

**ML193DF SERIES UNITS**

ML193DF series units are high-efficiency gas furnaces manufactured with Lennox DuralokPlus™ aluminized steel clamshell-type heat exchangers, with a stainless steel condensing coil. ML193DF units are available in heating input capacities of 44,000 to 110,000 Btuh (13 to 32.2 kW) and cooling applications from 2 through 5 tons (7.0 through 17.6 kW). Refer to Engineering Handbook for proper sizing.

Units are factory equipped for use with natural gas. A kit is available for conversion to LPG operation. All ML193DF units are equipped with a hot surface ignition system. The gas valve is redundant to assure safety shut-off as required by C.S.A.

The heat exchanger, burners and manifold assembly can be removed for inspection and service. The maintenance section gives a detailed description on how this is done.

All specifications are subject to change. Procedures outlined in this manual are presented as a recommendation only and do not supersede or replace local or state codes.



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

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<b>⚠ WARNING</b>	
<b>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 installer (or equivalent), service agency or the gas supplier.</b>	

<b>⚠ WARNING</b>	
<b>Sharp edges. Be careful when servicing unit to avoid sharp edges which may result in personal injury.</b>	

## SPECIFICATIONS

		Model No.	ML193DF045P36B	ML193DF070P36B	ML193DF090P48C	ML193DF110P60C
<b>Gas Heating Performance</b>		<sup>1</sup> AFUE	93%	93%	93%	93%
		Input - Btuh	44,000	66,000	88,000	110,000
		Output - Btuh	41,000	61,000	82,000	102,000
		Temperature rise range - °F	25 - 55	50 - 80	40 - 70	50 - 80
		Gas Manifold Pressure (in. w.g.) Nat. Gas / LPG/Propane	3.5 / 10.0	3.5 / 10.0	3.5 / 10.0	3.5 / 10.0
		High static - in. w.g.	0.50	0.50	0.50	0.50
	<b>Connections in.</b>		Intake / Exhaust Pipe (PVC)	2 / 2	2 / 2	2 / 2
		Gas pipe size IPS	1/2	1/2	1/2	1/2
		Condensate Drain Trap (PVC pipe) - i.d.	1/2	1/2	1/2	1/2
		with field supplied (PVC coupling) - o.d.	3/4	3/4	3/4	3/4
<b>Indoor Blower</b>		Wheel nom. dia. x width - in.	10 x 8	10 x 8	10 x 10	11 ½ x 10
		Motor output - hp	1/3	1/3	1/2	1
		Tons of add-on cooling	2.5 - 3	2.5 - 3	3 - 4	4 - 5
		Air Volume Range - cfm	605 - 1615	560 - 1550	920 - 2145	1210 - 2410
<b>Electrical Data</b>		Voltage	120 volts - 60 hertz - 1 phase			
		Blower motor full load amps	6.1	6.1	8.2	11.5
		Maximum overcurrent protection	15	15	15	15
<b>Shipping Data</b>		lbs. - 1 package	124	129	147	162

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

<sup>1</sup> 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 - MUST BE ORDERED EXTRA**

			"B" Width Models	"C" Width Models
<b>CABINET ACCESSORIES</b>				
<b>Downflow Combustible Flooring Base</b>			<b>11M60</b>	<b>11M61</b>
<b>CONDENSATE DRAIN KITS</b>				
<b>Condensate Drain Heat Cable</b>	6 ft.		<b>26K68</b>	<b>26K68</b>
	24 ft.		<b>26K69</b>	<b>26K69</b>
	50 ft.		<b>26K70</b>	<b>26K70</b>
<b>Heat Cable Tape</b>	Fiberglass - 1/2 in. x 66 ft.		<b>36G53</b>	<b>36G53</b>
	Aluminum foil - 2 in. x 60 ft.		<b>16P89</b>	<b>16P89</b>
<b>Crawl Space Vent Drain Kit</b>			<b>51W18</b>	<b>51W18</b>
<b>CONTROLS</b>				
<b>Twinning Kit</b>			<b>65W80</b>	<b>65W80</b>
<b>DOWNFLOW FILTER KITS</b>				
<b>Downflow Air Filter and Rack Kit</b>			<b>51W07</b>	<b>51W08</b>
			No. and Size of filter - in.	(2) 20 x 20 x 1
<b>NIGHT SERVICE KITS</b>				
<b>Night Service Kit</b>			<b>51W03</b>	<b>51W03</b>
<b>TERMINATION KITS</b>				
See Installation Instructions for specific venting information.				
<b>Termination Kits - Direct Vent Applications Only</b>	Concentric	US - 2 in.	<b>71M80</b>	<b>69M29</b>
		3 in.	---	<b>60L46</b>
	Canada	- 2 in.	<b>44W92</b>	<b>44W92</b>
		3 in.	---	<b>44W93</b>
	Flush-Mount	2, 2-1/2 or 3 in.	<b>51W11</b>	<b>51W11</b>
	Wall - Close Couple	US - 2 in.	<b>22G44</b>	---
		3 in.	<b>44J40</b>	<b>44J40</b>
	Wall - Close Couple WTK	Canada - 2 in.	<b>30G28</b>	---
3 in.		<b>81J20</b>	<b>81J20</b>	
<b>Termination Kits - Direct or Non-Direct vent</b>	Roof	2 in.	<b>15F75</b>	<b>15F75</b>
	Wall Ring Kit	2 in.	<b>15F74</b>	<sup>3</sup> <b>15F74</b>
<b>Roof Termination Flashing Kit - Direct or Non-Direct Vent - Contains two flashings</b>			<b>44J41</b>	<b>44J41</b>

<sup>1</sup> Cleanable polyurethane frame type filter.

<sup>2</sup> Kits contain enough parts for two, non-direct vent installations.

<sup>3</sup> Non-direct vent only.

NOTE - Termination Kits **44W92**, **44W93**, **30G28**, **81J20** are certified to ULC S636 standard for use in Canada only.

**GAS HEAT ACCESSORIES**

Input	High Altitude Pressure Switch Kit		Natural Gas to LPG/Propane Kit	LPG/Propane to Natural Gas Kit	Natural Gas High Altitude Orifice Kit
	4501 - 7500 ft.	7501 - 10,000 ft.	0 - 7500 ft.	0 - 7500 ft.	7501- 10,000 ft.
all models	<b>74W90</b>	<b>74W91</b>	<b>69W73</b>	<b>73W81</b>	<b>73W37</b>

**BLOWER DATA**

**ML193DF045P36B PERFORMANCE (Less Filter)**

External Static Pressure in. w.g.	Air Volume / Watts at Various Blower Speeds							
	High		Medium-High		Medium-Low		Low	
	cfm	Watts	cfm	Watts	cfm	Watts	cfm	Watts
0.00	1615	650	1385	555	1205	465	1045	390
0.10	1605	640	1375	545	1195	455	1035	380
0.20	1500	620	1340	525	1165	445	1015	370
0.30	1450	590	1290	490	1125	420	975	365
0.40	1350	560	1235	480	1090	405	920	345
0.50	1300	545	1170	450	1035	380	875	335
0.60	1195	500	1095	425	990	365	840	320
0.70	1140	485	1020	400	895	345	780	300
0.80	1025	450	920	370	840	330	695	275
0.90	945	435	800	335	700	295	605	250

**ML193DF090P48C PERFORMANCE (Less Filter)**

External Static Pressure in. w.g.	Air Volume / Watts at Various Blower Speeds							
	High		Medium-High		Medium-Low		Low	
	cfm	Watts	cfm	Watts	cfm	Watts	cfm	Watts
0.00	2145	900	1865	740	1545	635	1295	530
0.10	2135	890	1855	730	1540	625	1290	520
0.20	2065	845	1815	710	1525	600	1285	500
0.30	2010	825	1760	685	1510	580	1275	485
0.40	1930	775	1705	630	1495	575	1235	455
0.50	1845	740	1645	610	1450	530	1215	450
0.60	1745	700	1525	550	1380	505	1185	430
0.70	1620	650	1460	535	1315	480	1110	405
0.80	1450	585	1340	505	1220	445	1020	375
0.90	1320	555	1130	450	1010	385	920	345

**ML193DF070P36B PERFORMANCE (Less Filter)**

External Static Pressure in. w.g.	Air Volume / Watts at Various Blower Speeds							
	High		Medium-High		Medium-Low		Low	
	cfm	Watts	cfm	Watts	cfm	Watts	cfm	Watts
0.00	1505	660	1310	570	1090	455	940	390
0.10	1480	625	1295	550	1070	435	935	365
0.20	1405	585	1255	515	1055	425	930	350
0.30	1355	580	1225	475	1045	405	900	330
0.40	1305	540	1165	470	1010	385	890	325
0.50	1270	525	1110	425	975	370	835	305
0.60	1175	500	1080	415	925	345	815	290
0.70	1105	460	1000	395	855	320	745	270
0.80	1040	440	925	365	790	300	670	250
0.90	920	400	825	335	680	270	560	225

**ML193DF110P60C PERFORMANCE (Less Filter)**

External Static Pressure in. w.g.	Air Volume / Watts at Various Blower Speeds							
	High		Medium-High		Medium-Low		Low	
	cfm	Watts	cfm	Watts	cfm	Watts	cfm	Watts
0.00	2410	1390	2190	1080	1860	910	1560	735
0.10	2405	1385	2180	1070	1855	905	1555	730
0.20	2285	1345	2120	1030	1850	865	1540	720
0.30	2220	1315	2015	1005	1770	840	1535	705
0.40	2185	1295	1950	955	1750	815	1530	685
0.50	2045	1240	1830	925	1680	790	1500	660
0.60	1965	1220	1710	890	1575	755	1445	640
0.70	1820	1165	1610	850	1495	720	1370	615
0.80	1625	1155	1510	820	1400	695	1315	595
0.90	1455	1110	1390	790	1350	660	1210	565

# PARTS ARRANGEMENT

CONTROL BOX  
(Includes integrated control,  
transformer and door switch)

BAG ASSEMBLY

BLOWER MOTOR  
(hidden)

BLOWER  
ACCESS  
PANEL

INTAKE  
EXHAUST

COMBUSTION  
AIR INDUCER

BLOWER DECK

BURNER  
ACCESS  
PANEL

PRIMARY LIMIT

HEAT EXCHANGER

GAS VALVE

COLD END HEADER BOX

BURNER BOX ASSEMBLY  
(includes sensor, rollout switches and ignitor)

FIGURE 1

## I-UNIT COMPONENTS

ML193DF unit components are shown in figure 1. The combustion air inducer, gas valve and burners can be accessed by removing the burner access panel. The blower and control box can be accessed by removing the blower access door.

### A-Control Box Components (Figure 2)

Unit transformer (T1) and integrated ignition control (A92) are located in the control box. In addition, a door interlock switch (S51) is located in the control box.

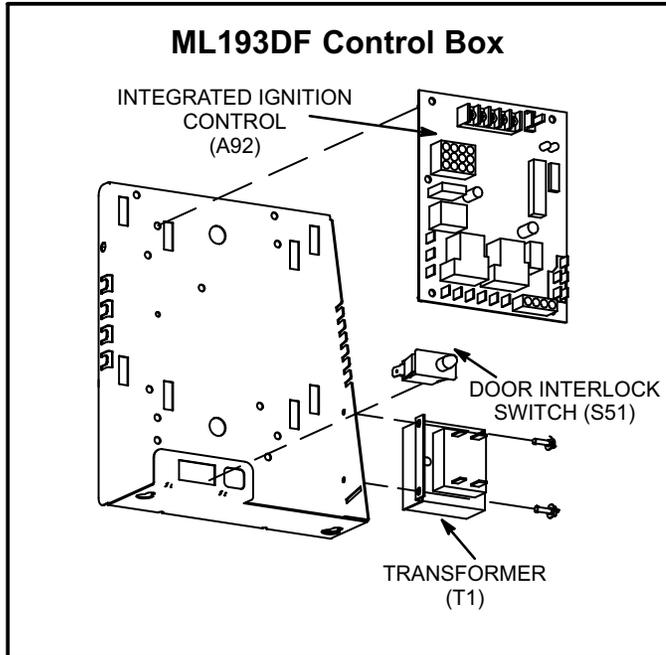


FIGURE 2

#### 1. Transformer (T1)

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

#### 2. Door Interlock Switch (S51)

A door interlock switch rated 14A at 120VAC is located on the control box. The switch is wired in series with line voltage. When the blower door is removed the unit will shut down.

#### 3. Integrated Ignition Control (A92)

 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.

## ⚠ WARNING

**Shock hazard.**

**Disconnect power before servicing. 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.**

The ignition control system consists of an integrated control (figure 4) ignitor (figure 6) and sensor (figure 6). The integrated control and ignitor work in combination to ensure furnace ignition and ignitor durability. The integrated control, controls all major furnace operations. The integrated control also features two LED lights (DS1 red and DS2 green) for troubleshooting and two accessory terminals rated at (1) one amp. The integrated control also features a (3) amp fuse for overcurrent protection. Tables 1 and 2 show jack plug terminal designations. See table 3 for troubleshooting diagnostic codes. The mini-nitride ignitor is made from a non-porous, high strength proprietary ceramic material that provides long life and trouble free maintenance. The integrated control continuously monitors line voltage and maintains the ignitor power at a consistent level to provide proper lighting and maximum ignitor life.

TABLE 1

4-Pin Terminal Designation	
PIN #	FUNCTION
1	Combustion Air Inducer Line
2	Ignitor Line
3	Combustion Air Inducer Neutral
4	Ignitor Neutral

TABLE 2

12-Pin Terminal Designations	
PIN #	FUNCTION
1	High Limit Output
2	Not Used
3	24V Line
4	Not Used
5	Rollout Switch Out
6	24V Neutral
7	High Limit Input
8	Ground
9	Gas Valve Common
10	Pressure Switch In
11	Rollout Switch In
12	Gas Valve Out

### Electronic Ignition (See Figure 5)

On a call for heat the integrated control monitors the combustion air inducer prove switch. The integrated control will not begin the heating cycle if the prove switch is closed (bypassed). Once the prove switch is determined to be open, the combustion air inducer is energized. When the differential in the prove switch is great enough, the prove switch closes and a 15-second pre-purge begins. If the prove switch is not proven within 2-1/2 minutes, the integrated control goes into Watchguard-Pressure Switch mode for a 5-minute re-set period.

After the 15-second pre-purge period, the ignitor warms up for 20 seconds during which the gas valve opens at 19 seconds for a 4-second trial for ignition. The ignitor remains energized for the first 3 seconds during the 4 second trial. If ignition is not proved during the 4-second period, the integrated control will try four more times with an inter purge and warm-up time between trials of 35 seconds. After a total of five trials for ignition (including the initial trial), the integrated control goes into Watchguard-Flame Failure mode. After a 60-minute reset period, the integrated control will begin the ignition sequence again.

The integrated control has an added feature of ignitor power regulation to maintain consistent lighting and longer ignitor life under all line voltage conditions.

### Fan Control

The fan on time of 30 seconds is not adjustable. The fan off delay (amount of time that the blower operates after the heat demand has been satisfied) may be adjusted by changing the jumper position across the five pins on the integrated control. The unit is shipped with a factory fan off setting of 90 seconds. The fan off delay affects comfort and is adjustable to satisfy individual applications. Adjust the fan off delay to achieve a supply air temperature between 90° and 110°F at the moment that the blower is de-energized. Longer off delay settings provide lower return air temperatures; shorter settings provide higher return air temperatures. See figure 3.

JUMPER POSITION		HEAT OFF DELAY
PIN1	PIN2	60
PIN2	PIN3	90
PIN3	PIN4	120
PIN4	PIN5	180
NO JUMPER		180

To adjust fan-off timing, reposition jumper across pins to achieve desired setting.

FIGURE 3

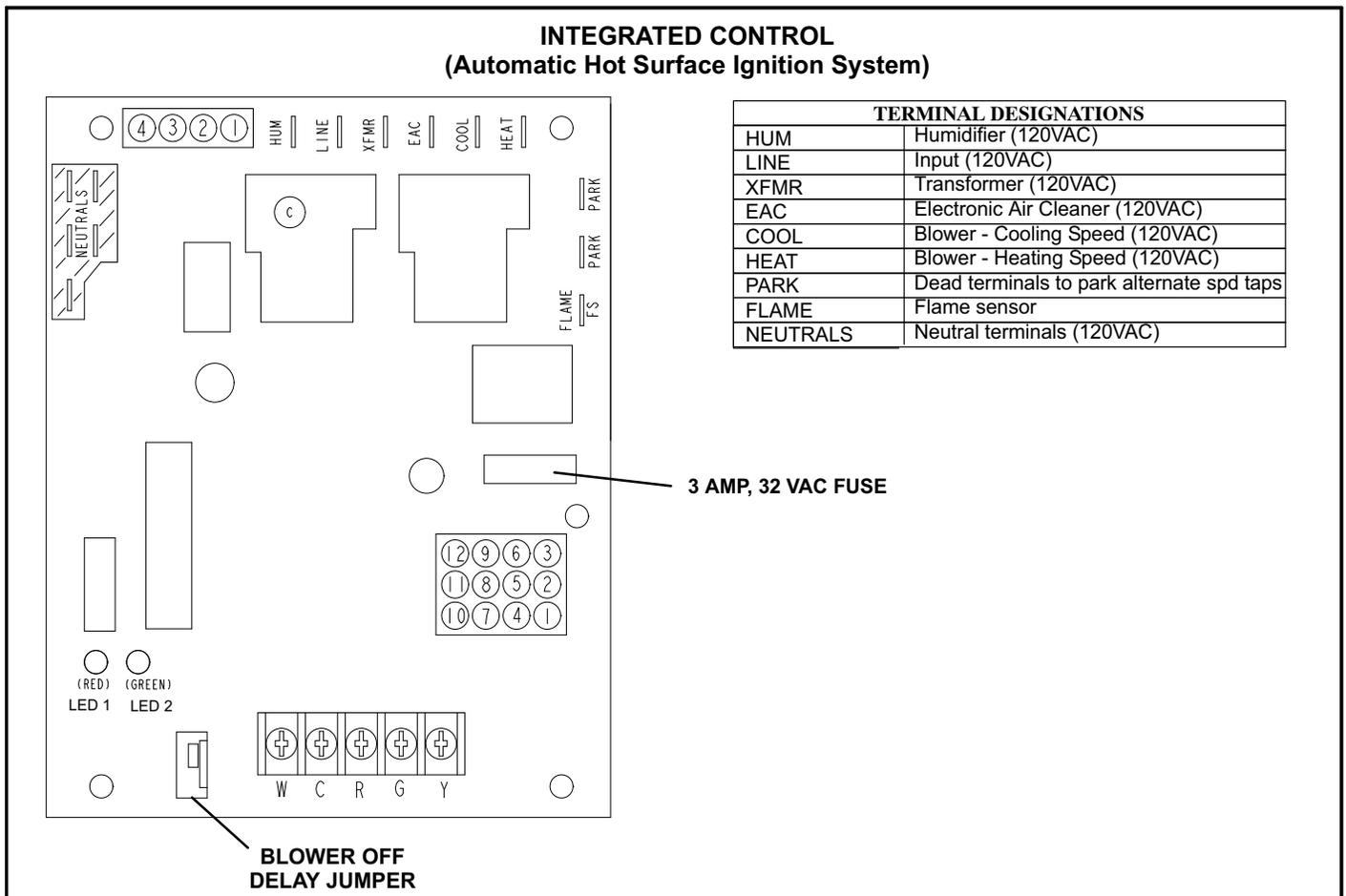


FIGURE 4

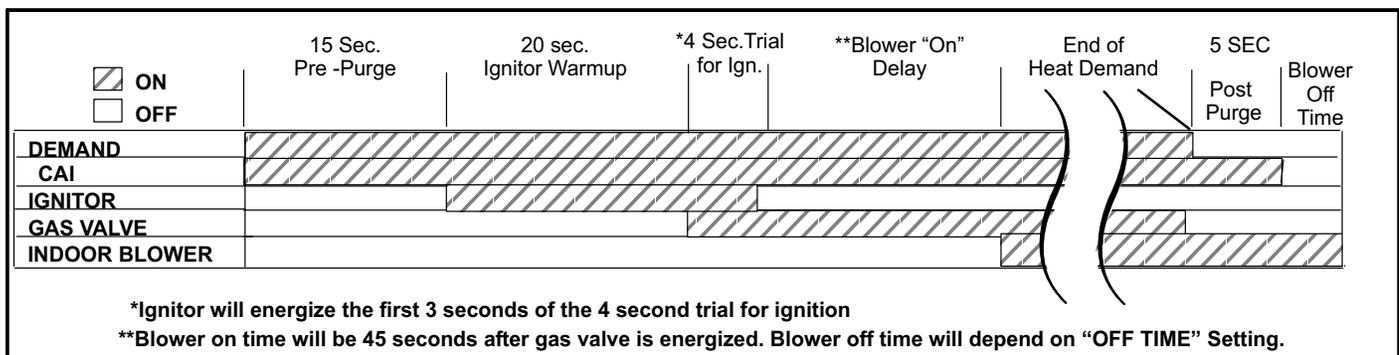
The integrated control is equipped with two LED lights for troubleshooting. The diagnostic codes are listed below in table 3.

