1 when disassembling unit. Use papers or protective covering in front of furnace while removing heat exchanger assembly.

1 - Turn off electrical and gas supplies to the furnace.
2 - Remove the furnace access panels.
3 - Disconnect the wires from the gas valve.
4 - Remove gas supply line connected to gas valve. Remove the burner box cover (if equipped) and remove gas valve/manifold assembly.
5 - Remove sensor wire from sensor. Disconnect 2-pin plug from the ignitor.
6 - Disconnect wires from flame roll-out switches.
7 - Loosen clamps at vent elbow. Disconnect condensate rain tubing from flue collar. and remove the vent elbow.
8 - Loosen clamps and remove combustion air intake flexible connector if equipped.
9 - Remove four burner box screws at the vestibule panel and remove burner box. Set burner box assembly aside.

NOTE - *If necessary, clean burners at this time. Follow procedures outlined in Burner Cleaning section.*

10 - Mark and disconnect all combustion air pressure tubing from cold end header collector box.
11 - Mark and remove wires from pressure switch assembly. Remove pressure switch assembly. Keep tubing attached to pressure switch assembly.
12 - Disconnect the plug from the combustion air inducer. Remove two screws which secure combustion air inducer to collector box. Remove combustion air inducer assembly. Remove ground wire from vest panel.
13 - Remove electrical junction box from the side of the furnace.

14 - Disconnect condensate line from cold end header box. Remove cold end header box.

15 - Loosen clamps on exhaust and air intake pipe seal plate. Slide exhaust and intake pipes up and out to clear blower deck. Remove exhaust and air intake pipe seal plate.

16 - Mark and disconnect any remaining wiring to heating compartment components. Disengage strain relief bushing and pull wiring and bushing through the hole in the blower deck.

17 - Remove the primary limit from the vestibule panel.

18 - Remove two screws from the front cabinet flange at the blower deck. Spread cabinet sides slightly to allow clearance for removal of heat exchanger.

19 - Remove screws along vestibule sides which secure vestibule panel and heat exchanger assembly to cabinet. Remove two screws from blower rail which secure top heat exchanger flange. Remove heat exchanger from furnace cabinet.

20 - Back wash heat exchanger with soapy water solution r steam. **If steam is used it must be below 275°F (135°C).**

21 - Thoroughly rinse and drain the heat exchanger. Soap solutions can be corrosive. Take care to rinse entire assembly.

22 - Reinstall heat exchanger into cabinet making sure that the clamshells of the heat exchanger assembly are engaged properly into the support bracket on the blower deck. Remove the indoor blower to view this area through the blower opening.

23 - Re-secure the supporting screws along the vestibule sides and top to the cabinet.

24 - Reinstall cabinet screws on front flange at blower deck.

25 - Reinstall the primary limit on the vestibule panel.

26 - Route heating component wiring through hole in blower deck and reinsert strain relief bushing.

27 - Reinstall electrical junction box.

28 - Reinstall exhaust and air intake pipe seal plate. Reinstall exhaust and air intake pipes and tighten clamps on pipe seal plate.

29 - Reinstall the cold end header box.

30 - Reinstall the combustion air inducer. Reconnect the combustion air inducer to the wire harness.

31 - Reinstall pressure switch assembly and reconnect pressure switch wiring.

32 - Carefully connect combustion air pressure switch tubing from pressure switches to proper ports on cold end header collector box.

33 - Reinstall condensate trap.

34 - Secure burner box assembly to vestibule panel using four existing screws. Make sure burners line up in center of burner ports.

35 - exhaust piping and exhaust drain tubing.

36 - Reconnect flame roll-out switch wires.

37 - Reconnect sensor wire and reconnect 2-pin plug from ignitor.

38 - Reinstall gas valve manifold assembly. Reconnect gas supply line to gas valve.

39 - Reinstall burner box cover if equipped.

40 - Reconnect plug to gas valve.

