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.

**WARNING**

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

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**WARNING**

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

**WARNING**

Sharp edges. Be careful when servicing unit to avoid sharp edges which may result in personal injury.
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Gas Heating Performance</th>
<th>Model No.</th>
<th>ML193DF045P36B</th>
<th>ML193DF070P36B</th>
<th>ML193DF090P48C</th>
<th>ML193DF110P60C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AFUE</strong></td>
<td></td>
<td>93%</td>
<td>93%</td>
<td>93%</td>
<td>93%</td>
</tr>
<tr>
<td><strong>Input - Btuh</strong></td>
<td></td>
<td>44,000</td>
<td>66,000</td>
<td>88,000</td>
<td>110,000</td>
</tr>
<tr>
<td><strong>Output - Btuh</strong></td>
<td></td>
<td>41,000</td>
<td>61,000</td>
<td>82,000</td>
<td>102,000</td>
</tr>
<tr>
<td><strong>Temperature rise range - °F</strong></td>
<td></td>
<td>25 - 55</td>
<td>50 - 80</td>
<td>40 - 70</td>
<td>50 - 80</td>
</tr>
<tr>
<td><strong>Gas Manifold Pressure (in. w.g.)</strong></td>
<td></td>
<td>3.5 / 10.0</td>
<td>3.5 / 10.0</td>
<td>3.5 / 10.0</td>
<td>3.5 / 10.0</td>
</tr>
<tr>
<td><strong>High static - in. w.g.</strong></td>
<td></td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connections in.</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intake / Exhaust Pipe (PVC)</strong></td>
<td></td>
<td>2 / 2</td>
<td>2 / 2</td>
<td>2 / 2</td>
<td>2 / 2</td>
</tr>
<tr>
<td><strong>Gas pipe size IPS</strong></td>
<td></td>
<td>1/2</td>
<td>1/2</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td><strong>Condensate Drain Trap (PVC pipe) - i.d.</strong></td>
<td></td>
<td>1/2</td>
<td>1/2</td>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td><strong>with field supplied (PVC coupling) - o.d.</strong></td>
<td></td>
<td>3/4</td>
<td>3/4</td>
<td>3/4</td>
<td>3/4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indoor Blower</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wheel nom. dia. x width - in.</strong></td>
<td></td>
<td>10 x 8</td>
<td>10 x 8</td>
<td>10 x 10</td>
<td>11 ½ x 10</td>
</tr>
<tr>
<td><strong>Motor output - hp</strong></td>
<td></td>
<td>1/3</td>
<td>1/3</td>
<td>1/2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Tons of add-on cooling</strong></td>
<td></td>
<td>2.5 - 3</td>
<td>2.5 - 3</td>
<td>3 - 4</td>
<td>4 - 5</td>
</tr>
<tr>
<td><strong>Air Volume Range - cfm</strong></td>
<td></td>
<td>605 - 1615</td>
<td>560 - 1550</td>
<td>920 - 2145</td>
<td>1210 - 2410</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical Data</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td></td>
<td>120 volts - 60 hertz - 1 phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Blower motor full load amps</strong></td>
<td></td>
<td>6.1</td>
<td>6.1</td>
<td>8.2</td>
<td>11.5</td>
</tr>
<tr>
<td><strong>Maximum overcurrent protection</strong></td>
<td></td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shipping Data</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>lbs. - 1 package</strong></td>
<td></td>
<td>124</td>
<td>129</td>
<td>147</td>
<td>162</td>
</tr>
</tbody>
</table>

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

1 Annual Fuel Utilization Efficiency based on DOE test procedures and according to FTC labeling regulations. Isolated combustion system rating for non-weatherized furnaces.
### OPTIONAL ACCESSORIES - MUST BE ORDERED EXTRA

<table>
<thead>
<tr>
<th>CABINET ACCESSORIES</th>
<th>“B” Width Models</th>
<th>“C” Width Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downflow Combustible Flooring Base</td>
<td>11M60</td>
<td>11M61</td>
</tr>
</tbody>
</table>

| CONDENSATE DRAIN KITS |  |
|-----------------------|------------------|------------------|
| Condensate Drain Heat Cable | 6 ft. | 26K68 | 26K68 |
|                        | 24 ft. | 26K69 | 26K69 |
|                        | 50 ft. | 26K70 | 26K70 |
| Heat Cable Tape | Fiberglass - 1/2 in. x 66 ft. | 36G53 | 36G53 |
|            | Aluminum foil - 2 in. x 60 ft. | 16P89 | 16P89 |
| Crawl Space Vent Drain Kit | 51W18 | 51W18 |

| CONTROLS |  |
|----------|------------------|------------------|
| Twinning Kit |  | 65W80 | 65W80 |

| DOWNFLOW FILTER KITS |  |
|----------------------|------------------|------------------|
| Downflow Air Filter and Rack Kit | 51W07 | 51W08 |
| No. and Size of filter - in. | (2) 20 x 20 x 1 | (2) 20 x 20 x 1 |

| NIGHT SERVICE KITS |  |
|--------------------|------------------|------------------|
| Night Service Kit | 51W03 | 51W03 |

| TERMINATION KITS |  |
|------------------|------------------|------------------|
| See Installation Instructions for specific venting information. |

#### Termination Kits - Direct or Non-Direct vent

1 Cleanable polyurethane frame type filter.  
2 Kits contain enough parts for two, non-direct vent installations.  
3 Non-direct vent only.

<table>
<thead>
<tr>
<th>Termination Kits -</th>
<th>Concentric</th>
<th>US - 2 in.</th>
<th>71M80</th>
<th>69M29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct or Non-Direct only</td>
<td>3 in.</td>
<td>- - -</td>
<td>60L46</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Canada - 2 in.</td>
<td>44W92</td>
<td>44W92</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 in.</td>
<td>- - -</td>
<td>44W93</td>
<td></td>
</tr>
<tr>
<td>Flush-Mount</td>
<td>2, 2-1/2 or 3 in.</td>
<td>51W11</td>
<td>51W11</td>
<td></td>
</tr>
<tr>
<td>Wall - Close Couple</td>
<td>US - 2 in.</td>
<td>22G44</td>
<td>- - -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 in.</td>
<td>44J40</td>
<td>44J40</td>
<td></td>
</tr>
<tr>
<td>Wall - Close Couple WTK</td>
<td>Canada - 2 in.</td>
<td>30G28</td>
<td>- - -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 in.</td>
<td>81J20</td>
<td>81J20</td>
<td></td>
</tr>
</tbody>
</table>

#### Roof Termination Flashing Kit - Direct or Non-Direct Vent  
- Contains two flashings

| Roof Termination Flashing Kit |  |
|------------------------------|------------------|------------------|
| 2 in. | 15F75 | 15F75 |
| Wall Ring Kit | 2 in. | 15F74 | 3 15F74 |
| 44J41 | 44J41 |

**GAS HEAT ACCESSORIES**

<table>
<thead>
<tr>
<th>Input</th>
<th>High Altitude Pressure Switch Kit</th>
<th>Natural Gas to LPG/Propane Kit</th>
<th>LPG/Propane to Natural Gas Kit</th>
<th>Natural Gas High Altitude Orifice Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4501 - 7500 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7501 - 10,000 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 7500 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 7500 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7501- 10,000 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>all models</td>
<td>74W90</td>
<td>74W91</td>
<td>69W73</td>
<td>73W81</td>
</tr>
</tbody>
</table>
### ML193DF045XP36B PERFORMANCE (Less Filter)

<table>
<thead>
<tr>
<th>External Static Pressure in. w.g.</th>
<th>Air Volume / Watts at Various Blower Speeds</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium-High</td>
</tr>
<tr>
<td></td>
<td>cfm</td>
<td>Watts</td>
</tr>
<tr>
<td>0.00</td>
<td>1615</td>
<td>650</td>
</tr>
<tr>
<td>0.10</td>
<td>1605</td>
<td>640</td>
</tr>
<tr>
<td>0.20</td>
<td>1500</td>
<td>620</td>
</tr>
<tr>
<td>0.30</td>
<td>1450</td>
<td>590</td>
</tr>
<tr>
<td>0.40</td>
<td>1350</td>
<td>560</td>
</tr>
<tr>
<td>0.50</td>
<td>1300</td>
<td>545</td>
</tr>
<tr>
<td>0.60</td>
<td>1195</td>
<td>500</td>
</tr>
<tr>
<td>0.70</td>
<td>1140</td>
<td>485</td>
</tr>
<tr>
<td>0.80</td>
<td>1025</td>
<td>450</td>
</tr>
<tr>
<td>0.90</td>
<td>945</td>
<td>435</td>
</tr>
</tbody>
</table>

