

## Tankless water heaters offer some important advantages, but they have some drawbacks, too

By Greg Guiltner

Should we buy a tankless hot water heater? That's the question my wife Vicki and I faced in 1981, when we began to plan our own superinsulated house. We were looking for the most efficient choices in everything from lighting to windows. Since water heating accounts for about 20% of home energy use, we really wanted to make sure we made the right choice. Advertisements for tankless hot water heaters, also called *demand-use* or *instantaneous* heaters, were appearing in many magazines at the time. For several reasons (which I'll explain later) we took the plunge and bought an Aquastar tankless heater. At the time, we knew of no one who owned one of these heaters and in fact had never even seen one. If you wonder if we made the right choice or if a tankless heater might be right for you, read on. Perhaps our experience over the last ten years can help you decide.

### Why tankless?

While planning to build our house, I approached my friendly former banker about a building loan. He showed his keen interest in the project by laughing in my face. Though I never even finished completing the loan application, the bank further demonstrated their enthusiasm by mailing out a written rejection: No building experience, no credit history, no collateral, no loan. As a result, we decided to scale back and try to build on a cash-and-carry basis, using meager savings and income from my job as we progressed.

Our goal changed from building the house we would live in forever, to building a small superinsulated house that would be low-cost to build and live in and easy to sell later. We would use this house as our testing ground to discover what worked for us and what features to incorporate in our dream home later.

The first advertisements I saw for tankless hot water heaters mostly promoted their ability to provide endless hot water. The ads typically showed a large family with Mom, Dad, and a bunch of kids in their bathrobes, right after they'd all taken showers, one right after the other. "Who needs

that?" I thought. "We don't even have any kids."

But later, when several energy-related magazines did reviews comparing the energy-saving features of these heaters, I began to take notice. We sent for information from several companies. The literature we received confirmed that there was a drawback: these heaters were not cheap. They cost about three times what a mid-range hot water tank cost.

The up-side was, the heater we picked was supposed to save 20-50% of the cost of heating water. If this panned out, payback would come well within the time frame that we expected to remain in the house. Still, that was a lot of money for us. I cringed as I mailed the check, sincerely hoping the expected savings appeared. Vicki encouraged me by saying, "Well, if it doesn't work, we'll know what not to get next time."

### How they work

If you have a conventional hot water tank, you've probably never had anyone ask, "What's that thing?" At our house, visitors often ask just that. Tankless water heaters don't look anything like their conventional cousins, and they work differently, too. As the name implies, they have no tank and store no hot water. As a result, they are much smaller—about the size of a suitcase. Also, they hang on the wall, taking up no floor space whatsoever. If you're as squeezed for space as we were, this can be a real benefit. We were able to put our water softener on the floor space that



*Is your hot water heater smaller than a four-year-old? Benjamin Guiltner shows how this Aquastar measures up. The model shown in the photo is one of the largest tankless heaters available.*

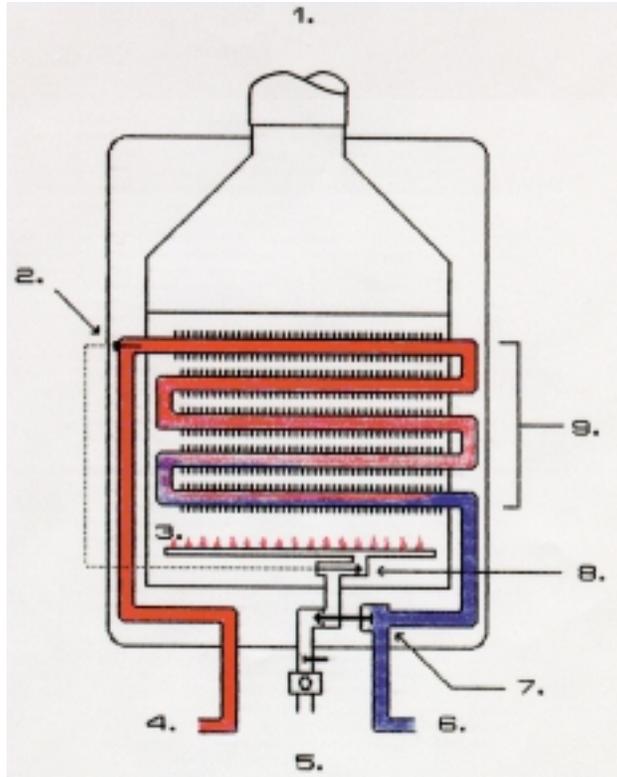
would have been occupied by a conventional hot water tank.

