

## OIL-FIRED UNIT HEATER INSTALLATION, OPERATION, AND MAINTENANCE

### DISCONTINUED MODEL OH



### ⚠ DANGER ⚠

- Improper installation, adjustment, alteration, service, or maintenance can cause property damage, injury, or death. Read the installation, operation, and maintenance instructions thoroughly before installing or servicing this equipment.
- The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.
- This appliance is not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, or atmospheres containing chlorinated or halogenated hydrocarbons.
- DO NOT use gasoline, crankcase oil, or any oil containing gasoline. Do not use aviation fuel.
- DO NOT attempt to burn paper or garbage in this heater.

**DO NOT DESTROY. PLEASE READ CAREFULLY. KEEP IN A SAFE PLACE FOR FUTURE REFERENCE.**

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## GENERAL INFORMATION

The instructions in this manual apply to the Reznor model OH oil-fired unit heater, which has a propeller fan for air delivery and requires a vent with a barometric draft regulator.

This unit has been tested for capacity and efficiency so as to provide many years of safe and dependable comfort providing it is properly installed and maintained. With regular maintenance, this unit will operate satisfactorily year after year. Abuse, improper use, and/or improper maintenance can shorten the life of the appliance and create unsafe hazards.

To achieve optimum performance and minimize equipment failure, it is recommended that periodic maintenance be performed on this unit. The ability to properly perform maintenance on this equipment requires certain tools and mechanical skills.

Installation should be done by a qualified agency in accordance with the instructions in this manual and in compliance with all codes and requirements of authorities having jurisdiction.

### Important Safety Information

There are warning labels on the unit and throughout this manual. Please read all information in this manual thoroughly and become familiar with the capabilities and use of your appliance before attempting to operate or maintain this unit. Pay attention to all dangers, warnings, cautions, and notes highlighted in this manual. Safety markings should not be ignored and are used frequently throughout to designate a degree or level of seriousness.

**DANGER:** A danger statement describes a potentially hazardous situation that if not avoided, will result in severe personal injury or death and/or property damage.

**WARNING:** A warning statement describes a potentially hazardous situation that if not avoided, can result in severe personal injury and/or property damage.

**CAUTION:** A caution statement describes a potentially hazardous situation that if not avoided, can result in minor or moderate personal injury and/or property damage.

**NOTE:** A note provides important information that should not be ignored.

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### DANGER

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**Improper installation, adjustment, alteration, service, or maintenance can cause property damage, injury, or death. Read the installation, operation, and maintenance instructions thoroughly before installing or servicing this equipment.**

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### WARNING

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**This appliance is not designed for use in hazardous atmospheres containing flammable vapors, combustible dust, or chlorinated or halogenated hydrocarbons.**

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### CAUTION

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**Do not tamper with the unit or its controls. Call your service person.**

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### Warranty

Refer to the limited warranty information on the warranty card in the *owner's envelope*. The warranty is void if:

- Wiring is not in accordance with the diagram furnished with the heater.
- Heater is operated in presence of chlorinated vapors.
- Ducts are attached to fan models.

## Fuel Specifications

The burner in this oil-fired heater is designed and orificed for use with #2 fuel oil (140,000 BTU/gallon) at 100 psig. Substitute fuels may be used as follows:

- #1 fuel oil: 132,000 BTU/gallon
- Kerosene (domestic only—do not use foreign): 132,000 BTU/gallon
- #1 diesel fuel: 132,000 BTU/gallon
- #2 diesel fuel: 140,000 BTU/gallon

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### WARNING

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**Do not use gasoline, crankcase oil, or any oil containing gasoline. Do not use aviation fuel.**

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### CAUTION

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**Do not attempt to burn paper or garbage in this heater.**

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#### NOTE:

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**Due to higher viscosity, the BTU/gallon capacity of some #1 oils may be 128,000–130,000 BTU/gallon. Check the BTU content of substitute fuel to determine burner input, which is as follows:**

- Unit size 095 burns an average of 0.85 gallons per hour.
  - Unit size 140 burns an average of 1.25 gallons per hour.
  - Unit size 190 burns an average of 1.65 gallons per hour.
- 

## Installation Codes

**In the US:** model OH units intended for installation in the US have a UL logo on the rating plate. In the US, the installation must be in accordance with the following:

- Standard for the Installation of Oil Burning Equipment NFPA 31
- National Electrical Code NFPA 70
- Requirements of inspection authorities having jurisdiction

**In Canada:** model OH units intended for installation in Canada have a CSA logo on the rating plate. In Canada, the installation must be in accordance with the following:

- CSA Standard B139: Installation Code for Oil Burning Equipment
  - CSA Standard C22.1: Canadian Electric Code, Part 1
  - Requirements of local regulatory authorities
- 

**NOTE: This heater is for commercial or industrial use only and should be installed by a trained installer who is thoroughly familiar with the installation of oil-fired appliances. Prior to installation, the installer should become familiar with the heater and its particular installation requirements.**

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## GENERAL INFORMATION—CONTINUED

### Clearances

#### ⚠ WARNING ⚠

Clearances apply to ALL combustibles. DO NOT leave paper, rags, or any combustible near the heater.

Clearance (refer to [Table 2](#)) to combustibles is defined as the minimum distance from the heater to a surface or object so as to ensure that a surface temperature of 90°F above the surrounding ambient temperature is not exceeded. The heater should be suspended at a height so that the heat exchanger cannot be touched. Clearance is also required at the sides of the heater for servicing the unit.

**NOTE:** For additional information on installation clearances, refer to CAN/CSA-B139, *Installation Code for Oil Burning Equipment* (paragraph 8, *Installation Clearances*).

| Table 2. Clearances              |           |          |          |         |           |
|----------------------------------|-----------|----------|----------|---------|-----------|
| Unit Surface                     |           |          |          |         |           |
| Top                              | Front     | Sides    | Rear     | Bottom  | Flue Pipe |
| Required Clearance (Inches (mm)) |           |          |          |         |           |
| 2 (51)                           | 48 (1219) | 18 (457) | 24 (610) | 6 (152) | 18 (457)  |

### Dimensions

Dimensions for the unit are shown in [Figure 1](#) and listed in [Table 3](#).

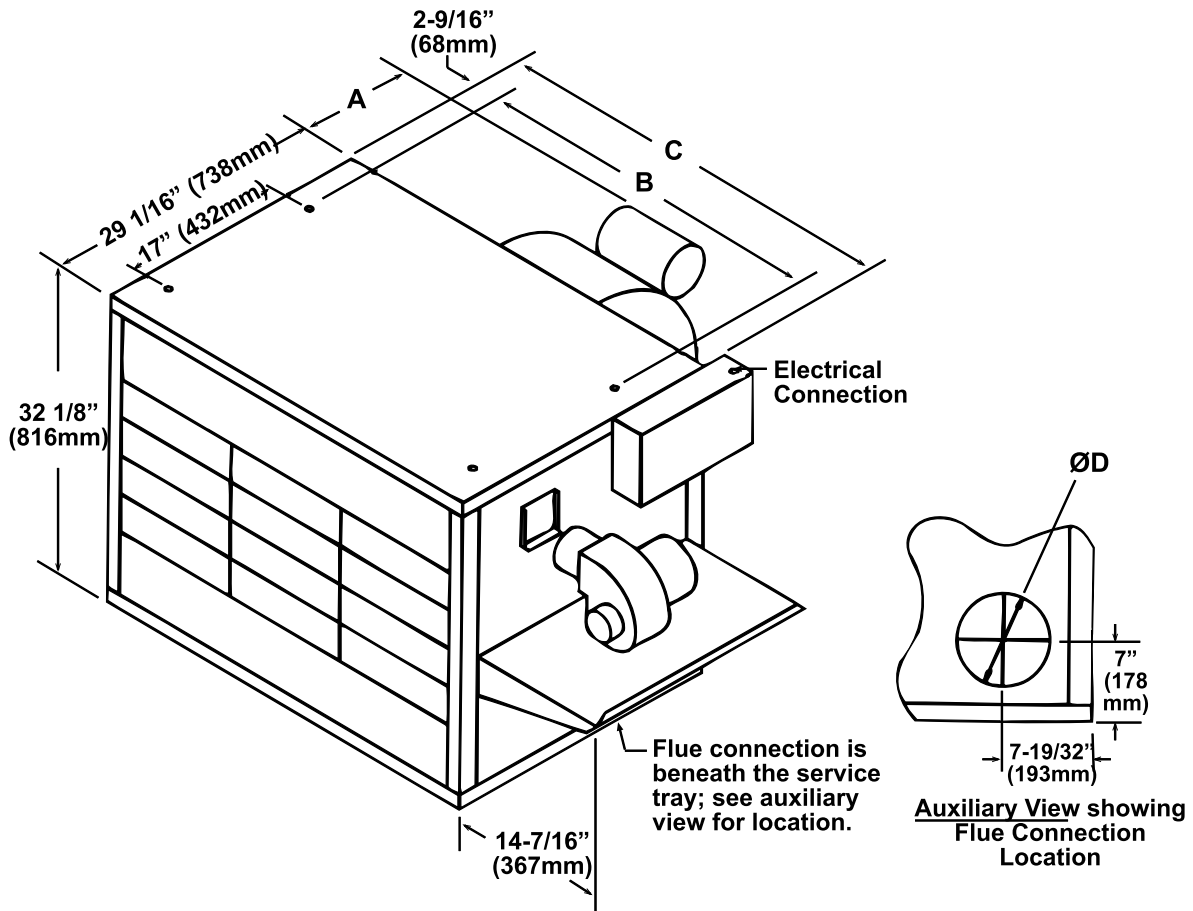


Figure 1. Dimensions (Refer to [Table 3](#))

| Table 3. Dimensions |                                       |              |           |         |
|---------------------|---------------------------------------|--------------|-----------|---------|
| Unit Size           | Alphabetic Designation (See Figure 1) |              |           |         |
|                     | A                                     | B            | C         | D       |
|                     | Inches (mm)                           |              |           |         |
| 095                 | 8 (203)                               | 17-3/8 (441) | 33 (838)  | 7 (178) |
| 140, 190            | 9-1/2 (241)                           | 37-3/8 (949) | 43 (1092) | 8 (203) |

## Weights

| Table 4. Weights |           |           |
|------------------|-----------|-----------|
| Unit Size        |           |           |
| 095              | 140       | 190       |
| Pounds (kg)      |           |           |
| 290 (132)        | 345 (156) | 345 (156) |

## Air Throw

| Table 5. Air Throw |           |           |
|--------------------|-----------|-----------|
| Unit Size          |           |           |
| 095                | 140       | 190       |
| Feet (Meters)*     |           |           |
| 50 (15.2)          | 65 (19.8) | 65 (19.8) |

\*Listed values are for a heater installed at a mounting height of 9 feet (2.7 meters).

# INSTALLATION

## Location Selection

The unit should be installed so as to derive maximum efficiency and minimum heat loss to the outside environment. As a rule, suspend a single heater over an area of low heat loss with the output air directed toward the area of greatest heat loss (refer to Table 5). Where two or more heaters are used in a common installation, arrange the heaters around the outside walls and blowing parallel to them. Heaters may be arranged in a supporting consecutive air pattern so that the output of one heater blows beneath the air-intake side of another. In installations where there are concentrated heat loss areas, a combination of single and multiple arrangements is desirable. Figure 2 shows recommended heater arrangements.

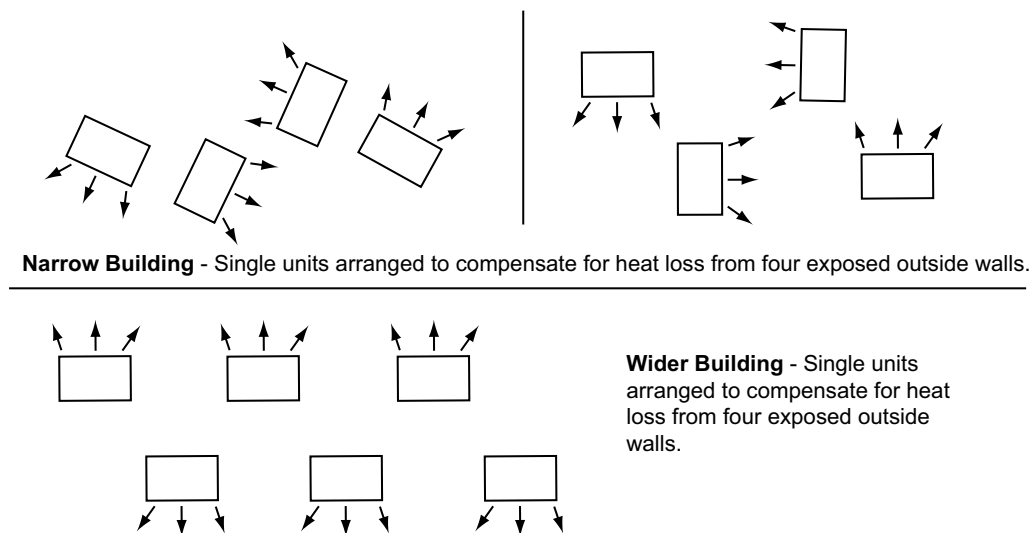


Figure 2. Recommended Heater Arrangements

## INSTALLATION—CONTINUED

### Unpacking Unit

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#### ⚠ CAUTION ⚠

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To prevent damage to the painted cabinet, it is recommended that the crate bottom be left in place until after the unit has been suspended.

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#### NOTE:

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- A cleaning rake base is included with all units. If the heater is being installed in Canada, a barometric draft regulator (option DB1, shipped separately) is required.
  - The installation could also include a variety of other shipped-separate options. Ensure that all optional components to be used in the installation are at the job site.
  - The unit was inspected and tested at the factory prior to crating and was in operating condition at that time.
- 

Immediately upon uncrating the unit, check for any damage that may have occurred during shipping. If any damage is found, immediately document the damage with the transporting agency and contact an authorized Reznor Distributor. If you are an authorized Distributor, follow the FOB freight policy procedures as published by Reznor, LLC.

### Unit Mounting

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#### ⚠ CAUTION ⚠

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The unit must be level for proper operation.

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The unit may be suspended or mounted on an optional workbench fuel tank (option OT) and heater stand (option HS). Ensure that adequate clearances (refer to [Table 2](#)) are available to accommodate the heater's dimensions (refer to [Table 3](#)).

