Water Heater Repair

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Instructor

How Water Heaters Came into Existence

Before the invention of the **water heater**, people used to heat water in a container on the stove or above an open fire. They used to fill the water physically in a tub for bathing or any other purposes. It was time consuming and an uphill struggle.

For the past 100 years or above, we have been making uses of the water heating technology for getting water heating.

History of the Water Heater

There are many assumptions about the real inventor of the water heater. Some theories say it was the Romans, some say it was Benjamin Waddy Maughan while some also say it was Edmund Rudd.

Overall, it appears like invention of the automated water heater was a collection of a few inventors over decades.

Quick facts about water heater invention:

- 306 AD: Romans had large baths facilitated with heated water, whereas these were not considered as real water heaters, but can be regarded as a pioneer work for water heating.

- 1868: An English painter Benjamin Waddy Maughan patented the first water heater. This was very first **residential water heater**, which used natural gases for heating the water. The heater did not have a flue for the ventilation of gas vapors, so it was unsafe to use in households.

- 1889: Edmund Rudd took inspiration from Waddy Maughan water heater and took forward his design by including additional safety features. This was the initial step towards the invention of *modern water heater.*
- 1990: 1990 eras is considered as golden period for water heater inventions. Many designs of water heaters were postulated by various people. It was the period when **electric water heater**, solar water heater and gas water heater came into existence.

Present: Today, we are just required to turn on the switch of water heater and hot water directly come in taps, shower, bathtub, sink, and basin etc. This is not a miracle but advancement of technology.

Now, many big brands are offering many different water heaters and every heater have some distinctive feature of its own.

Electric shower heads

Electric shower heads

As the name implies, an electric heating element is incorporated into such shower heads to instantly heat the water as it flows through.

These self-heating shower heads are specialized point-of-use (POU) tankless water heaters, and are widely used in some countries.

Invented in Brazil in the 1930s and used frequently since the 1940s, the electric shower is a home appliance often seen in South American countries due to the higher costs of gas distribution.

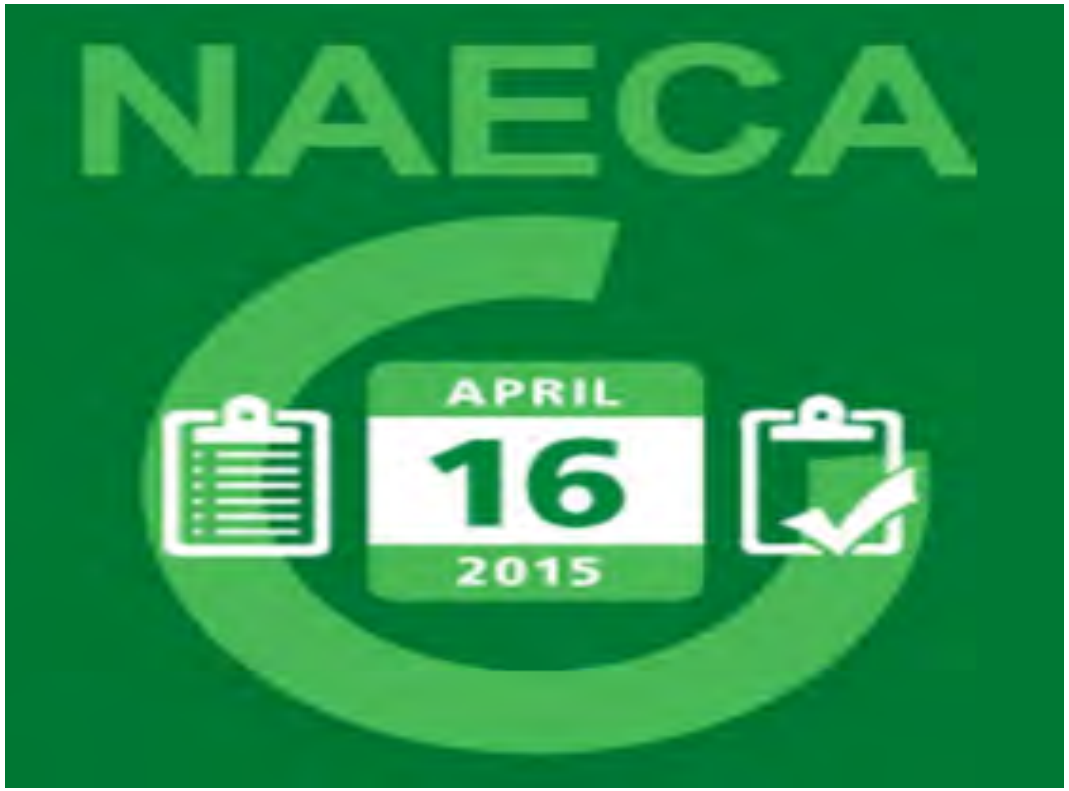
Earlier models were made of chromed copper or brass, which were expensive, but since 1970, units made of injected plastics are popular due to low prices similar to that of a hair dryer.

Electric showers have a simple electric system, working like a coffee maker, but with a larger water flow. A flow switch turns on the device when water flows through it.

Once the water is stopped, the device turns off automatically.

An ordinary electric shower often has three heat settings: low (2.5 kW), high (5.5 kW) or cold (0 W) to use when a central heater system is available or in hot seasons.

A NEW CHAPTER IN **WATER HEATING IS HERE**



National Appliance Energy Conservation Act Enacted in 1975,

NAECA creates uniform efficiency standards for certain household appliances, including refrigerators, dishwashers, clothes washers, clothes dryers and water heaters.

New NAECA Standards

U.S. Department Of Energy (DOE), as part of the national appliance energy conservation act (NAECA), issued final rule energy efficiency mandates in April 2010. while these mandates only apply to products manufactured for sale in the U.S.

These far-reaching new requirements will have important impacts on water heating manufacturers, distributors, contractors and homeowners.

How The Changes Impact The U.S.

- NAECA 2015 standards were developed as part of the Department of Energy's ongoing efforts to save energy and alleviate stress on the national power grid.
- Once the change is in effect, significant progress will be made in achieving savings related to energy, consumers' utility bills, and emissions related to utilities producing electricity and gas.

How The Changes Impact You

Improved efficiency

- By upgrading from an older unit with lower efficiencies to a new NAECA-compliant unit, the improved efficiency ratings will help compensate for your increased upfront investment with energy savings in the long run. In addition, many new water heaters provide added hot water delivery performance.

Increased upfront investment

More efficient water heater models require more materials and parts, and therefore are more expensive to manufacture.

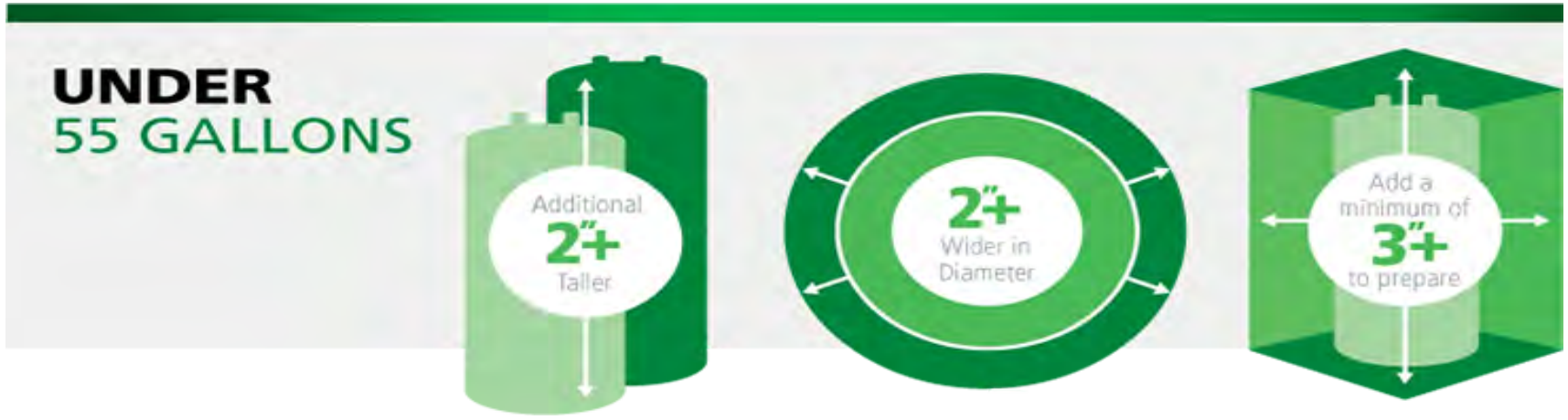
However, with the improved efficiency ratings in place, the energy savings delivered by your new water heater will compensate for your upfront investment.

CHANGES IN PRODUCT DIMENSIONS

Under the new NAECA regulations most water heaters will be larger, requiring more space for installation.

In addition, the height of a new unit with the same gallon capacity as an existing unit may be two or more inches taller.

For example, the diameter of a new unit that has the same gallon capacity as an existing unit may be two or more inches wider.



WATER HEATER TANKS UP TO 55 GALLONS

~ 2" DIAMETER INCREASE

< 10% CAPACITY DECREASE

New heaters will require at least 3" more space around the exterior of the water heater.

Do you have enough room?

