



THERMIFIC[®] **GAS-FIRED BOILER**



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



ASME Code, Section IV
Certified by Patterson-Kelley



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

INSTALLATION DATE: _____



Patterson-Kelley
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INSTALLATION
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MANUAL

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INSTALLATION

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

What to do if you smell gas:

- Do not try to light any appliance.
- Do not touch any electrical switch.
- Do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier call the fire department.

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

Patterson-Kelley guarantees all materials, components and workmanship used in the construction of P-K Thermific Hot Water Boilers to be of the highest quality. If any part should prove defective within one year from the 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 the 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 improper installation or operation. There are no other guarantees or any warranties, expressed or implied, of merchantability or otherwise.

All P-K Thermific boilers must be started up and serviced by factory-authorized personnel.

[illegible]



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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.

INTRODUCTION

The **P-K Thermific Gas-Fired Boiler** combines a radial pre-mix fan-assisted 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.

This manual covers installation of P-K Thermific Boiler Models N-700, (N,D)-900, (N,D)-1200, (N,D)-1500-2, N-1700-2 and (N,D)-1900-2. The model numbers may be followed by a suffix letter in some cases to indicate special features or different options.

While details may differ slightly, basic operation is the same for all models. Boilers may be built to operate with natural gas or liquified petroleum gas. Check the 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 burner is centered and has not moved in shipment (see the section on **Cleaning the Burner** for proper location, page 12).

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 the 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 **P-K Thermific Boiler** with standard components and many options is A.G.A. Design Certified and complies with ANSI Z21.13, latest edition, Low-Pressure Boilers. Units with a "C" suffix on the model number are CGA 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 160 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/NFPA 54, 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 (ASME CSD-1).

INSTALLATION MANUAL

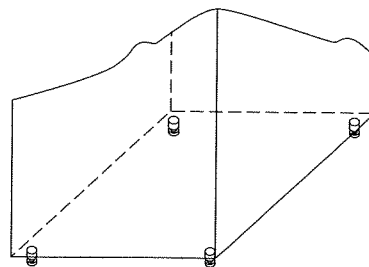
Foundation

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

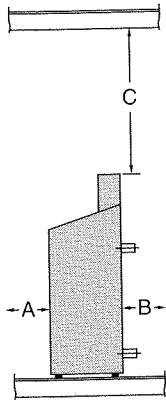
The boiler must be level to function properly. To assist in leveling the boiler, the four (4) leg bolts (1/2"-13NC) holding the boiler to the shipping skid must be reinstalled in the threaded legs on the bottom. The adjustable legs are also necessary to provide adequate floor clearance and prevent distortion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



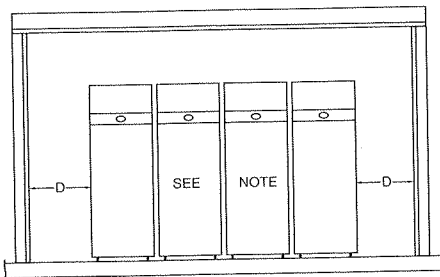
Adjustable Legs for Leveling and Floor Clearance

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 table below 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 as described in Section 6.3 of the National Fuel Gas Code, ANSI Z223.1, latest edition.



Minimum Clearances from Adjacent Walls and Ceiling

Type of Surface	Dimensions			
	A	B	C†	D
Combustible Surfaces	30	24*	24	24
Non-Combustible Surfaces	30	24*	24	24**

† "C" dimension includes clearance to remove the burner.

* A.G.A. minimum. Actual clearance depends upon stacking requirements.

** Service access need be only on one side of a boiler or row of boilers. Boilers may be installed immediately adjacent to each other. However, P-K recommends, when possible, that service access space be provided between each boiler.

In Canada: The boilers are approved for installation with zero clearance to combustible surfaces, but 48 inch service clearances are recommended.

Electrical Connections

The boiler is wired for 120 volts, single phase, 60 hertz. The total operating amperage is indicated on the rating nameplate. The N-700 and (N,D)-900 models require less than 8 amps; the (N,D)-1200 less than 9 amps; the (N,D)-1500-2, N-1700-2 and (N,D)-1900-2 less than 12 amps. Before starting the boiler, check to insure that the proper voltage and amperage is connected to the boiler.

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 latest edition and in Canada, wire according to the current Canadian Electrical Code.

Note: A dedicated earth ground (green wire) is required to avoid nuisance shutdowns. Do not ground through the conduit. It is also important that proper polarity be maintained.

Combustion Air

Combustion air must be free from dust, lint, etc. The presence of such materials in the air supplied to the burner could cause nuisance "Low Air" shutdowns or premature burner failure. The boiler should not be operated during construction while the possibility of drywall dust, demolition dust, etc. exists.

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. Please see the back of the manual for Canadian requirements.

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 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 1,200,000 Btu per hour input.

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).

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

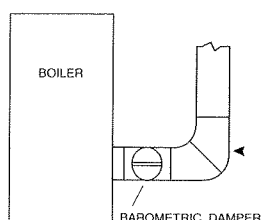
For boilers connected to gas vents or chimneys, vent installations shall be in accordance with Part 7, Venting of Equipment, of the National Fuel Gas Code, ANSI Z223.1, or applicable provisions of the local building codes.

This boiler is certified as Category I as it is defined in ANSI Z21.13, latest edition. This boiler is suitable for use with Type "B" vent. It is certified for use with a Type "B" vent by the Canadian Gas Association (C.G.A.).

The venting system and the horizontal portions of the venting system shall be supported to prevent sagging.

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 slightly negative pressure (less than 0.1 inches of water column) at the boiler flue outlet with a stack temperature of 280°F.

Note: The turn from horizontal to vertical shown should be made with (2) 45° Ells or with (1) long radius 90° Ell for best operation.



IMPORTANT
SEE NOTE
ABOVE

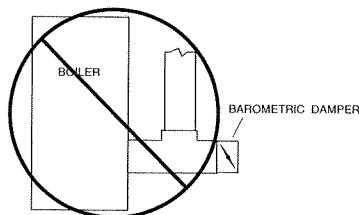
This boiler is certified for operation without a barometric damper. However, some venting installations may require a barometric damper for smooth operation. A barometric damper is supplied with each boiler, and when used, should be installed according to the following guidelines:

Barometric Damper Location

1. We recommend that the barometric damper is located immediately after the flue connector for best operation. Consult vent supplier for specific installation requirements.
2. The damper may be located in either side of the horizontal section of stack.
3. In a multiple boiler installation, one barometric damper must be installed with **each boiler**.

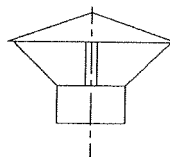
Be sure that the damper hinge is mounted horizontally (**never vertically**). Be sure to remove all three red stops from the damper **before start-up**. The damper door should swing freely. Carefully follow all the instructions provided with the barometric damper.

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.

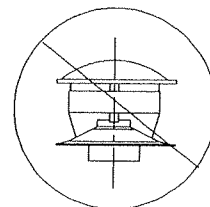


The connection from the boiler to the vent should be as direct as possible and the upward slope of any horizontal breeching should be at least 1/4 inch per linear foot. This boiler should not be connected into any portion of a mechanical draft system operating under positive pressure. Provisions must be made for supports to prevent contact of the vent with combustible surfaces.

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 part 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.



Typical Correct



Typical Incorrect

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.

Instructions for removing an existing boiler from a common venting system...

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 appliances remaining connected to it.

At the time of removal of an existing boiler, while the other appliances remaining connected to the common venting system are not in operation, the following steps should be followed with each appliance remaining connected to the common venting system placed in operation:

- Seal any unused openings in the common venting system.
- Visually inspect the venting system for proper size and horizontal pitch and determine that there is no blockage or restriction, leakage, corrosion or other deficiency which could cause an unsafe condition.
- 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 appliances 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.
- Place the appliance being inspected in operation. Follow the lighting instructions. Adjust the thermostat so that the appliance will operate continuously.
- Test for spillage at the draft hood 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.

- 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.

Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, 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 11 in the National Fuel Gas Code, ANSI Z223.1.

Gas Piping

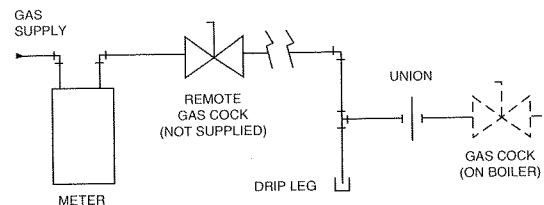
Before making the gas hook-up, make sure the boiler is being supplied with the type of fuel shown on the boiler nameplate.

The boiler shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, control replacement, etc.)

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.

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 on page 14 for more information.)



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

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.

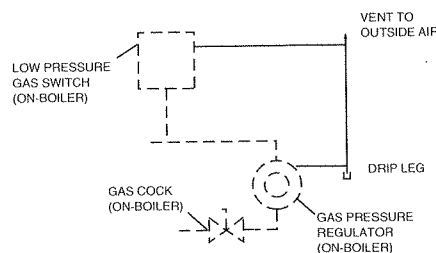
The boiler must be **disconnected** at the boiler manual shut-off valve (located at the end of the supplied gas train) from the gas supply piping system during any pressure testing of the system at pressures in excess of 1/2 psig (14 inch W.C.).

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

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 Z21.13. 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 main pressure regulator and gas pressure switches. The pilot regulator is equipped with a vent limiting device and does not require external venting!



* When installing per ASME CSD-1, disconnect factory-piped bleed vents and vent the diaphragm gas valves to outdoor air (field piping).

PIPE CAPACITY FOR NATURAL GAS

Nominal Iron Pipe Size (Inches)	Internal Diameter (Inches)	Equivalent Pipe Length		Maximum Capacity in Cubic Feet of Natural Gas per Hour Pressure Drop of 0.5 Inch Water Column/Equivalent Length of Pipe (Feet)						
		90° Ell (Feet)	Tee (Feet)	20	40	60	80	100	150	200
1-1/4	1.380	3.5	6.9	950	-	-	-	-	-	-
1-1/2	1.610	4.0	8.0	1460	990	810	-	-	-	-
2	2.067	5.2	10.3	2750	1900	1520	1300	1150	950	800
2-1/2	2.469	6.2	12.3	4350	3000	2400	2050	1850	1500	1280
3	3.068	7.7	15.3	7700	5300	4300	3700	3250	2650	2280
4	4.026	10.1	20.2	15800	10900	8800	7500	6700	5500	4600

Gas Vents by Installer

Note: Provide a drip leg, as shown, in the vent line. All vent lines should be pitched up at all times to prevent building a trap into the vent line.

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, latest edition, Sections 2.8.4 and 2.9.7. If an N.O. vent valve is provided, it must be vented separately.

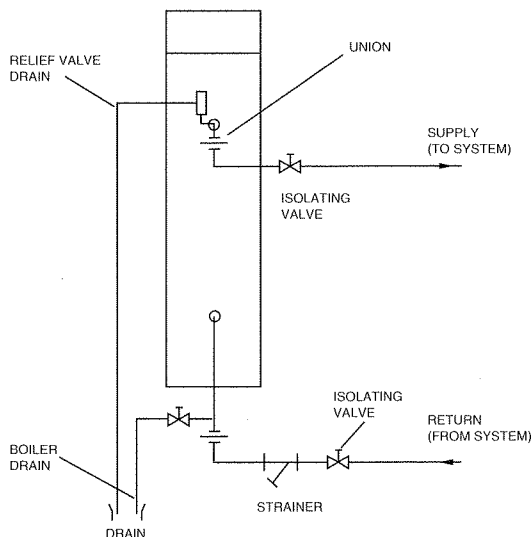
Boiler Inlet and Outlet Connections

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

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 the 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 the debris. Clean and flush old piping thoroughly before installing the boiler.

