



## Housing Fact Sheets

# Demand (Tankless or Instantaneous) 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 or 49°-60°C). Even if no hot water is drawn from the tank (and no cold water enters the tank), the heater will operate periodically to maintain the water temperature. 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.



## Selecting a Demand Water Heater

Select a demand water heater based on the maximum amount of hot water needed 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 shower heads: 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 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 (39°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 and with 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. It is a good idea to use low-flow shower heads and water-conserving faucets 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.

## 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-\$1,000.

The appeal of demand water heaters is not only the elimination of the tank 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 some of the savings achieved by the elimination of tank 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.

## Bibliography

This list does not cover all available sources of information on tankless water heaters, nor is the mention of any publication, product, service, or organization to be considered a recommendation or endorsement.

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