

# INSTALLATION & MAINTENANCE MANUAL

## POWER VT<sup>®</sup> WATER HEATER



Installation and service must be performed by a qualified service installer, service agency or the gas supplier.

**IMPORTANT:** THIS MANUAL CONTAINS INFORMATION REQUIRED FOR INSTALLATION, OPERATION AND MAINTENANCE OF THIS EQUIPMENT. READ AND FOLLOW THE INFORMATION IN THIS MANUAL AND ALL OTHER PROVIDED INSTRUCTIONS, LABELS AND MARKINGS BEFORE INSTALLING, OPERATING OR SERVICING THIS UNIT.



**TO THE INSTALLER:** After installation, these instructions must be given to the equipment user or left near the appliance.

**SPECIAL INSTRUCTIONS TO THE OWNER:** Retain this manual for future reference. These instructions contain important information that will help you in maintaining and operating this appliance.



PVI INDUSTRIES, LLC - Fort Worth, Texas 76111 - Web [www.pvi.com](http://www.pvi.com) - Phone 1-800-433-5654

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**Warranty forms ship separately with each product.**

## 1 SAFETY CONSIDERATIONS

**WARNING: If the information in the supplied manual(s) is not followed exactly, a fire, explosion or exposure to hazardous materials may result, causing property damage, personal injury or loss of life.**

### FOR YOUR SAFETY

- Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.

### WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a location away from your building and the smell of gas. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

This product contains, or may come to contain materials that have been identified as carcinogenic, or possibly carcinogenic to humans. Before installing, servicing or removing this product, read and follow the supplied instructions

**WARNING: Installation and service must be performed by a qualified installer, service agency or the gas supplier, who must read and follow the supplied instructions before installing, servicing or removing this appliance. Refer to the information contained in this manual. Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury, exposure to hazardous materials or loss of life.**

**WARNING: Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the unit and to replace any part of the control system, all gas controls and all other items affecting safe appliance operation and which has been under water.**

**WARNING: In an emergency shut the main gas supply valve to the appliance from a location safely away from the emergency. Failure to follow these instructions can cause property damage, personal injury, and exposure to hazardous materials or loss of life.**

### PRODUCT SAFETY INFORMATION REFRACTORY CERAMIC FIBER PRODUCT WITH CRYSTALLINE SILICA

**WARNING: This product contains or may come to contain crystalline silica, which has been identified by the International Agency for Research on Cancer (IARC) as carcinogenic to humans. This product also contains refractory ceramic fibers, which have been identified by the IARC as possibly carcinogenic to humans. Avoid breathing fiber particulates and dust.**

#### RISKS:

- Air borne fibrous insulation is a possible cancer hazard by inhalation.
- Airborne crystalline silica may cause silicosis (lung disease) by inhalation.
- May cause temporary irritation to eyes, skin, and respiratory tract.

#### PRECAUTIONARY MEASURES:

- Minimize airborne fibers with engineering controls.
- Use NIOSH/MSHA approved respirators as required (see MSDS).
- Wear long sleeved, loose-fitting clothing, eye protection and gloves.

#### FIRST AID MEASURES: (If any of the irritations listed persists, seek medical attention)

- Eyes: Flush with water.
- Skin: Wash with soap and warm water.
- Ingestion: Do not induce vomiting. Get medical attention if gastrointestinal symptoms develop.
- Inhalation: Remove to fresh clean air.

**WARNING: If you are unfamiliar with the safe handling of refractory ceramic fiber products, or if you wish additional information prior to beginning any disassembly of the water heater or boiler that might expose refractory ceramic fiber materials, contact: Unifrax Corporation, 2351 Whirlpool Street, Niagara Falls, NY 14305-2413, 1-800-322-2293.**

#### IDENTIFICATION OF REFRACTORY CERAMIC FIBER MATERIALS (RCF):

The burner, lower tank and upper and lower flue collector assemblies utilize RCF material. (The RCF materials are located within the product and not generally exposed except during service, disassembly or assembly.)

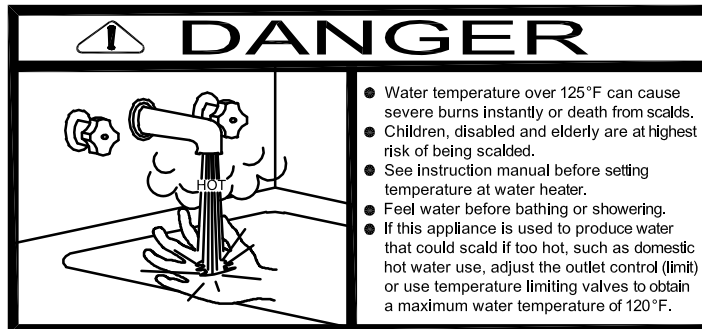
**IMPORTANT SAFETY NOTE**

*It takes only 5 seconds of skin contact with 140°F water to cause a second degree burn! You must protect against high water temperatures at all lavatories, tubs, showers and other points of hot water contact.*

**Accidental scalding from high water temperatures is a greater risk in some types of installations. Some examples are:**

***HOMES FOR THE MENTALLY HANDICAPPED  
HOMES FOR THE PHYSICALLY HANDICAPPED  
HOSPITALS AND NURSING HOMES  
ELDER CARE FACILITIES AND REST HOMES  
ORPHANAGES AND CHILD CARE FACILITIES***

***OTHER INSTALLATIONS - WHERE RESPONSE TO CONTACT WITH HOT WATER MAY BE SLOWER OR WHERE THE DANGER OF HOT WATER CONTACT IS GREATER***