#### ***Suspension Mounting***

Hang the heater as follows.

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#### ⚠ DANGER ⚠

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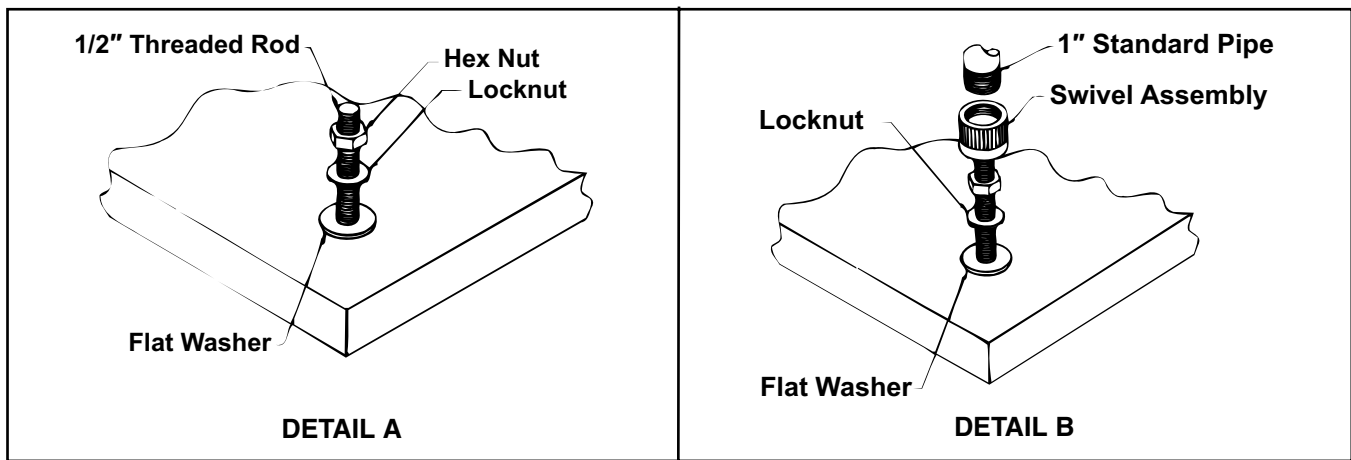
- To prevent injury, death, or equipment damage, before suspending the heater, check the supporting structure to ensure that it has sufficient load-carrying capacity to support the weight (refer to [Table 4](#)) of the heater.
  - Before lifting the heater into place, ensure that the lifting device is rated to adequately support the weight of the heater.
  - Do not place on or add additional weight to the suspended heater.
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**NOTE: Units manufactured *before* OCT 1994 are suspended using 3/8-inch rods and hardware.**

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1. Attach suitable lifting device to heater and lift it into position.
2. To suspend heater using 1/2-inch threaded rod, lock four threaded rods using washers and nuts as shown in [Figure 3](#), DETAIL A. To suspend heater using optional swivel connectors (option CK10) and field-provided 1 inch threaded pipe, lock four threaded pipes using swivel connectors, washers, and nuts as shown in [Figure 3](#), DETAIL B.
3. Remove shipping crate bottom from heater.
4. Remove shipping crate angle clips from heater and reinstall screws into heater cabinet.
5. Remove lifting device from heater.



**Figure 3. Suspension Mounting**

### ***Optional Heater Stand Mounting***

Mount the heater using the optional workbench fuel tank (option OT) and heater stand (option HS) as follows:

1. Position tank in accordance with tank instructions.
2. Assemble heater stand in accordance with stand instructions.
3. Position and secure heater on stand in accordance with stand instructions.

### **Mechanical Connections**

## **⚠ DANGER ⚠**

**Prior to entering enclosures such as vaults or pits, where pumps and accessories are installed, provide for adequate ventilation.**

### ***Fuel Tanks***

- Oil tanks must be installed in accordance with all local regulations and the National Board of Fire Underwriters or CSA Standard.
- All oil tanks must include a vent pipe to the outdoors. The lower end of the vent pipe should not extend more than 1 inch below the uppermost point of the tank. The vent pipe terminal should be weatherproof and clog-proof.
- Installation of the fuel tank and piping is the responsibility of the installing contractor.

### ***Pipe Tubing***

- All piping shall be standard full weight black iron pipe with standard fittings or approved brass or copper tubing, with UL-listed fittings.
- All piping shall be protected from possible injury and shall be rigidly fastened. Where practical, it should be buried underground or in a concrete floor or placed in a metal-covered pipe trench. If installed above ground, the pipe must be insulated to avoid freezing.
- Pipe joints and connections shall be made tight and only unions and tube fittings of an approved type shall be used.
- Use only pipe thread compound resistant to oil. Do not use TEFLON® (a registered trademark of E.I. DuPont de Nemours and Company) tape or TEFLON®-based pipe dope.
- Do not cover the piping until the burner has been installed and operated so that any leaks may be detected and corrected.
- For connecting the burner to the tank, use at least 1/2-inch iron pipe or 3/8-inch OD copper tubing (1/2-inch OD copper tubing is preferred) having a wall thickness of not less than 0.049-inch.

## INSTALLATION—CONTINUED

### Mechanical Connections—Continued

#### Shutoff Valves

- Install a readily-accessible manual shutoff valve at each point to properly control the flow of fuel in normal operation and where required to avoid oil spillage during servicing. The valve should close against the supply. If the heater will not be operating for an extended period of time, close the shutoff valve.
- Where a shutoff is installed in the discharge line of an oil pump that is not an integral part of a burner, connect a pressure relief valve into the discharge line between the pump and the shutoff valve and arrange to return surplus oil to the supply tank or to bypass it around the pump unless the pump includes an internal bypass.
- Any fuel oil line that incorporates a heater shall be provided with a relief valve arranged to discharge to the return line when any valve, pump, or other device may prevent the release of excessive pressure because of the expansion of the oil when heated.
- Where oil is supplied to a burner that requires uniform flow by gravity feed and a constant level valve is not incorporated in the burner assembly or the oil is not supplied by an automatic pump, install a constant level valve in the supply line at the gravity tank or as close as practical, to ensure uniform delivery of oil to the burner. The vent opening of the constant level valve should be connected by piping or tubing to the outside of the building unless the constant level valve is provided with an anti-flooding device. Do not connect the vent piping or tubing of constant level valves to tanks or tank vents.

#### Oil Filter

- Install a UL-listed (US) or CSA/USC (Canada) oil filter of generous capacity between the tank shutoff valve and the burner.
- For ease of servicing, locate the filter and shutoff valve close to the oil burner.

#### Piping System Selection

Piping system selection depends on the application. The following four methods of piping fuel to an oil-fired heater are recommended for specific installation conditions:

- one-pipe supply with the standard single-stage burner pump
- two-pipe supply with either the standard single-stage burner pump or an optional two-stage burner pump
- loop and pressurized systems require an additional booster pump for oil delivery and are used when installing more than one heater

#### One-Pipe Supply with Standard Single-Stage Burner Pump

- The standard burner is equipped with a single-stage, 3,450-RPM pump with the lift capacity shown in [Figure 4](#).

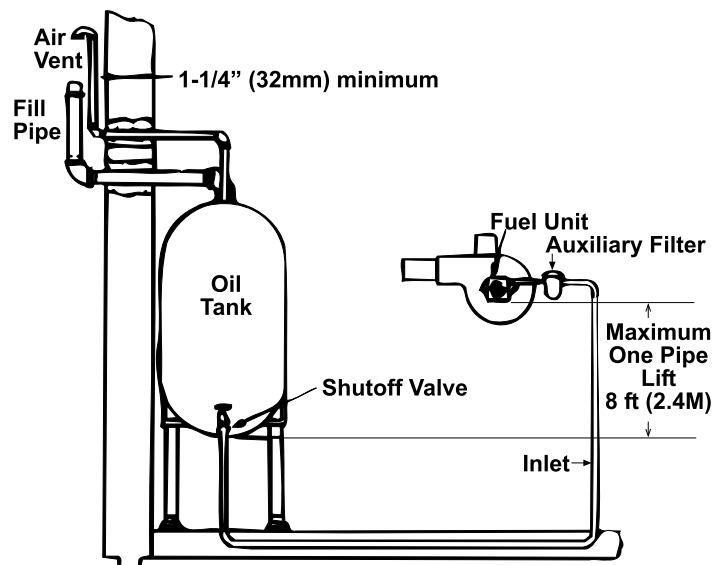


Figure 4. One-Pipe Supply System

- Refer to [Table 6](#) for the maximum horizontal line length with a one-pipe supply system. Fittings, valves, and filters reduce the total line length allowed. Check the component manufacturer's information for equivalent length reductions required to compensate for pressure loss.

| Table 6. Maximum Horizontal Line Length for One-Pipe Supply System |                    |                                                |            |            |            |            |            |           |           |         |
|--------------------------------------------------------------------|--------------------|------------------------------------------------|------------|------------|------------|------------|------------|-----------|-----------|---------|
| Unit Size                                                          | Pipe Size (Inches) | Lift (Feet (Meters))                           |            |            |            |            |            |           |           |         |
|                                                                    |                    | 0 (0.0)                                        | 1 (0.3)    | 2 (0.6)    | 3 (0.9)    | 4 (1.2)    | 5 (1.5)    | 6 (1.8)   | 7 (2.1)   | 8 (2.4) |
|                                                                    |                    | Maximum Horizontal Line Length (Feet (Meters)) |            |            |            |            |            |           |           |         |
| 095                                                                | 3/8                | 822 (251)                                      | 719 (219)  | 616 (188)  | 514 (157)  | 411 (125)  | 308 (94)   | 205 (62)  | 103 (31)  | 0 (0)   |
|                                                                    | 1/2                | 3158 (963)                                     | 2763 (842) | 2368 (722) | 1974 (902) | 1579 (481) | 1184 (361) | 789 (240) | 395 (120) |         |
| 140                                                                | 3/8                | 556 (169)                                      | 486 (148)  | 417 (127)  | 347 (106)  | 278 (85)   | 208 (63)   | 139 (42)  | 69 (21)   |         |
|                                                                    | 1/2                | 2222 (677)                                     | 1944 (593) | 1667 (508) | 1389 (423) | 1111 (339) | 833 (254)  | 556 (169) | 278 (85)  |         |
| 190                                                                | 3/8                | 423 (129)                                      | 370 (113)  | 317 (97)   | 264 (80)   | 211 (64)   | 158 (48)   | 106 (32)  | 53 (16)   |         |
|                                                                    | 1/2                | 1667 (508)                                     | 1458 (444) | 1250 (381) | 1042 (318) | 833 (254)  | 625 (191)  | 417 (127) | 208 (63)  |         |

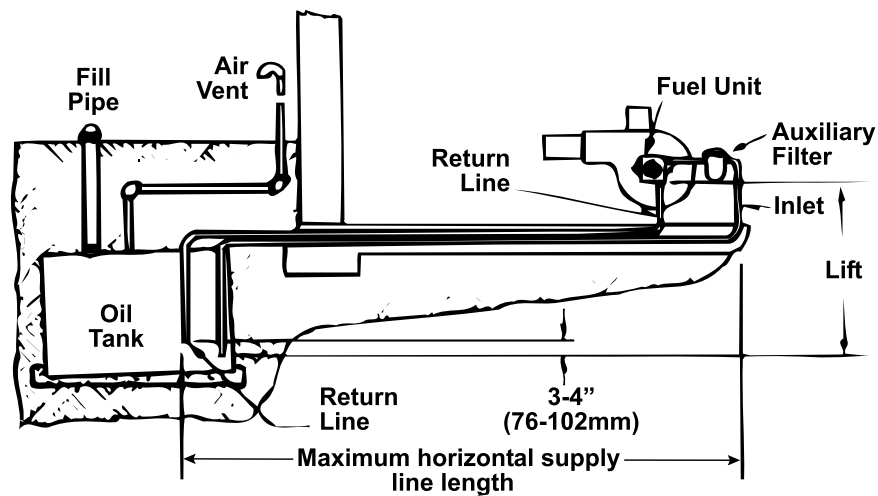
- In the following formula for determining lift in [Table 6](#), *Firing Rate* = 0.085 for unit size 095, 1.25 for unit size 140, or 1.35 for unit size 190:

$$Length = \frac{6 \text{ feet} - (0.75 \times Lift)}{(0.0086 \text{ for } 3/8" \text{ tubing or } 0.00218 \text{ for } 1/2" \text{ tubing}) \times (Firing Rate \text{ in GPH})}$$

- A one-pipe supply system must be absolutely airtight or else leaks and/or loss of prime may result.
- Bleed the line (refer to [Startup Checklist](#) section) for 15 seconds after last air is seen from easy-flow bleed valve to ensure that the line is air-free.

#### **Two-Pipe Supply with Standard Single-Stage Burner Pump or Optional Two-Stage Pump**

- A two-pipe supply system may be used with the standard burner pump or with an optional two-stage pump (option BZ1).
- The two-stage pump provides dual pumping gears.
- Install the two-pipe supply system (see [Figure 5](#)) as follows:
  - Remove 1/4-inch plug from return line port and insert 1/16-inch bypass plug (shipped with burner pump).
  - Connect inlet and return lines.
  - Terminate return line 3 to 4 inches (76 to 102 mm) above supply line inlet.



**Figure 5. Two-Pipe Supply System**

- Refer to [Table 7](#) for the maximum horizontal line (return and supply) length with a two-pipe supply system.