### ML193DF090XP48C PERFORMANCE (Less Filter)

<table>
<thead>
<tr>
<th>External Static Pressure in. w.g.</th>
<th>Air Volume / Watts at Various Blower Speeds</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium-High</td>
</tr>
<tr>
<td></td>
<td>cfm</td>
<td>Watts</td>
</tr>
<tr>
<td>0.00</td>
<td>2075</td>
<td>800</td>
</tr>
<tr>
<td>0.10</td>
<td>1995</td>
<td>755</td>
</tr>
<tr>
<td>0.20</td>
<td>1910</td>
<td>715</td>
</tr>
<tr>
<td>0.30</td>
<td>1825</td>
<td>680</td>
</tr>
<tr>
<td>0.40</td>
<td>1730</td>
<td>645</td>
</tr>
<tr>
<td>0.50</td>
<td>1630</td>
<td>615</td>
</tr>
<tr>
<td>0.60</td>
<td>1530</td>
<td>585</td>
</tr>
<tr>
<td>0.70</td>
<td>1430</td>
<td>555</td>
</tr>
<tr>
<td>0.80</td>
<td>1300</td>
<td>525</td>
</tr>
<tr>
<td>0.90</td>
<td>1185</td>
<td>495</td>
</tr>
</tbody>
</table>

### ML193DF070XP36B PERFORMANCE (Less Filter)

<table>
<thead>
<tr>
<th>External Static Pressure in. w.g.</th>
<th>Air Volume / Watts at Various Blower Speeds</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium-High</td>
</tr>
<tr>
<td></td>
<td>cfm</td>
<td>Watts</td>
</tr>
<tr>
<td>0.00</td>
<td>1505</td>
<td>660</td>
</tr>
<tr>
<td>0.10</td>
<td>1480</td>
<td>625</td>
</tr>
<tr>
<td>0.20</td>
<td>1405</td>
<td>585</td>
</tr>
<tr>
<td>0.30</td>
<td>1355</td>
<td>580</td>
</tr>
<tr>
<td>0.40</td>
<td>1305</td>
<td>540</td>
</tr>
<tr>
<td>0.50</td>
<td>1270</td>
<td>525</td>
</tr>
<tr>
<td>0.60</td>
<td>1175</td>
<td>500</td>
</tr>
<tr>
<td>0.70</td>
<td>1105</td>
<td>460</td>
</tr>
<tr>
<td>0.80</td>
<td>1040</td>
<td>440</td>
</tr>
<tr>
<td>0.90</td>
<td>920</td>
<td>400</td>
</tr>
</tbody>
</table>

### ML193DF110XP60C PERFORMANCE (Less Filter)

<table>
<thead>
<tr>
<th>External Static Pressure in. w.g.</th>
<th>Air Volume / Watts at Various Blower Speeds</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium-High</td>
</tr>
<tr>
<td></td>
<td>cfm</td>
<td>Watts</td>
</tr>
<tr>
<td>0.00</td>
<td>2410</td>
<td>1390</td>
</tr>
<tr>
<td>0.10</td>
<td>2405</td>
<td>1385</td>
</tr>
<tr>
<td>0.20</td>
<td>2285</td>
<td>1345</td>
</tr>
<tr>
<td>0.30</td>
<td>2220</td>
<td>1315</td>
</tr>
<tr>
<td>0.40</td>
<td>2185</td>
<td>1295</td>
</tr>
<tr>
<td>0.50</td>
<td>2045</td>
<td>1240</td>
</tr>
<tr>
<td>0.60</td>
<td>1965</td>
<td>1220</td>
</tr>
<tr>
<td>0.70</td>
<td>1820</td>
<td>1165</td>
</tr>
<tr>
<td>0.80</td>
<td>1625</td>
<td>1155</td>
</tr>
<tr>
<td>0.90</td>
<td>1455</td>
<td>1110</td>
</tr>
</tbody>
</table>
CONTROL BOX
(Includes integrated control, transformer and door switch)

BLOWER MOTOR
(hidden)

BLOWER ACCESS PANEL

COMBUSTION AIR INDUCER

BURNER ACCESS PANEL

GAS VALVE

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

BLOWER DECK

COLD END HEADER BOX

PRIMARY LIMIT

HEAT EXCHANGER

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.

ML193DF Control Box

![ML193DF Control Box](image)

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 100973 (A92)

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 (by-passed). Once the prove switch is determined to be open, the combustion air inducer is energized. When the differen-
tial 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 after which the gas valve opens 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.

<table>
<thead>
<tr>
<th>JUMPER POSITION</th>
<th>REST OFF DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN1 PIN2</td>
<td>60</td>
</tr>
<tr>
<td>PIN2 PIN3</td>
<td>90</td>
</tr>
<tr>
<td>PIN3 PIN4</td>
<td>120</td>
</tr>
<tr>
<td>PIN4 PIN5</td>
<td>180</td>
</tr>
<tr>
<td>NO JUMPER</td>
<td>180</td>
</tr>
</tbody>
</table>

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

**FIGURE 3**

---

**INTEGRATED CONTROL**

(Automatic Hot Surface Ignition System)

**TERMINAL DESIGNATIONS**

- **HUM**: Humidifier (120VAC)
- **LINE**: Input (120VAC)
- **XFMR**: Transformer (120VAC)
- **EAC**: Electronic Air Cleaner (120VAC)
- **COOL**: Blower - Cooling Speed (120VAC)
- **HEAT**: Blower - Heating Speed (120VAC)
- **PARK**: Dead terminals to park alternate spd taps
- **FLAME**: Flame sensor
- **NEUTRAL**: Neutral terminals (120VAC)

**3 AMP, 32 VAC FUSE**

**FIGURE 4**
The integrated control is equipped with two LED lights for troubleshooting. The diagnostic codes are listed below in Table 3.

**TABLE 3**

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

**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**

*Ignitor will energize the first 3 seconds of the 4 second trial for ignition
**Blower on time will be 45 seconds after gas valve is energized. Blower off time will depend on “OFF TIME” Setting.
4. Integrated Ignition Control 103085 (A92)

**WARNING**

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

The hot surface ignition control system consisting of an integrated control (figure 6 with control terminal designations in tables 4 and 5), flame sensor and ignitor (figure 10). 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 a RED LED for troubleshooting and two accessory terminals rated at (1) one amp. See table 6 for troubleshooting diagnostic codes. The 120 volt ignitor is made from a high strength, silicon nitride material that provides long life and trouble free maintenance.

**Electronic Ignition (Figure 7)**

On a call for heat the integrated control monitors the combustion air inducer pressure switch. The control will not begin the heating cycle if the pressure switch is closed (bypassed). Once the pressure switch is determined to be open, the combustion air inducer is energized. When the differential in the pressure switch is great enough, the pressure switch closes and a 15-second pre-purge begins. If the pressure 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 after which the gas valve opens for a 4-second trial for ignition. The ignitor remains energized for the first 3 seconds of the trial for ignition. If ignition is not proved during the trial for ignition, the integrated control will try four more times with an inter purge and warm-up time between trials of 30 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.

**TABLE 4**

<table>
<thead>
<tr>
<th>PIN #</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Combustion Air Inducer Line</td>
</tr>
<tr>
<td>2</td>
<td>Ignitor Line</td>
</tr>
<tr>
<td>3</td>
<td>Combustion Air Inducer Neutral</td>
</tr>
<tr>
<td>4</td>
<td>Ignitor Neutral</td>
</tr>
</tbody>
</table>

**TABLE 5**

<table>
<thead>
<tr>
<th>PIN #</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Limit Output</td>
</tr>
<tr>
<td>2</td>
<td>Sensor</td>
</tr>
<tr>
<td>3</td>
<td>24V Line</td>
</tr>
<tr>
<td>4</td>
<td>Not Used</td>
</tr>
<tr>
<td>5</td>
<td>Rollout Switch Out</td>
</tr>
<tr>
<td>6</td>
<td>24V Neutral</td>
</tr>
<tr>
<td>7</td>
<td>High Limit Input</td>
</tr>
<tr>
<td>8</td>
<td>Ground</td>
</tr>
<tr>
<td>9</td>
<td>Gas Valve Common</td>
</tr>
<tr>
<td>10</td>
<td>Pressure Switch In</td>
</tr>
<tr>
<td>11</td>
<td>Rollout Switch In</td>
</tr>
<tr>
<td>12</td>
<td>Gas Valve Out</td>
</tr>
</tbody>
</table>

**TABLE 6**

<table>
<thead>
<tr>
<th>LED Status</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED Off</td>
<td>No power to control or control hardware fault detected.</td>
</tr>
<tr>
<td>LED On</td>
<td>Normal operation.</td>
</tr>
<tr>
<td>1 Flash</td>
<td>Flame present with gas valve de-energized.</td>
</tr>
<tr>
<td>2 Flashes</td>
<td>Pressure switch closed with combustion air inducer de-energized.</td>
</tr>
<tr>
<td>3 Flashes</td>
<td>Pressure switch open with combustion air inducer energized.</td>
</tr>
<tr>
<td>4 Flashes</td>
<td>Primary limit switch open.</td>
</tr>
<tr>
<td>5 Flashes</td>
<td>Rollout switch open.</td>
</tr>
<tr>
<td>6 Flashes</td>
<td>Pressure switch cycle lockout.</td>
</tr>
<tr>
<td>7 Flashes</td>
<td>Lockout, burners fail to light.</td>
</tr>
<tr>
<td>8 Flashes</td>
<td>Lockout, burners lost flame too many times.</td>
</tr>
<tr>
<td>9 Flashes</td>
<td>Line voltage polarity incorrect.</td>
</tr>
</tbody>
</table>