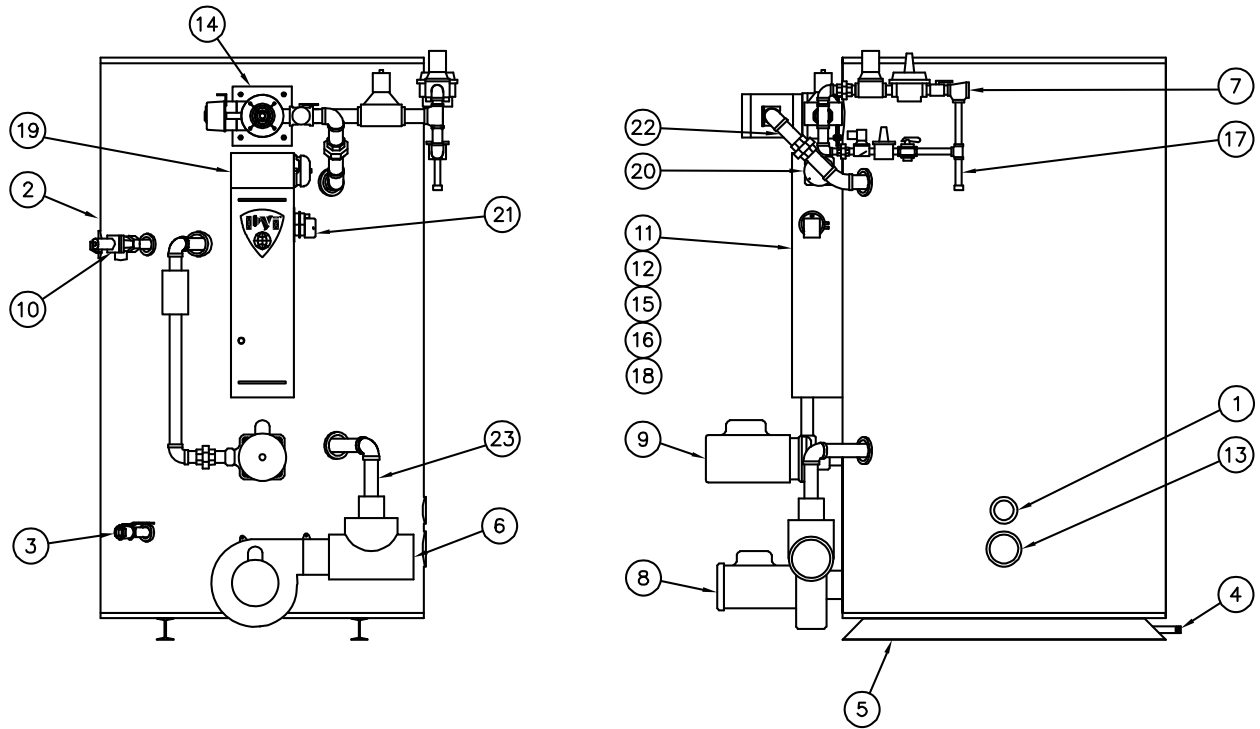


**Thermostatically controlled mixing valves must be used in the design of the potable hot water system.**

**Potable hot water should be tempered to no more than 110°F when used for bathing or other personal uses.**

**Good engineering practice mandates the use of thermostatically controlled mixing valves set at 120°F or less to keep the delivered water temperature below scalding temperatures.**

## 2 PRODUCT DESCRIPTION



**Figure 1**

- |  |  |
|--|--|
| 1. Cold water inlet                            | 13. Hand hole access                                       |
| 2. Hot water outlet                            | 14. Burner   |
| 3. Drain                                       | 15. Manual reset temperature limiting device               |
| 4. Condensate drain                            | 16. Operating control                                      |
| 5. I-beam skid                                 | 17. Drip leg   |
| 6. Flue outlet                                 | 18. Electronic LWCO control (optional)                     |
| 7. Gas inlet                                   | 19. Temperature & pressure gauges (optional)               |
| 8. Induced draft blower motor                  | 20. Audible alarm  |
| 9. Circulating pump                            | 21. Differential air switch                                |
| 10. Temperature & pressure relief valve        | 22. Passive FGR duct (factory installed for Low NOx units) |
| 11. Electronic LWCO probe                      | 23. Passive FGR duct (field installed for Low NOx units)   |
| 12. Control enclosure with switch(s) & fuse(s) |  |

### 3 STANDARD FEATURES AND EQUIPMENT

#### 3.1 Warranty

Factory warranty does not cover improper installation or operation. (See warranty for complete details).  
Warranty exclusions include but are not limited to failure or malfunctions resulting from:

1. Failures to properly apply, install, operate, or maintain the appliance in accordance to printed instructions.
2. Abuse, alteration, accident, fire, flood and the like.
3. Corrosive or contaminated atmosphere.

### 4 WATER HEATER INSTALLATION

#### 4.1 Checking Equipment Before You Install

Inspect the unit completely upon receipt from the freight carrier before signing the bill of lading. Inspect the appliance and all accompanying parts for signs of impact or mishandling. Verify the total number of pieces shown on packing slips with those actually received. Contact the freight carrier immediately if any damage or shortage is detected.

#### 4.2 Codes

The equipment shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installation is made. In the absence of such requirements, the installation shall conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1 and with the National Electrical Code, NFPA 70. All appliances conform to the latest edition of the ASME Boiler and Pressure Vessel Code, Section IV. Where required by the authority having jurisdiction, the installation must comply with the Canadian Codes, CAN/CSA-B149.1 and/or B149.2, C22.1 and/or local codes.

#### 4.3 Electrical Requirements

**WARNING:** Turn off all electrical service to the appliance when accessing the controls located inside the control cabinet. The cabinet contains high voltage wiring and terminals. If the electrical service is not turned off and these wires or terminals are touched, a dangerous shock causing personal injury or loss of life could occur. Close the control cabinet before restoring electrical service to the appliance.

1. Wiring to the unit should conform to the National Electrical Code or the code legally authorized in your locality. A fused disconnect switch should be used. When required, PVT water heaters are equipped with step-down transformers located within the control enclosure. This allows for an effective single point electrical connection.
2. Be certain that high and low voltages are connected to the correct points.
3. When remote on/off or lead-lag enable operation is used, remove jumper from R1 and R2 and wire in series.
4. A proper earth ground for this unit must be provided. A single conductor ground wire pulled from the distribution panel to the sub panel (or some similar type) is recommended.

**CAUTION:** Use only copper wiring of proper sizing for incoming service. Damage resulting from use of aluminum wiring will be excluded from coverage under the warranty of this unit.

#### 4.4 Location

1. Locate the unit in a clean and dry area as close as possible to the greatest hot water usage and as near to gas, oil, steam, boiler water and/or electrical power as practical.
2. Install the unit on a firm, non-combustible and level foundation.
3. Locate the foundation on a pitched floor near a suitable drain, or make other provisions to prevent contact to areas of the building subject to water damage should the boiler or a water connection leak. The drain must be sufficient to contain water in excess of 210°F.

## 4.5 Installation

**WARNING: Use industry standard safe rigging methods when attempting to lift or move this product. Failure to follow these instructions could result in property damage, serious injury or death. One common method includes the use of straps and spreader bars, lifting from the water heater base skid assembly.**

1. Check the data decal on the heater. Be sure the electrical, water, oil, or gas supply is adequate for the installation.
2. Carefully remove all shipping supports and bracing.
3. Install shut-off valves and unions on the inlet and outlet water piping for servicing. Use caution when threading pipe nipples into tank connections to prevent cross threading, or over-tightening. Always use a back-up wrench on tank nipples when tightening unions, valves, etc.
4. Insulate hot water and return circulation lines. Insulate cold water supply lines if subject to freezing during shutdown periods. **IMPORTANT: Do not use the plumbing connected to the appliance as a ground for welding or any other purpose.**
5. The heater is equipped with a temperature and pressure relief valve(s) rated for the input. Pipe the relief valve discharge to a suitable open drain. The drain pipe may not be smaller than the relief valve opening and must be secured to prevent it from lifting out of the drain under discharge pressure. Do not install valves or restrictions in the discharge line.
6. Pipe the drain valve to a suitable open drain.
7. Verify that the type of gas specified on rating plate is supplied to the unit. This unit is orificed for operation up to 2000 feet altitude. Appliance Btu/h output derates approximately 4% per 1000 feet elevation. Consult Factory for installations above 2000 feet elevation.

## 4.6 Service Clearances

Allow sufficient space to provide adequate clearances on all sides for service and inspection. Recommended clearance is 24" at the top and front, 18" at left and right sides of the appliance. Optional equipment may increase the clearance requirements. Allow sufficient space for installing and servicing connections such as water, gas, vent, combustion air, electrical, pump and other auxiliary equipment.

## 4.7 Clearances to Combustible Surfaces

The appliance must not be installed on a combustible floor, or on a non-combustible floor covering combustible material. Clearance to unprotected combustible material must be 8" minimum at top, sides and rear, and 24" minimum in front. Recommended access for service is 18" at sides and rear and 24" in front.

