Thermific™
Boiler

GAS-FIRED BOILER
INSTALLATION GUIDE

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A.G.A. Design Certified
Complies with ANSI Z21.13
Low-Press. Boiler

C.G.A. Approved
Complies with CAN1-3.1
Ind. & Comm. Boilers

Water heaters • warm-air heaters • boilers • heat exchangers • blenders • dryers • fractionation internals • protective linings
GUARANTEE

Patterson-Kelley Co. guarantees all materials, components and workmanship used in the construction of Thermific Hot Water Boilers to be of the highest quality. If any part should prove defective within one year from date of start-up, a new part will be supplied without charge F.O.B. East Stroudsburg, PA, provided that the boiler is started within six months from date of shipment. We further guarantee each boiler to perform at its rated capacity.

The Company makes no warranties covering deterioration or failure due to corrosion, erosion, scaling, sooting or to improper installation or operation. There are no other guarantees or any warranties, expressed or implied, of merchantability or otherwise.

FOR YOUR SAFETY

If you smell gas:
1. Open windows.
2. Don’t touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

FOR YOUR SAFETY

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

WARNING:

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

Authorized Representative:

Installation Date: ____________________________
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INTRODUCTION

The P-K Thermific Gas-Fired Boiler combines a radial premix burner with a compact, finned-tube heat exchanger to provide maximum efficiency in a minimum of space. The high-quality materials and thoroughly-tested design of the boiler should provide years of trouble-free, hot-water service, if the instructions in this manual are followed carefully.

Please read this entire manual before installing or operating the boiler. The same features which permit this boiler to achieve high-efficiency performance make it unlike most other boilers of this general size, so it is important to understand how this boiler operates.

This manual covers installation of P-K Thermific Boiler Models N-700, N-900, N-1200, N-1500, N-1700, and N-1900. The model numbers may be followed by a suffix letter in some cases to indicate special features or different options. Not all boilers and not all options are A.S.A. Design Certified or CSA Approved, check the rating plate.

While details may differ slightly, basic operation is the same for all models; determine from the purchase order if any special features apply to the boiler. Boilers may be built to operate with natural gas or liquefied petroleum gas, check rating plate for correct fuel usage and gas pressures.

The boiler is only a part of the complete heating system. This boiler may be fully operational and yet because of poor circulation, control or other operating characteristics, may not deliver heat to the desired location. Additional equipment such as temperature sensors, pumps, flow switches, balancing valves and check valves will be required for satisfactory operation of any system. Patterson-Kelley cannot be responsible for the design or operation of such systems and a qualified engineer or contractor must be consulted.

INITIAL INSPECTION

Upon receiving the boiler, inspect it for signs of shipping damage. Pay particular attention to the control panel on the top of the boiler and the components mounted on the back, which may show damage from mishandling.

The exterior cabinet must be reasonably air-tight for the burner to operate correctly. Leaks caused by dents to the sheet metal or panels out of position may cause the limit controls to show Low Air. Check to be sure that the mixer core in the top of the burner is centered and has not moved in shipment (see section on CLEANING THE BURNER for proper location).

Verify that the total number of pieces shown on the packing slip agrees with those actually received.

IMPORTANT: Note any damage or shortage on the freight bill and immediately notify the carrier. File all claims for shortage or damage with carrier.

STORAGE PRIOR TO INSTALLATION

If the boiler is not installed immediately, it must be stored in a location adequately protected from the weather, preferably indoors. If this is not possible, then it should remain in the shipping container and be covered by a tarpaulin or other waterproof covering.

NOTE: Controls and other equipment that are damaged or fail due to weather exposure are not covered by warranty.

CODES

The Thermific Boiler with standard components and many options is A.S.A. Design Certified and complies with ANSI Z21.13-1987, or latest edition, Low-Pressure Boilers. Units with a "C" suffix on the model number are CSA Approved and conform to CAN1-3.1, with latest revisions, Industrial and Commercial Boilers. The heat exchanger is constructed and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section IV for 100 psig maximum operating pressure and/or 250°F maximum operating temperature. Other codes or approvals which apply will be labeled on the boiler.

Installation of the boiler must conform to all the requirements of the local codes established by the authorities having jurisdiction or, in the absence of such requirements, in the U.S. to the National Fuel Gas Code, ANSI Z223.1-1988/NFPA 54-1988, or latest edition. In Canada, the equipment shall be installed in accordance with the current Installation Code for Gas Burning Appliances and Equipment, CAN/CGA-B149, and applicable Provincial Regulations for the class; which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

Where required by local codes, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, No. (CSD-1).