Under no circumstances should the hydronic system be flushed while the boiler is attached to the system since the debris or corrosion products could accumulate in the boiler and plug the boiler heat exchanger.

If the piping system attached to this unit will be chemically cleaned, the boiler must be disconnected from the system and a bypass installed so that the chemical cleaning solution does not circulate through the 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 P-K Thermific Boiler would call for a 20°F temperature differential across the heat exchanger. The operating thermostat has an adjustable temperature differential. 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

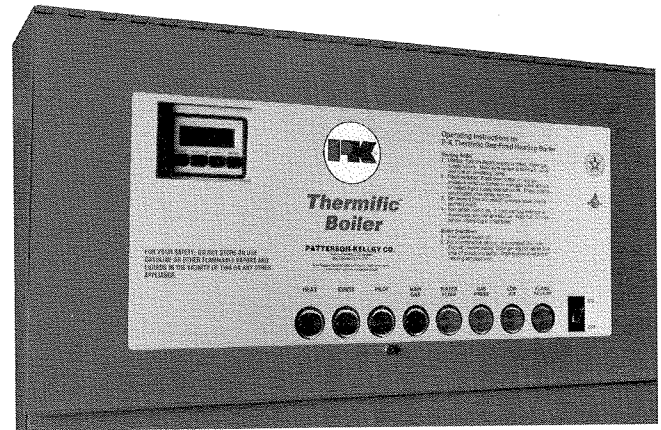
The boiler piping system of a hot water heating boiler connected to heating coils located in air handling units, where they may be exposed to refrigerated air circulation, must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the 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**” on page 12). Inspect the pilot line, main gas train and ignition electrodes to be sure 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.

Control Panel Front

Become familiar with the basic operation of the boiler. The front of the control panel shows **Operating Instructions** and a series of illuminated green and amber (operating) and red (problem) indicators. The illuminated letters indicate the condition of the boiler.



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 & Owner’s Manual.
7. Relief valves have been piped to floor drains.

SAFETY CHECKS

Ignition Safety System

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

Disconnect wire #26 (On/Off) or #17 (Lo Hi Lo) at the terminal block. With the main gas cock (manual gas valve) open and the pilot gas cock open, the burner should be cycled on.

After all the safety limits on gas pressure, water flow and temperature **are satisfied**, the blower will run and pre-purge the boiler. When air flow is established, the ignition transformer and pilot will operate. Both functions will be indicated by separate green lights on the control panel. If a satisfactory pilot is established, the green “ignite” light will extinguish and the pilot will remain on, alone, for 10 seconds. After 10 seconds, the green “Main Gas” light will go on (the main gas valve will not open with the wire disconnected and gas cannot flow to the burner). The “Pilot” will remain on, along with the “Main Gas”, for another 10 seconds and then go out. Since the main flame cannot be burning, at this point there will be no flame signal and the flame safeguard programmer will assume a “Flame Failure” and will either re-cycle through the complete pre-purge and ignition cycle or, if insurance or local codes require, go to a “lockout” mode. Lockout will require manual reset of the flame safeguard.

After completing this test, turn off the boiler and reconnect the wire to the main gas valve.

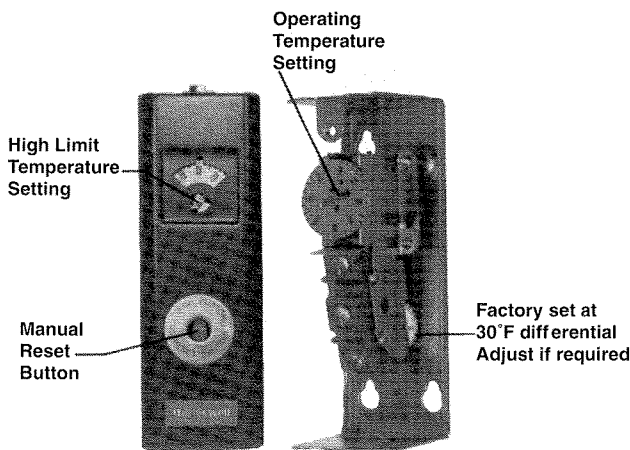
Low Water Cutoff

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 system. After turning off the pump, turn the boiler back on. It should **not** operate, and a red indicator for "Low Water" or "Water Flow" 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. 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) (see next section for Lo Hi Lo units). Readjust thermostats to desired operating temperature and set high-limit temperature, typically 20°F above operating temperature.



High-Limit and Operating Thermostats

Operating Temperature Controller for

Lo Hi Lo Thermifics

The two stages of this boiler are operated by programming each set point and differential into the controller. The boiler will be turned on at set point 1 minus its differential and turned off at set point 1. The Hi fire operation of the boiler will be energized at set point 2 minus its differential and de-energized at set point 2.

Example:

Set point 1 at 180°F with a 2°F differential, and
Set point 2 at 170°F with a 2°F differential.

NOTE: The set points should be adjusted for system requirements.

In this example, the boiler would operate as follows:

Stage 1 energized (Boiler/Low fire turned on) at 178°F.
Stage 1 de-energized (Boiler turned off) at 180°F.
Stage 2 energized (Hi fire on) at 168°F.
Stage 2 de-energized (Hi fire off/Low fire on) at 170°F.

The following formulas will ensure proper programming of the controller:

Boiler off at _____ °F (Ta)

Low fire on at _____ °F (Tb)

Hi fire on at _____ °F (Tc)

(Note: Tb must be between Ta and Tc)

Differential 1 (Td1) = Ta - Tb; _____ - _____ =
(Td1)

Differential 2 (Td2) = Tb - Tc; _____ - _____ =
(Td2)

Programming Worksheet

Stage 1:

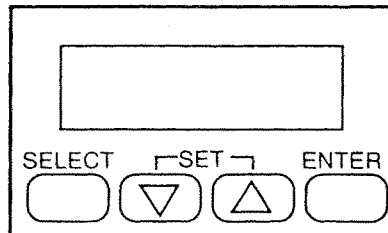
SetPt 1: _____ (Ta) On at _____ (Tb)

Diff 1: _____ (Td1) Off at _____ (Ta)

Stage 2:

SetPt 2: _____ (Tb) On at _____ (Tc)

Diff 2: _____ (Td2) Off at _____ (Tb)



Programming Operating Thermostat

For Lo Hi Lo Units

How to reset operating temperature controller:

1. Turn the boiler **ON**. The controller will begin counting down from 210. This countdown sequence will last for approximately 3-1/2 minutes.
2. To override this time delay, press **Select**.
3. Press **Select** to display the current stage set point.
4. Press **Up Arrow** to increase or **Down Arrow** to decrease to the desired set point.
5. Press **Enter** to enter the displayed value into memory (you must press enter to save each value into the controller).
6. Press **Select** to display the current stage switching differential.
7. Press **Up Arrow** to increase or **Down Arrow** to decrease to the desired switching differential.
8. Press **Enter** to enter the displayed value into memory (you must press enter to save each value into the controller).
9. Repeat steps 3 thru 8 to program stage 2.
10. Press **Select Select** (2 times) to return to stage 1 parameters. Scroll through the programming loop a second time to confirm that the appropriate values have been entered into memory by pressing **Select**.

NOTE: The control values programmed into memory will not be lost because of a power failure.

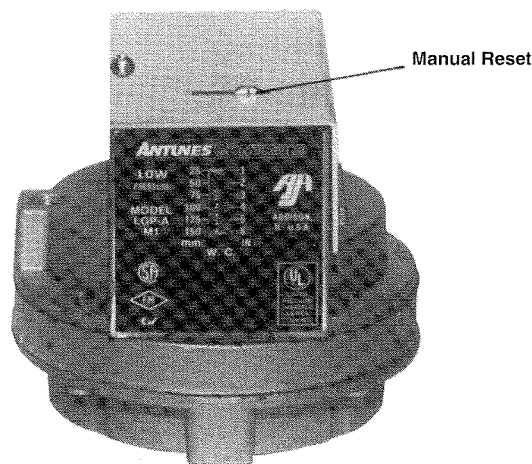
IMPORTANT - After initial programming, altering the set point for stage 1 up or down will result in a change in set point 2 by the same number of degrees and in the same direction. If increasing or decreasing the set point for stage 1 results in exceeding the control limits (-40° to +220°F) for stage 2, the control will not allow the user to enter a value for stage 1 higher or lower than this limit.

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” or “Gas Press” indicator will illuminate. Upon re-opening the main gas cock, the “Low Gas” or “Gas Press” indicator should remain on until the low gas-pressure switch is reset.

Warning: After checking controls by manual readjustment, 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.



Low Gas Pressure Switch

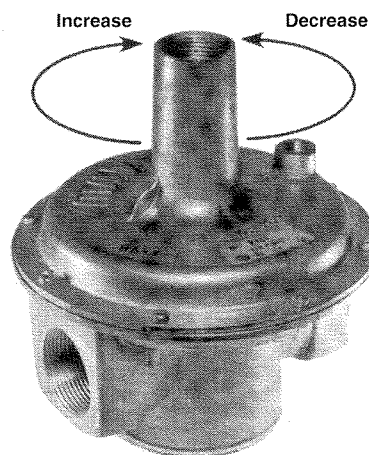
Water Quality

This boiler is designed to operate in a closed-loop system. As such, the system should be tight and not require make-up water. A high percentage of untreated make-up water can cause premature failure due to a buildup of “scale” which is not covered by warranty. It can also cause a loss of efficiency. For example, a scale thickness of 1/16” will result in 12.5% loss in efficiency.

The water quality should be within the guidelines established by the American Boiler Manufacturers Association as follows:

Gas Pressure Adjustment

See rating plate for the minimum and maximum gas pressure of the boiler. Each boiler is furnished with two plugged taps in the gas manifold for test gauge connections. One tap is located at the main gas cock for measuring the gas supply pressure (1/4” I.P.S.). The supply pressure during main burner operation must be greater than the minimum indicated on the rating plate (4 in. W.C. for natural gas, 7 in. W.C. for propane). The second tap is located downstream from the last main gas control at the elbow where the gas line enters the back of the cabinet and is for measuring the manifold gas pressure (1/8” I.P.S.).



Gas Pressure Regulator

If a replacement Lo Hi Lo actuator is required, follow manufacturers instructions and pre-set the Lo fire setting of the actuator the same as the original actuator. This should be performed by qualified service personnel.

To adjust gas pressure, first connect appropriate pressure-sensing device at the manifold tap, then remove seal cap from regulator. Turn adjusting screw clock-wise to increase pressure, counter-clockwise to decrease pressure. The manifold gas pressure on the “Rating Plate,” on the back of the cabinet, is provided only as a guide to the proper setting. The manifold gas pressure indicated on the “Factory Firetest” label (affixed on the back of the cabinet) should be used to achieve the proper firing rate of the individual boiler. Replace seal cap after adjustment.

Total Solids: 2500 ppm

Total Alkalinity: 500 ppm

Total Hardness: 150 ppm

The amount of oils, fats, grease and other organic matter is restricted to a maximum 10 ppm. Consult your water conditioning or chemical treatment supplier for an analysis and recommendation.

Air Flow Adjustment

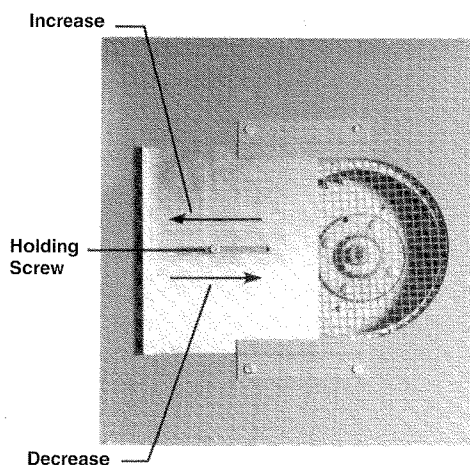
The air flow is pre-set at the factory prior to shipment. The air (and gas) may have to be adjusted for local conditions.