## 5 CONDENSATE NEUTRALIZATION & DISPOSAL

The PVT water heater can produce significant amounts of condensate because of their high efficiency. Condensate occurs naturally when water vapor in combustion gases is cooled below the dew point. Although only slightly acidic, condensate can be routed through an optional neutralization system to become pH neutral allowing for disposal into any drain or sewer system without concern for corrosion. Condensate from the heater can be plumbed together with condensate from the vent (see Vent System Design) to enter a single condensate trap (minimum 3 inch water column) and a single discharge to the sewer or building drain.

Crushed limestone fills the optional condensate neutralization bath. Condensate slowly flows through the limestone bed and is neutralized thus avoiding chemical treatment or dilution using substantial quantities of tap water. If the condensate pH is lower than 4 when checked with a pH meter or pH paper, consult the factory for replacement treatment system. Condensate drainage from the POWER VT<sup>®</sup> heater will only occur after a recovery run cycle. If no condensate is drained during this time, the drainpipe should be inspected for blockage. Should the heater not be installed on a housekeeping pad to ensure gravity drainage, a means of removing condensate, such as a pump, should be supplied in the system.

## 6 VENTING INSTRUCTIONS

Vent this appliance in accordance with the latest edition of the National Fuel Gas Code and in accordance with the authority having jurisdiction. The PVT water heater is designed for operation with 4", 5" or 6" positive pressure vent systems constructed of schedule 40 or 80 solid **CPVC** pipe.

Do **not** use ABS or PVC pipe of any type. ABS can emit toxic fumes in the event of a building fire and neither ABS nor PVC is temperature rated for this appliance.

Do **not** use CPVC pipe with cell/foam type construction (such as "CellCore") or other non-solid CPVC plastic pipe. If 4" pipe is difficult to obtain locally, larger solid CPVC pipe may be substituted; however, a solid CPVC increaser from 4" to the larger size must be used.

Do **not** insulate the plastic vent pipe.

Where the authority having jurisdiction requires venting to comply with the Canadian Standards Association Code, CAN/CSA-B149.1 and/or B149.2, the CPVC and PVC vent pipe described in this section must comply with the following requirements:

1. Venting systems, or total vent run if less than 3 ft (900 mm), that employ plastic vents shall be installed such that the first 3 ft (900 mm) from the appliance flue outlet is readily accessible for inspection and
2. Vents constructed using plastic piping shall be certified to ULC S636.

**WARNING: Use only solid CPVC pipe or stainless steel venting listed by a nationally recognized testing laboratory for Category IV positive pressure gas appliance venting. Use of other types of plastic pipe or pipe with cell/foam type construction or use of venting materials other than specified in these instructions can result in failure of the venting system and/or exposure to carbon monoxide which can result in property damage, personal injury or death.**

### 6.1 Vent System Design

The POWER VT<sup>®</sup> can be vented either vertically, through a ceiling or roof, or horizontally through a wall. From the vent pipe at the blower outlet, the vent can be routed in any direction except down. Like any closed piping system, the vent should maintain a downward slope toward the heater of at least ¼ inch per lineal foot of horizontal vent run to allow proper drainage of any accumulated moisture. The vent system must have a condensate drain no more than 18" from the combustion blower. This vent condensate drain may be connected to the appliance condensate drain.

**WARNING: All condensate drain or drains must have a trap with a minimum of 3 inch water column. If the trap(s) are not provided, flue gasses containing carbon monoxide, may be released into the building, possibly resulting in personal injury or loss of life.**

### 6.2 Determination of Equivalent Length (vent must not exceed the maximum length identified in Table 1)

Vent Pipe	Equivalent Length		Maximum Vent Length	
	90° elbow	45° elbow	1000 MBtu	All others
4	14	5	50	100
5	15	6	150	300
6	17	7	390	500

**Table 1**

- A. Add total length of straight pipe (in feet).
- B. Multiply number of 90° elbows used in vent system by the equivalent length of straight pipe specified in Table 1.
- C. Multiply number of 45° elbows used in vent system by the equivalent length of straight pipe specified in Table 1.
- D. Add (A), (B) and (C) together to obtain the total feet of venting. This length must not exceed the maximum vent length identified in Table 1.

Example: A 4" venting system of 25 ft. of straight pipe and two 90° elbows:

- Total straight pipe = 25 feet.
- Number of elbows (2) x 14 = 28 equivalent feet of straight pipe.
- 25 feet plus 28 feet = 53 equivalent feet of venting.

This is an acceptable vent system. Consult the vent system manufacturer for specific design and installation details.



### 6.3 Vent Construction

- Joining vent components – All joints in the vent system must be air tight. Use an all purpose CPVC cement for 4" diameter pipe and rated for 180°F when joining adjacent components (e.g. a straight length of pipe and an elbow).
- Vent support – The vent system should be supported at six-foot horizontal intervals to prevent sagging and distortion.

### 6.4 Horizontal Venting Through a Wall

**WARNING: Vent terminals for the flue and inlet air must use only vent terminations as supplied or available from the appliance manufacturer for these purposes. Failure to use the correct terminations could result in carbon monoxide poisoning causing personal injury or loss of life.**

- The vent must extend one foot beyond the wall.
- The vent must not exit over a public walkway or over any other area where condensate or vapor could be hazardous.
- The vent must discharge at least three feet above grade of the level of normal snow accumulation.
- The vent must terminate at least four feet below, four feet horizontally from, or one foot above any building air inlet including doors and windows.

### 6.5 Vertical Venting Through a Roof

- The vent must extend upwards beyond nearby obstructions in accordance with Figures 2 and 3.

### 6.6 Venting of Multiple Units

- Multiple PVT models must not be vented into a common duct or breeching. Vent each unit independently in accordance with the instructions for either horizontal or vertical venting included above.

## 7 AIR INLET DUCT OPTION

**WARNING: Vent terminals for the flue and inlet air must use only vent terminations as supplied or available from the appliance manufacturer for these purposes. Failure to use the correct terminations could result in carbon monoxide poisoning causing personal injury or loss of life.**

Air inlet duct is defined as a means of ducting the outside combustion air to the burner for the purpose of avoiding corrosion that can be caused by contaminants which may be contained in indoor air and/or providing sufficient fresh air for proper combustion. If your POWER VT<sup>®</sup> water heater requires an air inlet duct, it can be connected directly to the burner inlet cap with self-tapping screws.

### 7.1 Constructing the Air Inlet Duct

- Use 6 inch, PVC sewer and drain pipe when constructing the combustion air duct for all POWER VT<sup>®</sup> water heater models. Single-wall galvanized may be used when PVC is not available. Care should be taken to tape all duct joints and connections.

### 7.2 When Ducting Vertically Through a Roof (Figure 4)

- The duct must terminate with the UL listed vent termination available from PVI Industries, LLC.

