

# **P-K COMPACT<sup>®</sup>**

## **Steam-Fired Water Heater**

### ***Operating and Maintenance Instructions***

P-K Reference # \_\_\_\_\_

LOCATION: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

RATING: \_\_\_\_\_ GPM \_\_\_\_\_ °F. to \_\_\_\_\_ °F.

STEAM LINE PRESSURE \_\_\_\_\_ P.S.I.G.

**PATTERSON-KELLEY**

100 Burson Street  
East Stroudsburg, PA 18301  
Phone: 570.421.7500  
Fax: 570.476.7247  
www.pkwaterheaters.com



**Patterson-Kelley**

Harsco

# PLEASE READ CAREFULLY BEFORE INSTALLING

## General Information

Upon receipt of this shipment, please inspect the unit for any damage. The P-K COMPACT® water heater was thoroughly inspected and tested prior to shipment, and any damage should be reported to the transportation company immediately.

Please refer to the P-K Serial Number of the unit when contacting the local P-K Sales Representative.

P-K COMPACT water heaters are completely packaged, ready to connect to services.

A standard packaged unit has the following trim:

- Shell insulated and covered with a reinforced PVC jacket
- Steam control valve
- Steam pressure gauge
- Thermometer
- Circulation pump
- Relief valve
- Double solenoid temperature-limit system

## General Operating Information

The diagrams on pages four and five show the various piping arrangements of the P-K COMPACT water heater in operation.

Steam passes through the tubes of the heat exchange bundle. The water is rapidly heated as it is directed over the tubes by segmental baffles. Above the baffled tube bundle, minimum storage volume is provided to give the controls sufficient time to produce the close temperature control.

The circulation pump maintains proper water velocity across the tubes, producing a high rate of heat transfer. Constant circulation produces extremely high performance and close temperature control, while preventing scale formation in all but the harshest hard-water conditions.

The shell section functions primarily as a “minimum storage” to permit the temperature control valve to open or close according to hot water demands without discharging unheated or overheated water.

The Anticipator temperature control is located in the small storage section just above the heat exchanger.

## Placement

The heater should be placed to permit gravity flow of condensate to the condensate return system. The head room above the heater should be at least 8” to permit the removal of the relief valve.

The heater should be secured to the building floor or mounting pad.

## Plumbing

**Water Connections:** Connect properly sized water service lines to the heater without check valves and provide a suitable gate valve. The hot water outlet may be run “dead-end”; however, a recirculated hot water line will provide hot water more rapidly to the fixtures.

When two or more heaters are piped in parallel, be sure the cold water inlet and hot water outlets are equally balanced to prevent one heater from carrying the bulk of the load.

## Relief Valve

A properly sized relief valve is installed on the connection provided at the top of the heater. This valve should be piped to the sewer without decreasing the pipe size or installing any valves. **Failure to pipe to a drain could cause a hazardous condition as well as flooding of the equipment room.**

## Heater Recirculation

All COMPACT water heaters have a properly sized integral circulator (all bronze). The heater recirculation pump is not intended to function as a building recirculation pump.

## Electrical

The circulation pump normally provided has a 115 volt, single phase motor which may be connected to ordinary house wiring. The connecting wires should be 12 gauge and a suitable fuse switch provided as protection from short circuits.

The wires should be protected by standard circuits.

## Steam Trap

A properly sized steam trap is supplied loose for field installation. Pipe to the condensate connection of the unit. The condensate connection is at the bottom rear of the bonnet.

When lift is encountered, do not attempt to lift condensate above the trap. Failure to permit free drainage of condensate will result in damage to the tube bundle. It will also cause poor temperature control.

## Temperature-Limit System

A double solenoid temperature-limit system is furnished as standard to prevent a runaway condition, should the steam control valve fail in the open position. The double solenoid system is controlled by a single pole, double-throw thermostat which should be set at least 15°F above the control point of the temperature control valve sensor. In the event of control sensor failure, the thermostat will activate the three-way solenoid valve, relieving the pressure on the steam valve diaphragm and allow the valve to close.

## Pipe Dump Valve to Drain

A 1/2" solenoid dump valve located on top near the hot water outlet will allow any excess hot water in the tank to be dumped into a drain, preventing overheated water from entering the hot water piping of the building. The dump valve should be piped to a drain. **Failure to pipe to a drain could cause a hazardous condition as well as flooding of the equipment room.**

## Steam Line

A properly sized steam line with strainer should be connected to the COMPACT. The strainer should be installed to protect the control valve from any foreign materials carried through the steam line. A drip trap should be installed in the dirt leg just before the steam control valve to protect the valve from steam hammer.