For initial light off, adjust the air flow until the cabinet pressure is the same as shown on the "Factory Firetest" labels.

Combustion measurement instrumentation must be used to reset the boiler for local conditions (See instructions below). Adjust the carbon dioxide (CO₂) or oxygen (O₂) reading corresponding to approximately 50% excess air. Excess air level for proper combustion with this burner is higher than with some other types of gas burners.

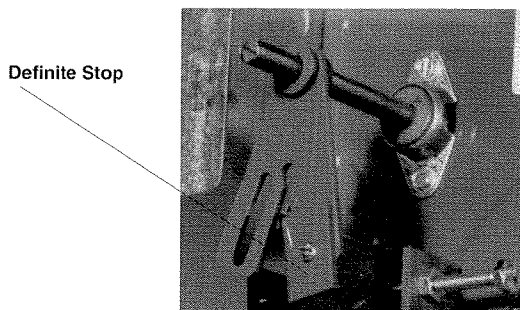
1. On/Off

Loosen the holding screw on the air shutter and open or close the shutter as required to adjust the air flow. Re-tighten the holding screw after adjustment.



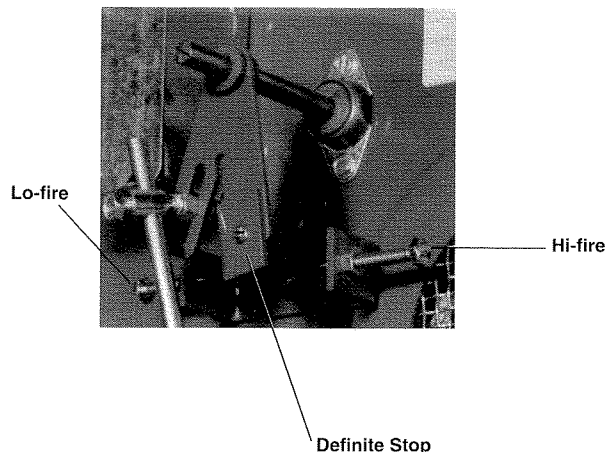
2. Alternate On/Off

The screws on the definite stop bracket hold the air damper in place. Loosen the nuts and rotate the screws as required for proper air flow. When the definite stop is in the desired position, tighten the nut on each screw. Both screws must be touching the definite stop before they are locked in place. Do not adjust any other part of this mechanism. This should be performed by qualified service personnel.



3. Lo Hi Lo

The screws on the definite stop bracket (Lo fire = right screw, Hi fire = left screw) will adjust the air damper. Loosen the nut and rotate the screw, with the definite stop resting against the screw, as required for proper air flow. Tighten the nut to lock the screw when at the desired position. Both Lo and Hi fire air flow must be adjusted. Do not adjust any other part of this mechanism. This should be performed by qualified service personnel.



OWNER'S MANUAL

LIGHTING AND SHUT-DOWN PROCEDURES

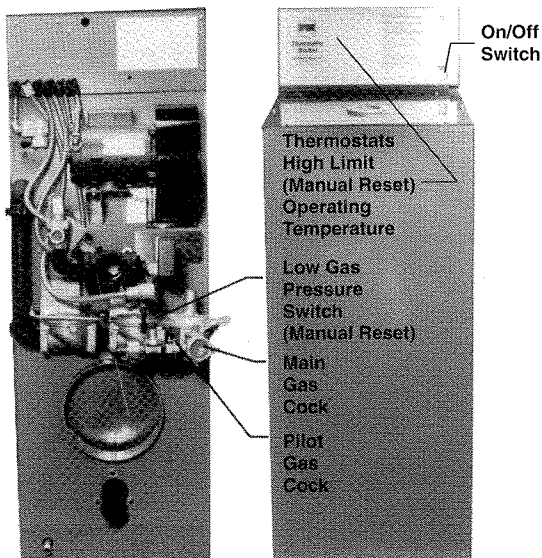
Tests

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 Z21.13, latest edition, or CAN1-3.1 in Canada (see "Factory Firetest" label)

Starting System

Do not use this boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control which has been under water.

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 (and high pressure gas switch if applicable).
8. Check to be sure that pilot has been established.



Location of Manual Controls

Shut Down

1. Close all manual gas valves.
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".

Should overheating occur or the gas supply fails to shut off, do not turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the boiler.

MAINTENANCE AND INSPECTION SCHEDULE

Caution: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

Verify proper operation after servicing.

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 illuminated red indicators, unusual noises or operating conditions and make the necessary corrections.

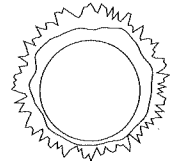
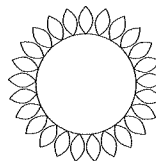
CAUTION: Check daily to be sure that the boiler area is free and clear of any combustible materials, including flammable vapors and liquids.

Weekly

Observe the 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 the flame pattern is pulsing or if flame is yellow and lifting off the burner, adjust the air shutter opening until correct flame pattern is achieved. 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 50% excess air.



Normal burner flame (left) and an abnormal burner flame (right)

Monthly (During Operation)

1. Safety relief valve. With the boiler off, lift the test lever (be sure that the valve closes completely after the 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 the thermostat, press the button to reset the 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 the 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 service 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.
3. Inspect and clean heat exchanger. Clean exterior of finned tubes and flush inside of heat exchanger as required (separate from system flush).
4. Examine the venting system at least once a year.
 - a. Check all joints and pipe connections for tightness.
 - b. Check pipe for corrosion or deterioration. If any piping needs replacing, do so immediately.
5. Inspect heating system for other problems.

This work should be performed by qualified service personnel.

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.

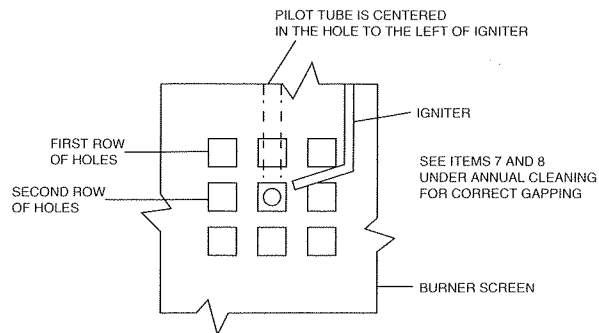
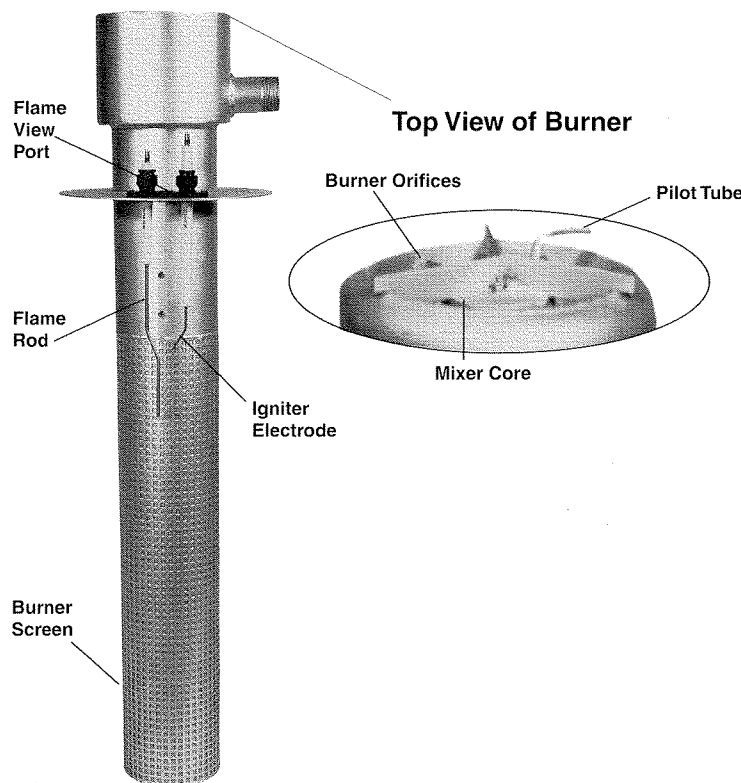
Semi-Annual Cleaning

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 that the ceramic portion of the ignition electrode and flame rod is not cracked.
7. Check the position of the ignition electrode: $3/32'' - 1/8''$ spark gap. Check the tightness of the electrode clamp.
8. Check the position of the flame rod which should be $1 - 1/4'' \pm 1/16''$ from the burner screen.
9. Before re-installing the burner, check the cleanliness of the exchanger and the condition of the firebox floor.

BURNER ASSEMBLY



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 (on the D series units, disconnect at the grooved pipe coupling).
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 the inner cabinet and exchanger are removed together as one unit. 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" and appropriate "Safety Checks", page 7.
2. Check gas pressure and adjust gas flow if necessary (see "Gas Pressure Adjustment", page 9).
3. Check air pressure and adjust air flow if necessary (see "Air Flow Adjustment", page 10).

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" or the amber switch 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. The limit series is complete unless an external control is placed ahead of the water flow limit (replacing the red jumper wire).
5. When heat is required, as indicated by outlet water temperature, power is applied to Terminal 6 of the programmer, which initiates the burner operating sequence, and to an indicator marked "Heat".

6. The programmer first energizes Terminal 4 which supplies power to the contractor 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 time delay of 10 seconds (standard) or 30 seconds (depending on insurance or local code requirements) occurs after the air proving switch closes and the programmer signals a continuation of the start sequence. During this time period the combustion chamber is pre-purged to eliminate any residual combustible gas or combustion products.
8. A 10-second "trial-for-ignition" period is initiated with both Terminals 10 and 8 being energized. Terminal 10 of the programmer powers the ignition transformer and the "Ignite" indicator. The transformer output creates a spark at the igniter. Terminal 8 powers the pilot gas valve and the indicator for "Pilot".
9. When a pilot flame is detected by the flame rod, a signal is sent to Terminal F in the programmer. Terminal 10 is de-energized shutting off the spark ignition and the pilot remains on for ten seconds during the flame establishing period.
10. After the flame establishing period, Terminal 9 is energized, which opens both main gas valves and lights the "Main Gas" indicator. After ten seconds, Terminal 8 is de-energized and the pilot valve and indicator light are extinguished.

Lo Hi Lo: When Terminal 9 is energized, the Lo Hi Lo valve will be maintained in the low fire position for "low fire start" for ten seconds. If the operating temperature control calls for high fire, the programmer will initiate high fire (Terminal 21) at the same time the pilot valve and indicator is de-energized.

11. When the desired water temperature is reached, the operating control switch opens and the programmer is de-energized at Terminal 6 and the indicator for "Heat" is turned off. This action also de-energizes Terminal 9, 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 that 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 is in the Off position), the "Power" indicator or amber switch 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 that all the limits are satisfied.

Loss of Water Flow

When the "Low Water" or "Water Flow" 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 that the other limits are satisfied.

Low Gas Pressure

When the "Low Gas" or "Gas Press" 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" or "Gas Press" 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" or "Gas Press" indicator may also be illuminated to indicate high gas pressure.

Once the switch is reset, the sequence returns to Step 5, provided that the other limits are satisfied.

High Water Temperature

When the boiler water has exceeded both the operating and high-limit temperature; power to the programmer is interrupted. When the water temperature falls 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 that the other limits are satisfied.

Low Air

If the "Low Air" indicator remains on for longer than 30 seconds, there is insufficient airflow through the burner. Check that the burner is clean (see "**Cleaning the Burner**", page 12) before adjusting the air inlet damper (see "**Air Flow Adjustment**", page 10).