INSTALLATION PROCEDURE

FOUNDATION

Provide a firm, level foundation, preferably of concrete.

NOTE: The boiler may be installed on a combustible floor, however, the boiler must never be installed on carpeting.

PLACEMENT

The boiler must be level to function properly. To assist in leveling the boiler, the four (4) leg bolts (1/2"-13NC) holding the boiler to the shipping skid must be reinstalled in the threaded legs on the bottom. The adjustable legs are also necessary to provide adequate floor clearance and prevent distortion of the cabinet, in addition to leveling.

Adjustable Legs for Leveling and Floor Clearance

NOTE: If for any reason the boiler is not level, air pockets may be trapped in the top of the heat exchanger, which could cause premature failure.
CLEARANCES

If the boiler is to be installed near combustible surfaces, the minimum clearances shown in the accompanying table must be maintained. Failure to provide for the service access clearances, even with non-combustible surfaces, will cause future problems servicing the boiler. The boiler must be installed in a space large in comparison to the boiler for adequate air circulation.

An external electrical disconnect (not supplied with the boiler) with adequate overload protection is required. The boiler must be grounded in accordance with local codes or in the absence of such requirements, in the U.S., with National Electrical Codes, ANSI/NFPA No. 70-1987, or latest edition. In Canada, wire according to the current Canadian Electrical Code.

NOTE: It is important that proper polarity be maintained.

COMBUSTION AIR OPENINGS

The boiler room should be provided with two openings to assure adequate combustion air and proper ventilation. One opening should be 6 to 12 inches above the floor and the other 6 to 12 inches below the ceiling, preferably on opposite walls. The size of each opening is determined by whether air is taken from inside or outside the building.

If air is taken directly from outside the building, each opening should have a net free area of 1 square inch for each 4,000 Btu per hour of total boiler input, for instance, 300 square inches (2-1/12 square feet) are required for a 1,200,000 Btu per hour boiler.

When air is taken from the outdoors through a vertical duct, 1 square inch per 4,000 Btu per hour is required. If a horizontal duct is used, 1 square inch per 2,000 Btu per hour is required, i.e., 600 square inches for 1,200,000 Btu per hour input.

If air is taken from another interior space, each opening should have a net free area of 1 square inch for each 1,000 Btu per hour of boiler input (1,200 square inches for a 1,200,000 Btu per hour).

Provisions for combustion and ventilation air must be in accordance with Section 5.3, Air For Combustion and Ventilation, of the National Fuel Gas Code, ANSI Z223.1, latest edition, or applicable provisions of the local building codes.

CAUTION: Under no circumstances should the boiler room ever be under a negative pressure. Particular care should be taken when exhaust fans, compressors, air-handling units or other equipment may rob air from the boiler.

The combustion air supply must be completely free of chemical fumes, which may be corrosive when burned in the boiler. Common chemicals which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or solvents, such as freon, trichlorethylene, perchlorethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the boiler tubes, tube sheets, flue collectors and the boiler stack. The result is improper combustion and premature boiler failure.

FLUE VENTING

This boiler operates with a non-positive flue vent pressure and with a vent gas temperature at least 140°F above its dew point. These flue conditions correspond to Category I as defined in Part IV of ANSI Z21.13-1987, or latest edition. This boiler is suitable for use with Type B gas vent. As such it may also be used with Type L gas vent or an appropriately sized chimney. If local codes (CAN/CGA-B149) specifically prohibit the use of B-vent without a draft hood, the alternative is usually single wall metal pipe.
Consult your local vent supplier for correct vent sizing and structural support requirements. Vent diameter is dictated by the length and height of horizontal and vertical portions of the vent installation and the materials of construction. Correct sizing should provide a zero to slightly negative pressure (less than 0.1 inches of water column) at the boiler flue outlet with a stack temperature of 280°F.

To assist in providing suitable draft conditions, a barometric damper is supplied with each boiler, and should be installed according to the following guidelines:

1. locate a barometric damper as close as possible to each boiler as possible.
2. the damper may be located in the side of either a horizontal or vertical section of stack near each boiler, as shown in the accompanying figures.
3. in a multiple boiler installation, one barometric damper should be installed with each boiler.

Be sure that the damper hinge is mounted horizontally (never vertically). Be sure to remove all three (3) red stops from the damper before start-up. The damper door should swing freely. Follow all the instructions, provided with the barometric damper, carefully.