Note - This control is equipped with a push button switch for diagnostic code recall. The control stores the last 5 fault codes in non-volatile memory. The most recent fault code is flashed first, the oldest fault code is flashed last. There is a 2 second pause between codes. When the push button switch is pressed for less than 5 seconds, the control will flash the stored fault codes when the switch is released. The fault code history may be cleared by pressing the push button switch for more than 5 seconds.
INTEGRATED CONTROL
(Automatic Hot Surface Ignition System)

TERMINAL DESIGNATIONS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUM</td>
<td>Humidifier (120VAC)</td>
</tr>
<tr>
<td>LINE</td>
<td>Input (120VAC)</td>
</tr>
<tr>
<td>XFMR</td>
<td>Transformer (120VAC)</td>
</tr>
<tr>
<td>EAC</td>
<td>Indoor Air Quality Accessory Air Cleaner (120VAC)</td>
</tr>
<tr>
<td>COOL</td>
<td>Blower - Cooling Speed (120VAC)</td>
</tr>
<tr>
<td>HEAT</td>
<td>Blower - Heating Speed (120VAC)</td>
</tr>
<tr>
<td>PARK</td>
<td>Dead terminals to park alternate spd taps</td>
</tr>
<tr>
<td>CONT</td>
<td>Continuous blower</td>
</tr>
<tr>
<td>NEUTRALS</td>
<td>Neutral terminals (120VAC)</td>
</tr>
<tr>
<td>TWIN</td>
<td>Twinning Terminal (24VAC)</td>
</tr>
</tbody>
</table>

FIGURE 6

FIGURE 7

*Blower on time will be 30 seconds after flame is sensed. Blower off time will depend on "OFF TIME" Setting.

Page 10
Fan Time Control

Heating Fan On Time
The fan on time of 30 seconds is not adjustable.

Heating Fan Off Time
Fan off time (time that the blower operates after the heat demand has been satisfied) can be adjusted by moving the jumper to a different setting. The unit is shipped with a factory fan off setting of 120 seconds. For customized comfort, monitor the supply air temperature once the heat demand is satisfied. Note the supply air temperature at the instant the blower is de-energized. Adjust the fan-off delay to achieve a supply air temperature between 90° - 110° at the instant the blower is de-energized. (Longer delay times allow for lower air temperature, shorter delay times allow for higher air temperature). See figure 8.

Cooling Fan On Time
The fan on time is 2 seconds and is not adjustable.

Cooling Fan Off Time
The control has a 60 second fan off delay after cooling demand has been met. This delay is factory set and not adjustable.

Twinning 2 ML193DF Furnaces
Integrated control 103085 is equipped with a provision to "twin" (interconnect) two (2) adjacent furnaces with a common plenum such that they operate as one (1) large unit. When twinned, the circulating blower speeds are synchronized between the furnaces. If either furnace has a need to run the blower, both furnaces will run the blower on the same speed. The cooling speed has highest priority, followed by heating speed and fan speed.

Field installation of twinning consists of connecting wires between the “C” and “Twin” terminals of the two controls. The 24 VAC secondary of the two systems must be in phase. All thermostat connections are made to one control only. Figure 9 show wiring for two-stage and single stage thermostats.

The twinned furnace without thermostat connections is to have the call for heat supplied by an external 24VAC isolation relay to prevent its rollout switch from being bypassed by the other twinned furnace. The coil of the isolation relay connects from the thermostat “W” to 24 VAC common. The contacts of the relay connect “R” to “W” on the non-thermostat twin.
**FIELD WIRING FOR TWINNING THE ML193DF**

**TWO-STAGE THERMOSTAT**

- Call For Cool: Y
- Call For Fan: R
- Call For 1st Stage Heat: G
- Call For 2nd Stage Heat: W
- TWIN 1: C
- TWIN 2: W

**SINGLE STAGE THERMOSTAT**

- Call For Cool: Y
- Call For Fan: R
- Call For Heat: G
- TWIN 1: C
- TWIN 2: W

**ISOLATION RELAY**

**FIGURE 9**
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 clamshell heat exchangers are located in the heating compartment. The heating compartment can be accessed by removing the burner access panel.

1. Ignitor (Figure 10)
ML193DF units use a mini-nitride ignitor made from a proprietary ceramic material. Ignitor longevity is enhanced by controlling the voltage to the ignitor. Units equipped with control 103085 have a 120V ignitor. Units equipped with control 100973 have a 95V ignitor. See figure 11 and table 7 for resistance and voltage checks.

2. Flame Sensor (Figure 10)
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 leftmost 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 10)
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°F ± 12°F (121°C ± 6.7°C) on a temperature rise. All flame rollout switches are manual reset.
**Test 1**

Check ignitor circuit for correct resistance.

Remove 4-pin plug from control.

Check ohms reading across terminals 2 and 4. See table 7. If value is correct, this is the only test needed. If the reading on the meter is not correct, (0 or infinity) then a second test is needed.

**Test 2**

Check ignitor for correct resistance.

Separate the 2-pin jack-plug near the manifold and check resistance of ignitor at the plug. See table 7. If the reading is correct, then the problem is with the wiring between the jack-plug and the control. If reading is not correct, the issue is the ignitor.

**Test 3**

Check ignitor for correct voltage

Insert meter probes into terminals 2 and 4 (use small diameter probes in order not to damage plug).

Check voltage during 20 second ignitor warm up period. See table 7. If voltage reads below these values, check for correct supply voltage to furnace.

---

**TABLE 7**

<table>
<thead>
<tr>
<th>Control</th>
<th>Ohms</th>
<th>Voltage ± 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>103085</td>
<td>39 to 70</td>
<td>120</td>
</tr>
<tr>
<td>100973</td>
<td>24 to 47</td>
<td>95</td>
</tr>
</tbody>
</table>

---

**FIGURE 11**
4. Primary Limit Control (Figure 12)
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.

5. Heat Exchanger (Figure 12)
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 13)
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 8 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>
<thead>
<tr>
<th>Unit</th>
<th>Fuel</th>
<th>Orifice Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Natural</td>
<td>0.0625</td>
</tr>
<tr>
<td>All</td>
<td>L.P./Propane</td>
<td>0.034</td>
</tr>
</tbody>
</table>

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 pressure screw is also located on the valve. An LPG changeover kit is available.
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>
<thead>
<tr>
<th>TABLE 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML193DF Unit</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>-045</td>
</tr>
<tr>
<td>-070</td>
</tr>
<tr>
<td>-090</td>
</tr>
<tr>
<td>-110</td>
</tr>
</tbody>
</table>

9. Combustion Air Pressure Switch (Figure 15)

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.

<table>
<thead>
<tr>
<th>TABLE 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML193DF</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>-045</td>
</tr>
<tr>
<td>-070</td>
</tr>
<tr>
<td>-090</td>
</tr>
<tr>
<td>-110</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

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 10.

Checks of pressure differential can aid in troubleshooting. When measuring the pressure differential, readings should be taken at the pressure switch. See figure 16. 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.

*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. 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 10.
5. Remove thermostat demand and allow to cycle off.
6. Remove manometer and tee's. Reinstall combustion air sensing hoses to the pressure switch.

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.

Blower Motor Housing

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 16

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

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 11 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 11

<table>
<thead>
<tr>
<th>Piping and Fittings Specifications</th>
<th>ASTM Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule 40 PVC (Pipe)</td>
<td>D1785</td>
</tr>
<tr>
<td>Schedule 40 PVC (Cellular Core Pipe)</td>
<td>F891</td>
</tr>
<tr>
<td>Schedule 40 PVC (Fittings)</td>
<td>D2466</td>
</tr>
<tr>
<td>Schedule 40 CPVC (Pipe)</td>
<td>F441</td>
</tr>
<tr>
<td>Schedule 40 CPVC (Fittings)</td>
<td>F438</td>
</tr>
<tr>
<td>SDR-21 PVC or SDR-26 PVC (Pipe)</td>
<td>D2241</td>
</tr>
<tr>
<td>SDR-21 CPVC or SDR-26 CPVC (Pipe)</td>
<td>F442</td>
</tr>
<tr>
<td>Schedule 40 ABS Cellular Core DWV (Pipe)</td>
<td>F628</td>
</tr>
<tr>
<td>Schedule 40 ABS (Pipe)</td>
<td>D1527</td>
</tr>
<tr>
<td>Schedule 40 ABS (Fittings)</td>
<td>D2468</td>
</tr>
<tr>
<td>ABS-DWV (Drain Waste &amp; Vent)</td>
<td>D2661</td>
</tr>
<tr>
<td>(Pipe &amp; Fittings)</td>
<td></td>
</tr>
<tr>
<td>PVC-DWV (Drain Waste &amp; Vent)</td>
<td>D2665</td>
</tr>
<tr>
<td>Pipe &amp; Fittings)</td>
<td></td>
</tr>
<tr>
<td>PRIMER &amp; SOLVENT CEMENT</td>
<td>ASTM SPECIFICATION</td>
</tr>
<tr>
<td>PVC &amp; CPVC Primer</td>
<td>F656</td>
</tr>
<tr>
<td>PVC Solvent Cement</td>
<td>D2564</td>
</tr>
<tr>
<td>CPVC Solvent Cement</td>
<td>F493</td>
</tr>
<tr>
<td>ABS Solvent Cement</td>
<td>D2235</td>
</tr>
<tr>
<td>PVC/CPVC/ABS All Purpose Cement For Fittings &amp; Pipe of the same material</td>
<td>D2564, D2235, F493</td>
</tr>
<tr>
<td>ABS to PVC or CPVC Transition Solvent Cement</td>
<td>D3138</td>
</tr>
<tr>
<td>CANADA PIPE &amp; FITTING &amp; SOLVENT CEMENT</td>
<td>MARKING</td>
</tr>
<tr>
<td>PVC &amp; CPVC Pipe and Fittings</td>
<td>ULCS636</td>
</tr>
<tr>
<td>PVC &amp; CPVC Solvent Cement</td>
<td></td>
</tr>
<tr>
<td>ABS to PVC or CPVC Transition Cement</td>
<td></td>
</tr>
<tr>
<td>POLYPROPYLENE VENTING SYSTEM</td>
<td>ULC-S636</td>
</tr>
</tbody>
</table>