WATER HEATER TANKS OVER 55 GALLONS

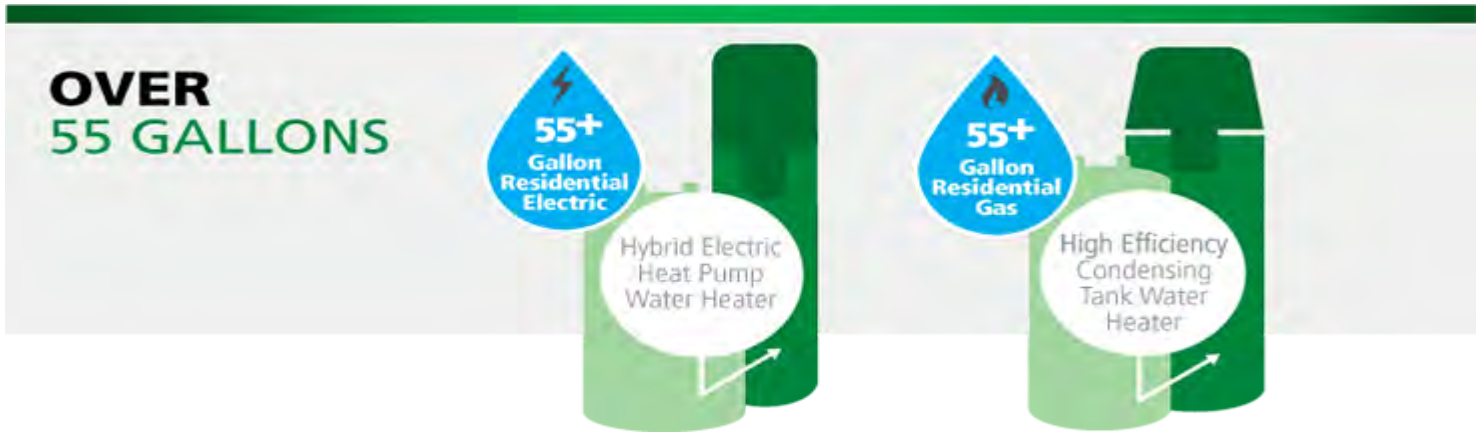
Current Standard 55+ Gallon Electric Water Heater

2015 Standard:

55+ Gallon Residential Hybrid Heat Pump Water Heater

"Based on the NAECA 2015 rules, all residential electric models over 55 gallons must be of the Hybrid Electric heat pump water heater design."

AO Smith



- **Water Heaters Over 55 Gallons**
- Water heaters that are larger than 55 gallons will undergo the biggest changes. They may require more space or potentially switching models.
- All residential electric models over 55 gallons must be of the Hybrid Electric heat pump water heater type design
- All residential gas models over 55 gallons must be of the condensing water heater type design

The Energy Factor

In order to effectively reduce home appliance energy use, conserve more natural resources and generate significant energy cost savings for homeowners, NAECA periodically requires higher energy efficiencies—as measured by Energy Factor or EF ratings—on almost all residential gas, electric, oil and tank-less gas water heaters.

These higher energy efficiencies are based on the Energy Factor, or EF, of the unit, which indicates overall water heating efficiency by measuring how much of the energy delivered to the water heater from your power source is actually used to heat your water. The higher the EF, the more efficiently the water heater converts your power into hot water while reducing losses—and the more money you save on overall energy costs.

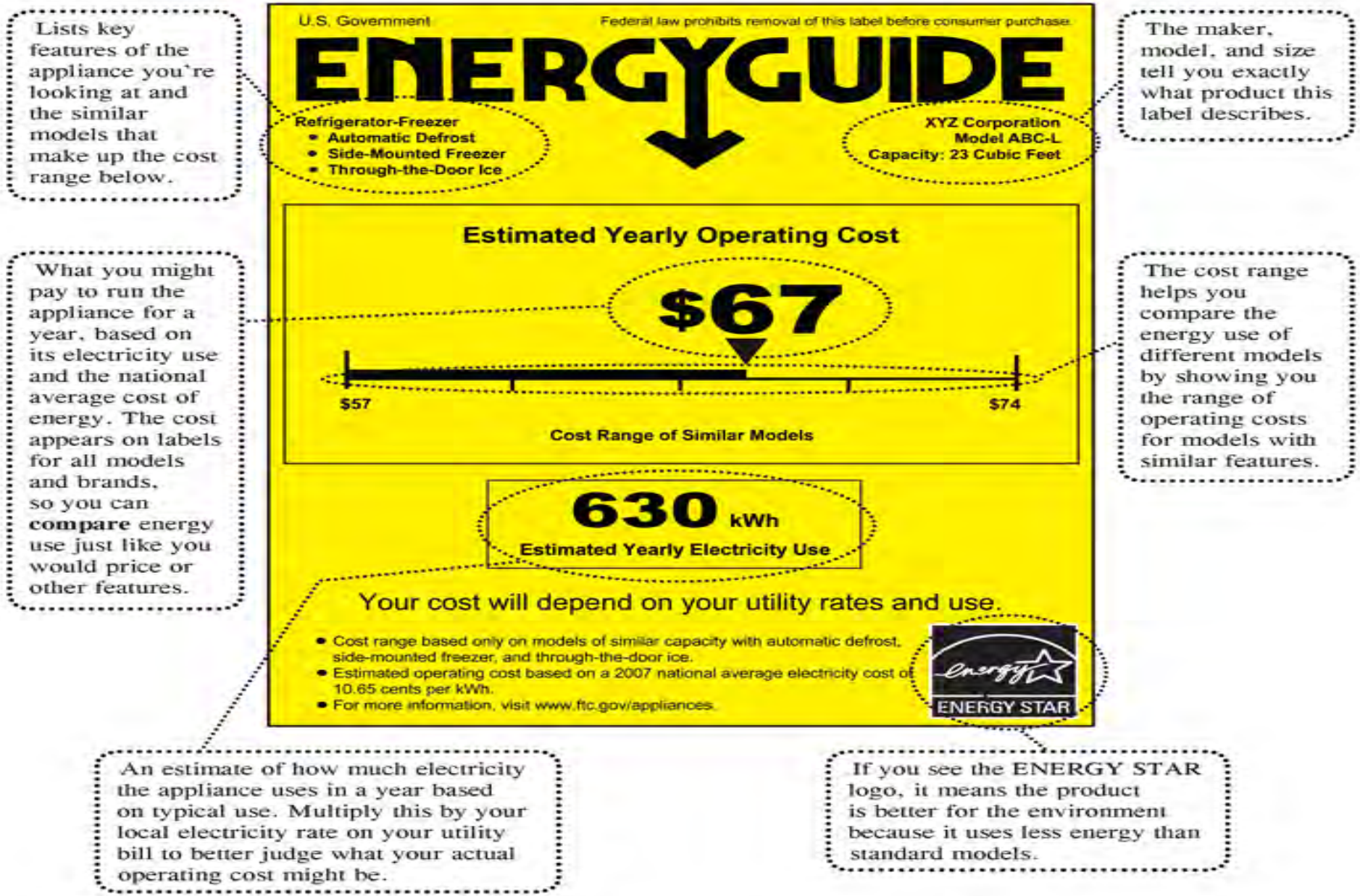
IF A WATER HEATER HAS A

0.94 EF,

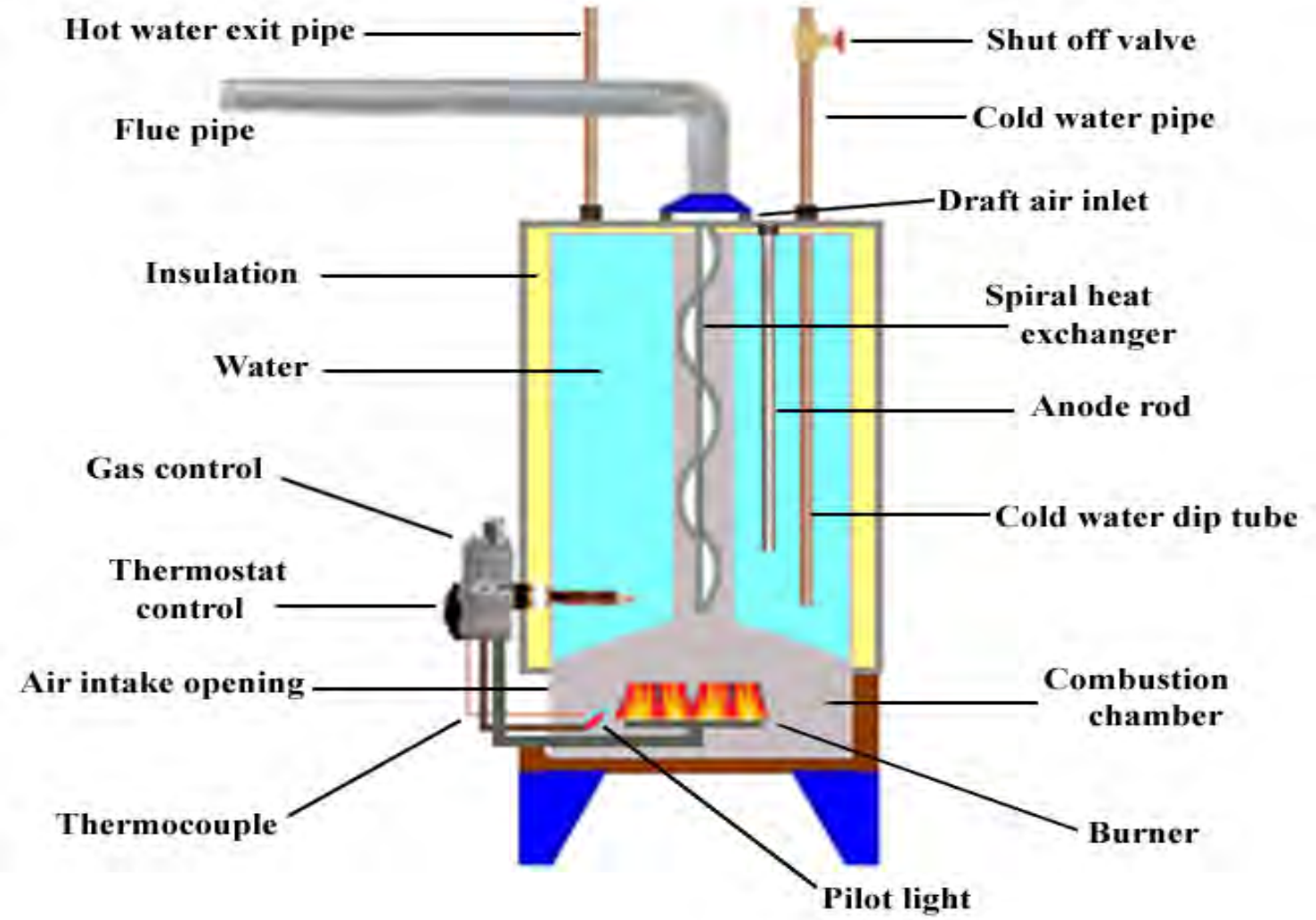
THAT MEANS...