Ignition Failure

In the event the pilot flame is not detected by the flame rod during the 10 second trial-for-ignition period (Step 8), 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 the "Flame Failure" indicator. A manual reset of the programmer (located inside 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 7 or goes into a "lockout" mode (see next paragraph). After the spark ignition is re-energized and the pilot valve is reopened, the 10 second trial-for-ignition begins again. If flame failure occurs during a trial-for-ignition, a safety lockout occurs (see Ignition Failure). If flame failure occurs and the indicator is illuminated, the programmer must be **manually reset**.

Because of special requirements of some insurance or local codes, the boiler may be equipped with a flame safeguard programmer that will NOT re-cycle after either a pilot- or main-flame failure, but will, instead, go into a "lockout" mode. This mode requires that the programmer be **manually reset**.

TYPICAL BOILER OPERATING CONDITIONS

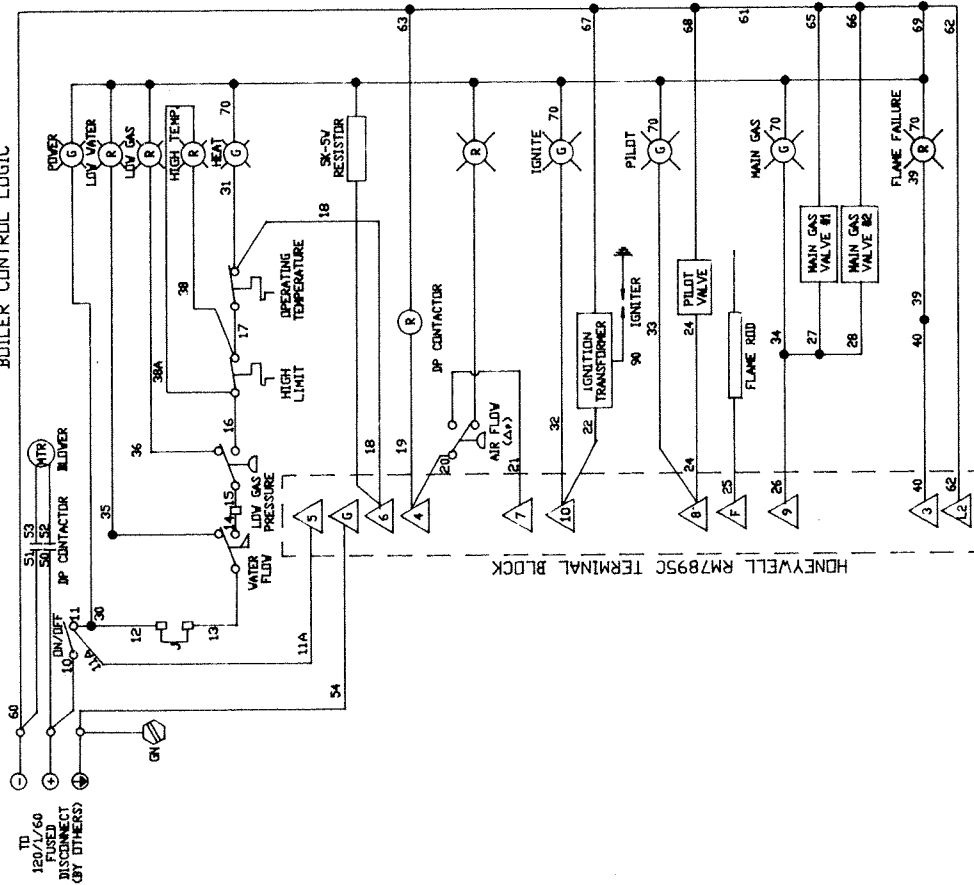
Model Number	Input Rating [Btu/hr]	Natural Gas			LP Gas			Total Amperage [amps]
		Gas Rate (1030 Btu/ft ³) [ft ³ /hr]	Manifold Pressure* [inches W.C.]	Output Capacity [Btu/hr]	Gas Rate (2522 Btu/ft ³) [ft ³ /hr]	Manifold Pressure* [inches W.C.]	Output Capacity [Btu/hr]	
N-700	700,000	680	1.7	595,000	278	4.2	609,000	8
N,D-900	900,000	874	1.7	765,000	357	4.5	783,000	8
N,D-1200	1,200,000	1165	2.6	1,020,000	476	5.0	1,044,000	9
N,D-1500-2	max 1,500,000	1456	2.8	1,275,000	595	4.2	1,305,000	12
	min 900,000	874	—	765,000	357	—	783,000	12
N-1700-2	max 1,700,000	1650	2.8	1,445,000	674	4.2	1,479,000	12
	min 1,020,000	990	—	867,000	404	—	887,400	12
N,D-1900-2	max 1,900,000	1845	2.7	1,615,000	753	4.0	1,653,000	12
	min 1,140,000	1107	—	969,000	452	—	991,800	12

Refer to Rating Plate on Boiler for Specific Information and Certification of 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.

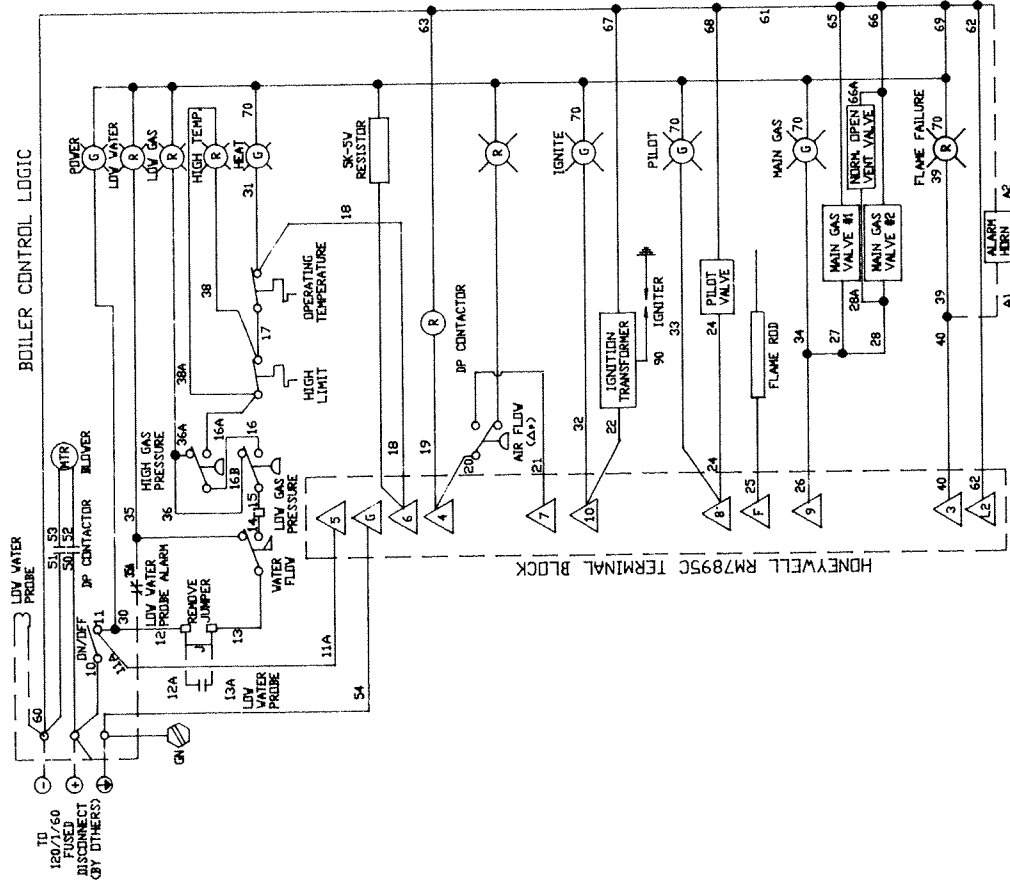
BOILER CONTROL LOGIC



IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED IT MUST BE REPLACED WITH TYPE MTW (90° C)

STANDARD LOGIC DIAGRAM
W/HONEYWELL RM789SC
THERMIFIC ON/OFF

PATTERSON-KELLEY CO.
1000 EAST 10TH AVE
EAST STROUDSBURG, PA. 18041



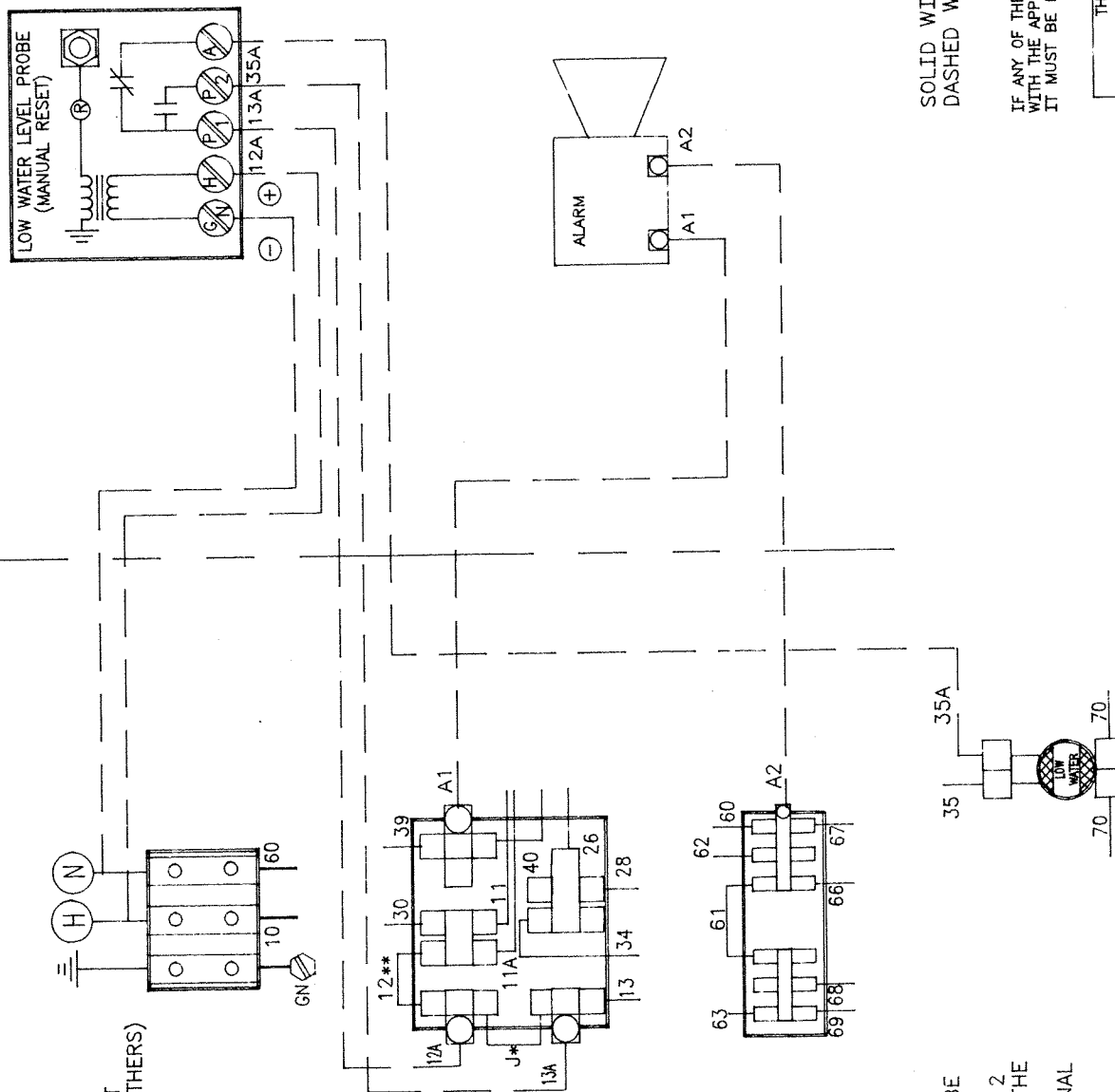
NOTE:
DASHED LINES INDICATE OPTIONAL FIELD
WIRING OF LOW WATER LEVEL PROBE AND/OR
ALARM. SEE DWG. 1000172993L FOR WIRING DIAGRAM.

