Domestic Hot Water

Introduction

An electric domestic hot water heater usually accounts for the largest portion of a household's electricity bill, assuming that electricity is not used for space heating. Natural gas, where available, is less costly. However, it is still a non-renewable resource that contributes to global warming.

Part of the heat output of a contraflow heater can be used to heat domestic hot water.

A heat exchanger consisting of one or more loops of stainless steel high pressure boiler tubing is located against the back of the firebox, in the hottest part of the fire.

It is very important to install the proper safety devices when adding a hot water coil. If water in the coil is allowed to turn to steam, an explosion could result. Also, the water in the tank can reach scalding temperatures, so that a tempering valve may need to be used. Never take any shortcuts when designing or installing a domestic hot water loop into a wood fired appliance.

Thermosyphon method

The heat transfer can take place in two ways, by thermosyphoning, using natural convection, or by means of a small circulation pump.

A thermosyphon system is the simplest, but also has some drawbacks. It requires that the storage tank be located higher than the coil. Best efficiency is obtained when horizontal distance to the tank is 4 ft. (1.2 m) or less and the vertical distance is 6 feet (1.8m) or more.

This arrangement is often not convenient because the domestic hot water tank is usually located in the basement. Sometimes you can get around this by adding a preheat tank. The preheat tank is located for good thermosyhoning and is plumbed to feed into the cold water inlet of the primary tank.

Heat transfer is lower with the thermosyphon method due to the slower water flow through the stainless loop(s). In order to achieve good efficiency, both lines from the coil to the tank should be insulated. A minimum of 3/4" dia. pipe must be used to ensure adequate flow.

Circulation pump method

This method allows the most flexibility in locating

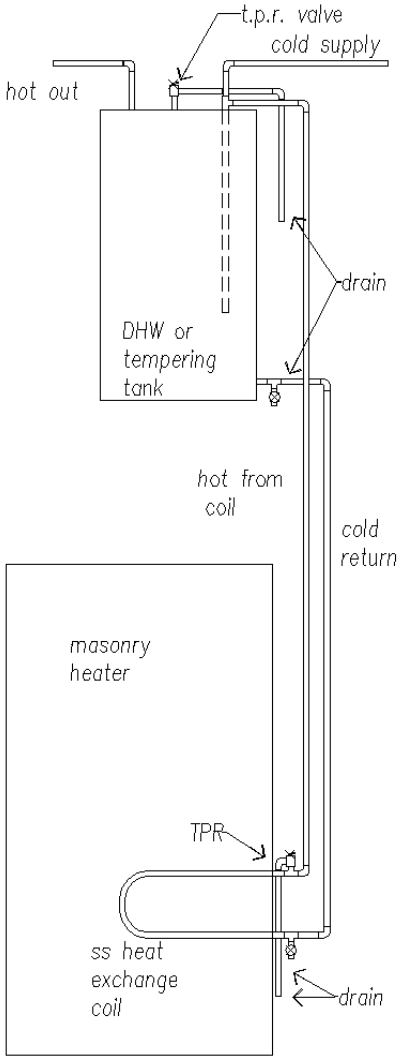

Figure 4. Hot water system -thermosyphon method

the tank(s) and provides the greatest amount of heat transfer. A small pump (1 - 2 gal/min or 0.07 - 0.15 l/sec) is used to circulate water between the coil and the tank. Usually, a standard hot water tank is used in an open system, i.e., there is not a separate heat exchanger inside the tank itself. With an open system, there is a continuous supply of oxygen in the water, requiring the use of a non-ferrous circulation pump body material such as bronze. With iron pump bodies, the oxygen in an open system will generate rust.

A controller is required to sense when the heater is being fired or the water from the heater is warmer than the water in the tank. Since a considerable amount of heat is stored in the firebox after a burn, water heating occurs for some time after the fire is out.

Two temperature sensors are used. One sensor is placed at the hot water outlet from the heater. The other sensor is placed at the tank where cooler water leaves the bottom of the tank on its way to the loop. A differential controller uses the temperature sensor information to determine when to turn the circulation pump on and off.

Tempering tank

A second tank can be installed to increase the capacity of the hot water system. This is known as the tempering tank method. It is often useful in thermosyphon systems (see above). For both types of systems, it has the advantage of being able to utilize more low-grade heat from the heater during periods of high usage. During high usage, water in the tempering tank will be cold. For a thermosyphon system, this creates a higher temperature differential for convection and increases flow in the loop and therefore heat transfer. For both types of systems, it allows low grade heat from the firebox to be utilized for a longer time after the fire is out, since the feedwater to the coil is cold.