Appliance Energy Guide Label

- **Do all appliances have Energy Guide labels?**
- No.
- Appliances with labels: boilers, central air conditioners, clothes washers, dishwashers, freezers, furnaces, heat pumps, pool heaters, refrigerators, televisions, water heaters and window air conditioners.
- Appliances without labels: clothes dryers, dehumidifiers, humidifiers, ovens and ranges.
- **Is the estimated operating cost close to what I'll actually pay each year?**
- No, it's only an estimate based on typical use and a national average price for electricity. How much you will pay depends on how you use the appliance and your local energy price.


Lists key features of the appliance you're looking at and the similar models that make up the cost range below.
U.S. Government
Federal law prohibits removal of this label before consumer purchase.
ENERGYGUIDE
Refrigerator-Freezer
• Automatic Defrost
• Side-Mounted Freezer
• Through-the-Door Ice
XYZ Corporation
Model ABC-L
Capacity: 23 Cubic Feet
The maker, model, and size tell you exactly what product this label describes.
What you might pay to run the appliance for a year, based on its electricity use and the national average cost of energy. The cost appears on labels for all models and brands, so you can compare energy use just like you would price or other features.
Estimated Yearly Operating Cost
$67
$57
$74
Cost Range of Similar Models
The cost range helps you compare the energy use of different models by showing you the range of operating costs for models with similar features.
630 kWh
Estimated Yearly Electricity Use
Your cost will depend on your utility rates and use.
• Cost range based only on models of similar capacity with automatic defrost, side-mounted freezer, and through-the-door ice.
• Estimated operating cost based on a 2007 national average electricity cost of 10.65 cents per kWh.
• For more information, visit www.ftc.gov/appliances.
energy
ENERGY STAR
An estimate of how much electricity the appliance uses in a year based on typical use. Multiply this by your local electricity rate on your utility bill to better judge what your actual operating cost might be.
If you see the ENERGY STAR logo, it means the product is better for the environment because it uses less energy than standard models.

Components of a Gas Water Heater (Tank Type)



Unlike tank-less water heaters, standard tank-type water heaters use an insulated storage tank.

Water heaters are generally very reliable but occasionally they do have problems.
These problems can include:

- No hot water
- Inadequate hot water
- Rust colored water
- Rotten egg odor
- Low rumbling or popping noise
- Water leaking around base of heater

Construction of the Hot Water Tank

The tank jacket itself is made of steel and encloses a pressure tested water storage tank. Between the storage tank and the tank jacket is insulation to reduce heat loss of the heated water. It is a good idea to supplement the insulation by adding a fiberglass insulation tank jacket to the outside of the hot water heater. These are inexpensive and easy to install.

Inside the tank you will see a **dip tube**.

The dip tube is where the cold water supply enters the tank to be heated by the gas burner. Since cold air and cold water is denser than hot air or hot water, the cold water sets at the bottom of the tank until it is warmed by the burner and heated enough to rise (through convection) to the top of the tank where the hot water hangs out.

In glass-lined tanks there will also be a metal rod in the tank, usually magnesium or aluminum) called a sacrificial anode. The anode rod is bolted and fastened to the top of the tank and extends deep into the tank. It's purpose is to draw corrosion to itself instead of the metal tank. Some models do not have a separate anode but combine the function of the anode with the hot outlet. Plastic lined tanks do not have an anode

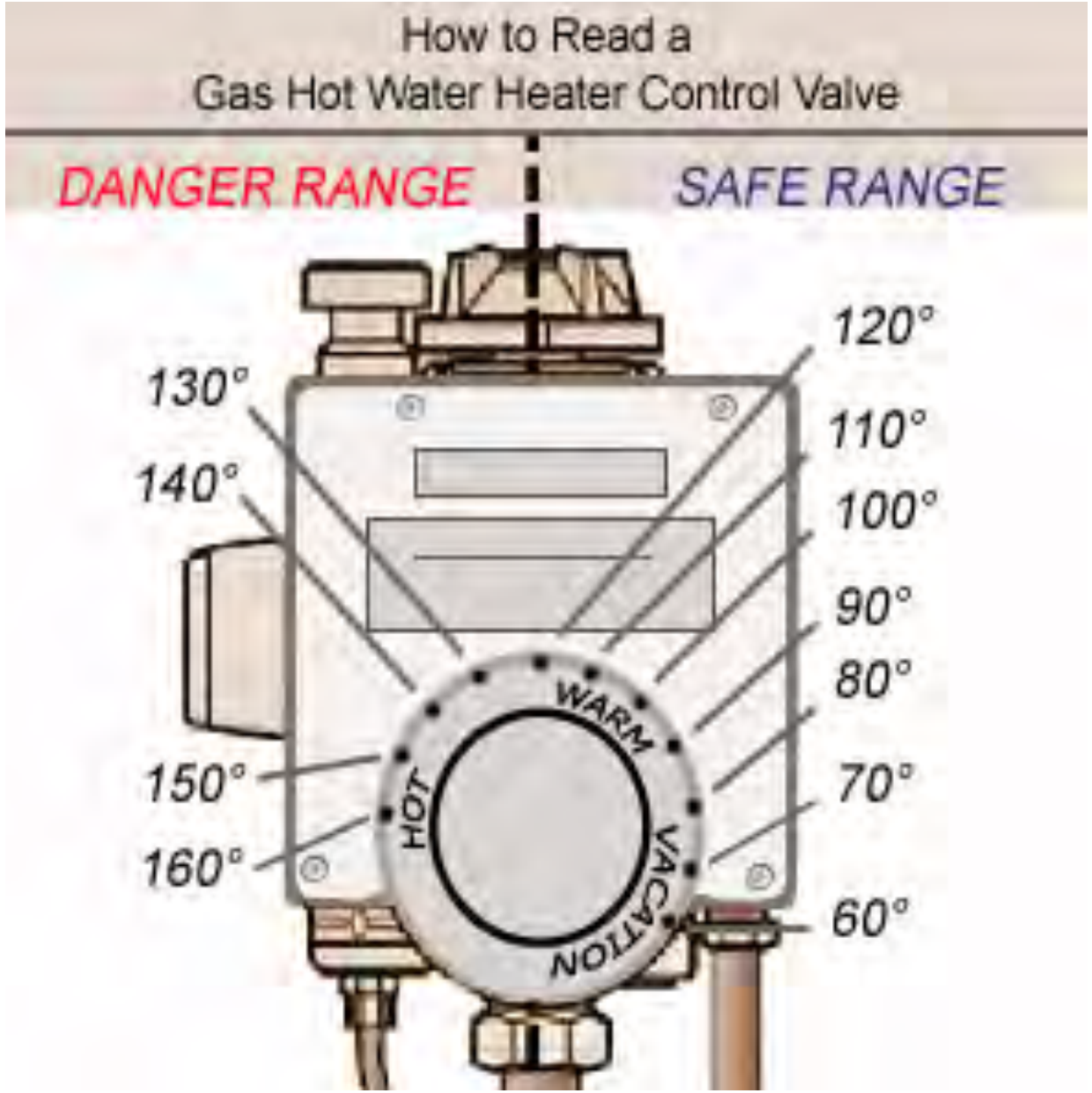
Gas Burner Control Module

The natural gas or propane is supplied by a pipe having its own gas shutoff valve. Just like you need to know where the water supply shutoff valve is located, you need to know where the gas line shutoff is located too.

The gas line feeds into a **gas burner control module** that serves as a kind of thermostat for the water heater. It also controls the ignition of the pilot light. From the control module we now proceed to the gas burner assembly.

This includes the **pilot light** and **gas burner** itself. The pilot light and burner adjustment are key to proper and energy efficient operation of the water heater.

The gas flame should about 1/2 inch in height and should have blue tips.