**TABLE 3**  
**DIAGNOSTIC CODES**

Make sure to Identify LED'S Correctly.

LED #1 (Red)	LED #2 (Green)	DESCRIPTION
SIMULTANEOUS SLOW FLASH	SIMULTANEOUS SLOW FLASH	Power on - Normal operation. Also signaled during cooling and continuous fan.
SIMULTANEOUS FAST FLASH	SIMULTANEOUS FAST FLASH	Normal operation - signaled when heating demand initiated at thermostat.
SLOW FLASH	ON	Primary or secondary limit switch open. Limit must close within 3 minutes or unit goes into 1 hour Watchguard.
OFF	SLOW FLASH	Pressure prove switch open. OR: Blocked inlet/exhaust vent; OR: Pressure switch closed prior to activation of combustion air inducer.
ALTERNATING SLOW FLASH	ALTERNATING SLOW FLASH	Watchguard 1 hour -- burners failed to ignite or lost flame 5 times during single heating demand.
SLOW FLASH	OFF	Flame sensed without gas valve energized.
ON	SLOW FLASH	Rollout switch open. OR: 12-pin connector improperly attached.
ON ON OFF	ON OFF ON	Circuit board failure or control wired incorrectly.
FAST FLASH	SLOW FLASH	Main power polarity reversed. Switch line and neutral.
SLOW FLASH	FAST FLASH	Low flame signal. Measures below 1.5 microamps. Replace flame sense rod.
ALTERNATING FAST FLASH	ALTERNATING FAST FLASH	Improper main ground. OR: Line voltage below 90 volts.

**NOTE** - Slow flash rate equals 1 Hz (one flash per second). Fast flash rate equals 3 Hz (three flashes per second). Minimum flame sense current = 0.5 microAmps.



**FIGURE 5**

## B-Heating Components

Combustion air inducer (B6), primary limit control (S10), SureLight ignitor, burners, flame rollout switch (S47), gas valve (GV1), combustion air prove switch (S18), and clam-shell heat exchangers are located in the heating compartment. The heating compartment can be accessed by removing the burner access panel.

### 1. Ignitor (Figure 6)

ML193DF units use a mini-nitride ignitor made from a proprietary ceramic material. Ignitor longevity is enhanced by controlling the voltage to the ignitor. Due to this feature of the board, voltage cannot be measured. To check ignitor, measure its resistance. A value of 25 to 47 ohms indicates a good ignitor.

### 2. Flame Sensor (Figure 6)

A flame sensor is located on the left side of the burner support. The sensor is mounted on the bottom burner box plate and the 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 ignition control allows the gas valve to remain open as long as flame signal is sensed.

*NOTE - The ML193DF furnace contains electronic components that are polarity sensitive. Make sure that the furnace is wired correctly and is properly grounded.*

### 3. Flame Rollout Switches (Figure 6)

Flame rollout switches S47 are SPST N.C. high temperature limits located on the top left and bottom right of the front burner box plate. S47 is wired to the burner ignition control A92. When either of the switches sense flame rollout (indicating a blockage in the combustion passages), the flame rollout switch trips, and the ignition control immediately closes the gas valve. Switch S47 in all ML193DF units is factory preset to open at  $250^{\circ}\text{F} \pm 12^{\circ}\text{F}$  ( $121^{\circ}\text{C} \pm 6.7^{\circ}\text{C}$ ) on a temperature rise. All flame rollout switches are manual reset.

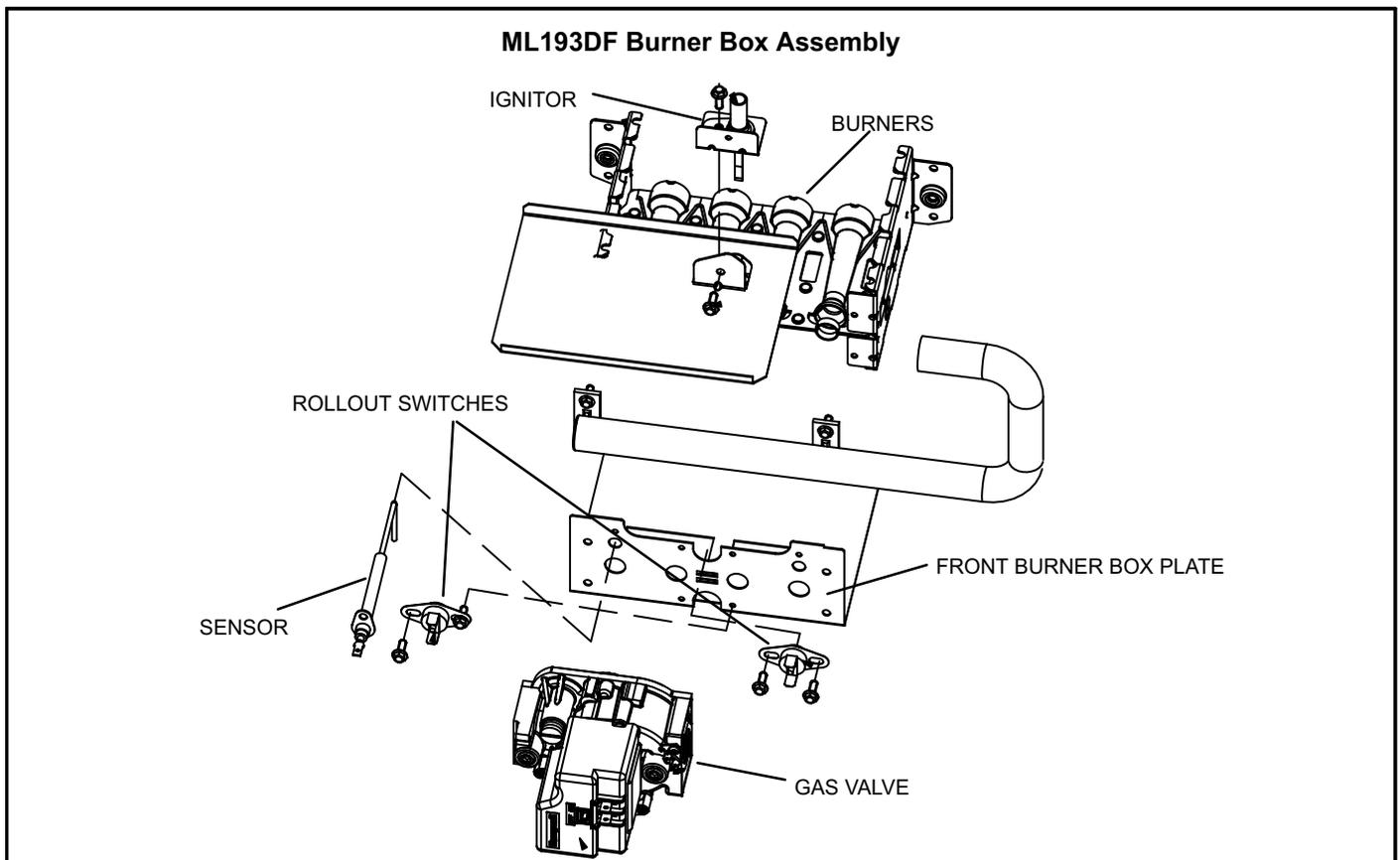


FIGURE 6

#### 4. Primary Limit Control (Figure 7)

Primary limit (S10) used on ML193DF units is located in the heating vestibule panel. When excess heat is sensed in the heat exchanger, the limit will open. Once the limit opens, the furnace control energizes the supply air blower and de-energizes the gas valve. The limit automatically resets when unit temperature returns to normal. The switch is factory set and cannot be adjusted. For limit replacement remove wires from limit terminals and rotate limit switch 90 degrees. Slowly remove from the vestibule panel. Install replacement limit with same care.

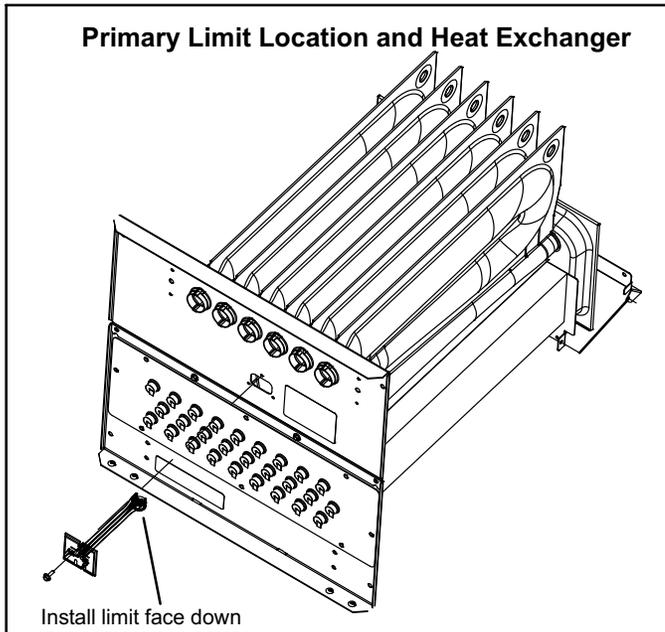


FIGURE 7

#### 5. Heat Exchanger (Figure 7)

ML193DF units use an aluminized steel primary and stainless steel secondary heat exchanger assembly. Heat is transferred to the air stream from all surfaces of the heat exchanger. The shape of the heat exchanger ensures maximum efficiency.

The combustion air inducer pulls fresh air through the burner box. This air is mixed with gas in the burners. The gas / air mixture is then burned at the entrance of each clamshell. Combustion gases are then pulled through the primary and secondary heat exchangers and exhausted out the exhaust vent pipe.

#### 6. Burners (Figure 8)

All units use inshot burners. Burners are factory set and do not require adjustment. Burners can be removed as an assembly for service. Burner maintenance and service is detailed in the MAINTENANCE section of this manual. Each burner uses an orifice which is precisely matched to the burner input.

See table 4 for orifice size. The burner is supported by the orifice and will easily slide off for service. A flame retention ring in the end of each burner maintains correct flame length and shape and keeps the flame from lifting off the burner head.

TABLE 4  
Gas Orifice Size

Unit	Fuel	Orifice Size
All	Natural	0.0625
All	L.P./Propane	0.034

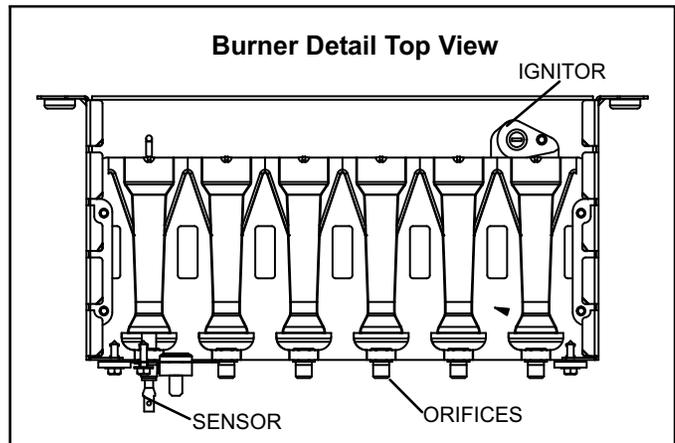


FIGURE 8

#### 7. Gas Valve (GV1)

The ML193DF uses an internally redundant to valve to assure safety shut-off. If the gas valve must be replaced, the same type valve must be used.

24VAC terminals and gas control switch are located on top of the valve. All terminals on the gas valve are connected to wires from the ignition control. 24V applied to the terminals opens the valve.

Inlet and outlet pressure taps are located on the valve. A manifold adjustment screw is also located on the valve. An LPG changeover kit is available.

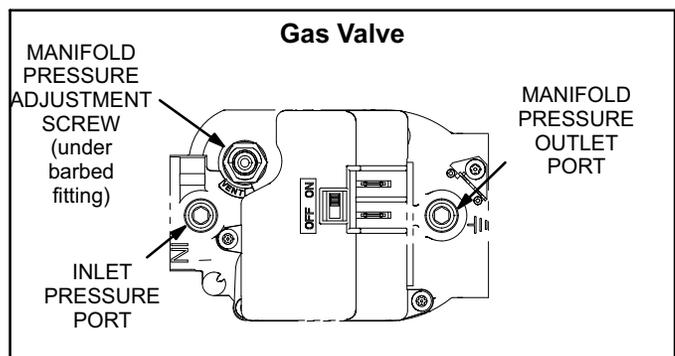


FIGURE 9

## 8. Combustion Air Inducer (B6) & Cold End Header Box

All ML193DF units use a combustion air inducer to move air through the burners and heat exchanger during heating operation. The blower uses a shaded pole 120VAC motor. The motor operates during all heating operation and is controlled by burner ignition control A3. Blower operates continuously while there is a call for heat. The burner ignition control will not proceed with the ignition sequence until combustion air inducer operation is sensed by the proving switches.

The CAI 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 CAI. The box has pressure taps for the CAI pressure switch hoses. The pressure switch measure the pressure across the CAI 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 CAI to the box, must also be replaced.**

TABLE 5

ML193DF Unit	C.A.I. Orifice Size
-045	0.618
-070	0.891
-090	1.031
-110	1.297

## 9. Combustion Air Pressure Switch (Figure 10)

ML193DF series units are equipped with a differential pressure switch located on the cold end header box. The switches monitor across the CAI orifice to insure proper flow through the heat exchanger.

The switch is a SPST N.O. prove switch electrically connected to the integrated control. The purpose of the switch is to prevent burner operation if the combustion air inducer is not moving enough air for proper combustion.

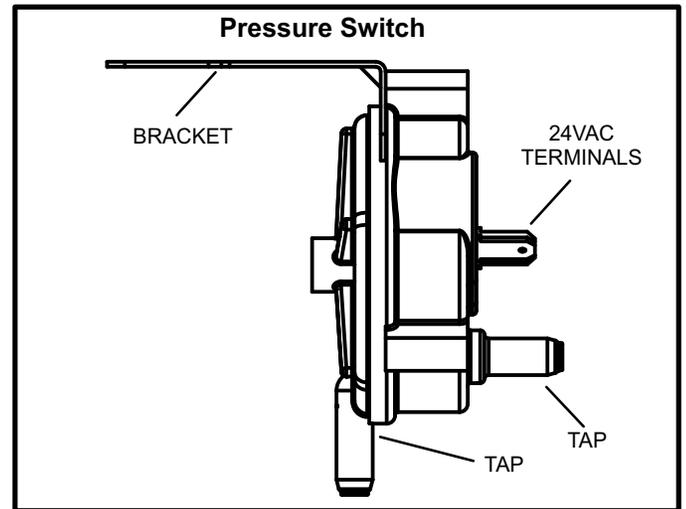


FIGURE 10

On start-up, the switch senses that the combustion air inducer is operating. It closes a circuit to the ignition control when the difference in pressure across the CAI orifice exceeds a non-adjustable factory setting. If the switch does not successfully sense the required differential, the switch cannot close and the furnace cannot operate. If the flue or air inlet become obstructed during operation, the switch senses a loss of pressure differential and opens the circuit to the ignition control. If the condensate line is blocked, water will back up into the header box and reduce the pressure differential across the switch. The prove switch opens if the differential drops below the set point. See table 6.