⚠️ 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 11. 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>
<thead>
<tr>
<th>Input Size</th>
<th>Vent Pipe Dia. in.</th>
<th>STANDARD</th>
<th>CONCENTRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wall Kit</td>
<td>Wall Ring Kit</td>
</tr>
<tr>
<td>045</td>
<td>2</td>
<td>3YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>2-1/2</td>
<td>3YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3YES</td>
<td>YES</td>
</tr>
<tr>
<td>070</td>
<td>2</td>
<td>3YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>2-1/2</td>
<td>3YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3YES</td>
<td>YES</td>
</tr>
<tr>
<td>090</td>
<td>2</td>
<td>3YES</td>
<td>YES</td>
</tr>
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<td>2-1/2</td>
<td>3YES</td>
<td>YES</td>
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<tr>
<td></td>
<td>2-1/2</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

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

* Kits must be properly installed according to kit instructions.
2 Requires field-provided outdoor 1-1/2" exhaust accelerator.
3 Concentric kits 71M80 and 44W92 include 1-1/2" outdoor accelerator, when used with 045 and 070 input models.
4 Flush mount kit 51W11 and 51W12 includes 1-1/2 in. outdoor exhaust accelerator, required when used with 045, 070 and 090 input models.
5 Termination kits 30G28, 44W92, 4493 and 81J20 are certified to ULC S636 for use in Canada only.
6 See table 17 for vent accelerator requirements.
**Joint Cementing Procedure**

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

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

---

**DANGER**

**DANGER OF EXPLOSION!**

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

---

1. Measure and cut vent pipe to desired length.
2. Debur and chamfer end of pipe, removing any ridges or rough edges. If end is not chamfered, edge of pipe may remove cement from fitting socket and result in a leaking joint.
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**

- SCHEDULE 40 PVC - 5'
- all other pipe* - 3'

* See table 11 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**

<table>
<thead>
<tr>
<th>CHIMNEY OR GAS VENT (Check sizing for water heater only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnace (Replaced by ML193)</td>
</tr>
<tr>
<td>Water Heater</td>
</tr>
<tr>
<td>Openings (To Adjacent Room)</td>
</tr>
</tbody>
</table>

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.

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

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

Exhaust Piping (Figures 21 and 22)

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

**NOTE** - Lennox has approved the use of DuraVent® manufactured vent pipe and terminations as an option to PVC. When using the PolyPro® by DuraVent venting system the vent pipe requirements stated in the unit installation instruction – minimum & maximum vent lengths, termination clearances, etc. – apply and must be followed. Follow the instructions provided with PolyPro by DuraVent venting system for assembly or if requirements are more restrictive. The PolyPro by Duravent venting system must also follow the uninsulated and unconditioned space criteria listed in table 16.

The ML193DF can be installed as either a Non-Direct Vent or a Direct Vent gas central furnace.

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

Intake and exhaust pipe sizing -- Size pipe according to tables 13 and 14. Count all elbows inside and outside the home. Table 13 lists the *minimum* vent pipe lengths permitted. Table 14 lists the *maximum* pipe lengths permitted.

<table>
<thead>
<tr>
<th>TABLE 13</th>
<th>MINIMUM VENT PIPE LENGTHS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ML193DF Model</strong></td>
<td><strong>MIN. VENT LENGTH</strong></td>
</tr>
<tr>
<td>045, 070, 090, 110</td>
<td>15 ft. or 5 ft plus 2 elbows or 10 ft plus 1 elbow</td>
</tr>
</tbody>
</table>

*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 17.

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.
Piping Size Process

1. What is the furnace capacity? 045, 070, 090 or 110?
2. Which style termination being used? Standard or concentric? See table 12.
3. Which needs most elbows? Intake or exhaust?
5. Desired pipe size? 2", 2-1/2", 3"
6. What is the altitude of the furnace installation?
7. Use table 14 or 15 to find max intake or exhaust pipe length. Includes all vent pipe and elbows inside and outside the house.

**NOTE** - It is acceptable to use any pipe size which fits within the guidelines allowed in table 14.

**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 14
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.

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

### Standard Termination at Elevation 0 - 10,000 ft.

<table>
<thead>
<tr>
<th>Number Of 90° Elbows Used</th>
<th>2&quot; Pipe</th>
<th>2-1/2&quot; Pipe</th>
<th>3&quot; Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>045</td>
<td>070 090 110</td>
<td>045</td>
</tr>
<tr>
<td>1</td>
<td>61</td>
<td>46 24</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>56</td>
<td>41 19</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>51</td>
<td>36 14</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>46</td>
<td>31</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>41</td>
<td>26</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>36</td>
<td>21</td>
<td>75</td>
</tr>
<tr>
<td>7</td>
<td>31</td>
<td>16</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>26</td>
<td>11</td>
<td>65</td>
</tr>
<tr>
<td>9</td>
<td>21</td>
<td>n/a</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>16</td>
<td>n/a</td>
<td>55</td>
</tr>
</tbody>
</table>

### Concentric Termination Elevation 0 - 10,000 ft.

<table>
<thead>
<tr>
<th>Number Of 90° Elbows Used</th>
<th>2&quot; Pipe</th>
<th>2-1/2&quot; Pipe</th>
<th>3&quot; Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>045</td>
<td>070 090 110</td>
<td>045</td>
</tr>
<tr>
<td>1</td>
<td>53</td>
<td>38 22</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
<td>33 17</td>
<td>85</td>
</tr>
<tr>
<td>3</td>
<td>43</td>
<td>28 12</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
<td>23</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>18</td>
<td>70</td>
</tr>
<tr>
<td>6</td>
<td>28</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>7</td>
<td>23</td>
<td>n/a</td>
<td>60</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>n/a</td>
<td>55</td>
</tr>
<tr>
<td>9</td>
<td>13</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>n/a</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

TABLE 15
Maximum Allowable Exhaust Vent Lengths With Furnace Installed in a Closet or Basement Using Ventilated Attic or Crawl Space For Intake Air in Feet

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

### Standard Termination at Elevation 0 - 10,000 ft.

<table>
<thead>
<tr>
<th>Number Of 90° Elbows Used</th>
<th>2&quot; Pipe</th>
<th>2-1/2&quot; Pipe</th>
<th>3&quot; Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>045</td>
<td>070 090 110</td>
<td>045</td>
</tr>
<tr>
<td>1</td>
<td>51</td>
<td>36 14</td>
<td>85</td>
</tr>
<tr>
<td>2</td>
<td>46</td>
<td>31 9</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>26 4</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>21</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>31</td>
<td>16</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>26</td>
<td>11</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>21</td>
<td>6</td>
<td>55</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
<td>n/a</td>
<td>45</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>n/a</td>
<td>40</td>
</tr>
</tbody>
</table>
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 14 for pipe sizes.

TYPICAL AIR INTAKE PIPE CONNECTIONS
NON–DIRECT VENT APPLICATIONS

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

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 23. 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 - If intake air is drawn from a ventilated attic (figure 24) or ventilated crawlspace (figure 25) the exhaust vent length must not exceed those listed in table 15. If 3" diameter pipe is used, reduce to 2" diameter pipe at the termination point to accommodate the debris screen.

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

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

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

NOTE - The inlet and outlet air openings shall each have a free area of at least one square inch per 4,000 Btu (645mm² per 1.17kW) per hour of the total input rating of all equipment in the enclosure.

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 27 or 28. 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** - See table 16 for maximum allowed exhaust pipe length without insulation in unconditioned space during winter design temperatures below 32°F (0°C). If required exhaust pipe should be insulated with 1/2" (13mm) Armaflex or equivalent. In extreme cold climate areas, 3/4” (19mm) Armaflex or equivalent may be necessary. Insulation must be protected from deterioration. Armaflex with UV protection is permissible. Basements or other enclosed areas that are not exposed to the outdoor ambient temperature and are above 32 degrees F (0°C) are to be considered conditioned spaces.