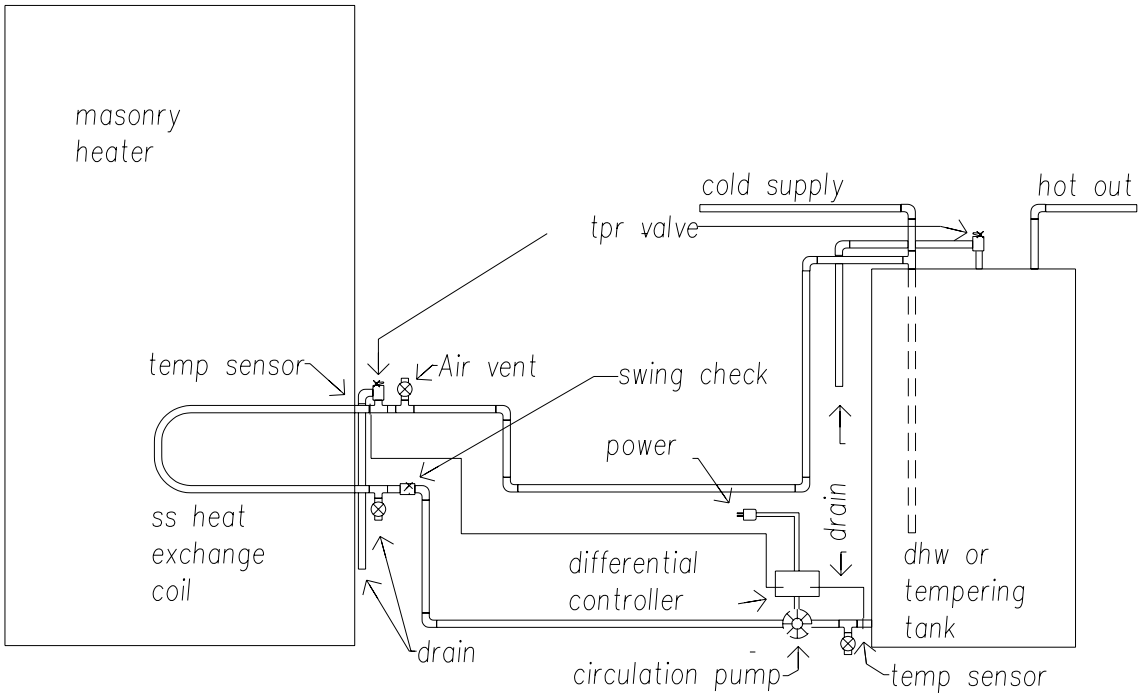

Figure 5. Hot water system - circulation pump method

Required safety devices

Temperature/pressure relief (TPR) valve

In all cases, it is necessary to install a temperature/pressure relief (TPR) valve at the hot water outlet of the coil, near the heater. A TPR valve is a standard plumbing item used on hot water tanks. In case of a temperature or pressure buildup, steam and/or excess hot water are safely diverted into the house drainage system. The valve should be accessible for servicing and testing.

The TPR valve is in addition to the TPR valve that is normally located at the hot water tank, and should not be used as a substitute for the tank TPR valve.

Coil construction

The only material used for the coil in the firebox should be certified Schedule 40 stainless steel high pressure boiler tubing, rated at 16,000 psi (for 3/4" pipe). Both ends of the coil should be threaded. A minimum of 3/4" copper tubing should be used for the coil loop to the tank.

Recommended safety devices

Tempering valve

If hot water usage is low, water in the tank can reach scalding temperatures. A tempering valve can be installed at the tank exit to mix cold water into the hot water line.

Swing check valve

A swing check valve is a one way valve that is installed in either the thermosyphon or the pumped loop. In both cases, a low resistance valve designed for horizontal installation should be used. It is installed near the heater at the water inlet side of the coil. The valve body is stamped with an arrow to indicate the direction of flow.

With a pumped system, it prevents reverse thermosyphoning when the tank is lower than the heater and the heater is cold.

With either a pumped or a thermosyphon system, it acts as a secondary safety device. If a bubble of steam forms in the coil, it creates a pressure pulse. This pulse will cause the swing check valve to open and pass a small amount of water. This mechanism creates a pumping action that circulates water through the coil in case of an emergency, such as a power outage. A small amount of noise will be apparent as the steam bubbles form and collapse.

Drain fitting

The coil loop should have a drain fitting to allow for servicing. Once a year, the loop should be flushed with water. In areas with hard water, the loop should be checked for scale buildup. This can be indicated by dislodged particles of scale coming out of the drain fitting during flushing. it may be necessary to use a cleaning solution to remove any scale buildup.

Air vent

It is a good idea to install an air vent at the high point in the hot water loop circuit. You can use either an automatic vent or simply a gate valve to allow the manual purging of any air that becomes lodged at the high point. This is more of an issue with a pumped system, since the tank is usually lower than the loop.

Operation

Power failures

Since a masonry heater is typically fired for about 2 hours out of 24, the odds of experiencing a power failure during a full burn are reduced accordingly. However, if power failures are a regular occurrence in your area, you should give due consideration to this fact when deciding what level of protection to install.

A properly installed and functioning swing check valve will maintain circulation under most conditions.

If your water supply is from city mains, then pressure will be maintained if the TPR valve vents hot water into the drain. Follow the annual maintenance checklist, below, to keep your system in shape.

If your water is from a well, then you will lose water pressure soon after a power failure. If water boils in the coil and is vented by the TPR valve, you may get air in the coil. If the coil is allowed to get hot enough, it may melt soldered connections. After an emergency of this type, shut off your water and check the system for leaks. You may be able to do this by restoring water pressure in a gradual way.

Optional safety devices

If you feel that your degree of risk warrants it, ie, you have a circulation pump system *and* you are in an area of frequent power failures that result in a loss of water pressure, you can drive the loop with a 12 volt circulation pump. Power the circulation pump with a 12 volt car battery that is maintained by a trickle charger.