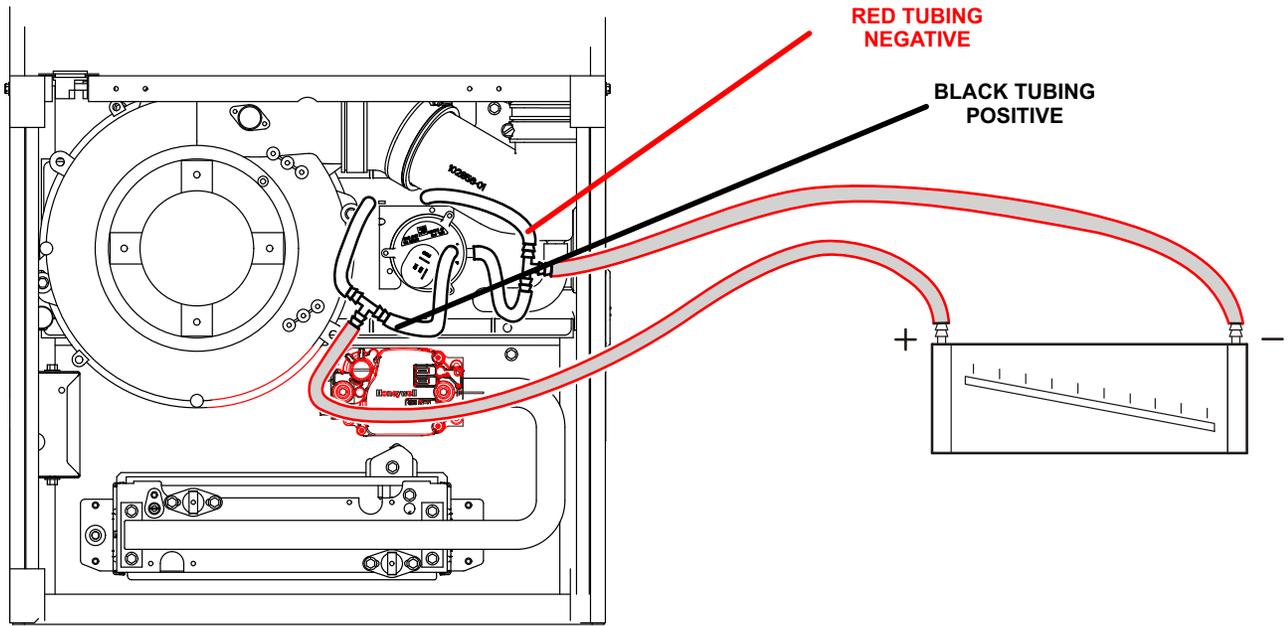
Checks of pressure differential can aid in troubleshooting. When measuring the pressure differential, readings should be taken at the pressure switch. See figure 11. Lack of differential usually indicates problems in the intake or exhaust piping, but may indicate problems in the heat exchanger, condensing coil, header boxes, combustion inducer or other components.

TABLE 6

ML193DF	Altitude ft		
	0 - 4500	4501 - 7500	7501 - 10000
	Set Point	SetPoint	Set Point
-045	-0.65	-0.60	-0.55
-070			
-090			
-110			

\*Set point is factory set and non-adjustable

## Measuring Pressure Differential



- 1 - Remove thermostat demand and allow unit to cycle off.
- 2 - Install a tee in the negative (-) line (red tubing) and a tee in the positive (+) line (black tubing) running from the pressure switch to the cold end header box.
- 3 - Install a manometer with hose from the negative (-) side of the manometer to the tee installed in the negative (-) line and with hose from the positive (+) side of the manometer to the tee in the positive (+) line.

*NOTE - Both sides of the cold end header box are negative. However the (+) port reads less negative pressure than the (-) port.*

- 4 - 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.

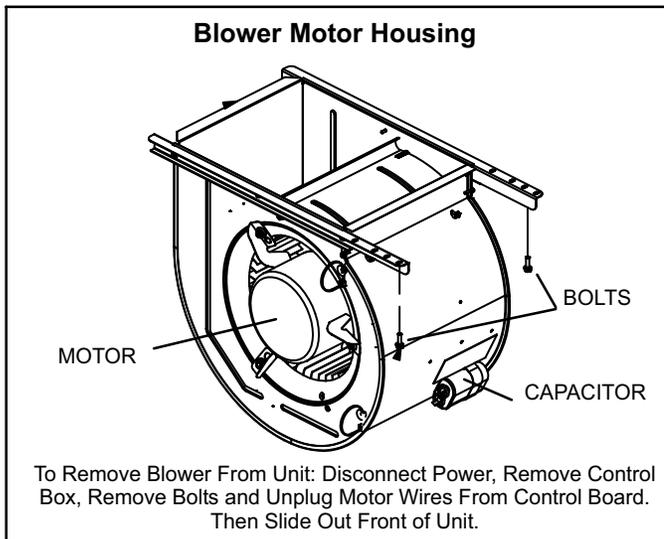
**The pressure differential should be greater than those listed in table 6.**

- 5 - Remove thermostat demand and allow to cycle off.
- 6 - Remove manometer and tee's. Reinstall combustion air sensing hoses to the pressure switch.

**FIGURE 11**

## C-Blower Compartment

Blower motor (B3) and capacitor (C4), are located in the blower compartment. The blower compartment can be accessed by removing the blower access panel.



To Remove Blower From Unit: Disconnect Power, Remove Control Box, Remove Bolts and Unplug Motor Wires From Control Board. Then Slide Out Front of Unit.

**FIGURE 12**

## 1. Blower Motor (B3) and Capacitor (C4)

All ML193DF units use single-phase direct-drive blower motors. All motors are 120V permanent split capacitor motors to ensure maximum efficiency. See SPECIFICATIONS table at the front of this manual for more detail. See motor nameplate for capacitor ratings.

## II-PLACEMENT AND INSTALLATION

### Combustion, Dilution & Ventilation Air

If the ML193DF is installed as a Non-Direct Vent Furnace, follow the guidelines in this section.

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

In the past, there was no problem in bringing in sufficient outdoor air for combustion. Infiltration provided all the air that was needed. In today's homes, tight construction practices make it necessary to bring in air from outside for combustion. Take into account that exhaust fans, appliance vents, chimneys, and fireplaces force additional air that could be used for combustion out of the house. Unless outside air is brought into the house for combustion, negative pressure (outside pressure is greater than inside pressure) will build to the point that a downdraft can occur in the furnace vent pipe or chimney. As a result, combustion gases enter the living space creating a potentially dangerous situation.

In the absence of local codes concerning air for combustion and ventilation, use the guidelines and procedures in this section to install ML193DF furnaces to ensure efficient and safe operation. You must consider combustion air needs and requirements for exhaust vents and gas piping. A portion of this information has been reprinted with permission from the National Fuel Gas Code (ANSI-Z223.1/NFPA 54). This reprinted material is not the complete and official position of the ANSI on the referenced subject, which is represented only by the standard in its entirety.

In Canada, refer to the CSA B149 installation codes.

### ⚠ CAUTION

**Do not install the furnace in a corrosive or contaminated atmosphere. Meet all combustion and ventilation air requirements, as well as all local codes.**

All gas-fired appliances require air for the combustion process. If sufficient combustion air is not available, the furnace or other appliance will operate inefficiently and unsafely. Enough air must be provided to meet the needs of all fuel-burning appliances and appliances such as exhaust fans which force air out of the house. When fireplaces, exhaust fans, or clothes dryers are used at the same time as the furnace, much more air is required to ensure proper combustion and to prevent a downdraft. Insufficient air causes incomplete combustion which can result in carbon monoxide.

In addition to providing combustion air, fresh outdoor air dilutes contaminants in the indoor air. These contaminants may include bleaches, adhesives, detergents, solvents and other contaminants which can corrode furnace components.

The requirements for providing air for combustion and ventilation depend largely on whether the furnace is installed in an unconfined or a confined space.

#### Unconfined Space

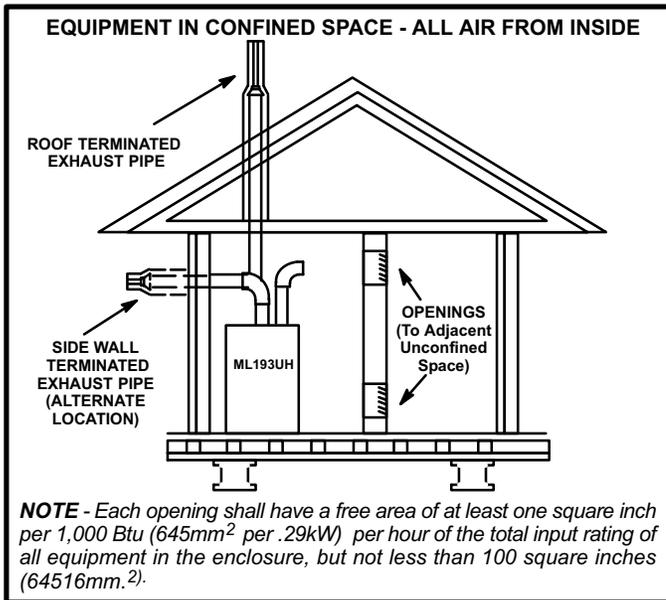
An unconfined space is an area such as a basement or large equipment room with a volume greater than 50 cubic feet (1.42 m<sup>3</sup>) per 1,000 Btu (.29 kW) per hour of the combined input rating of all appliances installed in that space. This space also includes adjacent rooms which are not separated by a door. Though an area may appear to be unconfined, it might be necessary to bring in outdoor air for combustion if the structure does not provide enough air by infiltration. If the furnace is located in a building of tight construction with weather stripping and caulking around the windows and doors, follow the procedures in the Air from Outside section.

#### Confined Space

A confined space is an area with a volume less than 50 cubic feet (1.42 m<sup>3</sup>) per 1,000 Btu (.29 kW) per hour of the combined input rating of all appliances installed in that space. This definition includes furnace closets or small equipment rooms. When the furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air **must be** handled by ducts which are sealed to the furnace casing and which terminate outside the space containing the furnace. This is especially important when the furnace is mounted on a platform in a confined space such as a closet or small equipment room. Even a small leak around the base of the unit at the platform or at the return air duct connection can cause a potentially dangerous negative pressure condition. Air for combustion and ventilation can be brought into the confined space either from inside the building or from outside.

#### Air from Inside

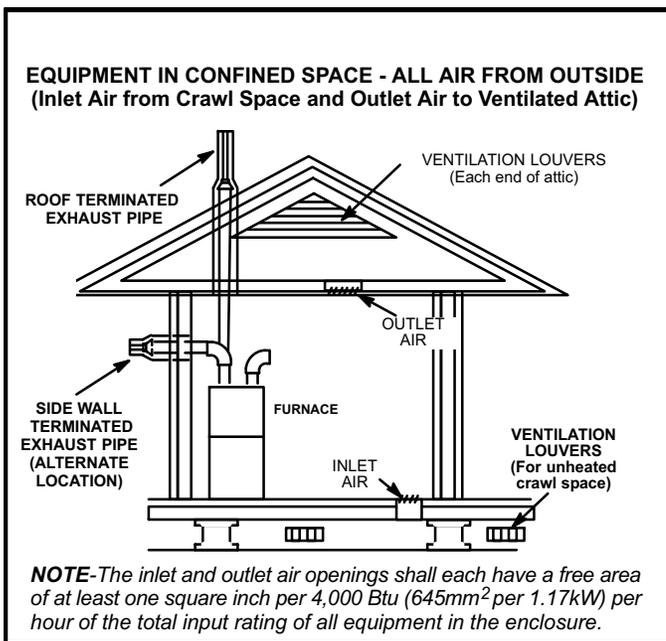
If the confined space that houses the furnace adjoins a space categorized as unconfined, air can be brought in by providing two permanent openings between the two spaces. Each opening must have a minimum free area of 1 square inch (645 mm<sup>2</sup>) per 1,000 Btu (.29 kW) per hour of total input rating of all gas-fired equipment in the confined space. Each opening must be at least 100 square inches (64516 mm<sup>2</sup>). One opening shall be within 12 inches (305 mm) of the top of the enclosure and one opening within 12 inches (305 mm) of the bottom. See figure 13.



**FIGURE 13**

**Air from Outside**

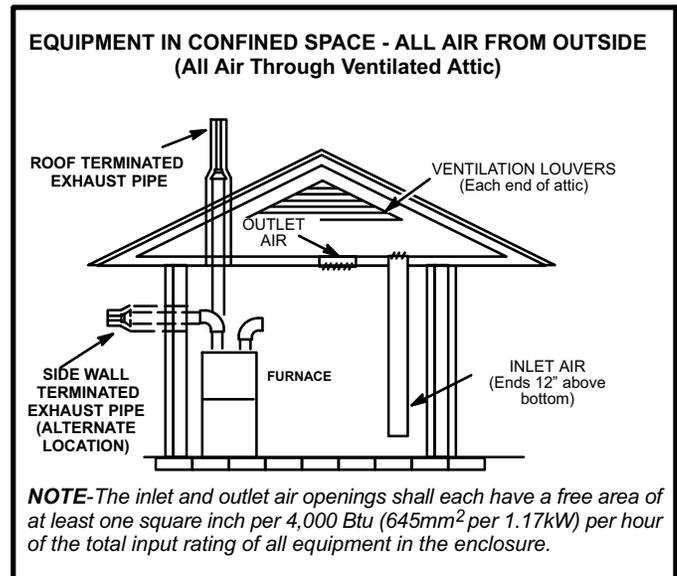
If air from outside is brought in for combustion and ventilation, the confined space shall be provided with two permanent openings. One opening shall be within 12" (305mm) of the top of the enclosure and one within 12" (305mm) of the bottom. These openings must communicate directly or by ducts with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors or indirectly through vertical ducts. Each opening shall have a minimum free area of 1 square inch per 4,000 Btu (645mm<sup>2</sup> per 1.17kW) per hour of total input rating of all equipment in the enclosure. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 square inch per 2,000 Btu (645mm<sup>2</sup> per .59kW) per total input rating of all equipment in the enclosure (See figure 14).



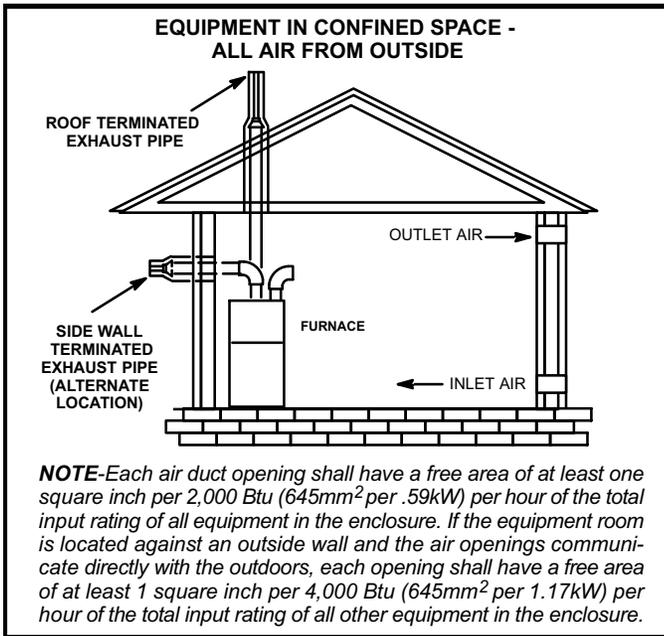
**FIGURE 14**

If air from outside is brought in for combustion and ventilation, the confined space must have two permanent openings. One opening shall be within 12 inches (305 mm) of the top of the enclosure and one opening within 12 inches (305 mm) of the bottom. These openings must communicate directly or by ducts with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors or indirectly through vertical ducts. Each opening shall have a minimum free area of 1 square inch (645 mm<sup>2</sup>) per 4,000 Btu (1.17 kW) per hour of total input rating of all equipment in the enclosure. See figures 14 and 15. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 square inch (645 mm<sup>2</sup>) per 2,000 Btu (.56 kW) per total input rating of all equipment in the enclosure. See figure 16.

When ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be no less than 3 inches (75 mm). In calculating free area, the blocking effect of louvers, grilles, or screens must be considered. If the design and free area of protective covering is not known for calculating the size opening required, it may be assumed that wood louvers will have 20 to 25 percent free area and metal louvers and grilles will have 60 to 75 percent free area. Louvers and grilles must be fixed in the open position or interlocked with the equipment so that they are opened automatically during equipment operation.



**FIGURE 15**



**FIGURE 16**

**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 7 below 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 7  
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
<b>PRIMER &amp; SOLVENT CEMENT</b>	<b>ASTM SPECIFICATION</b>
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	D3138
<b>CANADA PIPE &amp; FITTING &amp; SOLVENT CEMENT</b>	<b>MARKING</b>
PVC & CPVC Pipe and Fittings	ULCS636
PVC & CPVC Solvent Cement	
ABS to PVC or CPVC Transition Cement	

**⚠ IMPORTANT**

**ML193DF 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 7. 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.

**TABLE 8  
OUTDOOR TERMINATION KITS USAGE**

ML193 UNIT	VENT PIPE DIA. (in.)	STANDARD						CONCENTRIC		
		Outdoor Exhaust Accelerator (Dia. X Length)	Outdoor Exhaust Accelerator (Dia. X Length)	2" Wall Plate Kit	3" Wall Plate Kit	2" Wall Ring Kit	Flush- Mount Kit	1-1/2" Concentric Kit	2" Concentric Kit	3" Concentric Kit
		1-1/2" X 12"	2" X 12"	22G44 or 30G28†	44J40 or 81J20†	15F74	51W11**	71M80 or †44W92††	69M29 or †44W92††	60L46 or 44W93†
045	2	YES		YES	YES*	YES	YES	YES		
	2-1/2	YES		YES	YES*	YES	YES	YES		
	3	YES		YES	YES*	YES	YES	YES		
070	2	YES		YES	YES*	YES	YES	YES		
	2-1/2	YES		YES	YES*	YES	YES	YES		
	3	YES		YES	YES*	YES	YES	YES		
090	2		YES		YES	YES	YES		YES	YES
	2-1/2		YES		YES	YES	YES		YES	YES
	3		YES		YES	YES	YES		YES	YES
110	3		YES		YES	YES	YES		YES	YES

\*Requires field-provided and installed 1-1/2" exhaust accelerator.

\*\* Kit 51W11 is provided with a 1-1/2" accelerator which must be used for all ML193DF-045, -070 and -090 installations.

† Termination kits 44W92, 44W93, 30G28 and 81J20 approved for use in Canadian installations to meet CSAB149.

†† The 44W92 Concentric kit is provided with a 1-1/2" accelerator which must be installed on the exhaust outlet when this kit is used with the ML193DF045P36B and ML193DF070P36B furnaces.

## 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 - Deburr 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.
- 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.

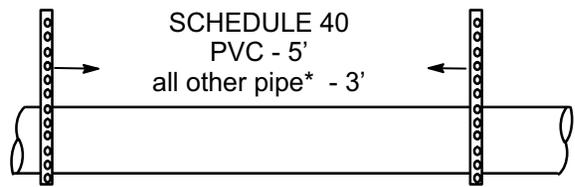
- 7 - Immediately after applying last coat of cement to pipe, and while both inside socket surface and end of pipe are wet with cement, forcefully insert end of pipe into socket until it bottoms out. Turn PVC pipe 1/4 turn during assembly (but not after pipe is fully inserted) to distribute cement evenly.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

### Piping Suspension Guidelines



\* See table 7 for allowable pipe.

**NOTE** - Isolate piping at the point where it exits the outside wall or roof in order to prevent transmission of vibration to the structure.