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

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

---

**TABLE 16**
Maximum Allowable Exhaust Vent Pipe Length (in ft.) Without Insulation In Unconditioned Space For Winter Design Temperatures Single - Stage High Efficiency Furnace

<table>
<thead>
<tr>
<th>Winter Design Temperatures 1 °F (°C)</th>
<th>Vent Pipe Diameter</th>
<th>045</th>
<th>070</th>
<th>090</th>
<th>110</th>
<th>135</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 to 21 (0 to -6)</td>
<td>PVC</td>
<td>2-PP</td>
<td>PVC</td>
<td>2-PP</td>
<td>PVC</td>
<td>2-PP</td>
</tr>
<tr>
<td>2 in.</td>
<td>26</td>
<td>24</td>
<td>44</td>
<td>41</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>2-1/2 in.</td>
<td>18</td>
<td>N/A</td>
<td>32</td>
<td>N/A</td>
<td>50</td>
<td>N/A</td>
</tr>
<tr>
<td>3 in.</td>
<td>14</td>
<td>12</td>
<td>26</td>
<td>23</td>
<td>38</td>
<td>33</td>
</tr>
<tr>
<td>2 in.</td>
<td>16</td>
<td>15</td>
<td>28</td>
<td>26</td>
<td>40</td>
<td>37</td>
</tr>
<tr>
<td>2-1/2 in.</td>
<td>12</td>
<td>N/A</td>
<td>20</td>
<td>N/A</td>
<td>30</td>
<td>N/A</td>
</tr>
<tr>
<td>3 in.</td>
<td>9</td>
<td>8</td>
<td>16</td>
<td>14</td>
<td>26</td>
<td>23</td>
</tr>
<tr>
<td>2 in.</td>
<td>10</td>
<td>9</td>
<td>20</td>
<td>18</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>2-1/2 in.</td>
<td>8</td>
<td>N/A</td>
<td>14</td>
<td>N/A</td>
<td>20</td>
<td>N/A</td>
</tr>
<tr>
<td>3 in.</td>
<td>4</td>
<td>3</td>
<td>10</td>
<td>8</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

---

1 Refer to 99% Minimum Design Temperature table provided in the current edition of the ASHRAE Fundamentals Handbook.
2 Poly-Propylene vent pipe (PP)

**NOTE** - Maximum uninsulated vent lengths listed may include the termination(vent pipe exterior to the structure) and cannot exceed 5 linear feet or the maximum allowable intake or exhaust vent length listed in table 14 or 15 which ever is less.

**NOTE** - If insulation is required in an unconditioned space, it must be located on the pipe closest to the furnace. See figure 26.
VENT TERMINATION CLEARANCES
FOR NON-DIRECT VENT INSTALLATIONS IN THE USA AND CANADA

![Diagram of vent termination details]

**US Installations**¹

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

¹ In accordance with the current ANSI Z223.1/NFPA 54 Natural Fuel Gas Code
² In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code
† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.
‡ Permitted only if veranda, porch, deck or balcony is fully open on a minimum of two sides beneath the floor. Lennox recommends avoiding this location if possible.

*For clearances not specified in ANSI Z223.1/NFPA 54 or CSA B149.1, clearance will be in accordance with local installation codes and the requirements of the gas supplier and these installation instructions.*
VENT TERMINATION CLEARANCES
FOR DIRECT VENT INSTALLATIONS IN THE USA AND CANADA

**INSIDE CORNER DETAIL**

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

\(^1\) In accordance with the current ANSI Z223.1/NFPA 54 Natural Fuel Gas Code

\(^2\) In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code

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

\(^\ddagger\) 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 28**
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 36.

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 31 through 37 show typical terminations.

1. Intake and exhaust terminations are not required to be in the same pressure zone. You may exit the intake on one side of the structure and the exhaust on another side (figure 29). You may exit the exhaust out the roof and the intake out the side of the structure (figure 30).

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

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

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

4. Exhaust piping must terminate straight out or up as shown. A reducer may be required on the exhaust piping at the point where it exits the structure to improve the velocity of exhaust away from the intake piping. See table 17.

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 figure 36.

6. On field supplied terminations, a minimum distance between the end of the exhaust pipe and the end of the intake pipe without a termination elbow is 8" and a minimum distance of 6" with a termination elbow. See figure 36.

### Table 17 - Exhaust Pipe Termination Size Reduction

<table>
<thead>
<tr>
<th>ML193 MODEL</th>
<th>Exhaust Pipe Size</th>
<th>Termination Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>*045 and *070</td>
<td>2&quot; (51 mm), 2-1/2&quot; (64 mm), 3&quot; (76 mm)</td>
<td>1-1/2&quot; (38 mm)</td>
</tr>
<tr>
<td>*090</td>
<td>3&quot; (76 mm)</td>
<td>2&quot; (51 mm)</td>
</tr>
<tr>
<td>110</td>
<td>3&quot; (76 mm)</td>
<td>2&quot; (51 mm)</td>
</tr>
</tbody>
</table>

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

**NOTE** - Care must be taken to avoid recirculation of exhaust back into intake pipe.
7. If intake and exhaust piping must be run up a side wall to position above snow accumulation or other obstructions, piping must be supported. At least one bracket must be used within 6" from the top of the elbow and then every 24" (610mm) as shown in figure 36, to prevent any movement in any direction. When exhaust and intake piping must be run up an outside wall, the exhaust piping must be terminated with pipe sized per table 17. 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 34.
**FIGURE 36**

**FIELD FABRICATED WALL TERMINATION**

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

See venting table 14 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).

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

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

1 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.

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

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

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Page 31
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 39 show typical terminations.

1. Exhaust piping must terminate straight out or up as shown. The termination pipe must be sized as listed in table 17. The specified pipe size ensures proper velocity required to move the exhaust gases away from the building.

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

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

4. Distance between exhaust pipe terminations on multiple furnaces must meet local codes.
Condensate Piping
This unit is designed for either right- or left-side exit of condensate piping. Refer to figures 40 and 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 40**

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

2 - For furnaces with a 1/2” drain connection use a 3/8 allen wrench and remove plug (figure 40) from the cold end header box at the appropriate location on the side of the unit. Install field-provided 1/2 NPT male fitting into cold end header box. For furnaces with a 3/4” drain connection use a large flat head screw driver or a 1/2” drive socket extension and remove plug. Install provided 3/4 NPT street elbow fitting into cold end header box. Use Teflon tape or appropriate pipe dope.

3 - Install the cap over the clean out opening at the base of the trap. Secure with clamp. See figures 46 and 47.

4 - Install drain trap using appropriate PVC fittings, glue all joints. Glue the provided drain trap as shown in figures 46 and 47. Route the condensate line to an open drain.

5 - Figure 44 shows the furnace and evaporator coil using a separate drain. If necessary, the condensate line from the furnace and evaporator coil can drain together. See figures 45 and 43. The field provided vent must be a minimum 1” to a maximum 2” length above the condensate drain outlet connection.

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

**NOTE** - Appropriately sized tubing and barbed fitting may be used for condensate drain. Attach to the drain on the trap using a hose clamp. See figure 41.

**FIGURE 41**

6 - 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.

**CAUTION**

Do not use copper tubing or existing copper condensate lines for drain line.
**CONSENSATE TRAP LOCATION** (shown with right side exit of condensation)

Trap can be installed a maximum of 5ft. from furnace (*PVC only) Field Provided Vent 1" min. 2" max. above condensate drain.

5' max. to drain

1" min. 2" max

Field Provided Vent 1" min. 2" max. above condensate drain.

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

**FIGURE 42**

**IMPORTANT**

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

**FIGURE 44**

**ML193DF with Evaporator Coil**

**Using a Separate Drain**

**FIGURE 45**

**Condensate Trap With Optional Overflow Switch**

From Evaporator Coil

Field Provided Vent 1" min. 2" max. above condensate drain.