## INSTALLATION—CONTINUED

### Mechanical Connections—Continued

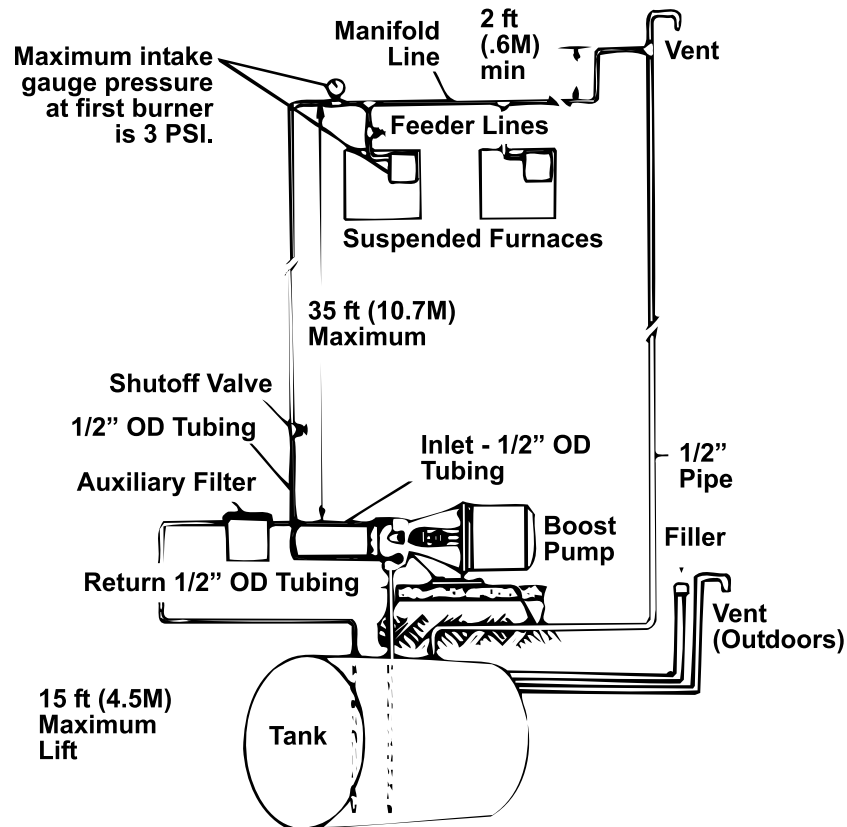
#### Two-Pipe Supply with Standard Single-Stage Burner Pump or Optional Two-Stage Pump—Continued

| Table 7. Maximum Horizontal Line Length for One-Pipe Supply System |                                                |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
|--------------------------------------------------------------------|------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Pipe Size<br>(Inches)                                              | Lift (Feet (Meters))                           |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
|                                                                    | 0<br>(0.0)                                     | 1<br>(0.3)   | 2<br>(0.6)   | 3<br>(0.9)   | 4<br>(1.2)   | 5<br>(1.5)   | 6<br>(1.8)   | 7<br>(2.1)   | 8<br>(2.4)   | 9<br>(2.7)   | 10<br>(3.0)  | 11<br>(3.3)  | 12<br>(3.6)  | 13<br>(3.9)  | 14<br>(4.2)  | 16<br>(4.8)  | 18<br>(5.4)  |
|                                                                    | Maximum Horizontal Line Length (Feet (Meters)) |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
| Standard Single-Stage Pump                                         |                                                |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
| 3/8                                                                | 84<br>(25.6)                                   | 77<br>(23.5) | 71<br>(21.6) | 65<br>(19.8) | 59<br>(18.0) | 52<br>(15.8) | 46<br>(14)   | 40<br>(12.2) | 34<br>(10.3) | 27<br>(8.2)  | 21<br>(6.0)  | 15<br>(4.5)  | 9<br>(2.7)   | —            |              |              |              |
| 1/2                                                                | 100<br>(30.5)                                  | 99<br>(30.1) | 98<br>(29.8) | 97<br>(29.5) | 96<br>(29.3) | 95<br>(29.0) | 94<br>(28.6) | 93<br>(28.3) | 92<br>(28.0) | 91<br>(27.7) | 90<br>(27.4) | 89<br>(27.1) | 71<br>(21.6) | 49<br>(14.9) | 27<br>(8.2)  | —            |              |
| Optional Two-Stage Pump                                            |                                                |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
| 3/8                                                                | 93<br>(28.3)                                   | 88<br>(26.8) | 83<br>(25.3) | 78<br>(23.8) | 73<br>(22.2) | 68<br>(20.7) | 63<br>(19.2) | 58<br>(17.7) | 52<br>(16.0) | 47<br>(14.3) | 42<br>(12.8) | 37<br>(11.3) | 32<br>(9.8)  | 27<br>(8.2)  | 22<br>(6.7)  | 11<br>(3.4)  | —            |
| 1/2                                                                | 100<br>(30.5)                                  | 99<br>(30.1) | 98<br>(29.8) | 97<br>(29.5) | 96<br>(29.3) | 95<br>(29.0) | 94<br>(28.6) | 93<br>(28.3) | 92<br>(28.0) | 91<br>(27.7) | 90<br>(27.4) | 89<br>(27.1) | 88<br>(26.8) | 87<br>(26.5) | 86<br>(26.2) | 84<br>(25.6) | 58<br>(17.7) |

### Loop System

**NOTE:** If a 2-foot rise cannot be maintained, use the pressurized system.

- The loop piping system (see [Figure 6](#)), a supply system for multiple-unit installations, uses the standard single-stage burner pump and an optional boost pump (option DA1 or DA2) and should not be operated at line pressures greater than 3 psi at the first burner supplied.



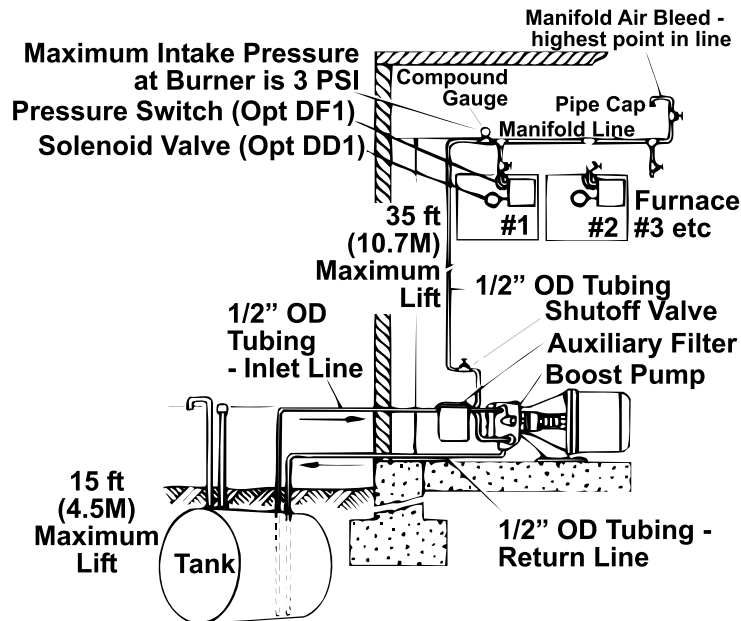
**Figure 6. Loop Supply System for Multiple-Unit Installations**

- The boost pump supplies fuel oil in excess of burner requirements from the supply tank to individual heaters. The fuel oil is returned to the supply tank.

- The boost pump operates full time during the heating season and must run continuously.
- All manifold and feeder lines must run in a horizontal plane at an elevation above the fuel intakes of the units. Extend feeder lines downward to fuel burner intakes.

### Pressurized System

- The pressurized system (see [Figure 7](#)) uses a boost pump to supply fuel oil to a manifold with branch lines that supply each heater. The end of the manifold is capped, and the system is operated at a pressure not exceeding 3 psi at the first burner supplied.

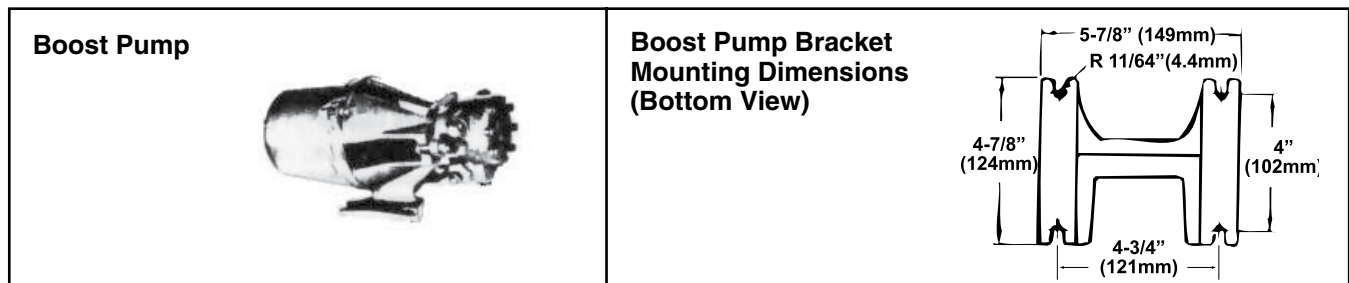


**Figure 7. Pressurized Supply System for Multiple-Unit Installations**

- BTU output is determined by boost pump capacity and by the subsequent number of burners that can be supplied adequately by fuel oil. For example, a 30-GPH booster pump will sustain eighteen 1.65-GPH burners.
- An optional solenoid valve is recommended to protect burner pump seal against excessive pressure. Optional pressure switch monitors nozzle pressure and will start booster pump on pressure fall.
- Boost pump operation in a pressurized system may be continuous or may be intermittent when optional pressure switches are used.

### Boost Pump Assembly (Option DA1 or DA2)

- The boost pump is equipped with a motor and is supplied with a two-stage fuel unit that incorporates a regulator valve and strainer.
- The regulator valve acts as a check to prevent the loss of oil supply between the boost pump and the burner, thus assuring instantaneous starts following shutdown periods. The regulator valve also prevents excessive pressures.
- The complete assembly with the motor is approximately 15 inches long x 7-1/2 inches high x 6-3/4 inches wide (381 x 191 x 171 mm). The dimensions for the boost pump mounting bracket are shown in [Figure 8](#).



**Figure 8. Boost Pump and Mounting Bracket**

## INSTALLATION—CONTINUED

### Mechanical Connections—Continued

#### Boost Pump Assembly (Option DA1 or DA2)—Continued

- The maximum height from boost pump to burner is 35 feet (10.7 meters).
- Refer to [Table 8](#) for the maximum horizontal line length for boost pump piping.
- See [Figure 9](#) for boost pump wiring.

| Table 8. Maximum Horizontal Line Length for Boost Pump Piping |     |                                                |           |            |                    |            |            |               |            |              |
|---------------------------------------------------------------|-----|------------------------------------------------|-----------|------------|--------------------|------------|------------|---------------|------------|--------------|
| Boost Pump to Burner(s)                                       |     |                                                |           |            |                    |            |            |               |            |              |
| Boost Pump Option                                             | GPH | Line Size                                      |           |            |                    |            |            |               |            |              |
|                                                               |     | 1/2-Inch OD Tubing                             |           |            | 1/2-Inch Pipe      |            |            | 3/4-Inch Pipe |            |              |
|                                                               |     | Maximum Horizontal Line Length (Feet (Meters)) |           |            |                    |            |            |               |            |              |
|                                                               |     | DA1                                            | 30        | 175 (53.3) |                    |            | 300 (91.4) |               |            | 1800 (548.6) |
| DA2                                                           | 70  | 50 (15.2)                                      |           |            | 100 (30.5)         |            |            | 600 (182.9)   |            |              |
| Oil Supply to Boost Pump                                      |     |                                                |           |            |                    |            |            |               |            |              |
| Boost Pump Option                                             | GPH | Line Size                                      |           |            |                    |            |            |               |            |              |
|                                                               |     | 1/2-Inch OD Tubing                             |           |            | 5/8-Inch OD Tubing |            |            | 1/2-Inch Pipe |            |              |
|                                                               |     | Lift (Feet (Meters))                           |           |            |                    |            |            |               |            |              |
|                                                               |     | 0–7 (0.0–2.1)                                  | 10 (3.0)  | 15 (4.6)   | 0–7 (0.0–2.1)      | 10 (3.0)   | 15 (4.6)   | 0–7 (0.0–2.1) | 10 (3.0)   | 15 (4.6)     |
|                                                               |     | Maximum Horizontal Line Length (Feet (Meters)) |           |            |                    |            |            |               |            |              |
| DA1                                                           | 30  | 64 (19.5)                                      | 49 (14.9) | 24 (7.3)   | 100 (30.4)         | 100 (30.4) | 65 (19.8)  | 100 (30.4)    | 100 (30.4) | 100 (30.4)   |
| DA2                                                           | 70  | 44 (13.4)                                      | 34 (10.4) | 17 (5.2)   | 100 (30.4)         | 95 (29)    | 48 (14.6)  | 100 (30.4)    | 90 (27.4)  | 65 (19.8)    |

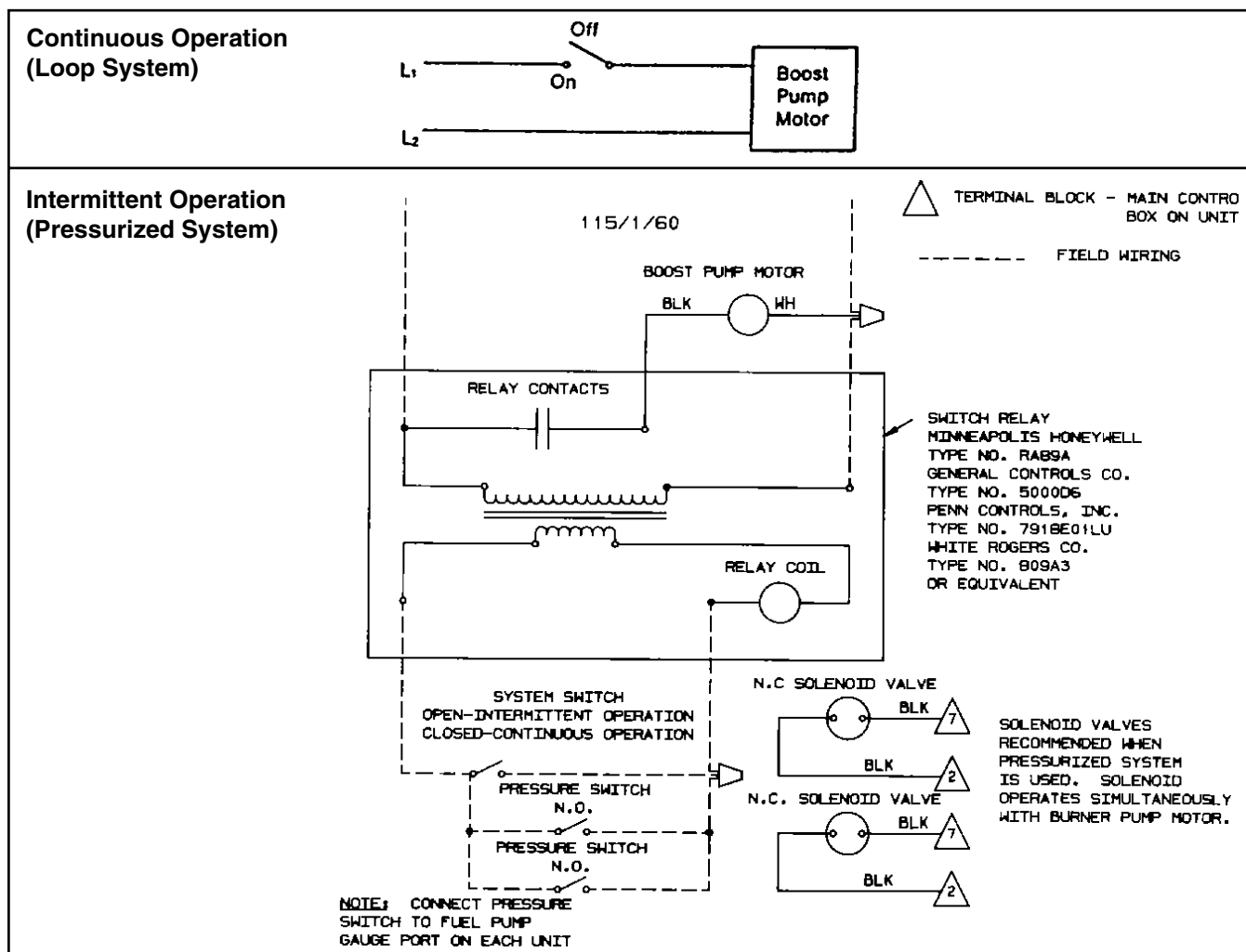


Figure 9. Boost Pump Wiring

### ***Boost Pump Pressure Switch (Option DF1, Shipped Separately)***

- The boost pump pressure switch is used for intermittent boost pump operation in a pressurized system. One is required for each burner. The switch is specifically designed for fuel oil and includes a 1/8" male pipe thread connector and screw terminals.
- The switch is a low-voltage, normally-open type that closes at approximately 50 psi.
- The maximum allowable pressure is 150 psi.
- A manual switch, for initial starting (or continuous operation) is recommended for installation in the low-voltage circuit.
- Pressurized piping systems must not exceed 3 psi. An oil solenoid valve (option DD1) is recommended at each unit to prevent seal damage should the pressure for any reason exceed the maximum of 3 psi.