### Wall Thickness Guidelines

24" maximum  
3/4" minimum

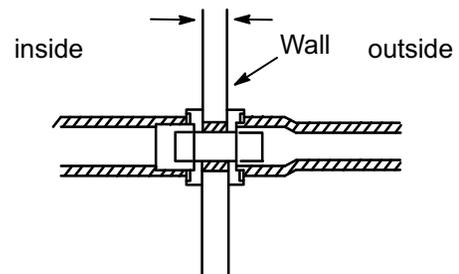
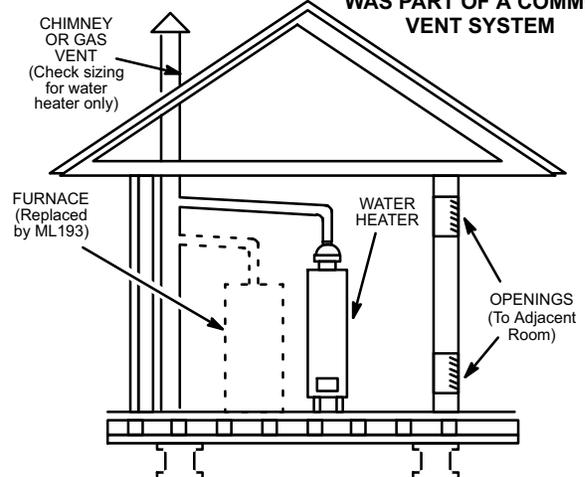


FIGURE 17

### REPLACING FURNACE THAT WAS PART OF A COMMON VENT SYSTEM



If an ML193DF furnace replaces 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 18

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.

- 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.

### Exhaust Piping (Figures 20 and 21)

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

**⚠ 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

The ML193DF 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 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 tables 9 and 10. Table 9 lists the *minimum* vent pipe lengths permitted. Table 10 lists the *maximum* pipe lengths permitted.

**TABLE 9  
MINIMUM VENT PIPE LENGTHS**

ML193DF MODEL	MIN. VENT LENGTH*
045, 070, 090, 110	15 ft. or 5 ft plus 2 elbows or 10 ft plus 1 elbow

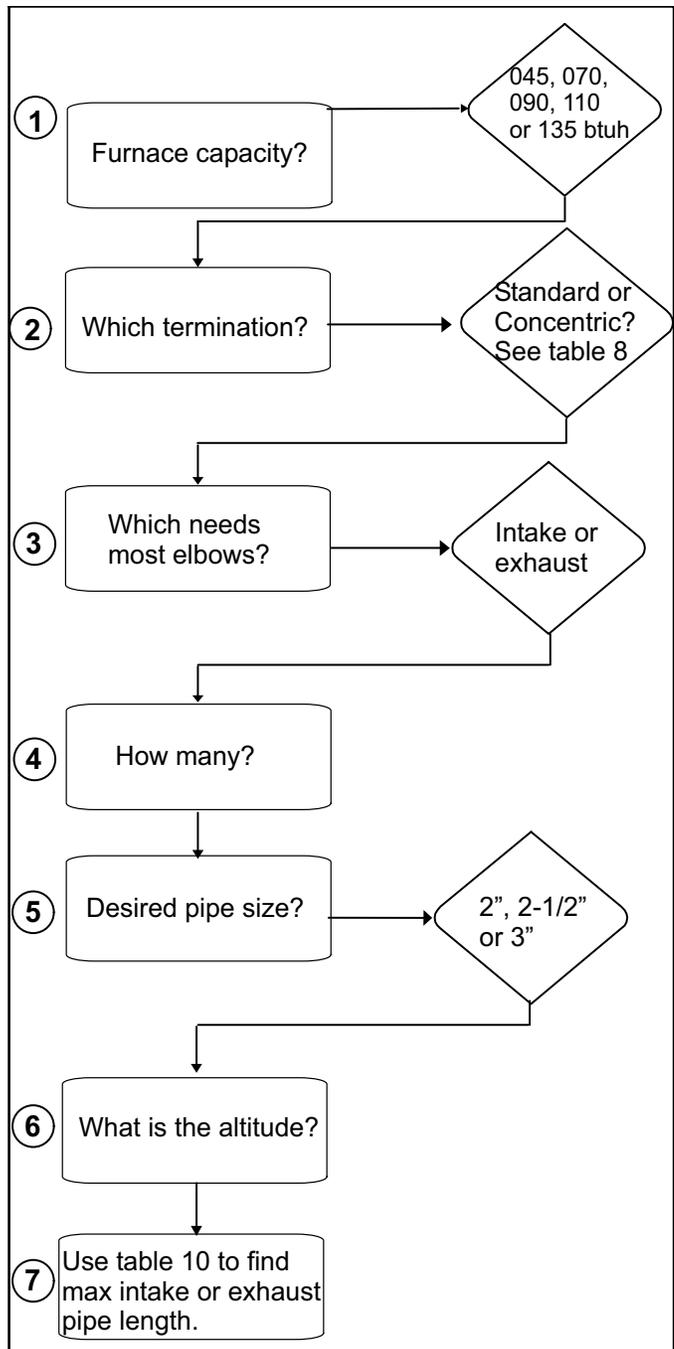
\*Any approved termination may be added to the minimum length listed.

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 11.

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.

Use the following steps to correctly size vent pipe diameter.



**FIGURE 19**

**NOTE** - It is acceptable to use any pipe size which fits within the guidelines allowed in table 10.

**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** - 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.

**TABLE 10**  
**Maximum Allowable Intake or Exhaust Vent Length in Feet**

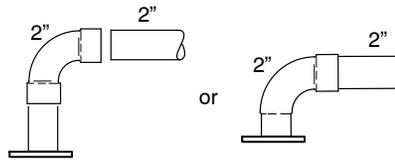
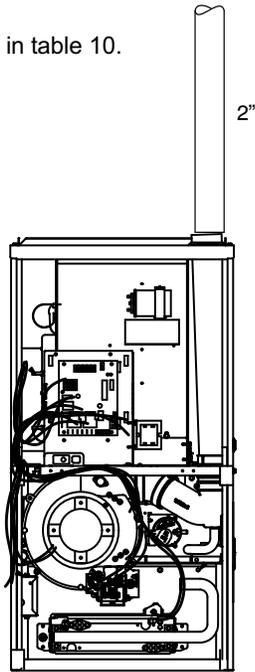
*\*Size intake and exhaust pipe length separately. Values in table are for Intake OR Exhaust, not combined total. Both Intake and Exhaust must be same pipe size.*

Standard Termination at Elevation 0 - 10,000 ft.												
Number Of 90° Elbows Used	2" Pipe				2-1/2" Pipe				3" Pipe			
	Model				Model				Model			
	045	070	090	110	045	070	090	110	045	070	090	110
1	61	46	24	n/a	100	80	43	n/a	127	127	108	108
2	56	41	19		95	75	38		122	122	103	103
3	51	36	14		90	70	33		117	117	98	98
4	46	31	n/a		85	65	28		112	112	93	93
5	41	26			80	60	23		107	107	88	88
6	36	21			75	55	18		102	102	83	83
7	31	16			70	50	13		97	97	78	78
8	26	11	n/a		65	45	n/a		92	92	73	73
9	21	n/a			60	40			87	87	68	68
10	16				55	35			82	82	63	63

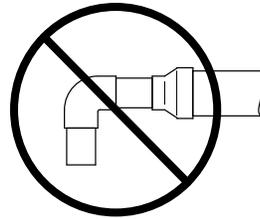
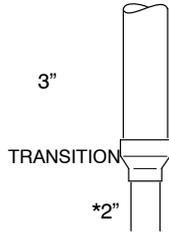
Concentric Termination Elevation 0 - 10,000 ft.												
Number Of 90° Elbows Used	2" Pipe				2-1/2" Pipe				3" Pipe			
	Model				Model				Model			
	045	070	090	110	045	070	090	110	045	070	090	110
1	53	38	22	n/a	90	70	39	n/a	111	111	104	104
2	48	33	17		85	65	34		106	106	99	99
3	43	28	12		80	60	29		101	101	94	94
4	38	23	n/a		75	55	24		96	96	89	89
5	33	18			70	50	19		91	91	84	84
6	28	13			65	45	14		86	86	79	79
7	23	n/a			60	40	n/a		81	81	74	74
8	18		55		35	76			76	69	69	
9	13		50		30	71			71	64	64	
10	n/a	45	25		66	66	59		59			

### TYPICAL EXHAUST PIPE CONNECTIONS

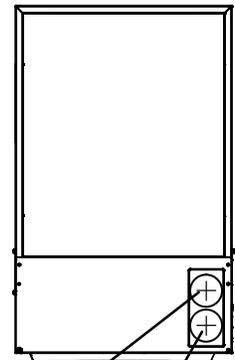
Pipe size determined in table 10.



or



DO NOT transition from smaller to larger pipe size in horizontal runs of exhaust pipe.



INTAKE EXHAUST

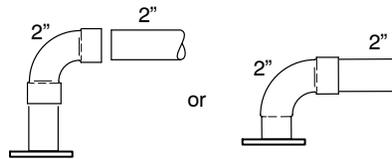
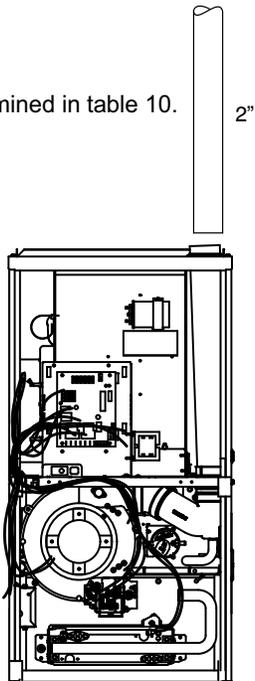
TOP VIEW

\* 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.

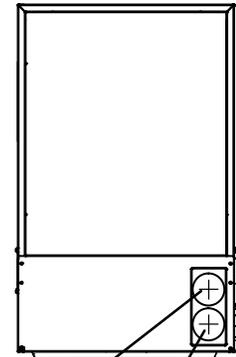
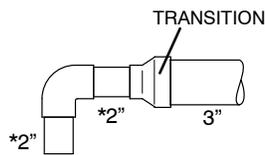
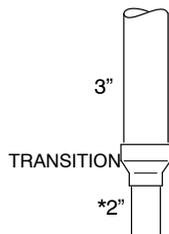
FIGURE 20

### TYPICAL INTAKE PIPE CONNECTIONS

Pipe size determined in table 10.



or



INTAKE EXHAUST

TOP VIEW

\* 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 21

## Intake Piping

The ML193DF 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 to secure the intake pipe to the inlet air connector.
- 2 - 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 10 for pipe sizes.

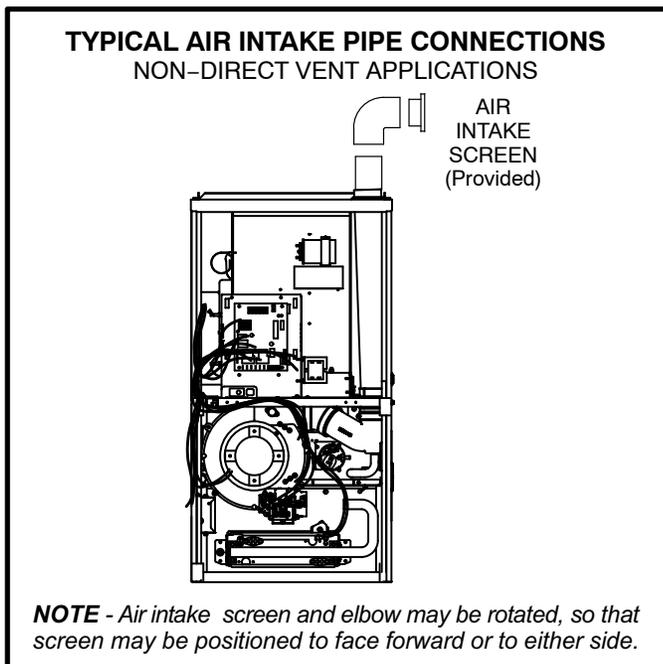


FIGURE 22

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 22. 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 ML193DF 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 ML193DF 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 23 or 24. 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 a condensing unit because the condensate can damage the painted coating.

**NOTE** - If winter design temperature is below 32°F (0°C), exhaust piping should be insulated with 1/2" (13mm), Armaflex or equivalent when run through unheated space. Do not leave any surface area of exhaust pipe open to outside air; exterior 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 on outside runs of exhaust pipe must be painted or wrapped to protect insulation from deterioration. Exhaust pipe insulation may not be necessary in some specific applications.

**NOTE** - During extremely cold temperatures, below approximately 20°F (6.7°C), units with long runs of vent pipe through unconditioned space, even when insulated, may form ice in the exhaust termination that prevents the unit from operating properly. Longer run times of at least 5 minutes will alleviate most icing problems. Also, a heating cable may be installed on exhaust piping and termination to prevent freeze-ups. Heating cable installation kit is available from Lennox. See Condensate Piping section for part numbers.

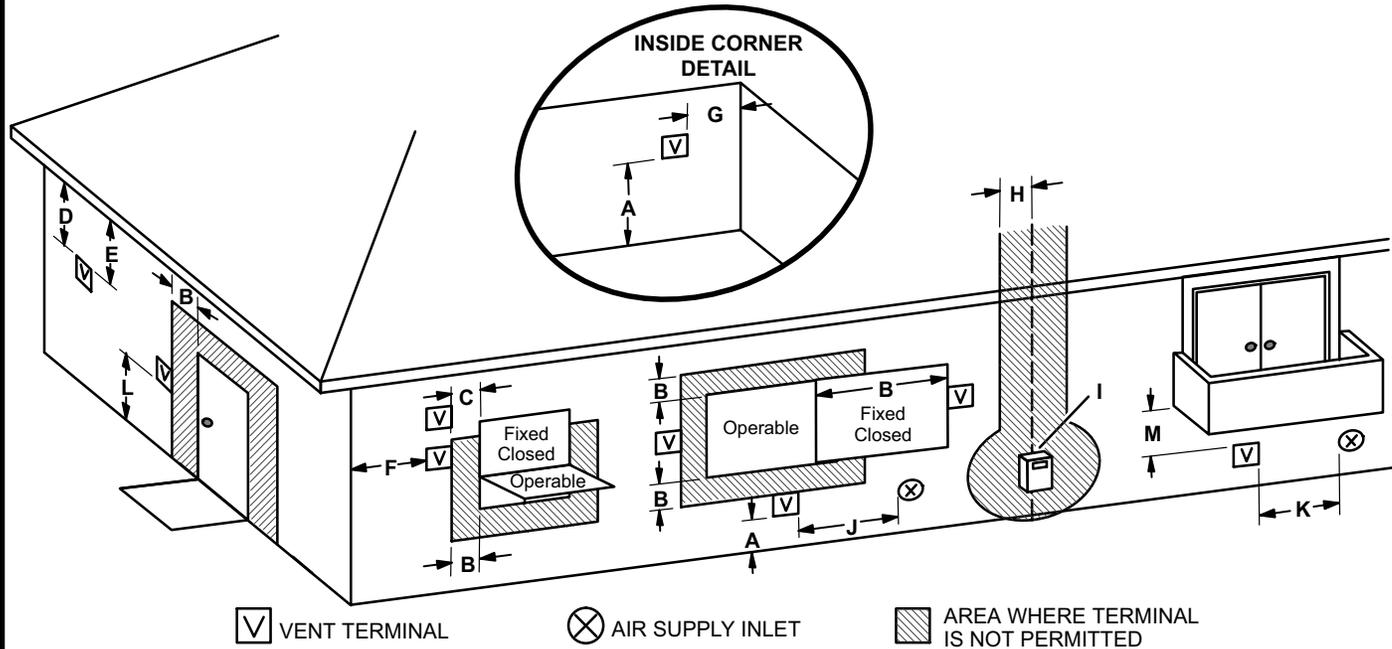
### ⚠ IMPORTANT

**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).**

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



	US Installations <sup>1</sup>	Canadian Installations <sup>2</sup>	
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 (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)
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 (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)‡

<sup>1</sup> In accordance with the current ANSI Z223.1/NFPA 54 Natural Fuel Gas Code

<sup>2</sup> In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code

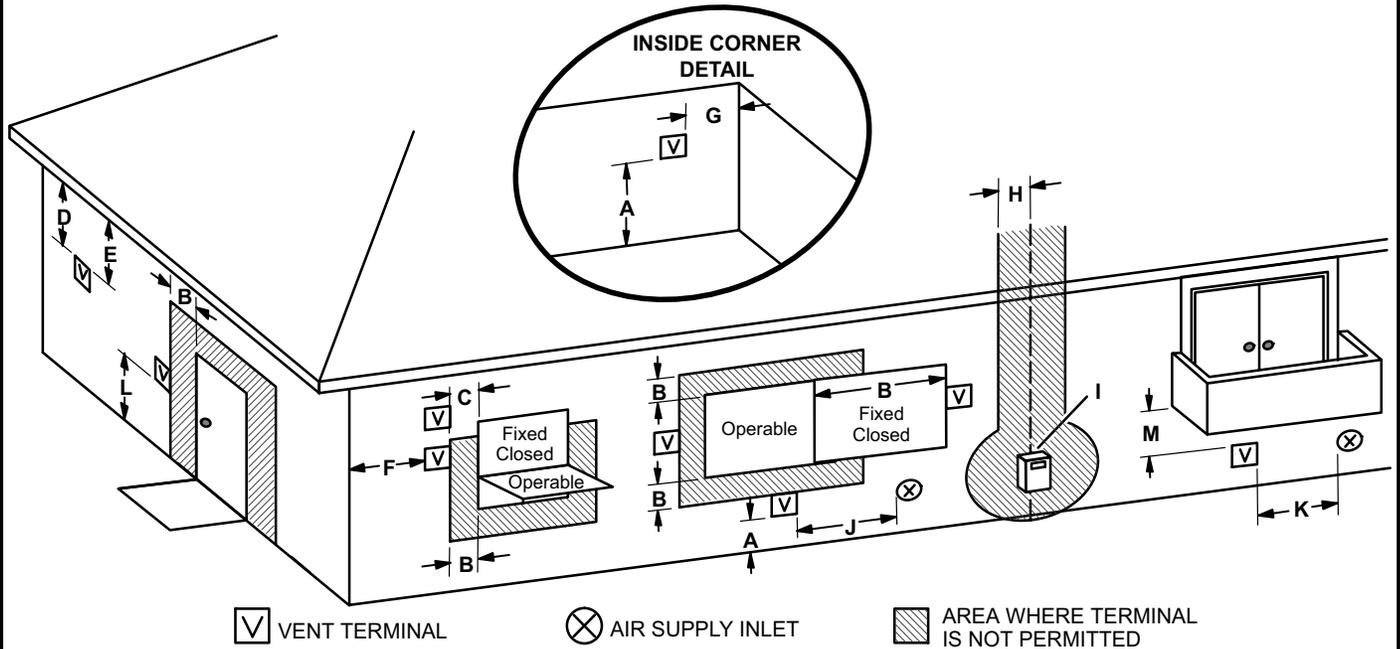
† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

‡ 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 23**

## VENT TERMINATION CLEARANCES FOR DIRECT VENT INSTALLATIONS IN THE USA AND CANADA



	US Installations <sup>1</sup>	Canadian Installations <sup>2</sup>	
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 (mm) 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 (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	6 inches (152mm) for appliances <10,000 Btuh (3kw), 9 inches (mm) 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)‡

<sup>1</sup> In accordance with the current ANSI Z223.1/NFPA 54 Natural Fuel Gas Code

<sup>2</sup> 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 24**

**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 27.

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. Figures 25 through 37 show typical terminations.