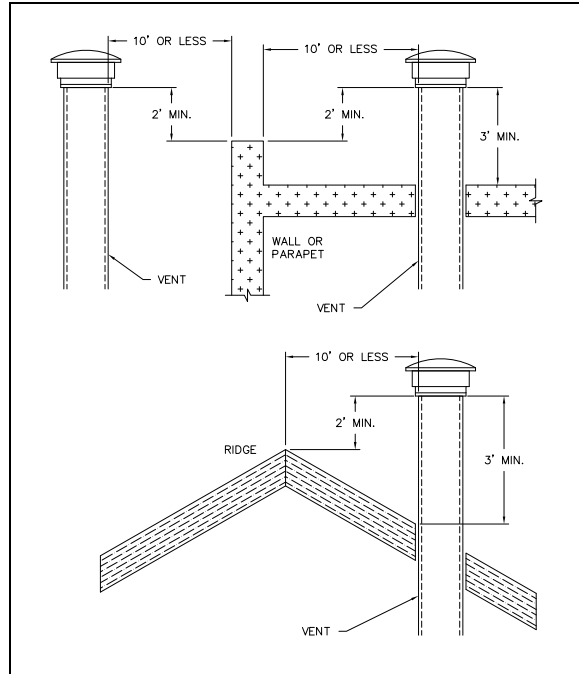
### 7.3 When Ducting Horizontally Through a Wall (Figure 5)

- The duct must extend one foot beyond the wall.
- The duct must terminate with the UL listed vent termination available from PVI Industries, LLC.
- The duct must terminate at least three feet above grade or the level of normal snow accumulation.

### 7.4 Maximum Equivalent Length of Duct

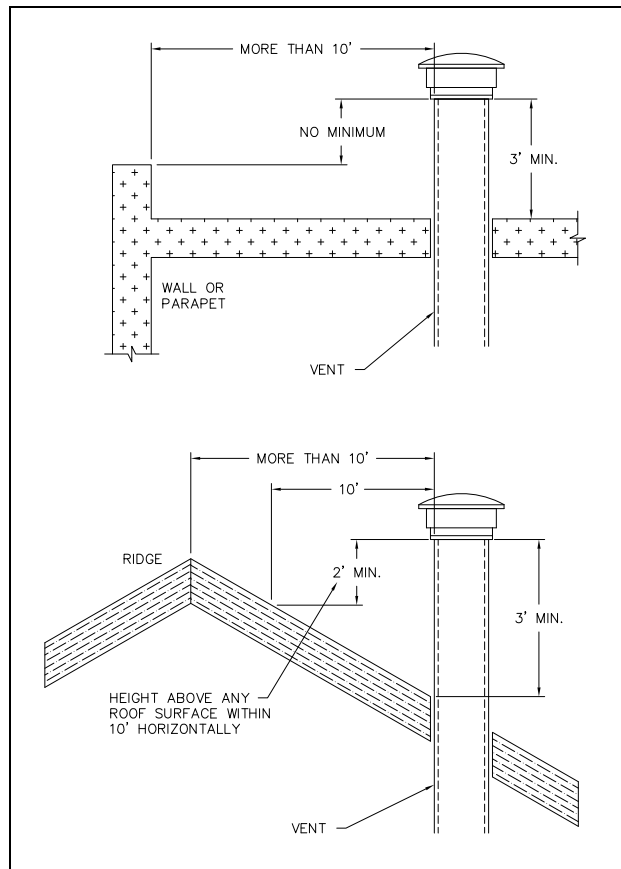
- The combustion air duct should be no more than 100 equivalent feet in length, but it may be of different configuration. See section on vent system design for details concerning combustion air duct construction.

## Typical Termination Locations for Vertical Vent Pipes



Termination of less than 10 feet

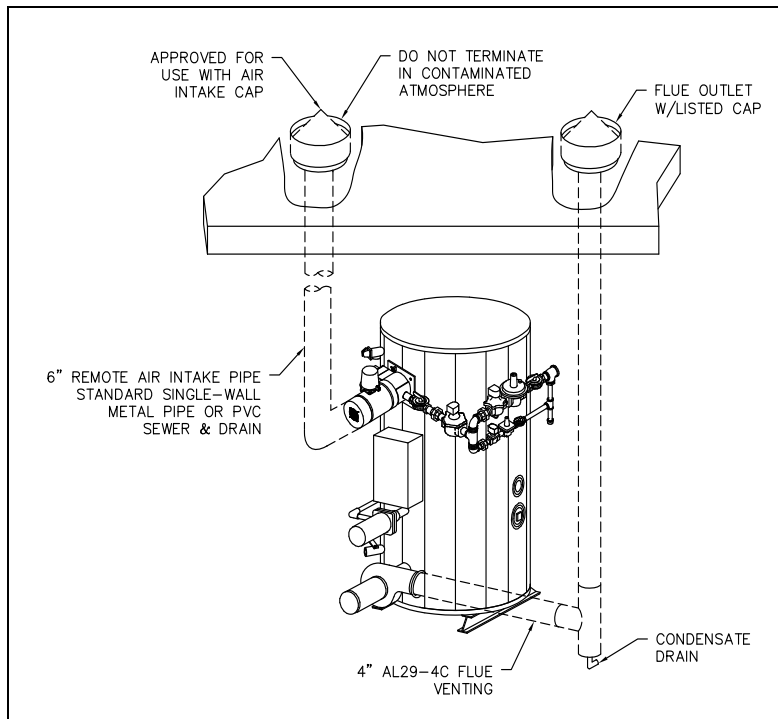
Figure 2



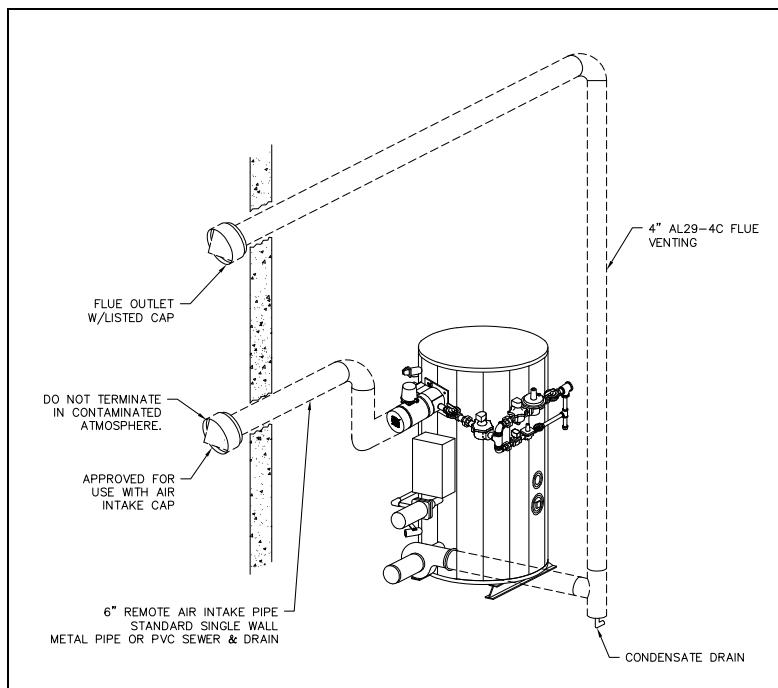
Termination of more than 10 feet

Figure 3

## Typical Locations for Vertical and Horizontal Vent Pipes



**Vertical Venting  
Figure 4**



**Horizontal Venting  
Figure 5**

- Install flue outlet and fresh air inlet with adequate separation to prevent recirculation of combustion products. Although the National Fuel Gas Code provides minimum clearances, use sound engineering judgment, considering prevailing winds, obstructions and the type vent termination used, etc.
- Either flue or remote air intake can be roof or side wall vented.
- Maximum length of remote intake ducting is 100 equivalent feet.
- See Table 1 for maximum length of combustion venting