Optional Overflow Switch

Furnace Condensate Drain Connection

**FIGURE 43**

**ML193DF with Evaporator Coil Using a Common Drain**

**Evaporator Drain Line (vent required)**

**FIGURE 44**

**FIGURE 45**
Optional Condensate Drain Connection

Adapter 3/4 inch slip X 3/4 inch mpt (not furnished)

90° Street Elbow 3/4 inch PVC (not furnished)

To Trap

Condensate Drain Connection In Unit

90° Street Elbow 3/4 inch PVC (furnished)

To Drain

Optional Drain Piping From Trap

Drain Assembly for 1/2 inch Drain Pipe

1/2 inch PVC Pipe (Not Furnished)

90° Elbow 1/2 inch PVC (Not Furnished)

To Drain

Drain Assembly for 3/4 inch Drain Pipe

90° Elbow 3/4 inch PVC (Not Furnished)

To Drain

Coupling 3/4 inch slip X slip (Not Furnished)

Condensate Drain Connection In Unit

1 (25 mm) Min. 2 (50 mm) Max. Above Top Of Condensate Drain Connection In Unit

90° Elbow 3/4 inch PVC (Not Furnished)

1/2 inch PVC Pipe (Not Furnished)

3/4 inch PVC Pipe (Not Furnished)

Drain Trap Assembly (Furnished)

Adapter 3/4 inch slip X 3/4 inch mpt (not furnished)

Condensate Drain Connection In Unit

5 Feet Maximum

Condensate Drain Connection In Unit

7 (178)

1/2 inch

Condensate Drain Connection In Unit

To Drain

Drain Trap Assembly with 1/2 inch Piping

1 (25 mm) Min. 2 (50 mm) Max. Above Top Of Condensate Drain Connection In Unit

1/2 inch

Condensate Drain Connection In Unit

To Drain

Drain Trap Assembly with 3/4 inch Piping

1 (25 mm) Min. 2 (50 mm) Max. Above Top Of Condensate Drain Connection In Unit

3/4 inch

Condensate Drain Connection In Unit

To Drain

FIGURE 46
TRAP / DRAIN ASSEMBLY USING 1/2" PVC OR 3/4" PVC

Optional Condensate Drain Connection

1/2 inch slip X 1/2 inch mpt (Not Furnished)
90° Street Elbow 1/2 inch PVC (Not Furnished)

Condensate Drain Connection In Unit

Drain Trap Assembly with 1/2 inch Piping

1 (25 mm) Min. 2 (50 mm) Max. Above Top Of Condensate Drain Connection In Unit

90° Elbow 1/2 inch PVC (Not Furnished)

Condensate Drain Connection In Unit

Drain Trap Assembly with 3/4 inch Piping

3/4 inch

Condensate Drain Connection In Unit

Optional Drain Piping From Trap

Drain Assembly for 1/2 inch Drain Pipe

1/2 inch PVC Pipe (Not Furnished)

Drain Trap Assembly with 3/4 inch Piping

3/4 inch

Condensate Drain Connection In Unit

Optional Condensate Drain Connection

Adapter 1/2 inch slip X 1/2 inch mpt (Not Furnished)

Condensate Drain Connection In Unit

5 Feet Maximum

Adapter 1/2 inch slip X 1/2 inch mpt (Not Furnished)

Condensate Drain Connection In Unit

Optinal Drain Piping From Trap

Condensate Drain Connection In Unit

1/2 inch PVC Pipe (Not Furnished)

Coupling 1/2 inch slip X slip (Not Furnished)

Drain Trap Assembly (Furnished)

7 (178)

Condensate Drain Connection In Unit

1 (25 mm) Min. 2 (50 mm) Max. Above Top Of Condensate Drain Connection In Unit

90° Elbow 3/4 inch PVC (Not Furnished)

To Drain

90° Street Elbow 1/2 inch PVC (Furnished)

To Drain

Condensate Drain Connection In Unit

To Drain

Condensate Drain Connection In Unit

Drain Trap Clean Out

Condensate Drain Connection In Unit

Vent

Drain Trap Assembly with 3/4 inch Piping

1/2 inch PVC Pipe (Not Furnished)

Condensate Drain Connection In Unit

To Drain

90° Elbow 3/4 inch PVC (Not Furnished)

To Drain

Condensate Drain Connection In Unit

To Drain

Condensate Drain Connection In Unit

To Drain

Condensate Drain Connection In Unit

To Drain

Condensate Drain Connection In Unit

To Drain

Condensate Drain Connection In Unit

To Drain

FIGURE 47
III-START-UP

A-Preliminary and Seasonal Checks

1 - Inspect electrical wiring, both field and factory installed for loose connections. Tighten as required.
2 - Check voltage at disconnect switch. Voltage must be within range listed on the nameplate. If not, consult the power company and have voltage condition corrected before starting unit.
3 - Inspect condition of condensate traps and drain assembly. Disassemble and clean seasonally.

B-Heating Start-Up

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

The gas valve on the 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 48)

1 - STOP! Read the safety instructions at the beginning of this section.
2 - Set the thermostat to the lowest setting.
3 - Turn off all electrical power to the unit.
4 - This furnace is equipped with an ignition device which automatically lights the burners. Do not try to light the burners by hand.
5 - Remove the upper access panel.
6 - Move gas valve switch to OFF. See figure 48.
7 - Wait five minutes to clear out any gas. If you then smell gas, STOP! Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions. If you do not smell gas go to next step.
8 - Move gas valve switch to ON. See figure 48.

Figure 48

9 - Replace the upper access panel.
10 - Turn on all electrical power to to the unit.
11 - Set the thermostat to desired setting.

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

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

Turning Off Gas to Unit

1 - Set the thermostat to the lowest setting.
2 - Turn off all electrical power to the unit if service is to be performed.
3 - Remove the upper access panel.
4 - Move gas valve switch to OFF.
5 - Replace the upper access panel.

Failure To Operate
If the unit fails to operate, check the following:
1 - Is the thermostat calling for heat?
2 - Are access panels securely in place?
3 - Is the main disconnect switch closed?
4 - Is there a blown fuse or tripped breaker?
5 - Is the filter dirty or plugged? Dirty or plugged filters will cause the limit control to shut the unit off.
6 - Is gas turned on at the meter?
7 - Is the manual main shut-off valve open?
8 - Is the internal manual shut-off valve open?
9 - Is the unit ignition system in lockout? If the unit locks out again, inspect the unit for blockages.
IV-HEATING SYSTEM SERVICE CHECKS
A-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 49.

![Figure 49](image)

**FIGURE 49**
When checking piping connections for gas leaks, use preferred means. Kitchen detergents can cause harmful corrosion on various metals used in gas piping. Use of a specialty Gas Leak Detector is strongly recommended. It is available through Lennox under part number 31B2001. See Corp. 8411-L10, for further details.

**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 48. 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 19.

**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 19.

**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.
F- Proper Gas Flow (Approximate)

**TABLE 18**

<table>
<thead>
<tr>
<th>ML193 Unit</th>
<th>Seconds for One Revolution</th>
<th>Natural 1 cu ft Dial</th>
<th>Natural 2 cu ft Dial</th>
<th>LP 1 cu ft Dial</th>
<th>LP 2 cu ft DIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>-045</td>
<td></td>
<td>80</td>
<td>160</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>-070</td>
<td></td>
<td>55</td>
<td>110</td>
<td>136</td>
<td>272</td>
</tr>
<tr>
<td>-090</td>
<td></td>
<td>41</td>
<td>82</td>
<td>102</td>
<td>204</td>
</tr>
<tr>
<td>-110</td>
<td></td>
<td>33</td>
<td>66</td>
<td>82</td>
<td>164</td>
</tr>
</tbody>
</table>

**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 18. If manifold pressure matches table 19 and rate is incorrect, check gas orifices for proper size and restriction. Remove temporary gas meter if installed.

**TABLE 19**

**Manifold and Supply Pressure (Outlet) inches w.c. At All Altitudes For -1 Through -6 Units**

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Model Input Sizes</th>
<th>Manifold Pressure in wg.</th>
<th>Supply Pressure in wg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nat. Gas</td>
<td>All sizes</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>L.P. Gas</td>
<td>All sizes</td>
<td>10.0</td>
<td>11.0</td>
</tr>
</tbody>
</table>

**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 20.

**TABLE 20**

<table>
<thead>
<tr>
<th>ML193 Unit</th>
<th>CO₂% For Nat</th>
<th>CO₂% For L.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-045</td>
<td>7.2 - 7.9</td>
<td>8.6 - 9.3</td>
</tr>
<tr>
<td>-070</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-090</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-110</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 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-1 through -6 units require no manifold pressure adjustments for operation at altitudes up to 10,000 feet (3048 m) above sea level. However, -7 units and later installed at altitude of 4501 - 10,000 feet (1373 to 3048m) require a pressure switch change which can be ordered separately and manifold de-rate. See table 19 or table 21 for manifold pressures at varying altitudes. Table 22 lists conversion kit and pressure switch requirements at varying altitudes.
The combustion air pressure switch is factory-set and requires no adjustment.

**TABLE 21**

**Manifold and Supply Line Pressure 0-10,000ft. For -7 Units and Later**

<table>
<thead>
<tr>
<th>ML193 Unit</th>
<th>Gas</th>
<th>Manifold Pressure in wg.</th>
<th>Supply Line Pressure in w.g. 0 - 10000 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Sizes</td>
<td>Natural</td>
<td>3.5</td>
<td>3.3</td>
</tr>
<tr>
<td>All Sizes</td>
<td>LP/propane</td>
<td>10.0</td>
<td>9.4</td>
</tr>
</tbody>
</table>

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

**TABLE 22**

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

<table>
<thead>
<tr>
<th>ML193 Unit</th>
<th>Natural to LP/Propane</th>
<th>High Altitude Natural Burner Orifice Kit</th>
<th>LP/Propane to Natural</th>
<th>High Altitude Pressure Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>-045</td>
<td>0 - 7500 ft (0 - 2286m)</td>
<td>7501 - 10,000 ft (2286 - 3038m)</td>
<td>0 - 7500 ft (0 - 2286m)</td>
<td>4501 - 7500 ft (1373 - 2286m)</td>
</tr>
<tr>
<td>-070</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-090</td>
<td>*69W73</td>
<td>73W37</td>
<td>*73W81</td>
<td>93W87</td>
</tr>
<tr>
<td>-110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 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 50. The transducer converts microamps to volts on a 1:1 conversion. Flame signal is shown in table 23. A digital readout meter must be used. The transducer plugs into most meters.

