Energy Efficiency and renewable Energy Network (EREN)
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Consumer Energy Information: EREC Reference Briefs

Demand (Tankless) Water Heaters

Water heating accounts for 20 % or more of an average household's annual energy expenditures. The yearly operating costs for conventional gas or electric storage tank water heaters average $200 or $450, respectively. Storage tank-type water heaters raise and maintain the water temperature to the temperature setting on the tank (usually between 120°-140°F (49°-60°C). The heater does this even if no hot water is drawn from the tank (and cold water enters the tank). This is due to "standby losses": the heat conducted and radiated from the walls of the tank-and in gas-fired water heaters-through the flue pipe. These standby losses represent 10% to 20% of a household's annual water heating costs. One way to reduce this expenditure is to use a demand (also called "tankless" or "instantaneous") water heater.

Demand water heaters are common in Japan and Europe. They began appearing in the United States about 25 years ago. Unlike "conventional" tank water heaters, tankless water heaters heat water only as it is used, or on demand A tankless unit has a heating device that is activated by the flow of water when a hot water valve is opened Once activated, the heater delivers a constant supply of hot water The output of the heater, however, limits the rate of the heated water flow.

Gas and Electric Demand Water Heaters

Demand water heaters are available in propane (LP), natural gas, or electric models. They come in a variety of sizes for different applications, such as a whole-house water heater, a hot water source for a remote bathroom or hot tub, or as a boiler to provide hot water for a home heating system. They can also be used as a booster for dishwashers, washing machines, and a solar or wood-fired domestic hot water system. You may install a demand water heater centrally or at the point of use, depending on the amount of hot water required. For example, you can use a small electric unit as a booster for a remote bathroom or laundry These are usually installed in a closet or underneath a sink. The largest gas units, which may provide all the hot water needs of a household, are installed centrally. Gas-fired models have a higher hot water output than electric models. As with many tank water heaters, even the largest whole house tankless gas models cannot supply enough hot water for simultaneous, multiple uses of hot water (i.e., showers and laundry). Large users of hot water, such as the clothes washer and dishwasher, need to be operated separately Alternatively, separate demand water heaters can be installed to meet individual hot water loads, or two or more water heaters can be connected in parallel for simultaneous demands for hot water. Some manufacturers of tankless heaters claim that their product can match the performance of any 40 gallon (151 liter) tank heater.

Selecting a Demand Water Heater

Select a demand water heater based on the maximum amount of hot water to meet your peak demand. Use the following assumptions on water flow for various appliances to find the size of unit that is right for your purposes.

Faucets:
0.75 gallons (2.84 liters) to 2.5 gallons (9.46 liters) per minute.

Low-flow showerheads:
1.2 gallons (4.54 liters) to 2 gallons (7.57 liters) per minute.

Older standard shower heads:
2.5 gallons (9 46 liters) to 3.5 gallons (13.25 liters) per minute.

Clothes washers and dishwashers:
1 gallon (3.79 liters) to 2 gallons (7.57 liters) per minute.

Unless you know otherwise, assume that the incoming potable water temperature is 50°F (10°C). You will want your water heated to 120°F (49°C) for most uses, or 140°F (60°C) for dishwashers without internal heaters. To determine how much of a temperature rise you need, subtract the incoming water temperature from the desired output temperature. In this example, the needed rise is 70°F (21 °C).

List the number of hot water devices you expect to have open at any one time, and add up their flow rates. This is the desired flow rate for the demand water heater Select a manufacturer that makes such a unit. Most demand water heaters are rated for a variety of inlet water temperatures. Choose the model of water heater that is closest to your needs.

As an example, assume the following conditions: One hot water faucet open with a flow rate of 0.75 gallons (2.84 liters) per minute. One person bathing using a shower head with a flow rate of 2.5 gallons (9.46 liters) per minute. Add the two flow rates together If the /inlet water temperature is 50°F (10°C), the needed flow rate through the demand water heater would need to be no greater than 3.25 gallons (12.3 liters) per minute. Faster flow rates or cooler inlet temperatures will reduce the water temperature at the most distant faucet. Using low-flow showerheads and water-conserving faucets are a good idea with demand water heaters.