## 8 TYPICAL GAS BURNER CONSTRUCTION

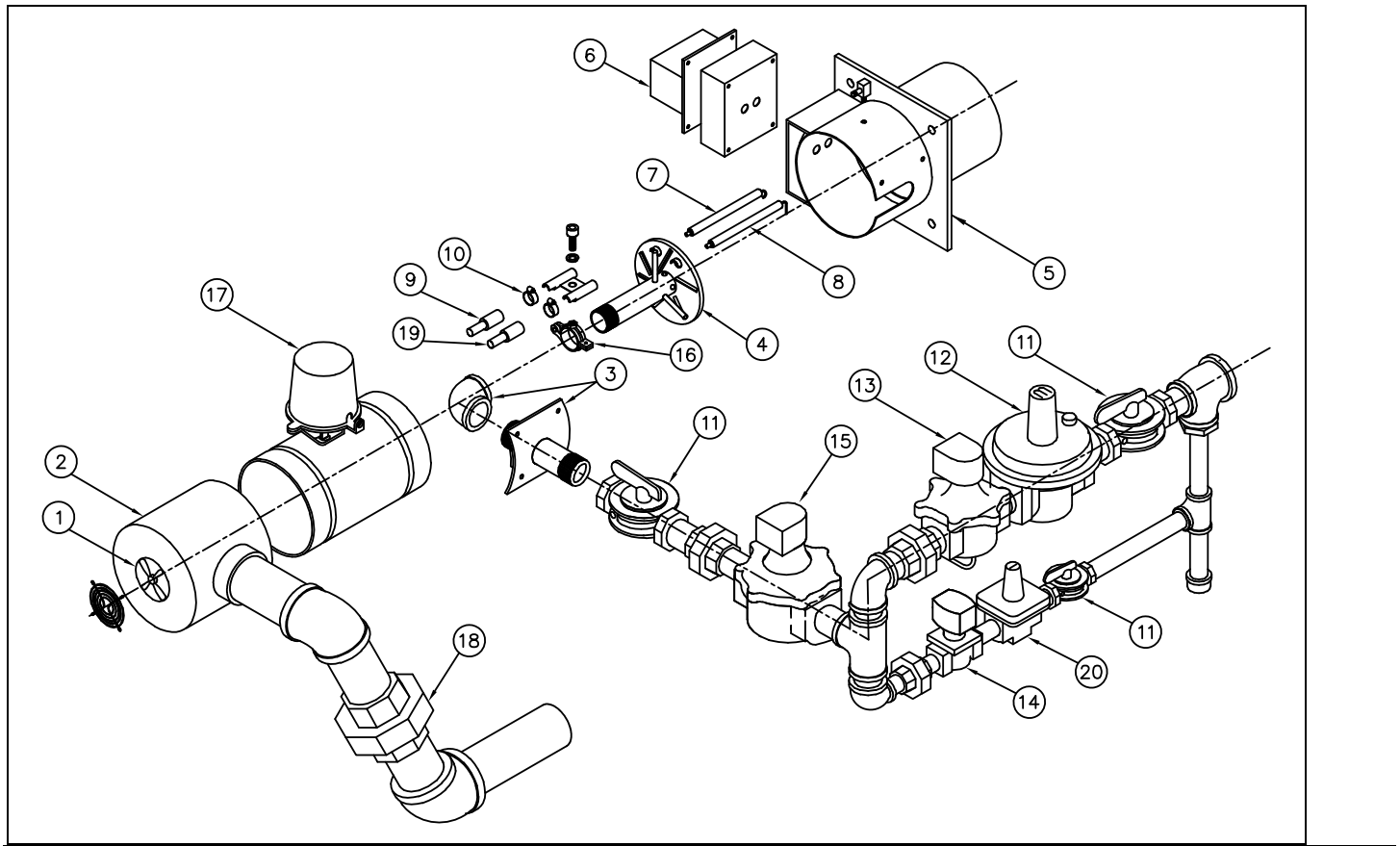


Figure 6

- |   |                                  |
|---|----------------------------------|
| 1. Static fan                           | 11. Manual shutoff valves        |
| 2. End cap                              | 12. Main gas pressure regulator  |
| 3. Gas nozzle assembly                  | 13. Main gas valve               |
| 4. Pressure plate                       | 14. Pilot gas valve              |
| 5. Blast tube & burner housing junction | 15. Auxiliary gas valve          |
| 6. Ignition transformer                 | 16. Electrode clamp              |
| 7. Ignition electrode                   | 17. Fresh air vent damper        |
| 8. Flame sensing electrode              | 18. FGR union with orifice       |
| 9. Ignition electrode boot (red)        | 19. Flame electrode boot (black) |
| 10. Electrode clamp                     | 20. Pilot gas pressure regulator |

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**CARBON MONOXIDE WARNING:** An annual or seasonal combustion checkout must be performed by a qualified service agency to ensure safe operation. Failure to maintain proper combustion can result in injury or death.

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## 9 START-UP PROCEDURES

**WARNING: Start-up should only be performed by a qualified technician.**

**CAUTION:** Do not relight pilot or start burner with combustion chamber full of gas or oil vapor, or with very hot combustion chamber.

**WARNING: You must connect the supplied gas train assembly to the burner union. Then connect the gas supply to the gas train. Do not connect the gas supply directly to this union. Failure to install the supplied gas train to the burner union before connecting the gas supply may result in uncontrolled gas flow into the appliance and/or the appliance area. Failure to follow this warning could result in fire or explosion causing property damage, personal injury or death.**

1. The POWER VT<sup>®</sup> gas valve and control train (gas train) provided with the appliance must be directly connected to the union piped out of the burner. After the gas train is attached to the burner, the gas supply can be connected to the gas shut-off valve (gas cock) at the gas train inlet. After gas plumbing is complete, verify the gas train is adequately supported and connect the conduit and multi-pin plug into the multi-pin receptacle in the gas train conduit box.
2. Carefully study the burner start-up information included in this manual.
3. Fill the water heater tank with water. Open the relief valve or a nearby hot water faucet to allow air in the tank to escape. Be sure all connections into the tank are tight, as leaks at tank fittings will damage the insulation.
4. The temperature limiting safety device is fixed at 200°F. The operating thermostat is set at the factory to 120°F. Adjustment may be made by turning the thermostat dial to the desired temperature.

**CAUTION:** Conduct the following gas train leakage test before start-up, at annual intervals and prior to investigating the cause of any reported occurrences of delayed ignition.

- Using an appropriate bubble detection solution, thoroughly coat all gas train pipe connections. If any bubbles are detected, the leaking connection must be tightened, recoated, and rechecked to assure stoppage of the leak.
- Attach a manometer to measure the gas pressure at the manual gas shutoff valve located just upstream of the gas train. Adjust gas train inlet pressure to the specified value (e.g. 14" W.C.), and tightly close the gas train manual shutoff valve closest to the burner.
- Reattach the manometer to the gas train manual shutoff valve at the burner and record the measured gas pressure in inches of water column (W.C.). Measure gas pressure again after 15 minutes. If gas pressure has increased 0.5" W.C. or more, the gas leak must be isolated to one or more of the operating gas valves. (For example, a solenoid actuated gas shutoff valve.) After any leaking valve is replaced, the reassembled gas train must be leak tested again before start-up is attempted.