1. Exhaust and intake exits must be in same pressure zone. Do not exit one through the roof and one on the side. Also, do not exit the intake on one side and the exhaust on another side of the house or structure.
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.
3. On roof terminations, the intake piping should terminate straight down using two 90° elbows (See figure 25).
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 11.

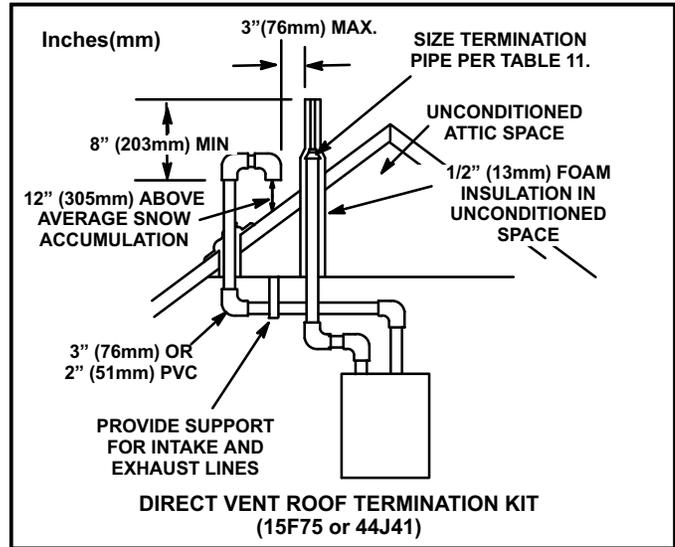
**TABLE 11  
EXHAUST PIPE TERMINATION SIZE REDUCTION**

ML193 MODEL	Exhaust Pipe Size	Termination Pipe Size
*045 and *070	2" (51mm), 2-1/2" (64mm),	1-1/2" (38mm)
*090	3" (76mm)	2" (51mm)
110	3" (76mm)	2" (51mm)

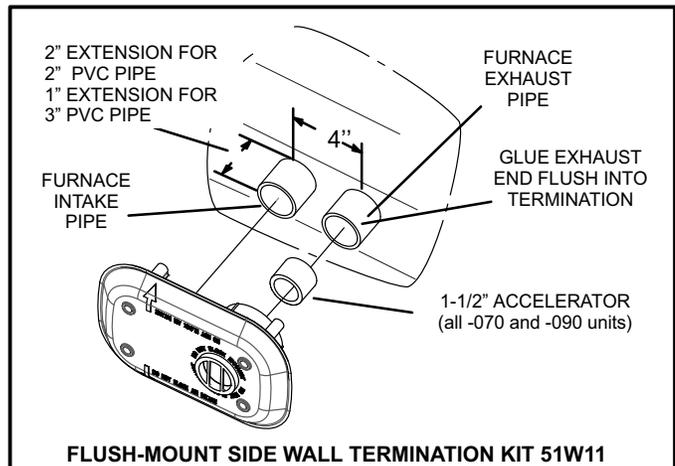
\*ML193DF-045, -070 and -090 units with the flush-mount termination must use the 1-1/2" accelerator supplied with the kit.

5. On field-supplied terminations for side wall exit, 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. Intake piping should be as short as possible. See figures 28 and 29.
- 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 figures 28 and 29.

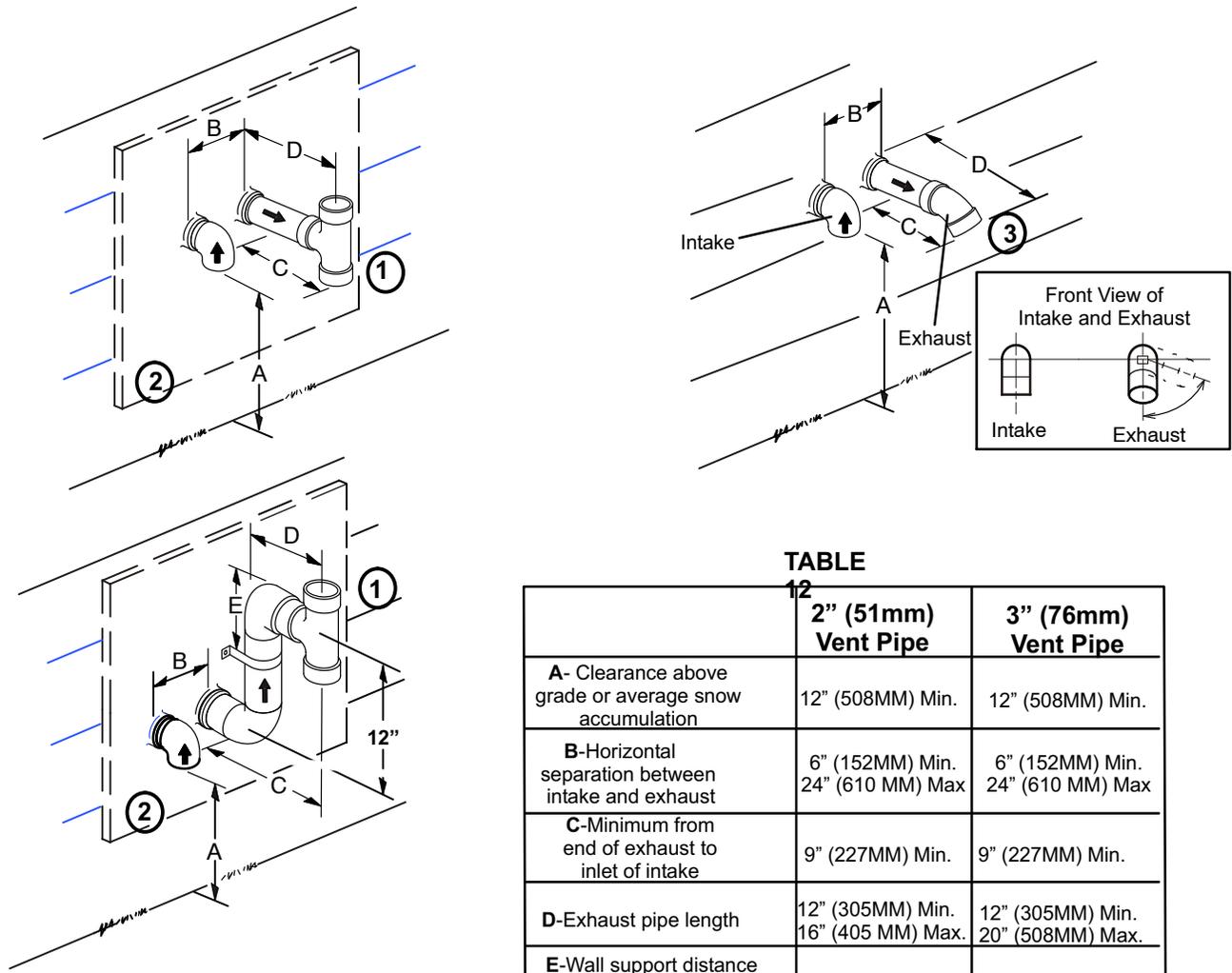


**FIGURE 25**



**FIGURE 26**

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 every 24" (610mm) as shown in figures 28 and 29. In addition, close coupled wall termination kits must be extended for use in this application. See figures 35 and 36. When exhaust and intake piping must be run up an outside wall, the exhaust piping must be terminated with pipe sized per table 11. 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 32.



**TABLE**

	<b>2" (51mm) Vent Pipe</b>	<b>3" (76mm) Vent Pipe</b>
<b>A</b> - Clearance above grade or average snow accumulation	12" (508MM) Min.	12" (508MM) Min.
<b>B</b> -Horizontal separation between intake and exhaust	6" (152MM) Min. 24" (610 MM) Max	6" (152MM) Min. 24" (610 MM) Max
<b>C</b> -Minimum from end of exhaust to inlet of intake	9" (227MM) Min.	9" (227MM) Min.
<b>D</b> -Exhaust pipe length	12" (305MM) Min. 16" (405 MM) Max.	12" (305MM) Min. 20" (508MM) Max.
<b>E</b> -Wall support distance from top of each pipe (intake/exhaust)	6" (152MM) Max.	6" (152MM) Max.

<sup>1</sup> The exhaust termination tee should be connected to the 2" or 3" PVC flue pipe as shown in the illustration. Do not use an accelerator in applications that include an exhaust termination tee. The accelerator is not required.

<sup>2</sup> 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.

<sup>3</sup>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.

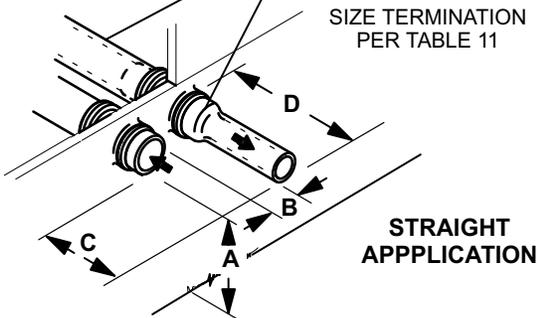
**FIGURE 27**

**FIELD SUPPLIED WALL TERMINATION OR (15F74) WALL RING TERMINATION KIT**

NOTE - FIELD PROVIDED REDUCER MAY BE REQUIRED TO ADAPT LARGER VENT PIPE SIZE TO TERMINATION

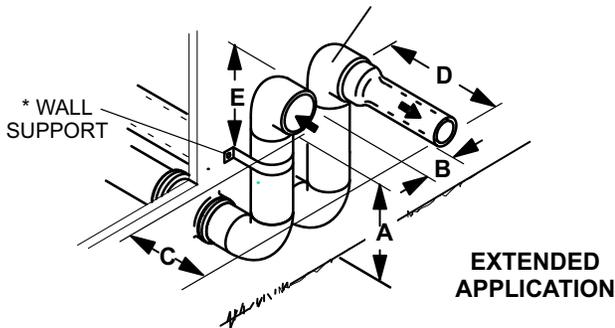
1/2" (13mm) ARMAFLEX INSULATION IN UNCONDITIONED SPACE

SIZE TERMINATION PER TABLE 11



**STRAIGHT APPLICATION**

1/2" (13mm) ARMAFLEX INSULATION IN UNCONDITIONED SPACE



**EXTENDED APPLICATION**

See venting table 10 for maximum 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 6" (152 mm) from top of each pipe (intake and exhaust)

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

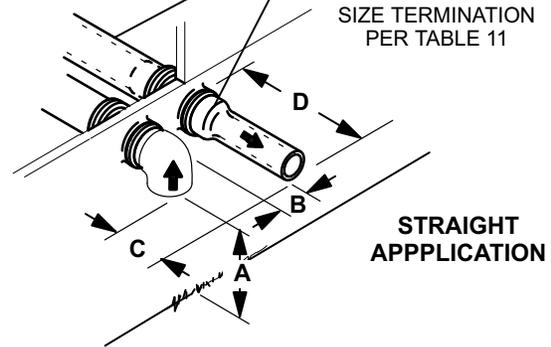
**FIGURE 28**

**FIELD SUPPLIED WALL TERMINATION OR (15F74) WALL RING TERMINATION KIT With INTAKE ELBOW**

NOTE - FIELD PROVIDED REDUCER MAY BE REQUIRED TO ADAPT LARGER VENT PIPE SIZE TO TERMINATION

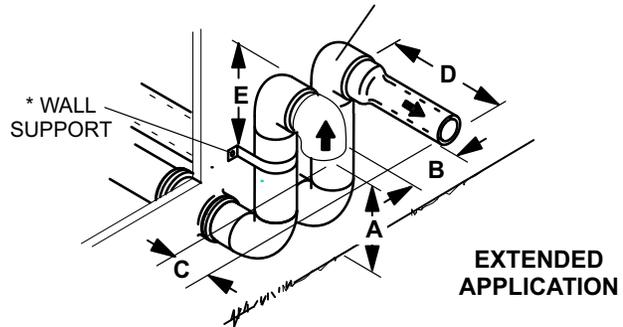
1/2" (13mm) ARMAFLEX INSULATION IN UNCONDITIONED SPACE

SIZE TERMINATION PER TABLE 11



**STRAIGHT APPLICATION**

1/2" (13mm) ARMAFLEX INSULATION IN UNCONDITIONED SPACE



**EXTENDED APPLICATION**

See venting table 10 for maximum 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 6" (152 mm) from top of each pipe (intake and exhaust)

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

**FIGURE 29**

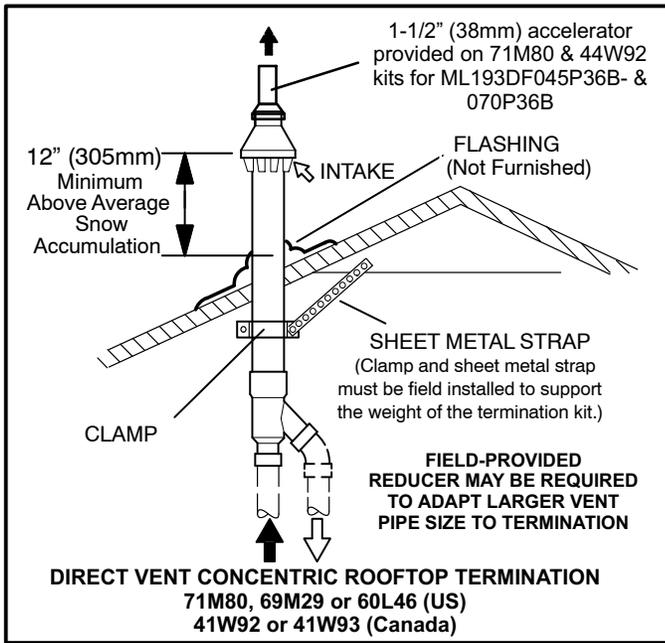


FIGURE 30

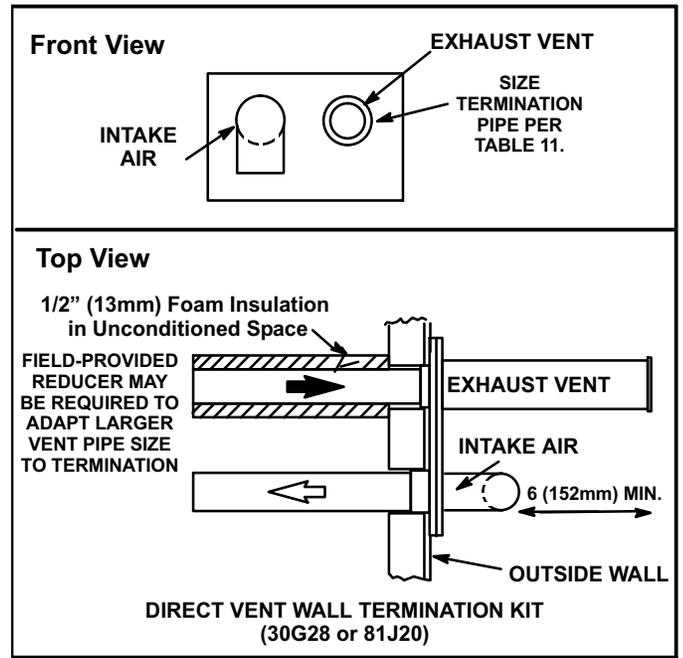


FIGURE 33

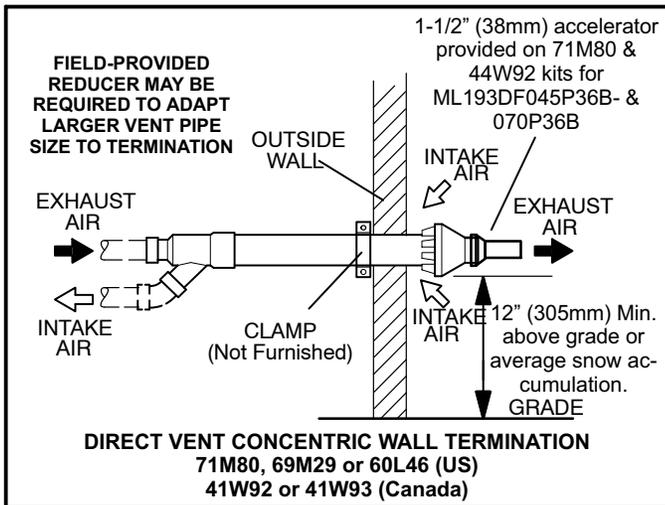


FIGURE 31

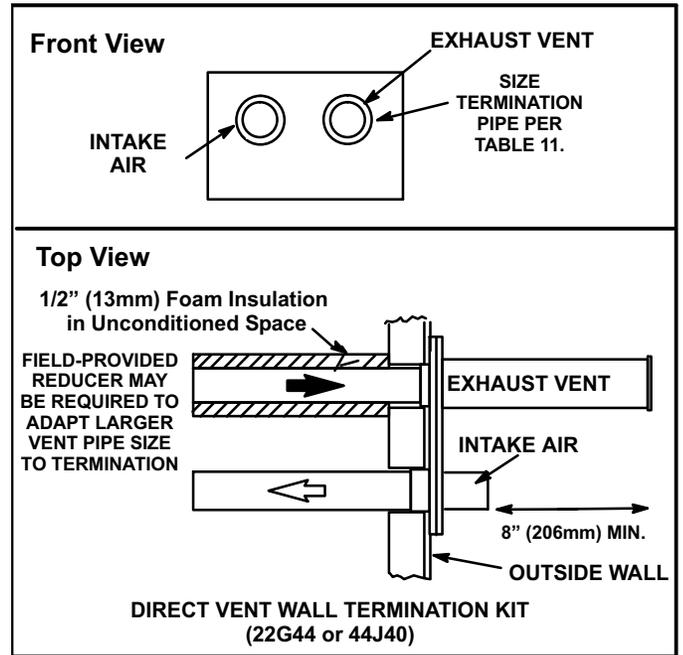


FIGURE 34

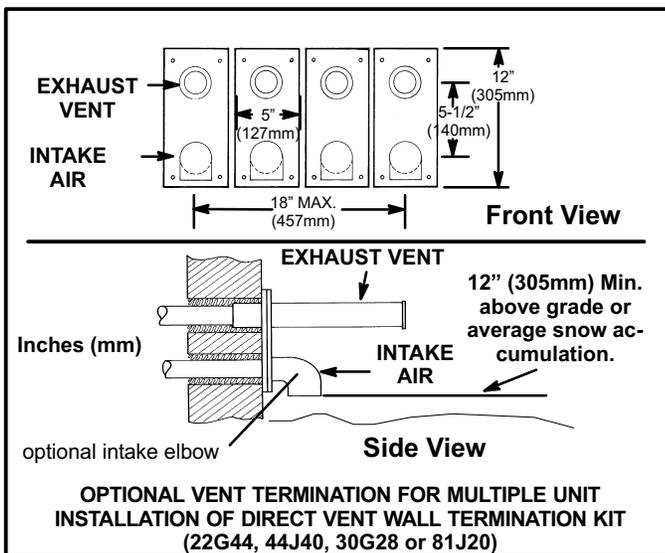
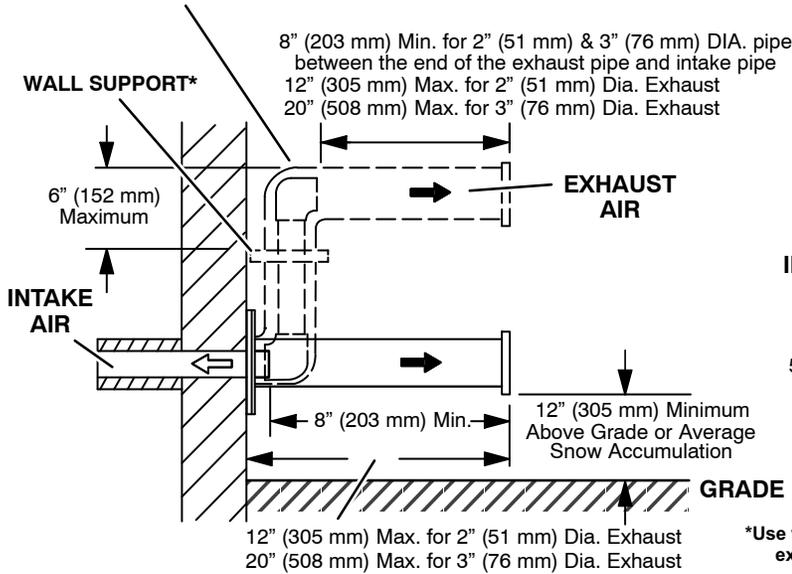


