DOMESTIC HOT WATER HEATING

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Domestic hot water heating often requires higher temperature water than space heating does. This is due to the fact that heat is being transferred to a 120ºF or greater sink rather than the 70ºF air in a space heat application. There are several ways to configure a domestic water heating system. The two most common are storage recharge and instantaneous. There is also the possibility of using the geothermal water directly as makeup to the domestic hot water heater if the water chemistry permits.

STORAGE RECHARGE

The storage recharge method is illustrated in Figure 1. A small heat exchanger transfers heat from the geothermal water to the domestic hot water. To accomplish this, water is circulated from the water heater tank to the heat exchanger by a circulating pump. This pump responds to a thermostat positioned to monitor the temperature of the storage tank. On a call for heat, the thermostat enables both the circulating pump and a motorized valve located on the geothermal water line. Depending upon the temperature of the water, it may be advisable to add a tempering valve at the hot water outlet. This valve assures that water delivered to the home does not exceed a preset value (adjustable). This method can only be used when relatively high temperature water (>140ºF) is available. Properly designed, this approach to water heating can provide 100% of the energy requirements.

The following components would be suitable for a residential hot-water heating system with capacity of 50,000 Btu/hr (60 gal/hr recovery @ 100ºF rise). Approximate list prices for the components appear at the end of each description.

INSTALLATION NOTES

As with all construction in the home, acceptable practices vary. Always review the design with your local building inspector to verify approval prior to construction.

This layout (Figure 1) assumes the use of a conventional water heater to provide for emergency backup and storage. All piping between the components described and the water heater should be of 1" copper. Some regulatory jurisdictions may require a small expansion tank in the system.

It is important to carefully verify the connections on the heat exchanger. These devices will perform poorly if the entering/exit connections are reversed. The above arrangement (and pricing) are based on the use of a single-wall heat exchanger. In some jurisdictions, depending upon water chemistry a double-wall heat exchanger may be required. This does not alter the basic design of the system as it appears in Figure 1. The cost of the heat exchanger will be much greater, however. In addition, the storage recharge approach may become impractical at the lower end of the temperature range.

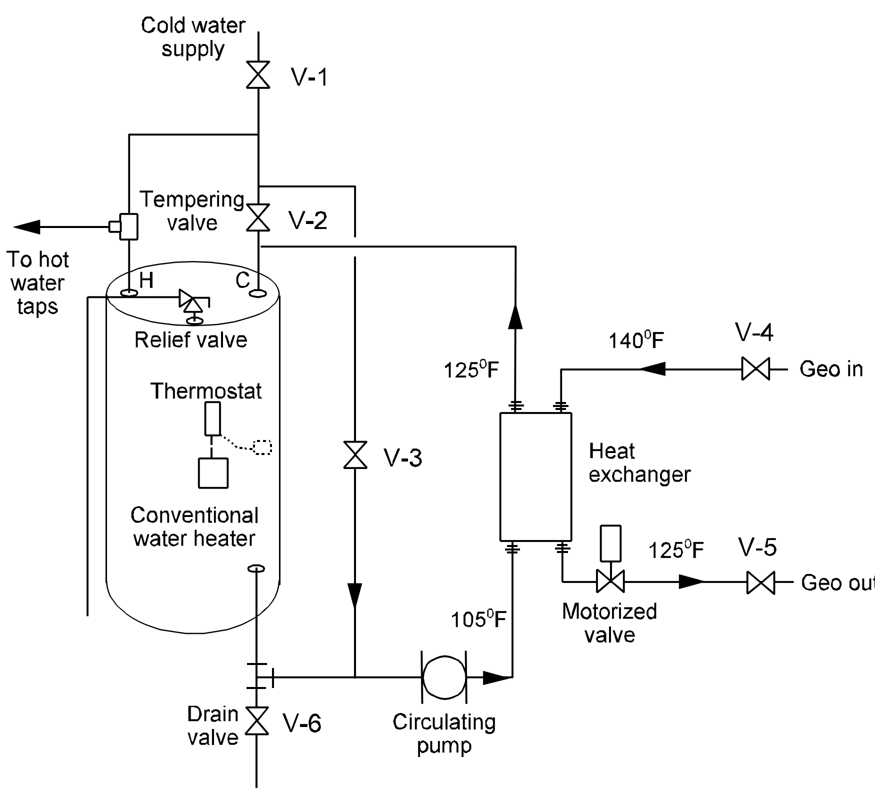

Figure 1.