### ***Oil Solenoid Valve (Option DD1, Shipped Separately)***

- Use of the optional solenoid valve is recommended with the pressurized oil delivery system.
- The solenoid valve is designed to operate simultaneously with the burner motor.

### ***Oil Safety Valve (Option DC1, Shipped Separately)***

- The Oil Safety Valve (OSV) is opened by the slight vacuum created by the burner pump. The OSV closes when the vacuum condition subsides to prevent siphoning of the supply line and to eliminate spills if any leaks develop downstream from the OSV.
- Use of the optional OSV is highly recommended.

### ***Check Valve***

- The check valve prevents reverse flow of oil maintaining static head pressure between the check valve and the automatic valve on the burner, thus preventing siphoning.
- Check valves are field-provided and are not needed when an OSV (option DC1) is used.

## **Venting and Combustion Air**

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### **⚠ DANGER ⚠**

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- **Failure to provide proper venting could result in death, serious injury, and/or property damage.**
  - **The unit must be connected to a flue that has sufficient draft to ensure safe and proper operation.**
  - **The unit must be properly vented to the outside of the building.**
  - **Safe operation of any gravity-vented heating equipment requires a properly-operating vent system, correct provision for combustion air, and regular maintenance and inspection.**
  - **Exercise care to ensure that an adequate supply of combustion air is available and free to enter the air openings on all units.**
  - **Openings equal to 1 inch square per each 1,000 BTU<sub>h</sub> should be used to allow combustion air to enter the room where the heater is installed.**
- 

### ***Chimney***

- **Masonry chimneys and metal chimneys:** must be built in accordance with accepted building code practice. Standards for chimneys can be found in NFPA Standard No. 211, published in National Fire Codes, Volume 4; the National Building Code of the American Insurance Association, New York, NY; ULC Standards for chimneys; or the National Building Code of Canada published by the National Research Council, Ottawa. A class A chimney or equivalent is required for this heater.
- **Existing masonry or metal chimney:** *before* installing the heater, clean and inspect the chimney. Make any necessary repairs and ensure that the chimney meets all requirements.
- **Approved factory-built chimney:** ensure that it meets all requirements and install it according to the manufacturer's instructions.

## INSTALLATION—CONTINUED

### Venting and Combustion Air—Continued

#### *Chimney—Continued*

- **Field-constructed metal chimney:** ensure that the vent pipe is as follows:

Minimum 7-inch (178-mm) diameter for unit size 095

Minimum 8-inch (203-mm) diameter for unit sizes 140 and 190

24-gauge or heavier triple-wall stainless steel (recommended) or 24-gauge or heavier galvanized steel

If the venting arrangement passes through a ceiling, triple-wall stainless vent pipe is required above the ceiling. The point of passage through a ceiling must be guarded by a metal ventilated thimble not less than 12 inches (305 mm) larger in diameter than the pipe.

Install a tee with a cleanout cap at the bottom of the vertical rise

- **Dimensions:** ensure that the dimensions of the chimney are as follows:

Minimum 7-inch (178-mm) diameter for unit size 095

Minimum 8-inch (203-mm) diameter for unit sizes 140 and 190

Minimum of 3 feet (0.9 meters) above the highest point of exit where it passes through the roof

Minimum of 2 feet (0.6 meters) higher than any portion of a building within 10 feet (3 meters) of the chimney

Minimum of 8 feet (2.4 meters) total chimney height

- **Draft:** the chimney must be capable of maintaining a steady draft of 0.04 IN WC. If the draft is below the minimum required, a draft inducer must be installed.

- **Vent connection from the flue outlet of the heater to the chimney:** ensure that the vent pipe is as follows:

Minimum 7-inch (178-mm) diameter for unit size 095

Minimum 8-inch (203-mm) diameter for unit sizes 140 and 190

24-gauge or heavier triple-wall stainless steel (recommended) or 24-gauge or heavier galvanized steel

Keep the length of the vent pipe connection as short and direct as possible

As it leaves the heater, slope the horizontal run upward at least 1 inch for each 3 feet of pipe. The horizontal run should not be longer than one-half of the vertical or chimney height and never over 10 feet (3 meters) unless a draft inducer is being installed.

- **Vent pipe connector passes through a combustible wall:** vent pipe must be guarded at the point of passage by either a metal ventilated thimble not less than 12 inches (305 mm) larger in diameter than the pipe or a metal or burned fireclay thimble built in brickwork or other approved fireproofing material extending not less than 8 inches (203 mm) beyond all sides of the thimble. If a thimble is not installed, all combustible material in the wall or partition must be cut away 9 inches (229 mm) from the pipe. If any material is used to close this opening, it must be non-combustible.
- **Fasteners and supports:** fasten all vent piping using sheet metal screws and support horizontal vent pipe from above using noncombustible straps.
- **Pipe runs:** avoid sharp turns in the vent pipe or other construction features that would create resistance to the flow of the flue gases.
- **Dampers:** do not use a manually operated damper or any other device that will obstruct the free flow of the flue gases.
- **Vent pipe connection inside chimney:** the end of the vent pipe connection must not extend past the inside wall of the chimney. A thimble may be used in the chimney connection to facilitate removal for cleaning. The thimble should be permanently cemented in place with high-temperature cement.

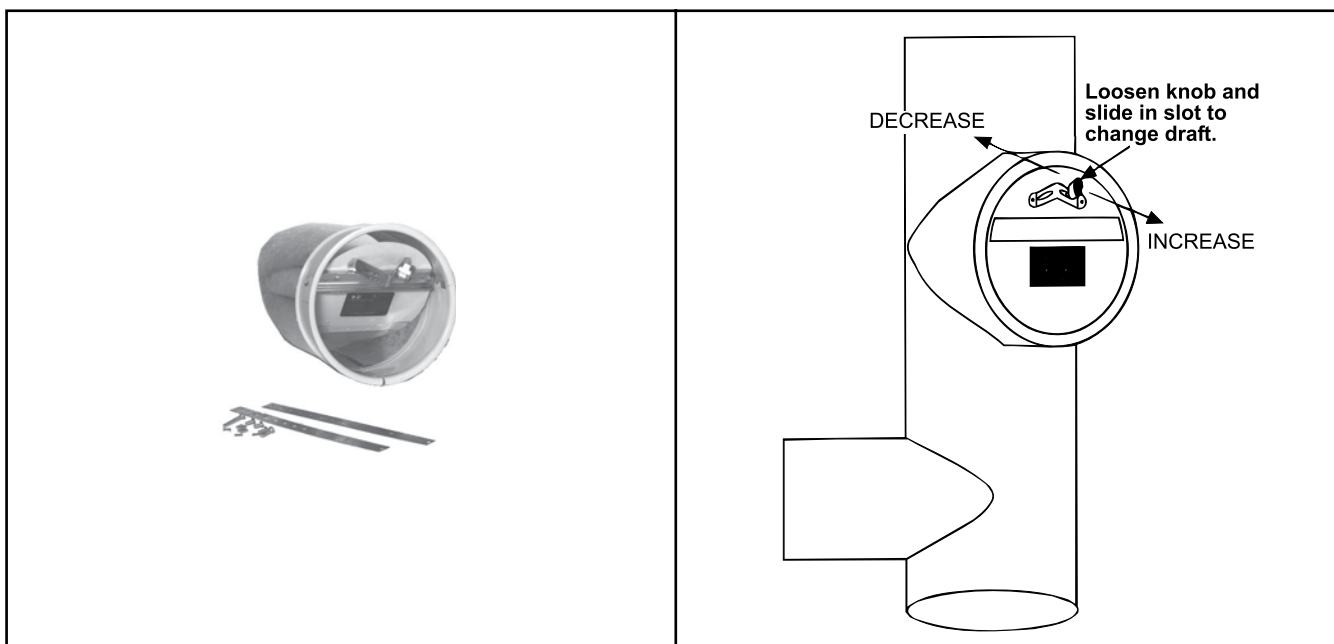
### Barometric Draft Regulator (Option DB1)

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#### NOTE:

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- Option DB1 (barometric draft regulator, see [Figure 10](#)) is required in Canada. Option DB1 or equivalent is required in the US.
  - Do not install a barometric draft regulator if the installation includes an optional outside combustion air inlet (option DE1).
- 



**Figure 10. Barometric Draft Regulator (Option DB1)**

- **Canadian installations:** option DB1 is required and must be installed near the heater flue outlet. The preferred mounting location for the draft regulator is in the vertical flue pipe (see [Figure 10](#)). Depending on the venting arrangement, the alternate location for installing the draft regulator is in the horizontal run. Follow the manufacturer's instructions included with the draft regulator.
- **US installations:** a UL-listed type barometric draft regulator such as option DB1, must be installed in the flue near the heater flue outlet. The preferred mounting location for the draft regulator is in the vertical flue pipe (see [Figure 10](#)). Depending on the venting arrangement, the alternate location for installing the draft regulator is in the horizontal run. Install the draft regulator according to the manufacturer's instructions.

### **Draft Inducer Relay (Option DH1)**

- A relay (Option DH1) is available for connecting a field-supplied UL-listed (US installations) or CSA/ULC-listed (Canadian installations).
- A draft inducer is required when the draft in the flue measures less than 0.04 IN WC on a draft gauge. Refer to [Startup Checklist](#) section for instructions for measuring draft.
- When a draft inducer is installed, the safety provision must be made to shut off the fuel supply to the burner in the event of the failure of the draft inducer. See the optional exhaust flow safety switch on the wiring diagram.

### **Outside Combustion Air Intake Adapter Kit (Option DE1, Shipped Separately)**

- A UL-listed outside combustion air intake adapter kit (option DE1) is available to provide outside air for combustion.
- Option DE1 is not available for Canadian installations.
- See [Figure 11](#) for installation and follow the manufacturer's instructions furnished with the kit.

## INSTALLATION—CONTINUED

### Venting and Combustion Air—Continued

#### Outside Combustion Air Intake Adapter Kit (Option DE1, Shipped Separately)—Continued

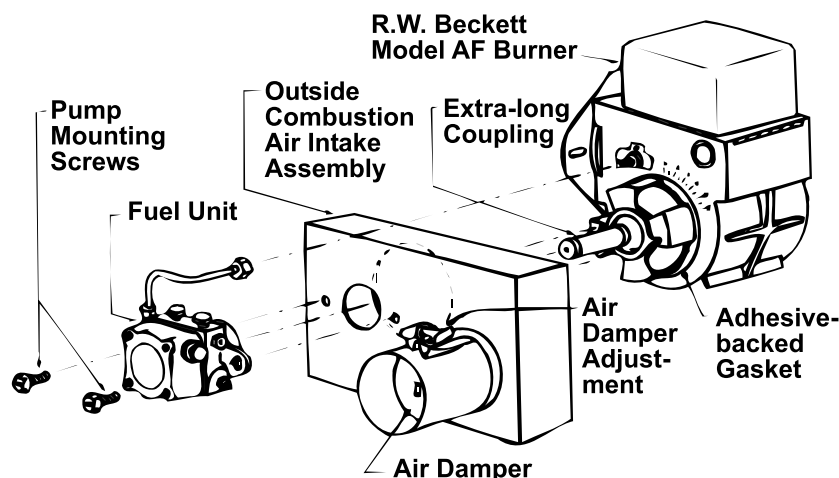


Figure 11. Outside Combustion Air Intake Adapter Kit (Option DE1)

### Electrical Connections

#### Electrical Connection Requirements

- All wiring must be done in accordance with the National Electric Code or CSA Standard C22.1, Canadian Electrical Code, Part 1, and local ordinances.
- In many localities, #14 wire run in rigid conduit must be used, but where permissible, two- and three-wire BX is recommended, particularly for connections to the controls and burner motor.
- A cutoff switch for the main 115V line to the burner should be mounted on a fireproof wall in an accessible place close to the burner.

#### Electrical Connections for Optional Equipment

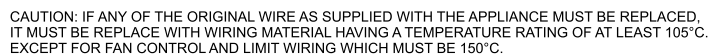
- The heater is equipped with low voltage controls (24V) for thermostat control.
- Refer to separate instructions for any optional equipment provided.