IF ANY OF THE ORIGINAL WIRE AS SUPPLIED
WITH THE APPLIANCE MUST BE REPLACED
IT MUST BE REPLACED WITH TYPE MTW (90° C)

IRI LOGIC DIAGRAM
W/HONEYWELL RM789C
THERMIFIC ON/OFF
PATTERSON-KELLEY CO.
Div. of Harsco Corporation
EAST STROUDSBURG, PA. 15301

THERMIFIC PANEL

FIELD WIRING



- * REMOVE RED JUMPER BEFORE CONNECTING LOW WATER PROBE
- ** ALTERNATE: REMOVE JUMPER 12 AND USE ITS TERMINALS IF THE RED JUMPER TERMINALS ARE ALREADY USED FOR AN EXTERNAL CONTROLLER.

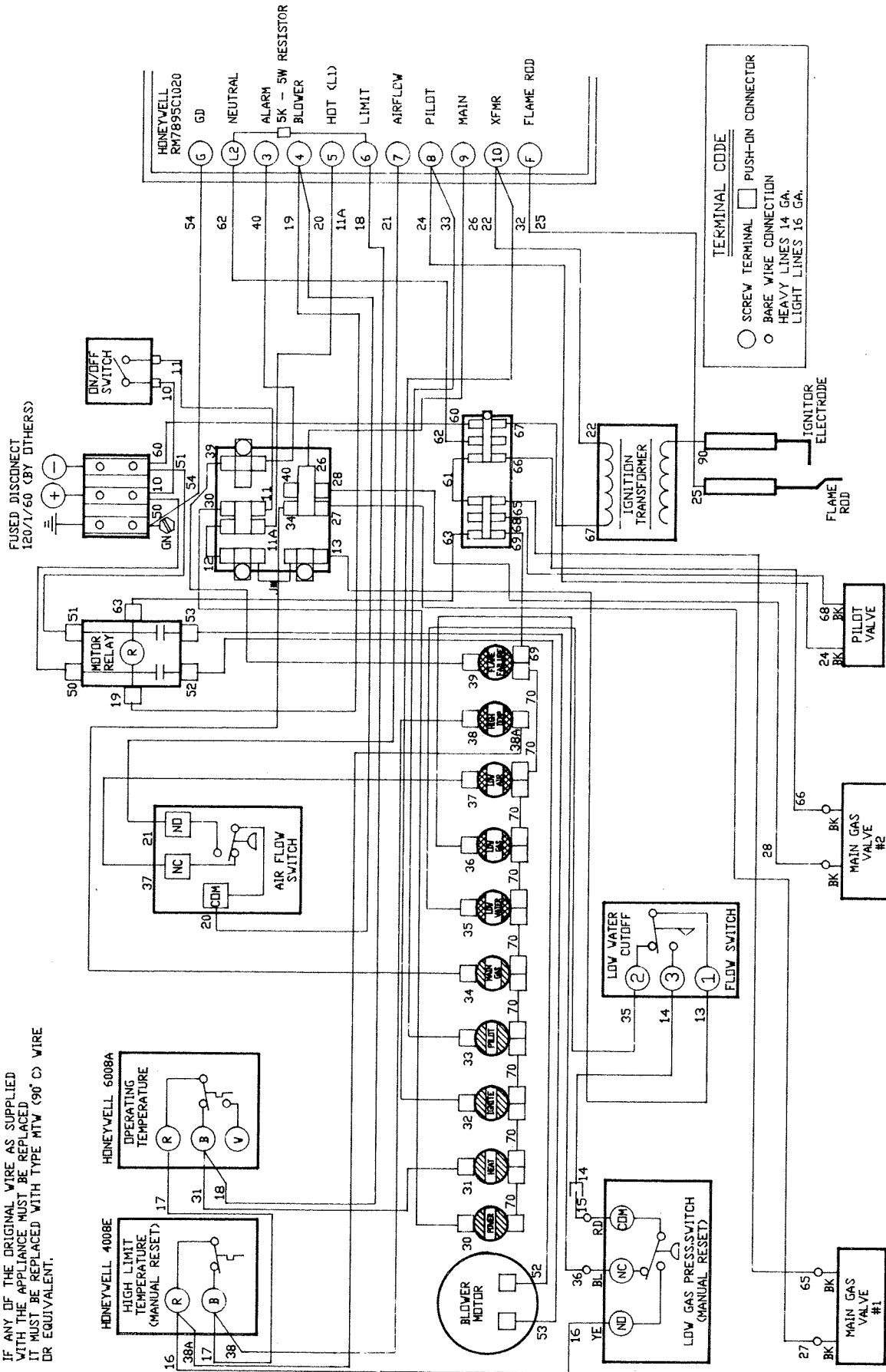
SOLID WIRES ARE FACTORY WIRED
DASHED WIRES ARE FIELD WIRED

IF ANY OF THE ORIGINAL WIRE AS SUPPLIED
WITH THE APPLIANCE MUST BE REPLACED
IT MUST BE REPLACED WITH TYPE MTW (90° C)

THERMIFIC ON/OFF WIRING
DIAG. FOR
LOW WATER CUT OFF & ALARM

PATERSON-KELLEY CO.
DIV. of HARSICO Corporation
EAST STROUDSBURG, PA. 18301

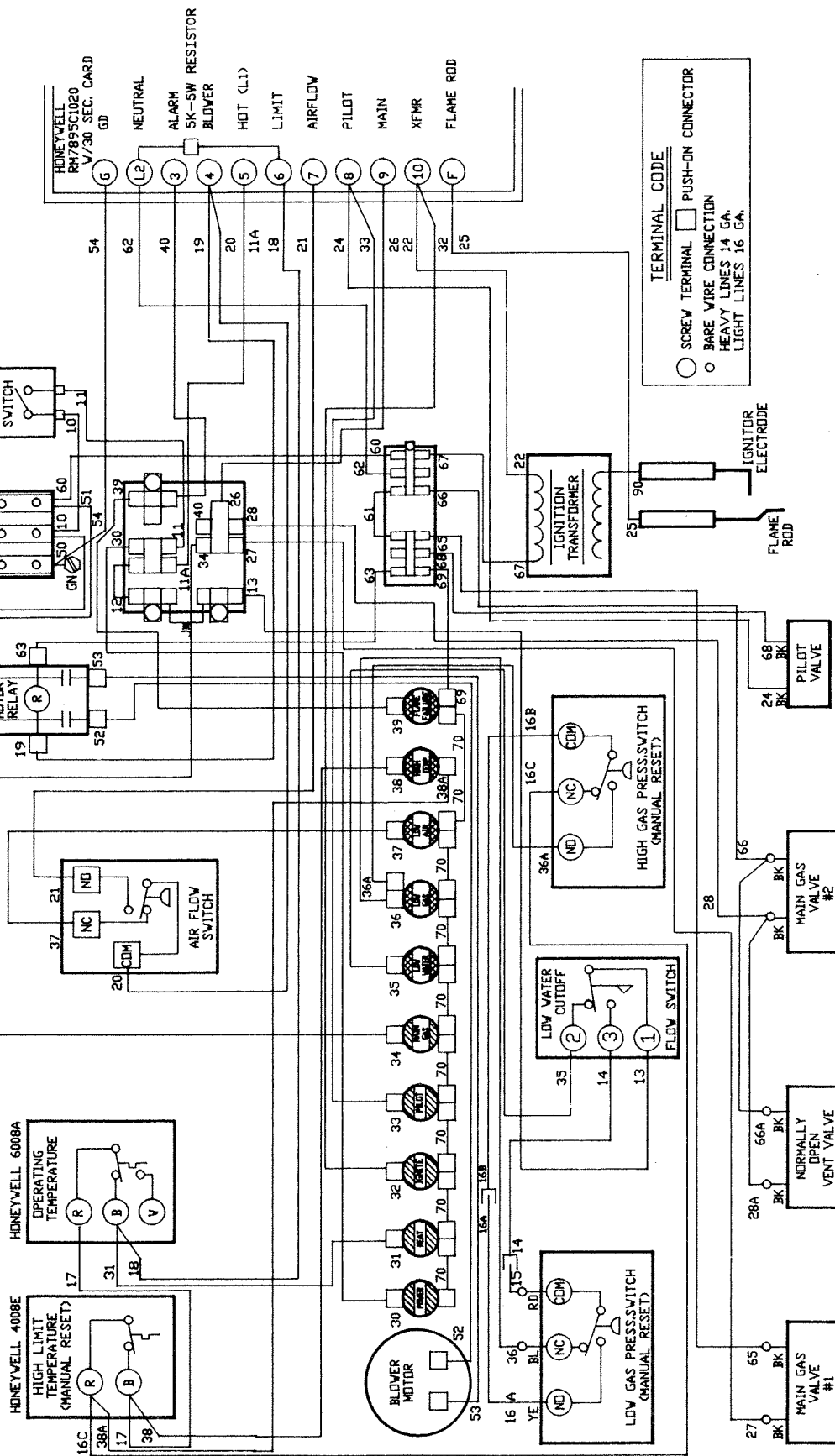
IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED IT MUST BE REPLACED WITH TYPE MTW (90° C) WIRE OR EQUIVALENT.



STANDARD WIRING DIAGRAM
W/HONEYWELL RM7895C1020
THERMIFLOW, ON/OFF
PATTERSON-KELLEY CO.
Div. of HARSco Corporation
EAST STROUDSBURG, PA. 18301

8645500094

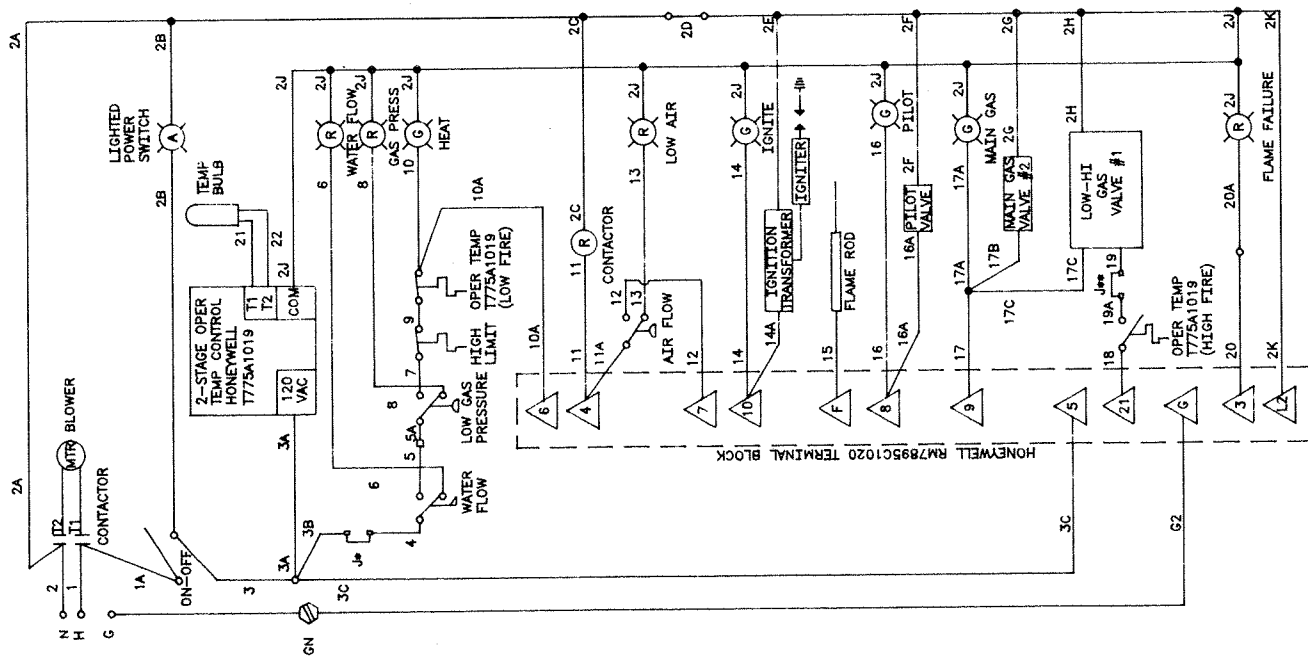
IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED IT MUST BE REPLACED WITH TYPE MTW (90° C) WIRE OR EQUIVALENT.