Important: To avoid spillage into the boiler room of dangerous flue gas, containing carbon monoxide, the opening in the damper (draft control gate) must never face against the flow of flue gas.

The minimum vent height above the flue outlet should be five (5) feet and the vent should extend at least three (3) feet above the roof, or at least two (2) feet above the highest point of any structure within ten (10) feet of the vent. The vent should be provided with a weather cap of approved design and adequate capacity.

NOTE: If the vent is erected directly behind the boiler, make sure that the weight of the vent is not supported by the boiler vent collar. The collar is not designed to support the weight of the vent. Structural support and spacing from combustible surfaces must be in accordance with the vent manufacturer's requirements.

All vent installations in the U.S. shall be in accordance with Part 7, Venting of Equipment, of the National Fuel Gas Code, ANSI Z223.1-1988, or latest edition, or applicable provisions of the local building codes. In Canada, refer to the current Installation Code for Gas Burning Appliances and Equipment, CAN/CGA-B149.

GAS PIPING

Before making the gas hook-up, make sure the boiler is being supplied with the type of fuel shown on the boiler nameplate.

The gas pressure regulator supplied with the boiler is set during a factory fire-test to provide the proper pressure to the main burner, which for natural gas is based on 7 inches W.C. inlet pressure to the regulator (11 inches W.C. for propane). The gas train components are designed to handle a maximum inlet pressure of 14 inches water column (1/2 psig). If the available gas pressure exceeds 14 inch W.C., a suitable intermediate gas pressure regulator of the "lock-up" type must be provided to reduce the pressure to less than 14 inch W.C. All boilers are designed to operate at rate with a minimum inlet pressure of 4 inches W.C. with natural gas, 7 inches W.C. with LP gas.

CAUTION: All threaded connections must be made using a pipe joint compound that is resistant to the action of liquefied petroleum gases. Do not use teflon tape on gas line threads.

NOTE: Install a sediment trap (drip leg) and a union connection ahead of the primary manual shutoff valve on the boiler. Gas piping should be installed in accordance with National Fuel Gas Code, ANSI Z223.1, latest edition, and any other local codes which may apply; in Canada see CAN/CGA-B149.

NOTE: See chart below for required pipe size, based on overall length of pipe from meter plus equivalent length of all fittings. Approximate sizing may be based on 1 cubic foot of natural gas per 1,000 Btu per hour input, i.e., 900,000 Btu per hour requires about 900 cubic feet per hour. (See Typical Boiler Operating Conditions table for more information.)

PIPE CAPACITY FOR NATURAL GAS

<table>
<thead>
<tr>
<th>Nominal Iron Pipe Size</th>
<th>Internal Diameter Inches</th>
<th>90 deg Elb 11 Feet</th>
<th>Tee Feet</th>
<th>Maximum Capacity in Cubic Feet of Natural Gas per Hour</th>
<th>Pressure Drop of 0.5 Inch Water Column</th>
<th>Equivalent Length of Pipe in Feet</th>
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</thead>
<tbody>
<tr>
<td>1-1/4</td>
<td>1.380</td>
<td>3.5</td>
<td>6.9</td>
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<td>1-1/2</td>
<td>1.610</td>
<td>4.0</td>
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<td>10900</td>
<td>10900</td>
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</table>

(continued on next page)
Gas Supply Piping by Installer

The boiler and all gas piping connections should be pressure-tested and must be checked for leaks before being placed into service. Test with compressed air or inert gas if possible.

The boiler must be disconnected at the boiler shut-off valve from the gas supply piping system during any pressure testing of the system at pressures in excess of 1/2 psig (14 inch W.C.).

The boiler should be isolated from the gas supply piping system by closing the manual shut-off valve during any pressure testing of the gas supply piping system at pressures equal to or less than 1/2 psig (14 inch W.C.).

Some leak test solutions, including soap and water, may cause corrosion. These solutions should be rinsed-off with water after testing.

GAS BLEEDS AND VENTS

The bleed vents on the diaphragm gas valves have been factory piped to terminate at the burner, as required by ANSI Z22.13. This feature provides combustion of any gas which leaks past a ruptured diaphragm during operation. Gas vents to outdoor air must be provided for the pressure regulator and gas pressure switches.

Gas Vents by Installer

NOTE: The vent line connection on the gas pressure regulator and the low gas pressure switch (and high gas pressure switch, if so equipped) must be piped to outdoor air by the installer in accordance with the National Fuel Gas Code ANSI Z223.1-1986, or latest edition, Sections 2.8.4 & 2.9.7.