#### Supply and Line Wiring

- Check the rating plate on the heater for supply voltage and current requirements.
- A separate line voltage supply with a fused disconnect switch should be run directly from the main panel to the heater, making connection to leads in the junction box. All external wiring must be within approved conduit. Conduit from the disconnect switch must be run so as to not interfere with heater service access. Refer to the wiring diagram in the heater junction box.
- All replacement wiring must be type SF, SEWF, TW, TEW, or equivalent. Use #18 gauge wire for control circuits and #14 gauge or larger for line connections depending on current requirements.
- Refer to [Table 9](#) for unit electrical ratings (115V, 60 Hz).

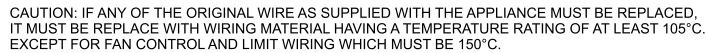
| Table 9. Electrical Ratings |                       |                          |                   |
|-----------------------------|-----------------------|--------------------------|-------------------|
| Unit Size                   | Total Current Amperes | Minimum Circuit Ampacity | Minimum Fuse Size |
| 095                         | 6                     | 8                        | 15                |
| 140, 190                    | 7                     | 9                        | 15                |

- See **Figure 12** for a typical wiring diagram for UL-listed models.
- See **Figure 13** for a typical wiring diagram for CSA-listed models.



**Figure 12. Typical Wiring Diagram for UL-Listed Model**

## Wiring Diagrams—Continued



### ***Electrodes and Nozzle***

- OH-IOM (05-26) 120390-A**

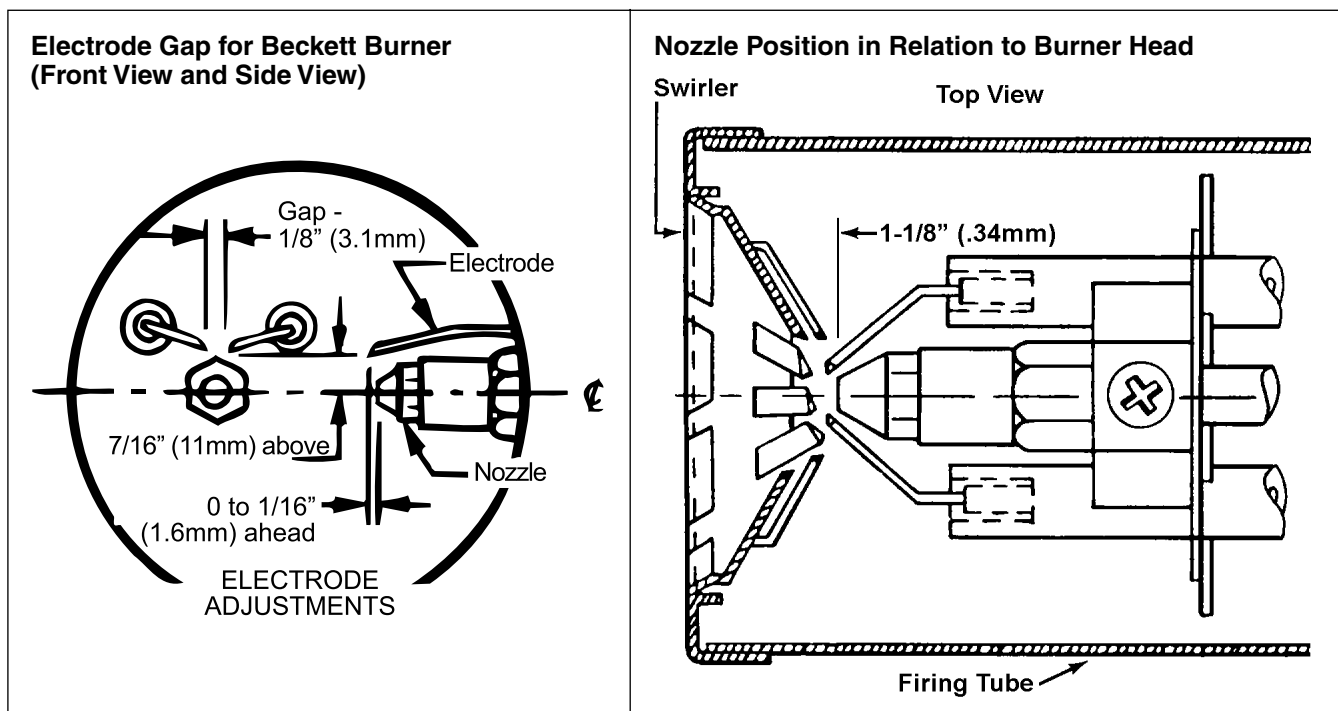


Figure 14. Electrodes and Nozzle

#### Thermostat Wiring

### ⚠ CAUTION ⚠

**Ensure that the thermostat has an adequate VA rating for the total requirements.**

- Use either an optional thermostat supplied with the heater or a field-supplied thermostat. A 24-volt thermostat is required to actuate the low voltage controls on this heater. A line voltage thermostat can be used when wired for low voltage use.
- Do not attempt to wire relays or other accessories to the thermostat connections as these are not load terminals.
- The thermostat should be located 5 feet above the floor on an inside wall, not in the path of warm or cold air currents, nor in corners where air may be pocketed.
- DO NOT install the thermostat on or directly suspend from the heater.
- DO NOT install the thermostat on a cold, outside wall.
- For specific connection details and instructions on setting the heat anticipator, refer to manufacturer's instructions provided with the thermostat.

## OPERATION

### Major Component Descriptions

#### Motors

Electrical characteristics of motors are listed in [Table 10](#).

| Table 10. Electrical Characteristics of Motors                                        |                                   |     |      |      |       |
|---------------------------------------------------------------------------------------|-----------------------------------|-----|------|------|-------|
| Unit Size                                                                             | Motor Type                        | HP  | Amps | RPM  | Volts |
| 095                                                                                   | Fan*                              | 1/8 | 2.7  | 1050 | 115   |
| 140, 190                                                                              |                                   | 1/4 | 3.7  | 850  |       |
|                                                                                       |                                   | 3/4 | 11.0 | 1725 |       |
| 095, 140, 190                                                                         | Standard single-stage burner pump | 1/7 | 2.0  | 3450 |       |
|                                                                                       | Optional two-stage burner pump    |     |      |      |       |
|                                                                                       | Optional boost pump               | 1/8 | 5.8  | 1725 |       |
| *The fan motor is totally enclosed and is equipped with internal overload protection. |                                   |     |      |      |       |

\*The fan motor is totally enclosed and is equipped with internal overload protection.

#### Burner Pump

##### NOTE:

- **IMPORTANT:** Long or oversized inlet lines may require the pump to operate during the initial bleeding period. In such cases, the priming may be assisted by injecting fuel oil into the pump gearset. Under lift conditions, oil lines and fittings must be airtight. To ensure this, apply oil-resistant pipe dope to both the used and unused inlet fittings and both return fittings.
- A bypass plug must be inserted when return connection is made by two-pipe supply system.
- The unit is provided with either a standard single-stage, 3,450-RPM pump or an optional two-stage, 3,450-RPM pump (option BZ1).
- Refer to [Burner Pump Pressure Adjustment](#) section for pressure check instructions.
- Refer to [Burner Pump Vacuum Adjustment](#) section for vacuum check instructions.
- See [Figure 15](#) for port, bleed, inlet, regulator, and bypass plug locations.

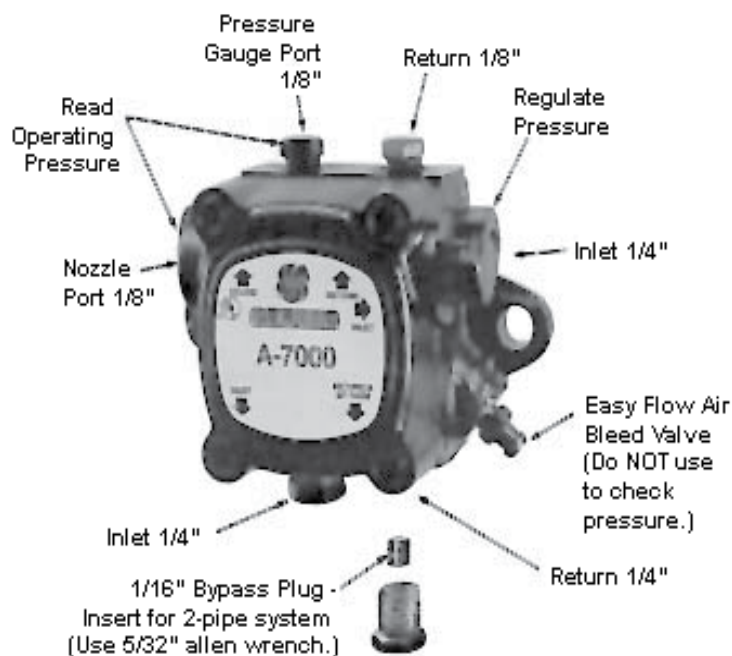


Figure 15. Burner Pump

### Fan and Limit Controls

- The unit is provided with a fan and limit control assembly consisting of a specially-designed control-mounting bracket with a fan control, a circulating air high limit control, and a super high limit control attached.
- The main functions of the fan/blower control are: 1) delay fan or blower operation to prevent the circulation of cold air at startup and 2) continue fan or blower operation as long as the unit temperature is above the minimum setting (120°F). The fan/blower control also provides additional safety control by operating the fan or blower in the event that a malfunction causes the oil burner to continue to fire when the thermostat is satisfied.
- The circulating air high limit switch has a nonadjustable setting of 145°F for unit size 095 and 160°F for unit sizes 140 and 190. The limit control automatically cycles when the internal temperature exceeds these setpoints. For the heater to operate properly and safely, the cause for the temperature exceeding the high limit setpoint must be determined and corrected.
- The super high limit switch provides redundant safety control and is calibrated to open at a much higher temperature (350°F) than the standard automatic-reset limit switch. An interruption of the circuit by the super high limit switch indicates a major failure caused by a malfunction of the primary safety controls or by incorrect wiring. Before attempting to restart the heater, the cause must be corrected and the fan and limit assembly replaced.
- To access the fan and limit control assembly, remove the plate shown in [Figure 16](#).

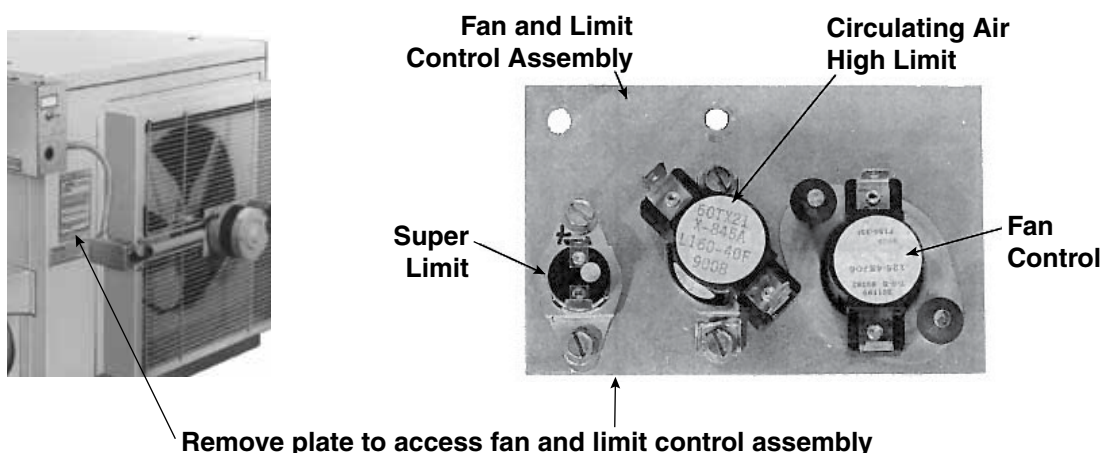


Figure 16. Access and Identification of Fan and Limit Controls

### Primary Control System

- The primary control, mounted on a 4 × 4 outlet box on the burner, is responsible for starting the burner, for monitoring a safety operating cycle, for shutting off the burner at the end of the call for heat, and for locking out *on safety* if there is a flame failure beyond the safety timing.
- The ignition system is comprised of an ignition transformer and two electrodes that deliver a concentrated spark across a fixed gap to ignite oil droplets in the nozzle spray.
- A cadmium sulfide cell responds to light intensity to sense the presence or absence of flame. If the spark is inadequate, the cadmium sulfide cell will not sense the presence of flame and the primary control system will lock out.

### Blocked Vent Switch (CSA Models Only)

- The blocked vent switch is a manually-reset, temperature sensitive switch designed to shut down the burner when there is a positive pressure in the combustion chamber.
- The blocked vent switch is mounted on a bracket on the control side of the heater.
- Before attempting to restart a heater that has been shut down by the blocked vent switch, find and remove the blockage causing the positive pressure. After correcting the problem, reset the switch.

### Pre-Startup Checklist

- ☐ **Check clearances:** ensure that clearances are in accordance with [Table 2](#).
- ☐ **Check hangers:** ensure that all hangers are adequately anchored and that all unions or threaded fittings are snug and do not rotate under conditions of vibration. Heater must be level.