Tankless water heaters are available in propane and natural gas models. There are also electric models, but these aren't energy conservers. The gas heaters have a pilot light, just like a regular hot water tank, but the burner never comes on until someone uses hot water. Water flow causes the heater to open the gas valve to the burner. Water is heated as it flows through a heat exchanger. The exchanger is nothing more than copper tubing that loops back and forth above the burner. Heat fins on the tubing increase the surface area and therefore the heating efficiency.

A conventional hot water tank heats water like a pan on the stove, only this pan is four or five feet high. A tankless exchanger is much more efficient than this. Better heat transfer is where some of the energy savings are accomplished. The rest of the savings come from the absence of any stand-by heat loss. No matter how well a regular hot water tank is insulated, some heat is lost through the walls of the tank, especially through the uninsulated flue, which passes through the center of the tank. On a tankless unit, more of the heat produced from the burner is actually delivered to the tap.

### Modulating burners

That's about all there is to some tankless heaters. The better heaters also have a modulating burner. On these heaters, a thermostatic sensor measures the temperature of the water exiting the heater, and adjusts the gas flow to the burner accordingly. Modulating heaters will continuously provide the precise temperature you have set them for, over a certain flow



(1) Gas vent [flue]. (2) Thermostat sensor. (3) Burner.  
 (4) Hot water outlet. (5) Gas pressure regulator.  
 (6) Cold water inlet. (7) Gas flow valve [water controlled]. (8) Gas flow modulator [temperature controlled]. (9) Heat exchanger.

range. If you exceed this maximum flow, the water exiting the heater will be cooler than the temperature you set it for. Assuming a 60° temperature rise, maximum flows range from around one gallon per minute on the smaller heaters, to about 4.4 gpm on the largest heaters.

The heater we bought had a modulating burner. I wouldn't recommend those that don't, though they are cheaper. With non-modulating units, the temperature of the water varies whenever the flow rate changes. You may eventually get used to this, but you might need to give visitors an instruction manual. Most people are accustomed to increasing the hot water flow when they want hotter water. On a non-modulating heater, this will actually *decrease* the temperature, since the water flows through

the exchanger faster. Conversely, when someone turns the water flow down low, the temperature can become scalding hot. Also, when running water at very low flow rates, the high temperatures produced tend to cook any hardness in the water onto the inside of the heat exchanger tubes, reducing their efficiency.

### Installation

Our heater was delivered in an impossibly small box. I'd seen the photos in brochures and magazines, but seeing this little box sitting in the middle of the living room floor brought home just how small these things really are. If you've ever wrestled a regular hot water tank into place, installing a tankless water heater is going to be a real delight.

First you'll want to carefully consider where to put your heater. You must pick a place where it will not freeze.

Remember, tankless heaters store no hot water. The meager pilot light is not enough to save your heater or your plumbing. The fact that you can put a regular hot water tank in a small, unheated space and have it maintain enough heat to preserve the tank and piping to it, should tell you something about where part of your energy dollars are going.

Hanging the heater is simple. My Aquastar came with a heat shield mounted on two wall brackets that screw onto the wall. The brackets were designed 16" apart to fit normal stud spacing. The heater itself then slid over the wall brackets. After the heater was hung, all that was left was connecting the water and gas lines and the flue. The front and sides of my heater had to be removed to provide easier access for these connections.

Connecting the water lines was just like on any water heater, except that the inlet and outlets are at the bottom of the heater, rather than on top. One difference: there is no place on the heater to put a temperature/pressure relief valve. This doesn't mean you don't need one. You have to install a T fitting in the plumbing at the hot water outlet to provide a place to mount the relief valve.

When you're ready to connect the vent, you'll find that a tankless unit will require a larger vent than a conventional water heater. This was no problem on my new installation. However, if you are replacing an old hot water tank, you'll have to make some changes. Conventional hot water tanks use small 3" vents. All propane or natural gas tankless heaters will need a bigger vent than this. Ours used a 5" vent. You definitely don't want to just put in a reducer. The reason standard hot water tanks use such small vents is because they burn slowly over a protracted length of time, to heat or reheat the water in the tank. The burner on a tankless heater, however, is only on for a short time, while you are using water. It must heat the water quickly as it passes through. As a result, when you are using a lot of hot water, gas is burned at a faster rate, but for a much shorter time. You need that bigger vent to keep up with the increased burn rate on the tankless heaters. Since the vent is so close to the wall, we used a type "B" gas vent. This double-walled vent can be used with as little as 1" clearance from combustibles.