BOILER INLET AND OUTLET CONNECTIONS

Make water connections as the application warrants, or at a minimum, as illustrated in BOILER WATER PIPING BY INSTALLER, but always in compliance with local requirements.

Note: Pipe unions and isolation valves must be installed in both water connections for ease of service.

The bottom connection to the boiler is the "INLET" and must be used for the return from the system.

The top connection on the boiler is the "OUTLET" and should be connected as the supply to the system.

Boiler Water Piping by Installer

To avoid possible contamination of the boiler with dirt, rust or sediment from the system, a strainer near the boiler inlet is strongly recommended. Even new systems may contain sufficient foreign material to eventually reduce the performance of the heat exchanger. Adequate circulation of good clean water is essential to maximum efficiency and long life of the boiler. (See Water Flow and Head Loss table.)

RELIEF VALVE

Each boiler is supplied with a pressure-relief valve sized in accordance with ASME requirements. The relief valve should be piped to a suitable floor drain. Reducing couplings or other restrictions are not permitted in the discharge line.

LOW WATER CUTOFF

The boiler is furnished with a flow-switch-type low water cutoff, no field piping is required. If the flow switch does not sense water flow, the boiler will shut down and a red indicator will be illuminated on the control panel.

WARNING: Never install a valve that can isolate the low water cutoff from the boiler.

Installation of an external low water cutoff or manual reset, low-water switch may be required by certain codes or in certain installations; consult factory for details.

DRAIN PIPING

The boiler is not provided with external drain connections. A drain valve should be installed near the inlet (system return) connection to the boiler and piped to a suitable floor drain. The boiler can be completely drained through the bottom header by removing the flush
plug in the bottom end plate. This plug may also be used to flush accumulated sediment from the bottom of the boiler.

**FILLING THE BOILER**

Before filling the boiler, flush the system to remove any debris. Clean and flush old piping thoroughly before installing boiler.

To be sure that the boiler is not air bound, open the pressure-relief valve located at the rear of the boiler. Leave the relief valve open until a steady flow of water is observed. Close the valve and finish filling the system.

**WATER FLOW IN SYSTEM**

Ideal operation of the Thermific Boiler would call for a 20°F degree temperature differential across the heat exchanger. The operating thermostat has an adjustable temperature differential. Water flow rates to achieve these conditions are shown in the Water Flow and Head Loss Table. Insufficient flow may result in excessive short cycling of the boiler and eventual damage or premature failure of the equipment.

In any case, Minimum Return Water Temperature should be Greater than 130°F to avoid problems of condensation on the outside of the heat exchanger or in the flue passages.

Proper flow rates and return water temperature may be achieved through a combination of primary and secondary flow loops. Multiple zones and pumps may result in different flow rates at different times. Consideration must be given to all possible conditions and their consequences.

**PIPING WITH REFRIGERATION MACHINE**

When used with a refrigeration system, the boiler shall be installed so that chilled medium is piped in parallel with the boiler. Valves should be installed to prevent chilled water from entering the boiler when the system is operated in the cooling mode.

**PIPING WITH AIR HANDLING UNITS**

The boiler piping system of a hot water heating boiler connected to heating coils located in air handling units, where they may be exposed to refrigerated air circulation, must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

**BURNER AND IGNITION SYSTEM INSPECTION**

Inspect the burners to be sure nothing was damaged or knocked loose during shipment. Make sure that the mixer core in the top of the burner is centered in the burner head. (See burner photo in section on "CLEANING THE BURNER"). Inspect the pilot line, main gas train and ignition electrodes to be sure that they were not damaged during shipment or installation. Check to see that the pilot is securely attached and that it is properly positioned to ignite the main burner.

**PRE-START CHECK LIST**

Before attempting to start the boiler, make sure the following items have been completed:

1. Flue gas from the boiler is properly vented.
2. Gas connection has been made and the line purged of air.
3. Water connections are complete, and the boiler and system have been filled and purged of air.
4. The boiler is connected to a 120 volt power source with a disconnect having adequate overload protection.
5. Combustion air openings are not obstructed in any way and have adequate capacity.
6. The boiler is placed the proper distance from any combustible walls, in accordance with the "CLEARANCES" section of this instruction manual.
7. Relief valves have been piped to floor drains.