**WARNING: Turn off all electrical service to the appliance when accessing the controls located inside the control cabinet. The cabinet contains high voltage wiring and terminals. If the electrical service is not turned off and these wires or terminals are touched, a dangerous shock causing personal injury or loss of life could occur. Close the control cabinet before restoring electrical service to the appliance.**

5. Remove enclosure panel cover on the water heater to expose control circuit. A wiring diagram, included in this packet, will show the controls used in the circuitry.
6. Visually check that all components are intact and no damage has occurred during transit.
7. Check all connections within the control cabinet. A loose connection could cause intermittent shutdowns.
8. Some burners will use direct spark ignition. They may use a single gas pressure regulator and gas valve or multiple valves and regulators. On a call for heat, the motor starts, gas primary control is energized, the air vent damper opens and after a short delay (pre-purge), the gas valve(s) opens and ignition should occur.

**NOTE:** Do not tamper with or readjust program dipswitch settings. This will cause the control to become inoperable. Damage resulting from tampering will be excluded from coverage under the warranty of this unit.

9. Connect a test meter to the control for reading the flame response signal.

**NOTE:** Some controls read the flame signal in micro amps and some in volts DC. The M series control has two terminals marked for reading volts in DC.

**CAUTION:** Be sure the tank is filled with water. Dry firing can destroy the boiler.

10. Check the gas pressure before start-up, using a U-tube manometer or a 0 to 28" W.C. pressure gauge for inlet gas pressure. (This is the pressure measured before all components in the gas train.) The manometer must stay connected throughout the testing, as the inlet pressure must be monitored during the firing of the burner. Record static pressure; it must not exceed 14" W.C. Pressures above this could cause damage to the diaphragm in the gas valve or pressure regulator.
11. Connect a manometer to the manifold test port at the shutoff valve closest to the burner. Turn off main gas shutoff valve. Turn unit on using the rocker switch on the side of the control enclosure assembly. If the operating control switches are closed, the burner blower should come on and pre-purge begins.
12. If nothing happens, check the control to be sure it is not in the tripped position and reset it by pushing the flame safeguard reset button. The burner should pre-purge at least thirty seconds.
13. When the blower motor starts, the air damper will open and the airflow proving light on the MEC120 should be on. This indicates a positive airflow condition. If the air proving light is not on, check the air-proving switch for operation. To adjust the air-proving switch, turn the adjustment screw counter-clockwise until the air proving light comes on, then turn the screw one turn counter-clockwise. If the gas valves open and close intermittently during normal operation, turn screw one half turn counter-clockwise until this condition ceases. This procedure should be followed with every burner.

### **9.1 This section is for Single-stage and Two-stage firing:**

After purging is complete, terminal 3 on the flame control energizes the pilot valve and terminal 4 energizes the ignition transformer. The pilot is then established. The VDC reading on the meter should read a steady 6-10 VDC; 6 VDC is the minimum flame signal for it to operate reliably. If the pilot fails to light during the initial period, it is probably due to air in the line. The control will lock out and require reset.

Once the flame is established, the ignition transformer will de-energize and terminal 5 will energize the main valve. At this point the boiler is operating at maximum firing rate (high fire). In order to insure the boiler is operating at the rated input, it is necessary to check the manifold gas pressure (measured at the pressure tap on the gas valve closest to burner). The manifold gas pressure should be adjusted at main gas regulator to the factory recommended pressure shown on tag attached to gas train. Do not screw the adjusting nut of the regulator in beyond point where no further increase in manifold pressure is noted. While firing, check the gas pressure at the inlet of the gas train. The minimum supply pressure requirement on the POWER VT<sup>®</sup> water heater is 4.5" W.C. supply unless otherwise specified on the data plate. It should be a minimum of that shown above with the boiler running at high fire. This is recorded as inlet flow pressure. It is important incoming pressure does not fall below this minimum or nuisance control lockouts could occur.

### **9.2 This section is for Two-stage firing only:**

After adjusting the high fire manifold gas pressure, it is now important to check the operation of the first stage (low fire). There is a toggle switch on the control cabinet labeled "Auto/Low Fire". Switch from the auto position to low fire and the main valve will de-energize shutting off the high fire gas supply and the air damper will close reducing the airflow to a minimum. Once the boiler is at low fire the manifold gas pressure can be adjusted as described in the previous paragraph but using the pilot gas regulator instead of the main gas regulator. Proceed to paragraph 10 to test and document combustion results for low fire and high fire.

14. Check flue gases with an electronic flue analyzer to make final settings of gas pressure regulator:
  - a) The readings need to be taken from a hole in the vent several inches downstream of the fan outlet connection.
  - b) Insert 0-6" W.C. manometer into the test opening in the vent. Pressure in stack should not exceed 2" W.C.
  - c) When water in tank is above 120°F, insert analyzer or O<sub>2</sub> testing in test opening; take O<sub>2</sub> reading in percentage.
  - d) Increase manifold gas pressure at the main gas pressure regulator taking O<sub>2</sub> reading at each adjustment of gas regulator until optimum O<sub>2</sub>% (5-7%) is reached. If O<sub>2</sub>% decreases, reduce the gas pressure to last reading where the greatest reading is achieved.
  - e) CO should not exceed 200 ppm. A reading greater than 200 ppm indicates lack of air. Reduce manifold gas pressure slightly and take readings until CO is within proper range. Optimum reading is no CO.
  - f) If manifold pressure was changed during startup, take a final CO and O<sub>2</sub> reading.
  - g) Record CO<sub>2</sub> and NO<sub>x</sub> if applicable. See paragraph 27 if NO<sub>x</sub> measurement is required.

- h) Insert vent temperature gauge in test opening and read gross vent temperature; maximum gross stack is to be 275°F. If an excessively high gross vent temperature is recorded; consult the factory.
15. When the POWER VT® water heater is equipped for Low NO<sub>x</sub> operation, it may be necessary to measure the NO<sub>x</sub> levels in the flue products for compliance verification. The NO<sub>x</sub> concentrations are measured in ppm (parts per million). When documenting the measurements on the startup report, be sure to note whether or not the readings are corrected to a baseline O<sub>2</sub> level. If during the course of startup the NO<sub>x</sub> levels do not meet your locally mandated requirements, it may be necessary to change the FGR (flue gas re-circulation) orifice. This orifice is contained in the FGR union shown on page 11, Figure 501-6. This union may contain two or more orifices. This allows the removal of one or more of the orifices in order to increase the flow of FGR and thereby reduce NO<sub>x</sub> in the flue products.

**IMPORTANT:** If the FGR orifice is changed for any reason, the startup procedure in paragraph 18-26 should be repeated.

16. Check each operating and limit control to be sure they function properly by lowering and raising the temperature setting on each of the controls, causing burner to cycle on and off.

**NOTE:** During the initial firing of the burner, smoke that is not related to the burner will be emitted from the heater. This is normal during "burn in" and could possibly continue for several hours.

9.3 Record the Following Information for Future Use:

Manifold gas pressure: \_\_\_\_\_ "W.C.

Vent pressure: \_\_\_\_\_ "W.C. (less than 2" W.C.)

O<sub>2</sub> reading: \_\_\_\_\_ % (5-7%)

CO<sub>2</sub> reading: \_\_\_\_\_ % ( 8-9%)

CO reading: \_\_\_\_\_ ppm (less than 200 ppm)

NO<sub>x</sub> reading: \_\_\_\_\_ ppm

Gross Vent Temp: \_\_\_\_\_ °F (250°F max)

Less Ambient Room Temp: \_\_\_\_\_ °F

= Net Vent Temp: \_\_\_\_\_ °F

Recorded By: \_\_\_\_\_ Date: \_\_\_\_\_



**CARBON MONOXIDE WARNING:** An annual or seasonal combustion checkout must be performed by a qualified service agency to ensure safe operation. Failure to maintain proper combustion can result in injury or death.