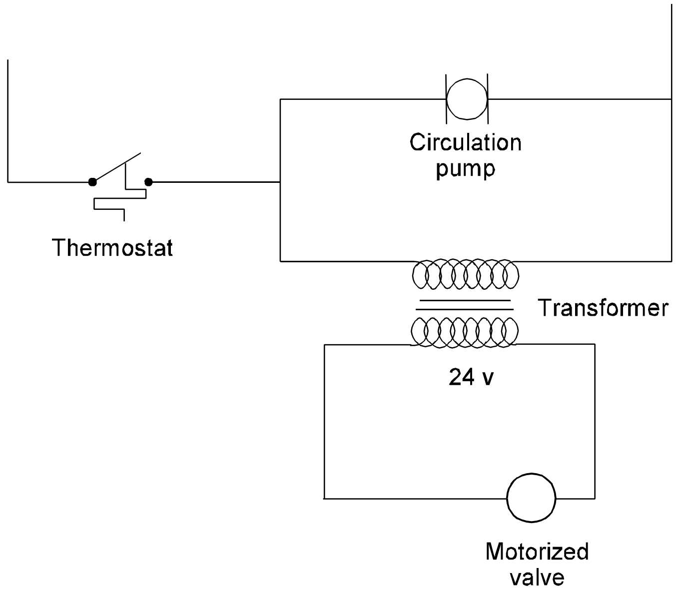

Figure 2.

Zone valves typically are capable of closing against no more than a 25 psi pressure difference across the valve. If the system design is such that a greater pressure difference will occur, a different type of valve should be selected or measures should be taken to reduce the pressure differences across the valve.

Not addressed above is a source of 115-v electricity for the system. Power is required for the circulating pump and the transformer.

The remote bulb of the thermostat must be positioned in such a way that it can sense the temperature of the water in the tank or the tank wall. It can be placed between the tank itself and the insulation if there is access for this. In some cases, on electric water heaters the lower thermostat for the electric element can be disconnected from the water heater circuit and used in place of the remote bulb thermostat. It must be temperature adjustable for this to be practical. In all cases to achieve maximum savings from an arrangement such as this, the thermostat controlling the conventional heating source (electricity, gas, oil, etc.) must be set LOWER than the thermostat controlling the geothermal portion of the system. At least 5 to 10ºF lower is advisable. As an alternative, the conventional heating source can simply be disabled (turning off the breaker or shutting off the fuel source).

For normal operation, V-2 and V-6 in Figure 1 are closed. All other valves are in the open position.

Since hydrogen sulfide is found in most geothermal waters and this chemical is known to attack copper (the brazing material for the heat exchangers), it must be understood that the life of the heat exchanger, in many geothermal installations will be less than in non-geothermal installations. Testing of brazed-plate heat exchangers in geothermal fluids has confirmed a time to H_2S induced failure of 7 years in fluids containing approximately 5 ppm H_2S to 12 years in fluids containing 1 ppm H_2S. These values are considered acceptable in view of the low cost of the exchangers.

MAJOR COMPONENTS AND FITTINGS

1. Brazed-plate heat exchanger - designed to heat 5 gpm from ____ ºF to ____ºF using 3.5 gpm of hot water entering at ____ºF and leaving at ____ºF. Pressure drop on the cold side not to exceed 3 psi and 3 psi on the hot side,

$300

The temperatures, flows and pressure drops on the hot water (geothermal) side of the heat exchanger depend on the temperature of the geothermal water available at the heat exchanger. Suggested values appear in the following table. Actual values will vary somewhat from manufacturer to manufacturer.