Just as the vent pipe was larger, the gas supply piping must be larger. The supply pipe on our

Aquastar was  $\frac{3}{4}$ ", rather than the  $\frac{1}{2}$ " typically used with a hot water tank. Other than the pipe size, the only difference in connecting the gas piping was that a pressure regulator (included with the heater) goes just before the heater. The regulator had  $\frac{3}{4}$ " female connections at the inlet and outlet, so installing it required a  $\frac{3}{4}$ " nipple between the heater and the regulator.

### **Trying it out**

At last we were ready to try out this expensive device. Lighting the pilot on one of these heaters is almost exactly like lighting a conventional heater. Turn the burner knob to the "pilot" position and hold in the button until the pilot is lit. Our heater had a convenient piezo igniter, like what you'd find on a gas grill. Just push the button, and the igniter throws a tiny spark that lights the pilot. Lighting it

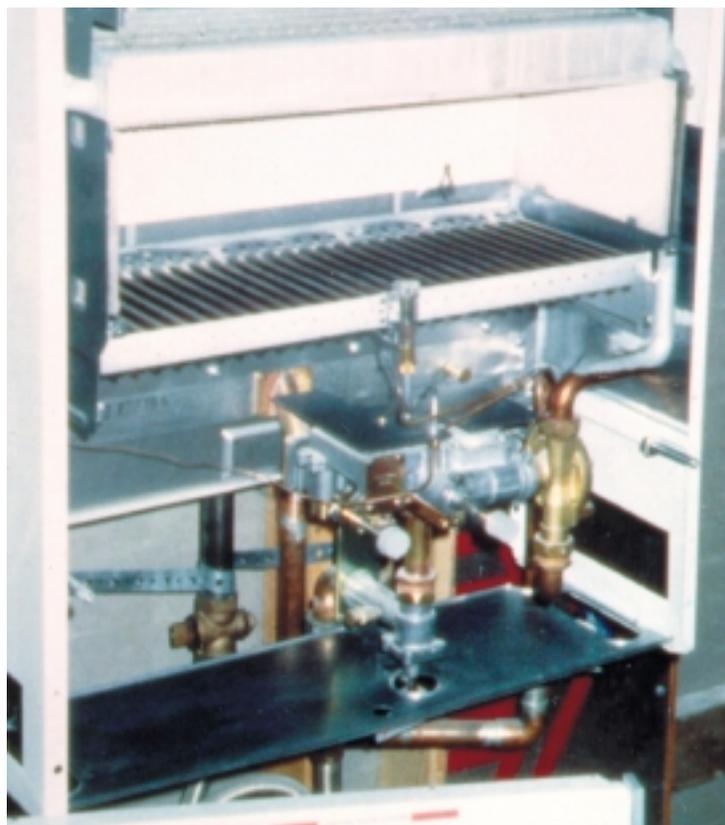
the first time took a bit longer, since all the air had to purge from the gas piping before it would stay lit. After the pilot is lit, you turn the burner knob to the "burner" position.

While our first hot water at the new house may not have rated up there with the first flush, it was at least a close second. I sent my dad, who was at the house helping me install the heater, to open a water faucet. As soon as he did, the burner popped to life, sounding much like a gas furnace coming on. In seconds, hot water was flowing out the faucet in the bathroom. When he turned up the water flow, the burner flame grew bigger, maintaining a constant temperature. When he cut back the flow of water, the flames cut back. The temperature on the outside of the heater cabinet remained surprisingly low, getting warm only on top. When he shut the water off completely, the burner instantly went out. I was ready to say "WOW" backwards. I won't own up to how many times I turned the water on and off just to watch that burner start and stop. It's enough to say that I didn't accomplish much the rest of the day.

### **Dollars & sense**

My family has lived with a tankless water heater for over a decade now. Do they live up to all their promises? Do they provide endless hot water? Do they cost 20-50% less to use than a conventional heater? The answer is Yes . . . with a few caveats.

