Price - $3.00

INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS SERIES 2PV GAS BOILER

For service or repairs to boiler, call your heating contractor. When seeking information on boiler, provide Boiler Model Number and Serial Number as shown on Rating Label.

Boiler Model Number	Boiler Serial Number	Installation Date
20_PV_I-_ _ _ _	6_ _ _ _ _ _ _	
Heating Contractor		Phone Number
Address		

Burnham®
AMERICA'S BOILER COMPANY
Burnham Corporation
Lancaster, PA 17604-3079

8141775R9-11/99

The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning product life.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury or property damage.

NOTICE

Indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

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NOTICE

USA boilers built for installation at altitudes greater than 2,000 feet above sea level have been specially orificed to reduce gas input rate 4 percent per 1,000 feet above sea level per the National Fuel Gas Code, NFPA 54/ANSI Z223.1, Section 8.1.2 and Appendix F. Canadian boilers' orifice sizing is indicated on the rating label. High altitude boiler models are identifiable by the second digit in the model number suffix on the rating label:

20_PV_I-__2: Less than 2000 ft. elevation
20_PV_I-__4: 2000 ft. and higher elevation, Canada
20_PV_I-__5: 2000 ft. and higher elevation, USA

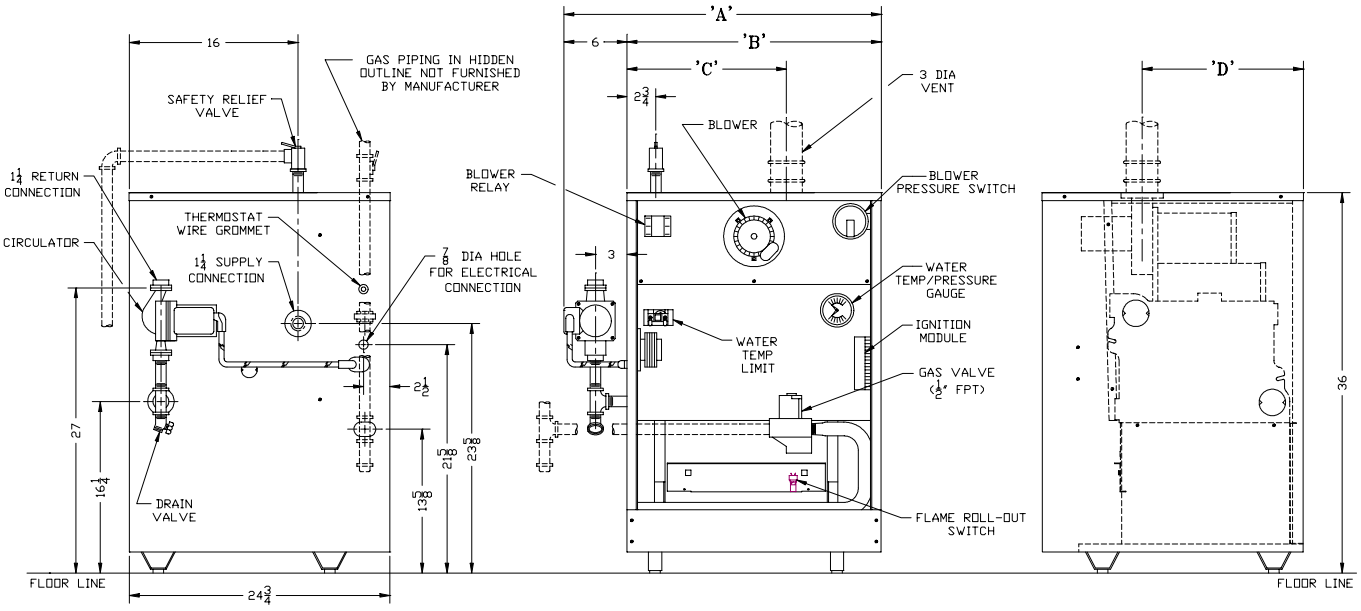


Figure 1: Elevation Views

Boiler Model	Dimensions [in inches]				Water Content [Gallons]	Approx. Shipping Weight (lb.)
	A	B	C	D		
203PV	20‰	14‰	10-1/16	15-5/8	3.2	265
204PV	23	17	11	15-5/8	4	309
205PV	27	21	13‰	15...	4.7	357
206PV	30...	24...	15-1/8	15...	5.5	419

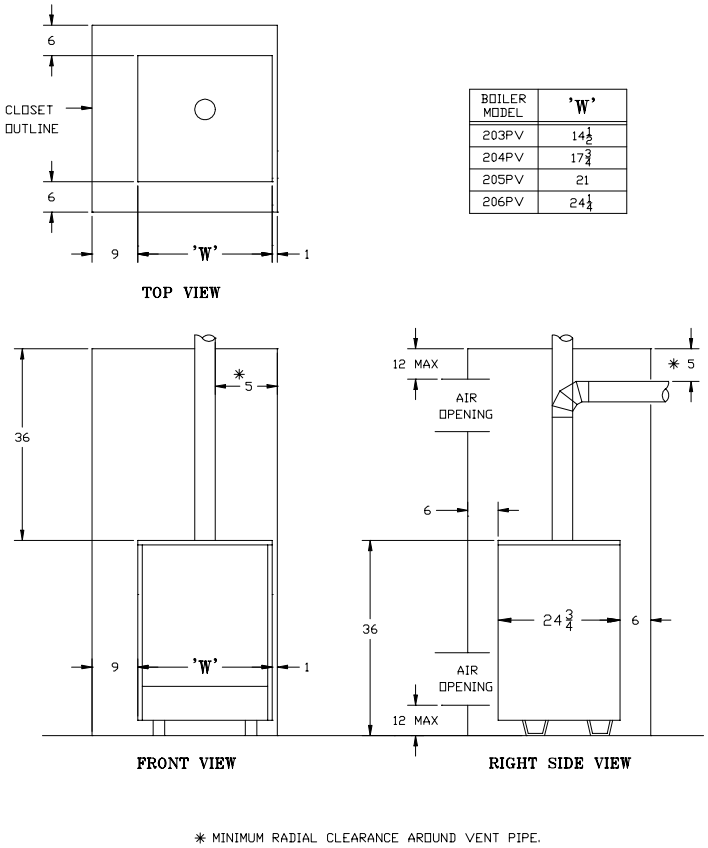
I. Pre-Installation

WARNING

Carefully read all instructions before installing boiler. Failure to follow all instructions in proper order can cause personal injury or death.

A. **Inspect shipment** carefully for any signs of damage. All equipment is carefully manufactured, inspected and packed. Our responsibility ceases upon delivery of boiler to carrier in good condition. Any claim for damage or shortage in shipment must be filed immediately against carrier by consignee. No claims for variances or shortages will be allowed by Boiler Manufacturer, unless presented within sixty (60) days after receipt of equipment.

B. **Installation must conform** to the requirements of the authority having jurisdiction. In the absence of such requirements, installation must conform to *National Fuel Gas Code*, NFPA 54/ANSI Z223.1, and/or CAN/CGA B149 Installation Codes. Where required by the authority having jurisdiction, the installation must conform to the *Standard for Controls and Safety Devices for Automatically Fired Boilers*, ANSI/ASME CSD-1.



BOILER MODEL	'W'
203PV	14 1/2
204PV	17 3/4
205PV	21
206PV	24 1/4

Figure 2: Minimum Clearances to Combustible Construction for Closet Installation

C. **Appliance is design certified** for installation on combustible flooring. The boiler must not be installed on carpeting.

D. **Provide clearance** between boiler jacket and combustible material in accordance with local fire ordinance. See Figure 2 for minimum clearance from combustible material for closet installation. For alcove installation provide top clearance of 27 inches and right side clearance of 6 inches. Recommended service clearance is 24 inches from left side, right side and front. Service clearances may be reduced to minimum clearances to combustible materials.

E. **Install on level floor.** For basement installation provide solid base, such as concrete, if floor is not level or if water may be encountered on floor around boiler.

F. **Install near outside wall** for through wall venting. Refer to Section V: Venting. Certified for minimum vent length of 2 feet with one (1) elbow and maximum vent length of 15 feet with one (1) or two (2) elbows.

WARNING

Certified as Category III appliance. Install vent system in accordance with Section V: Venting. Do not vent using masonry chimney, Type B gas vent, or other Category I venting system.

G. **Protect gas ignition system components** from water (dripping, spraying, rain, etc.) during boiler operation and service (circulator replacement, condensate trap, control replacement, etc.).

H. **Provide combustion and ventilation air** in accordance with applicable provisions of local building codes, or National *Fuel Gas Code*, NFPA 54/ANSI Z223.1, Section 5.3, Air for Combustion and Ventilation, or Sections 7.2, 7.3 or 7.4 of CAN/CGA B149 Installation Codes.

WARNING

Adequate combustion and ventilation air must be provided to assure proper combustion.

The following guideline is based on the *National Fuel Gas Code*, NFPA 54/ANSI Z223.1.

1. Determine volume of space (boiler room). Rooms communicating directly with space (through openings not furnished with doors) are considered part of space.