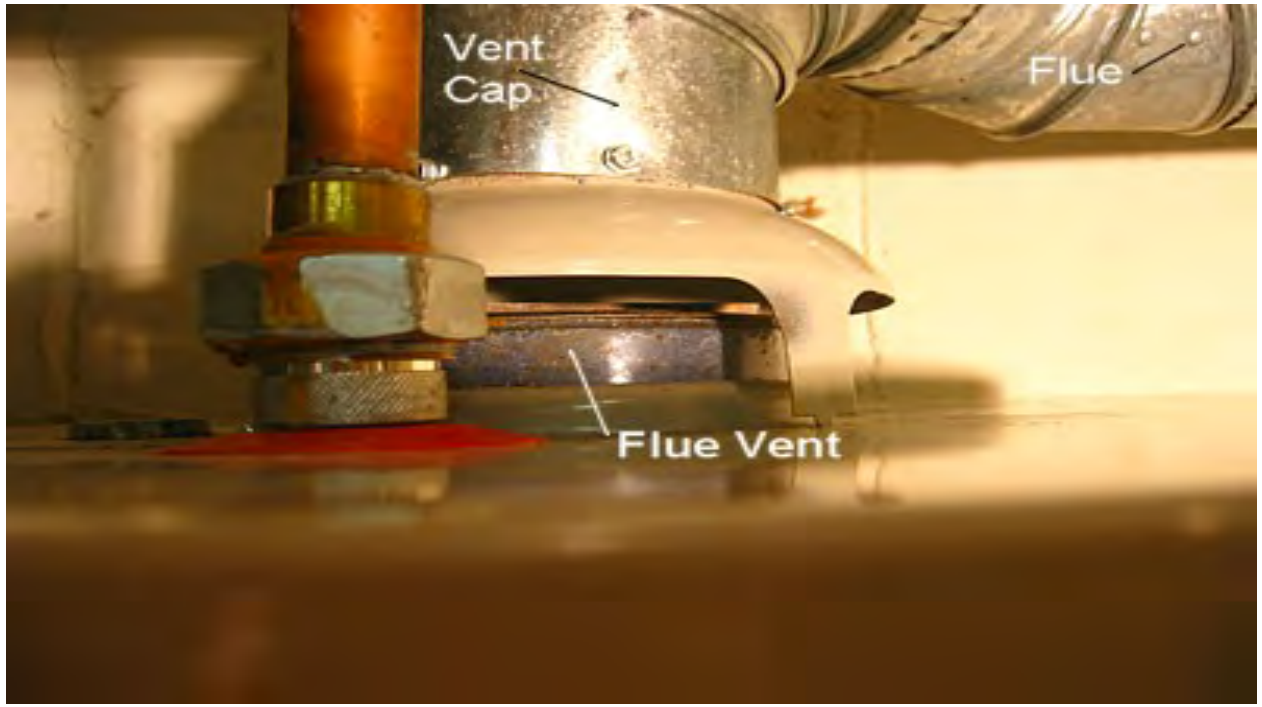


Water Scalding Chart

Set water heater to 120 degrees or less for safety!

TEMPERATURE	TIME TO PRODUCE SERIOUS BURN
120 degrees (hot)	More than 5 minutes
130 degrees	About 30 seconds
140 degrees	Less than 5 seconds
150 degrees	About 1 1/2 seconds
160 degrees (very hot)	About 1/2 second

W008



Gas Combustion Exhaust Flue

The exhaust flue serves two purposes.

It exhausts combustion gasses from the burner and it serves as a type of heat exchanger helping to heat the water in the storage tank.

The flue must be properly exhausted to the outside and there are specific code requirements for the type of flue construction and acceptable details.

Temperature and Pressure Relief Valve

A safety feature of the hot water heater includes the **pressure relief valve** and discharge pipe. It operates like the radiator cap on your car.

The purpose of this valve is to relieve excessive temperature or pressure build up inside the tank if it approaches the limits of the tank's safe design range.
This valve can be located on top of the tank and often is threaded directly into the tank top itself.

To test the valve lift up on the handle slightly and hot water should discharge out of the overflow pipe.

Water heaters potentially can explode and cause significant damage, injury, or death if these safety devices are not installed.

Most plumbing codes require that a discharge pipe be connected to the valve to direct the flow of discharged hot water to a drain, typically a nearby floor drain, or outside the living space.

Some building codes allow the discharge pipe to terminate in the garage.

For older houses where the water heater is part of the space heating boiler, and plumbing codes allow, some plumbers install an automatic gas shutoff in addition to a TPR valve.

When the device senses that the temperature reaches 99 °C (210 °F), it shuts off the gas supply and prevents further heating.

In addition, an expansion tank or exterior pressure relief valve must be installed to prevent pressure buildup in the plumbing from rupturing pipes, valves, or the water heater.

Thermal burns (scalding)

Scalding is a serious concern with any water heater. Human skin burns quickly at high temperature, in less than 5 seconds at 140 °F, but much slower at 127 °F — it takes a full minute for a second degree burn.

Older people and children often receive serious scalds due to disabilities or slow reaction times.

In the United States and elsewhere it is common practice to put a tempering valve on the outlet of the water heater.

The result of mixing hot and cold water via a tempering valve is referred to as "tempered water".

A tempering valve mixes enough cold water with the hot water from the heater to keep the outgoing water temperature fixed at a more moderate temperature, often set to 50 °C (122 °F).

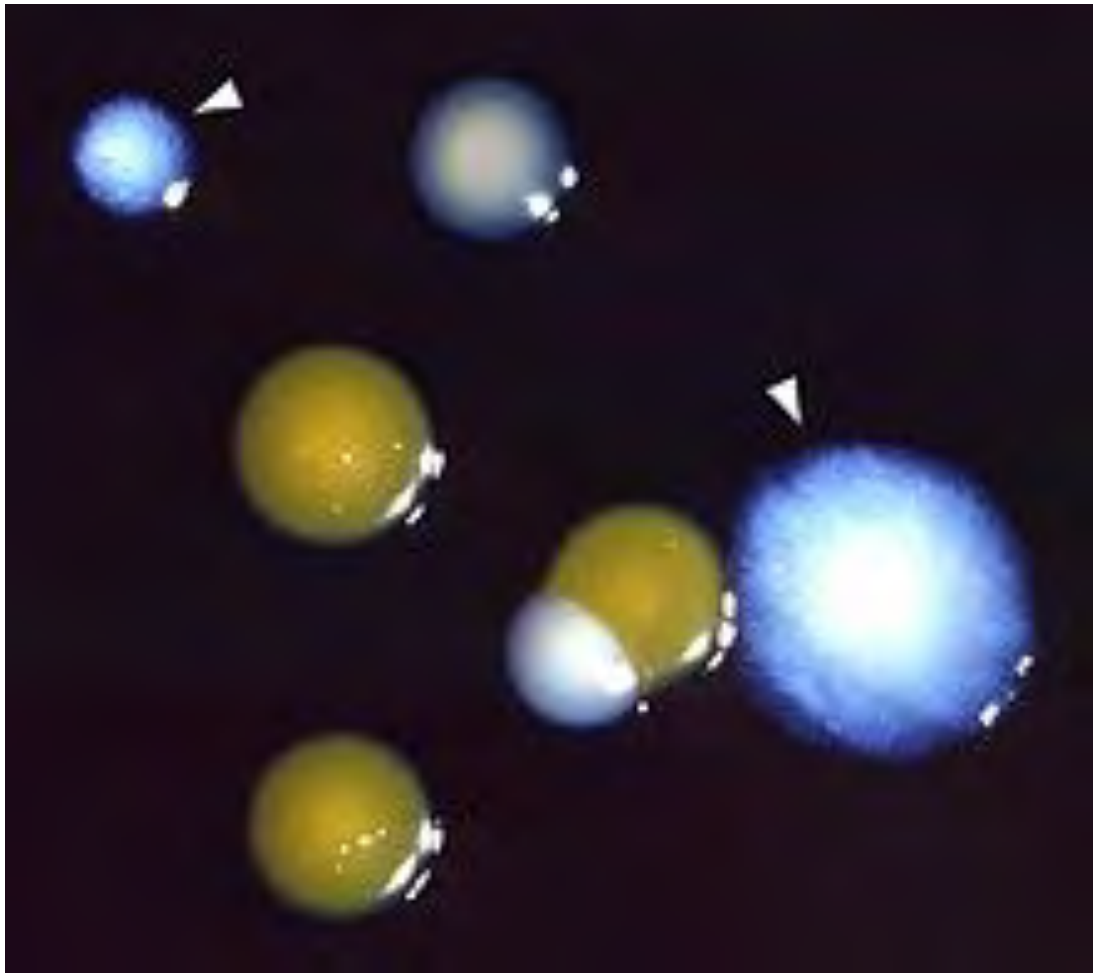
Without a tempering valve, reduction of the water heater's set-point temperature is the most direct way to reduce scalding.

However, for sanitation, hot water is needed at a temperature that can cause scalding. This may be accomplished by using a supplemental heater in an appliance that requires hotter water.

Most residential dishwashing machines, for example, include an internal electric heating element for increasing the water temperature above that provided by a domestic water heater.

Bacterial contamination

Bacterial colonies of *Legionella pneumophila* (indicated by arrows)



Bacterial contamination

Two conflicting safety issues affect water heater temperature—the risk of scalding from excessively hot water greater than (131 °F), and the risk of incubating bacteria colonies, particularly *Legionella*, in water that is not hot enough to kill them.

Both risks are potentially life-threatening and are balanced by setting the water heater's thermostat to (131 °F).

The European Guidelines for Control and Prevention of Travel Associated Legionnaires' Disease recommend that hot water should be stored at (140 °F) and distributed so that a temperature of at least (122 °F) and preferably (131 °F) is achieved within one minute at points of use.

Bacterial contamination

Tank thermostats are not a reliable guide to the internal temperature of the tank. Gas-fired water tanks may have no temperature calibration shown.

An electric thermostat shows the temperature at the elevation of the thermostat, but water lower in the tank can be considerably cooler.

An outlet thermometer is a better indication of water temperature.

Tank Drain Valve

The hot water tank can build up sediments in the bottom of the tank if left unmaintained and by
draining the tank using the **tank drain valve** these sediments cannot build up.

And if you don't have sedimentation then that helps to prolong the life of your tank and
improve your water quality.

Prepare the tank for flushing by performing the following steps:

•Turn off power to an electric water heater. Do this by turning off the
•Circuit breaker or fuse powering the heater.
•Turn gas pilot control valve to "pilot" setting.
•Shut off water supply to water heater.
•Open nearest hot water faucet.
•Attach hose to drain valve.