When the steam line is over 10 ft. long, it should be trapped ahead of the strainer to prevent condensate from collecting. Condensate would be carried through the valve at such a velocity that damage could occur.

When the steam line is of any great length, it may be necessary to provide a pipe size which is greater than the pipe size of the strainer. In selecting the proper steam line size, consideration should be given to the steam pressure, steam velocity and the length of the line.

## Steam Control Valve

A self-contained steam regulator or a pneumatically operated steam control valve is supplied. Three different kinds of steam valves will operate satisfactorily on the COMPACT. Connections to the valve should be made according to the installation diagrams in this manual.

## Condensate Line

**NOTE:** Do not attempt to lift condensate above the condensate outlet without the help of a condensate pump. **Failure to comply with this can result in tube bundle failure and will cause erratic temperature control.**

The condensate line requires a check valve to prevent condensate from being drawn back into the heat exchanger.

## Operation and Adjustment

1. Turn on water supply to unit.
2. Trip relief valve to expel entrained air.
3. Lubricate pump and read pump installation manual before starting.
4. Turn on circulation pump. (Do not operate pump before water is in unit!)
5. Turn on steam.
6. Turn on faucets or other devices.
7. Operate unit at approximately 1/2 rated capacity.
8. Adjust the steam control valve to obtain desired outlet temperature. This is the setpoint. Please carefully read the manufacturer's instructions for adjusting the control valve. Since the P-K COMPACT is used with many steam pressures and water temperatures, they are not set at the factory.
9. Rerun the unit at one-half low capacity as in Item 7 and recheck the setpoint.



# PIPING ARRANGEMENTS

## Steam System:

### Single Unit Installation

	Stop Valve		Strainer
	Check Valve		Relief Valve
	Control Valve		Thermometer
	Orifice Union		Steam Trap
	Thermal Control Gage		Circulator
	Pressure Gage		Balancing Cock
	Pipe Union or Flanges		Petcock
	Compound Pressure Gage		Flow Indicator

Note: Relief valve must be piped to a drain to prevent hazardous condition.

Note: Installer must provide strainer on

\*Valve must be piped to a drain to prevent hazardous condi-

Note: Relief valve must be piped to a drain to prevent hazardous condition.

Note: Installer must provide strainer on steam supply line.

\*Valve must be piped to a drain to prevent hazardous condition.