## OPERATION—CONTINUED

### Pre-Startup Checklist—Continued

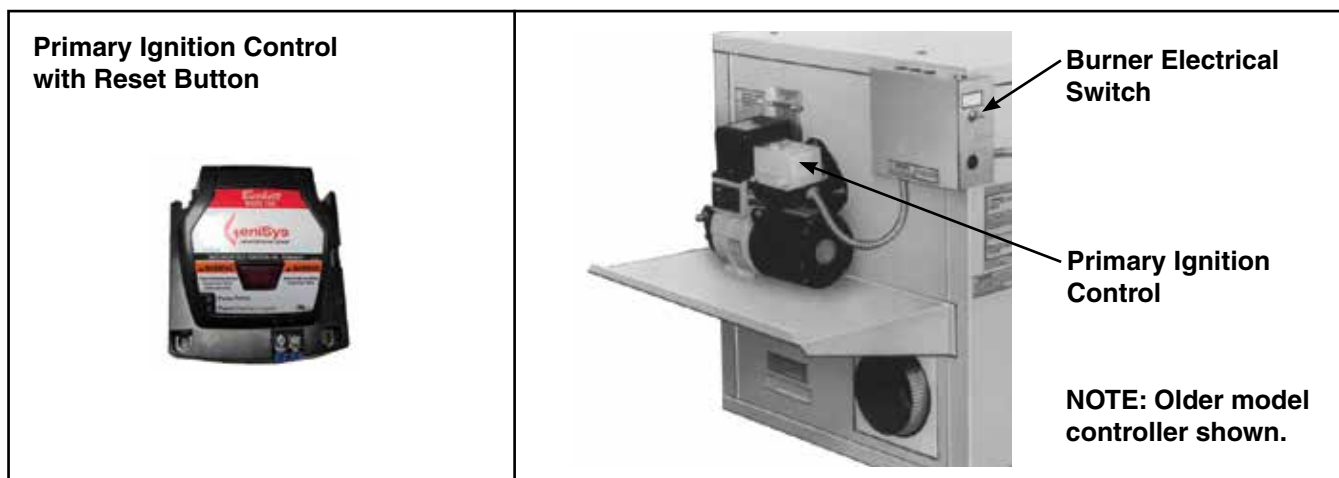
- ❑ **Check the electrical supply:** ensure that wire gauges are as recommended and that the voltage is as stated on the furnace. A service disconnect switch should be used. Also determine that fusing or circuit breakers are adequate for the load use.
- ❑ **Check the oil supply.**
- ❑ **Check piping:** after installation and before being covered, piping should be tested for leaks. Before testing, disconnect supply piping at the burner and cap. Test piping hydrostatically or with equivalent air pressure not less than 1-1/2 times the maximum working pressure but not less than 5 pounds per square inch at the highest point of the system. The test shall be made so as not to impose a pressure of more than 10 pounds per square inch on the tank. This test shall be maintained for at least 30 minutes or for sufficient time to complete a visual inspection of all joints and connections. Instead of a pressure test to check piping, suction lines may be used under a vacuum of not less than 20 inches of mercury maintained for at least 30 minutes.
- ❑ **Check vents:** ensure that the vent pipe and chimney are in accordance with the requirements listed in the **Venting and Combustion Air** section. An approved draft regulator is required. In order to measure the draft in the stack after firing, drill a 5/16-inch hole in the flue pipe, halfway between the heater and the draft regulator, for inserting the draft gauge.
- ❑ **Check electrode adjustment.** ensure electrode positioning is in accordance with **Figure 14**. Turn OFF the electrical power before making the check.
- ❑ **Check the oil delivery.** For an accurate check of the oil delivery, remove the burner assembly and connect it outside the firebox. Disconnect the high tension lead. Start the burner and collect the oil flow for 1 minute and measure it in a container marked in cubic centimeters. Some safety controls may trip when operated for 1 minute. If this occurs, collect the flow from the nozzle for 30 seconds, measure the cubic centimeters, multiply by two, and check the values listed in **Table 11**, which lists the oil flow rate in Cubic Centimeters (cc) per minute to obtain the output in Gallons Per Hour (GPH).

| Table 11. Oil Flow Rate |               |      |
|-------------------------|---------------|------|
| Unit Size               | cc Per Minute | GPH  |
| 095                     | 54.0          | 0.85 |
| 140                     | 78.5          | 1.25 |
| 190                     | 85.0          | 1.35 |

### Startup Checklist

**NOTE: Priming the oil line can take up to 30 minutes depending on the size of heater and the length of the supply line.**

- ❑ **Prime the unit (one-pipe supply):** the oil supply line to the heater must be full of oil and free of air for proper heater operation. Prime the oil line as follows:
  - a. Ensure that oil tank is filled to level at least 6 inches (152 mm) above foot valve.
  - b. Set thermostat to its lowest setting.
  - c. Connect one end of rubber tubing to air bleed valve on burner pump (see **Figure 15**) and place other end into open container (no smaller than 1 pint).
  - d. Turn OFF electrical power at switch on heater electrical box (see **Figure 17**).
  - e. Using 3/8-inch wrench, loosen air bleed valve two or three turns.
  - f. Set thermostat to above room temperature.
  - g. Turn ON electrical power. Burner pump operates. Oil runs into container when air has been bled from line. While operating under these conditions, heater will not light because pressure valve in pump will not open.
  - h. Push reset button (see **Figure 17**) if primary control shuts down pump before line is bled. It may be necessary to push reset button several times while bleeding off air. Wait 3 to 4 minutes between pushes of reset button to allow internal bimetal strip to cool down. Pump runs for 45 seconds each time.
  - i. After all air is bled from line, close bleeder valve and turn OFF main power.



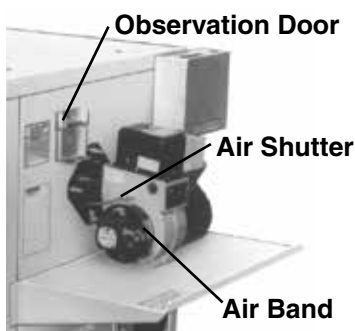
**Figure 17. Heater Controls**

- ❑ **Prime the unit (two-pipe supply):** install a pressure gauge and turn the burner on. The system will vent itself through the return line. Flame will appear as soon as the air has been eliminated.
- ❑ **Check nozzle pressure:** check and adjust nozzle pressure as follows:
  - Install pressure gauge (125-psig minimum) into pressure gauge port on burner pump (see [Figure 15](#)).
  - Verify that air shutter setting (preset at factory) on burner is in accordance with [Table 12](#). All other controls should be in normal position.
  - Turn OFF electrical power.
  - Set thermostat to above room temperature. Pump starts and burner ignites.
  - With burner ignited, check and adjust oil pressure if necessary to pressure of 100 pounds for unit sizes 095 and 140 or to 150 pounds for unit size 190.

| <b>Table 12. Air Shutter Settings</b> |                    |                 |                                 |
|---------------------------------------|--------------------|-----------------|---------------------------------|
| <b>Unit Size</b>                      | <b>Air Shutter</b> | <b>Air Band</b> | <b>CO<sub>2</sub> Range (%)</b> |
| 095                                   | #6                 | #0              | 9–11                            |
| 140                                   | #6                 | #0              | 10–12                           |
| 190*                                  | #7-1/2             | #0              | 11–13                           |

\*Unit size 190 models manufactured **before** JUN 1996 had the same settings as unit size 140.

- ❑ **Check draft:** prior to continued operation, check to be sure that there is sufficient draft for proper combustion. A draft of –0.01 IN WC is required over the fire. When firing, the draft measurement in the stack should be –0.03 to –0.04 IN WC. Measure draft as follows:
  - To measure overfire draft, remove metal plug in observation door (see [Figure 18](#)).



**Figure 18. Combustion Air Band and Air Shutter**

- Insert air pressure gauge such as Dwyer pressure gauge and observe reading on gauge.

## OPERATION—CONTINUED

### Startup Checklist—Continued

- c. Adjust draft regulator as necessary until reading on gauge  $-0.01$  IN WC.
- d. Replace metal plug in observation door.
- e. To measure flue draft, insert air pressure gauge in 5/16-inch hole that was drilled in flue pipe halfway between furnace and draft regulator. Flue draft measurement must be  $-0.03$  to  $-0.04$  IN WC.

---

### CAUTION

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- **If draft is insufficient, it will create back pressure that results in oil fumes in the building, pulsating when the burner starts and stops, and/or excessive soot deposits. If there is too much draft, it could cause ignition problems, erratic burner, and loss of thermal efficiency.**
- **Back pressure (backdraft or downdraft) may be caused by the chimney being lower than surrounding objects, such as buildings, hills, trees, rooftops, etc. It may be caused by an exhaust fan in the building. The air intake in the room where the heater is installed must be of sufficient size so that there is no change in the draft reading in the flue with the exhaust fan running.**
- **If there is a backdraft or downdraft, do not continue operation of the heater until the situation is corrected. Equipment and/or property damage could result.**

- f. Correct insufficient draft by increasing chimney height and/or installing UL-listed draft inducer. If draft inducer is used, provision must be made to shut OFF fuel supply to burner in event of draft inducer failure.
- g. Correct too much draft by adjusting barometric damper regulator to reduce draft.

- ☐ **Check combustion air shutter and air band settings:** the heater is shipped from the factory with the settings listed in [Table 12](#). Ordinarily, these settings will result in a  $\text{CO}_2$  level shown in the tabled ranges. However, certain field conditions may require a change. To determine if the air setting needs to be adjusted, a smoke tester and  $\text{CO}_2$  analyzer are required. Adjust combustion air as follows:
  - a. Service and clean burner, combustion chamber, and heat exchanger as necessary.
  - b. Operate unit for at least 10 minutes.

---

**NOTE: The longer and more restrictive the flue, the higher the draft necessary to obtain accepted overfire conditions.**

---

- c. Adjust overfire draft to  $-0.01$  to  $-0.02$  IN WC. Draft readings in breaching will be higher depending on flue passages of heater.
- d. Take smoke reading in accordance with smoke tester manufacturer's instructions. Adjust combustion air to obtain preliminary reading of about No. 3 smoke spot. Then, readjust air until reading between No. 0 and No. 1 (trace smoke) is achieved. Do not open air adjustment more than absolutely necessary to obtain trace or No. 0 smoke spot.
- e. Take  $\text{CO}_2$  sample in accordance with  $\text{CO}_2$  gas analyzer manufacturer's instructions. Open air shutter (see [Figure 18](#)) until  $\text{CO}_2$  level lowers by 1%.  $\text{CO}_2$  reading should fall within range listed in [Table 12](#).
- f. Burner is now set for optimum but stable efficiency.

### Adjustments

#### Burner Pump Pressure Adjustment

---

### CAUTION

---

**Pressurized or gravity feed installations must not exceed 3 psi on inlet line or return line at the pump. A pressure greater than 3 psi may cause damage to the shaft seal.**

---

- Connect gauge to the gauge port or the nozzle port (see [Figure 15](#)) to check burner pump pressure.

- Do not use easy flow bleed valve port. The easy flow bleed valve port contains pressure higher than operating pressure. Setting pump pressure with gauge in the easy flow bleed valve port results in WRONG operating pressure.
- Adjust as necessary.

#### ***Burner Pump Vacuum Adjustment***

- To check the burner pump vacuum, connect a vacuum gauge on either side of the 1/4-inch inlet ports or in the 1/8-inch return port (on single pipe installation), whichever is most convenient.
- With a standard single-stage pump, the vacuum should not exceed 6 inches Hg on a single-pipe system or 12 inches Hg on two-pipe system. With an optional two-stage pump, the vacuum should not exceed 17 inches Hg.
- Adjust as necessary.

#### ***Electrode Adjustment***

Check the position of the electrodes before firing the unit and after electrode service or replacement. Adjust them as necessary in accordance with the [Service Oil Nozzle and Spark Electrodes](#) section.

## **MAINTENANCE**

The maintenance and troubleshooting information in this section is designed to assist a qualified service person.

### **Maintenance Requirements**

---

#### **⚠ WARNING ⚠**

---

#### **Turn OFF electrical power before inspecting or cleaning this heater.**

---

Like all quality equipment, this oil-fired unit heater will operate with a minimum of maintenance. However, to ensure long life and satisfactory performance, the following service regimen is recommended:

- Heaters should be inspected once every four months where the equipment is operating under normal conditions. If the heater is located in an area where an unusual amount of dust or soot or other impurities are contained in the air, more frequent inspection is recommended.
- Check the motor for cleanliness. Remove dirt and grease from the outside of the motor, and especially around the shaft.
- Keep air openings free of grease and dirt.
- The heat exchanger should be checked at least once a year and more often in areas where the air is heavily dust laden.

### **Maintenance Procedures**

#### ***Clean Combustion Chamber/Heat Exchanger and Flue Pipe***

Remove soot from the combustion chamber/heat exchanger and flue pipe as follows:

---

#### **⚠ WARNING ⚠**

---

#### **Turn OFF electrical power before cleaning the unit.**

---

1. Turn OFF electrical power to unit.

---

**NOTE: On Canadian models, there is a screw at the bottom of the outer exhaust door panel that must be removed—using a flat-head screwdriver—before the panel can be removed.**

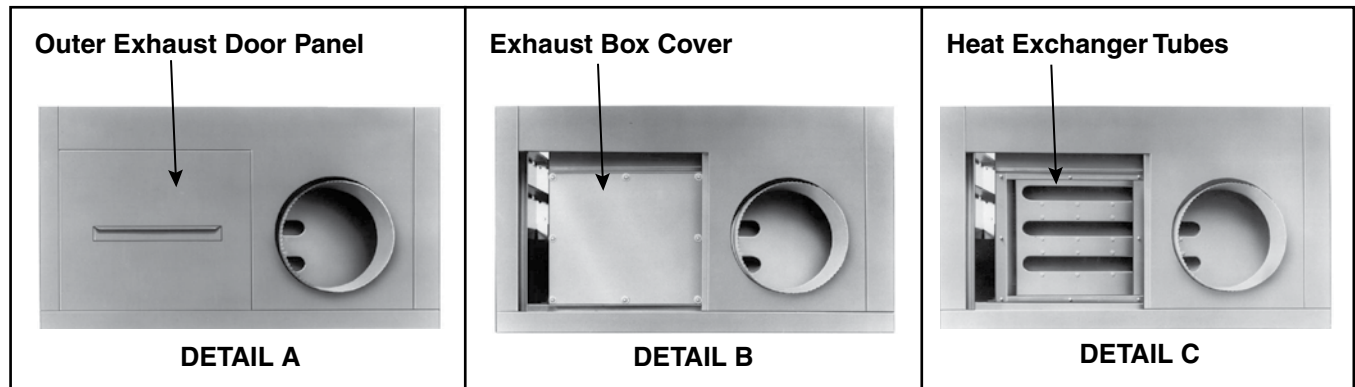
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2. On burner end of heater underneath burner tray, remove outer exhaust door panel (see [Figure 19](#), DETAIL A) by lifting upward and outward on handle. Exhaust box cover (see [Figure 19](#), DETAIL B) is now in view.
3. Remove nuts that secure exhaust box cover and pull cover directly forward off welded studs. Heat exchanger tubes (see [Figure 19](#), DETAIL C) are now in view.