**SAFE OPERATIONS**

Before placing boiler in operation, test ignition system safety shutoff as follows:

Disconnect at least one wire leading to a main gas valve. With the main gas cock (manual gas valve) open and the pilot gas cock open, the burner should be cycled on.

After all of the safety limits on gas pressure, water flow and temperature are satisfied, the blower will run and pre-purge the boiler. When the air flow is established the ignition transformer and pilot will operate. Both of these functions will be indicated by separate green lights on the control panel. If a satisfactory pilot is obtained, the main gas valve indicator will be illuminated, even though a main gas valve will not open with a wire disconnected and gas will not flow to the main burner. Check for a good pilot flame, then immediately close the pilot gas cock. This will quench the pilot flame, and close the the main gas valves, indicator lamp off. The pilot will try to re-light, but with the pilot cock closed the pilot cannot re-light and the flame safeguard programmer will go to a "lockout" mode, illuminating the red "FLAME FAILURE" indicator. This condition requires a manual reset of the flame safeguard.

Reconnect the wire(s) to the main gas valves.

**LOW WATER CUTOFF**

The boiler is furnished with a flow-switch-type low water cutoff in the outlet nozzle. Operation of the switch can be checked by first turning the boiler off and then turning the system pump off, stopping water flow in the
WATER FLOW AND HEAD LOSS

Design Temperature Rise Across Boiler

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<td>81</td>
<td>4</td>
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</table>

*** Not Recommended - Insufficient Flow for Good Heat Transfer

System. After turning off the pump, turn the boiler back on. It should not operate, and a red indicator for "LOW WATER" should be illuminated. Do not shut the pump off while the boiler is operating.

Perform appropriate tests on any external probe-type low water cutoff.

HIGH-LIMIT CONTROL

With the main burner operating, turn down the temperature setting on the "high-limit" thermostat until the main burner shuts off and the red "HIGH TEMP." indicator is illuminated. The high-limit switch must be manually reset after testing. This check should also be made for the "Operating Temperature" control (the green "HEAT" indicator will go out). Re-adjust thermostats to desired operating temperature and set high-limit temperature, typically 20°F above operating temperature.

![Low Gas Pressure Switch](image)

**WARNING:** After checking controls by manual re-adjustment, make sure they are always reset to their proper settings.

**NEVER** attempt to operate a boiler that has failed to pass all the safety checks outlined above. This work should be done by qualified service personnel.

GAS PRESSURE SWITCH

The boiler is furnished with a low gas pressure switch. The operation of this switch should be checked by slowly closing the main gas cock while the burner is operating. The low gas-pressure switch should shut down the main burner before combustion problems are encountered. When the gas-pressure switch opens, the "LOW GAS" indicator will illuminate. Upon re-opening the main gas cock, the "LOW GAS" indicator should remain on until the manual reset on the low gas-pressure switch is depressed. Reset the switch by pushing a pointed tool, such as a pen or screw driver, in the recessed rubber-protected hole.

![High-Limit and Operating Thermostats](image)
AIR FLOW ADJUSTMENT

Loosen the holding screw on the air shutter and open or close the shutter as required to adjust cabinet pressure, measured at the fitting on the back of the cabinet, to that shown on the "Factory Firetest" label. Re-tighten holding screw after adjustment.

If combustion measurement instrumentation is available, adjust air flow for carbon dioxide (CO₂) or oxygen (O₂) reading corresponding to 50% excess air. Excess air level for proper combustion with this burner is higher than with some other types of gas burners.

Under most circumstances, little if any change in the air adjustment is necessary, and factory setting will normally provide good combustion.

LIGHTING AND SHUT-DOWN PROCEDURES

TESTS

Safe lighting and other performance criteria were met with the gas manifold and control assembly provided on this boiler when the boiler underwent tests specified in ANSI Z221.13, latest edition, or CAN-I-3.1 in Canada (see "Factory Firetest" label inside the control panel).

STARTING SYSTEM

1. Close main and pilot gas cocks.
2. Turn electric switch to "OFF" position.
3. Wait 5 minutes.
4. Open main and pilot gas cocks.
5. Turn electric switch to "ON" position.
6. Push reset button on flame safeguard programmer control.
7. Push reset on low gas pressure switch.
8. Check to be sure that pilot has been established.

SHUT DOWN

2. Turn off electric power.

EMERGENCY SHUT OFF

Main and pilot gas cocks should be closed immediately if an emergency situation occurs, see Location of Manual Controls.