41 - Replace the blower compartment access panel.

42 - Follow lighting instructions on unit nameplate to light and operate furnace for 5 minutes to ensure the furnace is operating properly.

43 - Check all piping connections, factory and field, for gas leaks. Use a leak detecting solution or other preferred means.

⚠ CAUTION

Some soaps used for leak detection are corrosive to certain metals. Carefully rinse piping thoroughly after leak test has been completed. Do not use matches, candles, flame or other sources of ignitionto check for gas leaks.

44 - Replace access panel.

Cleaning the Burner Assembly (if needed)

1 - Turn off electrical and gas power supplies to furnace.

2 - Disconnect the 2-pin plug from the gas valve.

3 - Remove the burner box cover (if equipped).

4 - Disconnect the gas supply line from the gas valve. Remove gas valve/manifold assembly.

5 - Loosen clamps and remove combustion air intake flexible connector (if equipped).

6 - Mark and disconnect sensor wire from the sensor. Disconnect plug from the ignitor at the burner box.

7 - Remove four screws which secure burner box assembly to vest panel. Remove burner box from the unit.

8 - Use the soft brush attachment on a vacuum cleaner to gently clean the face of the burners. Visually inspect the inside of the burners and crossovers for any blockage caused by foreign matter. Remove any blockage.

9 - Reinstall the burner box assembly using the existing four screws. Make sure that the burners line up in the center of the burner ports.

10 - Reconnect the sensor wire and reconnect the 2-pin plug to the ignitor wiring harness.

11 - Reinstall combustion air intake flexible connector (if equipped), secure using existing clamps.

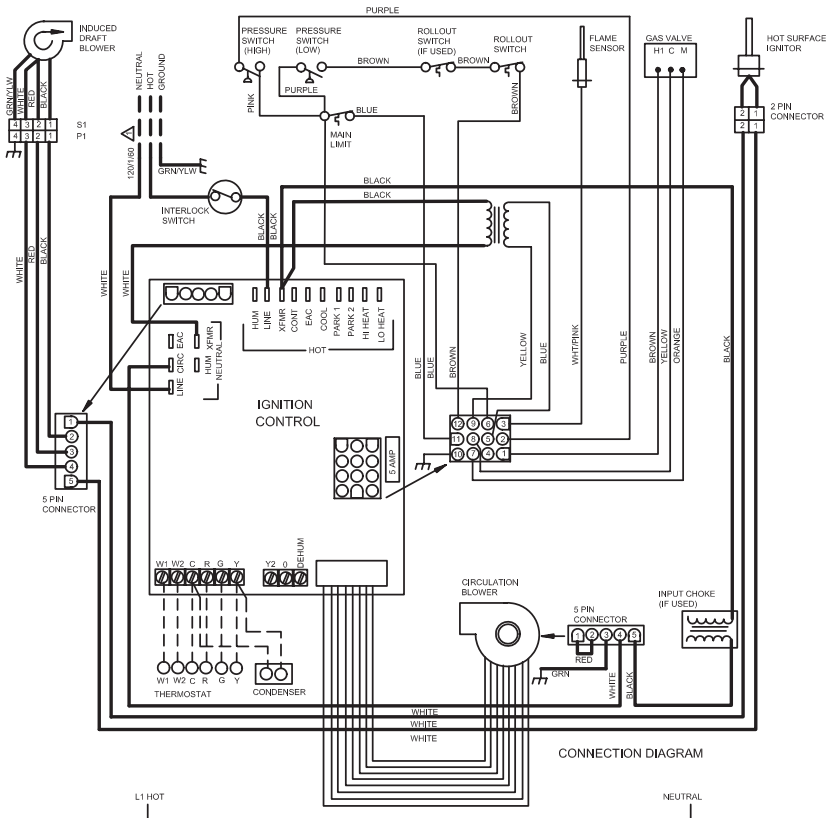
12 - Reinstall the gas valve manifold assembly. Reconnect the gas supply line to the gas valve. Reinstall the burner box cover.