## MAINTENANCE—CONTINUED

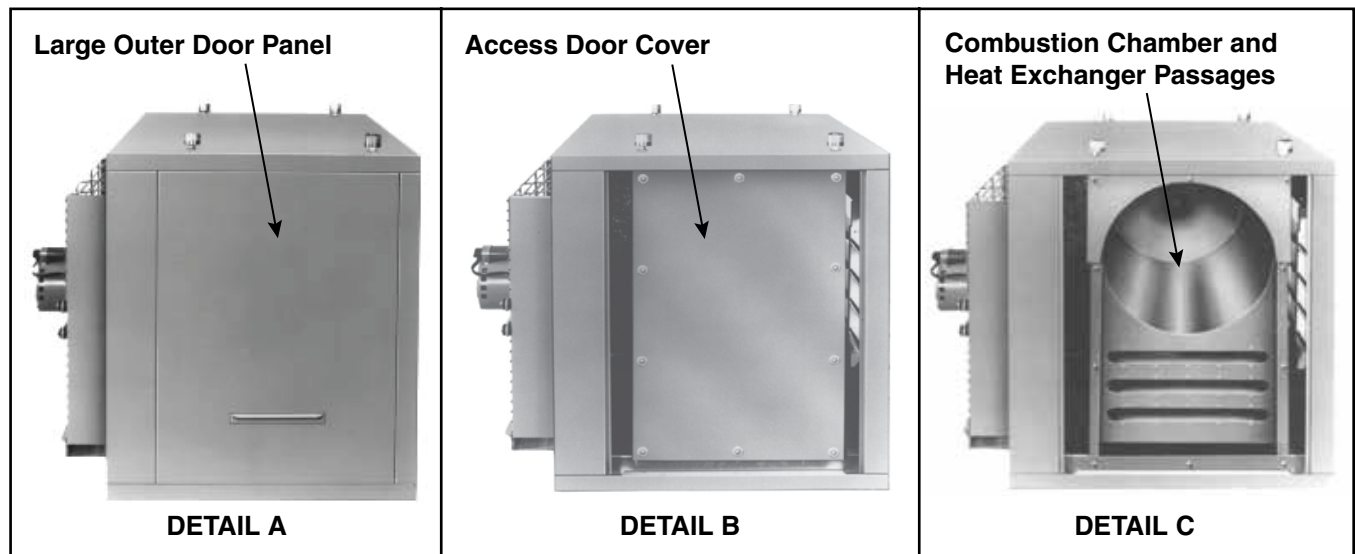
### Maintenance Procedures—Continued

#### *Clean Combustion Chamber/Heat Exchanger and Flue Pipe—Continued*



**Figure 19. Exhaust Box**

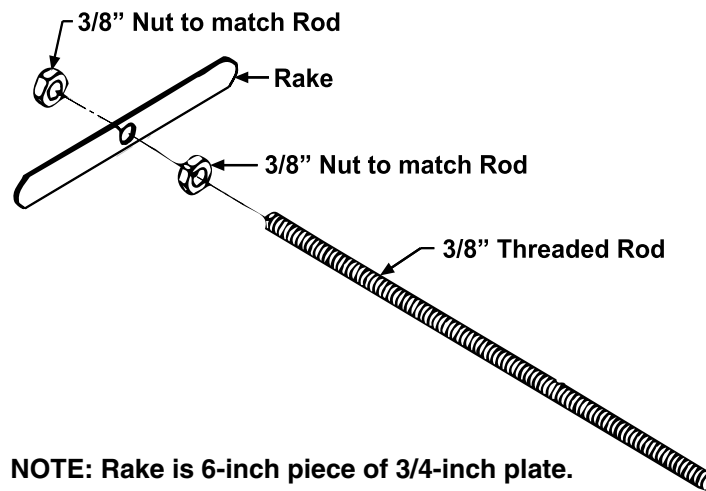
4. Remove two vertical pieces of woven gasket and leave horizontal gasket pieces still attached to vent pipe side of opening.
5. On end of heater opposite burner, remove screw—using flat-head screwdriver—at bottom center of large outer door panel (see [Figure 20](#), DETAIL A).
6. Remove large outer door panel—while supporting it—by lifting upward and outward on handle. Access door cover (see [Figure 20](#), DETAIL B) is now in view.
7. Remove nuts that secure access door cover and pull cover directly forward off welded studs. Combustion chamber and heat exchanger passages (see [Figure 20](#), DETAIL C) are now in view.



**Figure 20. Combustion Chamber/Heat Exchanger**

8. Remove woven gasket material.

**NOTE:** If a furnace brush is not available, a cleaning rake may be fabricated as shown in [Figure 21](#).



**NOTE:** Rake is 6-inch piece of 3/4-inch plate.

**Figure 21. Fabricated Cleaning Rake**

9. Scrape soot from combustion chamber walls and heat exchanger passages using furnace brush and/or fabricated cleaning rake. Shop vacuum may be used to aid in cleaning process.
10. Remove cleanout cap from flue pipe tee and tap flue pipe gently to cause any loose soot that may be out of reach to fall out. Scrape soot from flue pipe walls that are accessible.
11. When cleaning is complete, install all gaskets in place and replace all covers. Replace gaskets if they are damaged or deteriorated,

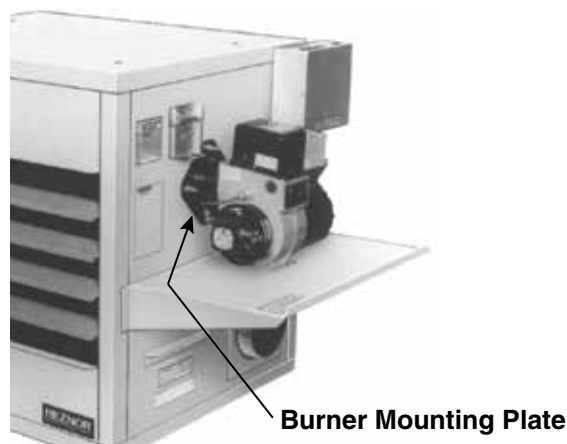
#### ***Clean End Cone***

To gain access to the end cone, the burner must be removed. Remove the burner and clean the end cone as follows:

### **⚠ WARNING ⚠**

**Turn OFF electrical power before the burner is removed for service.**

1. Turn OFF electrical power to unit.
2. Locate two yellow wires that go from burner to ignition controller and disconnect these wires at terminals on ignition controller.
3. Remove three nuts that secure burner mounting plate (see [Figure 22](#)) to heater.



**Figure 22. Burner End of Heater**

4. Slide burner out of heater and rotate.
5. With burner on service tray, remove screws that secure end cone to burner tube and remove end cone.
6. Check end cone for deterioration and replace if deterioration exists. Otherwise, clean end cone using stiff wire brush.

## MAINTENANCE—CONTINUED

### Maintenance Procedures—Continued

#### *Clean End Cone—Continued*

7. When cleaning is complete, install screws that secure end cone to burner tube.
8. Check burner mounting plate gasket for damage and replace as necessary.
9. Install burner mounting plate gasket on studs, align burner mounting plate with bolts, and slide burner into heater.
10. Secure burner mounting plate to heater using three nuts.
11. Reconnect two yellow wires to ignition controller.

#### *Service Oil Nozzle and Spark Electrodes*

Remove the fuel line assembly and service the oil nozzle and spark electrodes as follows:

---

### WARNING

---

#### **Turn OFF electrical power before servicing oil nozzle and spark electrodes.**

---

1. Turn OFF electrical power to unit.
2. Remove fuel line assembly:
  - a. Loosen connection nut (where line connects to burner) one or two turns.
  - b. Loosen 5/16-inch inverted flare fitting to disconnect fuel connection assembly. Pull fuel connection assembly clear of burner housing.
  - c. Remove two screws that secure spark transformer cover to burner housing and lift hinged transformer to its open position.
  - d. Pull fuel line assembly up slightly and toward rear of burner housing and remove.
3. If necessary, replace oil nozzle:
  - a. With fuel line assembly removed, use box wrench to remove oil nozzle.

---

**NOTE: Replace the oil nozzle only with a factory-authorized replacement. Do not substitute nozzles.**

---

- b. Install replacement oil nozzle (refer to [Table 13](#)) using box wrench.

**Table 13. Replacement Oil Nozzle and Pump Pressure**

| Unit Size | Delavan Nozzle Type | Pump Pressure (Pounds) | PN      |
|-----------|---------------------|------------------------|---------|
| 095       | 0.85, 80°, B        | 100                    | 32437   |
| 140       | 1.25, 70°, B        | 100                    | 146815* |
| 190       | 1.35, 70°, B        | 150                    | 146816* |

\*Used on units manufactured **after** MAY 1996. Always check the nozzle for size and replace it with an identical nozzle.

---

**NOTE: When replacing the nozzle, inspect the electrodes and check electrode adjustment before reassembling the heater.**

---

4. Service spark electrodes:
  - a. Check electrodes for deterioration and insulators for cracks or damage. Replace electrode assemblies if any damage or deterioration exists. Otherwise, remove any carbon formation on spark electrodes.
  - b. After service or replacement, check position of electrodes and adjust electrode location precisely as shown in [Figure 14](#).
5. Re-install fuel line assembly.

### ***Clean Exterior Surfaces of Combustion Chamber/Heat Exchanger and Clean Fan Assembly***

When the fan assembly and the exterior surfaces of the combustion chamber/heat exchanger require cleaning, proceed as follows:

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## **⚠ WARNING ⚠**

---

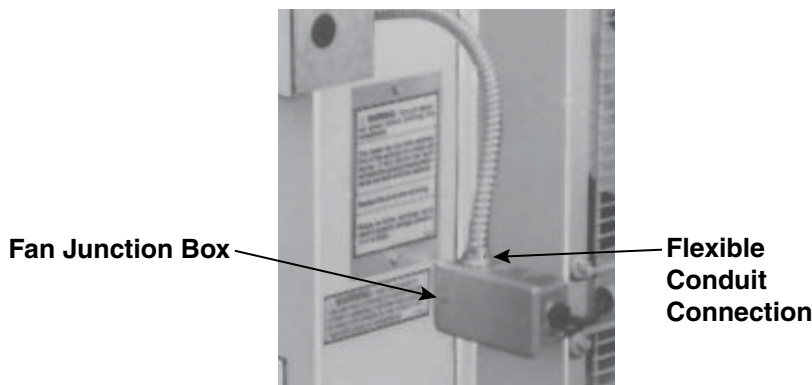
**Turn OFF electrical power before cleaning the heater.**

---

**NOTE: Cleaning ensures maximum efficiency and eliminates the possibility of the heater cycling on the limit switch from lack of air flow.**

---

1. Turn OFF electrical power to unit.
2. Remove discharge louvers to gain access to front of combustion chamber/heat exchanger assembly.
3. Remove fan assembly to access the rear of combustion chamber/heat exchanger assembly. To remove fan, first disconnect wiring in fan junction box on rear of heater and disconnect flexible conduit (see [Figure 23](#)).



**Figure 23. Fan Junction Box**

4. Use stiff brush and shop vacuum to clean accumulated dust and dirt from exterior surfaces of combustion chamber /heat exchanger assembly.
5. Use brush and shop vacuum to clean fan, being careful not to bend or damage fan blades.
6. Use shop vacuum to remove accumulated dirt from fan motor.
7. Re-install discharge louvers.
8. Reconnect flexible conduit and fan wiring. Re-install fan assembly.
9. Turn ON electrical power and check operation.

### **Troubleshooting**

This oil-fired heater has been designed and manufactured to provide trouble-free operation. However, as with any type of mechanical equipment, it can fail. For your safety, contact a qualified service person if there is a problem,.

---

## **⚠ WARNING ⚠**

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**Before test firing any heater, check the combustion chamber for an excessive accumulation of unburned oil and restore to a safe condition before firing.**

---

To diagnose malfunctions properly, the following testing equipment is required:

- ☐ Electrical test meter that can measure volts, ohms, and amps
- ☐ Ignition transformer tester
- ☐ Combustion analyzer kit to measure oxygen, carbon dioxide, smoke, stack temperature, draft, and system efficiency
- ☐ Pressure/vacuum gauge with a scale of 0–200 psig and 0–30 inches Hg

## MAINTENANCE—CONTINUED

### Troubleshooting—Continued

#### Oil Burner Troubleshooting

Refer to [Table 14](#) to troubleshoot the oil burner.

### ⚠ WARNING ⚠

**Do not attempt to start the burner when excess oil has accumulated, when the furnace is full of vapor, or when the combustion chamber is very hot.**

**Table 14. Oil Burner Troubleshooting**

| Symptom                                                  | Probable Cause                                                          | Remedy                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Burner motor does not start                              | 1. Incomplete electrical circuit                                        | Ensure that line voltage is nominal 120V when measured at primary control input connection<br><b>NOTE: Line voltage &lt;105V may cause operating problems.</b><br>Check disconnect switch, fuses, and thermostat connections if no reading                                                                                                                                                     |
|                                                          | 2. Primary control activated                                            | Refer to <a href="#">Primary Control Troubleshooting</a> section to correct malfunction<br><b>NOTE: Relay ON SAFETY position will lock out burner operation.</b>                                                                                                                                                                                                                               |
|                                                          | 3. Inadequate voltage between motor/primary lead and neutral connection | Line voltage must be within 10% of voltage specified on motor rating plate                                                                                                                                                                                                                                                                                                                     |
|                                                          | 4. Motor hums but shaft does not rotate                                 | Start switch may be defective; with power turned OFF, rotate blower wheel by hand—replace motor if blower wheel turns freely                                                                                                                                                                                                                                                                   |
|                                                          | 5. Motor bearings frozen                                                | Free shaft and lubricate or replace motor                                                                                                                                                                                                                                                                                                                                                      |
|                                                          | 6. Overload protection activated                                        | Allow motor to cool<br>Start motor and measure current draw; line voltage should not exceed rating plate specifications under load conditions by more than 10%<br><b>NOTE: Excessive amp draw usually means an overload condition, a defective start switch, or shorted windings.</b><br>Replace motor as necessary—it is difficult and not usually cost-effective to attempt to rebuild motor |
|                                                          | 7. Blocked vent switch is open (CSA models only)                        | Determine and correct reason blocked vent switch is activated<br>Reset the switch                                                                                                                                                                                                                                                                                                              |
| Burner motor operates but no fuel is delivered at nozzle | 1. Oil level below intake in tank                                       | Fill and bleed air from fuel line                                                                                                                                                                                                                                                                                                                                                              |
|                                                          | 2. Clogged strainer                                                     | Remove and clean strainer                                                                                                                                                                                                                                                                                                                                                                      |
|                                                          | 3. Restricted fuel supply line                                          | Open all valves in supply line                                                                                                                                                                                                                                                                                                                                                                 |
|                                                          |                                                                         | Replace any kinked tubing                                                                                                                                                                                                                                                                                                                                                                      |
|                                                          | 4. Clogged nozzle                                                       | Replace nozzle                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                          | 5. Air leak in the supply line                                          | Tighten all fittings in line                                                                                                                                                                                                                                                                                                                                                                   |
|                                                          |                                                                         | Tighten unused intake port plug in fuel pump                                                                                                                                                                                                                                                                                                                                                   |
|                                                          |                                                                         | If there are valves in line, ensure that valve stems are packed solid and tightened securely                                                                                                                                                                                                                                                                                                   |
|                                                          | 6. Air-bound two-pipe system                                            | Insert bypass plug if not in place<br>Restart unit and prime pump                                                                                                                                                                                                                                                                                                                              |
|                                                          | 7. Motor operates but does not drive pump shaft                         | Check coupling for slippage due to stripped end caps; replace as coupling necessary                                                                                                                                                                                                                                                                                                            |
|                                                          | 8. Frozen oil pump shaft                                                | Replace oil pump                                                                                                                                                                                                                                                                                                                                                                               |
|                                                          | 9. Dirty suction line oil filter cartridge                              | Replace suction line oil filter cartridge                                                                                                                                                                                                                                                                                                                                                      |