   Volume [ft³] = Length [ft] x Width [ft] x Height [ft]

2. Determine Total Input of all appliances in space. Round result to nearest 1,000 Btu per hour (Btuh).
3. Determine type of space. Divide Volume by Total Input.
   a. If result is greater than or equal to 50 ft³ per 1,000 Btuh, space is considered an *unconfined space*.
   b. If result is less than 50 ft³ per 1,000 Btuh, space is considered a *confined space*.
4. Determine building type. A building of *unusually tight construction* has the following characteristics:
   a. Walls and ceiling exposed to outside atmosphere have a continuous water vapor retarder with a rating of 1 perm or less with openings gasketed and sealed, and;
   b. Weather-stripping has been added on openable windows and doors, and;
   c. Caulking or sealants applied in joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, at plumbing and electrical penetrations, and at other openings.
5. For boiler located in an *unconfined space in a building of other than unusually tight construction*, adequate combustion and ventilation air is normally provided by fresh air infiltration through cracks around windows and doors.
6. For boiler located within *unconfined space in building of unusually tight construction* or within *confined space*, provide outdoor air through two permanent openings which communicate directly or by duct with the outdoors or spaces (crawl or attic) freely communicating with the outdoors. Locate one opening within 12 inches of top of space. Locate remaining opening within 12 inches of bottom of space. Minimum dimension of air opening is 3 inches. Size each opening per following:
   a. Direct communication with outdoors. Minimum free area of 1 square inch per 4,000 Btu per hour input of all equipment in space.
   b. Vertical ducts. Minimum free area of 1 square inch per 4,000 Btu per hour input of all equipment in space. Duct cross-sectional area shall be same as opening free area.
   c. Horizontal ducts. Minimum free area of 1 square inch per 2,000 Btu per hour input of all equipment in space. Duct cross-sectional area shall be same as opening free area.

   Alternate method for boiler located within confined space. Use indoor air if two permanent openings communicate directly with additional space(s) of sufficient volume such that combined volume of all spaces meet criteria for unconfined space. Size each opening for minimum free area of 1 square inch per 1,000 Btu per hour input of all equipment in spaces, but not less than 100 square inches.
7. Ventilation Duct Louvers and Grilles. Equip outside openings with louvers to prevent entrance of rain and snow, and screens to prevent entrance of insects and rodents. Louvers and grilles must be fixed in open position or interlocked with equipment to open automatically before burner operation. Screens must not be smaller than ¼ inch mesh.

   Consider the blocking effect of louvers, grilles and screens when calculating the opening size to provide the required free area. If free area of louver or grille is not known, assume wood louvers have 20-25 percent free area and metal louvers and grilles have 60-75 percent free area.

I. **Do not install boiler** where gasoline or other flammable vapors or liquids, or sources of hydrocarbons (i.e. bleaches, cleaners, chemicals, sprays, paint removers, fabric softeners, etc.) are used or stored.

II. Unpack Boiler

CAUTION

Do not drop boiler. Do not bump boiler jacket against floor.

A. Move boiler to approximate installed position.

B. Remove all crate fasteners.

C. Lift outside container and remove with all other inside protective spacers and bracing. Save two of the wooden slats from the container sleeve for use in Steps E and F.

D. Remove all boiler hold-down fasteners.

E. Tilt the boiler to one side and slide a wooden slat under the two raised feet.

F. Tilt the boiler to the other side and slide another wooden slat under the two raised feet.

G. Slide the boiler forward or backward off the skid using the two wooden slats as runners.

H. Move boiler to its permanent location.

III. Water Piping and Trim

CAUTION

Failure to properly pipe boiler may result in improper operation and damage to boiler or building.

A. Design and install boiler and system piping to prevent oxygen contamination of boiler water.

CAUTION

Oxygen contamination of boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure. Burnham's standard warranty does not cover problems caused by oxygen contamination of boiler water.

Oxygen contamination sources are system leaks requiring addition of makeup water, fittings, and oxygen permeable materials in distribution system. Eliminate oxygen contamination by repairing system leaks, repairing fittings, and using nonpermeable materials in distribution system.

B. Connect system supply and return piping to boiler. See Figure 3. Also consult I=B=R Installation and Piping Guides. Maintain minimum ½ inch clearance from hot water piping to combustible materials.

C. Install Circulator with flanges, gaskets and bolts provided. Five foot circulator harness allows circulator to be mounted on supply or return. Connect harness to circulator and secure any excess conduit.

D. Install Safety Relief Valve. See Figure 3. Safety Relief Valve must be installed with spindle in vertical position. Installation of the relief valve must be consistant with the ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

WARNING

Safety relief valve discharge piping must be piped near floor to eliminate potential of severe burns. Do not pipe in any area where freezing could occur. Do not install any shut-off valves.

E. Install Drain Valve in ¾" NPT connection in tee provided. See Figure 1.

F. Space heating and domestic water heating with Alliance water heater. Install Alliance water heater as a separate heating zone. Refer to Alliance Installation, Operating and Service Instructions for additional information.

G. If boiler is used in connection with refrigeration systems, boiler must be installed with chilled medium piped in parallel with the heating boiler using appropriate valves to prevent chilled medium from entering boiler, see Figure 4. Also consult I=B=R Installation and Piping Guides.

H. If boiler is connected to heating coils located in air handling units where they may be exposed to refrigerated air, boiler piping must be equipped with flow control valves to prevent gravity circulation of boiler water during operation of cooling system.

I. Use a boiler bypass if the boiler is to be operated in a system which has a large volume or excessive radiation where low boiler water temperatures may be encountered (i.e. converted gravity circulation system, etc.).

Install pipe tee between circulator and boiler return along with second tee in supply piping as shown in Figure 5. Bypass should be same size as the supply and return lines with valves located in bypass and supply outlet as illustrated in Figure 5 in order to regulate water flow to maintain higher boiler water temperatures.

After the boiler is operational (reference Section VII. System Start-Up) set by-pass and boiler supply valves to half throttle position to start. Operate boiler until system water temperature reaches normal operating range. Adjust valves to provide 180° to 200°F supply water temperature. Opening the boiler supply valve will raise system temperature, while opening the by-pass valve will lower system supply temperature.

J. A hot water boiler installed above radiation level must be provided with a low water cutoff device as part of installation.

K. Oil, grease, and other foreign materials which accumulate in new hot water boilers and a new or reworked system should be boiled out, and then thoroughly flushed. A qualified water treatment chemical specialist should be consulted for recommendations regarding appropriate chemical compounds and concentrations which are compatible with local environmental regulations.

L. After the boiler and system have been cleaned and flushed, and before refilling the entire system add appropriate water treatment chemicals, if necessary, to bring the pH between 7 and 11.

Figure 3: Recommended Boiler Piping For Series - Loop Hot Water Heating Systems

Figure 4: Recommended Piping for Combination Heating & Cooling (Refrigeration) Systems

Figure 5: Recommended Bypass Piping

IV. Gas Piping

A. Size gas piping. Design system to provide adequate gas supply to boiler. Consider these factors:

1. Allowable pressure drop from point of delivery to boiler. Maximum allowable system pressure is ½ psig. Actual point of delivery pressure may be less; contact gas supplier for additional information. Minimum gas valve inlet pressure is listed on rating label.

2. Maximum gas demand. Table 1 lists boiler input rate. Also consider existing and expected future gas utilization equipment (i.e. water heater, cooking equipment).

Table 1: Rated Input

Boiler Model Number	Input Rate [cubic feet per hour]		Gas Connection Size
	Natural Gas	LP/Propane	
203PV	62	24	‰
204PV	96	38‰	‰
205PV	130	52	‰
206PV	164	65	‰

3. Length of piping and number of fittings. Refer to Table 2 for maximum capacity of Schedule 40 pipe. Table 3 lists equivalent pipe length for standard fittings.

4. Specific gravity of gas. Gas piping systems for gas with a specific gravity of 0.70 or less can be sized directly from Table 2, unless authority having jurisdiction specifies a gravity factor be applied. For specific gravity greater than 0.70, apply gravity factor from Table 4. If exact specific gravity is not shown choose next higher value.

For materials or conditions other than those listed above, refer to *National Fuel Gas Code*, NFPA 54/ ANSI Z223.1, or size system using standard engineering methods acceptable to authority having jurisdiction.

B. Connect boiler gas valve to gas supply system.

1. Use methods and materials in accordance with local plumbing codes and requirements of gas supplier. In absence of such requirements, follow *National Fuel Gas Code*, NFPA 54/ANSI Z223.1 and/or CAN/CGA B149 Installation Codes.

2. Use thread (joint) compounds (pipe dope) resistant to action of liquefied petroleum gas.

3. Install sediment trap, ground-joint union and manual shut-off valve upstream of boiler gas control valve and outside jacket. See Figure 6.

4. All above ground gas piping upstream from manual shut-off valve must be electrically continuous and bonded to a grounding electrode. Do not use gas piping as grounding electrode. Refer to *National Electrical Code*, ANSI/NFPA 70 and/or CSA C22 Electrical Code.

C. Pressure test. The boiler and its gas connection must be leak tested before placing boiler in operation.

1. Protect boiler gas control valve. For all testing over ½ psig, boiler and its individual shutoff valve must be disconnected from gas supply piping. For testing at ½ psig or less, isolate boiler from gas supply piping by closing boiler's individual manual shutoff valve.

2. Locate leaks using approved combustible gas detector, soap and water, or similar nonflammable solution. Do not use matches, candles, open flames, or other ignition source.