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**WARNING:** Turn off all electrical service to the appliance when accessing the controls located inside the control cabinet. The cabinet contains high voltage wiring and terminals. If the electrical service is not turned off and these wires or terminals are touched, a dangerous shock causing personal injury or loss of life could occur. Close the control cabinet before restoring electrical service to the appliance.

Preventive Maintenance is recommended to assure a long, trouble-free life of the water heater. A table of periodic safety inspections is attached to this manual for ease of reference by the building service technician or licensed equipment operator. Since water heater designs vary, only some of these listed inspections may be appropriate for your particular model.

PVI strongly recommends the recording of significant events, such as maintenance or repair actions and safety inspections, and encourages the preparation of an event log for this purpose. All recorded events should be dated, fully described, and signed by the individual performing the service, repair, or inspection. (See Table 2 for sample of Inspection Record.)

1. The tank should be flushed at two- or three-month intervals depending on water conditions in your location. To flush, turn off electrical disconnect switch to prevent the burner from operating. Open the drain valve and allow water to flow through the tank until it runs clear. Close the drain valve and turn the electrical switch back on. Draining two or three gallons from the bottom of the tank on a weekly basis will also help prevent the accumulation of sediment. Water impurities consist of fine particles of soil and sand, which will settle out and form a layer of sediment on the bottom of the tank.
2. A scale of lime will normally form during operation and will accumulate on the bottom of the tank. Lime is formed from the natural chemicals in the water, which precipitate out during heating cycles. Some water supplies contain more of these chemicals than others do and scale buildup will occur more rapidly.

Other factors affecting scale buildup are the amount of hot water used and the temperature of the water. The more hot water used, the more fresh water containing scale-forming chemicals is brought into the tank. As the temperature of water increases, the rate of scale deposition will increase.

3. The tank may have a hand hole for inspection and cleaning. (See Figure 1). To inspect tank for scale buildup, remove the handhole cover. If scale is present, it can be loosened with a high-pressure stream of water. The smaller pieces can be flushed through the drain and the larger pieces removed by hand through the hand hole. The frequency of inspections will be determined by the rate of scale buildup. Intervals of 30-60 days are recommended.
4. If a firetube leaks for any reason, consult the factory for instructions.

**NOTE:** Condensate coming from the tubes on a cold start is normal and does not indicate a leaking tube.

### 10.1 Periodic Inspection of Operational Components

1. Examine the venting system at least once each year for proper connections, alignment and corrosion. The static fan inlet will collect dust from the air during operation. Disconnect the power to the heater and clean the fan guard when necessary.
2. The temperature and pressure relief valve may be checked by slowly lifting the seat lever on top of the valve to determine its condition for safe operation. Openings inside the valve may become restricted by a buildup of scale and become inoperative. If the valve does not open and close properly when tested, it must be replaced. Replace the relief valve with like kind or one meeting the requirements stated on the rating decal located adjacent to the relief valve.

**CAUTION:** The Relief Valve Is A Primary Safety Device.

## 10.2 Instructions for Taking Water Heater Out of Service

Extended shutdown of the unit and restarting are as follows:

- a) Turn off all power and fuel supplies.
- b) Drain and flush tank as previously discussed.
- c) Tag power switch(s) that fuel is off and tank is empty.
- d) Refill tank with water and turn fuel and power switch(s) on to restart. Reset all controls and conduct start-up of the appliance as discussed.

## 10.3 Burner and Control Maintenance

Periodic inspection and checkout of the burner ignition, control system, and fuel valve operation (for tight close off) should be made. Refer to the burner installation instructions for recommended.

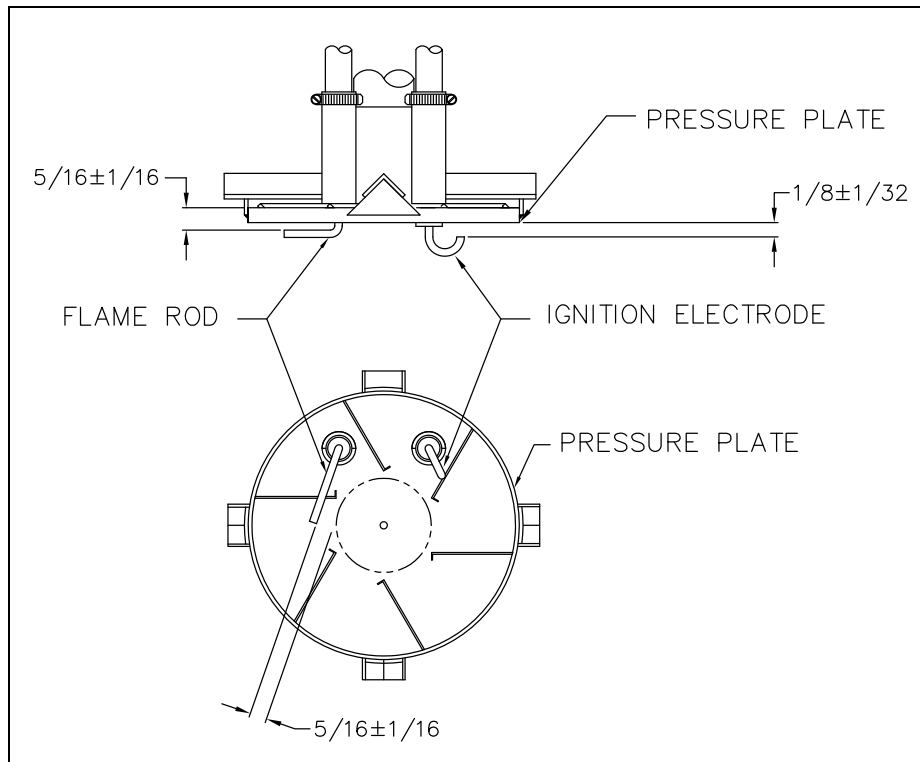
**CAUTION:** Be sure manual valves and burner electrical switch are turned off before removing any part for service or cleaning. Ensure there is no pressure on the vessel prior to disassembly of any water carrying component to prevent serious injury.

1. The burner should be cleaned each year according to the burner manufacturer's recommended procedures. Inspect all parts and make replacements when necessary. Check wiring for loose connections and burned wires.
2. Remove the flame safeguard control from its base. Check the connections in control mounting base; loose connections can cause nuisance shutdowns.