Water Heater Thermocouple

Similar to that found on a gas furnace, a thermocouple is used to control gas flow in gas water heaters including older style standing pilot models and newer electronic ignition pilot models.
The thermocouple is part of or attached to a pilot burner assembly and will connect to the gas control valve on the outside of the water heater.

Quite often the reason a water heater pilot does not ignite or a burner does not stay lit is because of a problem with the thermocouple.

Electric Water Heaters

Unlike gas water heaters that have gas burners to heat the water, electric water heaters rely upon an upper and lower pair of metal heating elements.

These heating elements are made of metal and get
hot from electrical resistance, similar to what you would find in an electric cooking range.

In any water heater the cold incoming water is not delivered at the top of the tank, but rather near the bottom through a dip tube as seen in the following diagram.

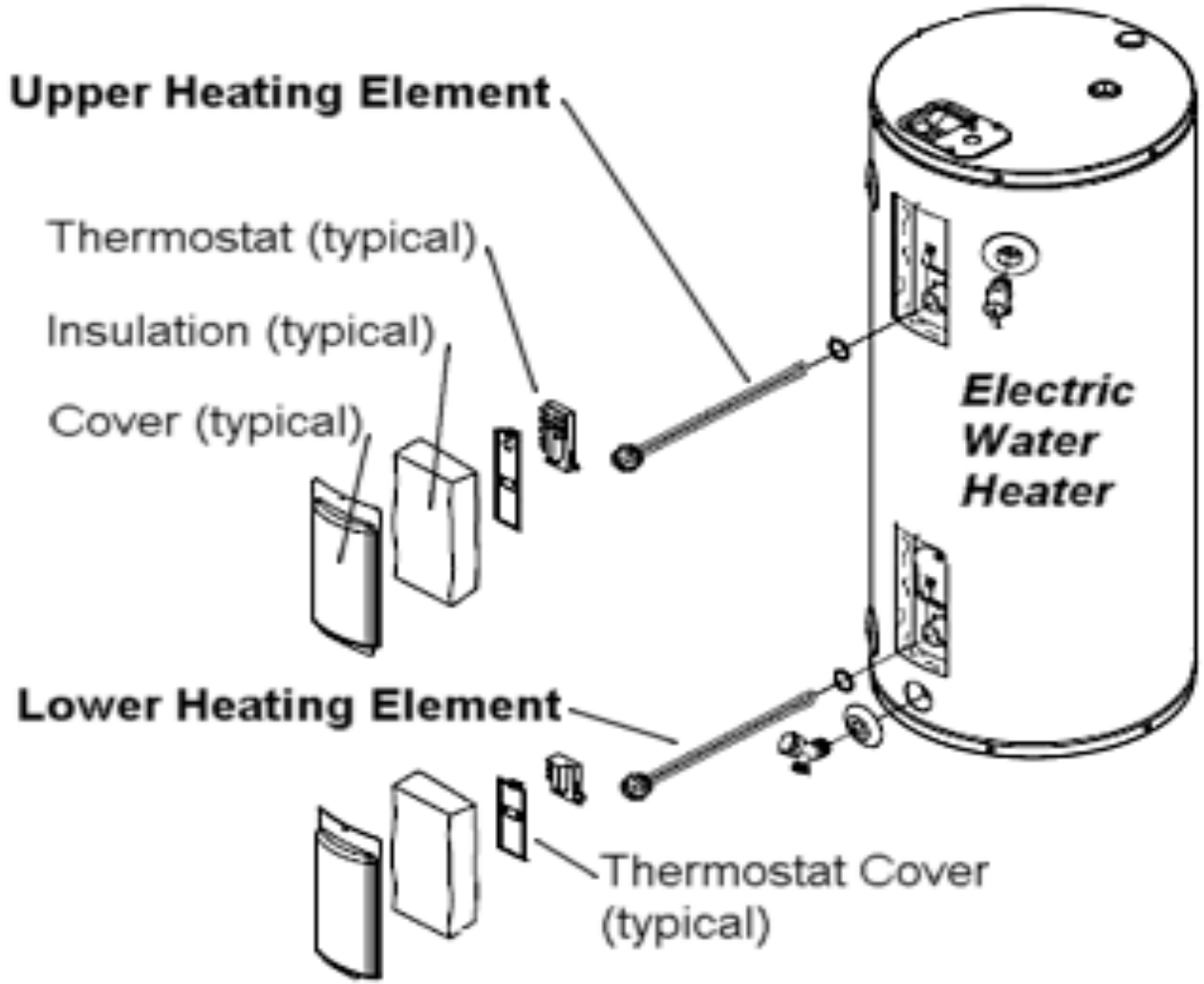
As a result of a cold water supply coming in near the bottom of the tank, the lower heating element Is the workhorse of the electric water heater.

The upper heating element really only contributes when there is a high hot water demand and only serves to heat water in the upper portion of the tank.

A constant supply of lukewarm water during a shower is indicative of a defective upper heating element.

Short duration hot water supply during a shower is indicative of a defective lower heating element.

Replacement heating elements must be of the same style and voltage/wattage rating as the ones presently in the water heater.


Upper Heating Element
Thermostat (typical)
Insulation (typical)
Cover (typical)
Electric
Water
Heater
Lower Heating Element
Thermostat Cover
(typical)

A water heater element has a limited life expectancy. When it fails, so does your supply of hot water. You may think your entire water heater needs to be replaced, but actually other components in the water tank may still function normally. To replace a heating element, follow the seven steps below.

Step 1 – Check for a Tripped Circuit

Before going to the expense and trouble of replacing a water heater element, check to see if your heating problem can be traced to a tripped circuit breaker. A circuit breaker protects both element and thermostat, so check to see if a tripped breaker may be your problem.

Step 2 – Shut Off Electrical Power and Water

Before proceeding with removal of your defective water heater element, shut off your power at your breaker box. Also shut off the water valve that feeds water into the heater

Step 3 – Drain the Unit

If you have dual heater elements and the top element is defective, you will need to drain only the water from the top water tank. To replace the lower water heater element, you will need to drain the entire tank. Attach one end of a garden hose. Take the other end of the hose outdoors and then open the valve to drain the water.

You can avoid draining the water heater if you work fast enough

First close the isolation valves you'll find on top of the water heater. While you are removing the old element and attaching the new one, you will see a small amount of water draining. If you're not confident in doing this with speed, you'll be better off just draining the water before you change the element.

Step 4 – Disconnect Electrical Connections

To disconnect the heater's electrical connections, remove the panel cover and disconnect the electrical wires. If they are connected to screw terminals, loosen the screws and pull the wire free. If the wires are connected with wire nuts, unscrew the nuts.

Step 5 – Remove the Water Heater Element

Use a socket wrench to remove bolts that hold the water heater element in place. Then, remove the defective part. If you have difficulty seeing the element’s wire connections or attaching bolts, you may need to use your work light.

Step 6 – Install Your New Water Heater Element
Insert your new element into place. Attach it by screwing in the bolts you removed. Reconnect the electrical wires and reattach the panel cover.

Step 7 – Finish
With your new heating element connected, you can now restore your electrical power and open the water valves you had closed. Your water tank will begin to fill, and the water will begin heating. In approximately 30 minutes, you should have hot water.

Introduction to the Electric Ignition Water Heater

AT A GLANCE:

energy STAR® rated

Save up to 25% on water heating costs

.70 EF (Energy Factor)

Easy installation in replacement applications—can use existing venting connections

Advanced electronic control with LCD display (easy temperature adjustments and diagnostics)

Electronic ignition—no standing pilot

Advanced powered anode rod provides exceptional performance in all water conditions

No Hot Water / Pilot Frequently Goes Out (New Style)

The most likely reason for no hot water is the pilot on your water heater has gone out. There are several reasons why the pilot would go out, but the most common is the water heater isn't getting enough air.

If the heater has a white thermal switch on the manifold door, try resetting the switch and cleaning any lint or dust from the filter screen and flame arrestor.

Reset Thermal Switch and check wiring

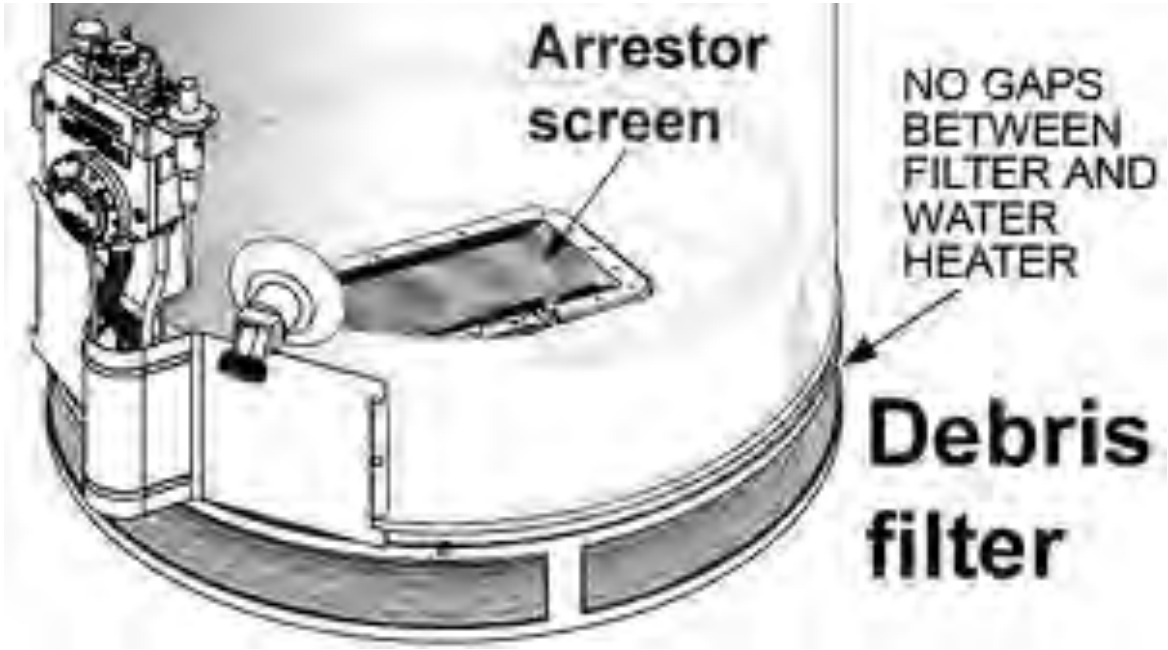
Locate the white thermal switch on the right side of the manifold door and make sure the connectors are firmly attached to the thermal switch. Next, press the reset button in the middle of the switch. If the thermal switch is tripped, the water heater's air supply may be restricted, the vent system may be blocked, or there could be negative air pressure in the home.