Figure 6: Recommended Gas Piping

Table 2: Maximum Capacity of Schedule 40 Pipe in CFH For Gas Pressures of 0.5 psig or Less

Length [Feet]	0.3 inch w.c. Pressure Drop				0.5 inch w.c. Pressure Drop			
	‰		1	1…	‰		1	1…
10	132	278	520	1,050	175	360	680	1,400
20	92	190	350	730	120	250	465	950
30	73	152	285	590	97	200	375	770
40	63	130	245	500	82	170	320	660
50	56	115	215	440	73	151	285	580
60	50	105	195	400	66	138	260	530
70	46	96	180	370	61	125	240	490
80	43	90	170	350	57	118	220	460
90	40	84	160	320	53	110	205	430
100	38	79	150	305	50	103	195	400

Table 3: Fitting Equivalent Lengths

Fitting	Nominal Pipe Size			
	‰		1	1…
45 Ell	0.7	1	1.2	1.6
90 Ell	1.6	2.1	2.6	3.5
Tee (As Elbow)	3.1	4.1	5.2	6.9

Table 4: Specific Gravity Correction Factors

Specific Gravity	Correction Factor	Specific Gravity	Correction Factor
0.50	1.10	1.30	1.07
0.55	1.04	1.40	1.04
0.60	1.00	1.50	1.00
0.65	0.96	1.6	0.97
0.7	0.93	1.7	0.94
0.75	0.9		
0.8	0.87		

V. Venting

A. General Guidelines.

1. Vent system installation must be in accordance with *National Fuel Gas Code*, NFPA 54/ANSI Z221.3, Part 7, Venting of Equipment; and/or CAN/CGA B149 Installation Codes, Section 7, Venting Systems and Air Supply for Appliances; or applicable provisions of local building codes. Contact local building or fire officials about restrictions and installation inspection in your area.
2. This appliance requires a Special Gas Vent. Use Vent Connector and Vent Terminal in Vent Accessory Carton provided with boiler (See Repair Parts, Key No. 8). The product is designed to use Burnham supplied AL 29-4C® Stainless Steel vent system components. The following manufacturers offer similar AL 29-4C® components and are approved for use with this product: Heat-Fab Inc. - Saf-T-Vent, Flex-L International Inc., - Star-34, Protech Systems, Inc. - FasNSeal™, and Z-Flex U. S., Inc. - Z-Vent. The use of these alternate manufacturer's venting systems will require adapters to connect to the Burnham supplied vent connector and vent terminal. These adapters are not supplied with this unit and should be obtained from the supplier of the alternate manufacturer's venting system. See Table 5 for complete list of Burnham Vent System Components.

WARNING

Do not use this appliance with nonmetallic vent systems such as Hart & Cooley Ultravent, Plexco Plexvent, or Selkirk-Metalbestos Sel-Vent.

Table 5: Burnham Vent System Components

Vent System Component	Burnham *Cartoned Part Number	Burnham Component Part Number
3" Dia. Pipe x 1 Ft	61160112	8116135
3" Dia. Pipe x 3 Ft	61160101	8116058
3" Dia. Pipe x 4 Ft	**	8116176
3" Dia. Pipe x 5 Ft	61160111	8116059
3" Dia. 90 Elbow	61160121	8116060
3" Dia. 45 Elbow	61160131	8116061

* Complete with Locking Band(s)

** 6116033 Contains (4) 4 ft. lengths
6116040 Contains (2) 4 ft. lengths

3. Minimum vent length requirement is 2 feet of pipe and one (1) elbow. Maximum vent length is 15 feet with one (1) or two (2) elbows.

4. Do not install venting system components on the exterior of the building except as specifically required by these instructions.

B. Removal of Existing Boiler. For installations not involving the replacement of an existing boiler, proceed to Step C.

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the remaining appliances. At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation:

(a) Seal any unused openings in the common venting system.

(b) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, and other deficiencies which could cause an unsafe condition.

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

(d) Place in operation the appliance being inspected. Follow the Lighting (or Operating) Instructions. Adjust thermostat so appliance will operate continuously.

(e) Test for spillage at the drafthood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.

(f) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.

(g) Any improper operation of the common venting system should be corrected so the installation conforms with the *National Fuel Gas Code*, NFPA 54/ANSI Z223.1. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part II in the *National Fuel Gas Code*, NFPA 54/ ANSI Z223.1.

C. Install Vent Connector.

1. Remove vent connector from vent accessory carton.
2. Remove gaskets, orifice plate and hardware from blower outlet flange.
3. Assemble orifice plate gaskets, orifice plate, and vent connector. See Figure 7.
4. Secure vent connector with washers and locknuts.

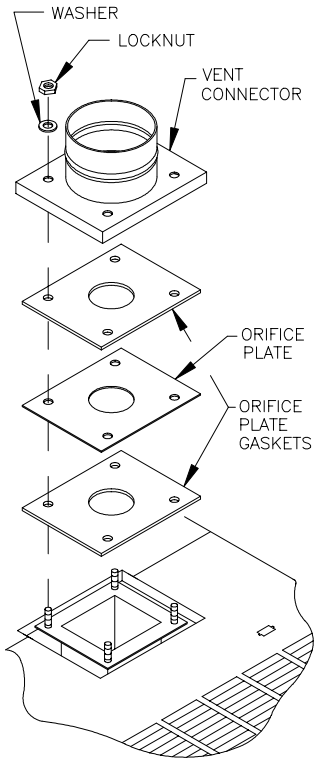


Figure 7: Vent Connector Installation

D. Install Vent Pipe, General.

1. Start at vent connector. Work toward vent terminal.
2. Use ¾ inch pipe strap to support horizontal runs, maintain vent location and slope, and prevent sags. Do not restrict thermal expansion movement. Maximum support spacing is 5 feet.
3. Provide minimum 5 inch clearance to combustible materials. Use thimble when penetrating combustible wall.
   a. 203PV and 204PV - Single wall thimble, Burnham Part No. 8116116. Other wall thimble manufacturers are American Metal Products, Hart & Cooley, and Metal Fab.
   b. 205PV and 206PV - Double wall thimble, Burnham Part No. 8116115 (accomodates 5" to 8¾" wall thickness). Another wall thimble manufacturer is Hart & Cooley.
4. Cut pipe to length using hacksaw with minimum 32 teeth per inch or circular saw with metal abrasive wheel. Remove bead end only - bell end accepts next fitting or pipe. Cut must be square with pipe. Scrape off burrs with sharp edged tool.

   Note: If remaining pipe (less bell) must be used, beaded end of mating pipe/fitting must be crimped.
5. Seal all joints using Dow Corning Silastic 732 RTV, Dow Corning Silastic 736 RTV, Polybac #500 RTV, or Sil-bond RTV 4500 (Acetoxy). Do not use other adhesives or sealants.
6. Procedure for joining pipe and fittings. See Figure 8.
   a. Clean pipe or fitting. Remove all dirt and grease.
   b. Slip locking band over pipe/fitting bell.
   c. Apply continuous ¼ inch bead of sealant around bead end of pipe/fitting no more than 1/8 inch from end.
   d. Insert pipe/fitting into bell. Smooth sealant for continuous seal around gap between bead and bell. Apply additional sealant if necessary.
   e. Slip locking band over joint and tighten. Do not secure joint with sheet metal screws or pop rivets.

E. Horizontal (Through Wall) Vent Installation.

1. Maintain minimum ¼ inch per foot slope in horizontal runs. Slope pipe down toward vent terminal.

CAUTION

Moisture and ice may form on surfaces around vent terminal. To prevent deterioration, surfaces should be in good repair (sealed, painted etc.)

2. Vent terminal location restricted per following:
   a. Minimum 12 inches above grade or normally expected snow accumulation level, or 7 feet above grade if located adjacent to public walkway. Do not install over public walkway where local experience indicates condensate or vapor from Category III appliances creates a nuisance or hazard.

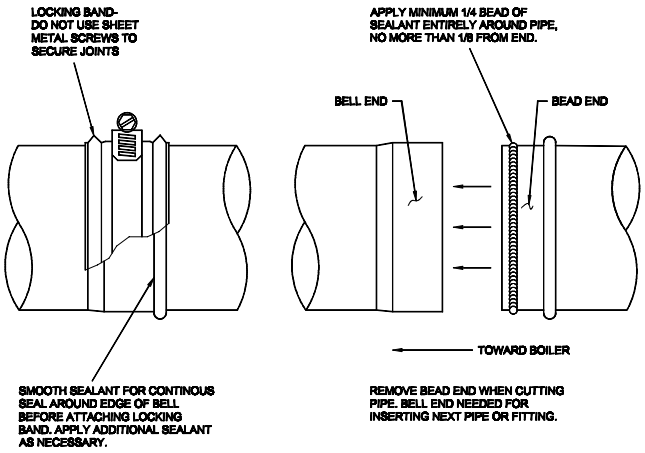


Figure 8: Typical Joint Detail

   b. Minimum 3 feet above any forced air inlet located within 10 feet.
   c. Minimum 4 foot below, 4 foot horizontally from, or 1 foot above any door, window, or gravity air inlet.
   d. Minimum 4 feet horizontally from, and in no case above or below, unless a 4-foot horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment.
   e. Minimum 12 inches from overhang or corner.
3. Use wall thimble when passing through combustible outside wall (thimble use optional for noncombustible wall). Insert thimble through wall from outside. Secure outside flange to wall with nails or screws, and seal with adhesive material. Install inside flange to inside wall, secure with nails or screws, and seal with adhesive material.
4. For noncombustible wall when thimble is not used, size opening such that bell with locking band attached cannot pass through.
5. Join vent terminal to vent pipe. Cut vent pipe to locate vent terminal 3 inches (minimum) and 6 inches (recommended) from wall when joined to inside vent piping. See Figure 9. Vent terminal clearance to vinyl wall surfaces is 6 inches.
6. Insert vent pipe through thimble/opening from outside and join to vent system. Apply sealant between vent pipe and opening/thimble to provide weathertight seal.