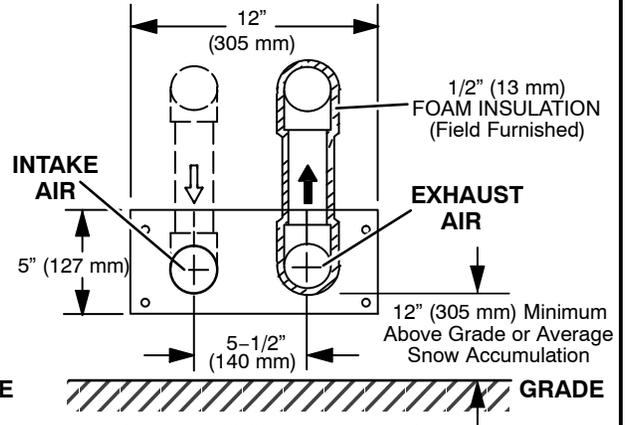
FIGURE 32

**WALL TERMINATION KITS (CLOSE-COUPLE)  
EXTENDED VENT FOR GRADE CLEARANCE  
2 inch (51 mm) 22G44 (US)  
3 inch (76 mm) 44J40 (US)**

If intake and exhaust pipe is less than 12 in. (305 mm) above snow accumulation or other obstructions, field-fabricated piping must be installed.



**FIELD-PROVIDED  
REDUCER MAY BE REQUIRED TO ADAPT  
LARGER VENT PIPE SIZE TO TERMINATION**



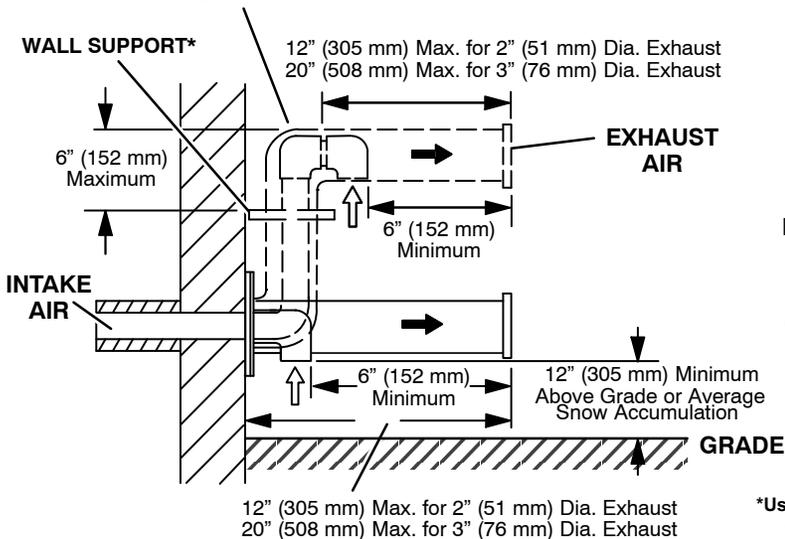
\*Use wall support every 24" (610). Use two supports if extension is greater than 24" but less than 48".

**FIGURE 35**

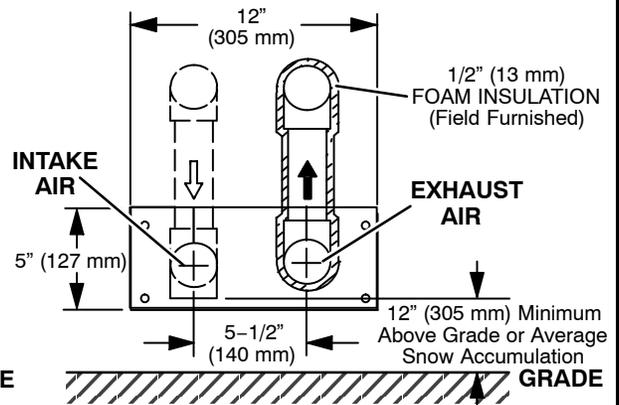
**WALL TERMINATION KITS (CLOSE-COUPLE)  
EXTENDED VENT FOR GRADE CLEARANCE  
2 inch (51 mm) 30G28 (WTK Canada)  
3 inch (76 mm) 81J20 (WTK Canada)**

**See Installation Instructions for additional information.**

If intake and exhaust pipe is less than 12 in. (305 mm) above snow accumulation or other obstructions, field-fabricated piping must be installed.

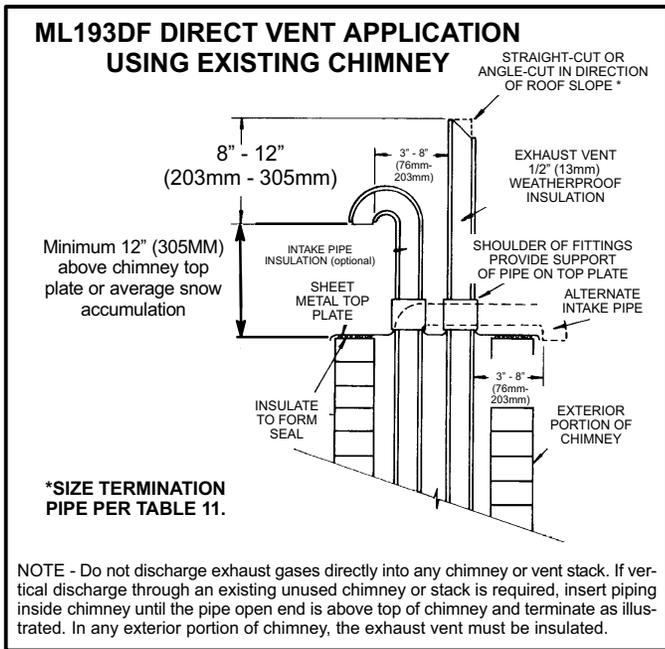


**FIELD-PROVIDED  
REDUCER MAY BE REQUIRED TO ADAPT  
LARGER VENT PIPE SIZE TO TERMINATION**



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

**FIGURE 36**

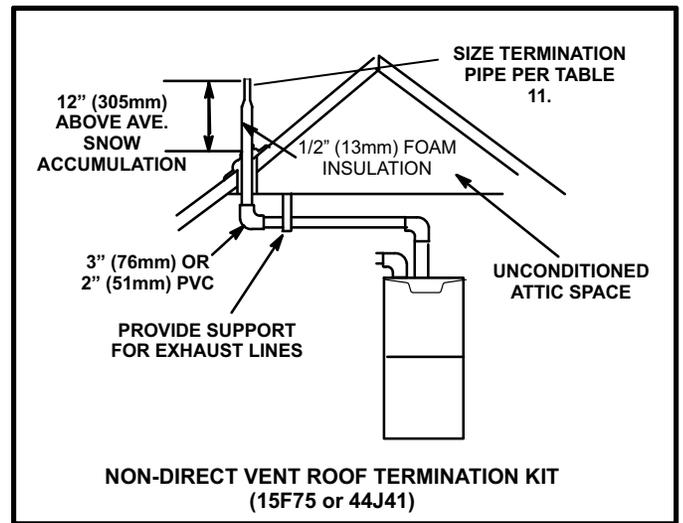


**FIGURE 37**

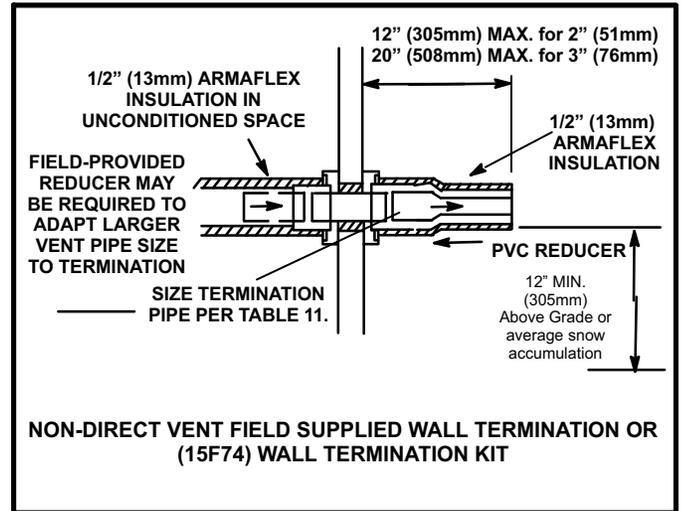
**Details of Exhaust Piping Terminations for Non-Direct Vent Applications**

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. Figures 38 through 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 11. 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. See figure 39.



**FIGURE 38**



**FIGURE 39**

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) as shown in figure 40. When exhaust piping must be run up an outside wall, any reduction in exhaust pipe size must be done after the final elbow.

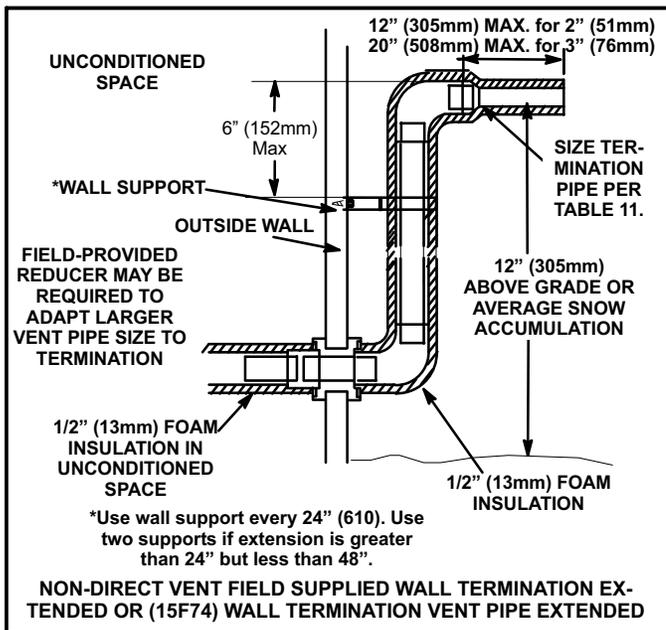


FIGURE 40

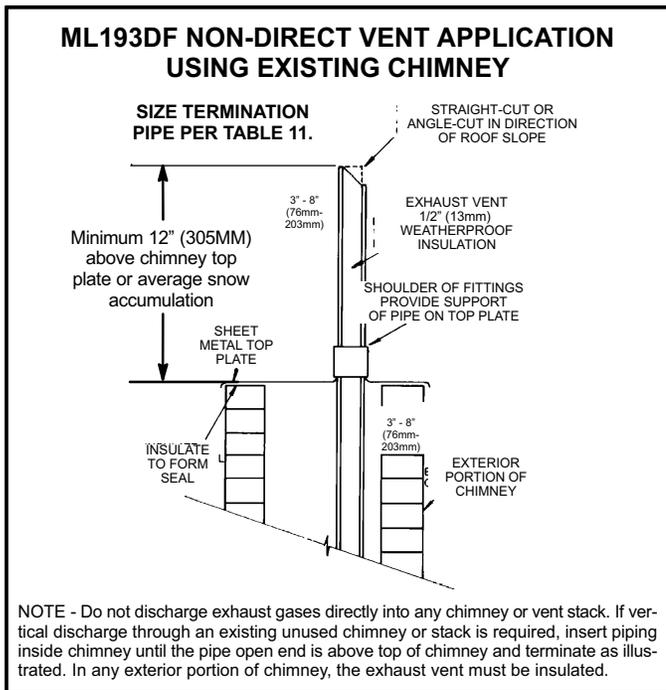


FIGURE 41

### Condensate Piping

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

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

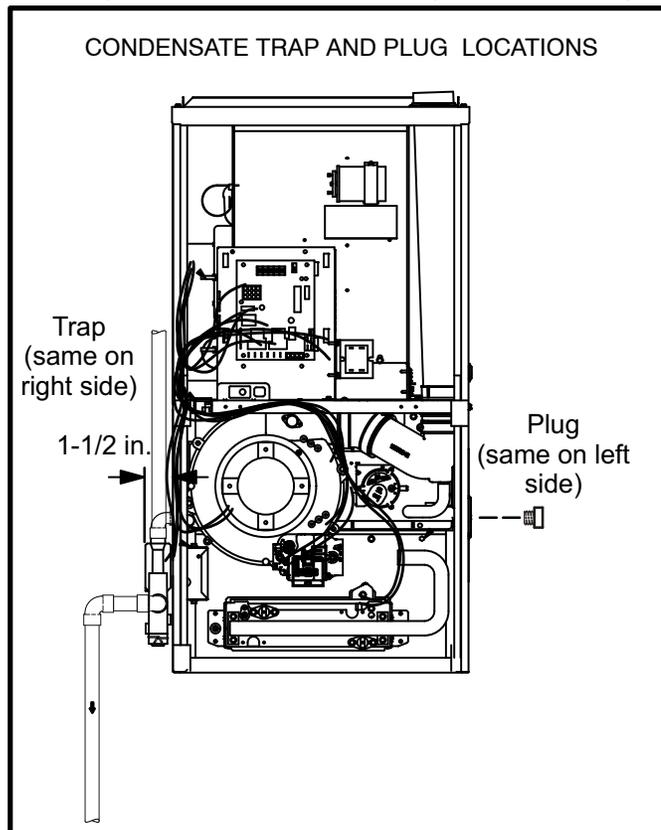


FIGURE 42

- 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 - 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. Use teflon tape or appropriate pipe dope.
- 3 - Install the cap over the clean out opening at the base of the trap. See figure 45.

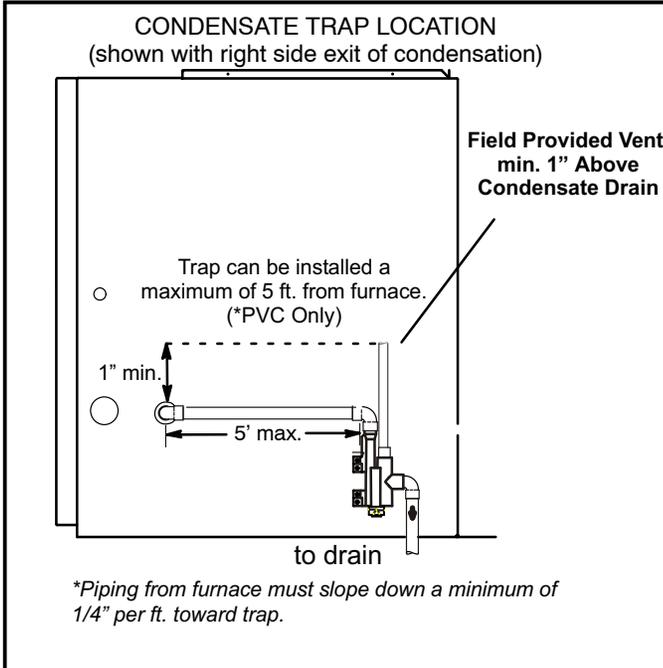
**NOTE** - Vinyl tubing may be used for condensate drain. Tubing must be 1-1/4" OD X 1" ID and should be attached to the drain on the trap using a hose clamp.

- 4 - Install drain trap using appropriate PVC fittings, glue all joints. Glue the provided drain trap as shown in figure 45. Route the condensate line to an open drain.

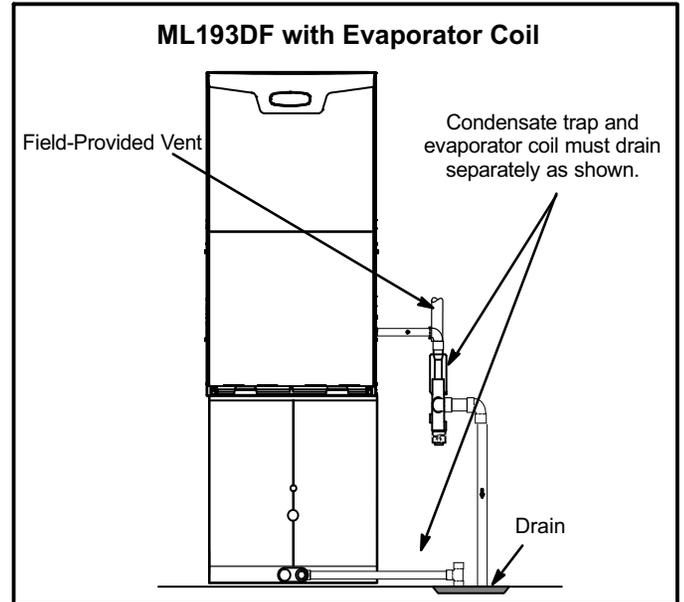
**NOTE** - If necessary the condensate trap may be installed up to 5 feet away from the furnace. Piping from furnace must slope down a minimum of 1/4" per ft. toward trap.