**NOTE:** Always secure gas lines and tag "Out of Service" before servicing burner nozzle or electrodes.

3. Pull the nozzle assembly to check the flame and ignition electrodes. This is done by first disconnecting the gas train by breaking at the unions. Then remove the nozzle assembly with the electrodes and pressure plate attached. Disconnect the electrode wires. Take care not to damage the insulation on the electrodes.
4. With electrodes exposed, check for the proper settings as in Figure 7 below. Check for any hairline cracks in the insulators. Should replacement of burner electrodes be required, certain procedures must be followed. In all cases, removal of electrodes is accomplished by loosening the electrode mounting clamps. Draw electrodes out of the nozzle assembly through the holes in the pressure plate.
5. Inspect electrodes for cracked ceramic or loose retaining studs that hold the wire within the ceramic. Select the proper pressure plate hole to place each electrode and insert electrode through hole, retaining stud end first.
6. Tighten electrode-mounting clamp slightly until electrode ceramics are seated firmly and completely in the mounting bracket without gaps between ceramics and mounting bracket at the bearing faces.
7. Measure and set electrodes according to Figure 7. After gaps and setting are complete, fully tighten the electrode-mounting clamp. Do not over tighten or ceramic insulation may crack.
8. Replace nozzle assembly; be sure to connect the flame and spark rod wires before installing nozzle assembly fully into blast tube. Check connections on the ends of the flame and spark rod wires for good contact. Look for properly stripped wire ends. Be sure connections are firmly attached to the flame and ignition rod ends. Insulating boots can give a false feeling of proper seating. **DO NOT MOVE ELECTRODES.** Be careful not to bump electrodes. Check fan wheel for free rotation.
9. Reinstall gas nozzle assembly.

### Pressure Plate Set Up and Tolerances



**Figure 7**

**10.4 Maintenance & Safety Inspection Report**

DATE	BURNER INSPECTION	COMBUSTION ANALYSIS	TANK INSPECTION	TANK FLUSH & CLEANOUT	TANK FITTING INSPECTION	VENT INSPECTION	THERMOST AT INPSECTION	GAS TRAIN LEAK TEST
Recommended Inspection Intervals	YEARLY	6 MONTHS	6 MONTHS	3 MONTHS	6 MONTHS	YEARLY	YEARLY	YEARLY

**TABLE 2**

## 11 TROUBLESHOOTING SUGGESTIONS

### 1. BURNER FAILS TO START:

- a) Defective on/off switch. Replace switch.
- b) Control circuit has open control contact. Check limits, low water cutoff, and others as applicable.
- c) Bad fuse or switch opens on incoming power source. Correct as required.
- d) Flame safeguard control safety switch tripped out. Reset and determine cause of apparent flame failure.
- e) Loose connections or faulty wiring. Tighten all terminal screws and consult wiring diagram furnished with the heater.
- f) Flame safeguard control starting circuit blocked due to flame relay being energized. Possible defective scanner or flame rod – replace. Possible defective amplifier – replace. Scanner actually sighting flame due to leaking fuel valve – correct unwanted flame cause. Defective flame safeguard control – replace.
- g) Defective blower motor. Check for free rotation of fan wheel. Repair or replace.
- h) Air proving switch is not properly adjusted. See Startup Procedures.
- i) Defective circulation pump. Repair or replace.
- j) Regulator vent line(s) plugged. Remove blockage.

### 2. OCCASIONAL LOCKOUTS FOR NO APPARENT REASON:

- a) Gas pilot ignition failure. Check to see that ignition is instant and flame signal readings are stable and above minimum values. Use an incline manometer to make certain pressure is as recommended.
- b) Loose or broken wires. Check all wire nut connections and tighten all terminal screw connections in panel and elsewhere as appropriate.
- c) With flame safeguard controls that incorporate the air flow switch in the non-recycling circuit, ensure that when main flame lights, the air flow switch is not so critically set as to allow occasional momentary opening of the air switch contacts.
- d) Occasional low supply voltage. Contact local utility to correct. Make certain the burner control circuit transformer (if supplied) is correct of the voltage and power (AC) being supplied.
- e) Occasional low gas supply pressure. Contact local utility to correct.
- f) Regulator vent line(s) plugged. Remove blockage.
- g) Excessive flue gas recirculation, causing unreliable or unstable operation. Reduce the orifice size in the FGR union and readjust the gas regulators to achieve proper excess air in combustion.

### 3. BURNER MOTOR RUNS, BUT PILOT DOES NOT LIGHT:

- a) Gas supply to burner shut off. Make sure all manual gas supply valves are open. Automatic high-pressure valve at meter such as "Sentry" type tripped shut due to high gas pressure. Reset valve and correct cause for trip out.
- b) Pilot solenoid valve not opening. Listen and feel for valve actuation. Solenoid valve not being powered. Check electrical circuitry. Replace coil of entire valve if coil is burned out.
- c) Defective gas pilot regulator. Replace.
- d) Gas pressure too high or too low at pilot orifice (if supplied). Check orifice size in gas pilot assembly. Replace if incorrect. Readjust pressure as required.
- e) Defective ignition transformer. Replace. Incorrect ignition electrode settings. Readjust as required.
- f) Defective component within the flame safeguard control. Replace as required.
- g) Airflow switch not making circuit. Check out electrically. Replace as required. Airflow switch negative pressure sensing tube out of position. Reposition as necessary.
- h) Regulator vent line(s) plugged. Remove blockage.

**4. BURNER MOTOR RUNS AND PILOT LIGHTS, BUT THE MAIN GAS FLAME IS NOT ESTABLISHED:**

- a) Main shutoff or test cock closed. Check to make certain fully open.
- b) Pilot flame signal reading too low to pull in flame safeguard relay. Readjust as required.
- c) Defective automatic main or auxiliary gas shutoff valves. Check electrical circuitry to valves. Replace valves or correct circuitry as required.
- d) Main diaphragm shutoff valve opening too slowly. Adjust bleed on valve.
- e) Defective flame safeguard control or plug on amplifier. Check and replace as required.
- f) Main gas pressure regulator atmospheric vent line obstructed. Correct.
- g) Defective main gas pressure regulator. Replace. Misadjusted main gas pressure regulator. Readjust to meet required operational values.
- h) Polarity reversed on incoming power (S89 control only). Correct.
- i) Regulator vent line(s) plugged. Remove blockage.

**5. CARBON MONOXIDE READINGS ON GAS FIRING:**

- a) Flame impingement on "cold" heat transfer surfaces caused by excessive firing rate. Reduce firing rate to correct input volume.
- b) Incorrect gas/air ratios. Readjust burner to correct CO<sub>2</sub> / O<sub>2</sub> levels, eliminates all CO formation.
- c) Excessive flue gas recirculation, causing insufficient excess air for complete combustion. Reduce the FGR orifice size and readjust the gas regulators to achieve proper excess air in combustion.

**6. GAS HIGH FIRE INPUT CANNOT BE ACHIEVED:**

- a) Gas Company pressure regulator or meter operating incorrectly, not allowing required gas pressure at burner train inlet. Contact Gas Company to correct.
- b) Gas cock upstream of train inlet not fully open. Check and correct.
- c) Gas line obstructed. Check and correct.
- d) Gas train main and/or lead test cocks not fully open. Check and correct.
- e) Gas supply line between gas company regulator and burner inlet too small. Check supply pressure at meter, determine pressure drop and increase line size as required, or raise supply pressure to compensate for small line. Do not raise pressure so high that under static (no flow) conditions the pressure exceeds the maximum allowable pressure to the gas train components on the burner.
- f) Automatic gas valve not opening fully due to defective operation. Replace gas valve.
- g) Defective main gas pressure regulator. Replace.
- h) Incorrect spring in main gas pressure regulator. Replace as required.
- i) Main gas pressure regulator vent line obstructed. Check and correct.
- j) Normally open vent valve (if supplied) not closing when automatic gas valves open. Replace vent valve, if not closing fully.
- k) Second stage thermostat is not properly adjusted. Second stage thermostat should be set approximately 10°F below the primary operating thermostat.

**Additional troubleshooting information can be found in the Flame Safeguard bulletin with the burner.**