Note: Check the area near the heater for any substances that may give off flammable vapors (gasoline, paint thinners, cleaning agents, etc.)

If these are present, clean the filter screen and flame arrestor.

Clean the FVIR Filter Screen and Flame Arrestor

Cleaning the FVIR (Flammable Vapor Ignition Resistant) filter screen and flame arrestor is fairly easy. The pilot can sometimes go out due to a dirty screen or flame arrestor, which the dirt could be blocking air needed for combustion. These filters and arrestors can be cleaned with a common household brush or a vacuum cleaner.



Steps to Clean Filter and Flame Arrestor

1. Turn the gas control knob to OFF and allow the burner to cool fro about 15 minutes.
2. Locate and remove the filter screen from the base of the heater (some heater may have two screens).
3. Clean the filter with a soft brush or vacuum. You may need to wash the filter in hand washing soap and water to remove oily residue.
4. Locate the flame arrestor and use household brush with plastic bristles to clean the arrestor with an in and out motion until completely clean. If the heater has a drain pan, use a brush with a flexible handle
5. Vacuum any remaining lint from the bottom of the heater.
6. Once you've cleaned the arrestor, replace the screen. Note the filter screen has arrows that should point up when reinstalling.

Relight the Pilot

After cleaning the flame arrestor and filter screen, try relighting the pilot. Resetting the thermal switch and cleaning the filter screen and flame arrestor should mot likely solve the problem.

A replacement wrap-around filter and are usually available from the manufacturer at no charge to you.

Keeping the area near the water heater free of dust, lint, and oily vapor can also prevent the pilot from going out in the future.

If the pilot still won’t light after resetting the switch and cleaning the arrestor and the filter, the technician may need to perform a diagnostics in order to determine the problem.

Since the most common cause is not enough air getting to the water heater, have the technician do the following air supply and vent test.

Air Supply and Vent Test

- First, close all windows and doors and turn on all exhaust fans including range hoods, bathroom exhaust fans, clothes dryer, tec. In the apartment.
- Light the pilot. Once the pilot is lit, adjust the thermostat to HOT to light the main burner. Allow the main burner to run for exactly 5 minutes before performing the test.
- Pass a newly extinguished match approximately 1” from the draft hood’s opening. Smoke from the match should be steadily drawn in to the draft hood indicating the heater is getting adequate air and the vent system is working.

- If the match hovers around or is blown away from the opening, there may be negative pressure in the apartment, the water heater may not be getting enough air, or the vent may be blocked.
- Turn the gas control knob OFF, shut the gas supply off, and do not operate the heater.

- Air pressure in a home is complicated, because it's affected by several forces such as a forced-air furnace circulating air, blowing wind, a clothes dryers, and even ceiling fans.
- When the pressure inside a house is greater than outside, it's called positive pressure.
- When the pressure inside is less than outside, it's called negative.
- Pressure is seldom uniform throughout the entire building. It can be strong in some areas, weak in others, or positive in some rooms and negative in others.

- Any device that pulls air out of a house can create negative pressure.
- These include bath fans, range hoods, clothes dryers, wood stoves, fireplaces as well as combustion furnaces.
- Downdraft cook top fans often move 200 to 400 cubic feet per minute of air, generating strong negative pressure.
- Take into consideration all the fans within the structure, bathroom, kitchen, clothes dryer, central vacuum, or a power vented furnace.
- Each of these blows air out, not one is designed to bring air in to balance itself.

Construction techniques in the last 20 years has improved the energy efficiency of buildings, making them tighter. The tighter the building the worse the potential for negative air pressure.

Combustion and ventilation air is not able to infiltrate into the structure and combustion devices are starved of air.

There is no replacement air for the exhaust fans to blow out which causes the house to depressurize.

When this happens, the negative air pressure inside the building draws air through every crack and crevice it can find to equalize the air pressure.

That is where the gas fired water heater comes in to play.

Here is what happens to the flow of heat around a gas fired water heater when the air pressure inside a structure is normal.

They show which way the hot flue gasses normally flow. Notice the combustion gasses are vented outside the structure through the vent assembly.

Here is what happens to the flow of heat when there is negative air pressure inside a structure.

You will notice the flue gasses have reversed direction. You will also notice that the venting assembly has become a fresh air intake source and does not allow the combustion gasses to exhaust properly.

As well as poor water heater performance, now there are harmful combustion gasses being pulled into the building.

Symptoms of negative air pressure problems could be:

- Pilot flame will not stay lit
- Flame rollout at the bottom of the heater
- Sooting around the bottom of the heater
- Slow recovery of the water heater

The issue here is not to fix the negative air pressure; after all venting fans over stoves, grease fryers and in bathrooms were put there for a reason.

The best solution is to relocate or isolate the water heater to its own environment. Install the water heater in a room or area that is not affected by negative air pressure. Provide a plentiful supply of fresh combustion air and tightly seal the doorframe if the unit is located close to areas using the venting fans.

You will normally find the negative air pressure phenomenon in one of two places:

Kitchens – because of the venting devices over stoves and grease fryers.

Laundry rooms - because of the dryers venting the moist air from the wet clothes to the outside of the building.

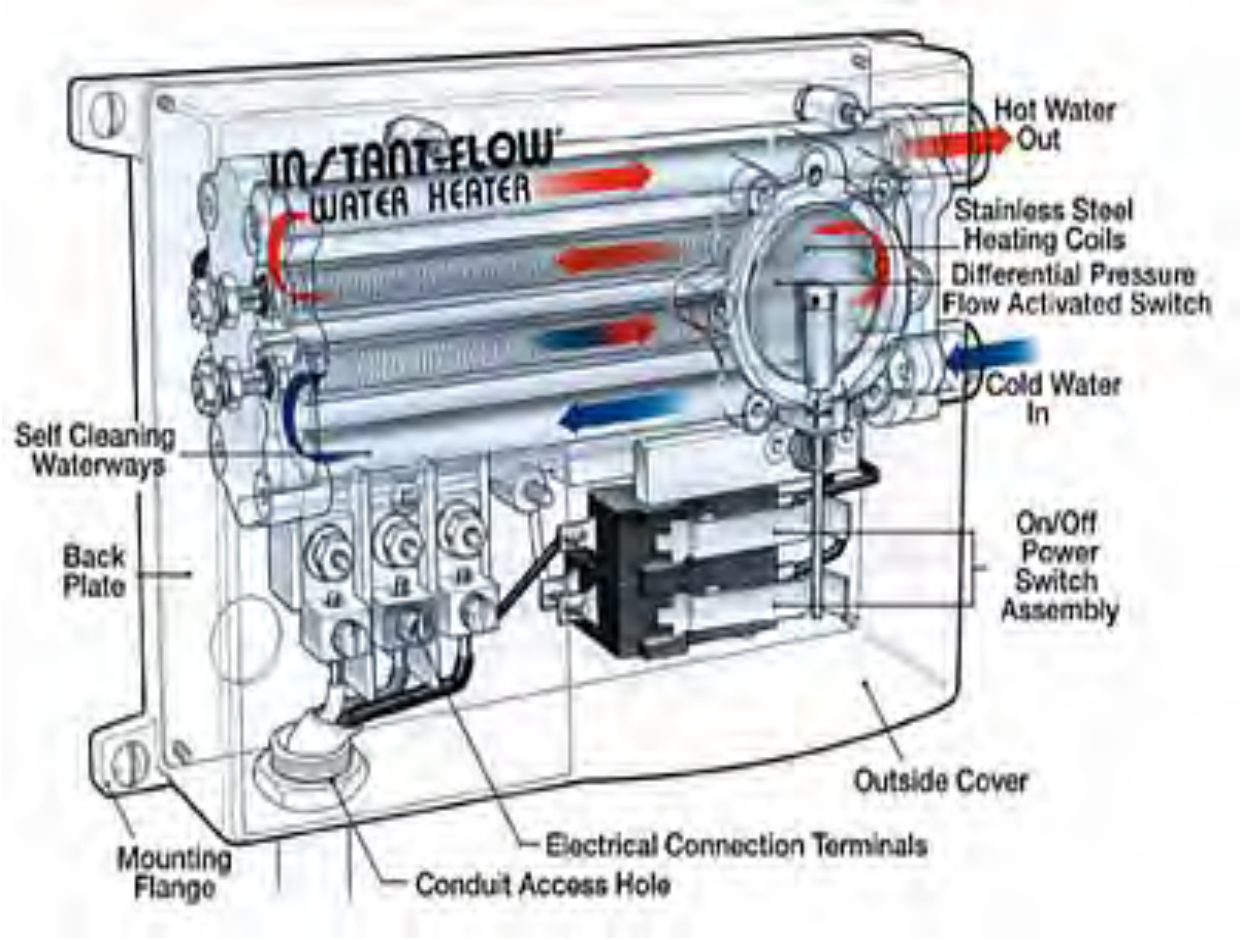
Any Questions?