Tankless heaters do provide an endless flow of hot water, but at a lower flow rate than most people are accustomed to. With the low-flow



*In this photo, the front and combustion chamber panels are removed to show the burner and heat exchanger.*

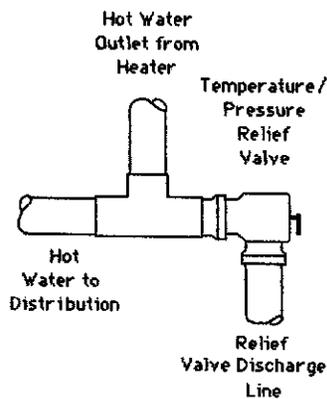
shower heads we were using anyway, this was not a problem. We did have to cut back the cold water valve going to our clothes washer, to prevent it from mixing in too much cold water, due to the lower flow rate. On the other hand, at the time we moved into our house, we had a water bed. We were able to fill the mattress completely with warm water, without pause, so we could sleep in it that same night. You'll have a bit less flow, but you can have that flow for as long as you like.

No big lifestyle changes, but how about the energy claims? Here's how we came out. The first full year we used the tankless heater, we saved 35% in hot water costs over the cost of using the fairly new hot water tank we had before we moved. Before you get too excited, note that this was an average savings of only \$6.50 a month. This is not big potatoes, but it does add up to annual savings of \$78. Unfortunately, we spent about \$560 for this heater, \$380 more than for a mid-range conventional hot water tank. This means it took almost five years to pay back the difference in cost with energy savings from the tankless heater. After that, the \$78 savings was just that, savings. That may or may not seem like much to you, but when's the last time you threw four \$20 bills into your wood stove, just to heat your house for a short time? If you still have a conventional hot water tank, that's almost what you're doing . . . throwing away money for a negligible short-term benefit.

Would we buy another tankless heater? After living inexpensively in our little superinsulated house for eight years, we wanted a bit more room and more land, further out in the country. We bought five acres, and in the spring of 1993, we started building the house where we live now. We incorporated everything we liked about the first house, and yes, we installed a tankless water heater. The surprise came when we discovered that these heaters have remained about

the same price as they were ten years ago. With increased propane and natural gas costs, your fuel savings may be even greater today.

This time around we bought one of the bigger Aquastar models that have since become available. The smaller heater we had before would have been fine, but for one small fact: after 15 years of marriage, we've accumulated seven children. With the old heater, if two people tried to use hot water at once, we would exceed the maximum flow the heater was capable of. With a large household like ours, this was happening more and more frequently.



*To install a temperature/pressure relief valve on a tankless hot water heater, use a T fitting in the hot water outlet line as shown.*

The larger heater has enough capacity to use hot water at two different points without exceeding the maximum flow.

Although the larger heater has more capacity, the energy savings are still there. Buying a bigger tankless heater is not like buying a bigger hot water tank. The larger unit does not use more energy at all times. The modulating burner only burns at whatever rate is needed to raise the water to the desired temperature. The only time the extra burner capacity is used is when two people are using hot water at once.

## Longevity

This extra convenience didn't come without a cost. While the first tankless heater was expensive, this one cost both arms and both legs. Payback, counting energy savings alone, would be on the order of nine or ten years. While this may seem like a long time, there's something else to consider. The main component that fails on a conventional hot water tank is the tank itself. There's no reason to believe that a tankless heater won't last the lifetime of your home. The two tankless water heaters we've bought both had stainless steel burners. The copper heat exchangers had ten-year warranties. We never had to do a thing to our first heater, and it's over ten years old and still working like new. If necessary, heat exchangers, burners, and other parts are all replaceable. Try replacing just the tank on your regular hot water heater. If you add in the cost of replacing an ordinary hot water tank every eight years or so, the payback on a tankless heater suddenly looks considerably better.

Obviously we're sold on using a tankless water heater. There are a few drawbacks however. For one thing, you'll probably have to buy mail order. We bought our first heater directly from the manufacturer. Our latest heater came from Kansas Wind Power. (They advertise in *BHM*.) Buying mail order means a wait for parts, if you ever need them.

Another problem may be resisting the temptation to use more hot water. With a conventional hot water tank, when the hot water runs out, I guarantee you, whoever's in the shower is coming out. With a tankless heater, the hot water never runs out. At our house, "shut off that water" has joined the frequent petition of "shut off the lights." It takes discipline not to use more hot water just because it's there. The cost savings are available, but it's still up to you to make them real. Δ