Hot Side		**Cold Side**		**Avg.**
In	**Out**	**In**	**Out**	**Tank Temp.**
140	110	105	125	115
145	115	105	125	115
150	120	110	130	120
155	125	110	130	120
160	130	115	135	125
165	135	115	135	125
170+	140	120	140	130

2. Circulating pump, 5 gpm @ 10 ft, wet rotor, in-line, single-stage circulator pump, 115-vac, 1/25-hp motor. Similar to Grundfos model UP15-18B7,

$220

3. Hydronic zone valve - motorized, 3/4" connections, 24-vac operation. Similar to White-Rogers model 13A02-102,

$170

4. Remote bulb thermostat - 90ºF to 150ºF adjustable set point, differential adjustable 5ºF to 30ºF. SPST switch, close on temperature fall,

$95

5. Relay 24-vac coil, NO contacts rated at a minimum of 10 amps FLA,

$40

6. Tempering valve, brass construction, 3/4" connections, adjustable set point 120ºF tp 160ºF, maximum temperature 180ºF, maximum pressure 150 psi. Similar to Watts #70A-3/4.

$44

7. Ball valve, bronze construction, 1" sweat-type connections, 6 required,

$15 each

8. Union, dielectric-type copper sweat x iron pipe connections, 1" size, 4 required,

$8 each

9. Transformer, 115-v primary/24-v secondary, 40 VA,

$17.

INSTANTANEOUS WATER HEATING

Instantaneous water heating is a strategy that can be used with any water temperature. When higher water temperature is available, this strategy can meet nearly 100% of the water heating needs (only tank standby losses would be met by the conventional fuel source). At lower water temperatures, this method supplies only a portion of the water heating needs with the conventional water heater supplying the balances. The major difference between this approach and the storage recharge above is that this design is based on providing all the heat to the water before it enters the water heater tank. The heat exchanger must have mush greater capacity to accomplish this and as a result, it is more expensive than the heat exchanger used in the storage design. The advantage of this design is that it is simpler in terms of the components required and it can make use of lower temperature water for which the storage recharge method is not practical.

Figure 3 presents a layout of the instantaneous water heating arrangement. Cold water, passes through the heat exchanger on its way to the water heater. When the flow switch senses flow in the line, it signals the hot water control valve to open and supply water to the heat exchanger. A requirement for fast response, the valve used in this application must be a solenoid or other fast opening design. In addition, the heat exchanger should be sized to minimize pressure drop in the hot water line. These valves can be noisy when switching positions and consideration of this should be reflected in the installation location.

INSTALLATION NOTES

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This layout assumes the use of a conventional water heater to provide for emergency backup and storage. All piping between the components described and the water heater should be of 1" copper.

It is important to carefully verify the connections on the heat exchanger. These devices will perform poorly if the entering/exit connections are reversed. The above arrangement (and pricing) are based on the use of a single-wall heat exchanger. In some jurisdictions, depending upon