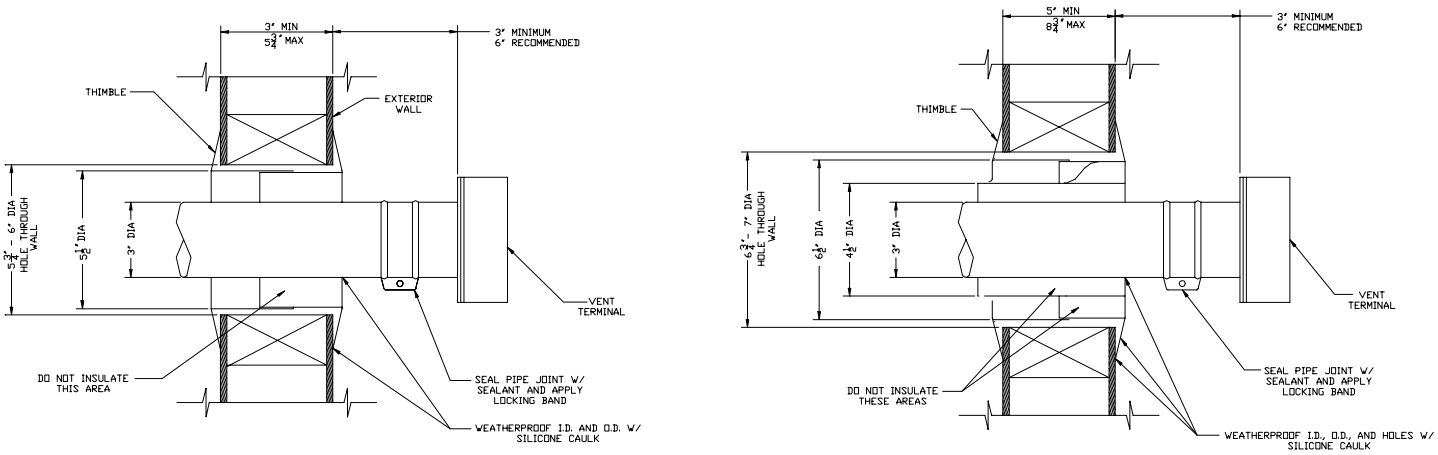


Figure 9: Recommendations for Thimble and Wall Penetration

VI. Electrical

A. General. Install wiring and ground boiler in accordance with requirements of authority having jurisdiction, or in absence of such requirements the *National Electrical Code*, ANSI/NFPA 70, and/or the CSA C22.1 Electric Code.

B. Install thermostat. Locate on inside wall approximately 4 feet above floor. Do not install on outside wall, near fireplace, or where influenced by drafts or restricted air flow, hot or cold water pipes, lighting fixtures, television, or sunlight. Allow free air movement by avoiding placement of furniture near thermostat.

C. Wire thermostat. Provide Class II circuit between thermostat and boiler. Run wires through grommet in Jacket Left Side Panel. Set thermostat heat anticipator to 0.6 amps. See Figure 10.

D. Wire boiler. Boiler is rated for 120 VAC, 60 hertz, less than 12 amperes. Provide individual branch circuit with fused disconnect. Connect to black and white wires and green ground screw. See Figure 10.

E. Alliance water heater (if used). See Figure 10. Also refer to Alliance *Installation, Operating and Service Instructions*.

1. Zoning with Circulators, Domestic Hot Water Priority. Provide DPDT relay (included with PAL). Connect coil to Alliance thermostat (prewired with PAL). Connect normally open contacts (red and white wires in PAL control harness) to transformer terminals 'R' and 'Y'. Disconnect yellow circulator wire. Connect normally closed contacts (violet wires in PAL boiler harness) to yellow relay wire and yellow circulator wire.
2. Zoning with Circulators, Nonpriority. Connect Alliance circulator zone control (or red and white wires in PAL control harness) to transformer terminals 'R' and 'Y'.
3. Zoning with Zone Valves. Connect Alliance thermostat to zone valve. Connect zone valve end switch to relay terminals 'R' and 'G'. See Paragraph F.

F. For installations using zone valves provide separate transformer for zone valve wiring. Consult zone valve manufacturer for assistance.

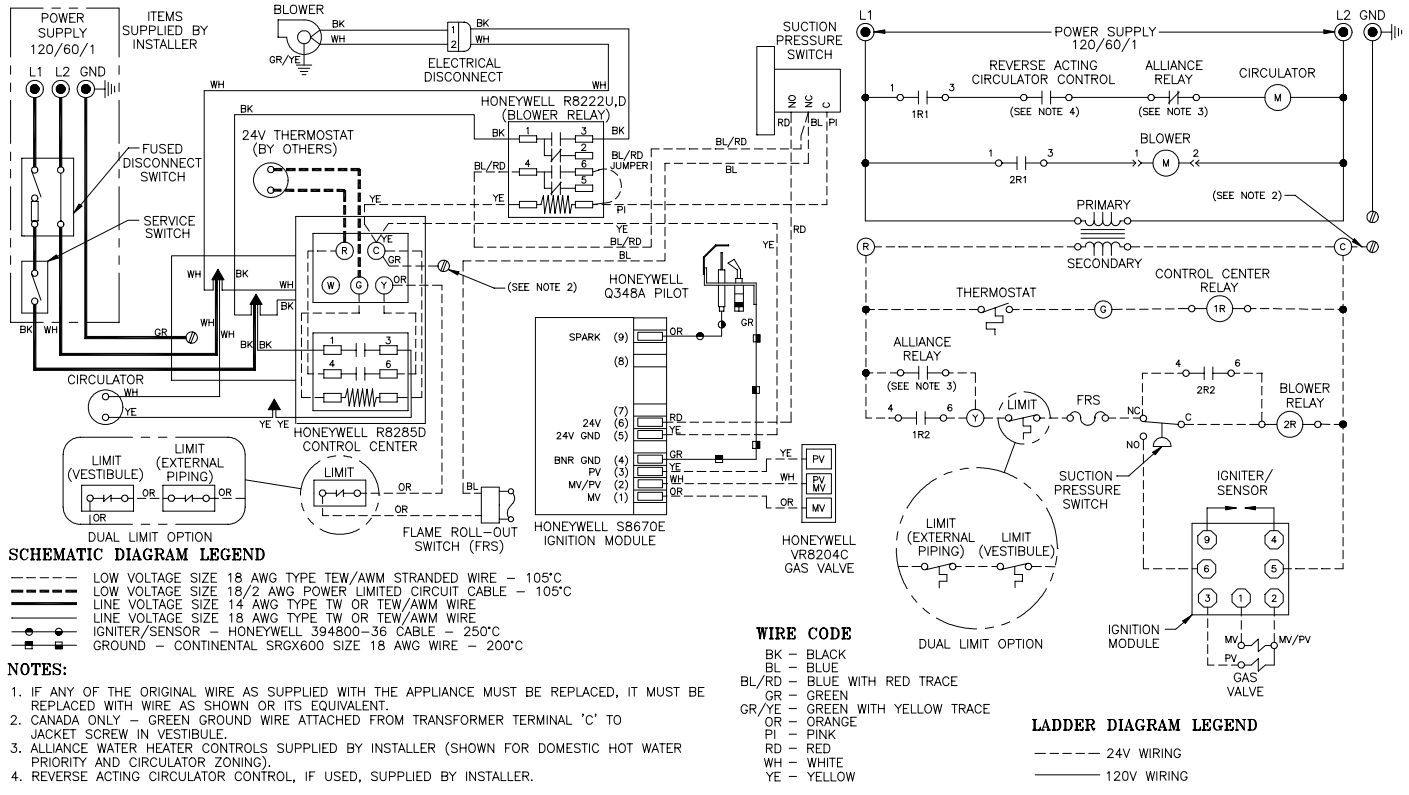


Figure 10: Wiring Diagram

VII. System Start-up

A. **Safe operation** and other performance criteria were met with gas manifold and control assembly provided on boiler when boiler underwent tests specified in *American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers,* ANSI Z21.13.

B. **Fill heating system with water** and vent air from system. Use the following procedure on a Series Loop System equipped with zone valves. See Figure 3.

1. Close isolation valve in boiler supply piping.
2. Isolate all circuits by closing zone valves or balancing valves.
3. Attach hose to bib cock located just below isolation valve in boiler supply piping. Terminate hose in five gallon bucket at a suitable floor drain or outdoor area).
4. Starting with one circuit, open zone valve.
5. Open bib cock.
6. Open fill valve. Makeup water line should be located directly above isolation valve in boiler supply piping.
7. Allow water to overflow from bucket until discharge from hose is bubble free for 30 seconds.
8. Open zone valve to second zone to be purged, then close first. Repeat this step until all zones have been purged, but always have one zone open. At completion, open all zone valves.
9. Close bib cock, continue filling system until pressure gauge reads 12 psi. Close fill valve.