TERMINAL CODE
 ○ SCREW TERMINAL
 ○ BARE WIRE CONNECTION
 ○ HEAVY LINES 14 GA.
 ○ LIGHT LINES 16 GA.

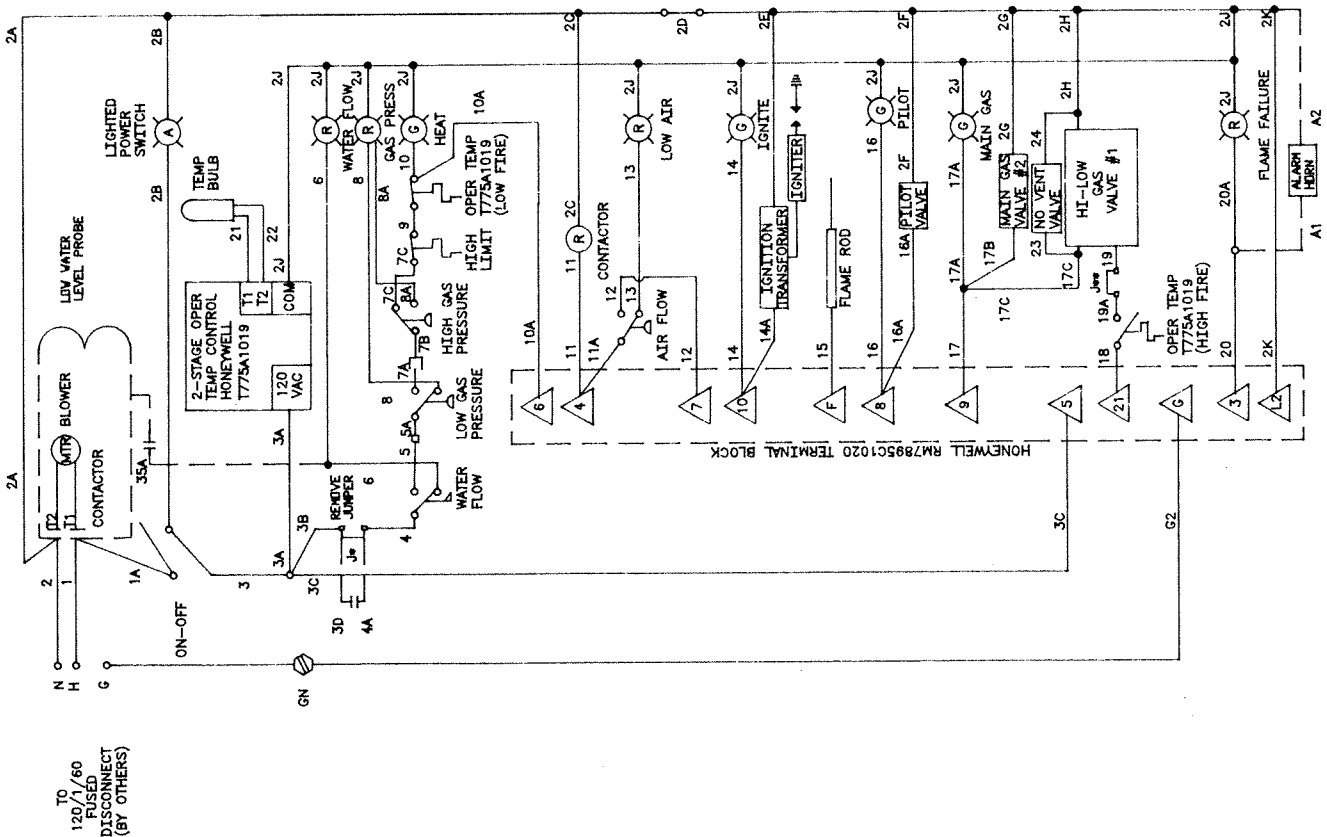
IRI WIRING DIAGRAM
 W/HONEYWELL RM7895C1020
 THERMIFIC. ON/OFF
 PATTERSON-KELLEY CO.
 DIV. OF JAMES CO. INC.
 EAST STROUBSBURG, PA. 15301

8645500092



IF ANY OF THE ORIGINAL WIRE AS SUPPLIED
WITH THE APPLIANCE MUST BE REPLACED
IT MUST BE REPLACED WITH TYPE MTW (90° C)

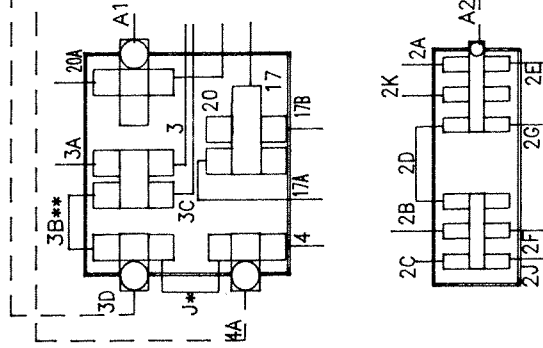
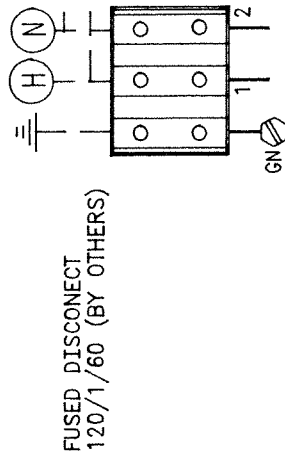
STANDARD CONTROL LOGIC
DIAGRAM
THERMIFIC LO-HI-LO
PATTERSON-KELLEY CO.
DIV. of HARSICO Corporation
EAST STROUBURG, PA. 15001



IRI CONTROL LOGIC
THERMIFIG, LO-HI-LO
PATTERSON-KELLEY CO.
DIV. of WESSCO Corporation
EAST STROUBURG, PA. 15501

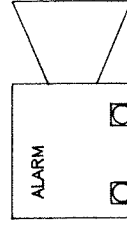
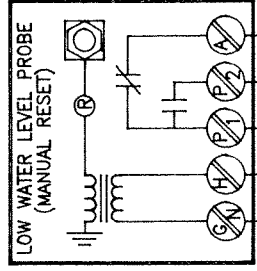
1000200465L

THERMIFIC PANEL



- * REMOVE RED JUMPER BEFORE CONNECTING LOW WATER PROBE
- ** ALTERNATE: REMOVE JUMPER 3B AND USE ITS TERMINALS IF THE RED JUMPER TERMINALS ARE ALREADY USED FOR AN EXTERNAL CONTROLLER.