MAINTENANCE AND INSPECTION SCHEDULE

DAILY

Observe operating temperature and general conditions. Make sure that the flow of combustion and ventilating air to the boiler is not obstructed. Determine the cause of any red indicators which are illuminated or unusual noises or operating conditions and make necessary corrections. CAUTION: Check daily to be sure boiler area is free and clear of any combustible materials, including flammable vapors and liquids.

WEEKLY

Observe conditions of the pilot and main flame. A normal flame is blue with a well defined inner core. If the flame is yellow or if it pulsates, or if the burner starts with a rumble or puff, corrective action must be taken.

If flame pattern is pulsing or if flame is yellow and lifting off the burner, adjust air shutter opening until
A general glow within the combustion chamber is normal.

Correct air adjustment is essential to the efficient operation of this boiler. If an adjustment in the combustion is necessary, the flue gas composition should be checked with a carbon dioxide (CO₂) or oxygen (O₂) analyzer to set conditions for about 5% excess air.

MONTHLY (During Operation)

1. Safety relief valve. With boiler off, lift test lever. (Be sure valve closes completely after test.)
2. Test flame detection by voltage reading at the control programmer.
3. Test high-limit control by reducing setting below the operating temperature. Burner should shut off, after readjusting thermostat, press button to reset switch.
4. Test operating temperature controls by reducing or increasing temperature setting as necessary to check burner operation.
5. Check flue gas temperature at outlet. If there is a temperature increase over previous readings, this probably indicates sooting or water scale build-up.
6. Test low water cutoff by trying to restart boiler with the system pump off. The boiler should not operate.
7. Test low gas pressure switch by closing main gas cock and attempting to restart boiler.

This work should be performed by qualified maintenance personnel.

SEMI-ANNUALLY

In addition to the recommended Monthly service.

1. Inspect and clean blower fan and inlet screen of any accumulated dust or lint.
2. Clean burner of any accumulated dust or lint. See section on "CLEANING THE BURNER".
3. Inspect burner for any signs of deterioration or corrosion. Replace immediately.

The blower motor is permanently lubricated and does not require periodic lubrication.

ANNUALLY

In addition to the recommended Monthly service.

1. Check burner and clean off any soot or foreign material that may have accumulated. See section on "CLEANING THE BURNER". Check for corrosion of the burner and its parts. If there is evidence of deterioration or corrosion, replace immediately.
2. Inspect combustion chamber through access door on front side of boiler. To remove doors, pull forward slightly, then pull upward. Note any signs of deterioration. Make repairs as necessary.

CLEANING THE BURNER

1. Close pilot and main gas cocks.
2. Turn off the electric current to the boiler.
3. Remove the top cover of the boiler.
4. Disconnect the electrode wires.

SEMI-ANNUAL CLEANING

1. Remove mixer core.
2. Brush and vacuum inside of burner to remove any accumulated dust or lint build-up.
ANNUAL CLEANING

1. Disconnect the union in the line at the burner.
2. Disconnect pilot and vent line, being careful not to disturb position of pilot.
3. Loosen and remove the four burner hold-down bolts.
4. Carefully remove the burner.
5. Brush the inside and outside of screen to remove all dust.
6. Check the position of the ignition electrode: 1/8" ±1/32" spark gap. Check the tightness of the electrode clamp.
7. Check the position of the flame rod which should be 5/8" ±1/16" from the burner screen, for N-700, N-900 and N-1200 or 13/16" ±1/16", for N-1500, N-1700 and N-1900.
8. Before re-installing the burner, check the cleanliness of the exchanger and the condition of the firebox floor.

REMOVING THE EXCHANGER

1. Remove the burner as above.
2. Remove the front doors by pulling forward and upward.
3. Remove the top panel of the inner cabinet.
4. Close the isolation valves to the system.
5. Drain the boiler.
6. Disconnect the supply and return lines.
7. Remove the pipe cross containing the temperature-pressure indicator and relief valve along with the tee containing the water flow switch.
8. Remove the nuts and bolts from the flanges of the inlet and outlet nozzles at the rear of the outer casing.
9. Remove the exchanger and clean the fins.

Note: the inner and outer cabinets are separate parts and re-assembly is easier if they are separated slightly as the heat exchanger is re-installed. When re-assembling, reseal the top of inner cabinet with aluminum tape as needed.

AFTER ALL REPAIRS OR MAINTENANCE

1. Follow "PRE-START CHECK LIST" in the "INSTALLATION GUIDE".
2. Check gas pressure and adjust gas flow if necessary (see "GAS PRESSURE ADJUSTMENT").
3. Check air pressure and adjust air flow if necessary (see "AIR FLOW ADJUSTMENT").