   Note: If makeup water line is equipped with pressure reducing valve, system will automatically fill to 12 psi. Leave globe valve open.
10. Open isolation valve in boiler supply piping.
11. Remove hose from bib cock.

C. **Check main burners.** See Figure 11. Rear of burner must be in vertical slot in rear of burner tray. Front of burner must be seated on orifice.

Figure 11: Main Burner Installation

Figure 12: Gas Valve Pressure Tap

D. Prepare to check operation.

1. Obtain gas heating value (in Btu per cubic foot) from gas supplier.
2. Connect manometer to pressure tap on gas valve. See Figure 12.
3. For natural gas fired boiler, temporarily turn off all other gas-fired appliances.

E. Follow Operating Instructions to place boiler in operation. See Figure 17.

F. Sequence of Operation. See Figure 14. If boiler fails to operate properly, see Troubleshooting Tree on pages 17-18.

G. Check gas piping and connections between Gas Valve and Manifold, Orifices and Pilot Tubing. Use soap solution or other approved method. See Figure 13.

H. Check pilot burner flame. See Figure 15. Flame should be steady, medium hard blue enveloping 3/8 to ½ inch of sensing probe.

I. Check main burner flame. See Figure 16. Flame should have clearly defined inner cone with no yellow tipping. Orange-yellow streaks should not be confused with true yellow tipping.

Figure 14: Sequence of Operation

Figure 13: Schematic Pilot and Gas Piping

Figure 15: Pilot Burner Flame

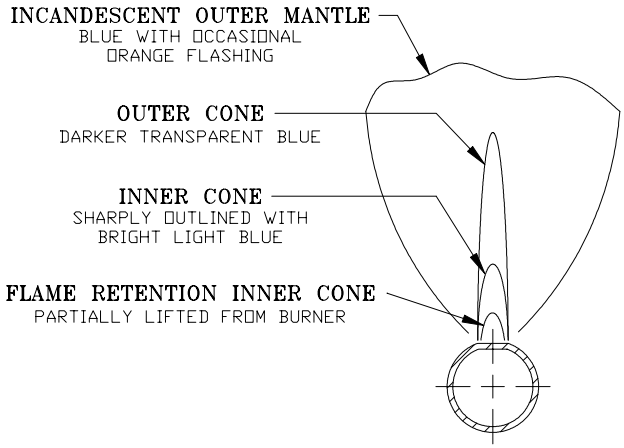


Figure 16: Main Burner Flame

J. **Check thermostat operation.** Raise and lower temperature setting to start and stop boiler operation.

K. **Check ignition control module shut-off.** Disconnect igniter/sensor cable from Terminal 9 (SPARK). Gas valve should close and pilot and main burners should extinguish.

L. **Check low water cutoff** (if used). Drain boiler water below LWCO set point. Burners should extinguish.

M. **Check limit.**

1. Adjust thermostat to highest setting.
2. Observe temperature gauge. When temperature is indicated, adjust limit to setting below observed temperature. Main burners and pilot burner should extinguish and blower stop.
3. Adjust limit to setting above observed temperature. Ignition sequence should begin.
4. Adjust thermostat to lowest setting. Adjust limit to desired setting.

N. **Adjust gas input rate to boiler (Natural Gas).**

1. Adjust thermostat to highest setting.
2. Check manifold gas pressure. Manifold pressure is listed on rating label. Adjust gas valve pressure regulator as necessary (turn adjustment screw counterclockwise to decrease manifold pressure, or clockwise to increase manifold pressure). If pressure can not be attained, check gas valve inlet pressure. If less than minimum gas supply pressure listed on rating label, contact gas supplier for assistance.
3. Clock gas meter for at least 30 seconds. Use Table 6 to determine gas flow rate in Cubic Feet per Hour.
4. Determine Input Rate. Multiply gas flow rate by gas heating value.
5. Compare measured input rate to input rate listed on rating label.

Table 6: Gas Flow Rate in Cubic Feet per Hour

Seconds for One Revolution	Size of Gas Meter Dial		
	One-Half Cu. Ft.	One Cu. Ft.	Two Cu. Ft.
30	60	120	240
32	56	113	225
34	53	106	212
36	50	100	200
38	47	95	189
40	45	90	180
42	43	86	172
44	41	82	164
46	39	78	157
48	37	75	150
50	36	72	144
52	35	69	138
54	33	67	133
56	32	64	129
58	31	62	124
60	30	60	120

   a. Boiler must not be overfired. Reduce input rate by decreasing manifold pressure. Do not reduce more than 0.3 inch w.c. If boiler is still overfired, contact your Burnham distributor or Regional Office for replacement Gas Orifice.
   b. Increase input rate if less than 98% of rating label input. Increase manifold gas pressure no more than 0.3 inch w.c. If measured input rate is still less than 98% of rated input:
      i. Remove Main Burners per procedure in Section VIII: Service.
      ii. Remove gas orifices. Drill one (1) drill size larger (drill size is stamped on orifice, or see Key No. 4D).
      iii. Reinstall gas orifices and main burners. Measure input rate.
6. Recheck Main Burner Flame.
7. Adjust thermostat to normal setting.
8. Return other gas-fired appliances to previous conditions of use.

O. Adjust gas input rate to boiler (LP/Propane).

1. Adjust thermostat to highest setting.
2. Check manifold pressure. Adjust gas valve pressure regulator to obtain 10 inches w.c. manifold

Figure 17: Operating Instructions

pressure. Adjust gas valve pressure regulator as necessary (turn adjustment screw counterclockwise to decrease manifold pressure, or clockwise to increase manifold pressure). If pressure can not be attained, check gas valve inlet pressure. If less than minimum gas supply pressure listed on rating label, contact gas supplier for assistance.

3. Recheck Main Burner Flame
4. Adjust thermostat to normal setting.

P. COMBUSTION CHAMBER BURN-OFF

1. The mineral wool combustion chamber panels contain a cornstarch based binder that must be burned out at installation to prevent odors during subsequent boiler operation.
2. Ventilate the boiler room, set the high limit to its maximum setting, set the thermostat to call for heat. Allow the boiler to fire for at least an hour or until the odor from the cornstarch has dissipated.
3. Return the high limit and thermostat to their desired settings.

Q. **Review User's Information Manual** and system operation with owner or operator.

R. **Post instructions** near boiler for reference by owner and service personnel. Maintain instructions in legible condition.

VIII. Service

A. General. Inspection and service should be conducted annually. Turn off electrical power and gas supply while conducting service or maintenance. Follow instructions TO TURN OFF GAS TO APPLIANCE. See Figure 17.

CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

B. Inspect Housekeeping. Boiler area must be clear and free from combustible materials, gasoline and other flammable vapors and liquids. Remove obstructions to the flow of combustion and ventilation air.

C. Service Low water cutoff (if so equipped). Follow instructions provided with low water cutoff

D. Inspect Vent System for obstructions in vent pipe, soot accumulation, deterioration of pipe or joints, and proper support:

1. Remove vent connector and vent pipe. See Figure 19.
2. Remove all obstructions. Check and clean vent terminal screens.
3. Remove soot accumulations with wire brush and vacuum.
4. Replace deteriorated parts.
5. Repair deteriorated joints. See Section V: Venting, Paragraph D.6.

E. Inspect Boiler Flue Passages for blockage or soot accumulation. See Figure 19.

1. Disconnect vent connector from blower discharge flange.
2. Remove sheet metal screws securing Jacket Top Panel. Lift panel and rotate about relief valve piping until top of boiler is exposed. If piping or wall prevent full rotation of top panel for access to canopy, cut slot into relief valve opening and remove top panel.
3. Disconnect blower connection from wiring harness in vestibule.
4. Remove bolts securing canopy to boiler sections. Cut silastic sealant around base of canopy, pry canopy from boiler sections and remove canopy/ blower assembly from boiler.
5. Using flashlight, examine all flue passageways.
   a. If passageways are free of soot and obstruction, replace canopy, secure and seal using kit available from Burnham Distributors, Part No. 6111716.
   b. If passageways need cleaning, remove burners as described in Paragraph F below. Using long handle wire or bristle flue brush and vacuum, brush flueways thoroughly from top of boiler as illustrated in Figure 19. Replace canopy and seal using kit available from Burnham Distributors, Part No. 6111716.

WARNING

Canopy must be resealed with RTV-732 Silicone Rubber Sealant (500 F Intermittent Duty).

6. Reinstall jacket top panel, vent pipe and vent connector in reverse manner. Reconnect electrical connector to blower.

F. Clean Main Burners and Firebox.

1. To remove burners for cleaning, changing orifice plugs, or repairs:
   a. Remove jacket Front Panel.
   b. Disconnect pilot tubing at gas valve.
   c. Disconnect igniter/sensor cable and ground wire at Ignition Module.
   d. Disconnect Flame Rollout Switch wires.
   e. Remove Burner Access Panel.
   f. Mark Pilot Main Burner location on Manifold.
   g. Hold burner on throat. Lift slightly to clear orifice. Pull burner from combustion chamber. See Figure 11. Pilot Main Burner can only be removed by lifting at 45° angle after adjacent burner to right is removed.
2. Brush top of burners with a soft bristle brush. See Figure 19. Vacuum burners.
3. Check orifices. Drilled passageways must be free of lint or dirt.
4. Vacuum tip of Pilot Burner.
5. Clean firebox by vacuuming. Exercise care not to disturb insulation inside base.
6. Install burners by reversing procedure used to remove burners. Burner with pilot assembly must be in same location as original installation. See Table 7. Burners must be properly located on

Table 7: Pilot Burner Location

Boiler Model	Main Burner with 60 Pilot Bracket *	Pilot Burner Located Between Main Burners *
203PV	1	1 & 2
204PV	2	2 & 3
205PV	3	3 & 4
206PV	4	4 & 5

* Main burners numbered left to right as viewed from front of boiler

support bracket at rear of burner. See Figure 11. Slide burner over orifice.