## Steam System:

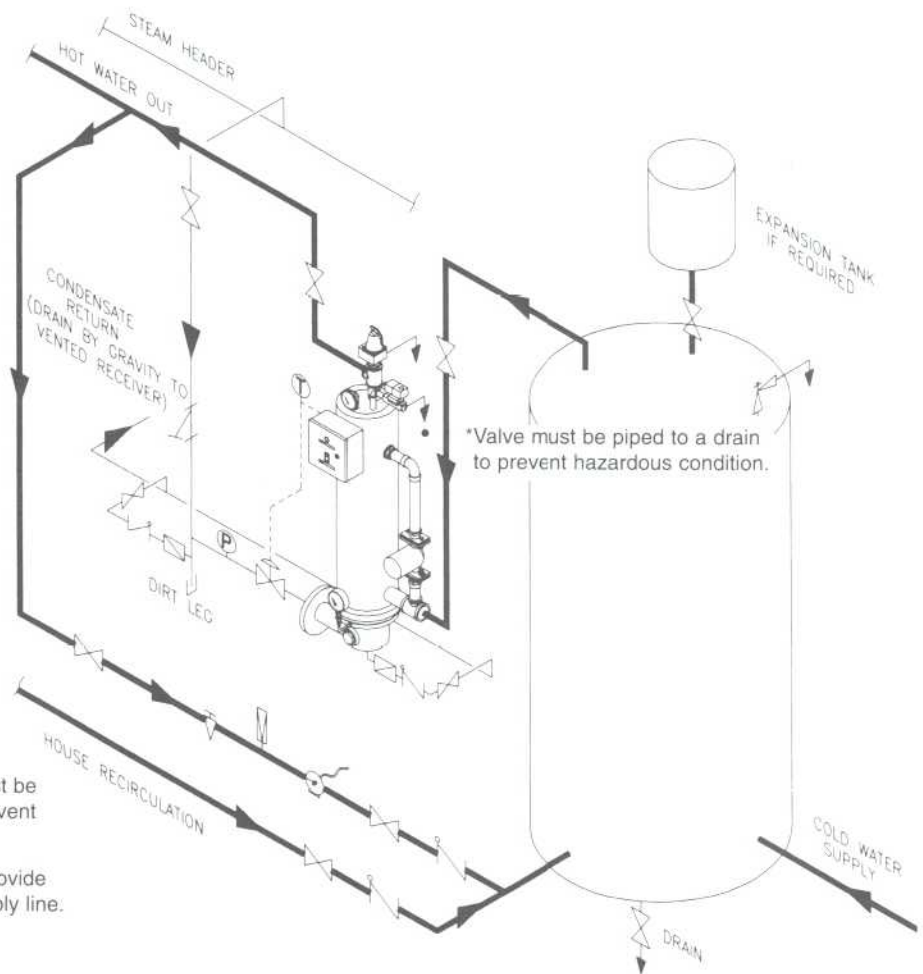
### Parallel Installation



**Steam System:**  
Accumulator Type Tank

**Application:**  
High Recovery Water Heater

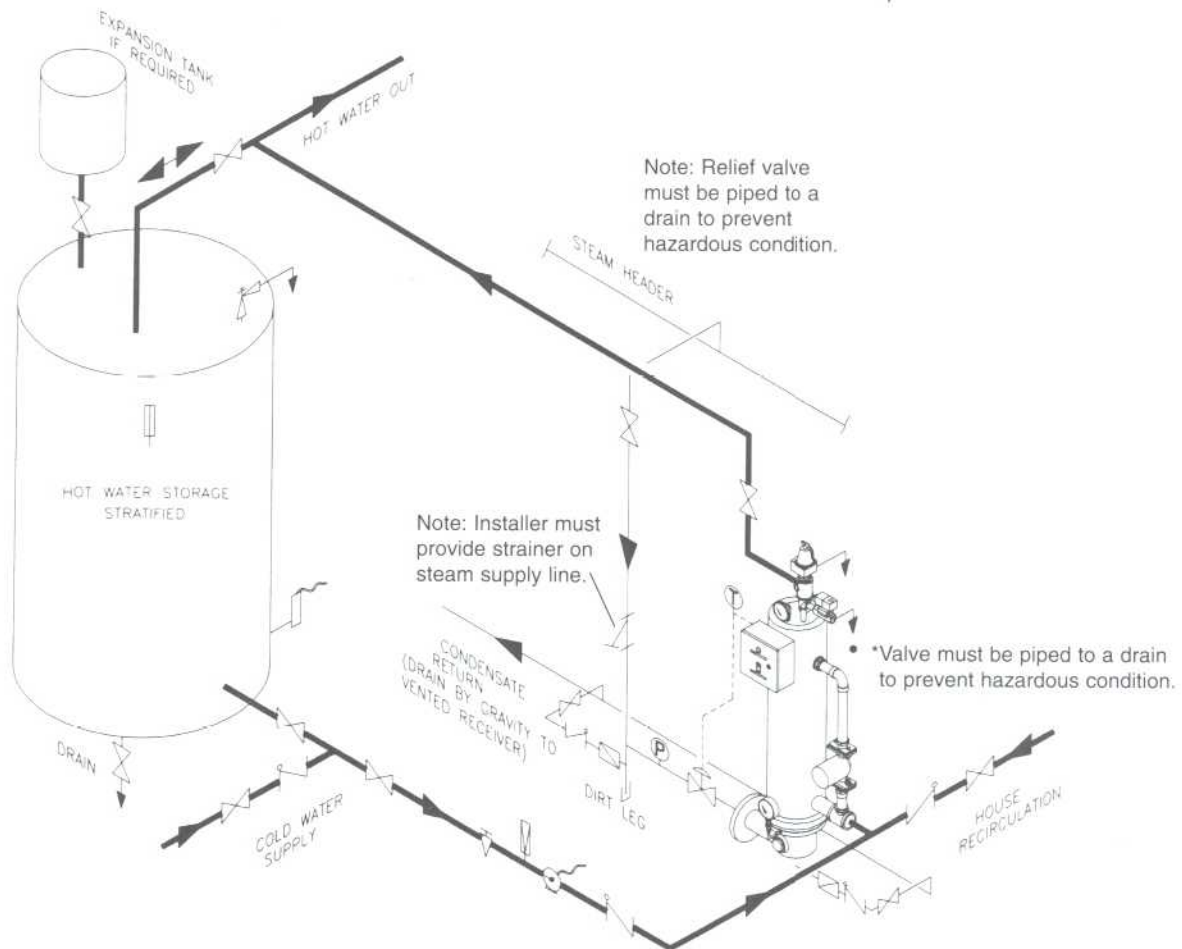
	Stop Valve		Strainer
	Check Valve		Relief Valve
	Control Valve		Thermometer
	Orifice Union		Steam Trap
	Thermal Control Gage		Circulator
	Pressure Gage		Balancing Cock
	Pipe Union or Flanges		Petcock
	Compound Pressure Gage		Flow Indicator