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



**FIGURE 43**



**FIGURE 44**

**⚠ CAUTION**

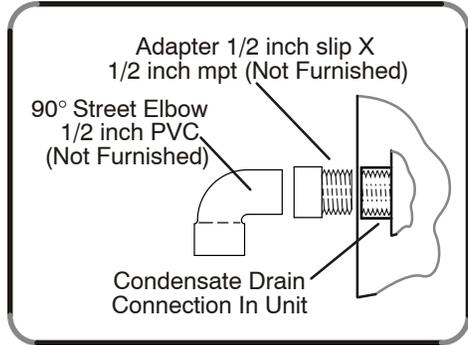
**Do not use copper tubing or existing copper condensate lines for drain line.**

**⚠ CAUTION**

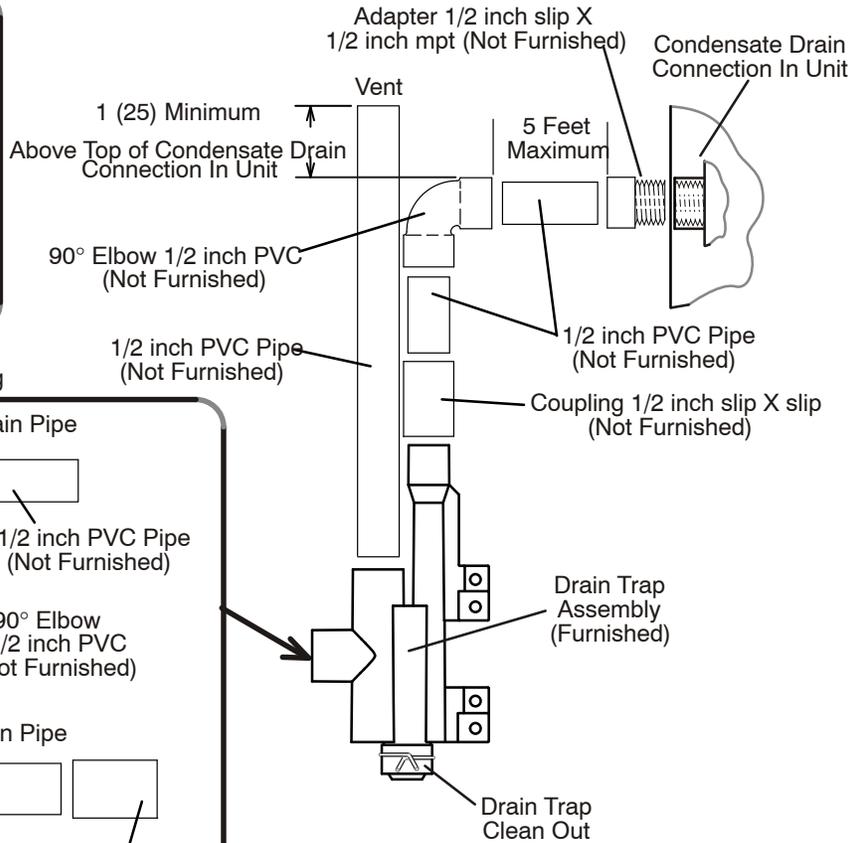
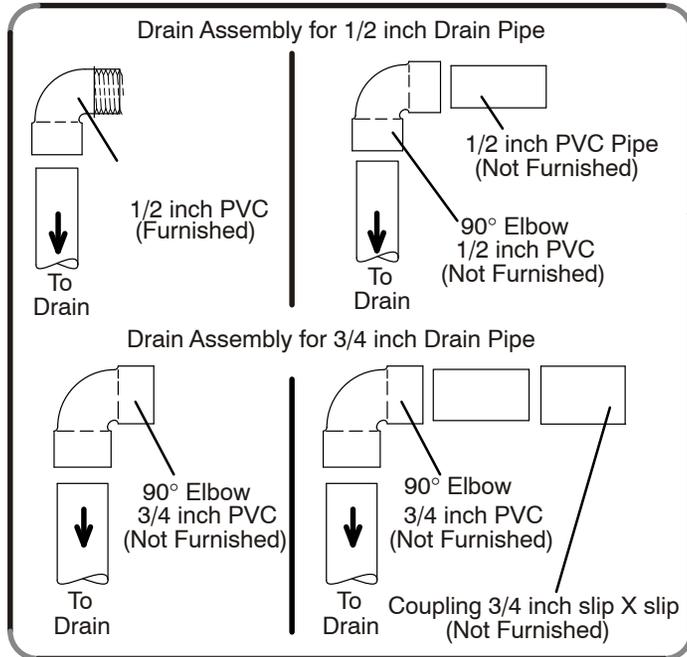
**A separate drain line must be run to the drain from the condensate trap to ensure proper drainage and pressure switch operation. DO NOT connect the condensate trap drain into the drain line from the evaporator coil.**

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

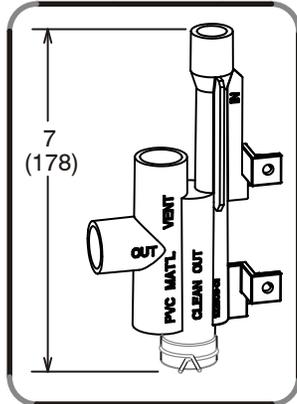
### OPTIONAL Condensate Drain Connection



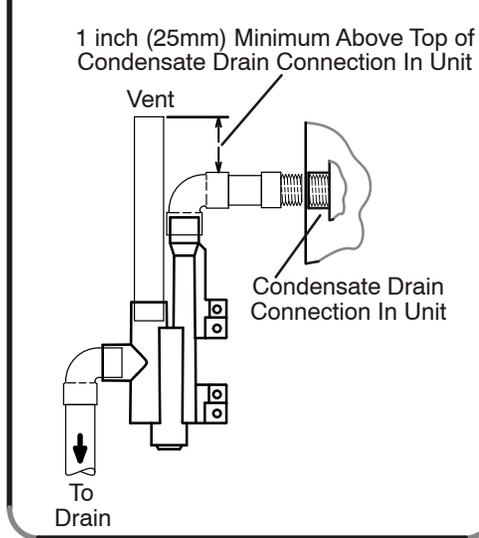
### OPTIONAL Drain Piping



### Drain Trap Assembly (Furnished)



### Drain Trap Assembly with 1/2 inch Piping



### Drain Trap Assembly with 3/4 inch Piping

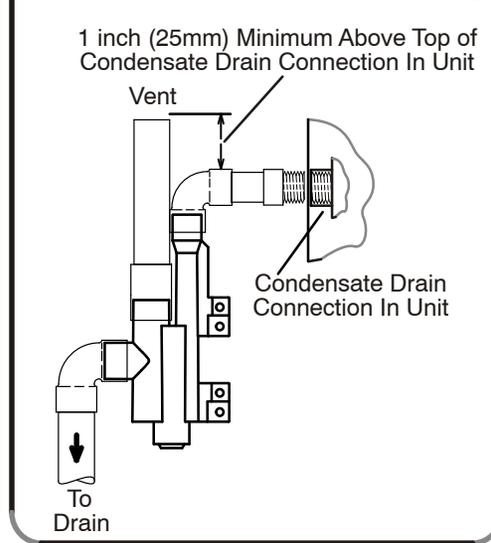


FIGURE 45

### 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 ML193DF 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:

ML193DF 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.

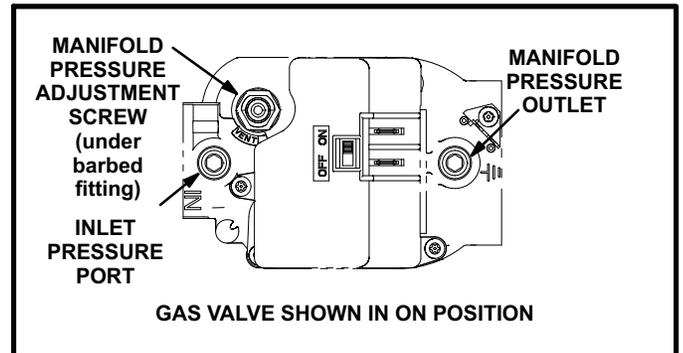
## ⚠ WARNING

**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 46)

- 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 46.
- 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 46.



**FIGURE 46**

- 9 - Replace the upper access panel.
  - 10 - Turn on all electrical power 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-C.S.A. Certification

All units are C.S.A. design certified without modifications. Refer to the ML193DF Operation and Installation Instruction Manual Information.

### 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.

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 0.5psig (14" W.C.). See figure 47.

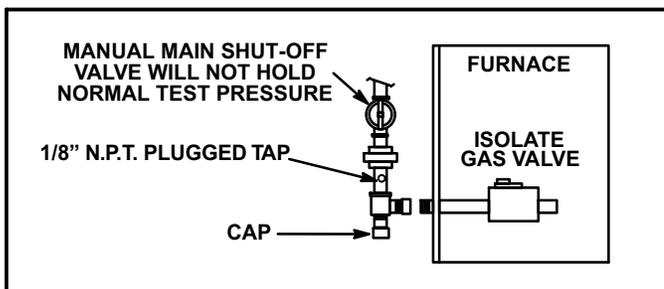


FIGURE 47

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.

#### ⚠ WARNING

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

### D-Testing Gas Supply Pressure

When testing supply gas pressure, use the 1/8" N.P.T. plugged tap or pressure post located on the gas valve to facilitate test gauge connection. See figure 46. Check gas line pressure with unit firing at maximum rate. Low pressure may result in erratic operation or underfire. High pressure can result in permanent damage to gas valve or overfire.

On multiple unit installations, each unit should be checked separately, with and without units operating. Supply pressure must fall within range listed in table 13.

### E-Check Manifold Pressure

After line pressure has been checked and adjusted, check manifold pressure. Move pressure gauge to outlet pressure tap located on unit gas valve (GV1).

Checks of manifold pressure are made as verification of proper regulator adjustment.

#### ⚠ 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 - Remove the threaded plug from the outlet side of the gas valve and install a field-provided barbed fitting. Connect to a manometer to measure manifold pressure.
- 2 - Start unit and allow 5 minutes for unit to reach steady state.
- 3 - While waiting for the unit to stabilize, observe the flame. Flame should be stable and should not lift from burner. Natural gas should burn blue.
- 4 - After allowing unit to stabilize for 5 minutes, record manifold pressure and compare to value given in table 13.

**NOTE** - Shut unit off and remove manometer as soon as an accurate reading has been obtained. Take care to remove barbed fitting and replace threaded plug.

TABLE 13

#### Manifold and Supply Pressure (Outlet) inches w.c.

Fuel	Model Input Sizes	Manifold Pressure in.wg.	Supply Pressure in.wg.	
			Min.	Max.
Nat. Gas	All sizes	3.5	4.5	10.5
L.P. Gas	All sizes	10.0	11.0	13.0

## F- Proper Gas Flow (Approximate)

### Gas Flow (Approximate)

TABLE 14

GAS METER CLOCKING CHART				
ML193 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
-110	33	66	82	164
Natural-1000 btu/cu ft			LP-2500 btu/cu ft	

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

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 14. If manifold pressure matches table 13 and rate is incorrect, check gas orifices for proper size and restriction. Remove temporary gas meter if installed.

## G- Proper Combustion

Furnace should operate at least 15 minutes with correct manifold pressure and gas flow rate before checking combustions. Take sample beyond the flue outlet and compare to table 15.

TABLE 15

ML193 Unit	CO <sub>2</sub> % For Nat	CO <sub>2</sub> % For L.P.
-045	7.2 - 7.9	8.6 - 9.3
-070		
-090		
-110		
The carbon monoxide reading should not exceed 50 ppm.		

## H- High Altitude

**NOTE** - In Canada, certification for installations at elevations over 4500 feet (1372 m) is the jurisdiction of local authorities.

ML193DF units require no manifold pressure adjustments for operation at altitudes up to 10,000 feet (3048 m) above sea level. Units installed at altitude of 4501 - 10,000 feet (1373 to 3048m) require a pressure switch change which can be ordered separately. Table 16 lists conversion kit and pressure switch requirements at varying altitudes.

The combustion air pressure switch is factory-set and requires no adjustment.

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

TABLE 16

### Conversion Kit and Pressure Switch Requirements at Varying Altitudes

ML193 Unit	Natural to LP/Propane	High Altitude Natural Burner Orifice Kit	LP/Propane to Natural	High Altitude Pressure Switch	
	0 - 7500 ft (0 - 2286m)	7501 - 10,000 ft (2286 - 3038m)	0 - 7500 ft (0 - 2286m)	4501 - 7500 ft (1373 - 2286m)	7501 -10,000 ft (2286 - 3048m)
-045	*69W73	73W37	*73W81	74W90	74W91
-070					
-090					
-110					

\* 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).

## I-Flame Signal

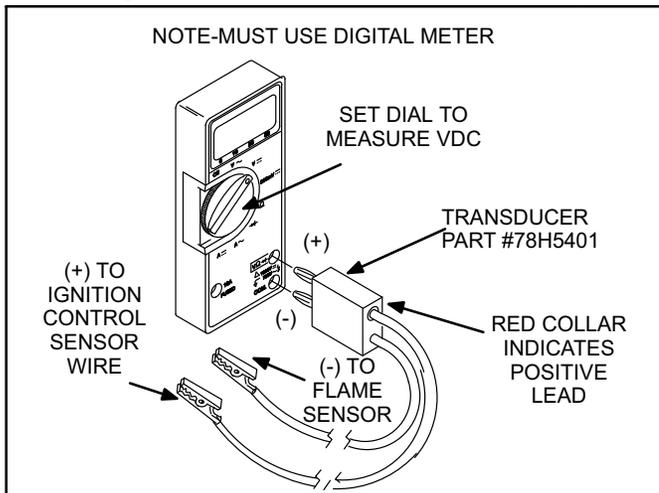
A transducer (Part #78H5401 available from Lennox Repair Parts) is required to measure flame signal if meter used will not read a low micro amp signal. See figure 48. The transducer converts microamps to volts on a 1:1 conversion. Flame signal is shown in table 17. A digital readout meter must be used. The transducer plugs into most meters.

**TABLE 17**

Normal Flame Signal	$\geq 1.50$ Microamps
Low Flame Signal	$\leq 1.40$ Microamps
Drop Out Signal	$= 0.50$ Microamps

### To Measure Flame Signal:

- 1 - Set the volt meter to the DC voltage scale. Insert transducer into the VDC and common inputs. Observe correct polarities. Failure to do so results in negative (-) values.
- 2 - Turn off supply voltage to control.
- 3 - Disconnect ignition control flame sensor wire from the flame sensor.
- 4 - Connect (-) lead of the transducer to flame sensor.
- 5 - Connect (+) lead of transducer to the ignition control sensor wire.
- 6 - Turn supply voltage on and close thermostat contacts to cycle system.
- 7 - When main burners are in operation for two minutes, take reading. Remember 1 DC volt = 1 DC microamp.



**FIGURE 48**

## 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 sub-base 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

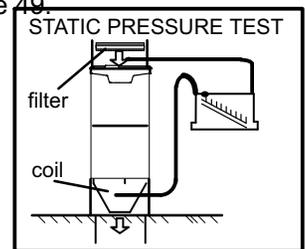
Temperature rise depends on unit input, blower speed, blower horsepower and static pressure as marked on the unit rating plate. The blower speed must be set for unit operation within the range of "TEMP. RISE °F" listed on the unit rating plate.

### To Measure Temperature Rise:

- 1 - Place plenum thermometers in the supply and return air plenums. Locate supply air thermometer in the first horizontal run of the plenum where it will not pick up radiant heat from the heat exchanger.
- 2 - Set thermostat for heat call. Unit must operate on second-stage heat.
- 3 - After plenum thermometers have reached their highest and steadiest readings, subtract the two readings. The difference should be in the range listed on the unit rating plate. If the temperature is too low, decrease blower speed. If temperature is too high, first check the firing rate. Provided the firing rate is acceptable, increase blower speed to reduce temperature.

### C-External Static Pressure

- 1 - Tap locations shown in figure 49.
  - 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 perma-gum. 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.
  - 4 - External static pressure drop must not be more than 0.8" W.C. in the heating mode and must not exceed 1.0" W.C in the cooling mode.
  - 5 - Seal the hole when the check is complete.
- To change existing heat tap, turn off power then switch out speed tap with tap connected to "PARK" . See unit diagram for blower motor tap colors for each speed.



**FIGURE 48**

## 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 18 lists recommended filter sizes.

**TABLE 18**

Furnace Cabinet Width	Filter Size
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). Correct voltage is 120VAC  $\pm$  10%
- 3 - Check amp-draw on the blower motor with blower access panel in place.  
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.

#### **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 2 wires from the gas valve.
- 4 - Remove gas supply line connected to gas valve. 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 drain tubing from flue collar. and remove the vent elbow.
- 8 - 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.

- 9 - Mark and disconnect all combustion air pressure tubing from cold end header collector box.
- 10 - Mark and remove wires from pressure switches. Remove pressure switches. Keep tubing attached to pressure switches.
- 11 - 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.
- 12 - Remove electrical junction box from the side of the furnace.
- 13 - 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.
- 14 - Remove the primary limit from the vestibule panel.
- 15 - Remove two screws from the front cabinet flange at the blower deck. Spread cabinet sides slightly to allow clearance for removal of heat exchanger.
- 16 - Remove screws along vestibule sides and bottom which secure vestibule panel and heat exchanger assembly to cabinet. Remove two screws from blower rail which secure bottom heat exchanger flange. Remove heat exchanger from furnace cabinet.
- 17 - Back wash heat exchanger with soapy water solution or steam. **If steam is used it must be below 275°F (135°C)**.
- 18 - Thoroughly rinse and drain the heat exchanger. Soap solutions can be corrosive. Take care to rinse entire assembly.