13 - 1Reconnect plug to gas valve.

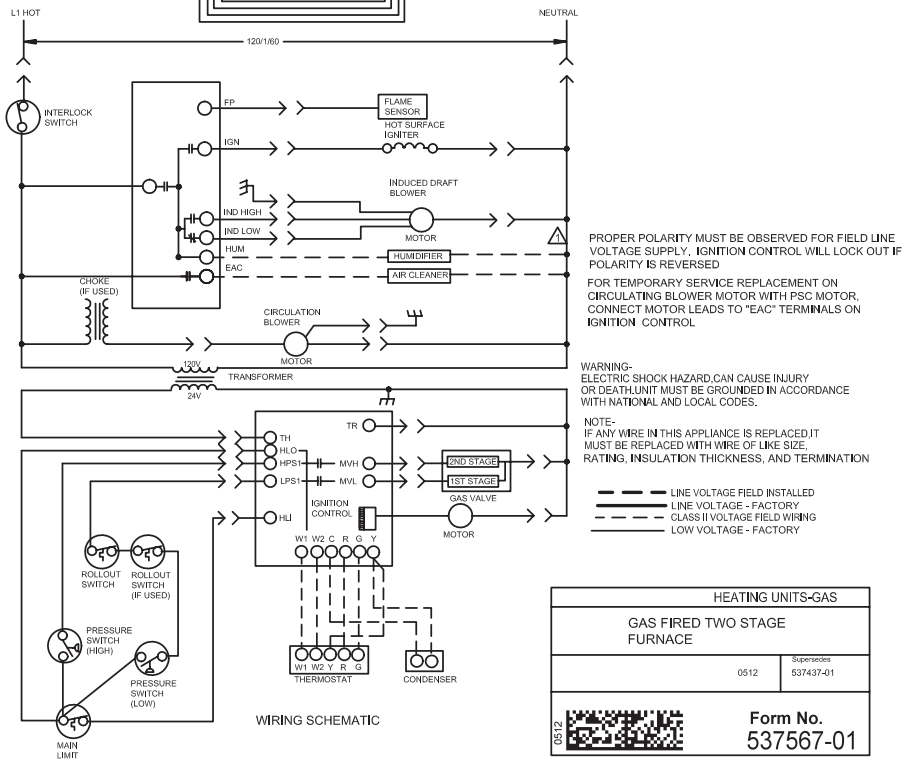
14 - Replace the blower compartment access panel.

15 - Refer to instruction on verifying gas and electrical connections when re-establishing supplies.

16 - Follow lighting instructions to light and operate furnace for 5 minutes to ensure that heat exchanger is clean and dry and that furnace is operating properly. Replace access panel.



CONNECTION DIAGRAM



WIRING SCHEMATIC

PROPER POLARITY MUST BE OBSERVED FOR FIELD LINE VOLTAGE SUPPLY, IGNITION CONTROL WILL LOCK OUT IF POLARITY IS REVERSED

FOR TEMPORARY SERVICE REPLACEMENT ON CIRCULATING BLOWER MOTOR WITH PSC MOTOR, CONNECT MOTOR LEADS TO "EAC" TERMINALS ON IGNITION CONTROL

WARNING-
ELECTRIC SHOCK HAZARD.CAN CAUSE INJURY OR DEATH.UNIT MUST BE GROUNDED IN ACCORDANCE WITH NATIONAL AND LOCAL CODES.

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

LINE VOLTAGE FIELD INSTALLED
LINE VOLTAGE - FACTORY
CLASS II VOLTAGE FIELD WIRING
LOW VOLTAGE - FACTORY

HEATING UNITS-GAS

GAS FIRED TWO STAGE FURNACE

0512 | Supersedes 537437-01

0512

Form No. 537567-01

Sequence of Operation

On a call for heat from the room thermostat, the control board performs a 1 second self check. Upon confirmation that the pressure switch contacts are in an open position, the control energizes the combustion blower on high speed. The control then checks for adequate combustion air by making sure the low-fire pressure switch contacts are closed.