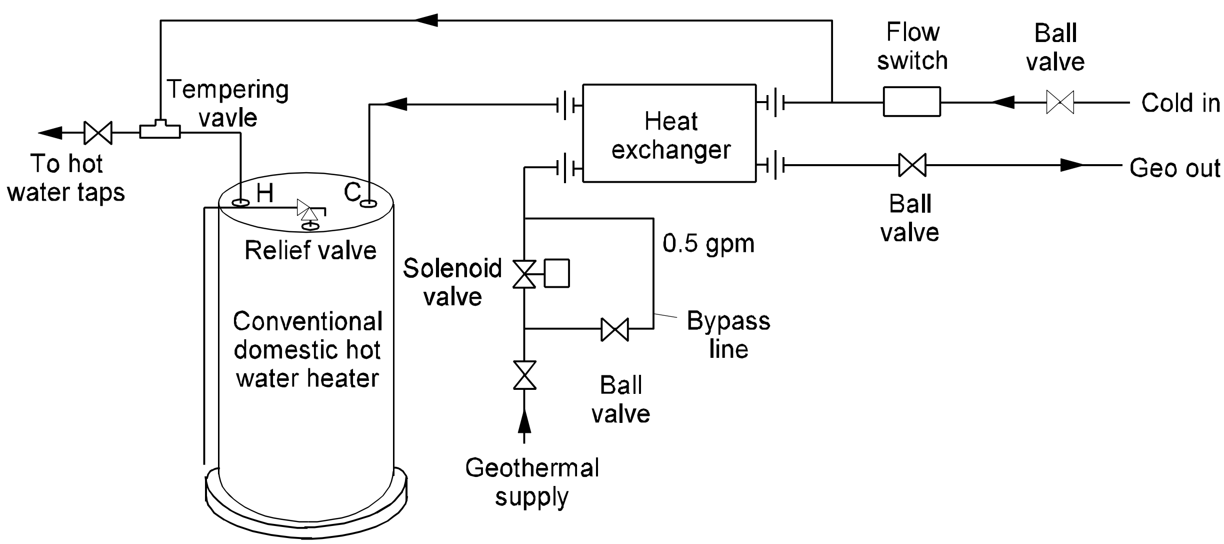

Figure 3.

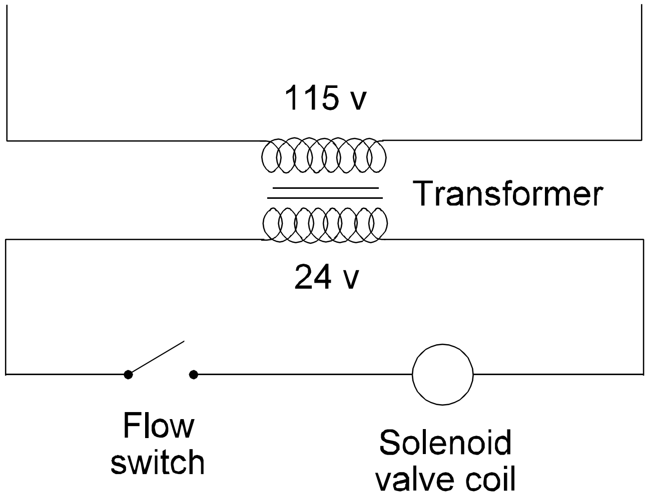

Figure 4.

water chemistry, a double-wall heat exchanger may be required. This does not alter the basic design of the system as it appears in Figure 3. The cost of the heat exchanger will be much greater, however. In addition, the storage recharge approach may become impractical at the lower end of the temperature range.

MAJOR COMPONENTS AND FITTINGS

1. Brazed-plate heat exchanger. To heat 5 gpm from ____ºF to ____ºF using ____ gpm of water entering at ____ºF and leaving at ____ºF. Type 304 or 316 stainless steel plates with 99%+ pure copper brazing material. Pressure drop not to exceed 2 psi on the cold side and 7 psi on the hot side.

   The following table lists temperatures and flow rates for brazed-plate heat exchangers sized to provide 5 gpm of heated water at various hot water temperatures. Exit water temperatures on the hot side for these selections varied from 75 to 80ºF.

2. Solenoid valve, 3/4" connections, 2-way, brass construction, Buna N seals, 180ºF maximum temperature, 24-v coil, 0-100 psi operating pressure differential, normally closed. Similar to Asco #8210G95 valve,

   $78, coil $18

3. Flow switch, mechanical, brass body, 1/2" connections, equipped for replaceable orifices to adjust flow sensitivity, 400 psi, 180ºF rated, SPDT switch 15 A @ 125-v. Similar to Omega FSW-30,

   $141

4. Ball valve, 1" bronze construction, 3 required,

   $15 each

5. Tempering valve, brass construction, 3/4" connections, adjustable set point 120ºF to 160ºF, maximum operating temperature 180ºF, maximum operating pressure 150 psi. Similar to Watts model 70A-3/4.

   $45

6. Transformer, 120-v/24-v, 40 VA,

   $20

7. Union, 1", dielectric type, copper sweat x iron pipe connections 1", 4 required,

   $8 each

8. Ball valve, 1/2" bronze construction,

   $11.

Hot Water ºF	Hot Flow gpm	Entering Water Cold ºF`	Leaving Water Cold ºF	Btu/hr
100	8.7	55	95	100,000
105	7.9	55	98.5	109,000
110	7.1	55	102	117,000
115	6.6	55	105	125,000
120	6.1	55	108	132,000
125	6.0	55	112	142,000
130	5.6	55	115	149,000
135	5.6	55	120	162,000