7. Reconnect pilot gas supply, igniter/sensor cable, and ground wire. Reinstall Burner Access Panel. Reconnect Flame Rollout Switch wires.

G. Check operation. Follow steps D through O from Section VII: System Start-up.

H. Removal or replacement of pilot assembly or pilot assembly parts. If pilot assembly, sensor or pilot orifice need replacing, remove main burner with pilot using procedure described in Paragraph F.1.

1. To replace orifice.
   a. Disconnect pilot tubing. Pilot orifices screw into Pilot Burner. Replace with Honeywell 388146NE (Natural Gas) or Honeywell 388146KP (LP/Propane).
   b. Reconnect pilot tubing and check for leaks.
2. To adjust or check spark gap between electrode and hood on Honeywell Q348A intermittent pilot. See Figure 18.
   a. Use round wire gauge to check spark gap.
   b. Spark gap should be 1/8 inch for optimum performance.
3. To replace complete pilot assembly.
   a. Remove two machine screws holding pilot burner to pilot bracket.
   b. Disconnect pilot tubing.
   c. Disconnect all other leads to pilot.
   d. Select pilot assembly with identical model number, reconnect leads and pilot tubing. Resecure to pilot bracket.
4. Reinstall main burner following procedure described in Paragraph F.

Figure 18: Spark Gap Setting

Figure 19: Flueway Cleaning

Table 8: Minimum Suction Pressure

Boiler Model	Minimum Suction Pressure
203PV	-0.50 inches w.c.
204PV	-0.50 inches w.c.
205PV	-0.80 inches w.c.
206PV	-0.80 inches w.c.

I. **Lubrication.** There are no parts requiring lubrication by service technician or owner. Circulator bearings are water lubricated. Blower motor bearings are factory sealed.

Figure 20: Procedure for Measuring Fan Suction Pressure

IX. Repair Parts

All Series 2PV Repair Parts may be obtained through your local Burnham Wholesale distributor. Should you require assistance in locating a Burnham distributor in your area, or have questions regarding the availability of Burnham products or repair parts, please contact your Burnham Regional Sales Office as listed below.

Burnham Corporation Regional Offices

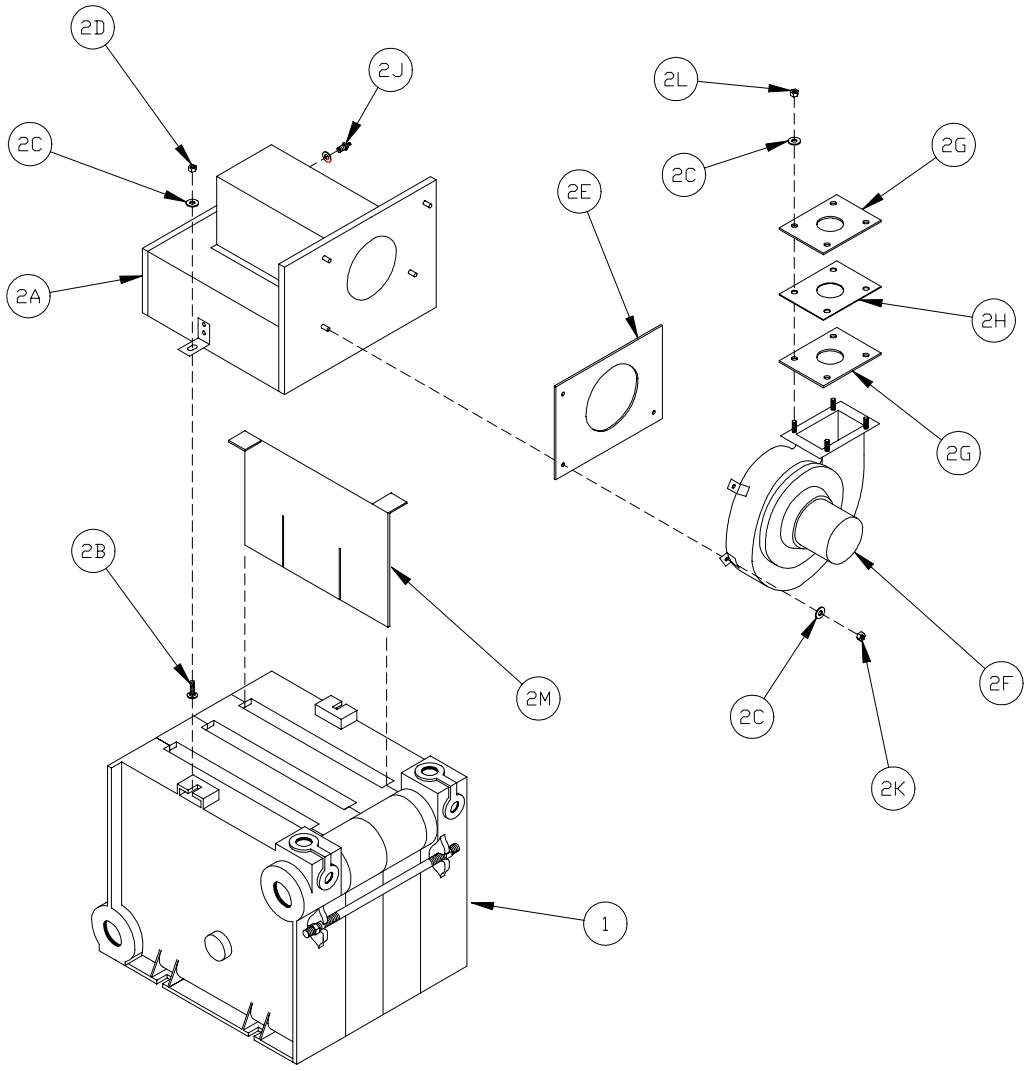
A. Burnham Corporation - Central & Western Regions P.O. Box 3079 Lancaster, PA 17604-3079 Phone: (717) 481-8400 FAX: (717) 481-8408	C. Burnham Corporation - Metropolitan Region P.O. Box 3079 Lancaster, PA 17604-3079 Phone: (717) 481-8400 FAX: (717) 481-8409
B. Burnham Sales Corporation - Northeast Region 19-27 Mystic Avenue Somerville, MA 02145 Phone: (617) 625-9735 FAX: (617) 625-9736	D. Burnham Corporation - Mid-Atlantic Region P.O. Box 3079 Lancaster, PA 17604-3079 Phone: (717) 481-8400 FAX: (717) 481-8409

Contact Regional Office Indicated for your State

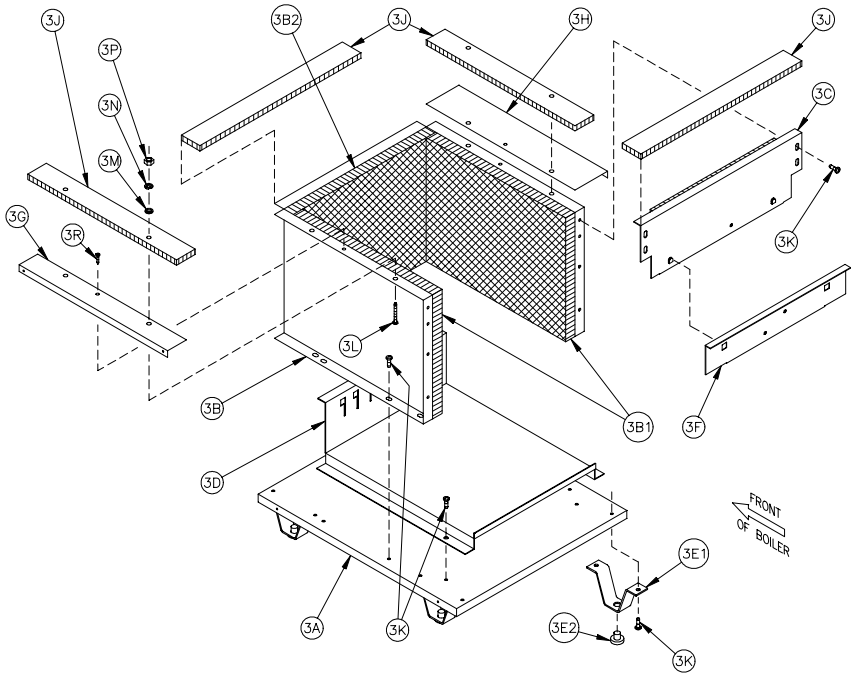
Alabama	A	Nebraska	A	Oregon	A
Alaska	A	Nevada	A	Pennsylvania	D
Arizona	A	New Hampshire	B	Rhode Island	B
Arkansas	A	New Jersey		South Carolina	A
California	A	*Atlantic, Burlington, Camden,*		South Dakota	A
Colorado	A	*Cape May, Cumberland,*	D	Tennessee	A
Connecticut	B	*Gloucester, Mercer,*		Texas	A
Delaware	D	*Monmouth, Ocean, Salem*		Utah	A
Florida	A	*Counties*		Vermont	B
Georgia	A	*All other Counties*	C	Virginia	
Hawaii	A	New Mexico	A	*Arlington,Accomack,Clarke,*	
Idaho	A	New York		*Fairfax,Frederick,Fauquier,*	D
Illinois	A	*Albany, Fulton, Montgomery,*		*Loudoun,Northampton and*	
Indiana	A	*Rensselaer, Saratoga,*	B	*Prince William Counties*	
Iowa	A	*Schenectady, Schoharie,*		*All other Counties*	A
Kansas	A	*Warren, Washington Counties*		Washington	A
Kentucky	A	*All Other Counties*	C	Washington, D.C.	D
Louisiana	A	North Carolina	A	West Virginia	D
Maine	B	North Dakota	A	Wisconsin	A
Maryland	D	Ohio		Wyoming	A
Massachusetts	B	*Athens, Belmont, Gallia,*			
Michigan	A	*Jefferson, Lawrence, Meigs,*	D		
Minnesota	A	*Monroe, and Washington*			
Mississippi	A	*Counties*			
Missouri	A	*All other Counties*	A		
Montana	A	Oklahoma	A	Canada	A