The igniter energizes and is allowed to warm up for 20 seconds before the gas valve energizes on 1st stage and burners ignite. 30 seconds after ignition the circulating blower is energized. 45 seconds after the control confirms ignition has occurred, the control drops the combustion blower to low speed.

Tthe circulating blower ramps up to 50% of 1st stage heat speed and operates at that speed for one minute (including ramp up time), then at 75% of 1st stage heat speed for an additional minute. After that, the circulating blower operates at full 1st stage heat speed until either the heat call is satisfied or the thermostat initiates a call for 2nd stage heat. On a call for 2nd stage heat, the control energizes the circulating air blower on full CFM 2nd stage heat.

If the automatic heat staging option is being used the furnace does not switch to 2nd stage heat in response to a call from the thermostat but instead operates at 1st stage heat for the duration of the selected time before automatically switching to 2nd stage heat.

When the call for heat is satisfied, the gas valve and combustion air blower shut down. The control board shuts off the gas valve and runs the combustion blower for an additional 15 seconds. The circulating air blower continues to run for 2 minutes at 82% of the selected heating speed (low fire or high fire) before ramping down.

In the event the unit loses ignition, the control will attempt to recycle up to five times before it goes into a 1 hour lockout. Lockout may be manually reset by removing power from the control for more than 1 second or removing the thermostat call for heat for more than 3 seconds.

If during a heating cycle the limit control senses an abnormally high temperature and opens, the control board deenergizes the gas valve and the combustion blower while the circulating blower ramps up to 2nd stage heat speed. The circulating blower remains energized until the limits are closed.

Fan On

When the thermostat is set for continuous fan operation and there is no demand for heating or cooling, a call for fan closes the R to G circuit energizing the the circulating blower. For -55 units the motor runs at 50% of the selected cooling CFM and for -56 units the motor runs at 38% of the selected cooling CFM, until switched off. When the call for fan is turned off, the control de-energizes the circulating blower.

Cooling

The unit is set up at the factory for single stage cooling. For two stage cooling operation, clip the jumper wire located between the Y to Y2 terminals on the integrated ignition/ blower control board. If the active dehumidification feature is enabled, the circulating blower runs at 70% of the selected cooling speed as long as there is a call for dehumidification.

⚠ IMPORTANT

The system must NOT be in either the passive or active dehumidification mode when charging a cooling system.

Single Stage Cooling

A call for cooling from the thermostat closes the R to Y circuit on the integrated ignition/blower control board. The control waits for a 1-second delay before energizing the circulating blower to 82% of the selected cooling CFM (passive dehumidification mode). After 7.5 minutes, the circulating blower automatically ramps up to 100% of the selected cooling airflow. When the call for cooling is satisfied, the circulating blower ramps back down to 82% of the selected cooling airflow for 1 minute, then shuts off.

Two-Stage Cooling

A call for 1st stage cooling from the thermostat closes the R to Y circuit on the control board. The control waits for a 1- second delay before energizing the circulating blower. The blower motor runs at 57% of the selected air flow for the first 7.5 minutes of the 1st stage cooling demand (passive dehumidification mode). After 7.5 minutes, the blower motor runs at 70% of the selected cooling air flow until 1st stage cooling demand is satisfied.

A call for 2nd stage cooling from the thermostat closes the R to Y2 circuit on the control board. The blower motor ramps up to 100% of the selected cooling air flow. When the demand for cooling is met, the blower ramps down to Y1 until satisfied, then ramps down to 57% for 1 minute, then turns off.

Heat Pump

For heat pump operation, clip the jumper wire located bellow the O terminal on the integrated ignition/blower control board. In heat pump mode, a call for heat will result in the circulating air blower operating at the selected cooling airflow after a brief ramp-up period.