Note: Relief valve must be piped to a drain to prevent hazardous condition.

Note: Installer must provide strainer on steam supply line.

**Steam System:**  
Stratified Storage  
**Application:**  
Limited Recovery Water Heater



Note: Relief valve must be piped to a drain to prevent hazardous condition.

Note: Installer must provide strainer on steam supply line.

\*Valve must be piped to a drain to prevent hazardous condition.

## SERVICE TIPS

### Failure

1. Water temperature too high.
2. Banging or pinging in heater
3. Erratic temperature control
4. Loss of recovery or poor recovery

### Remedy

- Check setting of temperature sensor.
- Check for dirt or foreign material in bleed ports on self-contained steam piloted valves.
- Check for proper spring tension on air-operated valves.
- Check for dirt under seat of valves.
- Check for proper seating of valve.
- Bad sensing element. (See enclosed valve literature.)
- Check for proper condensate drainage.
- Do not attempt to lift condensate above tube bundle.
- Check for back pressure in condensate line. (Condensate should flow by gravity to vented receiver.)
- Check traps for proper operation (when used). (See trap literature.)
- Check for proper rotation of circulation pump.
- Check for flow of circulator pump, (be sure pump is pumping.)
- Check valves in pipe line must be open.
- Check for condensate lift.
- Check for proper steam pressure. Be sure it is not more than heater is designed to operate at.
- Check traps for proper operation when used.
- Check for proper air pressure on air-operated valves. (See valve bulletin.)
- Shut down unit – remove steam chamber and tube bundle. Inspect tube bundle for scale or fouling which could restrict heat transfer.
- Clean with Dow Chemical Versene 100 or equal.
- Replace tube bundles using new gaskets.
- Check and be sure heater design rating is not being exceeded. (See specifications on front cover of this manual.)
- Check for fouling of steam pilot and self-contained valves due to carry over of treatment compound.

### Removal of Tube Bundle

To remove tube bundle, use the following procedure:

1. Valve off steam supply.
2. Valve off cold water supply to heater.
3. Valve off hot water to building.
4. Valve off recirculations line.
5. Turn off all power to heater.
6. Break flange or union on steam valve and condensate line.
7. Loosen nuts on top of tube bundle flange. This will permit dropping of tube bundle for inspection without breaking steam chamber seal.
8. To check the tube bundle for leaks, simply remove the steam chamber only. Tubesheet is threaded to permit examination of possible ruptured tubes without draining heater.
9. When reassembling heater or replacing tube bundle, use new gaskets supplied by manufacturer.

### Recommended Spare Parts

1. Circulator pump – bearing and seal assembly.
2. Thermometer.
3. Temperature sensor on air-operated valve, use Accritem. On steam-piloted valve, use thermal system for Sarco valve and thermostat assembly on Spence valves.
4. Relief valve.
5. Solenoid 3-way valve for pneumatic, 2-way for self contained.
6. Solenoid Thermostat.
7. Replacement tube bundle.
8. Steam trap cage unit (if used).
9. Tube bundle gaskets.
10. Pressure gauge (steam).