SERVICE SCHEDULE

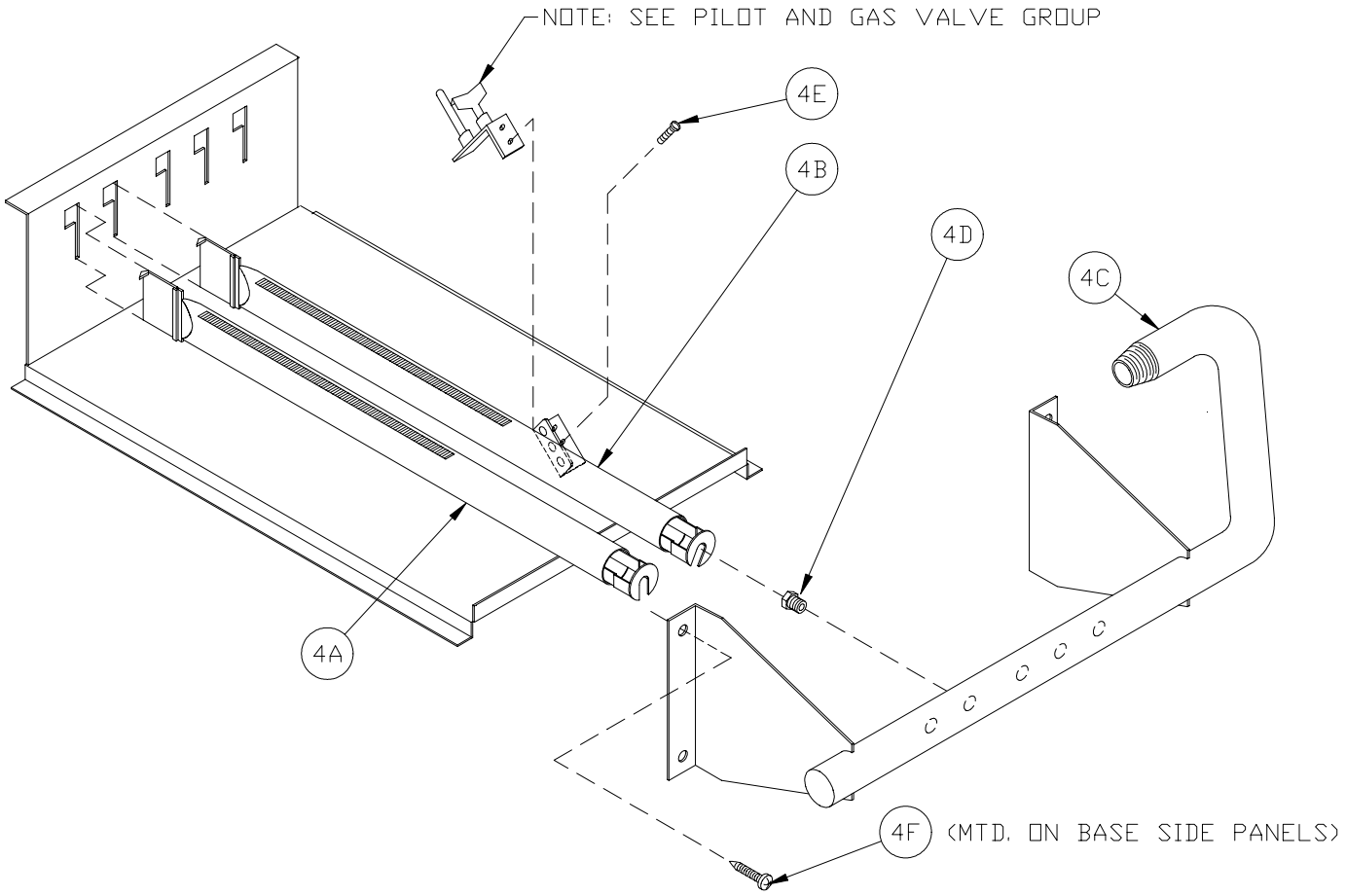
DATE	SERVICE PERFORMED



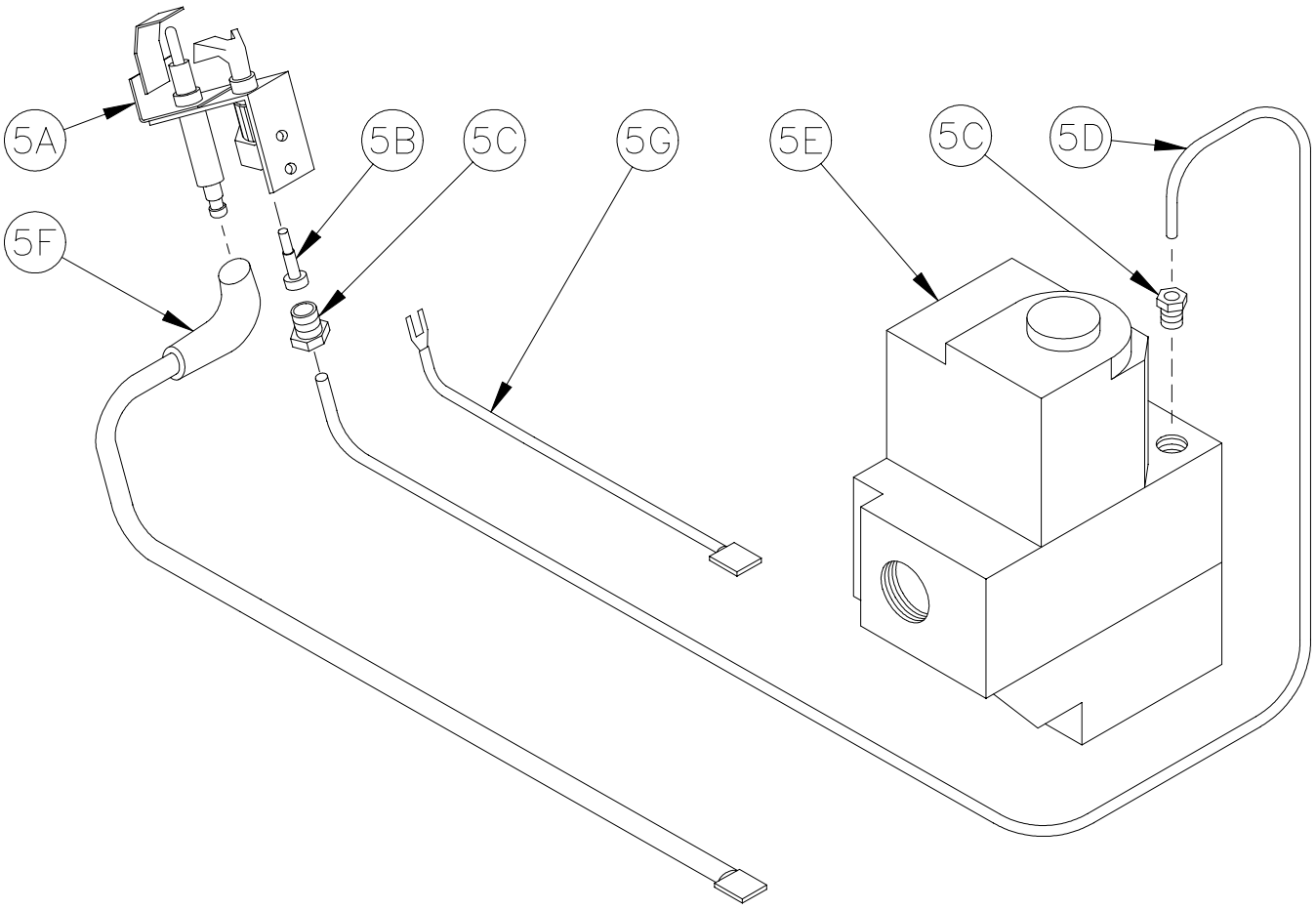
Key No.	Description	[Quantity] Part Number			
		203PV	204PV	205PV	206PV
1. Section Assembly		617170321	617170421	617170521	617170621
2. Canopy/Blower Assembly					
2A	Canopy	[1] 61117034	[1] 61117044	[1] 61117054	[1] 61117064
2B	Carriage Bolt, ...-20 x 1"	[2] Common Hardware			
2C	Washer, ..., SAE	[10] Common Hardware			
2D	Nut,...-20, Heavy Hex	[2] Common Hardware			
2E	Blower Mounting Gasket [Included in Key No. 2F]	[1] 8206048		[1] 8206049	
2F	Blower	[1] 6111714		[1] 6111715	
2G	Orifice Plate Gasket [(2) Included in Key No. 2F]	[2] 8206042		[2] 8206035	
2H	Orifice Plate	[1] 71117035	[1] 71117045	[1] 71117055	[1] 71117065
2J	Pressure Fitting, Dwyer A308	[1] 822657			
2K	Hex Nut, 1/4-20, Brass [(4) Included in Key No. 2F]	[4] 80860424			
2L	Hex Locknut, ...-20	[4] Common Hardware			
2M	Flue Baffle	Not Applicable			