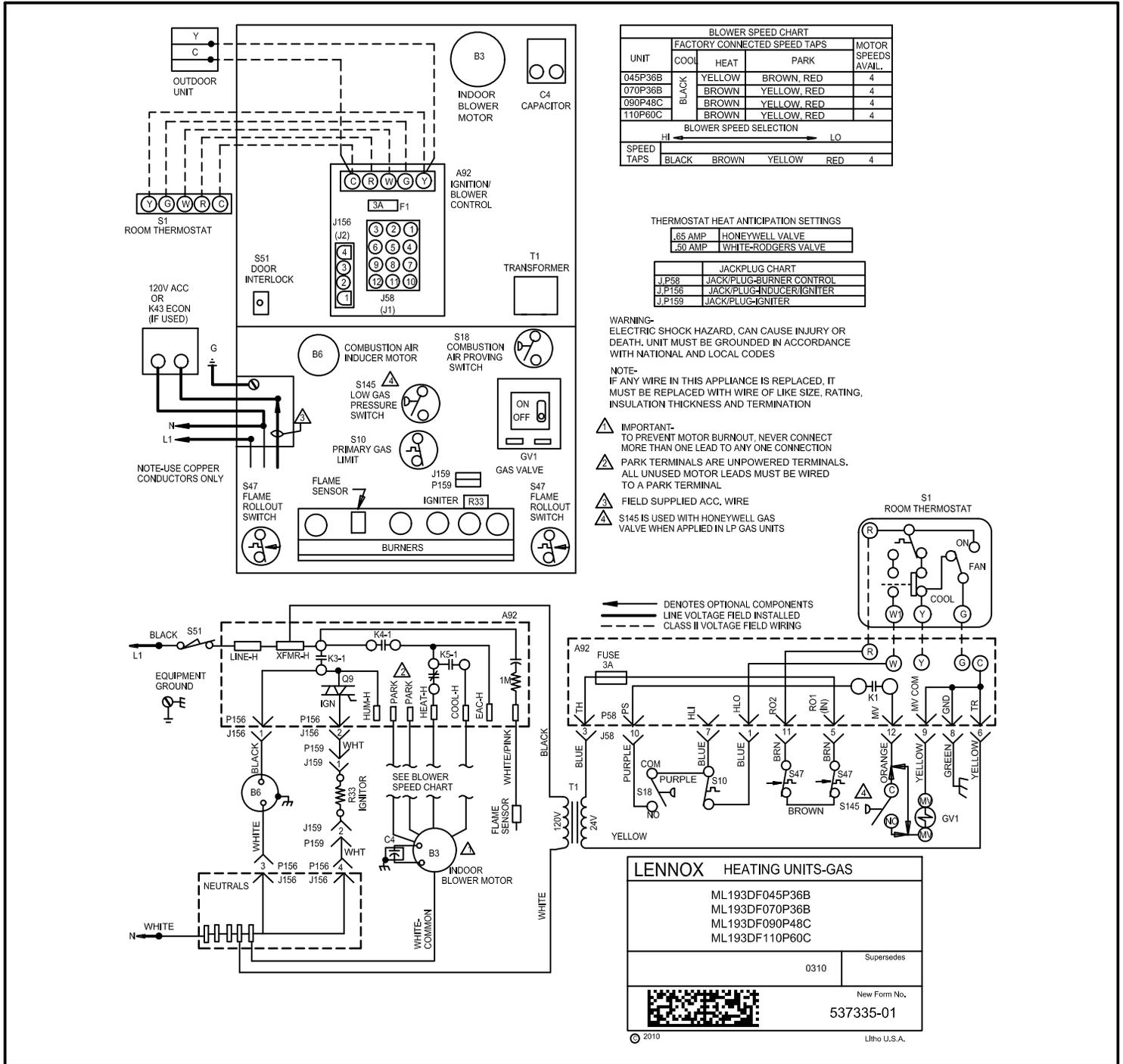
- 19 - Reinstall heat exchanger into cabinet making sure that the clamshells of the heat exchanger assembly are resting on the support located at the rear of the cabinet. Remove the indoor blower to view this area through the blower opening.
- 20 - Re-secure the supporting screws along the vestibule sides and bottom to the cabinet. Reinstall blower and mounting screws.
- 21 - Reinstall cabinet screws on front flange at blower deck.
- 22 - Reinstall the primary limit on the vestibule panel.
- 23 - Route heating component wiring through hole in blower deck and reinsert strain relief bushing.
- 24 - Reinstall electrical junction box.
- 25 - Reinstall the combustion air inducer. Reconnect the combustion air inducer to the wire harness.
- 26 - Reinstall pressure switches and reconnect pressure switch wiring.
- 27 - Carefully connect combustion air pressure switch hosing from pressure switches to proper stubs on cold end header collector box.
- 28 - Reinstall condensate trap.
- 29 - Reconnect exhaust piping and exhaust drain tubing.
- 30 - Reinstall burner box assembly in vestibule area.
- 31 - Reconnect flame roll-out switch wires.
- 32 - Reconnect sensor wire and reconnect 2-pin plug from ignitor.
- 33 - Secure burner box assembly to vestibule panel using four existing screws. **Make sure burners line up in center of burner ports.**
- 34 - Reinstall gas valve manifold assembly. Reconnect gas supply line to gas valve.
- 35 - Reconnect 2 wires to gas valve.
- 36 - Replace the blower compartment access panel.
- 37 - Refer to instruction on verifying gas and electrical connections when re-establishing supplies.

- 38 - 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.
- 39 - Replace heating compartment access panel.

#### **Cleaning the Burner Assembly**

- 1 - Turn off electrical and gas power supplies to furnace. Remove upper and lower furnace access panels.
- 2 - Disconnect the 2-pin plug from the gas valve.
- 3 - Remove the burner box cover.
- 4 - Disconnect the gas supply line from the gas valve. Remove gas valve/manifold assembly.
- 5 - Mark and disconnect sensor wire from the sensor. Disconnect 2-pin plug from the ignitor at the burner box.
- 6 - Remove four screws which secure burner box assembly to vest panel. Remove burner box from the unit.
- 7 - 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.
- 8 - Reconnect the sensor wire and reconnect the 2-pin plug to the ignitor wiring harness.
- 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 - Reinstall the gas valve manifold assembly. Reconnect the gas supply line to the gas valve. Reinstall the burner box cover.
- 11 - Reconnect 2-pin plug to gas valve.
- 12 - Replace the blower compartment access panel.
- 13 - Refer to instruction on verifying gas and electrical connections when re-establishing supplies.
- 14 - 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.
- 15 - Replace heating compartment access panel.

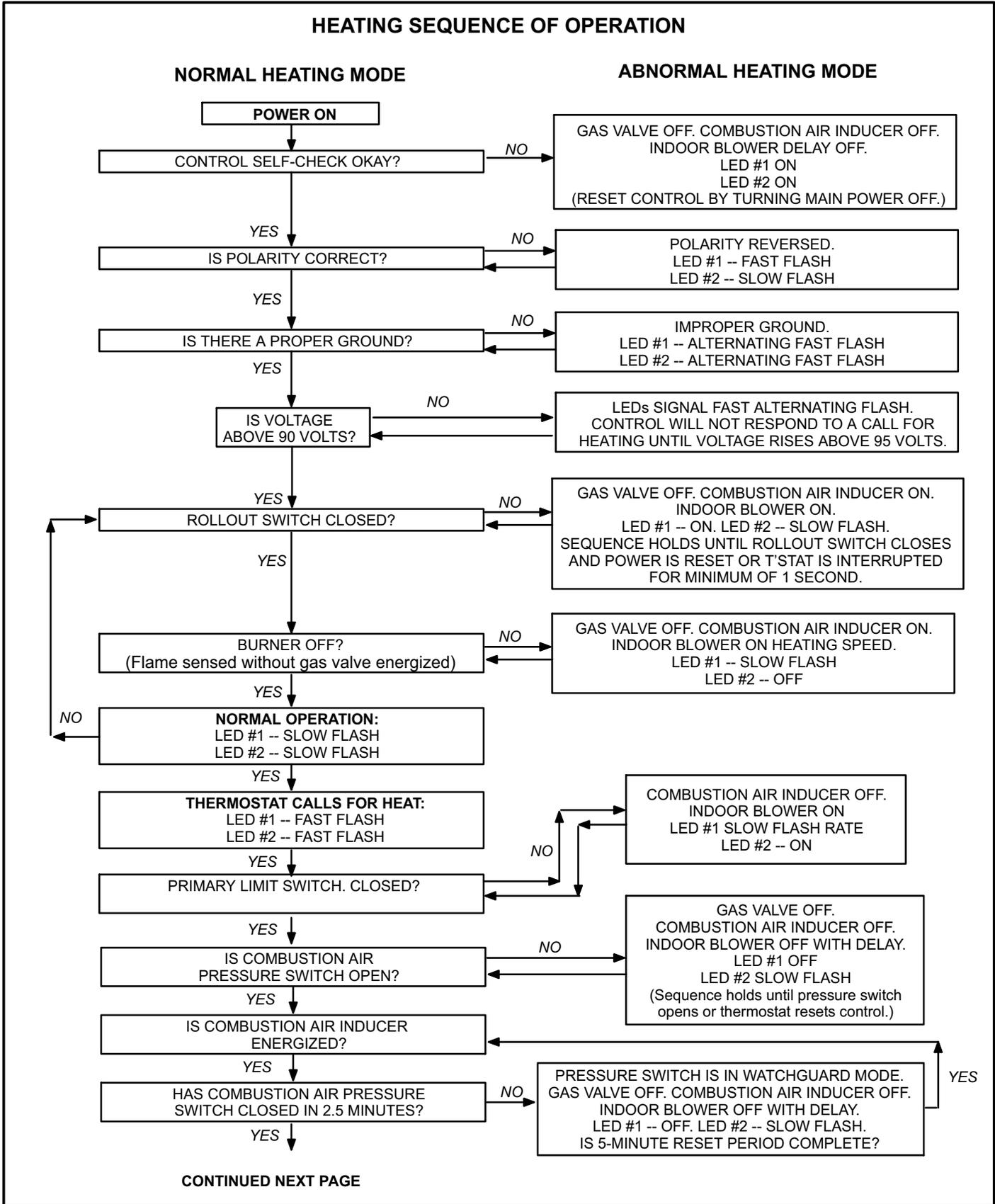
# VII-WIRING DIAGRAM AND SEQUENCE OF OPERATION



- When there is a call for heat, W1 of the thermostat energizes W of the furnace control with 24VAC.
- S10 primary limit switch and S47 rollout switch are closed. Call for heat can continue.
- The integrated control (A92) energizes combustion air inducer B6. Combustion air inducer runs until S18 combustion air prove switch closes (switch must close within 2-1/2 minutes or control goes into 5 minute Watchguard Pressure Switch delay). Once S18 closes, a 15-second pre-purge follows.
- The integrated control (A92) energizes ignitor. A 20-second warm-up period begins.

- Gas valve opens for a 4-second trial for ignition
- Flame is sensed, gas valve remains open for the heat call.
- After 45-second delay, the integrated control (A92) energizes indoor blower B3.
- When heat demand is satisfied, W1 of the indoor thermostat de-energizes W of the integrated control which de-energizes the gas valve. Combustion air inducer B6 continues a 5-second post-purge period, and indoor blower B3 completes a selected OFF time delay.

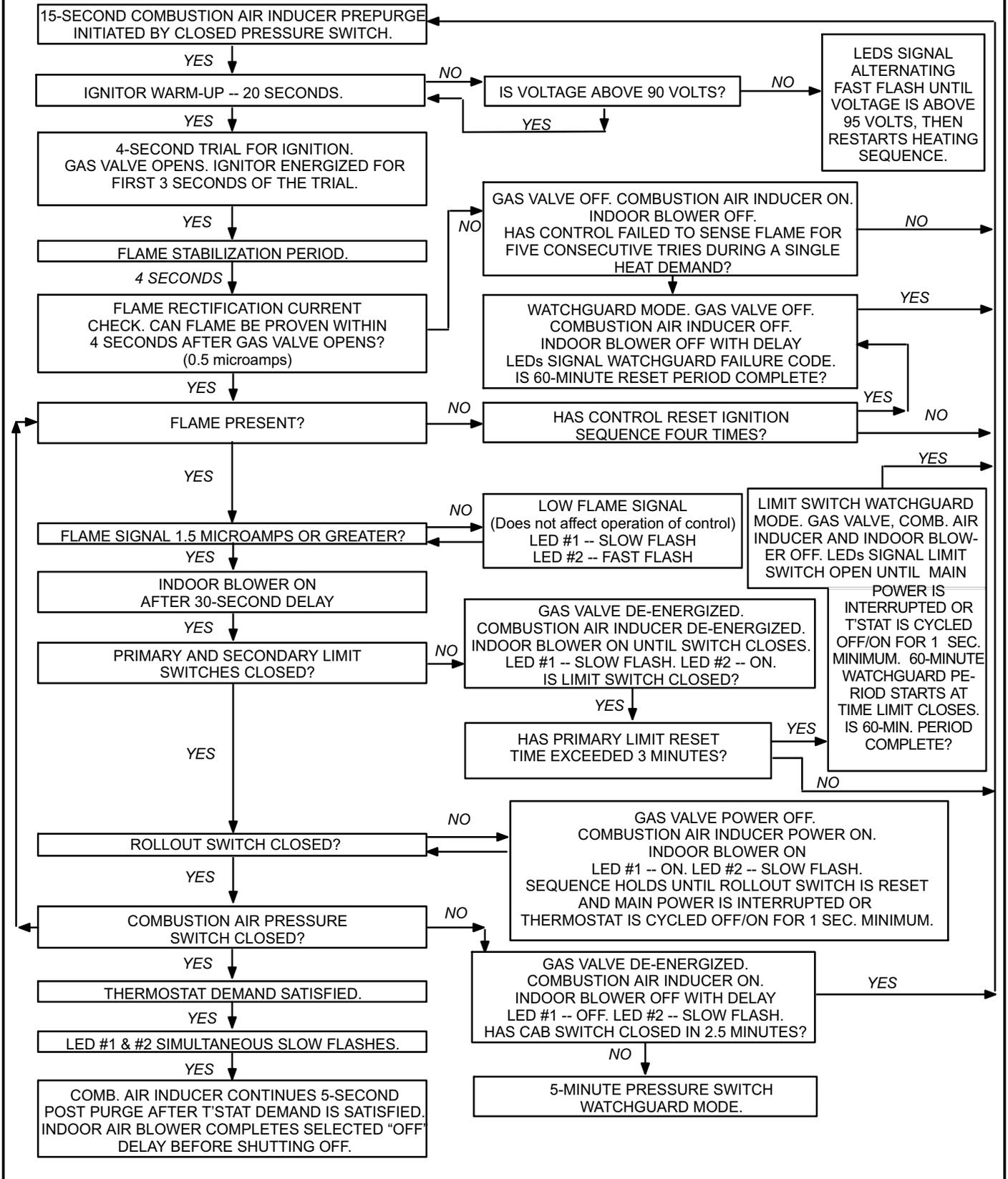
# Sequence of Operation Flow Chart



## HEATING SEQUENCE CONTINUED

### NORMAL HEATING MODE

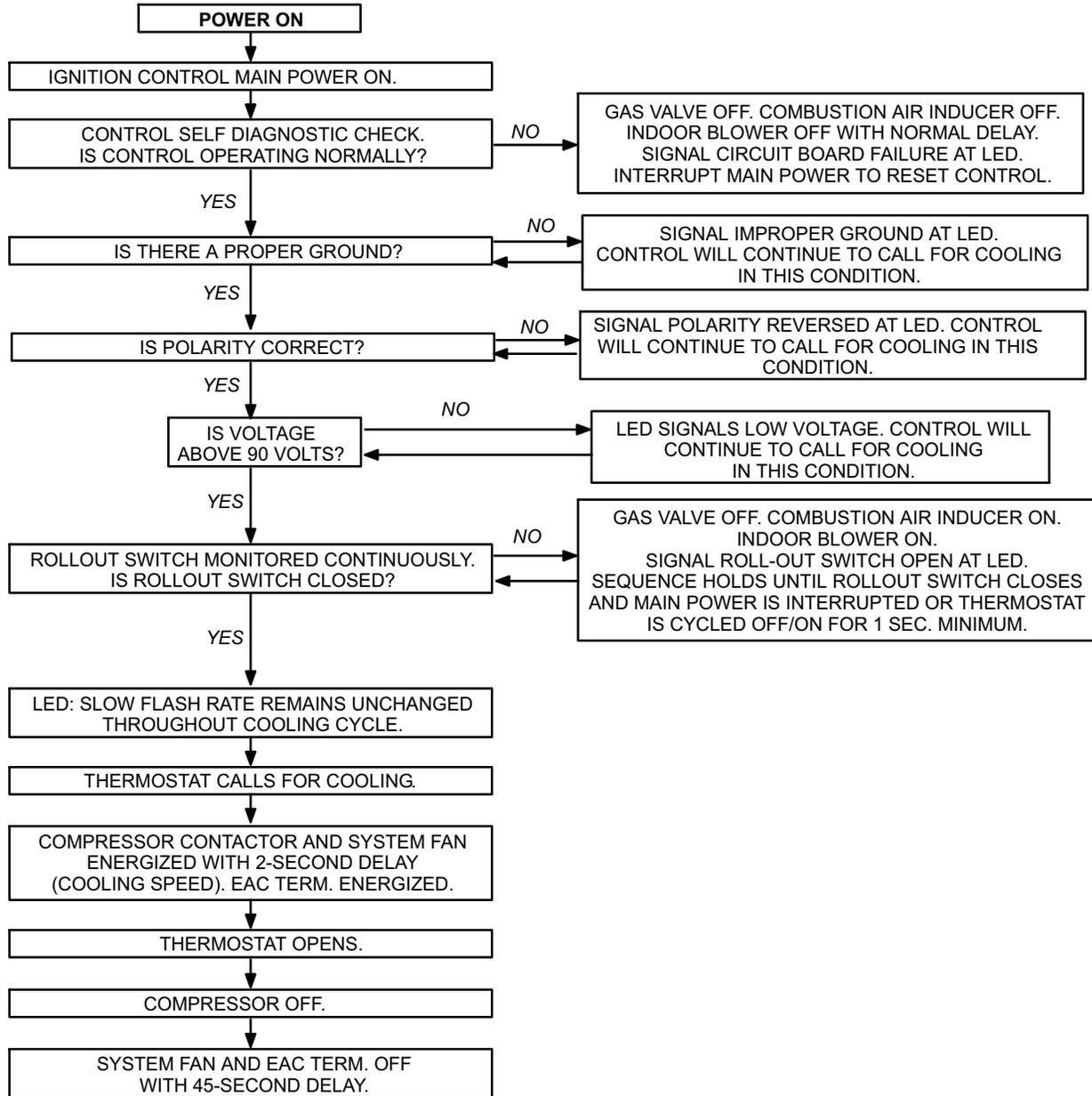
### ABNORMAL HEATING MODE



## COOLING SEQUENCE OF OPERATION

### NORMAL COOLING MODE

### ABNORMAL COOLING MODE



## CONTINUOUS HEAT SPEED FAN SEQUENCE OF OPERATION