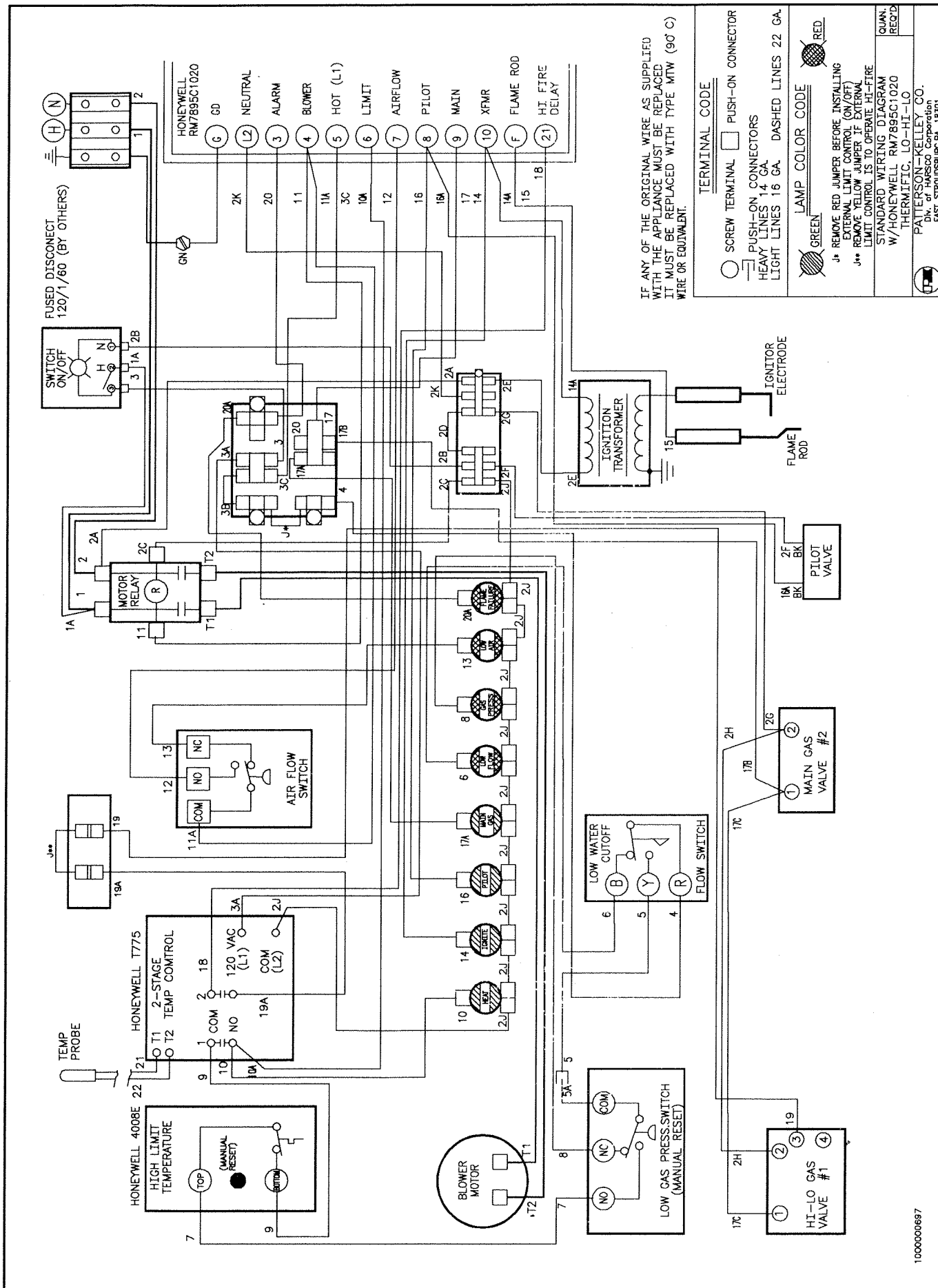
FIELD WIRING



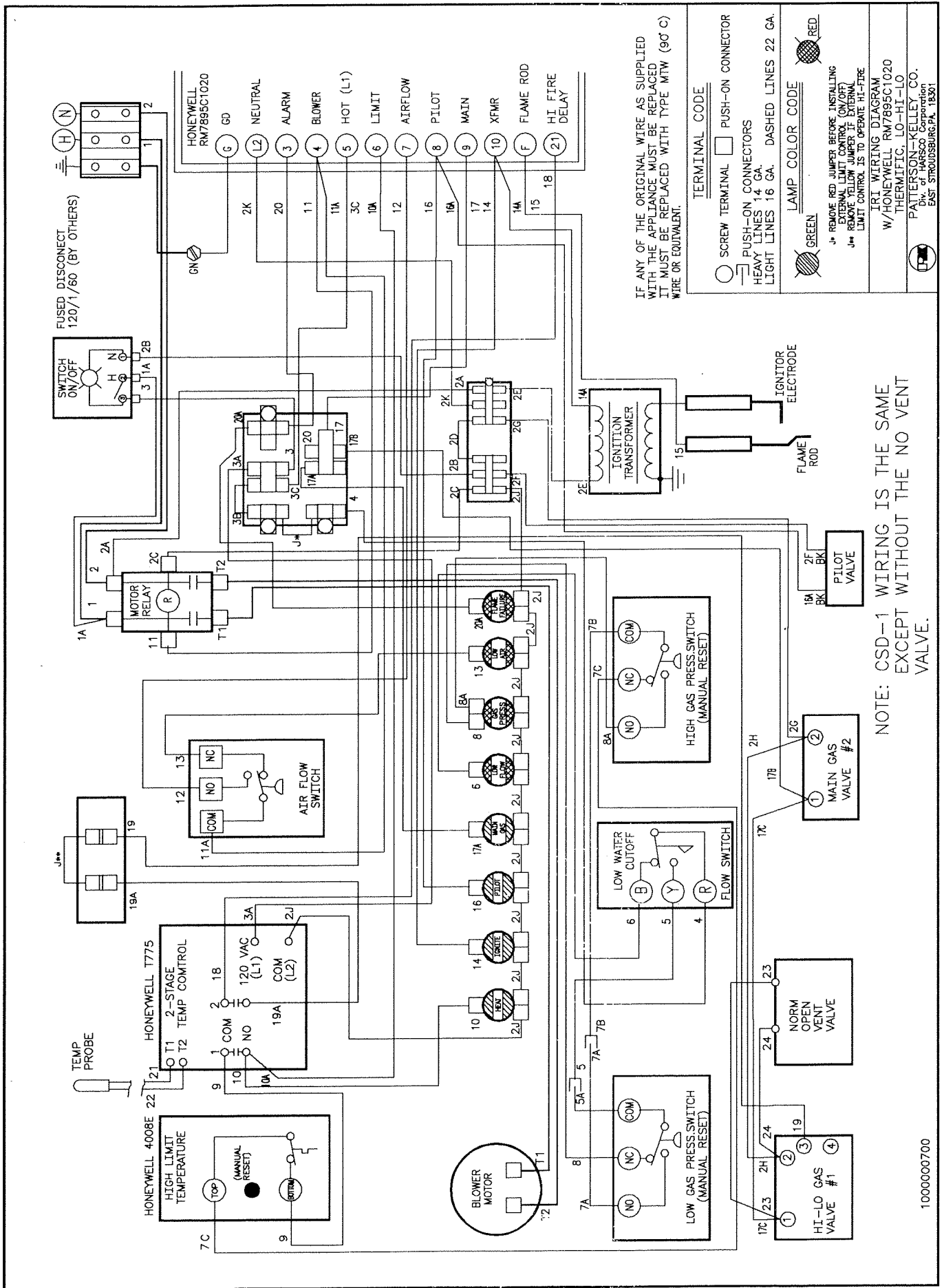
SOLID WIRES ARE FACTORY WIRED
DASHED WIRES ARE FIELD WIRED

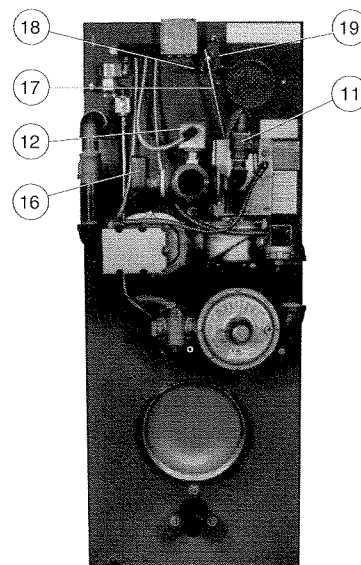
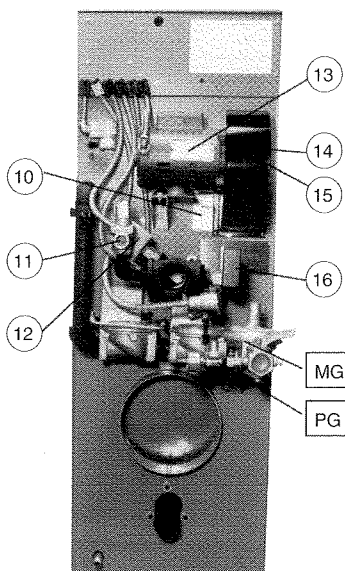
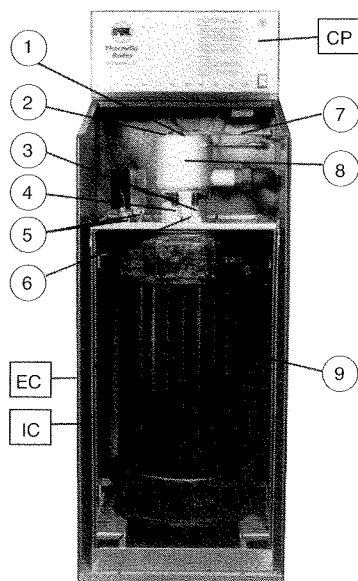
IF ANY OF THE ORIGINAL WIRE AS SUPPLIED
WITH THE APPLIANCE MUST BE REPLACED
IT MUST BE REPLACED WITH TYPE MTW (90° C)

THERMIFIC LO-HI-LO WIRING
DIAG. FOR
LOW WATER CUT OFF & ALARM
PATERSON-KELLEY CO.
DIV. OF HAKSCO Corporation
EAST STROUSSBURG, PA. 18041



1000000697





BOILER PARTS LIST

Main Assembly

		Prefix No.	D-900	D-1200	D-1500-2		D-1900-2	
No.	Part		N-700	N-900	N-1200	N-1500-2	N-1700-2	N-1900-2
1	Mixer Core, Burner	See "Burner" for Part No.						
2	Burner Orifice	See "Burner" for Part No.						
3	Spark Igniter Electrode	86-2450-	0820	0820	0820	0820	0820	0820
4	Flame Rod Electrode	86-7100-	0230	0230	0230	0230	0230	0230
5	Thermowell w/Clamp	86-8800-	0890	0890	0890	0890	0890	0890
6	Electrode Assembly w/Mica	BP-0000-	0030	0030	0030	0030	0030	0030
7	Pilot Tube	87-6440-	1076	1076	1076	1176	1176	1176
8	Burner	86-1187-	0024	0026	0029	0032	0034	0036
9	Heat Exchanger	Contact factory for Part No.						
10	Blower, Damper (inside cabinet)	86-7653- 10-0020	0300	0300	0300			
						0443	0443	0443
11	Pressure Relief Valve (100 PSI)	86-9420-	0090	0090	0090	0250	0250	0250
12	Water Flow Switch	86-8350-	0800	0800	0800	0800	0800	0800
13	Blower, Motor	80-6250- 80-6300-	5022	5022	5166			
						5166	5166	5166
14	Blower, Housing	86-4030- 10-0020-	0020	0020	0020			
						0440	0440	0440
15	Blower, Wheel	86-4140-	0001	0001	0002	0003	0003	0003
16	Press./Temp. Gauge	86-3560-	0200	0200	0200	0200	0200	0200
17	Damper Rod, Lo Hi Lo	10-0020-				0444	0444	0444
18	Definite Stop Bracket	10-0020-				0445	0445	0445
19	Definite Stop	10-0020-				0446	0446	0446

Installation/Owner's Manual

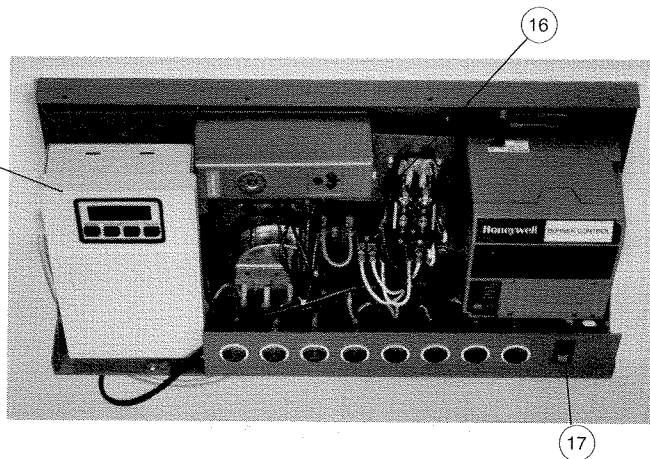
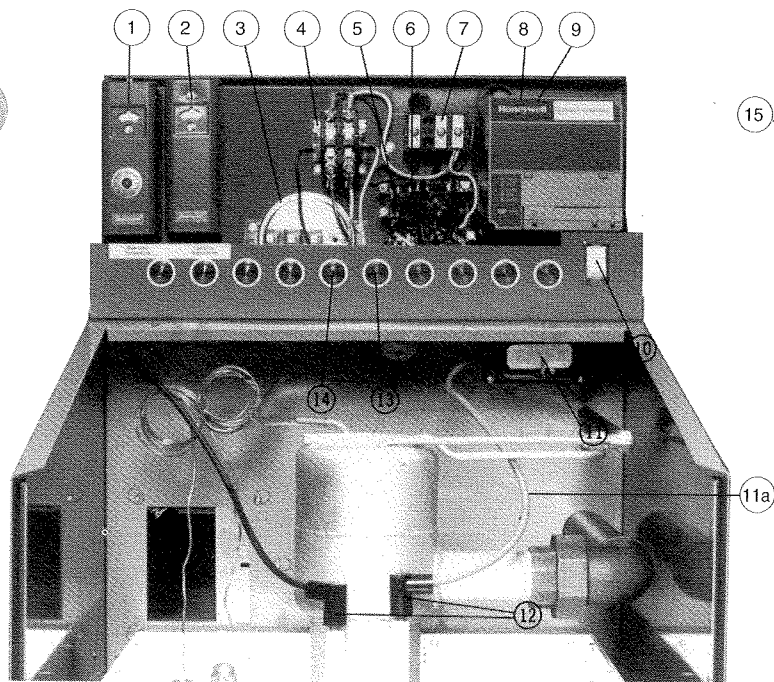
CP	Control Panel (see page 26)
EC	Exterior Cabinet (see page 28)
IC	Interior Cabinet (see page 28)
PG	Pilot Gas Train (see page 27)
MG	Main Gas Train (see page 27)

All Models -TBIG

Identify Part No. by Prefix plus Model No. Suffix
i.e., Burner for N-1500-2 Part No.:

XX-XXXX-XXXX
86-1187-0032

Replacement parts are available from your P-K Thermific representative or from
Patterson-Kelley, P.O. Box 458, 100 Burson Street, East Stroudsburg, PA 18301 Phone (717)421-7500 Fax (717)476-7247



Inside the Lo-Hi-Lo Control Panel

BOILER PARTS LIST (cont.)