Some types of tankless water heaters are thermostatically controlled. They can vary their output temperature according to the water flow rate and the inlet water temperature. This is useful when using a solar water heater for preheating the inlet water If, using the above example, you connect this same unit to the outlet of a solar system, it only has to raise the water temperature a few degrees more, if at all, depending on the amount of solar gain that day.

Cost

Demand water heaters cost more than conventional storage tank-type units. Small point-of-use heaters that deliver 1 gallon (3.8 liters) to 2 gallons (7.6 liters) per minute sell for about $200. Larger gas-fired tankless units that deliver 3 gallons (11.4 liters) to 5 gallons (19 liters) per minute cost $550-$1000.

The appeal of demand water heaters is not only the elimination of the standby losses and the resulting lower operating costs, but also the fact that the heater delivers hot water continuously Gas models with a standing (constantly burning) pilot light, however, offset the savings achieved by the elimination of standby losses with the energy consumed by the pilot light.

Moreover, much of the heat produced by the pilot light of a tank-type water heater heats the water in the tank; most of this heat is not used productively in a demand water heater The exact cost of operating the pilot light will depend on the design of the heater and price of gas, but could range from $12 to $20 per year Ask the manufacturer of the unit how much gas the pilot light uses for the models you consider It is a common practice in Europe to turn off the pilot light when the unit is not in use.

An alternative to the standing pilot light is an intermittent ignition device (IID). This resembles the spark ignition device on some gas kitchen ranges and ovens. Not all demand water heaters have this electrical device. You should check with the manufacturer for models that have this feature.

Life Expectancy

Most tankless models have a life expectancy of more than 20 years. In contrast, storage tank water heaters last 10 to 15 years. Most tankless models have easily replaceable parts that can extend their life by many years more.

Typical Flow Rates in Gallons per Minute (gpm)

Fixture Type	Lavatory	Bathtub	Shower	Kitchen Sink	Pantry Sink	Laundry Sink	Dish-washer
Flow Rates	.5	2.0 - 4.0	1.5 - 3.0	1.0 - 1.5	1.5 - 2.5	2.5 - 3.0	1.0 - 3.0

FLOW CHART

POWER REQUIRED - kW

GPM	20°F	30°F	40°F	50°F	60°F	70°F	80°F	90°F	100°F	110°F
10	29.34kW	44kW	58.6kW	73.2kW						
9	26.4kW	39.5kW	52.7kW	65.9kW	79kW					
8	23.4kW	35.1kW	46.9kW	58.6kW	70.3kW	82kW				
7	20.5kW	30.7kW	41kW	51.2kW	61.5kW	71.5kW	82kW			
6	17.6kW	26.4kW	35.1kW	44kW	52.7kW	61.5kW	70.3kW	79kW		
5	14.6kW	22kW	29kW	37kW	44kW	51.2kW	58.6kW	65.9kW	73.2kW	
4	11.7kW	17.6kW	23.4kW	29kW	35.1kW	41kW	46.9kW	52.7kW	58.6kW	64.4kW
3	8.8kW	13.0kW	17.6kW	22kW	26.4kW	30.7kW	35.1kW	39.5kW	44kW	48.3kW
2	5.8kW	8.8kW	11.7kW	14.6kW	17.6kW	20.5kW	23.4kW	26.4kW	29.3kW	32.2kW
1	3.0kW	4.4kW	5.8kW	7.3kW	8.8kW	10.2kW	11.7kW	13.0kW	14.6kW	16.1kW
½	—	—	3.0kW	3.6kW	4.4kW	5.1kW	5.8kW	6.5kW	7.3kW	8kW

Temperature Rise - °F

FORMULAS

$$\text{Flow Rate, (GPM)} = \frac{\text{kW rating x 6.83}}{\text{rise in temp (°F)}}$$

$$\text{Rise in Temp. (°F)} = \frac{\text{kW rating x 6.83}}{\text{GPM}}$$

$$\text{kW Rating} = \frac{\text{GPM x rise in temp}}{6.83}$$