<table>
<thead>
<tr>
<th>Flame Signal</th>
<th>Microamps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Flame Signal</td>
<td>≥ 1.50</td>
</tr>
<tr>
<td>Low Flame Signal</td>
<td>≤ 1.40</td>
</tr>
<tr>
<td>Drop Out Signal</td>
<td>≤ 0.50</td>
</tr>
</tbody>
</table>

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.

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 51.
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.
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.

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 24 lists recommended filter sizes.

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.

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 ± 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.

Condensate Hose Screen (Figure 52)

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

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

Condensate Hose Screen

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 Bumer 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 - Backwash 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 housing 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.
1 - When there is a call for heat, W1 of the thermostat energizes W of the furnace control with 24VAC.

2 - S10 primary limit switch and S47 rollout switch are closed. Call for heat can continue.

3 - 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.

4 - The integrated control (A92) energizes ignitor. A 20-second warm-up period begins.

5 - Gas valve opens for a 4-second trial for ignition

6 - Flame is sensed, gas valve remains open for the heat call.

7 - After 30-second delay, the integrated control (A92) energizes indoor blower B3.

8 - 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.
HEATING SEQUENCE OF OPERATION

NORMAL HEATING MODE

POWER ON

CONTROL SELF-CHECK OKAY?

YES

IS POLARITY CORRECT?

YES

IS THERE A PROPER GROUND?

YES

IS VOLTAGE ABOVE 90 VOLTS?

NO

ROLLOUT SWITCH CLOSED?

YES

BURNER OFF?

(Flame sensed without gas valve energized)

YES

NORMAL OPERATION:

LED #1 -- SLOW FLASH
LED #2 -- SLOW FLASH

NO

THERmostAT CALLS FOR HEAT:

LED #1 -- FAST FLASH
LED #2 -- FAST FLASH

YES

PRIMARY LIMIT SWITCH CLOSED?

YES

IS COMBUSTION AIR PRESSURE SWITCH OPEN?

YES

IS COMBUSTION AIR INDUCER ENERGIZED?

YES

HAS COMBUSTION AIR PRESSURE SWITCH CLOSED IN 2.5 MINUTES?

NO

CONTINUED NEXT PAGE

ABNORMAL HEATING MODE

GAS VALVE OFF. COMBUSTION AIR INDUCER OFF. INDOOR BLOWER DELAY OFF.
LED #1 ON
LED #2 ON

(RESET CONTROL BY TURNING MAIN POWER OFF.)

NO

POLARITY REVERSED.

LED #1 -- FAST FLASH
LED #2 -- SLOW FLASH

YES

IMPROPER GROUND.

LED #1 -- ALTERNATING FAST FLASH
LED #2 -- ALTERNATING FAST FLASH

NO

LED's SIGNAL FAST ALTERNATING FLASH.
CONTROL WILL NOT RESPOND TO A CALL FOR HEATING UNTIL VOLTAGE RISES ABOVE 90 VOLTS.

YES

GAS VALVE OFF. COMBUSTION AIR INDUCER ON.
INDOOR BLOWER ON.
LED #1 -- ON. LED #2 -- SLOW FLASH.

SEQUENCE HOLDS UNTIL ROLLOUT SWITCH CLOSES AND POWER IS RESET OR T'STAT IS INTERRUPTED FOR MINIMUM OF 1 SECOND.

NO

GAS VALVE OFF. COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER OFF.
LED #1 -- SLOW FLASH
LED #2 -- OFF

NO

COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER ON.
LED #1 SLOW FLASH RATE
LED #2 -- ON

NO

GAS VALVE OFF.
COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER OFF WITH DELAY.
LED #1 OFF
LED #2 SLOW FLASH

(Sequence holds until pressure switch opens or thermostat resets control.)

YES

PRESSURE SWITCH IS IN WATCHGUARD MODE.
GAS VALVE OFF. COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER OFF WITH DELAY.
LED #1 -- OFF. LED #2 -- SLOW FLASH.
IS 5-MINUTE RESET PERIOD COMPLETE?
HEATING SEQUENCE CONTINUED

NORMAL HEATING MODE

15-SECOND COMBUSTION AIR INDUCER PREPURGE INITIATED BY CLOSED PRESSURE SWITCH.

YES

IGNITOR WARM-UP - 20 SECONDS.

YES

4-SECOND TRIAL FOR IGNITION. GAS VALVE OPENS. IGNITOR ENERGIZED FOR FIRST 3 SECONDS OF THE TRIAL.

YES

FLAME STABILIZATION PERIOD.

4 SECONDS

FLAME RECTIFICATION CURRENT CHECK. CAN FLAME BE PROVEN WITHIN 4 SECONDS AFTER GAS VALVE OPENS? (0.5 microamps)

YES

FLAME PRESENT?

YES

FLAME SIGNAL 1.5 MICROAMPS OR GREATER?

YES

INDOOR BLOWER ON AFTER 30-SECOND DELAY

YES

PRIMARY AND SECONDARY LIMIT SWITCHES CLOSED?

YES

ROLLOUT SWITCH CLOSED?

YES

COMBUSTION AIR PRESSURE SWITCH CLOSED?

YES

THERMOSTAT DEMAND SATISFIED.

YES

LED #1 & #2 SIMULTANEOUS SLOW FLASHES.

YES

COMB. AIR INDUCER CONTINUES 5-SECOND POST PURGE AFTER T'STAT DEMAND IS SATISFIED. INDOOR AIR BLOWER COMPLETES SELECTED "OFF" DELAY BEFORE SHUTTING OFF.

NO

IS VOLTAGE ABOVE 90 VOLTS?

NO

GAS VALVE OFF, COMBUSTION AIR INDUCER ON, INDOOR BLOWER OFF. HAS CONTROL FAILED TO SENSE FLAME FOR FIVE CONSECUTIVE TRIES DURING A SINGLE HEAT DEMAND?

YES

LIMIT SWITCH WATCHGUARD MODE. GAS VALVE OFF, COMB. AIR INDUCER OFF, INDOOR BLOWER OFF WITH DELAY. LEDS SIGNAL WATCHGUARD FAILURE CODE. IS 60-MINUTE RESET PERIOD COMPLETE?

YES

HAS CONTROL RESET IGNITION SEQUENCE FOUR TIMES?

YES

LOW FLAME SIGNAL (Does not affect operation of control) LED #1 -- SLOW FLASH LED #2 -- FAST FLASH

NO

HAS PRIMARY / SECONDARY LIMIT RESET TIME EXCEEDED 3 MINUTES?

NO

HAS PRESSURE SWITCH OPENED 5 TIMES IN THE SAME HEAT DEMAND?

NO

HAS PRESSURE SWITCH CLOSED?

YES

1 HR PRESSURE SWITCH WATCHGUARD MODE

ABNORMAL HEATING MODE

LEDS SIGNAL ALTERNATING FAST FLASH UNTIL VOLTAGE IS ABOVE 95 VOLTS, THEN RESTARTS HEATING SEQUENCE.

NO

GAS VALVE OFF, COMBUSTION AIR INDUCER ON, INDOOR BLOWER OFF. LEDS SIGNAL WATCHGUARD FAILURE CODE. IS 60-MINUTE RESET PERIOD COMPLETE?

YES

IS VOLTAGE ABOVE 90 VOLTS?

YES

GAS VALVE OFF, COMBUSTION AIR INDUCER OFF, INDOOR BLOWER OFF WITH DELAY. LEDS SIGNAL WATCHGUARD FAILURE CODE. IS 60-MINUTE RESET PERIOD COMPLETE?

NO

HAS CONTROL RESET IGNITION SEQUENCE FOUR TIMES?

YES

LOW FLAME SIGNAL (Does not affect operation of control) LED #1 -- SLOW FLASH LED #2 -- FAST FLASH

NO

HAS PRIMARY / SECONDARY LIMIT RESET TIME EXCEEDED 3 MINUTES?

NO

HAS PRESSURE SWITCH OPENED 5 TIMES IN THE SAME HEAT DEMAND?

YES

HAS PRESSURE SWITCH CLOSED?

NO

1 HR PRESSURE SWITCH WATCHGUARD MODE

NO

GAS VALVE DE-ENERGIZED, COMBUSTION AIR INDUCER DE-ENERGIZED. INDOOR BLOWER ON UNTIL SWITCH CLOSES. LED #1 -- SLOW FLASH, LED #2 -- ON. IS LIMIT SWITCH CLOSED?

YES

HAS PRIMARY / SECONDARY LIMIT RESET TIME EXCEEDED 3 MINUTES?

NO

HAS PRESSURE SWITCH OPENED 5 TIMES IN THE SAME HEAT DEMAND?