Key No.	Description	[Quantity] Part Number			
		203PV	204PV	205PV	206PV
3. Base Assembly Group					
3	Base Assembly, Complete	[1] 618600391	[1] 618600491	[1] 618600591	[1] 618600691
3A	Base Tray Assembly	[1] 718600391	[1] 718600491	[1] 718600591	[1] 718600691
3B	Base Wrapper	[1] 718600311	[1] 718600411	[1] 718600511	[1] 718600611
3B1	Base End Insulation	[2] 720601			
3B2	Base Rear Insulation	[1] 72060035	[1] 72060045	[1] 72060055	[1] 72060065
3C	Base Front Panel Assembly	[1] 618600341	[1] 618600441	[1] 618600541	[1] 618600641
3D	Burner Tray	[1] 718600305	[1] 718600405	[1] 718600505	[1] 718600605
3E	Base Leg Assembly	[4] 6186001			
3E1	Base Leg	[4] 71860021			
3E2	Nylon Glide	8186006			
3F	Burner Access Panel	[1] 718600361	[1] 718600461	[1] 718600561	[1] 718600661
3G	Jacket Attachment Bracket, Left	[1] 70460011			
3H	Jacket Attachment Bracket, Right	[1] 70460012			
3J	Cerafelt Gasket, ‰" x 2" Johns-Mansville CRF-400	[1] 6206002			
3K	Screw, Self-Tapping Type F, Phillips Pan Head, ...-20 x ‰", Plated	[20] 80860700			
3L	Screw, Self Tapping, 5/16-18 x 1..."	[4] 80860717			
3M	Washer, 5/16, USS	[4] Common Hardware			
3N	Washer, Lock, USS	[4] Common Hardware			
3P	Nut, Hex, 5/16-18, Brass	[4] 80860403			
3R	Screw, Sheet Metal, Phillips Head, #8 x ‰"	[2] Common Hardware			



Key No.	Description	[Quantity] Part Number			
		203PV	204PV	205PV	206PV
4. Manifold and Main Burners					
4A	Main Burner	[2] 8236099	[4] 8236099	[6] 8236099	[8] 8236099
4B	Main Burner with 60 Pilot Bracket	[1] 8236098			
4C	Manifold	[1] 82260033	[1] 82260043	[1] 82260053	[1] 82260063
4D (Natural Gas Only)	Main Burner Orifice, #44, Orange	[3] 822712	-----	-----	-----
	Main Burner Orifice, #45, Pink	-----	[5] 822711	[7] 822711	[9] 822711
4D (LP/Propane Only)	Main Burner Orifice, #55, Green	[3] 822708	-----	-----	-----
	Main Burner Orifice, 1.25mm, Purple	-----	[5] 822705	[7] 822705	[9] 822705
4E	Screw, Machine, #10-32 x 3/16"	[2] 80860800			
4F	Screw, Self-Tapping Type F, Phillips Pan Head, 1/4-20 x 1/2", Plated	[4] 80860700			



Key No.	Description	[Quantity] Part Number			
		203PV	204PV	205PV	206PV
5. Pilot Burner and Gas Valve					
5A	Pilot Assembly, Natural Gas, Honeywell Q348A1333	[1] 8236104			
	Pilot Assembly, LP Gas, Honeywell Q348A1341	[1] 8236107			
5B	Pilot Orifice, Natural Gas Honeywell 388146NE	Included with Key No.5A			
	Pilot Orifice, LP/Propane Honeywell 388146KP				
5C	Compression Nut/Fitting, 1/8" OD x ... NPT	Included with Key No.5A and 5E			
5D	Pilot Tubing, 1/8" OD x 30"	[1] 8236110			
5E	Gas Valve, ‰ x ‰, Natural Gas, Honeywell VR8204C6000	[1] 81660176			
	Gas Valve, ‰ x ‰, LP/Propane, Honeywell VR8204C6018	[1] 81660180			
5F	Igniter/Sensor Cable, 36", Honeywell 394800-36	[1] 8236084			
5G	Ground Wire Assembly	[1] 6136054			

Key No.	Description	[Quantity] Part Number			
		203PV	204PV	205PV	206PV
6. Jacket					
6A	Jacket Wrap-A-Round Panel (1)	[1] 604170312	[1] 604170412	[1] 604170512	[1] 604170612
6B	Jacket Upper Vestibule Panel (1)	[1] 6041703221	[1] 6041704221	[1] 6041705221	[1] 6041706221
6C	Jacket Lower Vestibule Panel	[1] 6041703222	[1] 6041704222	[1] 6041705222	[1] 6041706222
6D	Jacket Top Panel (1) (2)	[1] 604170334	[1] 604170434	[1] 604170534	[1] 604170634
6E	Jacket Front Removable Door	[1] 604170344	[1] 604170444	[1] 604170544	[1] 604170644
6F	Jacket Lower Front Panel	[1] 604170313	[1] 604170413	[1] 604170513	[1] 604170613
6G	Screw, Sheet Metal, #8 x ‰"	[20] Common Hardware			
6H	Snap Bushing, Heyco SB-1093-15	[2] 8136257			
6J	Snap Bushing, Heyco SB-2000-26	[1] 8136266			
6K	Snap Bushing, Heyco SB-437-5	[1] 8136048			
6L	Burnham Logo Plate	[1] 81460107			

(1) For boilers installed in Canada, indicate 'For Canada' when ordering.
(2) For boilers installed in California, indicate 'For California' when ordering.

Key No.	Description	[Quantity] Part Number			
		203PV	204PV	205PV	206PV
7. Miscellaneous Trim and Controls					
7A	Safety Relief Valve, 30 psi, NPT, Conbraco 10-408-05	[1] 81660319			
7B	Limit, Honeywell L4080D1036	[1] 80160156			
7B1	Immersion Well, ‰ NPT	Included with 7B			
7B2	Immersion Well, NPT, Honeywell 123870A (Dual Limit Only)	[1] 80160426			
7B3	Limit Honeywell L4080B1212 (Dual Limit Only)	[1] 80160474			
7C	Transformer/Relay, Honeywell R8285D5001	[1] 80160155U			
7C1	Relay, DPST, Honeywell R8222U1006	[1] 80160096U			
7C2	Junction Box, 4" x 4" x 1‰"	[1] 8136259			
7D	Flame Rollout Switch	[1] 80160044			
7D1	Flame Rollout Switch Bracket	[1] 7186018			
7E	Suction Pressure Switch	[1] 80160180		[1] 80160181	
7E1	Silicone Tubing, 1/8" x 11"	9016001 (Specify Length)			
	Silicone Tubing, 1/8" x 12‰"				
	Silicone Tubing, 1/8" x 13-5/8"				
	Silicone Tubing, 1/8" x 15..."				
7F	Ignition Module, Honeywell S8670E1007	[1] 80160108			
7G	Temperature-Pressure Gauge	[1] 8056164U			
7H	Circulator with Gaskets, Bell & Gossett NFR-22	[1] 8056174			
	Circulator with Gaskets, Grundfos UP15-42F	[1] 8056173			
	Circulator with Gaskets, Taco 007F	[1] 8056170			
	Circulator with Gaskets, Taco 0010	[1] 8056176			
7H1	Gasket, Bell & Gossett NFR-22 (SLC-30)	[2] 806602029			
	Gasket, Grundfos 510179	[2] 806602016			
	Gasket, Taco '00' Series	[2] 806602006			
7J	Flange, 1... NPT	[2] 806602013			
7J1	Screw, Cap Hex Head, 7/16-14 x 1‰"	[4] Common Hardware			
7J2	Nut, Hex, 7/16-14	[4] Common Hardware			
7K	Drain Valve, NPT, Conbraco 31-606-02	[1] 806603011			

Key No.	Description	[Quantity] Part Number			
		203PV	204PV	205PV	206PV
8. Vent Accessory Carton		611170322		611170522	
8A	Vent Connector	[1] 8116102		[1] 8116103	
8B	Vent Terminal	[1] 8116063			
8C	Locking Band	[1] 8116101			
8D	Silicone Sealant, 3 oz. tube, Dow Corning Silastic 732 RTV, or Sil-Bond RTV 4500 (Acetoxy)	[1] 8056052			