Introduction to the Tankless Water Heater

Tankless Water Heaters

In the United States, for many people, the term water heater brings visions of cylindrical vessels that heat and store water for use in their homes. This trend is shifting as consumers become more informed about energy usage and plumbing professional adopt new technologies, that make water heating more efficient. Tankless water heaters are one product that is gaining popularity among commercial and residential consumers, and manufacturers have enjoyed significant market share growth for their tankless water heater lines in recent years compared to other water heater types.

How the Tankless Water Heater Works



What is a Tankless Hot Water System?

Basically a tankless water heater heats water only as it is required. It doesn't heat and store 30 or 40 gallons of water in a large tank, just waiting for it to be needed.

A tankless unit contains a heating device that is activated when someone turns on a hot water tap. The pressure of the water passing through the unit turns on a series of burners or electric heating coils to provide a supply of hot water, literally on demand. The result for a homeowner is a win-win - they can get rid of that big storage tank in the basement, and they can also save on energy for heating water since they are only heating water when they use it.

How to Determine the Required Size of a Tankless Hot Water Heater

Tankless water heaters come in two types, gas or electric. On average, gas-fired heaters are more efficient and heat the water faster than electrically powered units.

However, they must be vented and have a higher initial cost for installation and plumbing. Electric tankless heaters are easier to install but are incapable of heating up large amounts of water to be usable. A basic size requirement for choosing between them is that for one or two people, a tankless electric heater may be adequate.

For more than two people, a gas fired tankless heater is the way to go.

Determine the Mounting Space

Tankless water heaters are much smaller than units with a storage tank, allowing them to be wall-mounted. Electric units have measurements in the 10-inch high to 7-inch wide range while gas-fired units have measurements in the 30-inch high by 20-inch wide range.

In essence, electric units can be mounted in very little space, but gas-fired units must have adequate space to be mounted and must have space to vent the fumes from combustion.

If space for the unit or space to run the vent pipes isn't available, your only choice would be an electric unit.

Measure your Cold Water Temperature

Find out your cold water temperature with a thermometer. The temperature of your water is the starting point.

This water will be heated to a desired temperature by your tankless unit, and should be capable of maintaining your desired temperature at maximum flow rate.

For example, kitchen sink hot water is generally desirable at 110 F. If the cold water flow measures 50 F, the tankless water heater must be able to boost the incoming water temperature 60 degrees higher, at maximum flow rate, in order to keep the kitchen water running at 110 F.

Determine your Water Flow Rates

Tankless water heater efficiency is determined by the water flow rates inside your home.

A low-flow shower head may use 1.5 gallons of hot water per minute, or GPM as it is called.

A sink may run 1.5 GPM through the faucet while doing dishes and a running bathtub may use 4 GPM. Most appliances have GPM ratings.

For example, the energy guide tag or the manufactures model number tag on a dishwasher will include the GPM rating of the unit.

If you cannot determine a basic GPM measurement, like say on a bathroom faucet, place a gallon jug beneath the faucet and time how long it takes to fill. If 1 jug fills in 20 seconds, that means 3 jugs will fill in 1 minute, or 3 times 1 equals 3 for your GPM rate.

GPM Heating Basics

Most gas fired tankless heaters cause a temperature rise of 70° F or more when 5 GPM of water is used.

Most electric tankless units cause a similar 70° temperature rise, but this occurs when a maximum of 1.5 to 2 GPM of water is used.

The less water that is being used at any given moment, the higher the water temperature that can be obtained.

Determine your Tankless Water Heater Size

Start with your incoming water temperature, and in this example its 50° F. Determine the maximum flow rate of gallons during use.

For example, one person is taking a shower, which is 1.5 GPM, and the temperature desired is 105° F. One person is doing the dishes, which is 1.5 GPM and the temperature desired is 110° F. The washer is also running, which is 2 GPM, and an average washer temperature is 120° F.

The total GPM for that time period is 5 GPM.

Ideally, to maintain the water temperature required by all of these functions at the same time, your requirements are a tankless water heater that is capable of raising the temperature of the water 70° F at 5 GPM. Most gas-fired water heaters are capable of doing this.

Determine your Tankless Water Heater Size

However, they are rated at a specific temperature rise over a maximum amount of GPM.

For example, a 200,000 BTU gas-fired tankless unit is able to raise the total water temperature 50 F at a maximum of 7.4 GPM.

As a basic rule of thumb, each GPM subtracted from the total allows a 10-degree increase in water temperature.

In this scenario, a 200,000 BTU water heater would be able to heat all of the water in a house at a 6.4 GPM flow rate to 110 F, and at a 5.4 GPM flow rate, all the flowing water would be heated to 120 F.

Since only the washer needs this temperature, a 200,000 BTU tankless water heater in this simulation is considered overkill.

Consider the Ground Water Temperature

Water temperature is as low as 37° F in the far northern regions of the country. In the far southern regions, water temperature gets into the high 70s. The Midwest latitudes have water temperatures in the high 50s to the low 60s.

The higher the incoming water temperature, the less energy needed to heat it and the less temperature rise there needs to be to supply your hot water needs.

For example, an electric tankless heater that is rated at raising the water temperature 55 degrees at 1.5 GPM, will supply you with a 120-degree temperature if the incoming water is 65 F or higher

Flow Rates

Fixture	Average Flow GPM	Avg. Temp.
Tub:	4.0	102°F
Shower:	2.5-3.0	104°F
Washing Machine:	2.0	120°F
Dishwasher:	1.5	110°F
Kitchen Sink:	1.5	110°F

Do They Really Work?

Providers of tankless systems claim energy savings of 10 to 20 percent due to the elimination of standby losses - the energy that's required to keep the water in a storage tank hot while it's waiting to be used. Think about how hot water tanks operate. Even if no hot water is used, the heat is constantly escaping through the walls of the tank, so the heater will turn on periodically just to keep the water at the required temperature. Plus, in gas-fired systems, the pilot light is constantly burning fuel. These are the standby losses that a tankless system eliminates.

Going Tankless

Switching from a storage water heater to tankless has advantages. The tankless heater (TWH), while more efficient than storage heaters, also produce a continuous flow of hot waters. A whole house TWH with an expected simultaneous use of one shower (2.5 GPM), one kitchen faucet (1.5 GPM), and one dishwasher (1.0 GPM) would need to be rated for a flow rate of 5.0 GPM or more.

The space required for a tankless heater is much lower than a storage heater and has more possible install locations, such as under-the-counter for an electric TWH, and wall mounting for almost all of the tankless heaters, gas and electric.

Outside Installation

Many tankless heaters models can be installed outside with adequate freeze protection; freeze protection is included in many modern tankless heaters as an option or standard on models designated for outdoor installation.

Since many of the tankless heaters designed for exterior installation require little to no venting, the cost for installation or retrofit will be reduced.

Advantages of a Tankless System

Beside the energy savings and the elimination of that big storage tank in the basement, there are other advantages to tankless systems.

Since it provides hot water almost instantaneously, tankless systems use less water (you don't need to run out cold water waiting for the hot water to arrive).

Tankless systems are less prone to rust and corrosion, so the expected life of a tankless system is about 20 years, while a storage tank's life expectancy is 12 - 15 years.

If you install a tankless water heater you may be eligible for a federal income tax credit of up to $300.

Sounds great!
What's the downside?

As with everything in life, tankless water heaters do have a downside.

The initial purchase price of a tankless system is substantially more than a storage system. Prices range from around $200 for a small under sink unit to well over $1800 for a central system (versus about $500 for a storage tank).

If you are going to be staying in your home for 10 to 15 years, you should get a return on your investment, but depending on the price of fuel, the payback period can be long.

•Tankless gas fired units will likely require modifications to your home's gas venting capability, while electric units will probably need an upgrade to your electrical service. These costs are over and above the cost for the tankless system itself.

•Tankless systems use a lot of energy when they are operating. If having an endless supply of hot water means that you end up taking longer showers and using more water than previously, you could end up eliminating any energy savings.

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Condensing Type Tank-type Water Heaters

What is “condensing”? A typical gas water heater, especially older tank types, burn a fuel and air mixture to produce the heat necessary to make the water in the tank (or tankless) hot.

Condensing water heaters extract as much heat as possible from the combustion gases before it leaves the water heater.