SEQUENCE OF OPERATION

Status (red and green) indicators located on the front of the control panel of this boiler are specifically designed to indicate the sequence of operations and the cause of common problems. Careful observation of indicators should provide a guide to most operational conditions and problems.

1. When the On/Off (main power) switch is turned on, a green indicator marked "POWER" is illuminated. Power is applied through a series of normally closed limit switches, including water flow, gas pressure and high temperature, and through the operating temperature control to the flame-safeguard programmer.
2. The water flow limit switch is closed when there is adequate water flow through the boiler.
3. When adequate gas pressure is available, the low gas-pressure limit switch is closed. Manual reset is required following conditions resulting in low gas pressure.
4. If the temperature sensed by the high-limit temperature control is below the set limit, the normally closed position of the switch sends power to the operating temperature control. Manual reset is required following conditions exceeding high-temperature limit. Water flow, low gas and high temperature complete the limit series, unless an external control is placed ahead of the water flow limit, by replacing the red jumper wire.
5. When heat is required, as indicated by outlet water temperature, power is applied to Terminal 7 of the programmer, which initiates the burner ignition and operation sequence, and to an indicator marked "HEAT".
6. The programmer first energizes Terminal 8 which supplies power to the definite purpose contactor for the blower motor and the air flow switch, which initially shows low air flow with the "LOW AIR" indicator. This indicator will remain on until sufficient air flow is sensed.
7. A total time delay of about 10 seconds (30 seconds for I.R.I design) occurs between the time the blower starts and the programmer signals a continuation of the start sequence. During this time period the combustion chamber is purged to eliminate any residual combustible gas or combustion products.
8. A 10-second "trial-for-ignition" period is initiated with both Terminals 4 and 3 being energized.

Terminal 4 of the programmer powers the ignition transformer and the "IGNITE" indicator. The transformer output creates a spark at the igniter.

Terminal 3 powers the pilot gas valve through the normally closed contacts of a time delay relay and the indicator for "PILOT".
9. When a pilot flame is detected by the flame rod, a signal is sent to Terminal S2 in the programmer.
10. With flame recognition, Terminal 5 of the programmer is energized, which opens both main gas valves and illuminates the indicator for "MAIN GAS".

At the same time Terminal 5 is energized, Terminal 4 is de-energized to shut off the spark ignition.
Terminal 5 also initiates the time delay for the pilot interrupt relay. After a 10-second delay, the relay switches and de-energizes both the pilot valve and the "PILOT" indicator.
11. When the desired water temperature is reached, the operating control switch opens and the programmer is de-energized at Terminal 7 and the indicator for "HEAT" is turned off. This action also de-energizes Terminal 5, thus closing both main gas valves and turning off the indicator for "MAIN GAS".
12. When the water temperature is reduced by the load on the system, the operating control switch will close again. The operating sequence will recycle to step 5, provided the limits on water flow, gas pressure and high temperature are all met.
PROBLEMS

LOSS OF POWER

In the event of a power failure (or when the On/Off switch in the Off position), the "POWER" indicator is not illuminated and the entire system is de-energized, closing all automatic valves and halting all boiler operations. When power is restored the sequence of operation will resume at Step 5, provided all of the limits are satisfied.

LOSS OF WATER FLOW

When the "LOW WATER" indicator is illuminated, there is insufficient water flow to close the switch and power to the programmer is interrupted. When water flow is re-established, the sequence returns to Step 5, provided other limits are satisfied.

LOW GAS PRESSURE

When the "LOW GAS" indicator is illuminated, there is (or has been) insufficient gas pressure available for safe and proper operation of the boiler, and power to the programmer is interrupted. If a gas-supply, shut-off valve is closed for any reason, a Low gas condition will result.

When gas pressure is restored, the "LOW GAS" indicator will remain on and the boiler will remain locked out until the low gas pressure switch is manually reset.

On certain boilers equipped with a high gas pressure switch, the "LOW GAS" indicator also may be illuminated to indicate high gas pressure.

HIGH WATER TEMPERATURE

When the "HIGH TEMP." indicator is illuminated, the boiler water has exceeded both the operating and high-limit temperature; power to the programmer is interrupted. When the water temperature returns below the high-limit temperature, the boiler will remain locked out until the switch is manually reset. Once the switch is reset, the sequence returns to Step 5 to await heat demand below the operating temperature, provided other limits are satisfied.