**Table 14. Oil Burner Troubleshooting—Continued**

| Symptom                                                      | Probable Cause                                                                  | Remedy                                                                                                                                                                                                          |
|--------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Burner motor operates and delivers oil but there is no flame | 1. No spark                                                                     | Check transformer, insulators, and electrodes<br>Transformer/ignition problems may be due to following causes:                                                                                                  |
|                                                              | a) Excessive gap on ignition electrodes                                         | Ensure that gap is 1/8 inch                                                                                                                                                                                     |
|                                                              | b) High ambient temperatures                                                    |                                                                                                                                                                                                                 |
|                                                              | c) High humidity                                                                |                                                                                                                                                                                                                 |
|                                                              | d) Carbon residue on the porcelain bushings                                     | Clean porcelain bushings                                                                                                                                                                                        |
|                                                              | e) Low input line voltage                                                       | Measure voltage between transformer/primary lead and neutral connection<br><b>NOTE: The secondary terminals of a good transformer deliver 5000V arc to ground for a total of 10,000V between the terminals.</b> |
|                                                              | f) Arcing between ignition electrodes and transformer springs                   | Ensure that ignition electrodes and transformer springs have good contact                                                                                                                                       |
|                                                              |                                                                                 | Measure arc with transformer tester or use well-insulated screwdriver to draw arc across two springs; ensure that arc is at least 3/4 inch long                                                                 |
|                                                              |                                                                                 | Check each secondary output terminal by drawing strong arc between spring and base<br>If arc is erratic, weak, or unbalanced between two terminals, replace transformer                                         |
|                                                              | g) Carbon residue, moisture, crazing, or pin holes on insulators                | Clean any carbon residue and replace any insulators that are questionable                                                                                                                                       |
| Burner starts but flame blows away from nozzle               | h) Improper positioning of nozzle in relation to radius of endcone              | Check and correct nozzle position as necessary                                                                                                                                                                  |
|                                                              | i) Carbon residue on electrode parts                                            | Clean any carbon residue                                                                                                                                                                                        |
|                                                              |                                                                                 | Replace electrodes when tips become worn or eroded                                                                                                                                                              |
| Burner starts but flame blows away from nozzle               | 1. Excessive combustion air                                                     | Adjust air band and air shutter in accordance with <a href="#">Startup Checklist</a> section                                                                                                                    |
|                                                              | 2. Excessive draft                                                              | Adjust draft regulator for 0.01 IN WC overfire draft                                                                                                                                                            |
|                                                              | 3. Poor atomization of oil                                                      | Adjust fuel feed pressure<br>Replace oil nozzle as necessary                                                                                                                                                    |
| Poor light off and shut down                                 | 1. Air pocket between pressure shutdown valve and nozzle                        | Tighten unused intake port plug in fuel pump                                                                                                                                                                    |
|                                                              |                                                                                 | Run burner, stopping and starting occasionally until pulsation, smoke, and after-flame disappear                                                                                                                |
|                                                              | 2. Insufficient draft over fire                                                 | Check venting for excessive length, insufficient pitch upward to chimney, too many elbows, obstructed chimney, or too small chimney<br>Check for too high combustion air setting                                |
| Noise                                                        | 1. Noisy motor                                                                  | Check for alignment of shaft with coupling and tighten or slightly loosen motor-to-burner-housing bolts in alternate sequence                                                                                   |
|                                                              |                                                                                 | Check for loose blower wheel, excessive radial shaft play, and loose start switch parts                                                                                                                         |
|                                                              |                                                                                 | Check if thermocouple is laying on blower wheel                                                                                                                                                                 |
| Oil Odors                                                    | 2. Clogged strainer                                                             | Remove and clean strainer                                                                                                                                                                                       |
|                                                              | 3. Burner vibrations transmitted through rigid electrical conduit or oil lines  | Ensure that tubing or conduit is not fastened to studs or beams so securely that vibration is transmitted to floor or roof                                                                                      |
|                                                              | 1. Oil leak(s)                                                                  | Check fittings and valve seals                                                                                                                                                                                  |
|                                                              | 2. Poor burner shutoff                                                          | Check fuel shutoff valve and time delay relay                                                                                                                                                                   |
|                                                              | 3. Smoky flame                                                                  | Check nozzle spray, air gap, and air shutter setting                                                                                                                                                            |
| Oil Odors                                                    | 4. Oil carbonization on burner endcone                                          | Check nozzle location relative to inside radius of endcone                                                                                                                                                      |
|                                                              | 5. Downdraft causing smoke to enter building through barometric draft regulator | Increase draft by extending chimney height or by adding ventilating cap or draft inducer                                                                                                                        |

## MAINTENANCE—CONTINUED

### Troubleshooting—Continued

#### *Primary Control Troubleshooting*

Determine the malfunction that caused the primary control to activate as follows:

1. Disconnect the nozzle line connector tube and reposition it so that oil goes into a container. Tighten the flare nut at the pump discharge fitting.
2. Reset the primary control safety switch and immediately be alert to watch and listen for the following:
  - a. **Contact action of primary control relay:** relay should pull in promptly without arcing erratically or chattering. If relay does not function properly, proceed to step 4.
  - b. **Quality of oil delivery:** oil stream should be immediate, clear, and steady. A white, frothy oil delivery indicates air in the supply system. No oil delivery indicates a severe restriction.
  - c. **Ignition arc:** when the ignition activates, you should hear a buzz. If the ignition does not activate, check the transformer and electrodes.
  - d. **Motor operating characteristics:** the motor should start quickly and smoothly. You can hear the RPM change and a click as the centrifugal switch disconnects the start (auxiliary) winding.
3. If the malfunction has not been revealed, reconnect the nozzle line fittings and prepare for a fire test. Be sure to check the combustion chamber and remove any accumulation of unburned oil.
  - a. Reset the primary control, if necessary, and observe the overall performance with concentration on the light-off. Run several cycles.
  - b. Observe the flame quality using a flame mirror, if possible. Flame base should be stable and close to the combustion head. Flame should be centered, uniform in shape and relatively quiet in operation.
  - c. Check the heat and combustion chamber for carbon or impingements that indicate a defective or partially clogged nozzle.
4. If the problem is not apparent, check the primary control system.
  - a. Measure the electrical voltage at the primary input (usually black) and neutral lead (usually white) connections.
  - b. Jumper the thermostat (TT terminals) or otherwise energize the primary control.
  - c. The control relay should pull in. If not, make sure that the wiring connections are secure. If wiring connections are secure, check that the cad cell that controls the safety lockout timing on ignition is not seeing too much stray light.
    - (1) Check the cad cell by starting the burner and disconnecting both cad cell leads from the control FF terminals.
    - (2) Jumper the FF terminals to keep the burner operating. Measure the ohms resistance across the cad cell leads as it views the flame. This should be 1600 ohms or less. A preferred reading is 300-1000 ohms.
    - (3) Next, with the meter still connected to the cad cell leads, turn the burner off. The dark condition should give a reading of 20,000 ohms or infinity. If the reading is lower, let the refractory cool down or look for stray light that might be entering the burner through the air inlet, or around the transformer baseplate.
    - (4) If the cad cell is not performing within these guidelines, replace it.
    - (5) If the wiring connections are secure and the safety lock timing and cad cell are functioning properly, replace the primary control.
  - d. If the primary control relay pulls in and then locks out again quickly, check the safety lockout timing. The safety lockout timing can be checked by removing one of the F (cad cell) leads from the control. Count the seconds until the control locks out. The time should be close to the rating plate specification found on the control body.
  - e. If the primary control relay pulls in erratically and chatters, check the wiring connections and verify that the heat anticipator setting of the thermostat matches the 24V current draw. Erratic operation can sometimes be traced to improper anticipator settings of the primary control. These settings are typically 0.2 or 0.4 amps (printed on the side of the control). Measure this value by connecting your multi-tester in series with one of the TT lead and reading the value of the appropriate milliampere scale. If the wiring connections are secure and the anticipator settings are correct, replace the primary control.
  - f. If the primary control relay pulls in, but the motor fails to start, measure the voltage between the neutral lead and the primary control lead for the motor. A severe voltage drop here would indicate that the relay switch contacts are defective. Replace the primary control.

### High Temperature Limit Troubleshooting

- The high temperature limit cycles whenever internal temperature exceeds the non-adjustable limit setpoint: 145°F for unit size 095 or 160°F for unit sizes 140 and 190.
- The cause must be found and corrected for heater to function safely/properly. Refer to the flowchart shown in [Figure 24](#) for troubleshooting steps.
- If the fan and limit controls require replacement, see [Figure 16](#).
- If the heat exchanger and fan require cleaning, refer to [Clean Combustion Chamber/Heat Exchanger and Flue Pipe](#) and [Clean Exterior Surfaces of Combustion Chamber/Heat Exchanger and Clean Fan Assembly](#) sections.

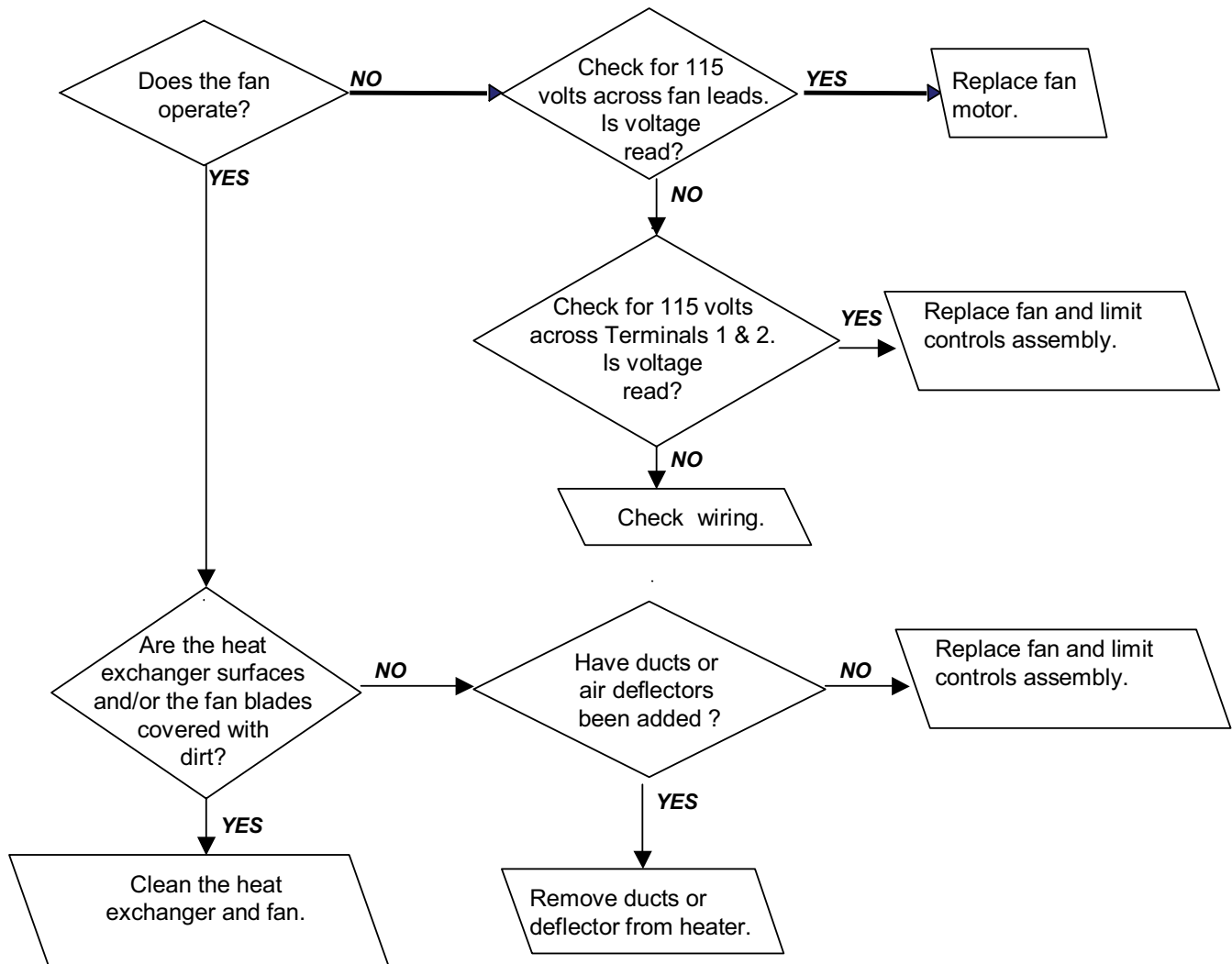


Figure 24. High Temperature Limit Troubleshooting Flowchart

## INSTALLATION RECORD (TO BE COMPLETED BY INSTALLER)

| Model     | Serial No. | Date of Installation | Notes |
|-----------|------------|----------------------|-------|
|           |            |                      |       |
|           | Installer  | Distributor          |       |
| Name      |            |                      |       |
| Company   |            |                      |       |
| Address   |            |                      |       |
|           |            |                      |       |
| Phone No. |            |                      |       |

For more information on Reznor HVAC products:

- Contact your local Reznor representative at 1-800-695-1901
- Refer to the technical specifications, manuals, and consumer materials found at [www.reznorhvac.com](http://www.reznorhvac.com)



US Installations



Canadian Installations