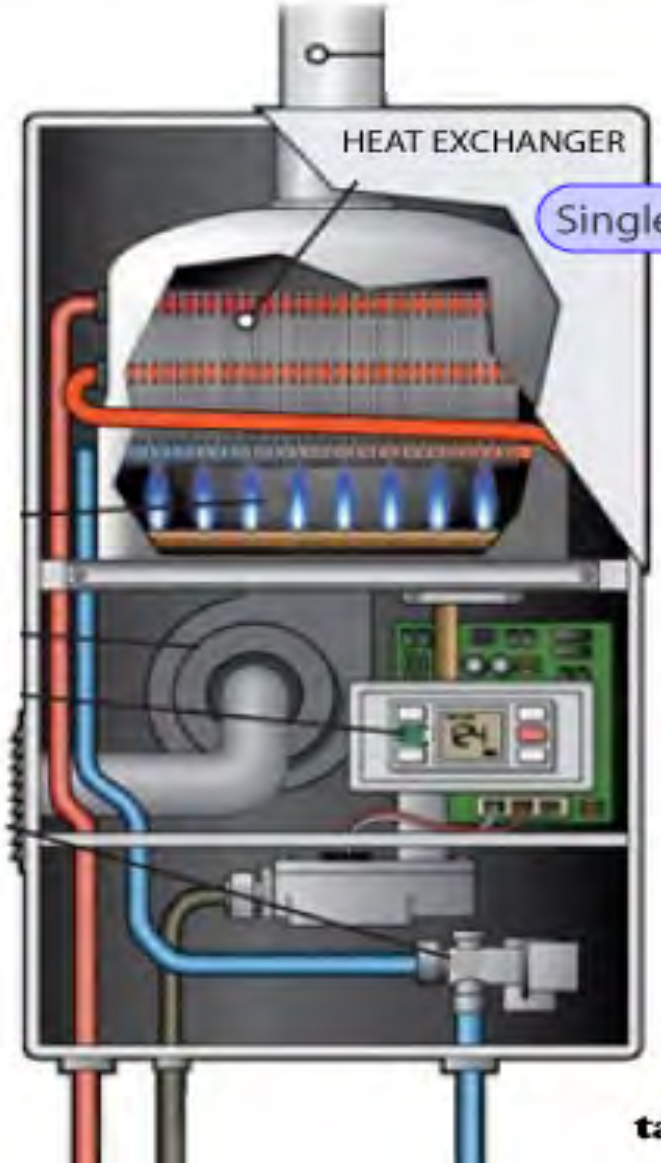
The picture to the right shows a tank type condensing water heater. The hotter combustion gases heat the warmer water that usually resides near the top of the tank. As the combustion gas is forced through the heat exchanger, it travels down the spiral, exchanging the heat with the cooler water until it exits the heat exchanger through the flue at the temperature close to 100°F.

Condensing Gas Tankless Water Heaters

These essentially function the same way: cooler water is heated by cooler gases, maximizing heat transfer. Tankless models differ from non-condensing tankless heaters by heat exchanger design. The primary heat exchanger heats the water that has be preheated by the condensing heat exchanger located above or after the primary heat exchanger. This results in condensation being trapped in the condensing heat exchanger.

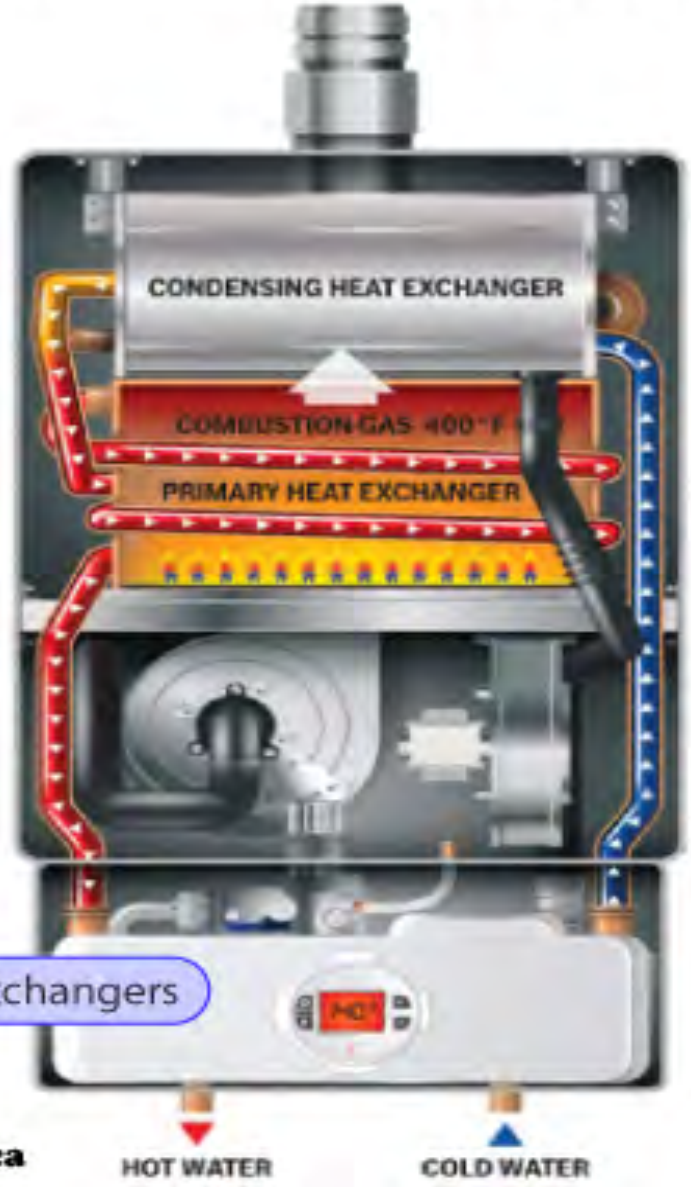
The resulting product of a properly installed condensing water heater is a hot water supply produced at up to 94% efficiency and requiring only schedule 40 PVC vent materials.

Non-Condensing Tankless



Single Heat Exchanger

Condensing Tankless



Dual Heat Exchangers

tanklesshotwaterguide.ca

Tankless Water heater safety

On average, 31 people die each year and 236 injured from water heater related fires. Carbon monoxide kills an average 170 people a year from consumer products, appliances, heating, and water heaters.

Improper installation, poor maintenance, leaks inadequate exhaust venting, and insufficient combustion air are just a few causes leading to carbon monoxide poisoning in a home or business.

Tankless water heaters installation requirements fifer from one manufacturer and model to the next, which makes safety education a continuous and adaptive process.

And finally

It is recommended carbon monoxide detectors be installed where home owners and businesses rely on gas fired appliances.

Tankless Water Heater Manufacturers

You find no lack of manufacturers from which to consider your new tankless hot water heater. The following are some manufacturers to check out:

- AO Smith
- Stiebel Eltron USA
- Rheem Manufacturing
- Sets Systems, Inc.
- Eemax, Inc.
- Noritz America Corp.
- Takagi Industrial Co.
- Bosch USA
- Bradford White Corp.
- Paloma Industries
- Chronomite Laboratories Inc.

Questions??

This Concludes this Session

Thank you for your attendance

Names

The tankless water heater has many names – demand-type, instantaneous, continuous flow, - these are just a few names commonly used for tankless water heaters. They are demand-type and they are continuous flow, but not all tankless models are instantaneous.

Demand-type refers to a water heater that only heats the water when a demand for hot water is made. Since the tankless heater doesn't store water and is only activated when flow into the heater is detected, it is a demand-type heater.

By design, they supply a continuous flow of hot water at a rate dependent upon the temperature rise desired. However, to be instantaneous, they need to provide hot water to all fixtures served without delay, which is quite a feat for any water heater including tank type and circulating systems.

Types

All tankless water heaters serve a common purpose, heat water only when there is a demand. Heating water without storing it is conserves energy by reducing stand-by heating; stand-by loss is the energy used to maintain the temperature of hot water in a storage water heater while there is no immediate demand for hot water.

Today’s residential and light commercial tankless heaters are typically categorized as point-of-use or whole-house, by their energy source:

Choosing a system

For example, a faucet typically uses .75 GPM, a showerhead about 1.0 to 2.0 GPM, and a washing machine or dishwasher about 2.0 GPM. So, if you want to be able to turn on a hot water faucet and run the washing machine at the same time, you will need a tankless system that has a flow rate of at least 2.75 gallons per minute.

If you assume your incoming water temperature is 50 degrees and you want to raise the water temperature to 120 degrees, your system will need to be capable of raising the water temperature 70 degrees. Therefore, in this example, you would require a tankless system capable of supplying at least 2.75 GPM with a temperature rise of 70 degrees.

Electricity – Typical flow rates for electric tankless heaters, residential and light commercial, range between one gallon per minute (GMP) up to 5 gallons per minute. Some “mini” heaters are rated as low as 0.32 GPM.

Natural Gas/Propane (Gas) – Gas units, typical for residential and light commercial, have minimum flow rates as low as 0.26 GPM; maximum flow rates can be as high as 14.5 GPM for some models but minimum flow rates on the higher output models can be as high as 1 GPM.

Fuel Oil – Uncommon but worthy of mention, fuel oil burning tankless heaters are often duel purpose; space heating and water heating, and are less efficient in warmer climates.

Electric Tankless Water Heaters

Electric water heaters rank second, behind gas and propane, in the United States, representing 41% of water heaters used in American homes and installations of residential electric heaters have increased nearly 10% since 1980.

Producing hot water in an electric tankless heater is similar to a storage heater, except the heating elements do not activate until the flow switch senses demand for hot water, and hot water is not stored in the heater for anticipated demand.

Electricity usage for a properly sized and installed electric tankless water heater is 10-20% less for a whole house system, compared to a conventional electric tank type water heater. When point of use heaters are installed at every fixture, electricity saved from heating water can be even greater.

To heat water rapidly in an electric tankless heater, one or more elements quickly heat the water in the heat exchanger as it passes. Instead of drawing 4500 watts an hour per element, a tankless electric heater would typically need 36,000 watts per hour and two sets of 60 amp breakers at 240 volts to produce 5 GPM continuous hot water at 113°F if 60°F cold water is supplied to the heater.

Gas Tankless Water Heaters

Gas fired water heaters are the most common type in the United States. For whole house tankless heaters, gas is the most common fuel as well. Like their electric counterparts, gas fired tankless heaters rapidly heat water when demand is made and require a much more energy to be available to fuel the heater.

For example, a high efficiency residential 50 gallon gas water heater averages 40,000 BTU’s per hour while its heating water. Retrofitting a gas fired tankless heater to take its place would require a gas service to the heater capable of supplying 180,000 BTUs per hour.