YES

GAS VALVE DE-ENERGIZED, COMBUSTION AIR INDUCER OFF, INDOOR BLOWER OFF WITH DELAY. LED #1 -- OFF, LED #2 -- SLOW FLASH, HAS CAB SWITCH CLOSED IN 2.5 MINUTES?

NO

5-MINUTE PRESSURE SWITCH WATCHGUARD MODE.
COOLING SEQUENCE OF OPERATION

NORML COOLING MODE

POWER ON

IGNITION CONTROL MAIN POWER ON.

CONTROL SELF DIAGNOSTIC CHECK. IS CONTROL OPERATING NORMALLY?

YES

IS THERE A PROPER GROUND?

YES

IS POLARITY CORRECT?

YES

IS VOLTAGE ABOVE 90 VOLTS?

YES

ROLLOUT SWITCH MONITORED CONTINUOUSLY. IS ROLLOUT SWITCH CLOSED?

YES

LED: SLOW FLASH RATE REMAINS UNCHANGED THROUGHOUT COOLING CYCLE.

THERMOSTAT CALLS FOR COOLING.

COMPRESSOR CONTACTOR AND SYSTEM FAN ENERGIZED WITH 2-SECOND DELAY (COOLING SPEED). EAC TERM. ENERGIZED.

THERMOSTAT OPENS.

COMPRESSOR OFF.

SYSTEM FAN AND EAC TERM. OFF WITH 45-SECOND DELAY.

NO

GAS VALVE OFF. COMBUSTION AIR INDUCER OFF. INDOOR BLOWER OFF WITH NORMAL DELAY. SIGNAL CIRCUIT CONTROL FAILURE AT LED. INTERRUPT MAIN POWER TO RESET CONTROL.

SIGNAL IMPROPER GROUND AT LED. CONTROL WILL CONTINUE TO CALL FOR COOLING IN THIS CONDITION.

SIGNAL POLARITY REVERSED AT LED. CONTROL WILL CONTINUE TO CALL FOR COOLING IN THIS CONDITION.

LED SIGNALS LOW VOLTAGE. CONTROL WILL CONTINUE TO CALL FOR COOLING IN THIS CONDITION.

NO

NO

NO

GAS VALVE OFF. COMBUSTION AIR INDUCER ON. INDOOR BLOWER ON. SIGNAL ROLL-OUT SWITCH OPEN AT LED. SEQUENCE HOLDS UNTIL ROLLOUT SWITCH CLOSES AND MAIN POWER IS INTERRUPTED OR THERMOSTAT IS CYCLED OFF/ON FOR 1 SEC. MINIMUM.

YES

YES

NO

NO

YES

NO

NO
CONTINUOUS HEAT SPEED FAN SEQUENCE OF OPERATION

LED: SLOW FLASH RATE REMAINS UNCHANGED THROUGHOUT SEQUENCE.

MANUAL FAN SELECTION MADE AT THERMOSTAT. CONTROL (G) ENERGIZES SYSTEM FAN AT HEAT SPEED. EAC TERMINAL IS ENERGIZED.

THERMOSTAT CALLS FOR HEAT (W).

HUM TERM. ENERGIZES WITH COMB. AIR INDUCER.

THERMOSTAT CALLS FOR COOLING.

SYSTEM FAN SWITCHED TO COOL SPEED. EAC TERM. REMAINS ON.

THERMOSTAT OPENS.

MANUAL FAN SELECTION MADE AT THERMOSTAT. CONTROL (G) ENERGIZES SYSTEM FAN AT HEAT SPEED. EAC TERM. ENERGIZED.

SYSTEM FAN REMAINS ON HEATING SPEED.

THERMOSTAT OPENS.

HUM TERM. DE-ENERGIZES WITH COMB. AIR INDUCER.

SYSTEM FAN REMAINS ON HEATING SPEED.
1 - When there is a call for heat, W1 of the thermostat energizes W of the furnace control with 24VAC.

2 - S10 primary limit switch and S47 rollout switch are closed. Call for heat can continue.

3 - 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.

4 - The integrated control (A92) energizes ignitor. A 20-second warm-up period begins.

5 - Gas valve opens for a 4-second trial for ignition

6 - Flame is sensed, gas valve remains open for the heat call.

7 - After 30-second delay, the integrated control (A92) energizes indoor blower B3.

8 - 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.
HEATING SEQUENCE OF OPERATION

NORMAL HEATING MODE

POWER ON

CONTROL SELF-CHECK OKAY?

IS POLARITY CORRECT?

IS THERE A PROPER GROUND?

IS VOLTAGE ABOVE 90 VOLTS?

ROLLOUT SWITCH CLOSED?

BURNER OFF? (Continuous Flame Check)

NORMAL OPERATION:
LED: STEADY ON

THERMOSTAT CALLS FOR HEAT:
LED: STEADY ON

PRIMARY AND SECONDARY LIMIT SWITCH CLOSED?

IS COMBUSTION AIR PRESSURE SWITCH OPEN?

IS COMBUSTION AIR INDUCER ENERGIZED?

HAS COMBUSTION AIR PRESSURE SWITCH CLOSED IN 2.5 MINUTES?

CONTINUED NEXT PAGE

ABNORMAL HEATING MODE

GAS VALVE OFF. COMBUSTION AIR INDUCER OFF. INDOOR BLOWER DELAY OFF.
LED: OFF

Polarity Reversed.
LED: 9 FLASHES

Improper Ground.
LED: OFF
Control will not respond to call for heat until proper ground.

LED: ON steady
Ignitor will glow dimly but will not light

GAS VALVE OFF. COMBUSTION AIR INDUCER ON.
INDOOR BLOWER ON.
LED: 5 FLASHES
Sequence holds until rollout switch closes and power is reset or thermostat is interrupted for minimum of 1 second.

GAS VALVE OFF. COMBUSTION AIR INDUCER ON.
INDOOR BLOWER ON HEATING SPEED.
LED: 1 FLASH

COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER ON.
LED: 4 FLASHES

GAS VALVE OFF.
COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER OFF WITH DELAY.
LED: 2 FLASHES
(Sequence holds until pressure switch opens or thermostat resets control.)

PRESSURE SWITCH IS IN WATCHGUARD MODE.
GAS VALVE OFF. COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER OFF WITH DELAY.
LED: 3 FLASHES
IS 5-MINUTE RESET PERIOD COMPLETE?

NO

YES

NO

YES

NO

YES

NO

YES

NO

YES
COOLING SEQUENCE OF OPERATION

NORMAL COOLING MODE

POWER ON

IGNITION CONTROL
MAIN POWER ON. LED: ON STEADY

CONTROL SELF DIAGNOSTIC CHECK.
IS CONTROL OPERATING NORMALLY?

NO

YES

IS THERE A PROPER GROUND?

NO

YES

IS POLARITY CORRECT?

NO

YES

IS VOLTAGE ABOVE 90 VOLTS?

NO

YES

LED: ON STEADY.
REMAINS UNCHANGED THROUGHOUT COOLING CYCLE.

THERMOSTAT CALLS FOR COOLING.

COMPRESSOR CONTACTOR AND SYSTEM FAN
ENERGIZED WITH 2-SECOND DELAY
(COOLING SPEED). EAC TERM. ENERGIZED.

THERMOSTAT OPENS.

COMPRESSOR OFF.

SYSTEM FAN AND EAC TERM. OFF
WITH 60-SECOND DELAY.

ABNORMAL COOLING MODE

GAS VALVE OFF. COMBUSTION AIR INDUCER OFF.
INDOOR BLOWER OFF WITH NORMAL DELAY.
LED: OFF
INTERRUPT MAIN POWER TO RESET CONTROL.

LED: ON STEADY.
CONTROL WILL CONTINUE TO CALL FOR COOLING
IN THIS CONDITION.

LED: 9 FLASHES.
CONTROL WILL CONTINUE TO CALL FOR COOLING
IN THIS CONDITION.

LED: ON STEADY.
CONTROL WILL CONTINUE TO CALL FOR COOLING
IN THIS CONDITION.

CONTINUOUS FAN SEQUENCE OF OPERATION

LED: ON STEADY.
MANUAL FAN SELECTION MADE AT THERMOSTAT.
CONTROL (G) ENERGIZES SYSTEM FAN ON CONTINUOUS
BLOWER SPEED. EAC TERMINAL IS ENERGIZED.

THERMOSTAT CALLS FOR HEAT (W).

NO

YES

HUM TERM. ENERGIZES
WITH COMB. AIR INDUCER.

THERMOSTAT CALLS FOR COOLING.

SYSTEM FAN SWITCHES TO
HEATING SPEED.

NO

YES

THERMOSTAT OPENS.

HUM TERM. DE-ENERGIZES
WITH COMB. AIR INDUCER.

HUM TERM. DE-ENERGIZES
WITH COMB. AIR INDUCER

MANUAL FAN SELECTION MADE AT THERMOSTAT.
CONTROL (G) ENERGIZES SYSTEM FAN ON
CONTINUOUS BLOWER SPEED.