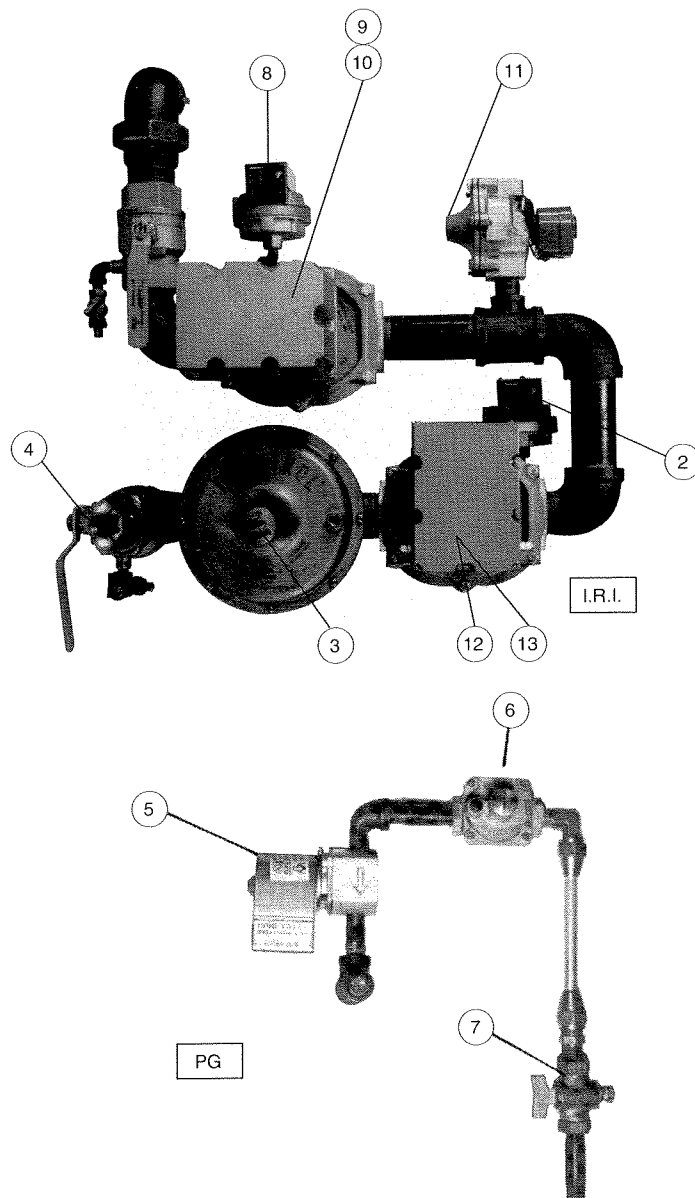
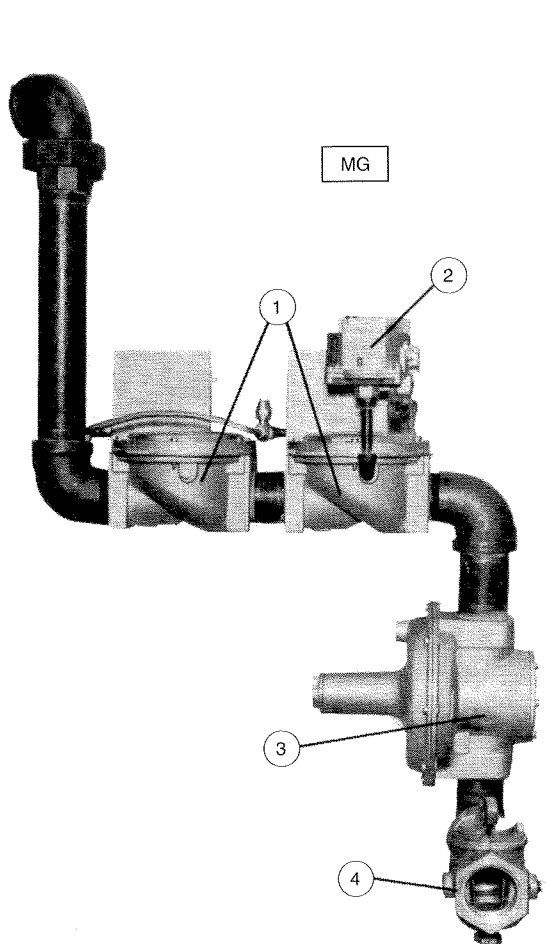
Control Panel Components

No.	Part	Prefix No.	N-700	D-900 N-900	D-1200 N-1200	D-1500-2 N-1500-2	D-1900-2 N-1700-2 N-1900-2
1	Thermostat (Manual Reset)	86-1761-	0330	0330	0330	0330	0330
2	Thermostat (Oper. Temp)	86-8730-	0809	0809	0809	0809	0809
3	Air Flow Switch	86-8335-	0170	0170	0170	0170	0170
4	Motor Starter Relay	86-1750-	0075	0075	0075	0075	0075
5	Terminal Block, Neutral	86-8610-	0220	0220	0220	0220	0220
6	Terminal Block, Junction	86-8610-	0230	0230	0230	0230	0230
7	Terminal Block, Power	86-8610-	0240	0240	0240	0240	0240
8	Flame Safeguard Programmer	86-1600-	0205	0205	0205	0205	0205
8 a	Amplifier	86-0303-	5045	5045	5045	5045	5045
8 b	Timing Card, 10 sec.	86-1331-	0062	0062	0062	0062	0062
8 c	Timing Card, 30 sec.	86-1331-	0064	0064	0064	0064	0064
9	Programmer, Sub-Base	86-1750-	0405	0405	0405	0405	0405
10	Switch, On/Off	86-8510-	0170	0170	0170	0170	0170
11	Ignition Transformer	10-0000-	1156	1156	1156	1156	1156
11 a	Ignition Cable	10-0000-	1145	1145	1145	1145	1145
12	Connector, Spark Plug	85-1900-	0585	0585	0585	0585	0585
13	Indicator Light, Red	86-4720-	0250	0250	0250	0250	0250
14	Indicator Light, Green	86-4720-	0260	0260	0260	0260	0260
15	Lo Hi Lo, Oper. Thermostat	10-0000-				0113	0113
16	Lo Hi Lo, Jumper Terminal Block	10-0000-				0997	0997
17	Switch, Lighted On/Off	10-0000-				0451	0451
	Low Water Switch (IRI-MR)	86-2215-	0050	0050	0050	0050	0050
	Alarm Bell (IRI)	86-0787-	5030	5030	5030	5030	5030

Identify Part No. by Prefix plus Model No. Suffix
i.e., Thermostat Part No.:

XX-XXXX-XXXX
86-8730-0809

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Patterson-Kelley, P.O. Box 458, 100 Burson Street, East Stroudsburg, PA 18301 Phone (717)421-7500 Fax (717)476-7247



BOILER PARTS LIST (cont.)

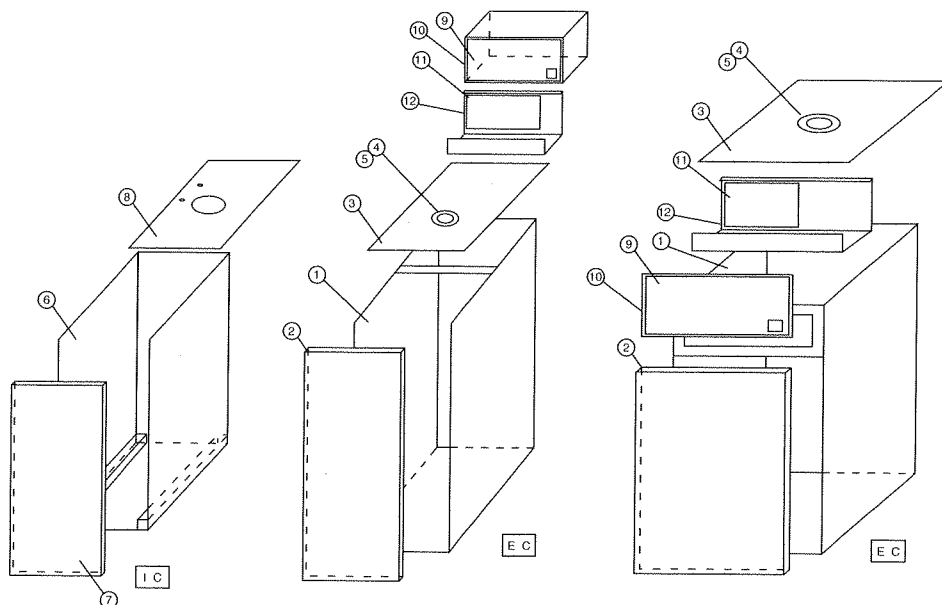
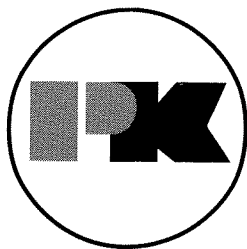
Gas Train Components

No.	Part	Prefix No.						
			N-700	D-900 N-900	D-1200 N-1200	D-1500-2 N-1500-2	N-1700-2	D-1900-2 N-1900-2
1	Main Gas, Valve (Diaphragm)	86-9306-	0100	0100	0120	—	—	—
2	Low Gas Pressure Switch	86-8363-	8100	8100	8100	8100	8100	8100
3	Main Gas, Regulator	86-6450-	0310	0310	0510	0630	0630	0630
4	Main Gas, Shut-off Cock	85-1540-	7715	7715	8515	8615	8615	8615
5	Pilot, Solenoid Valve	86-5905-	1030	1030	1030	1030	1030	1030
6	Pilot, Regulator	86-5905-	1020	1020	1020	1020	1020	1020
7	Pilot, Shut-off Cock	10-0000-	1181	1181	1182	1183	1183	1183
8	High Gas Pressure Switch	86-8363-	5100	5100	5100	5100	5100	5100
9	Main Gas, Valve Body	86-9309-	9010	9010	9015	9020	9020	9020
10	Main Gas, Valve Actuator	86-0039-	9070	9070	9070	9070	9070	9070
11	Vent Valve, Gas	86-9490-	0130	0130	0130	0230	0230	0230
12	Lo Hi Lo, Valve Body	10-0000-				0125	0125	0125
13	Lo Hi Lo, Valve Actuator	10-0000-				0114	0114	0114

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

XX-XXXX-XXXX
86-9306-0120

Replacement parts are available from your P-K Thermific representative or
Patterson-Kelley, P.O. Box 458, 100 Burson Street, East Stroudsburg, PA 18301 Phone (717)421-7500 Fax (717)476-7247



BOILER PARTS LIST (cont.)

No.	Part	Prefix No.						
			N-700	D-900 N-900	D-1200 N-1200	D-1500-2 N-1500-2	D-1900-2 N-1900-2	
1	Exterior Cabinet, Assy.	86-1290- 10-0200-	0070	0070	0120			
2	Exterior Cabinet, Door	86-1291-	0070	0070	0140	0442	0442	0442
3	Exterior Cabinet, Top					0200	0200	0200
4	Sight Glass	86-7660-	0310	0310	0310	0310	0310	0310
5	Sight Glass Bezel							
6	Combustion Chamber, Assy.							
7	Combustion Chamber, Door							
8	Combustion Chamber, Top							
9	Control Panel, Label							
10	Control Panel, Cover							
11	Control Panel, Sub Panel							
12	Control Panel, Base Assy.							

Identify Part No. by Prefix plus Model No. Suffix
i.e., Exterior Cabinet, Assy. for N-1200 Part No.:

XX-XXXX-XXXX
86-1290-0120

Replacement parts are available from your P-K Thermific representative or
Patterson-Kelley, P.O. Box 458, 100 Burson Street, East Stroudsburg, PA 18301 Phone (717)421-7500 Fax (717)476-7247

Requirements in Canada

In Canada, the equipment shall be installed in accordance with the current "Installation Code for Gas Burning Equipment," CAN/CGA B.149.

Combustion air openings shall comply with CAN/CGA B.149. The formula is "not less than 100 square inches plus 1 square inch for each 14,000 Btu/hr in excess of 400,000 Btu/h." The location shall be "neither more than 18", nor less than 6" above the floor level."

Ventilation air openings shall be at least 10% of the cross

sectional area required for combustion air, but not less than 10 square inches. It is to be located at the highest practical point communicating with outdoors.

This boiler is certified for installation with Type "B" vent by the Canadian Gas Association (CGA).

This boiler is certified for installation with a "Power Venter" by the Canadian Gas Association when installed with the "listed accessories." Consult your local distributor for information on the proper selection.