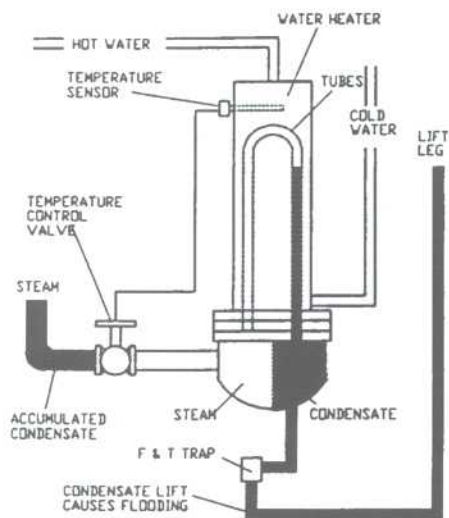
# DRAINING CONDENSATE FROM DOMESTIC WATER HEATERS

The heating of domestic water with steam has been going for over 100 years. The principle is to extract the latent heat from the steam in the tubes resulting in the steam condensing. In the last 30 years the Semi-Instantaneous water heater has grown in acceptability due to its compact size and its accurate temperature control. For proper operation, the Semi-Instantaneous design requires the rapid removal of condensate.

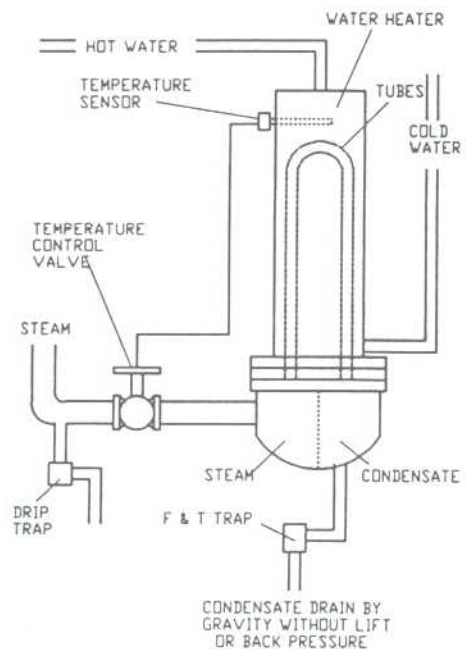
Proper drainage of the condensate from the tubes of the water heater is needed to avoid:

1. Possible tube rupture
2. Damage to steam traps
3. Damage to the temperature control valve
4. Erratic water temperature control

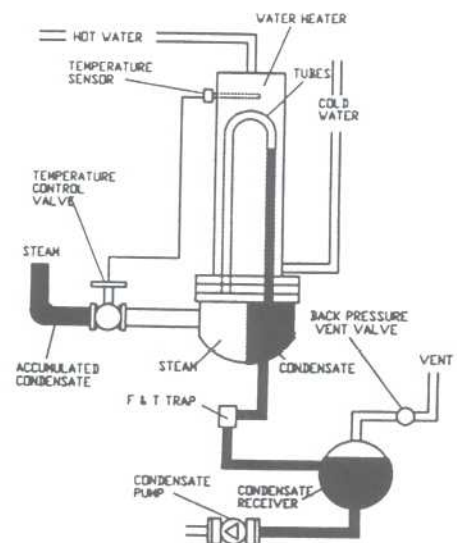
Keep in mind that the sole function of the temperature control valve is to control the outlet temperature of the water! To do this the temperature control valve will proportion the steam flow according to the water flow rate. This means that at lower flow rates the steam in the tubes can be at a sub-atmospheric pressure. Since the water heater will operate at less than its design capacity 90% of the time, the steam pressure in the tubes will be lower than the design pressure and cannot possibly be used to lift condensate above the trap level! To assist in visualizing the proper method of draining condensate from the water heater note the following diagrams.



**FIGURE 2** – Illustrates how condensate, formed in the steam feed line, can accumulate under no or low water flow rates. This condensate will be carried with the steam when the valve opens damaging the valve and tubes. It also shows how the tubes will flood when trying to lift condensate at less than design flow rates. There are no types of traps or check valves that can avoid this condition when there is no steam pressure in the tubes.



**FIGURE 1** – Illustrates the proper method to be used to drain condensate from a semi-instantaneous water heater. Note the drip trap before the temperature control valve to prevent condensate from accumulating under no or low water flow thereby avoiding erratic temperature control, valve damage or impingement of condensate on the tubes. All condensate must drain from the tubes by gravity without lift or back pressure.



**FIGURE 3** – Illustrates the same problems shown in FIGURE 2, but with the addition of a condensate receiver employing a back pressure vent valve in the receiver vent line. This has become a popular method of avoiding a flash steam flume to the atmosphere and any complaints by a client that energy is being lost. It can also provide additional 'net positive suction head' pressure to the condensate pump to aid in pumping hot condensate. This design, however, may cause serious drainage problems for the water heater condensate.

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