IGNITION FAILURE

In the event the pilot flame is not detected by the flame rod during the 10 second trial-for-ignition period (Step 6), the pilot gas valve and spark ignition are de-energized. At this time a safety lockout occurs which de-energizes all outputs from the programmer except Terminal A, which is connected to a "FLAME FAILURE" indicator. A manual reset (located on the front of the control panel) is required when a safety lockout occurs.

FLAME FAILURE

In the event of a flame failure during a firing period, the main fuel valves are de-energized and the programmer immediately returns to Step 8 to try to relight the main flame (lock-out occurs with I.R.I. design, no trial for re-start). After the spark ignition is re-energized and the pilot valve reopened, the 10 second trial-for-ignition begins again. If flame failure occurs during a trial-for-ignition, a safety lock-out occurs (see Ignition Failure). If flame failure occurs and the indicator is illuminated, the programmer must be manually reset.

Because of special requirements for IRI (Industrial Risk Insurers) and some local codes, the boiler may be supplied with a Fireye, Model TPM-3, programmer which will not recycle after either pilot or main flame failure during a firing period. If flame failure occurs and the indicator is illuminated, the controller must be manually reset.

TYPICAL* BOILER OPERATING CONDITIONS

| Model Number | Input Rating [Btu/hr] | Natural Gas | | | LP Gas | | | | |
|--------------|------------------------|-------------|-------------|-------------|------------------------|-------------|-------------|-------------|
| N-700        | 700,000                | 680         | 1.7         | 595,000     | 280         | 4.2         | 609,000     | 8           |
| N-900        | 900,000                | 874         | 1.7         | 765,000     | 360         | 4.5         | 783,000     | 8           |
| N-1200       | 1,200,000              | 1165        | 2.6         | 1,020,000   | 480         | 5.0         | 1,044,000   | 9           |
| N-1500       | 1,500,000              | 1456        | 2.8         | 1,275,000   | 600         | 4.2         | 1,305,000   | 12          |
| N-1700       | 1,700,000              | 1650        | 2.8         | 1,445,000   | 680         | 4.2         | 1,479,000   | 12          |
| N-1900       | 1,900,000              | 1845        | 2.7         | 1,615,000   | 760         | 4.0         | 1,653,000   | 12          |

Refer to Rating Plate on Boiler for Specific Information and Certification or Approval Agencies

* Manifold Pressure is measured at the test opening in the elbow where the main gas pipe enters the back of the boiler. See "Factory Firetest" label for exact pressures recommended for the firing rate.
Note: If any of the original wire as supplied with the appliance must be replaced. It must be replaced with type MTW (90°C) wire or its equivalent.
BOILER PARTS LIST

Main Assembly

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<tr>
<th>No.</th>
<th>Part</th>
<th>Prefix No.</th>
<th>N-700</th>
<th>N-900</th>
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CP Control Panel (see Page 18)
EC Exterior Cabinet (see Page 20)
IC Interior Cabinet (see Page 20)
PG Pilot Gas Train (see Page 19)
MG Main Gas Train (see Page 19)

Identify Part No. by Prefix plus Model No. Suffix
i.e., Burner Assembly for N-1500 Part No.: XX-XXXX-XXXX

Replacement parts are available from your P-K Thermific representative or
Patterson-Kelley, East Stroudsburg, PA 18301 Phone No. (717) 421-7500 Fax No. (717) 421-8735

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BOILER PARTS LIST (cont.)

Control Panel Components

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Identify Part No. by Prefix plus Model No. Suffix
i.e., Pilot Time Delay Relay  Part No.: 86-6520-0420

Replacement parts are available from your P-K Thermific representative or
Patterson-Kelley, East Stroudsburg, PA 18301  Phone No. (717) 421-7500  Fax No. (717) 421-8735
BOILER PARTS LIST (cont.)

Gas Train Components

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Identify Part No. by Prefix plus Model No. Suffix
i.e., Main Gas Valve for N-1200 Part No.: XX-XXXX-XXXX

Replacement parts are available from your P-K Thermific representative or
Patterson-Kelley, East Stroudsburg, PA 18301 Phone No. (717) 421-7500 Fax No. (717) 421-8735

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BOILER PARTS LIST (cont.)

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Identify Part No. by Prefix plus Model No. Suffix
i.e., Combustion Chamber, Assy. for N-1200 Part No.: 86-1600-0120

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